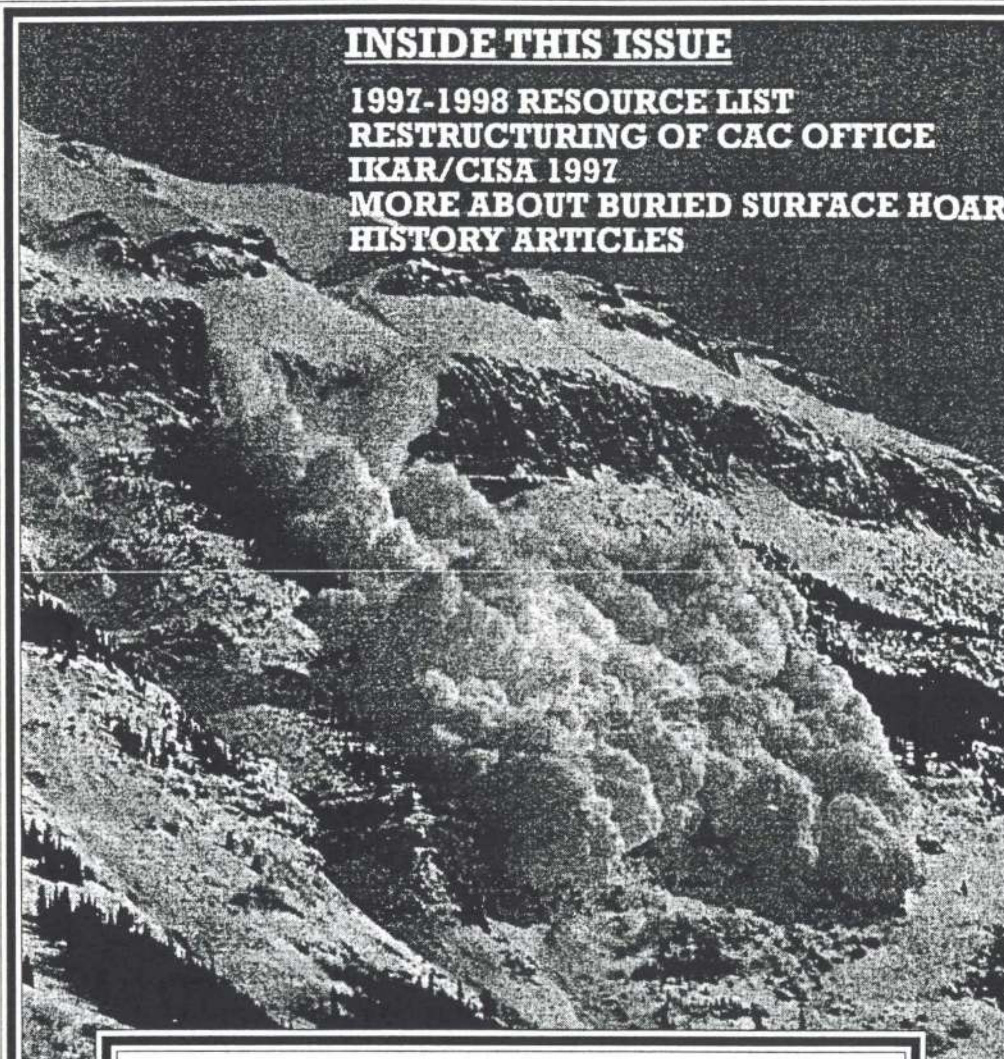
AVALANCHE NEWS

FALL 1997 VOLUME 53



CANADIAN AVALANCHE ASSOCIATION

WEIS WORDS FROM OUR PRESIDENT

Dear members and readers:

It is October 16 and I am off to Alta Utah to join the AAAP in their annual meetings and professional education seminars.
It has been a busy summer at the CAA /CAC, with the Re-organization of the Centre, and countless other projects... Our Schools are ready to fly, safety fuse is again available and the InfoEx™ name is now trademarked. The support and involvement of our members, and the community, continues to enable us as a group to maintain our improvements and forward momentum. Be sure to thank yourself and any of our supporters for their contribution. We appear poised on the brink of International acceptance and prominence as an Avalanche / Mountain oriented Association. To protect and improve on this position we must be safe, consistent, friendly, professional and be ourselves. Hoping for the best possible season for you, your family, and your enterprise."
Niko

Niko Weis
President
Canadian Avalanche Association
caaweis@mars.ark.com
Phone (250)338-6702
Fax (250)334-2852

FROM THE EDITOR'S DESK

I hope that you enjoy this issue of Avalanche News. I had a lot of fun putting this one together. Lots of interesting articles as well as our annual Resource List. As you can see we have made it a separate booklet so you can tuck it away for reference. I especially enjoyed putting togethter the History articles on the 1910 Canadian and US disasters. I was dissappointed though, at not being able to get the weather stats on the US one. Seems the weather data from January and February for 1910 have dissappeared. I look forward to any suggestions you, the reader may have as far as future history articles. We are hoping to do some stories on Highway avalanches as well as Industrial Avalanches. Any contributions would be greatly appreciated.
I know most of you are anxious for the season to begin, and I hope that all of you have a good winter.
The next issue of Avalanche News will contain our equipment and supply issue. If you have product that would be of interest to our readers please supply your name and address. We cannot of course list prices and individual items, but you can give a broad range of what you have available. Please note that the deadline for information is January 15, 1998.
Until next time.......

✡ AVALANCHE NEWS ✡

FALL ISSUE VOLUME 53

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LETTERS TO THE EDITOR

The summer 1997 issue (vol. 52) of the Avalanche News shows on the title page a photograph of the Rogers Pass Avalanche that fell on March 4th, 1910.

That photograph recalls me the avalanche disaster of about the same date on Stevens Pass, Washington USA of March 1st 1910(Ruby El Hult: Northwest Disaster, Binsford & Mort, Portland 1960). Both Avalanches disasters must be connected to the same snow storm that struck the Northwest

I tried to find out more details on the Rogers Pass Avalanche but I could only find one reference to it. I am giving the following citation out of B.B. Fitzharris: Frequency and climatlogy of major avalanches at Rogers Pass 1909 to 1977; NCR division of building Research, paper no. 956, Ottawa 1981, p. 13: "The major disaster of 5 March 1910, when 62 railway men were killed, received a great deal of attention in the press(Calgary Herald , Province), but little information was given regarding winter snow conditions or weather. In fact there is some uncertainty as to which path produced the avalanche, except, that it appears to have come from one of the areas opposite Cheops. Compared with later avalanche activity, the winter of 1909-1910 was not an exceptional winter."

After El Hult Stevens Pass got a tremendous amount of snow in the days February 22 to March 1, 1910 and I have a feeling that nearby B.C. got also exceptional snow. There are some questions raising. Was the date of the disaster March 4th or 5th? Were all 62 victims really railway men? Or were among those also passengers? And does one really not know the exact place of the accident? Since you are publishing the photo you may have more information. If so I would like to know the source.

Sincerely
Hans Frutiger-Gmunder
Tannackerstrasse 29
CH 3653
Oberhofen

Hans:
I hope that I have answered some of your questions in this issue. Please look at the history articles and the relationship between the two disasters.
L

Hello:

From the sole representative of the CAA in the People's Republic of China....

Haven't seen any avalanches yet, but was swimming/ body surfing in the South China Sea yesterday.Things are going well here, getting set up and finding my way around etc... I've been exploring local hills and peaks, meditating in local temples, kayaking on a nearby lake (I brought a Folbot with me- hope to get it in the ocean soon), will start my Tai Chi classes with a master of 40 years experience soon.

Regards to anyone who might know me around there.
My e-mail address is:
<gregbyn@public.qz.fj.cn>
Thanks again Greg Allen

OUTSTANDING MEMBERSHIPS ARE NOW DUE

1998 MEMBERSHIPS WILL BE DUE IN JANUARY!

NOVA'S

"AVALANCHE"

TO AIR ON PBS
November 25, 1997
AT 8 pm ET

VANNI EIGENMANN FOUNDATION

In 1961 the Eigenmann family lost their nephew at Val Salin in a large avalanche. Weeks of dog searches, probe lines and shoveling were unsuccessful recovering Vanni's body. Only later in the season was a recovery possible. The family committed themselves to establish a foundation to assist in research to develop systems that assured the accurate location of a person covered by a slide to improve chances of survival. So the Vanni Eigenmann Foundation was created. The first time contact was established with North America was when Chair of the Foundation Mrs. Ruth Eigenmann called a conference on this subject in Sulden in April of 1975. From the USA, Dr John Lawton, the developer of the Skadi was invited. From Canada Peter Fuhrmann, Alpine Specialist Parks Canada was also invited. The conference covered everything from three dimensional radar to the Hohenester Balloon. In retrospect the conference was the catalyst for the IKAR to concentrate on a common sense solution and to direct energies towards a reasonably achievable resolution. Many avenues have to be explored, systems perfected to suit a variety of applications. But had it not been for the drive and commitment of the Eigenmann Foundation, countless lives would have been lost during the past years and recoveries would have been more dangerous and time consuming.
submitted by: PETER FUHRMANN

Dear Friends,

Most of you know our Foundation "**VANNI EIGENMANN**" and many friends of my generation will remember the start of our work in 1961, after weeks and weeks of vain efforts to find our nephew under a big avalanche in Val Selin. These tragic days made our family decide to promote the development of suitable technical means for the location of avalanche victims.

At that time. 36 years ago, there was nothing else than dogs and probes. There were some pioneers who studied the development of transceivers and other systems, but none of them went beyond the state of experimentation. The lack of interest for these first steps was mainly due to mistrust and negative attitude of the Alpine rescue organizations of that time. This latter has radically changed during the last 30 years and you will permit me to say that the work of our foundation played an important role in this change.

There is, however, one goal that our foundation was not able to achieve and which I think should still be pursued:

> A rescue means that does not need any signal not emitted by the victim's own body, consequently, an instrument that is reacting to biological signals (as for instance heart beats, perspiration or other biochemical substances).

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Unfortunately, there has now come the moment for me to stop working. My husband is now 85 years old, I am 76. It is since 1994 that I was not able to do more than read some reports about experiences with transceivers and the ABS rescue balloon and to give some small help to finance the new ABS with the two smaller balloons. (I am convinced that this solution with the two balloons fixed more to the side of the back and more quickly inflated will solve the main problem of the big balloon.)

Who or which organization is interested – and has the necessary knowledge and the financial means – to continue our work?

Here I have to say that our foundation never did have outside financing. At the beginning the necessary means were given by the whole Eigenmann family, by the company EIGENMANN & VERONELLI and some good friends. They covered all expenses until 1980. From that, time my husband did all financing by himself, as the younger generation never showed much interest in our work.

I will now briefly list the tasks that my successor should undertake:

1. Continuous control of new scientific achievements in view of the possibilities to develop a search instrument based on biological signals from the victim's body and suitable for the use by rescue teams as well as by the companions.
2. Helping the rapid diffusion of the new ABS.
3. Bringing up-to-date our Dictionary "SNOW & AVALANCHES" at least every 3 years.
4. Cooperation with the Subcommission Avalanches of the IKAR.

To all other friends I herewith say good-bye, wishing to the IKAR good work and much success.

Mechanisms for Strength Changes of Buried Surface Hoar Layers

Bruce Jamieson and Colin Johnston
Dept. Of Civil Engineering
University of Calgary
Calgary, Alberta T2N 1N4
http://casual.enci.ucalgary.ca/research/avalanche/l
e-mail: jbjamies@acs.ucalgary.ca

For many of the slab avalanches that cause accidents, the failure planes consist of surface hoar (Jamieson and Johnston, 1992). In this paper we summarize our field observations and cite some of the limited research on strength changes of buried layers of surface hoar. Measured changes in strength and stability are related to natural and skier triggered avalanche activity in Jamieson (1995).

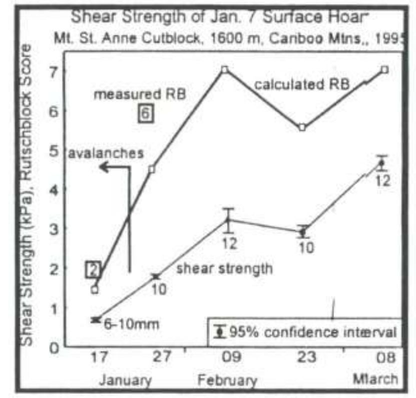

fig 1: Shear strength, grain sizes and a shear frame stability index known as the calculated rutschblock score for a surface hoar layer buried 7 January 1995 in a cut block on Mt. St. Anne in the Cariboos.

Before discussing how strength of surface hoar layers change, it is useful to distinguish between the strength of a weak layer and the stability of the overlying slab. Stability depends on the strength of the weak layer and the stress due to the weight of the slab acting down the slope. For skier stability, the stress due to the skier must also be considered. Instability is due to the stress due to the slab (and perhaps a skier) approaching the strength of the weak layer (McClung and Schaerer, p. 80). If precipitation or wind-loading causes the stress due to the weight of slab to increase faster than the weak layer is gaining strength, then it is possible for the stability of the slab can decrease while the weak layer is gaining strength.

In this report, we focus on the mechanisms by which dry weak layers of buried surface hoar gain strength. Although we have occasionally measured decreases in strength of surface hoar layers during periods of cold weather and strong temperature gradient within the snowpack, increases in strength are more common.

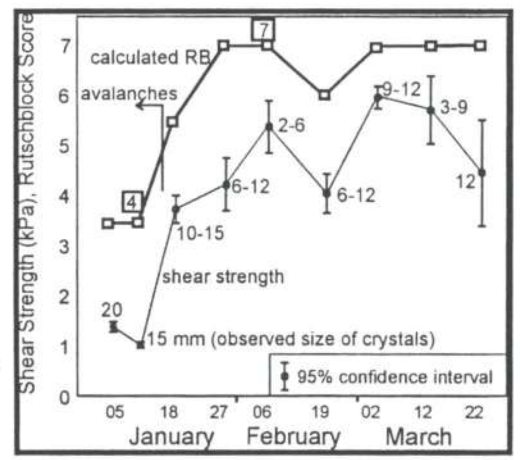

fig. 2: Shear strength, grain sizes and calculated rutschblock scores for a surface hoar layer buried 28 December 1995 in a cut block on Mt. St. Anne in the Cariboos.

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Crystal Size

The size of snow crystals is defined as the average of the greatest extensions while ignoring the smaller particles (Colbeck and others, 1990; CAA, 1995). To "measure" crystal size, field workers have traditionally removed surface hoar crystals from the snowpack and observed them on a 1, 2 or 3 mm grid under low magnification (approximately 8x). While a decrease in size over a period of weeks has sometimes been reported by field workers, we have observed little decrease in size over periods exceeding two months during which the strength of the layers more than doubled (Figs. 1 and 2). The change in strength does not appear to be associated with a change in crystal size. A month or two after burial, we have often observed relatively strong surface hoar layers (> 2 kPa) which contained relatively large crystals (> 6 mm).

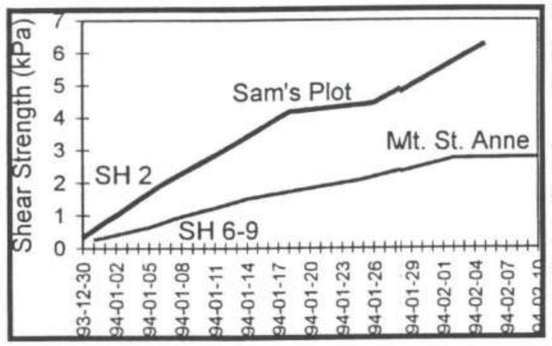

fig. 3: At Sam's Plot 2mm surface hoar gained strength, more strength than 6-9mm surface hoar at Mt St. Anne even though Sam's Plot received only 19% more load than Mt. St. Anne.

However, the initial size of surface hoar (usually observed within a week of burial) is more interesting. In late December 1993, 2 mm surface hoar was buried at one site in the Monashees and 6-9 mm crystals were buried at a site in the Cariboos. Both sites tend to accumulate similar amounts of snow (load), yet the layer of smaller surface hoar gained strength faster and remained stronger throughout the two month monitoring period than the site with larger crystals (Fig. 3). This suggests that large surface hoar tends to have lower initial strength and be slower to stabilize that smaller crystals.

Bonds at the Base of Surface Hoar Crystals

When a surface hoar layer is fractured by a shear frame test, a shovel shear test, or a compression test, some surface hoar crystals often remain bonded to the overlying slab but rarely to the layer below (Schweizer and others, in preparation). This observation combined with microphotographs showing that bonds at the base of crystals are usually small compared to bonds at the top of the surface hoar layer (Schweizer and others, in preparation; Geldsetzer and others, 1997) indicates that surface hoar layers typically fail at the base of the crystals. Consequently, the bonds at the base of surface hoar crystals (which are destroyed when crystals are removed from the snowpack to observe them on a crystal screen) are critical to the strength of surface hoar layers.

Rounding

Low temperature gradients (roughly less than 1oC/10 cm) and warm temperatures (e.g. between -10oC and 0oC) favour rounding and the growth of bonds between grains. The progressive growth of bonds, particularly at the base of grains, will contribute to strength gain.

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Thinning of Surface Hoar Layers

Over time, layers of surface hoar become thinner (Davis and others, 1997). On slopes, we expect that creep gradually leans the crystals downslope eventually creating more contacts and bonds between crystals. However, this effect may be quite slow since after 5 weeks we observed little lean on a 26o slope (Geldsetzer and others, 1997). In level areas, the crystals may be gradually flattened under the weight of the overlying load. However, from a side view, the crystals form the triangles of a truss-like structure which tends to resist deformation (Fig. 4). An alternative mechanism for layer thinning on the flats involves the crystals gradually penetrating the layers above and below as the grains in these adjacent layers metamorphose and rearrange. Penetration of surface hoar crystals into the layers above and below would build larger and stronger bonds. We expect penetration into the layer below would greatly increase the size of the bonds at the base of the surface hoar layer and increase the strength. If this is true, then surface hoar on crusts should be slower to stabilize since crusts would resist penetration more than softer layers. The thinning mechanism will be verified with microphotographs and plane sections.

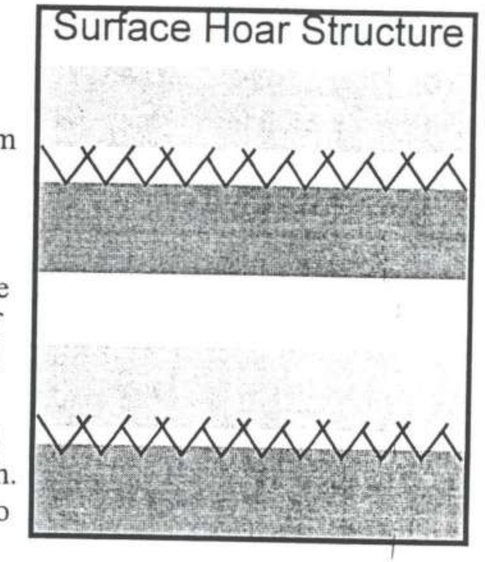

fig 4: Schematic showing penetration of surface hoar crystals into adjacent layers. This is one mechanism by which surface hoar layers could thin over time.

Also, when surface hoar layers collapse (often associated with a whumpf sound), crystals are fractured and more contacts between crystals are created. Bonds will tend to form at the new contacts and the surface hoar layer will gradually gain strength.

Effect of Load on Strengthening

Increased load above a surface hoar layer should contribute to strengthening through the mechanisms associated with thinning. As well, in a winter snowpack, deeper layers (with greater load) tend to have warmer temperatures and reduced temperature gradients, which would also promote strengthening. In general, greater load should contribute to strengthening.

Umbrella Effect

We have noticed for years that one form of surface hoar, known as striated wedges or sector plates (Breyfogle, 1987) is found more frequently in the failure planes of slab avalanches than on the surface of the snowpack. But once buried, why should one form of surface hoar release more slab avalanches that other forms such as spikes? Well, based on plane sections, Bert Davis proposed that larger, broader surface hoar crystals (such as wedges) would form umbrellas that prevent snow from the subsequent storm from falling between the surface hoar crystals and forming additional bonds (Davis and others, 1997). We plan on gathering more field data to

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assess this promising idea.

Proposed Subclassification

For a couple of years, we have been subclassifying surface hoar into: wedges, feathers, spikes, cups, and composite forms including "Christmas trees". However, we expect this subclassification to be refined based on the growth processes (Lang and others, 1985; Breyfogle, 1987; Colbeck, 1988). Once we have sufficient data using our subclassification, we will assess whether certain forms tend to be stronger than others. However, until we know more, the umbrella effect suggests that broader forms that create spaces may be particularly slow to stabilize.

Relevant Field Observations & Tests

So how can these ideas about strength changes of surface hoar layers be applied?

1. Certainly we should consider that large, and/or broad surface hoar crystals may be particularly slow to strengthen and stabilize.
1. Layers with larger spaces between the crystals will tend to be slower to strengthen than layers with smaller spaces between the crystals, other factors being equal.
2. Evidence of rounding may provide a better indication of strengthening than any decrease in crystal size over time.
3. Surface hoar on crusts may be slower to strengthen than surface hoar that grew on softer snow.
4. Areas with greater load on the surface hoar are likely to strengthen faster than areas with less load.
5. Strength tests such as the shovel test and stability tests such as the rutschblock and compression test provide can provide useful information regarding the changes in strength and stability over time. However, once a shear fracture starts, for example at a localized weakness, it can propagate within surface hoar layers, through areas where the surface hoar was too strong to be triggered by a skier. (Jamieson, 1995, p. 185-194). In other words, surface hoar may allow fractures to propagate through areas of apparent stability.

Acknowledgements

This study is part of a ongoing Collaborative Research and Development Project funded by the BC Helicopter and Snowcat Skiing Operators Association and Canada's Natural Sciences and Engineering Research Council of Canada. Also, Canadian Mountain Holidays and Mike Wiegele Helicopter Skiing provided logistical support and a productive environment for field studies.

Thanks also to Jürg Schweizer, Bert Davis and Sam Colbeck for stimulating discussions on surface hoar, and to Jill Hughes, Joe Filippone, Torsten Geldsetzer, Greg McAuley, Steve
(Continued on page 11)

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Lovenuik, Ken Black and Adrian Wilson for their field work.

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SUBMISSION DEADLINE
FOR
AVALANCHE NEWS
IS
JANUARY 15, 1998

Submitted by Alan Dennis

INTERNATIONAL COMMISSION FOR ALPINE RESCUE

REPORT ON MEETING OF THE AVALANCHE SUB-COMMISSION

Saint Vincent, Italy 24 – 27 September 1997

The general theme of this year's meeting was "**public awareness of prevention and rescue**".
From the eighteen member countries there were 16 representatives. The sub-commission chairman is Francois Valla who chaired the meeting. The first order of business was the reporting of national avalanche accident statistics. Overall European fatalities were slightly below average with Switzerland, France and Austria having 24, 23 and 27 fatalities respectively. In the USA there continues to be a high proportion of avalanche accidents for snowmobilers. All countries (except specifically the USA) report that to some degree it is felt that improved dissemination of information and education is helping to maintain the average annual fatality number reasonably constant while the growth in use is known to be increasing rapidly. In the USA the average annual number of recreational fatalities shows the greatest increase of any country.

Each country reported their most unusual incidents. In the USA discussion about the size/ density of the snowmobile was considered because victims are being found upslope from the machine and often the machine is still partially visible on the surface. There was discussion about observer's reports that larger objects are often carried further (cornices) but size and speed of the avalanche are also important criteria. For avalanche probing purposes the position of the victim in relation to the machine is important. Search by probe uphill of the machine first unless there are other obvious indicators. Dale Atkins of the Colorado Avalanche Information Centre has done the work of analyzing this data.

Ruth Eigenmann, of the Vanni Eigenmann Foundation, was introduced to the commission by Francois Valla. She read a letter that is shown in this issue. Francois, on behalf of all countries thanked her for the work of the Foundation.

In the area of accident prevention there was discussion about how to improve messages and information. Each country had different experiences that related to the users level of knowledge and to a large degree the more concentrated nature of mountain use in the central European alpine countries. The Swiss avalanche bulletins are now going to be prepared for the afternoon at 1700h. For many years the Bulletins have been prepared in the morning.

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Various technical presentations followed. The avalanche transceivers from Barryvox/Swiss, Ortovox/German, Arva/French, Fitre/Italian, Tracker/USA all described new developments with their product. Recco/Swedish also showed their new searching unit. The new models of the ABS avalanche balloon were demonstrated. Of particular interest among the transceivers were modifications to improve the search capability from a helicopter. In some units a headset and jack can be used effectively by the pilot and searchers without interfering with other radio communication both in and from the aircraft.
As far as I know, the first use of the avalanche transceiver specifically to search large avalanche deposits from a helicopter was by Wayne Carran, Area Supervisor Milford Road, New Zealand in 1993. With the transceiver duct-taped to the skid on maximum receive range and an extension of the ear piece cord it gave a much faster search on the size 5 avalanches before placing a searcher on foot inside the audible grid.

There was much debate about the avalanche balloon. After more discussion when the manufacturers were not in the meeting the following motion passed -

*The avalanche commission of **CISA-IKAR** is pleased with recent progress (ABS, Recco) and the ongoing developments (transceivers) of avalanche rescue systems.*

It reminds that the ones allowing self-rescue and companion rescue will always be better than systems for organized rescue teams.

It emphasizes no system can absolutely guarantee the prevention of injuries or the survival of avalanche victims

A rewarming device for avalanche victims was also shown. The model shown was French, works for five hours using 600g of soda lime and carbon dioxide to deliver warm 100% relative humidity air through a standard oxygen mask.

On the second day of the avalanche commission meeting there were two items on the agenda

1. **Descriptors for avalanche burial –**
   When Bruce Jamieson and Torsten Geldsetzer were writing *Avalanche Accidents in Canada –Volume 4* they identified a problem with the Canadian descriptor for *partially buried* (p 66 of *Observation Guidelines and Recording Standards for Weather, Snowpack and Avalanches).* Bruce wrote recommendations for the CAA Technical Committee. I took these to the IKAR meeting for discussion. The discussion lasted for over one hour while different countries described their reasons for using various

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(Continued from page 13) IKAR/CISA

terminology. Frank Tschirky from FISAR at Davos described the use of the term *critically buried* which means that the head and thorax are buried. Obviously the consequences of partial burial are then much more serious. The consensus among the countries was that critically buried was the preferred term. Of the eighteen member countries there are about five where this has an impact on the accident data base.

2. **Further discussion about the balloon** - There was an extended discussion about the developments in the balloon. Some of the points raised were:
   -The use of two balloons (one on each side of the pack is preferred to the one balloon system).
   -Heliski operation in Russia is using the balloon the data base for balloon experiences is small [14 incidents-,in 2 the balloon did not open and in 2 the victim could not initiate inflation]
   The female fitting where the detachable control handle fits may get plugged with condensation/ice/snow in certain conditions
   The victim may not "fight like hell" at a critical moment while trying to pull the handle
   Some avalanches have proven more 'survivable' when the snow cushions impact over cliffs, the balloon may have a negative effect
   The potential to travel faster than the avalanche in trees and rocky terrain was discussed
   Users of balloons may feel they are 'saved' from the effects of being caught in the avalanche

The motion shown above was the end result of these discussions about the balloon and other companion rescue equipment.

RECREATIONAL AVALANCHE EDUCATION UPDATE

Obtaining avalanche knowledge and skills is a must for safe mountain travel in the winter and the number of people taking advantage of avalanche safety courses and training continues to increase in Canada every year.

In order to improve the quality of the avalanche education to meet the needs of recreational backcountry users, the Canadian Avalanche Association (CAA) with the cooperation of the Canadian Ski Patrol Systems (CSPS) has developed new course standards for both an Introductory Avalanche Safety Course and an Advanced Avalanche Safety Course. This project was made possible by a grant from the National Search and Rescue Secretariat.

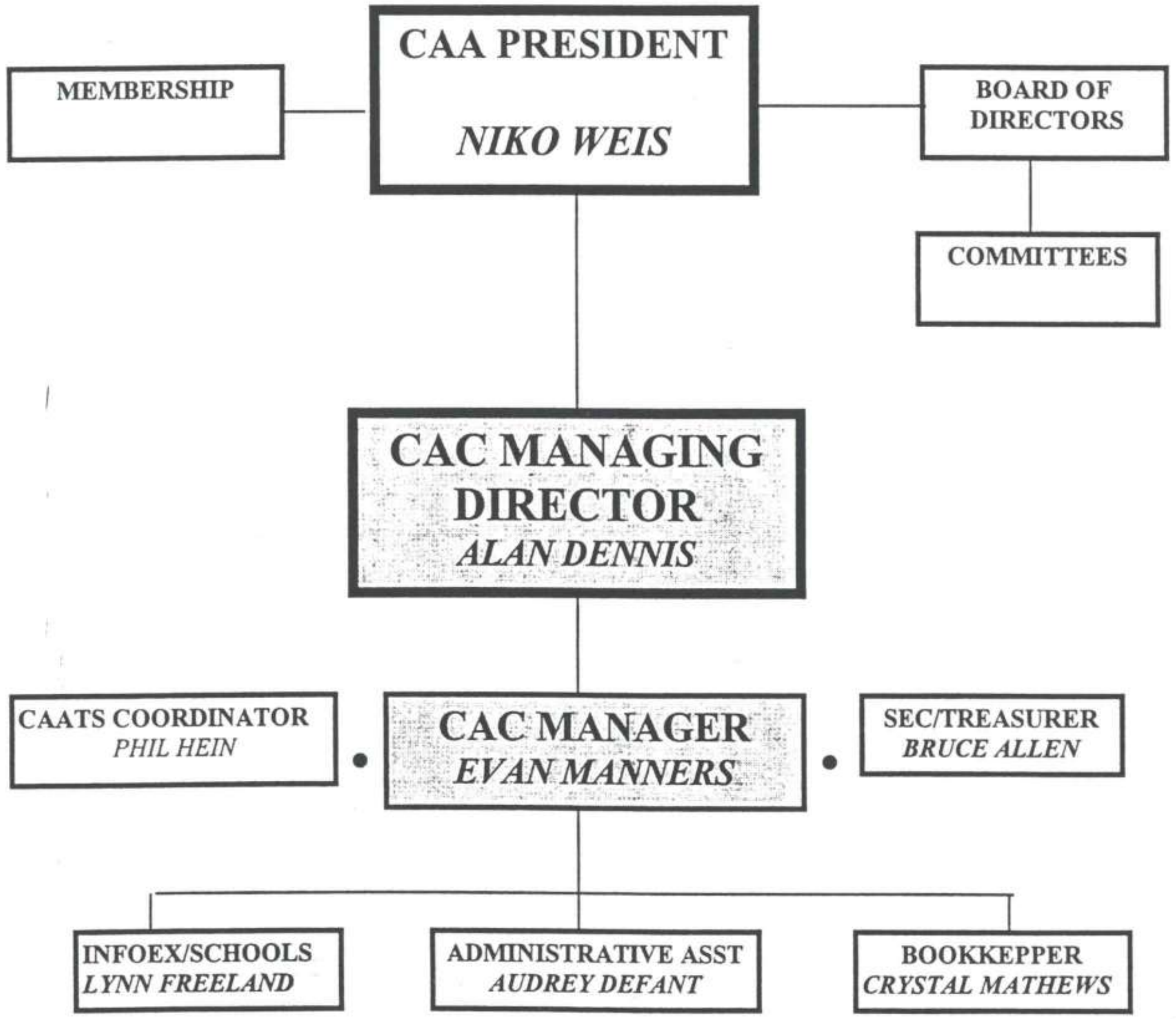
The project is developing new educational materials for these courses including and instructor manual, overhead transparencies, and slides. A student manual has also been developed for use in conjunction with the course. The initial version of these materials are now available.

The *Introductory Avalanche Course* will include classroom and field time. It will be capable of being taught in an intensive weekend format. The *Advanced Avalanche Safety Course* will typically be a weeklong course, although a minimum of four days is required. It is expected that the *Advanced Avalanche Safety Course* will become the course of preference for non-professionals. Currently, a large number of recreationalists are attending the CAA's week long Level 1course which focuses on snow and weather observations for avalanche professionals. Recreationalists needs will be better served by the new *Advanced Avalanche Safety Course*, which focuses on developing decision making and leadership skills in avalanche terrain.

The CAA will endorse the new standards and will distribute the new materials to persons or organizations involved in avalanche education. The CAA will not offer recreationalist avalanche courses to the public. Users of the new materials and standards will be required to sign a Users Agreement with the CAA stipulating certain minimum standards to be maintained. The CAA will maintain a resource list of Course Providers who adhere to the new standards.

For more information on Recreational Avalanche Courses contact the Canadian Avalanche Centre in Revelstoke, BC at 250-837-2435 or fax your request to 250-837-4624 or you can e-mail to canav@mindlink.bc.ca

RESTRUCTURING OF CAC



RESTRUCTURING OF CAC

This Spring a Re-organization Committee (Jack Bennetto, Phil Hein, Bruce Allen, Dan MacDonald and Bob Sayer) was formed to oversee the restructuring of the Canadian Avalanche Centre. David Larade, a Human Resources Consultant was retained to assist the Committee in writing job descriptions and determining reporting relationships for the staff. A series of meetings/interviews/ conference calls/drafts/ and redrafts resulted in a re-organization and new job descriptions for all staff.

Job descriptions were developed in consultation with the staff and the Re-org Committee. The Re-org plan and the job descriptions were presented to the staff on September 29th and 30th by Niko Weis, Jack Bennetto and David Larade. At that time, Niko assumed responsibility for the implementation of the reorganization. Any inquiries should be directed to Niko as the Re-org committee has disbanded.

On the previous page is a copy of the new organizational structure for the Centre. Alan Dennis, Managing Director is responsible for providing overall direction to Centre operations and ensures the Centre achieves its operating goals. Alan is also responsible for fund raising for the Centre. Evan Manners, Centre Manager is responsible for administrative and tehnical functions in the Centre. Lynn Freeland, INFOEX™/Schools Technician, is responsible for INFOEX™, Schools Administration and Registration, and the newsletter. Audrey Defant, Administrative Assistant is responsible for office administrationi, including receptionist services and Schools Administration and Registration. Crystal Mathews, Bookkeeper, is responsible for maintaining Centre financial records.

The Re-Org Committee is confident that the changes and streamlining of the Centre will result in a more efficient and effective utilization of staff, resulting in better member services and support for programs.

CANADIAN DISASTER 1910

1910 Rogers Pass

On March 5th, 1910, the worst avalanche disaster in the history of Canada occured in Rogers Pass.

Below is a weather table supplied by Environment Canada for Glacier, BC in 1910.

DATE	TEMPERATURES (DEGREES CELCIUS)		PRECIPITATION			
MTH dy	MAXIMUM	MINIMUM	MEAN	RAIN	SNOW cm	TOTAL
FEB 01	-1.1	-5.0	-3.1			
02	-3.9	-16.1	-10.0			
03	-10.6	-18.9	-14.8			
04	-10.0	-18.3	-14.2			
05	-7.2	-15.6	-11.4			
06	-8.3	-16.1	-12.2		17.8	17.8
07	-6.1	-8.3	-7.2		12.7	12.7
08	-5.6	-11.7	-8.7			
09	-11.1	-18.3	-14.7			
10	-10.6	-16.1	-13.4		7.6	7.6
11	-7.8	-11.1	-9.5			
12	-5.6	-12.2	-8.9			
13	-4.4	-16.7	-10.6		10.2	10.2
14	-7.8	-11.1	-9.5			
15	-7.2	-13.9	-10.6			
16	-8.3	-16.1	-12.2			
17	-15.0	-22.8	-18.9			
18	-12.8	-20.6	-16.7			
19	-12.2	-17.2	-14.7			
20	-11.1	-20.6	-15.9		2.5	2.5
21	-9.4	-19.4	-14.4			
22	-13.3	-23.3	-18.3			
23	-19.4	-27.8	-23.6		2.5	2.5
24	-20.00	-23.9	-22.0		38.1	38.1
25	-13.3	-20.0	-16.7		17.8	17.8
26	-6.7	-13.3	-10.0		7.6	7.6
27	-3.9	-6.7	-5.3		25.4	25.4
28	-1.1	-8.3	-4.7		17.8	17.8
TOTALS				**0.0**	**219.7**	**219.7**
MEAN	**2.6**	**-3.1**	**-0.2**			
MARCH01	-1.1	-8.3	-4.7		22.9	22.9
02	-4.4	-7.2	-5.8			
03	1.7	-5.0	-1.7		17.8	17.8
04	3.9	0.0	2.0		55.9	55.9
05	1.1	-1.1	0.0		30.5	30.5
06	3.3	0.0	1.7		5.1	5.1

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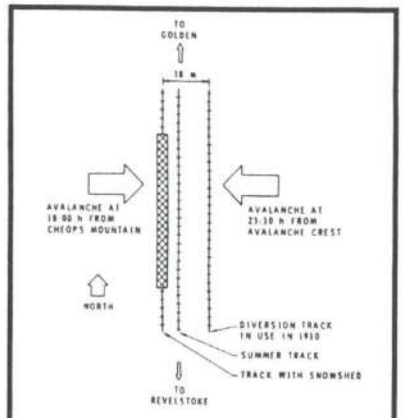


FIGURE 1
SKETCH MAP OF RAILWAY TRACKS, ROGERS PASS, 1910

The accident took place at the summit of Rogers Pass, elevation 1330m. The main railway line was completed in 1885 and was open for regular traffic in the spring of 1886. Snowsheds were constructed in 1886 and 1887. No. 17 at the summit of Rogers Pass was one of the longest. There was a second track on the open side of the shed that was used in the summer.

A track diversion was later built in a cut 15 to 18m east of snowshed No. 17 with the object of reducing the grade. Because no known avalanche had crossed the snowshed from the west since the line had opened and because the east side was covered with heavy timber, a new snowshed was considered unnecessary for the new track. Snowshed No. 17 was abandoned.

About 220cm of snow had fallen during the nine days prior to the accident. On March 3rd, 1910, heavy rain and warm weather, (temperatures up to 3.9 Celsius) had weakened the snowpack. It snowed heavily all of March 4th, and then the storm increased to blizzard conditions in the early hours of March 5th.

At approximately 18:00h on March 4th, 1910 an avalanche from Cheops Mountain came down over the No. 17 snowshed and blocked the new diversion railway line. The old track through snowshed No. 17 was not useable so a 63 man railway crew was sent out to start digging thorough the avalanche hoping to restore railway traffic. The men felt safe in the fact that the heavy timber on the east had never seen any avalanche activity. It is unknown whether look outs were posted while the men worked in the now blizzard conditions. By 23:30 hours the men had made a steep 7m deep cut through the obstructing snow. The work had mainly been done by hand as a large rotary snowplough hooked to a steam locomotive had to withdrawn from the snowbank when it's blades encountered uprooted trees and rocks. It sat idly back of the toiling gang.

A foreman left the crew to proceed to the watchman's shack to report on the progress of the work. He returned to find that all the lantern lights and

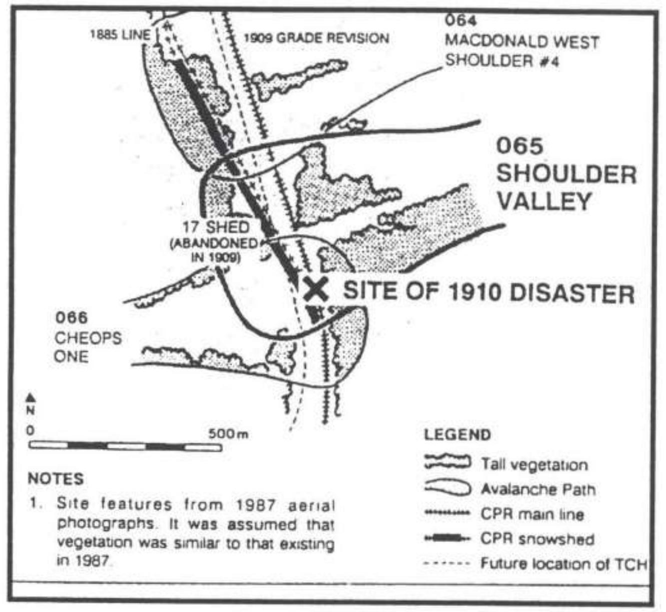
(Continued on page 20)

Snow cut filled by avalanche of March 04, 1910
(photo credit: Provincial archives of BC)

(Continued from page 19)
the beam of light from the rotary plow had disappeared. A few more steps and he saw that another avalanche had come down and buried the worksite. As he stood in the dark he heard a muffled cry for help from above the broken timber of snowshed No. 17. Here he found the loan survivor of the avalanche that had just claimed the lives of 62 co-workers. He was the fireman from the rotary plough's locomotive.

The fireman had been in the gangway of his engine when the avalanche struck, but the force of the snow in motion blew him out through the window and threw him 30m to the top of the snowshed. When the avalanche had stopped only his hands were visible in the snow. He was able to dig himself out but realized that he had severe internal injuries, a badly fractured leg and with his light clothing, now drenched, he would not be able to survive without help.

The foreman had now found the injured fireman and gave him his coat but was unable to carry him in the deep snow. The foreman then walked one mile to recruit some help and sent back two men with blankets. The injured fireman protested: "Two slides have come down and I've been in one of them. If a third comes down I don't want to be rolled up in a blanket. So pull me out of here". He was dragged to a sleeping car and left there alone until daylight. Only then was he removed to Glacier where a doctor set his shoulder. He was evacuated to Revelstoke but word on the telegraph was that he was not expected to make it there alive. The lone survivor of the worst avalanche in Canadian history eventually recovered and lived until 1973.



When the foremans message reached Revelstoke, 70km to the west, 200 inhabitants, including doctors and nurses, were dispatched on a relief train. No train could reach the Rogers Pass Summit from the East because another avalanche had blocked the line at shed # 14. That avalanche covered 400m of track to a depth of 5m, and that had to be dug out by hand.

The message was received in Revelstoke at midnight and by the early daylight hours the train had arrived at the summit.

The snow at the accident sight was 10m deep and shoveling was slow. Most of the debris was hard packed like ice. Most of the victims were found in the trench, upright and in natural positions. Escape had been impossible owing to the depth and nature of the cut. Four of the bodies were not found until the following May, victims carried away from the tender of the locomotive where they had been shoveling snow into the tank. The 150 ton locomotive had flipped on its side and the rotary plough, weighing almost 100 tons, was lifted right out of the cut and thrown on top of the shed.

The first avalanche on the afternoon of March 4, 1910 ran from the top of Cheops Mountain west of Rogers Pass from an elevation of about 2400m, falling 1100m over a distance of 2600m. The second fatal avalanche originated east of the monument now marking the summit

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of Rogers Pass, in a cirque just north of Avalanche Crest, and swept down the slopes of Macdonald West Shoulder. The starting zone elevation and travel distance was roughly the same as for the Cheops avalanche. The deposit covered all of shed No. 17 with over 2m of avalanche snow. 80m of the shed was destroyed.

The third avalanche that occurred on the 5 of March 1910 at shed No. 14 came down from Tractor shed East, Tractor Shed West, and Lone Pine. Shed No 14 provided inadequate avalanche defense in two respects. First it only protected approximately one half of the effective avalanche area, Second, its design strength was insufficient and the entire structure was badly damaged.

The avalanche disaster in 1910, along with other problems with snow and avalanches, steep grades, and a need to replace in the near future all the 25 year old timber snowsheds led to the decision in 1912 to relocate the railway line in the new 8km long Connaught Tunnel 160m below the summit. When the tunnel was opened in 1916, the railway line over the summit of Rogers Pass was abandonded. The old rail line at the summit of Rogers Pass is now a historical trail aptly named Abandoned Rails, and marks the old railway snowshed No 17. The Trans Canada Highway runs parallel to the Abandonded Rails Trail and is protected from the avalanches by Avalanche control (artillery fire) and earth mounds.

◈ ◈

USA DISASTER 1910

STEVENS PASS, WASHINGTON USA, 1910

March 1st, 1910 was the date of the worst avalanche disaster to happen in the United States.

The Stevens Pass area had experienced one of the heaviest snowfalls ever recorded in the Cascade Mountains so late in the season. The storm progressed as follows:

DATE	STORM PROGRESSION
FEB. 21	Storm started with snow being deposited at a rate of one foot per hour and continued throughout the night
FEB. 22	Wind and snow continued in blizzard like conditions. Railway crews were just able to keep the railway line open.
FEB.23	High winds and cold temperatures caused some avalanche activity along with a few scattered fatalities.
FEB. 24	Temperatures became very cold and gale force winds increased the number of slides.
FEB. 25	Temperatures were still cold while the blizzard continued. Eleven feet of new snow was reported in nearby Wellington.
FEB. 26	Snowfall had at times again reached a foot an hour and drifts of 20 feet deep were reported in many places. The roar of avalanches made the passengers on the trains nervous. During this night the wind increased in intensity.
FEB. 27	Storm grew worse before it got better, then late in the day snowfall dwindled to a thin sleet.
FEB. 28	Sleet continued all this day and into the night. At midnight the sleet quit and a warm moist chinook set in. It began to rain.
MARCH 01	At 0120 hours, the slope above the trains avalanched killing 96 people.

TERRAIN:
The slope above the railway was about 2000 feet in length and it was another 150 feet from the tracks down to the river. The slope had been burned by a forest fire.

THE ACCIDENT:
The Great Northern Railway, a main link between Spokane and Seattle carried travelers

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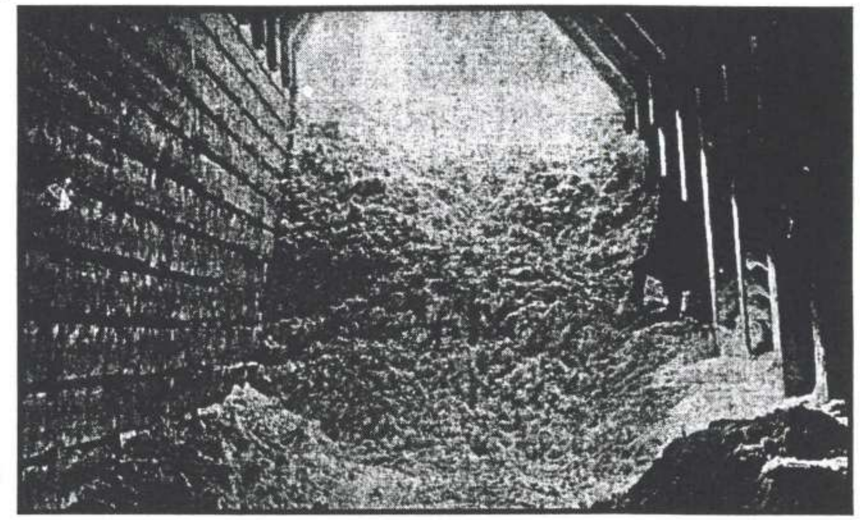
across the Cascade Mountains in the State of Washington. On February 23rd, 1910 train # 25 with 5 passenger cars, and train # 27 a mail train, spent several hours in Leavenworth, waiting for slides to be cleared from the latest winter storm. Later that same Wednesday they were stopped at the east portal of the Cascade Tunnel. Gale force winds had drifted the tunnel portals closed and had also disrupted electrical service in the tunnel. The trains became locked in deep drifts, which had to be dug out. It took a day to clear the portals and several more hours to free the trains. Finally at 2000 hours on Thursday night, February 24th, both trains proceeded through the tunnel. They passed the little town of Wellington, about ¼ mile past the west end of the tunnel and were put on parallel sidings approximately 400 yards beyond the town. The drifts were so deep that only the telegraph poles protruded. The main line was again closed by a large avalanche at Windy Point, covering the tracks for 900 feet with a depth up to 25 feet. During that Thursday night a small avalanche came down the mountain and crossed the tracks were the two trains had been previously parked. It swept the small cook shack into a ravine killing two men. The 55 passengers had all eaten at this cook shack on the 24th



A view similar to this one was seen at the end of the tunnels that were blocked in Stevens Pass.

On Friday February 25th, passengers waded through the snow to the hotel in nearby Wellington. Word was passed through the train that the rail line would be cleared by Saturday. Passengers asked why the train couldn't be moved back into the tunnel. Railway employees explaining that they were situated in the safest possible place, and if they did go into the tunnel, the portals could become blocked and coal smoke would foul the air.

The trains did not move on Saturday, the 26th, and the storm continued. New avalanches continued to hamper efforts to clear the line and now avalanches blocked the trains in both directions. A double rotary plow was disabled and also stuck between the two slides. During the afternoon the telegraph lines went dead, ending communication both east and west. For five days the crews had worked to the point of collapse and the railway line was blocked tighter than before.

Saturday night a committee from the passengers met with the Superintendent, and urged him to move the train back into the tunnel. The Superintendent refused citing that the tunnel was cold and damp and smoke and fumes would be unbearable.

The passengers could no longer walk to the hotel as water was now running on both sides of the

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tracks. Food could not be brought to the passengers, and the people were becoming very irritable. They were assured that relief rotaries were on their way and the line would be cleared. On Sunday February 27th, the storm grew even worse. The passengers on the train held a church service, led by a minister on board. Tension was somewhat eased and a division superintendent and two other workers began to hike westward to Scenic, a small railroad town 8 ½ miles away.

Later that same day five other men from the train decided to walk out also. All arrived a t Scenic, but during the trip one man was caught in an avalanche and miraculously survived after being carried 1000 feet into a ravine. The five passengers were near collapse when they arrived and it was very obvious that the remaining passengers could not walk out.

Back at Wellington, railway workers were beginning to quit. They had worked round the clock and their demand for higher wages was refused. Another rotary crew had walked back to Wellington to report that their equipment was stalled between two slides and on their ten-mile trek back to Wellington they had encountered several avalanches along the way.

One of the passengers, fascinated by the mountainside above the train, had remarked that when they had first arrived a number of stumps and snags from a forest fire a number of years before could be seen. Now there were no blemishes in the immense quilt of pure white snow. Later that day the passenger went to the hotel to replenish his tobacco. On the way back to the train he observed a " part of the hill simply fold up and start sliding with a roar." This slide did no damage, but was an ominous warning.

Late Sunday the snowfall changed to a thin sleet. Monday the 28th was the fourth day the trains had been on the siding. Tension was high and all were a bundle of nerves. The slightest noise startled everyone. Around midnight the sleet quit and a warm southwest chinook wind set in. By this time drifts had reached 20 feet in depth. Not being able to cope anymore, seven passengers and four railroad men set off for Scenic.

On Tuesday, March 01, 1910, the avalanche that many had feared came down at 01:20 hours. It swept everything in its path 150 feet down into the Tye River Canyon. Two trains, three steam locomotives, four electric locomotives, a rotary snowplow, several boxcars, an engine shed, a water tower and telegraph poles and wires lay buried under the snow and debris. The town of Wellington had been spared, but the avalanche had cut a swath 1400 feet wide and over 2000 feet long. Rescuers on the scene found only one end of a coach, the sides and blades of a rotary plow, and the roof of a shack exposed on the surface. All else was buried. The men worked desperately in wind driven rain. The precipitation made the threat of additional avalanches a real hazard, as well as packing the snow from the avalanche and making it more difficult to dig. The rescue continued, yielding occasional survivors as well a many bodies. After six hours 17 people had been found alive. Around 0830, seven hours after the accident, a crew heard faint tapping noises and uncovered the end of a popped open mail car. Four railroad men were found slightly injured in a corner that had not been crushed.

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Eleven hours after the fatal avalanche, all hope had been given up of finding any one alive. All they were uncovering now was twisted wreckage and bodies. At 1230 hours some men had paused to rest when they heard a faint sound. Digging down, they found a large tree trunk and under it was a woman, barely alive. This was the last of the survivors, 22 in all.

At 1300 hours a rescue party arrived from Scenic. This crew worked until March 9th to recover the remainder of the bodies. During the spring melt one more body was found bringing the final death toll to 96, the largest avalanche tragedy in the United States. The record still holds.
It took until March 09, 1910 for the first train to arrive at Wellington from the east. The west line was not opened until March 12th. The death toll did not stop there. On the morning of March 13th another avalanche fell just west of Windy Point, sweeping a rotary plow train into the canyon below, killing one man.

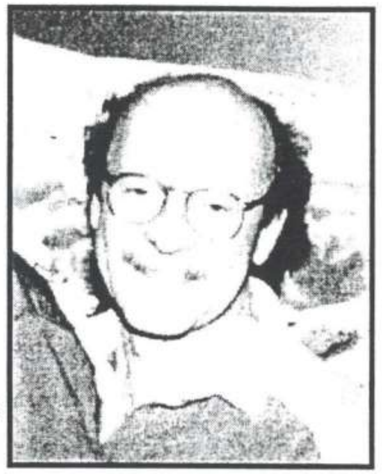
COMMENTS:

The Cascade Tunnel is now closed, and all the remains of Wellington are now gone. The summer after the tragedy, the Railroad spent 1.5 million dollars building an additional mile of snowsheds. In 1929, the Great Northern Railroad gave up on this Stevens Pass route and bored an 8 mile tunnel lower in the mountain. The original route used 40 miles of track.

CITATION

FOR

DR. BRUCE JAMIESON



Dr. Bruce Jamieson is broadly recognized for his outstanding Chairmanship of the Organizing Committee for the 1996 International Snow Science Workshop at Banff, Alberta. Primarily for this accomplishment, The American Association of Avalanche Professionals has selected him as recipient of its **"Special Service Award"** for 1997.
Since this is only one of his many on-going services to the Avalanche Community, it is germane also to mention several other of his notable achievements.

In 1981, Bruce commenced teaching avalanche awareness courses for the University of Calgary, and authored a very useful booklet to augment these course entitled, *Back Country Avalanche Awareness.* These activities continue to support future avalanche developments, particularly serving the Canadian Heli-ski Industry and employing the results of his important work on the use of the shear frame, the "Rutschbloch Test", and the role of snow compression in avalanche fields. In addition, his Ph.D. Thesis (1995) under the Dept. of Civil Engineering at the University of Calgary has been widely distributed, and is recognized as having important practical significance. It has been cited by colleagues as "one of the most comprehensive publications on avalanches of the past 25 years".
Always conscious of the need to maintain the link between research and practice, Bruce has devoted a great deal of time to the Canadian Avalanche Association, of which he was the president and a director from 1992-1995. He continues his avalanche research collaboration with industry while at the same time fostering a program of post-graduate studies and instruction offered both for the University of Calgary and the Canadian Avalanche Association.

CLAIR ISRAELSON WINS SILVER PLAQUE AWARD

The International Alpine Rescue Association annually honours an individual who has made an outstanding contribution to alpine rescue. This year the 26th Silver Plaque Award was presented in Italy to our own Canadian, Clair Israelson, longtime CAA member.
Clair is the first Canadian to receive this honour. Having been involved in more than 250 mountain search and rescue efforts, Clair has risked his life on many occasions. From 1974 to 1997, Clair provided leadership for Parks Canada at Banff National Park, Alberta. This is one of the busiest search and rescue programs in the country and while fulfilling his job he also developed the Avalanche Control Program at the Lake Louise Ski Area. Clair was also a lead figure in the development of a safer design for Helicopter Sling Rescue.
He has also shown his dedication to the betterment of search and rescue by representing Canada on the International Committee for Alpine Rescue **(ICAR),** organizing and chairing the Wildlands Rescue Workshop in 1995, as well as sharing his techniques and concepts with fellow colleagues around the world.
A truly great honour for an individual who has made such a great contribution to search and rescue programs everywhere.

INTERNATIONAL SYMPOSIUM ON SNOW AND AVALANCHES

BY PETER SCHAERER

at Chamonix Mont-Blanc, France

26 - 30 May 1997

Venue

The International Glaciological Society (IGS) with the co-operation of the Association Nationale pour l'Etude de la Neige et des Avalanches (ANENA) had organized a symposium on snow and avalanches at Chamonix Mont Blanc in the French Alps. Simon Ommanney, the Secretary General of the IGS, together with his wife Margaret, dealt efficiently with the administration and the program. François Sivardière, the Director of ANENA was responsible for the well-run local arrangements.

A total of 151 participants from 18 countries had registered for the symposium, including the representatives from Canada: Dave McClung, Bruce Jamieson, Chris Stethem, Colin Johnston, Walter Bruns, Laurent Mingo, and Peter Schaerer. Dave McClung was the Chief Editor of the papers that were presented.

The sessions were held in the ballroom of the old Grand Hotel Majestic, which now serves as a conference centre in Chamonix. A clear sky and warm weather during the whole week, mountains with exciting rock climbs and glaciers, an abundance of hiking trails around the town, and the rich Savoyard food together with the excellent French wine and beer offered numerous attractions beside the scientific presentations and discussions. As a result of these distractions, the audience in the meeting room usually was around 120 persons and often it was difficult to find a specific colleague for an informal exchange of ideas.

In his opening address, the Mayor of Chamonix drew attention to the avalanche hazard in the valley and the need to develop solutions to avalanche problems. This was evident from the windows of the hotel room and on walks around the town where one could observe numerous avalanche paths and wonder about the safety of buildings near the runout zones.

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Program

The five-day long conference was divided into six half-day meeting room presentations, two half-day poster presentations, and an afternoon with excursions to the Aiguille du Midi and the Mer de Glace. A heavy load of contributions resulted in rather crammed meeting room sessions, which allowed little discussion, but the poster sessions were welcome opportunities for a close inter-action with authors. Although avalanches were the principal topic, properties of snow at low elevations, on the prairies, and in arctic regions were also addressed. The topics of both audience and poster contributions may be summarized as follows:

- 28 presentations were concerned with mechanical and other physical properties of snow, including snow forces.
- 14 additional presentations dealt with snow cover properties that have specific applica tion to stability evaluation and the formation of avalanches.
- 8 presentations described methods and observations of the distribution of snow and avalanches across the terrain.
- 14 presentations dealt with theories and observations of the motion of blowing snow and the locations of wind-transported snow.
- 15 presentations described the nature of motion, speeds, and impact pressures of moving avalanches.
- 6 poster presentations were concerned with protective measures against avalanches.
- 3 papers described the formation and properties of slush flows.

A large number of contributions in the meeting room and in poster sessions contained applicable information by describing and summarizing field observations and laboratory experiments, but several papers consisted of pure theories supported by numerous equations which were difficult to follow during the short presentations in the meeting room. It would have been better if the authors of theoretical papers had given only a summary of their assumptions and conclusions, or displayed the theory in a poster session. All talks were given in English, and one must admire the accomplishment of the participants with a non-english native tongue, in particular Japanese and Russian.

As a rule, symposia of the International Glaciological Society emphasize scientific knowledge, therefore a knowledge of physics generally was necessary for understanding the papers, but avalanche technicians who do not have an adequate scientific knowledge still would find in the proceedings much useful background information about the intricate properties of snow and avalanches. The International Glaciological Society will publish the papers that were accepted by the scientific editor in Volume 26 of the Annals of Glaciology. Following are highlights, which may be of interest to avalanche workers.

Properties of Snow and Snow Stability

Several papers described the reaction of snow to densification. The models that were presented allow making estimates of mechanical properties of the snow from parameters such

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as grain size, density, and temperature. The information would assist in solving engineering problems, for example snow pressures, trafficability, and the compaction of snow for runways.

Paul Föhn reported on the investigations in Switzerland concerning the behaviour of weak snow layers, in particular on relationships between the shear strength and strain rate for different types of snow grains. One of his conclusions was that measurements of the shear strength with the aid of a shear frame is the best technique for monitoring the strength of fragile layers.

Bruce Jamieson presented his studies of the stability index for skier-triggered slab avalanches. The stability index concerned is the ratio of shear strength of a weak layer (measured with the shear frame) to the downslope stress induced by the weight of the slab plus a skier by taking into account the ski penetration. In the discussion which followed the presentation, it was concluded that the stability index may not be scientifically perfect but it has proven to be a useful element of stability evaluation.

Jürg Schweizer and Dave McClung reported on their laboratory experiments concerning the relationships of shear strength, strain rate, failure conditions and snow temperature on samples of homogenous snow. Slab stiffness (hardness) appears to be the most important feature when influences of temperatures on stability are considered.

Howard Conway of the University of Washington presented a West Coast problem on how rain initiates slab avalanches.

One of the meeting room sessions dealt with the verification of models. Laurent Mingo and Dave McClung reported on the verification of the CROCUS snowpack simulation model with observations at Fidelity Mountain (Rogers Pass) and at Blackcomb Mountain. They found good agreement of predictions of densities and depths of snow layers, but the predictions were unsatisfactory with respect to surface hoar. The Italian and Spanish avalanche study centres described their method for verifying the danger levels that were predicted in avalanche bulletins with the actual danger in the Dolomite Alps and the Catalan Pyrenees. The actual danger was determined by observing avalanche activity, making slope tests, taking snow profiles, and Rutschblocks in the back country. In the two winters of the study, the 24-hour forecasts proved to be reliable 93% in one winter and 76% in the other.

Blowing Snow

Information on blowing and drifting snow has application in the formation of avalanches, prediction of drifts and visibility at roads, and snow management on ski trails. The 14 papers may be divided into;

a) mathematical models and wind tunnel experiments of the motion of wind-transported snow particles;

b) field observations of the amount of transported snow and its deposition at mountain ridges and on level terrain;

c) measurements on electrical charges of the snow particles in Wyoming.

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Field observations in Switzerland and in Scotland again drew attention to the difficulty of predicting the amount, location, and depth of wind-transported snow. This is a consequence of the variability of mountain terrain and the complex interactions between the wind, irregular terrain and snow cover. Experiments in the wind tunnel also seem to fail in making numerical predictions.

In an investigation of several techniques for catching blowing snow and measuring the mass-flux in the Spanish Pyrenees, stacks of boxes proved to have a catching capacity, which was superior to conventional drift gages.

Avalanche Dynamics

An advance was obvious in knowledge on the motion of avalanches through theoretical models, experiments with small size physical models, and observations on full-size avalanches.

It is recognized, that a well-developed dry snow avalanche in motion contains three layers: a) dense flowing snow at the bottom, b) a saltation layer of lighter snow, c) a powder component of suspended snow. Because of the complexity of avalanches in motion, however, a one-layer (dense flow or powder) or two-layer (dense flow plus powder) model still is assumed in applications. Dieter Issler from Switzerland described a theory of turbulent interaction among the three components, but his three-dimensional model with 8 parameters, would be difficult to apply in practice. Margarita Eglit from Russia reviewed historical mathematical models and Bozhinskiy and Sukhanov had developed a laboratory model of a two-layer avalanche and found good agreement with observations of a full-size avalanche. Norwegian investigators produced a numerical simulation of dense avalanche flow against a deflection dam and found good agreement of the run-up height with observed avalanches.

Most valuable was information from studies of real avalanches. Jimmie Dent described the observations of avalanche speeds, depths, densities, shear rate, and friction coefficient at the experimental avalanche path at Bridger Bowl, Montana. Kouichi Nishimura presented the results of measurements of speeds and pressures of the three layers of moving avalanches in the Kurobe Canyon in Japan. Another interesting experiment in Japan involved the release of avalanches of up to 300,000 ping-pong balls on a skijump and in a channel. The ping-pong avalanches, simulating the dense flow, allowed the study of the formation of the head at the avalanche tip and the distribution of velocities of the particles.

Distribution of Avalanches

Tanya Glazovskaya from Russia reported on studies of the avalanche activity in the past and in the future. She found that in the past 100 years the avalanche activity in the Eurasian mountains had increased. Predictions for the Northern Hemisphere, based on climate models,

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are that at the begin of the 21st century, the avalanche activity will decrease in areas which are most active now, and the avalanche activity will increase in areas with a low activity now.

Investigations and proposals were presented on the acoustic monitoring of avalanche activity, but they have not reached useful applications. At the Ecole Polytechnique in Lausanne, Switzerland equipment was developed for the detection of infrasonic vibrations caused by avalanches, but problems with separating the avalanche noise from other noise sources still need to be solved.

Slush Flows

Slush flows are avalanches of water-saturated snow, which occur during rapid melting of snow when the water is unable to drain properly. Three papers described the phenomena and presented case histories of slush flows in the Spitsbergen, Norway, and Sweden. Erik Hestnes of the Norwegian Geotechnical Institute summarized his 25-year experience with slush flows, and concluded that they occur on a wide variety of terrain with respect to the starting zone and track.

Closing Comments

The symposium at Chamonix was one of the most informative recent scientific conference on avalanches. The organizers and authors of the papers made a great effort in presenting new knowledge, which will assist the solution of practical problems and will lead to a further pursuit of wisdom on the complex nature of snow and avalanches. They deserve the thanks of the participants. Because an important feature of conferences is not only to listen to talks, but to meet colleagues with similar interests, the meeting offered a great opportunity to meet old friends from Switzerland, France, Japan, and other countries and to make the acquaintance with the younger generation of avalanche investigators.

The interest and number of studies on avalanches around the world is amazing, but avalanche research is a slow process because usually nature provides a limited number of avalanches for study in a given winter. This makes it difficult to generate continuously new information for the numerous snow and avalanche conferences that are held; therefore a repetition of contributions is unavoidable. For example, a few papers at the Chamonix symposium contained material that was already presented at the International Snow Science Workshop at Banff in 1996, but this may be forgiven because the audience largely was different. The next meetings of avalanche scientists and workers will be in May 1998 in Norway for the celebration of 25 years snow avalanche research in Norway and in October 1998 the International Snow Science Workshop in Oregon.

The Added Value of Specialized Weather Forecast Products

submitted by Gabor Fricska

For the past several years, the Canadian Avalanche Centre has provided a specialized weather forecast for its members. The need for a specialized forecast service has sometimes been questioned, given that there is already a readily available forecast issued free of charge by Environment Canada. The public forecast is issued to fulfill Environment Canada's mandate to protect the safety and security of Canadians. Public forecasts apply to broad regions and concentrate on the areas where people live and work. In most cases in B.C. and western Alberta, these areas are at lower elevations where the climate is more benign. To protect the travelling public, snow levels are mentioned in public forecasts when snow is expected to fall below the level of the major mountain passes within a region. In winter, snowfall amounts are indicated in public forecasts when significant accumulations are expected at lower elevations, however accumulations generally are not stratified to higher elevations.

The specialized weather forecast product produced by the Mountain Weather Services Office in Kelowna expands on the Public Forecast, adding higher elevation site details which are not found in any regular Environment Canada product.
With the evolution of technology and reductions in budgets, the job of meteorologists is increasingly becoming one of interpreting the various weather models and intervening when the models are deficient. Determining when and how the models are deficient is a specialized task, fully occupying the meteorologist's analytic and diagnostic skills. There are already routines in place to have computers write the first draft of the public forecasts based strictly on the output of the models. It is anticipated that public forecasts will become increasingly reliant on this technology. Meteorologists add value to forecasts by identifying areas where the models are having trouble and by including local climate effects that the models are not able to resolve. The CAA is an example of this. The forecast is written by a core group of six meteorologists who have an interest in winter weather and its impacts throughout western Canada. By identifying the needs and wishes of the avalanche community we are able to provide a weather product that expands on basic requirements of the public forecast.

FUSE NEWS

BY MIKE BOISSENNEAULT

A new safety fuse assembly (sfa) called the X-381 is currently available from your local explosives distributor. It is manufactured by ICI Explosives Limited. The X-381 sfa uses a 12 grain Scottish military detonator, Ensign Bickford, Sword fuse and a copper thermolite connector. Each fuse is x-rayed to ensure no defects. This fuse has been approved by the Department of Energy Mines and Resources, Explosives Branch.

After three years of "grief" using substandard quality safety fuse assemblies and having to abide by a manufacturers recommendation to use two fuses, this winter will see a return to the use a single fuse to initiate explosive charges.

The X-381 safety fuse assembly is expected to be safe and reliable. It is what the Explosive Committee asked for and virtually insisted for on behalf of its members. As expected, the cost of the X-381 is more than previously available fuse assemblies, however, it must be kept in mind that this new premium product reflects the high quality of materials and associated costs to ensure no defects.

Besides the X-381 sfa there is also another fuse product available in the Canadian market. It is a fuse supplied by Austin Explosives which uses an 8 grain detonator. There is no thermolite connector on this product. Attempts to find out who manufactured the detonator used in the Austin fuse product have been unsuccessful. As more information becomes available about the Austin sfa it will be reported in both the Infoex and future CAA News Letters.

As these products begin to see use within our industry it will be important to report any irregularities or inconsistencies in their use. Besides reporting any incidents involving sfa to WCB, please report them to me and to the Infoex bulletin (if you are a subscribing member).

The Explosive Committee will continue to work towards ensuring that the safest fuse products possible are made available to our members. If you have any questions or concerns, feel free to contact me at (250) 387-7514.

Mike Boissonneault
Chair, Explosives Committee

Members: Colani Bezzola
Bernie Protsch

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CANADIAN AVALANCHE ASSOCIATION

BOX 2759
REVELSTOKE, BC
VOE 2SO

TELEPHONE : 250-837-2435
FAX: 250-837-4624

E-MAIL : canav@mindlink.bc.ca
Web site: http://avalanche.ca/snow