

AVALANCHE NEWS NO. 39

NOVEMBER 1992

EDITORIAL NOTE

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

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

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

AVALANCHE NEWS will now be issued only two times per year, in June and November. There is no subscription fee. Requests for copies and notifications of change of address should be sent to the publisher.

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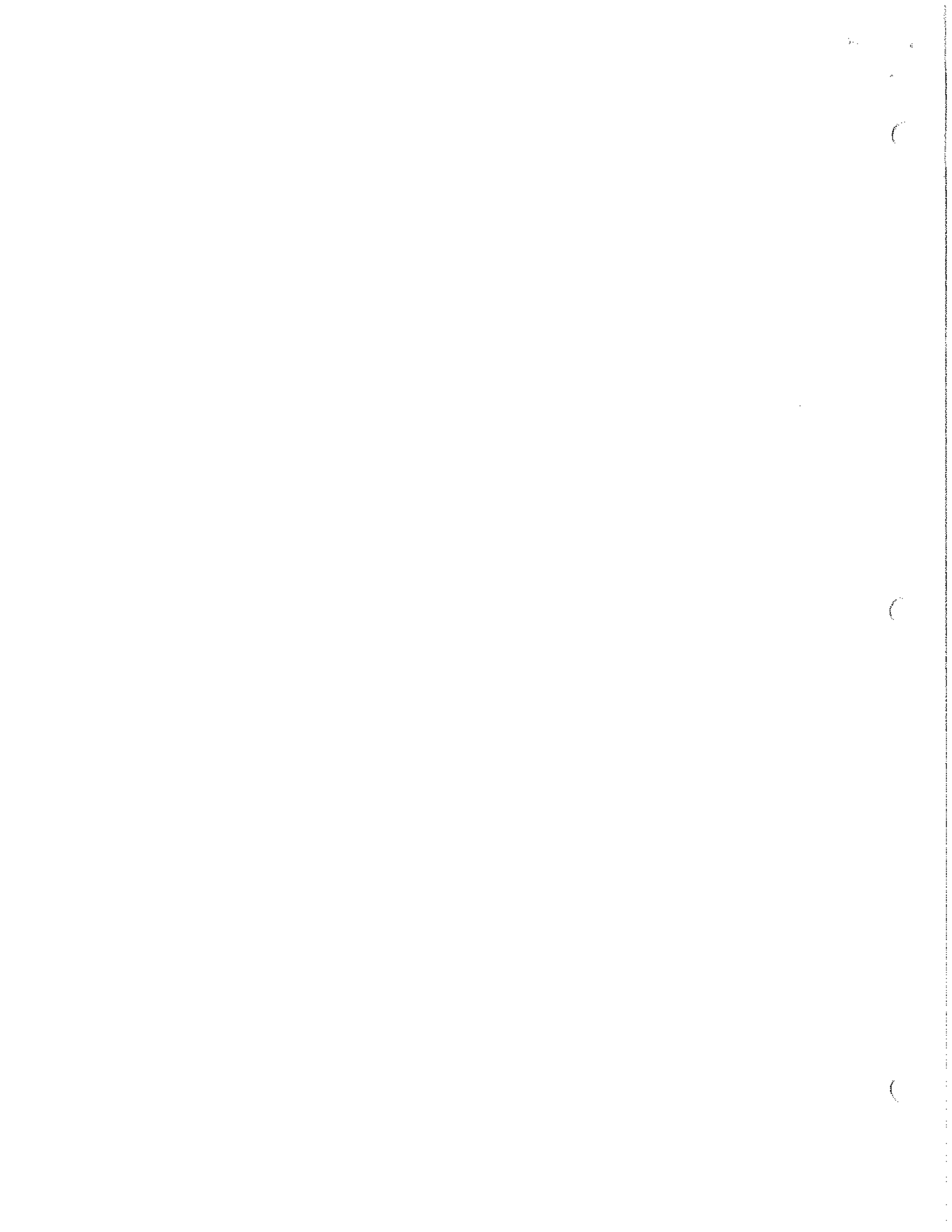
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CANADIAN AVALANCHE CENTRE

by Alan Dennis
& Chris Whalley

The Canadian Avalanche Centre (CAC) is preparing for the second winter of full operations which include:

1. Industry Information Exchange (INFOEX). This is the third winter of this service for avalanche safety operations. Last year there were more new subscribers bringing the network up to forty-two exchanging a daily summary of weather, snowpack, avalanche and stability information. The subscribers are from avalanche safety programs for ski areas, highways, parks, snow-cat skiing and helicopter skiing operations.

This winter there will be data available from remote weather stations and west coast buoys. It is also expected that more subscribers will have access to the INFOEX through modem which will be cheaper, more efficient and timely.

All avalanche safety personnel find the INFOEX an invaluable part of their forecasting process whether the information is from a near neighbour or a "prompt" from a more distant operation.

A sample of the INFOEX from last winter is attached. The contract with the subscribers includes a confidentiality clause that the INFOEX will not be distributed outside their operation. In the sample shown the date has been removed.

2. Canadian Avalanche Association Training Schools (CAATS). This will be the second winter that the CAC has been wholly responsible for the operation of the Schools. An error on page 12 of AVALANCHE NEWS 38 showed the plans for courses in the winter 1991-1992, this should have read 1992-1993. All the other dates are correct and the brochure with details is now available from the CAC.

As in past years the courses provide technical training for personnel of operations that are concerned with avalanche safety: maintenance of highways, railways and powerlines; ski areas; ski guiding; park operation. In addition, the courses are attended by people who seek education in greater depth than is usually offered in short avalanche safety courses.

3. Public Avalanche Information Bulletin (PAIB). Over seventy-five responses to the questionnaire in the last AVALANCHE NEWS have been received. The suggestions fell into three main categories requesting more frequency, more detail and coverage for additional areas. This winter the PAIB will be issued more frequently and give more detail. The availability of Bulletin information for additional areas will depend on what data is available to pass on from the Centre.



The development of the PAIB relies on support from public and private agencies. Judging from the questionnaires received the PAIB is an important public safety service.

A poster has been prepared to help with distribution of the PAIB. If you have a suitable place to post the Bulletin please contact the CAC and request the poster. A sample of last winters PAIB is at the back of this issue, the current PAIB can be attached to the poster. The toll free number for the Bulletin is 1-800-667-1105. The PAIB is also available from a PC BBS at (604) 837-4893.

4. Canadian Avalanche Association (CAA)

Accidents: Two avalanche fatalities occurred in April; however, the cause was not identified until late July when the bodies were found and recovered. This accident involved two ski tourers who were climbing in the Coast Range. Total avalanche fatalities for the winter (1991-1992) is six.

Annual General Meeting: At the last AGM it was decided to make more of the sessions open to the public. This is the best opportunity for interested people to keep up to date with avalanche developments and to discuss these developments with personnel involved. The following dates are for the next AGM to be held in Revelstoke at the Anglican Church Hall, 650 W. 2nd Street.

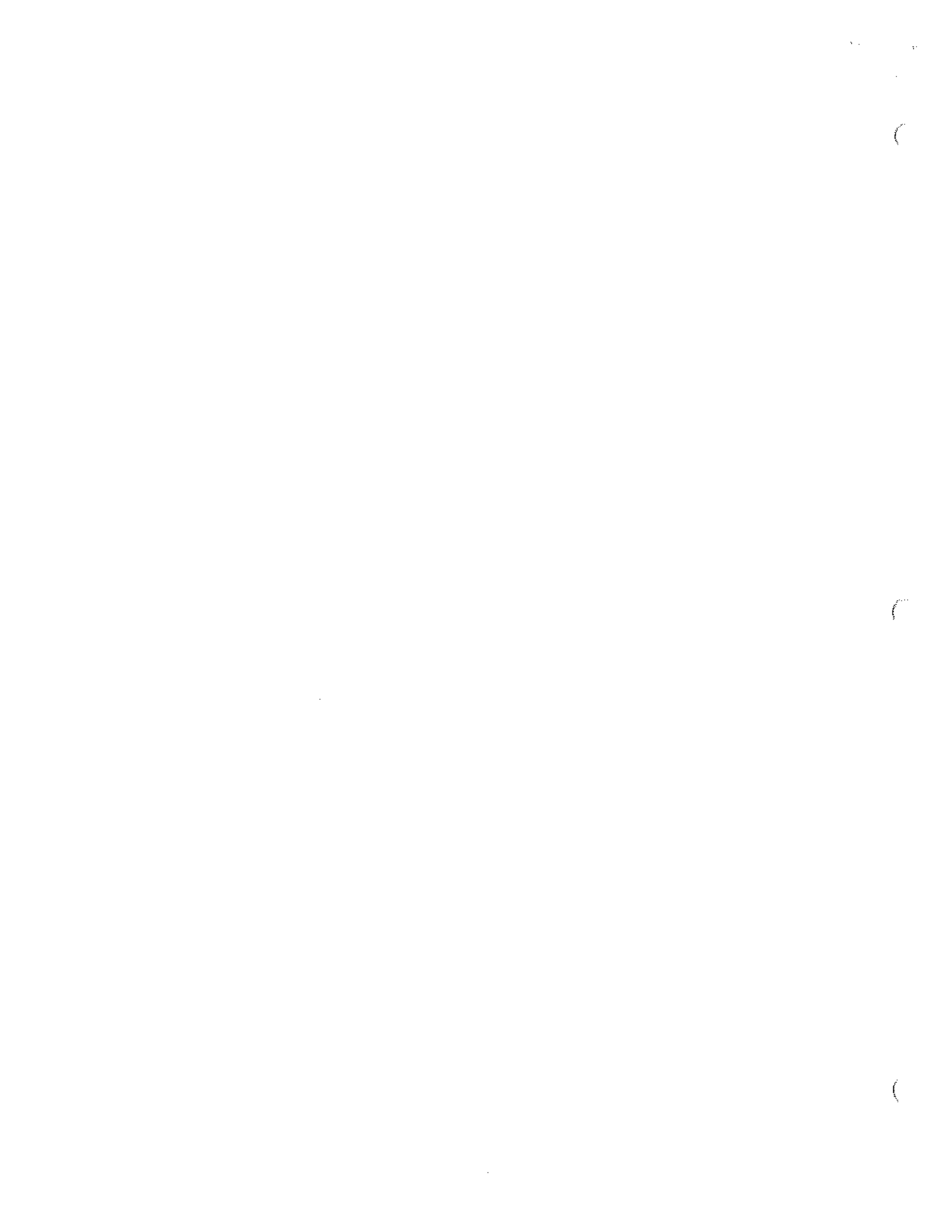
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May 4	all day (0800 hrs)	CAATS Instructors Meeting
May 5	all day (0830 hrs)	CAA Public Sessions (items of general interest)
May 5	evening	INFOEX Subscriber's Meeting
May 6	morning (0830 hrs)	Technical Session for Members
May 6	afternoon (1330 hrs)	Annual General Meeting (business)

There has been interest expressed in commercial presentations being made at the AGM. There will be an opportunity for display booths at the meeting. For further details contact the CAC.

CAA T-shirt: This T-shirt was first sold at the 1992 AGM in Revelstoke and also at the ISSW in Breckenridge. It is available for Christmas at \$21, GST included.

CAA office address: The Canadian Avalanche Association has moved the office and operations of the Canadian Avalanche Centre to 518B - 2nd Street West, Revelstoke, B.C., V0E 2S0. The postal address remains the same.



BC WORKER'S COMPENSATION BOARD - CAA EXPLOSIVES USE COMMITTEE UPDATE

by John Tweedy

It was a quiet off-season for the joint committee. No formal meetings were held. The Association applied for a blanket variance on the pre-arming of hand charges but it was rejected since the WCB does not issue industry wide variances. We are suggesting that each operation request the pre-arm variance, if they so desire, when they request the other variances that must be applied for annually (signals etc.). There is documentation available from John Tweedy or Chris Stethem that may be of assistance if your operation wishes to apply for the pre-arm variance. They can be reached at either (604) 428-3270 (JT) or (403) 678-2477 (CS). If you are not using a particular method of delivery and it's in your procedure, the Board feels it should be eliminated.

We expect explosives use inspections will continue this season; probably unannounced.

Other Explosives Info

Single high strength blasting caps are still available in Canada. At one point this summer it was a concern.

NEW avalaunchers will require certification through the BC Gas Safety Branch. Garry Walton of Sear Search and Rescue Equipment Ltd., has more information. His address is as follows:

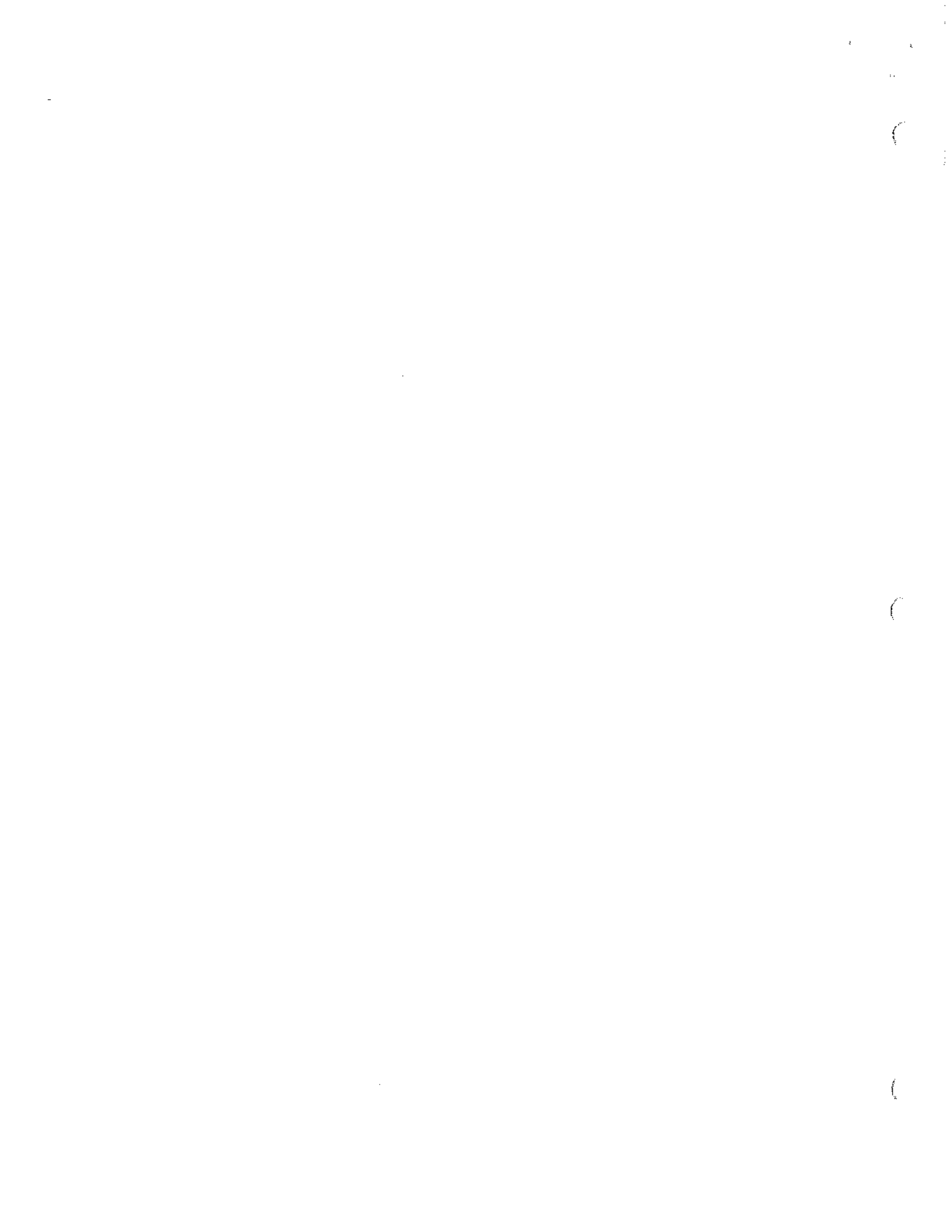
2828 Bayview Street
Surrey, B.C.
V4A 2Z4

Telephone: (604) 535-2700

SNOWFRAC

ICI Explosives announces the introduction of a new product specifically designed for hand charges in avalanche control. SNOWFRAC is an emulsion explosive, which is considered safer to handle than the dynamite often used for hand charges. The product contains no nitroglycerin, in fact, no self-explosive ingredients of any kind. However, it detonates at 5500 m/s (18,000 ft/s), and shoots reliably with a safety fuse assembly to temperatures below -30°C (-22°F).

SNOWFRAC comes in a specially-developed cardboard shell, which leaves no debris or soot after detonation. The shell incorporates a plastic cap-well and an integral device for attaching the safety fuse. Therefore, no punching or taping is necessary to arm each cartridge. Also, the safety fuse can be easily removed if the charge is unused. Each cartridge measures 57 X 400 mm (2 1/4 X 16"), weighs 1.0kg (2.2 lbs), and there are 20 charges in every case.



SNOWFRAC, developed at the request of the avalanche control industry, will be available in western Canada very early in the New Year. For further information, please contact:

Terry Matts, Richmond, British Columbia (604) 278-3464

or

Jim Cunningham, North York, Ontario (416) 229-7121

FORMS FOR PLOTTING TEST PROFILES

by Peter Schaerer

At the technical meeting of the CAA on May 7, 1992, I presented a draft of a form that could be used for plotting test snow profiles. In the meantime, the improvements suggested at the meeting were made and the revised form is ready for trial and use.

The test profile form has the following features:

The layout is similar to the conventional form for plotting full snow profiles (which many operations have used in the past for test profiles).

The columns for snow hardness, free water, and density were omitted. The hardness must be plotted as a bar diagram at the left side of the columns.

Much space is available for comments and the recording of snow strength observed by shovel shear, shovel bump, rutschblock, shear frame, and other tests.

The graph allows the plotting of snow temperatures between 0 C and -13 C; lower temperatures should be written in numerals at the appropriate height.

Snow observers are encouraged to utilize the form, to evaluate its usefulness during this coming winter, and to submit their comments to the Manager of the CAC. For this purpose members of the CAA may, on request, obtain up to 10 forms free of charge from the CAC.



INTERNATIONAL COMMISSION FOR ALPINE RESCUE

by Peter Schaerer

Introduction

The annual meetings of the International Commission for Alpine Rescue (ICAR) was held at Windischgarsten in Austria on 22-24 October 1992. The sessions included two days of discussions by four separate subcommittees (Terrestrial Rescue, Air Rescue, Avalanche Rescue, and Mountain Emergency Medicine), a meeting for the presentation of reports of the subcommittees, and the annual general meeting of the delegates who represent the member organizations; the Canadian Parks Service is the ICAR member organization for Canada.

Following are the highlights of the business of the Avalanche Subcommittee, which was chaired by François Valla (France).

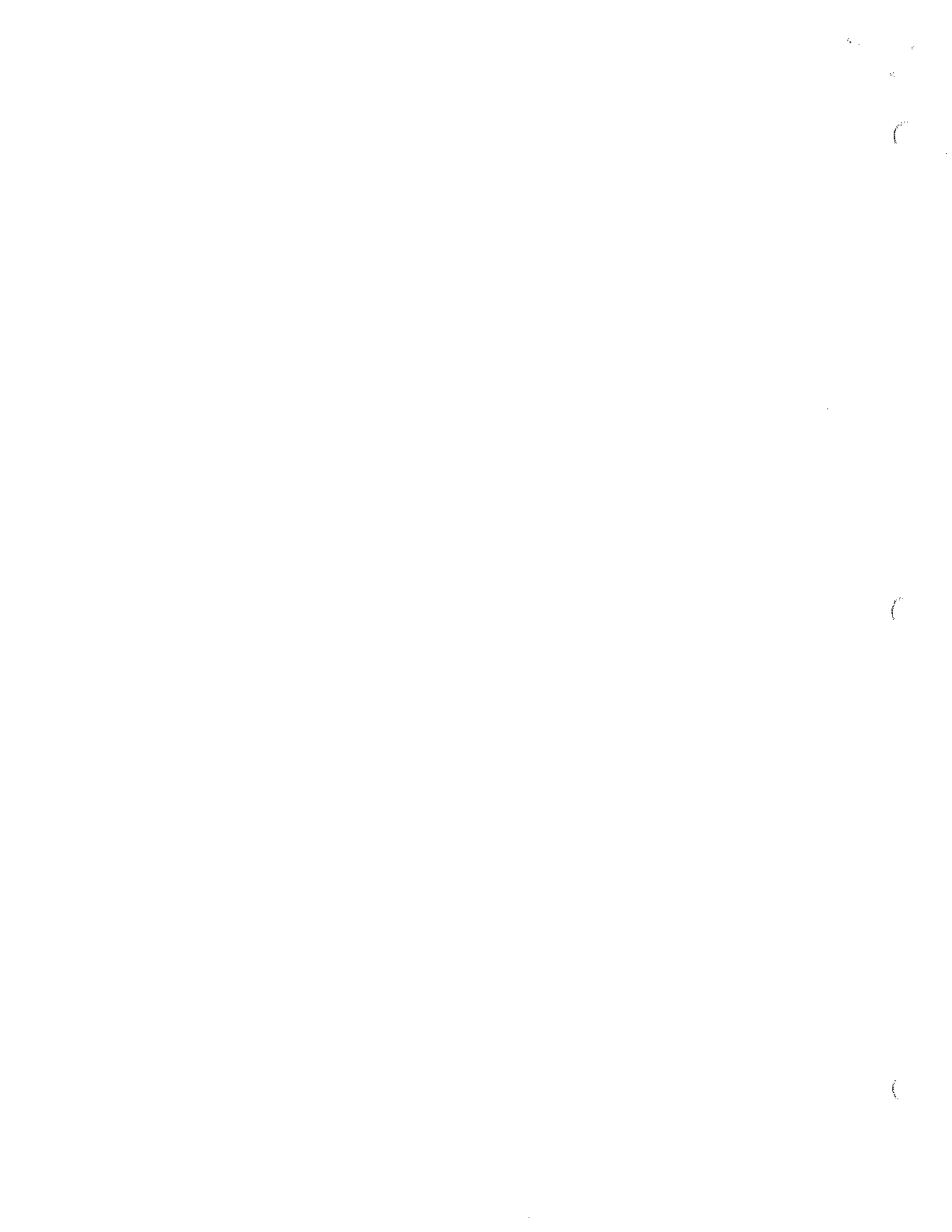
Summary of Avalanche Accidents

The enclosed table shows the number of avalanche fatalities in 1991-1992. Fewer accidents occurred in 1991-1992 than in previous years (99 deaths compared with 150 to 190); favourable weather in the European Alps was the principal reason for the low number. The proportion of ski touring accidents was higher than in previous years, but the accidents in the categories roads, buildings, and others have decreased from previous years, which was partially attributed to the efforts of ICAR.

The table of avalanche deaths contains only the statistics from countries that are members of ICAR. In addition, there were numerous avalanche fatalities in Turkey, Iran, Pakistan, India, and Nepal, which were not reported because of a lack of reliable and complete information. The Italian delegate at the meeting reported that 281 people were known to have died in avalanches in Turkey in 1991-1992, but probably the actual number of fatalities was even greater (Reference: Neve e Valanghe No. 16, July 1992; A.I.NE.VA.). Most of the Turkish victims died on roads in Eastern Anatolia and were reported as being government employees (probably from the armed forces and road maintenance). Heavy snowfall with wind was the principal cause of the avalanches which frequently ran on slopes that had been logged bare for firewood in the past 30 years.

Selected Avalanche Accidents

On May 1st a small avalanche covered the road at the Fluela Pass in Switzerland. It stopped a bus and three cars at one side, and at the other side a car attempting to drive through became stuck. A few bus passengers and car drivers assisted in freeing the impaired car when another large avalanche caught the waiting bus with 25 passengers inside, the three cars, and unprotected persons outside. The bus was pushed 200 m down the slope, snow entering the bus buried the passengers, then additional smaller avalanches caught the rescuers outside. Three persons inside the bus and one that was thrown out died and sixteen persons were injured.



The avalanches occurred at an avalanche path which was controlled during the winter by helicopter bombing and firing with a bazooka. On the two previous days, there was a snowfall of 26 cm at a low temperature, and on the accident day the air temperature climbed to +1°C under a clear sky; a control by explosives prior to the accident was unsuccessful. The avalanches initiated in the new snow then removed old snow lower down in the path. As a rule, the road was closed between 1100 hours and 1800 hours on sunny warm days, but on the day of the accident, the avalanches ran already at 1000 hours when the road still was open.

At the Montblanc in France an avalanche swept a party of climbers into a crevasse on 19 July. The inexperienced climbers were on the glacier when the snow was wet and unstable. Wet avalanches continued to run during the rescue and covered the injured and swept the rescuers into a crevasse. Other rescuers attempted to hold back the unstable snow above the crevasse by building barriers with shovels. One rescuer died, one injured climber was recovered but died later, and one was buried too deep to be recovered. The reporter at the meeting concluded that too many climbers without proper knowledge visit the mountains. In July 1992 there were a total of 7 avalanche fatalities at the Montblanc.

At the Wolzer Tauern in Austria an avalanche buried four skiers in the backcountry. Three skiers did not have transceivers (though a few days previous to the trip one of them had expressed the intention of buying one) and one member of the group carried a transceiver switched off in a pack. A fifth, independent skier with a transceiver had followed the group about 300 m behind, had observed the avalanche, and after an (obviously) unsuccessful transceiver search had skied down to report the accident. One of the buried skiers freed himself but the other three bodies were found by probing during an organized rescue.

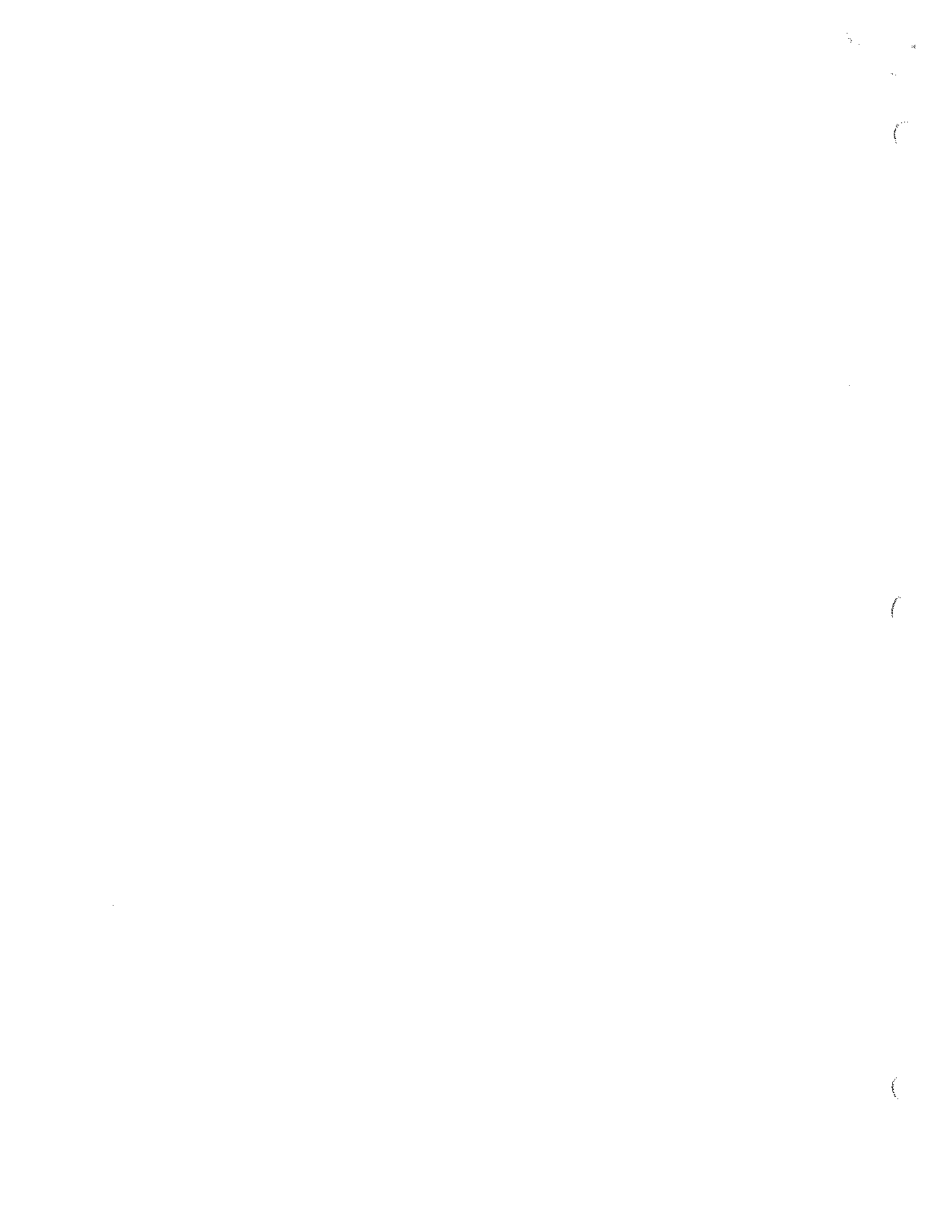
Another accident in Austria with one victim involved a group of three skiers who carried transceivers with different frequencies and who had neglected to check them at the start of the trip. The victim was found later by a dog.

In Spitsbergen (Norway) a slush avalanche, 2 km long swept away a victim who died by drowning. The victim was found by probing from a boat. The case illustrates the hazard from slush avalanches in arctic areas.

In response to the description of accidents with snowmobiles in Canada, the Subcommittee acknowledged that snowmobiles cannot be banned in terrain subject to avalanches, but it recommends that snowmobile operators carry transceivers, shovels, and probes.

RECCO Search Equipment

RECCO uses a secondary-radar system which consists of a transmitter-receiver, carried by a rescuer, and a transponder (reflector) worn by persons at risk of burial. The equipment has been developed in Sweden for several years and about one million transponders have been either sold or given away as promotion. The latest version of the transmitter-receiver (Model III), weights



less and costs less than previous models, was tested in 1992 by a working group in Switzerland (test report by W. Good; Federal Institute for Snow and Avalanche Research Weissfluhjoch-Davos, Switzerland). The working group has determined the reliable width of the scanning strips, but concluded that the equipment best be used on the ground; the rescue technique should only be applied from a helicopter in inaccessible terrain.

It must be emphasized, that the RECOO system works only when an avalanche victim wears a transponder, and that it should be considered only as a tool for an organized rescue and supplementary to other conventional rescue devices.

Accident Site Markers

The delegates from France demonstrated a First Party Pack that contained sets of flags of standard colours and shapes. The idea was to standardize the flags that are used for marking the avalanche boundary, the location of objects found on the surface, spots indicated by a dog, the probed areas, and the escape route. The Subcommittee recommended that the member countries consider the idea of standardizing the flagging and make a decision in 1993.

Avalanche Dogs

The Avalanche Subcommittee includes an avalanche rescue dog group. The objectives of the group are, to act as a coordination and exchange centre, to develop standards for the dogs and handlers, and to exchange teams among countries for training.

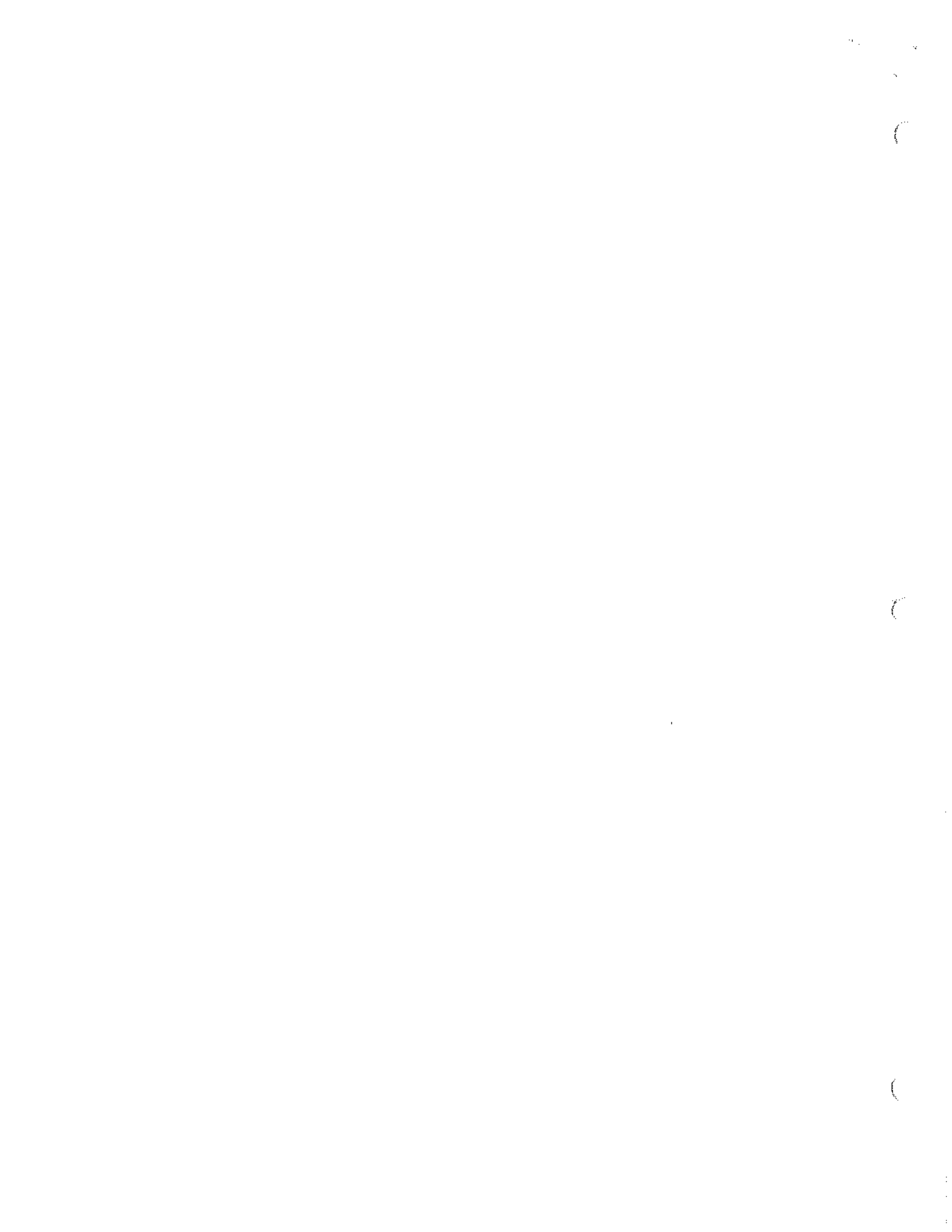
Avalanche Prevention

The individual members of the Subcommittee outlined their approaches to accident prevention by education and public warnings. It was agreed that greater efforts are needed, because the majority of travellers in mountains have poor perceptions of avalanches and other hazards. A working group was formed to meet in the winter for a discussion of means of educating and informing the public.

Survival Probability in Avalanches

Herman Brugger (South Tirol, Italy) presented the results of his study of the survival time of 332 avalanche victims in Switzerland. In applying a complex statistical analysis (Turnbull Algorithms, a method generally accepted in biology) and including only victims that had at least the head and upper body buried in the snow he was able to identify four phases, as follows:

- a) 0 - 15 minutes after burial: survival phase. Buried persons that were found within 15 minutes had a 93% probability of being alive.
- b) 15 to 45 minutes after burial: asphyxiation phase. The survival probability dropped sharply to 26%. Asphyxiation is the common cause of death.



- c) Burial longer than 45 minutes: latent phase. Survival is possible only when a breathing space is available and the thorax is free. In this case, the probability of survival decreased slowly; victims are relatively safe, but their bodies cool and after about 90 minutes death by hypothermia may occur. In the study, the conclusions for burials longer than 90 minutes were uncertain, because of an insufficient number of cases.
- d) Rescue phase; Survival is more critical during the actual rescue and recovery of the victim. Dangers to the victim include the destruction of the breathing space by trampling and shovelling, and in moving the injured and cold victim.

The study confirmed that the first 15 minutes following a burial are the most critical. During that time the search must be conducted intensively by all persons and means.

The author concluded further, that a future study of the survival of avalanche victims would require better data which should include the cause of death, the position of the victim, type of snow, presence of a breathing space, and type of clothing.

NUMBER OF AVALANCHE DEATHS 1991-1992

(in ICAR countries)

Country	Ski Touring	Outside Skiruns	On Skiruns	Climbg	Roads	Bldg	Other	Total
Switzerland	5	2			4		2	13
France	12	5		10		1		28
Austria	7	2						9
Italy	8			1			1	10
Germany	1							1
Liechtenstein								0
Slovenia								0
Spain *	4		2					6
U.K.								0
Norway	2	1		1				4
Poland				1				1
Czechoslovakia								0
Bulgaria				1				1
Canada	2			2			2	6
U.S.A.	10	3		4	1		2	20
TOTAL	51	13	2	20	5	1	7	99

* The figures for Spain are not final.

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RESEARCH ON PERSISTENT INSTABILITIES

Starting this winter, the Civil Engineering Department of the University of Calgary will be working with Canadian Mountain Holidays, Mike Wiegele Heliskiing, the Canadian Parks Service and the BC Ministry of Transportation & Highways on a three year avalanche research project. The team will include two seasonal staff from the University of Calgary posted in the Blue River and Bugaboos/Bobbie Burns areas. Measurements will also be performed by Canadian Parks Service staff in Banff, Glacier, Jasper and Yoho National Parks and by BC Ministry of Transportation and Highways staff at Kootenay Pass. The team will use profiles, shear frame tests and rutschblock tests to assess changes on strength and stability of persistent instabilities which typically involve weak layers of faceted grains, surface hoar or poorly bonded crusts. The primary goal of the project is to improve forecasting techniques for slabs that overlie persistent weak layers.

This is a University-Industry project jointly funded by the Natural Sciences and Engineering Research, Mike Wiegele Helicopter Skiing and Canadian Mountain Holidays. The project Director is Dr. Colin Johnston, Civil Engineering Department, University of Calgary. Bruce Jamieson, of the same department will organize staff training and supervise the field work.

EMPLOYMENT OPPORTUNITY

Avalanche Forecaster/Ski Patrol

Mt Washington Ski Resort Ltd, a progressive expanding resort, require a senior patroller with CAA level 2 certification. This is a full time position, salary \$964 bi-weekly. Send resume or contact:

Niko Weiss
Patrol Director
Mt Washington
Box 3069
Courtenay, B.C.
V9N 5N3

Telephone: (604) 338-6702



AVALANCHE OF AUGUST 1992

BROKEN RIVER SKI AREA, NEW ZEALAND

by Dr. Ian Owens & Peter Weir

On 10 August 1992, an avalanche occurred as the result of a combination of factors typical of New Zealand weather conditions, especially in the intermontane areas - cold enough to develop depth hoar but maritime enough to allow rainfall to high elevations in mid-winter. It occurred in one of several ski basins located above tree line in south-east facing cirques in the South Island's Craigieburn Range.

An overview of the starting zone shows that snow over almost the entire basin failed. The initial release was on the steeper shady aspects followed by propagation towards the sunny aspects. Approximately 40,000 t was involved. Avalanche speeds were relatively slow and most snow remained within the cirque basin deposited in depths up to 30 m. About one quarter of the debris flowed over the lip such that the total length of run-out was 1.2 km.

The avalanche occurred at 1300 hours on a clear day. While the skifield was open only the Rugby Tow was operating. Three people were clearing the rope on the Main Tow when the avalanche occurred. Two near the top clung to the rope while the avalanche moved out from under them but one person lower down was swept away and was not recovered. A groomer working near the Rugby Tow was engulfed by the avalanche and may have been the trigger. Approximately 60 people were on the field, fortunately most were in Palmer Lodge when the avalanche occurred.

The 1992 winter was characterized by several heavy snowfalls interspersed with cold periods (at least by NZ standards). This produced a weak layer of depth hoar in the bottom 15 cm of the snowpack on all aspects. Avalanche control with explosives and ski cutting had been done during the winter. On 19 July helicopter bombing produced no avalanches at Broken River and on 5 August a size 2 avalanche was released from Nervous Knob.

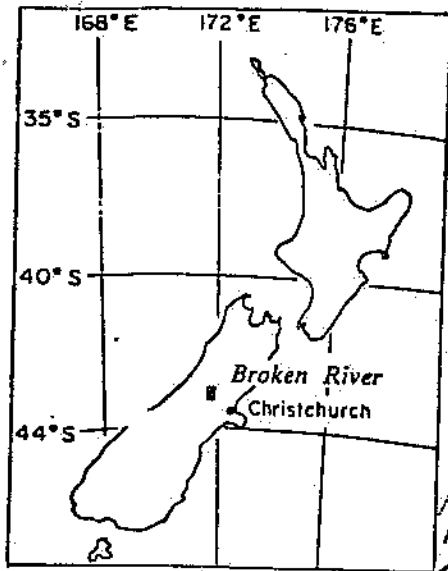
Synoptic conditions progressed from a period of northwesterly flow to passage of an intense pressure system with associated fronts and ended with a disturbed southwesterly flow. As a result, very heavy rainfall totaling almost 150 mm occurred to ridge line in the period 24 to 72 hours before the avalanche. The 24 hours before release were cold and clear and the top 30 cm or so of the snowpack was frozen to produce a hard slab. Below this the snow remained moist and creep within this layer undoubtedly placed the slab under considerable tension. This was the largest avalanche in the fifty year history of the ski area. A map of avalanche is shown on page 11.

The winters of 1991 and 1992 produced heavy snowfalls and large avalanches in many mountain regions of New Zealand. Two events, although unrelated, are noteworthy. On the Milford Road avalanches as large as any in the sixty years of observations were recorded. On Mt Cook a rock slab failure produced an avalanche that included 70 million cubic metres of rock, snow and ice that terminated seven kilometres below the summit. The peak is now 10 metres lower and 14 metres south and west of its previous position.

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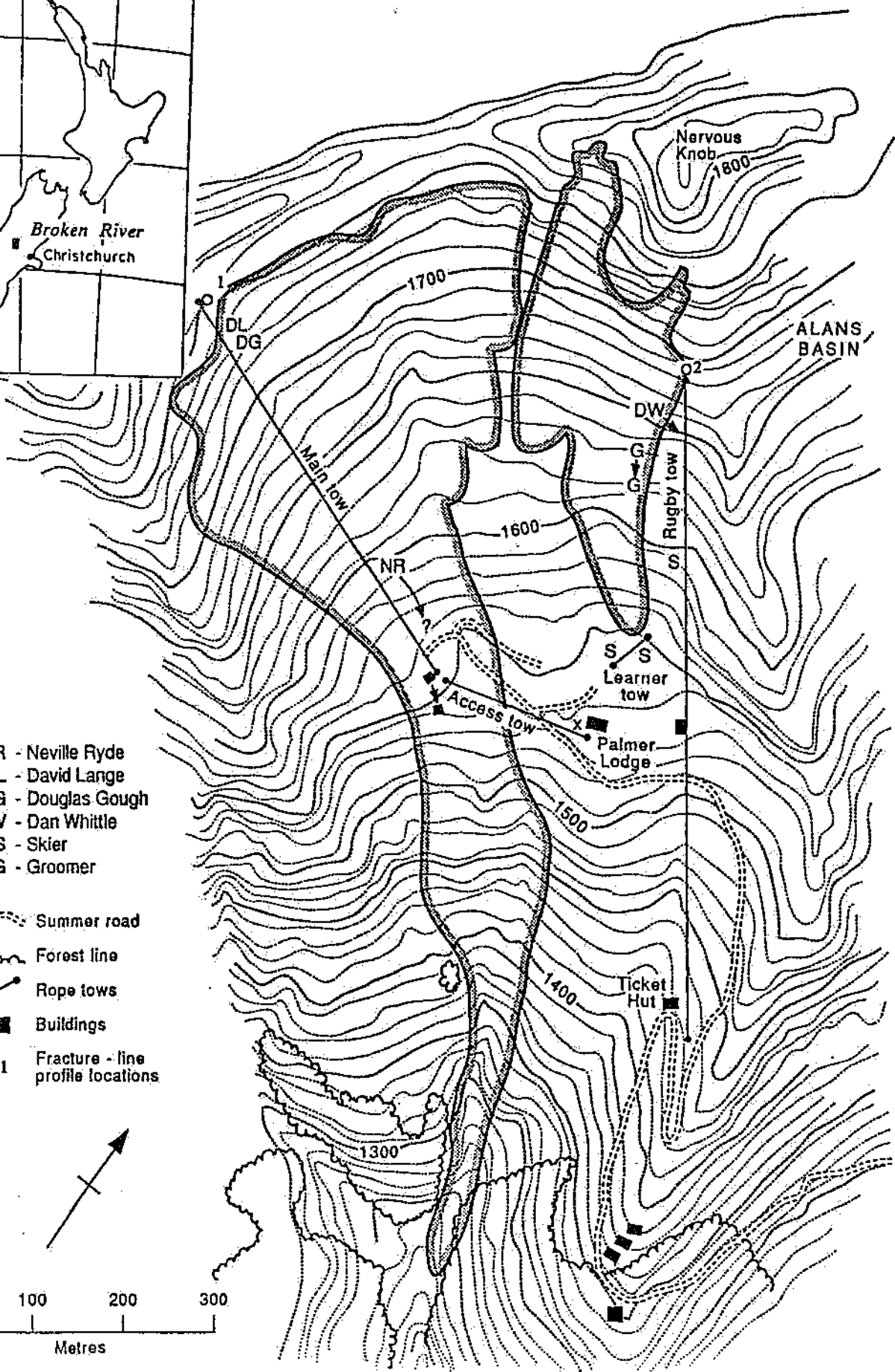
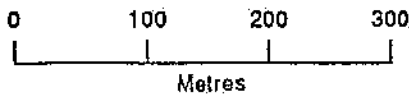
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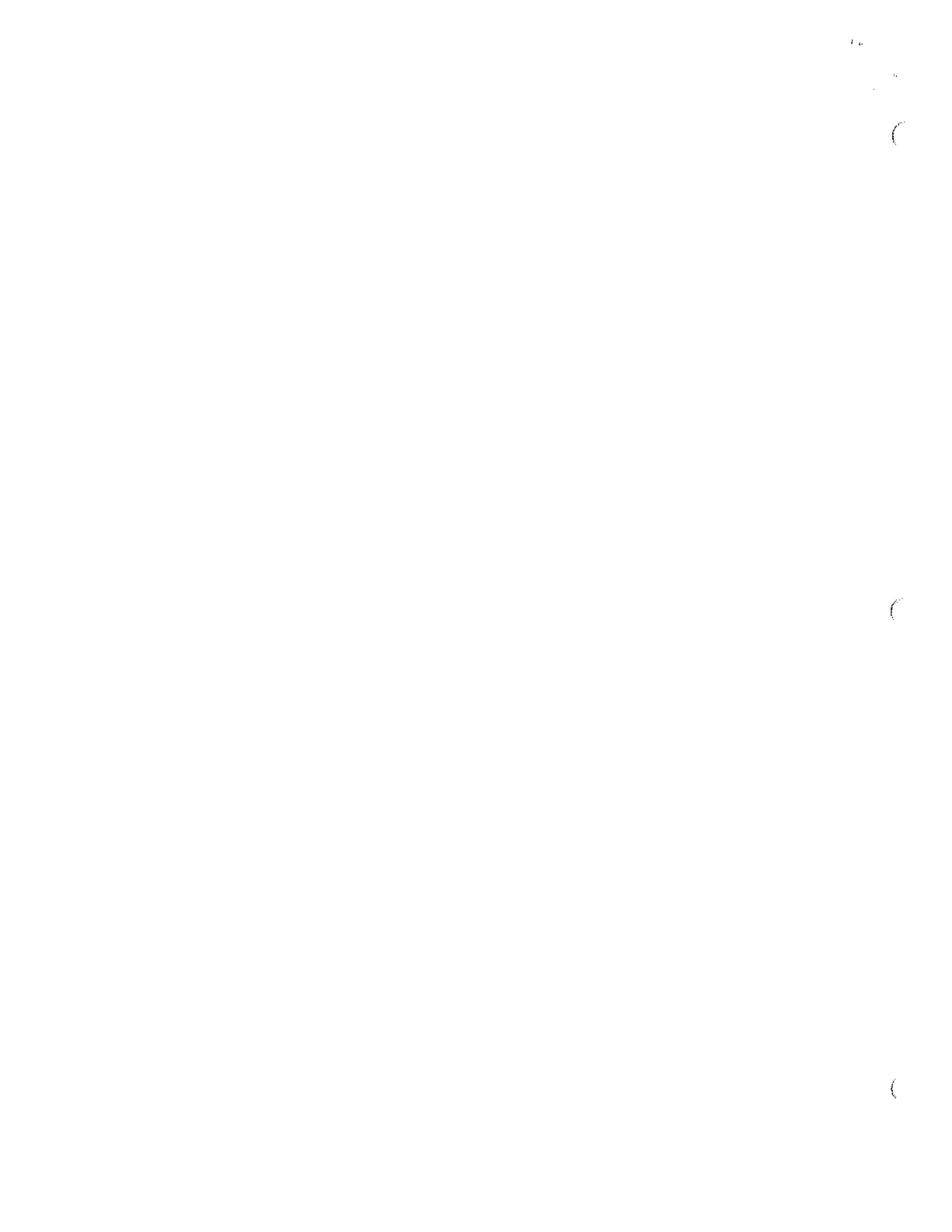
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- NR - Neville Ryde
- DL - David Lange
- DG - Douglas Gough
- DW - Dan Whittle
- S - Skier
- G - Groomer

- Summer road
- Forest line
- Rope tows
- Buildings
- Fracture - line profile locations





PUBLICATIONS & EQUIPMENT

FIELD GUIDE TO SNOW CRYSTALS by E. R. LaChapelle has been reprinted by the International Glaciological Society from the original artwork. It was first published by the University of Washington Press in 1969. The guide is 102 pages long in a 146 mm wide by 202 mm long format; the front cover is shaded in blue, with crystals superimposed.

Copies may be obtained from the IGS office in Cambridge, UK, where the stock is held. The prices are: 10 pounds UK net, \$18 US, including postage by seairmail, for airmail the cost is \$23 US. Payment should be made by pound sterling cheque or bank transfer, or by US currency, made payable to International Glaciological Society. The address is Lensfield Road, Cambridge CB2 1ER, UK.

AVALANCHE SAFETY FOR SKIERS & CLIMBERS. Second Edition by Tony Daffern is now available from Rocky Mountain Books, 4 Spruce Centre SW, Calgary, AB, T3C 3B3. The cost is \$14.95.

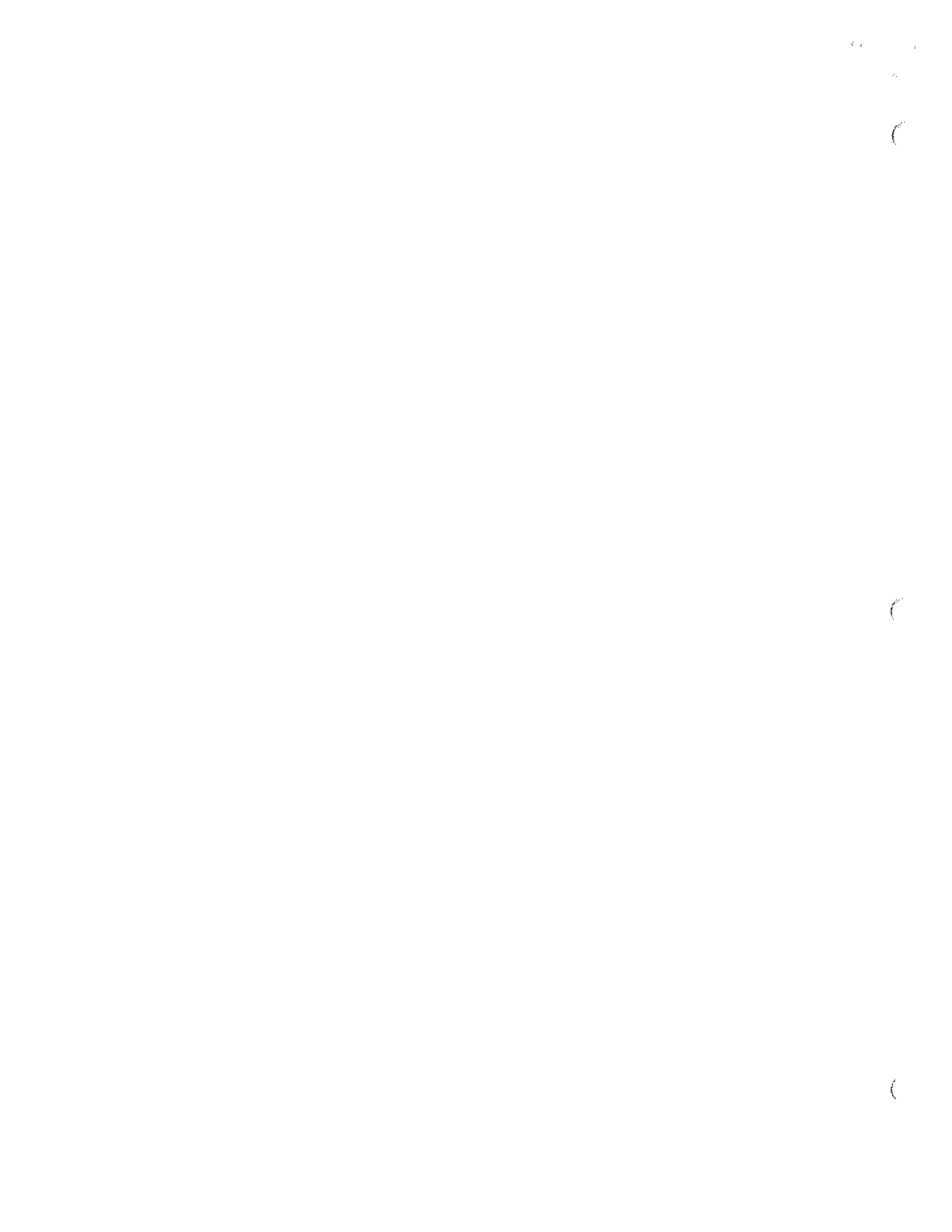
RUFESCHBLOCK, SHEAR FRAME & SPRING TABLE TESTS from the Department of Civil Engineering, University of Calgary, Calgary, Alberta, T3B 2A7, Attention: Bruce Jamieson; is available on VHS NISC (17 minutes). The cost is \$25 + \$5 shipping.

BACKCOUNTRY AVALANCHE AWARENESS. Third Edition by Bruce Jamieson, course notes for avalanche awareness courses, 53 pages, flexicoil bound, cost \$3.50 + shipping from Snowline Technical Services, 7943-48th Avenue NW, Calgary, Alberta, T3B 2A7.

'ARVA' AVALANCHE TRANSCIEVER TRAINING. A promotional, educational video (in French) is available from Carleton Rescue Equipment, 3201 Kingsway, Vancouver, British Columbia, V5R 5K3, Attention: Doug Harstrom, telephone: (604) 438-6303.

AVALANCHE CRIMPING TOOL HOLSTER. Will no longer be made by Mt Tam Sports. They have a limited number still in stock. They continue to make and sell the Harper Rescue Packs. For further information contact MIS, Box 111, Kentfield, CA, USA, 94914-0111, telephone: (415) 461-8111.

AVALANCHE TRANSCIEVER TESTING UNIT for Ortovox is available at The Hostel Shop, 1414 Kensington Road NW, Calgary, Alberta, telephone: (403) 283-8311.



CANADIAN AVALANCHE RESCUE DOG ASSOCIATION

The 1993 AGM of CARDA will be held on 8 & 9 May at Apex Alpine Resort, Penticton, British Columbia. For further details about their courses contact:

Rod Pendlebury
Box 364
Fernie, B.C.
VOB 1M0

Telephone: (604) 423-7932
Fax: (604) 423-4973

COMPUTER SYSTEMS DEVELOPMENTS at the BC Ministry of Transportation & Highways' Snow Avalanche Program, 1992

by Peter Weir

A coupled expert system is being designed for Snow Avalanche Programs by Dr. Dave McClung of The University of British Columbia (UBC) to run on a PC to evaluate a method of predicting the probability of avalanching at Kootenay Pass, British Columbia. A numerical forecasting method has been developed to make predictions based on patterns determined from analysis of 10 years of weather and snowpack data. An innovative approach using Bayesian Statistics has been developed which enables the avalanche forecaster, John Tweedy, to link his estimate of the likelihood of avalanching based on factors other than direct meteorological variables to that proposed by the numerical technique. The probability ascribed by the human expert is used to modify the rating based on meteorological variables.

The system makes a prediction of the probability of avalanching, as well as indicating whether the avalanches will be dry or moist/wet. It also undertakes a nearest neighbours search of a 10 year database to find the 30 closest days to the current day. Prototype software which uses a PC database manager linked to a custom statistical program will be evaluated in the 1992-1993 winter season. Once the Expert System has been tested in the transitional climate of the Kootenays it is hoped to apply the technique in the West Coast's maritime climate regime.

New PC software for drafting snow profiles has been developed by Snow Avalanche Programs and is ready for testing. The drafting application runs on an IBM or compatible PC and requires Windows 3.1 to operate. It incorporates the International Classification For Seasonal Snow on the Ground developed by Colbeck and others (IASH, 1990). The application presents the user with the new basic classification which is very similar to that described in the CAA/NRCC guidelines. However the application gives the user the option of



employing the IASH's new sub-classification. It is necessary to use the sub-classification to describe graupel, or to discriminate between wind crusts, rime or melt-freeze crusts. Provided that densities are known, the package computes an average density for the whole snowpack, as well as computing the water content of each layer and the entire snowpack. The final profile is printed in accordance with the template in the international classification. Further development is required to link the snow profile information into a database so that queries can be made to, for example, retrieve profiles of similar characteristics.

New software is proposed for Snow Avalanche Programs Technicians. Prototype Time Profile and Storm Profile displays have been developed. The prototype uses a graphics package which reads information directly from a database stored on a PC. The Storm Profile graphic displays hourly data for a two day period from a manual or automatic weather station while the Time Profile displays one month's weather and avalanche occurrence data observed twice a day.

(Note: Highlighting and underlining have been inserted on the following SAMPLE pages to make text easier to read.)

February 20, 1992

CANADIAN AVALANCHE CENTRE
PUBLIC AVALANCHE INFORMATION BULLETIN

AREA 111, N GARIBALDI/DUFFEY LAKE
WEATHER Storm snow amounts of over 50 cm have been common throughout the area during the past four days. Freezing levels have been at the valley floor. Winds at ridge elevation have been mostly from south and southwest at not more than 50 kmh.

SNOWPACK Storm related instabilities are widespread; slab layers in the alpine are poorly bonded to the old surface. At lower elevations on steep ground a weakness persists at the old/new snow interface. Solar radiation in breaks between storm snow is rapidly weakening the new snow on sun exposed aspects.

AVALANCHES Widespread avalanching up to size 2.5 from explosives and numerous smaller ski cut and ski releases.

AREA 222, SELKIRKS
WEATHER Wide variation in snow amounts throughout the region from a few centimetres to over half a metre in some parts. Freezing levels have been up to 1000 m. Cooler (-3 to -7) above 1500-2000 m. Winds from southerly quadrant (30-50 kmh) during the period.

SNOWPACK Cooler temperatures at higher elevation have slowed the rate of settlement. Pre-existing surface weaknesses have not gained in strength. Surface hoar and new snow overlying sun crusts are particularly delicate. There may be up to 50 cm on these weak layers. Ski penetrations of 30 cm are common.

AVALANCHES Northern and southern Selkirks report natural and skier released avalanches up to size 2.5. The central Selkirks report smaller natural avalanches in steep non-skiable terrain.

AREA 333, PURCELLS
WEATHER Moderate snow accumulations, some clear breaks conducive to surface hoar growth, temperatures of -2 to -15 at 1500 m and light to moderate winds from the S & W in the previous few days.

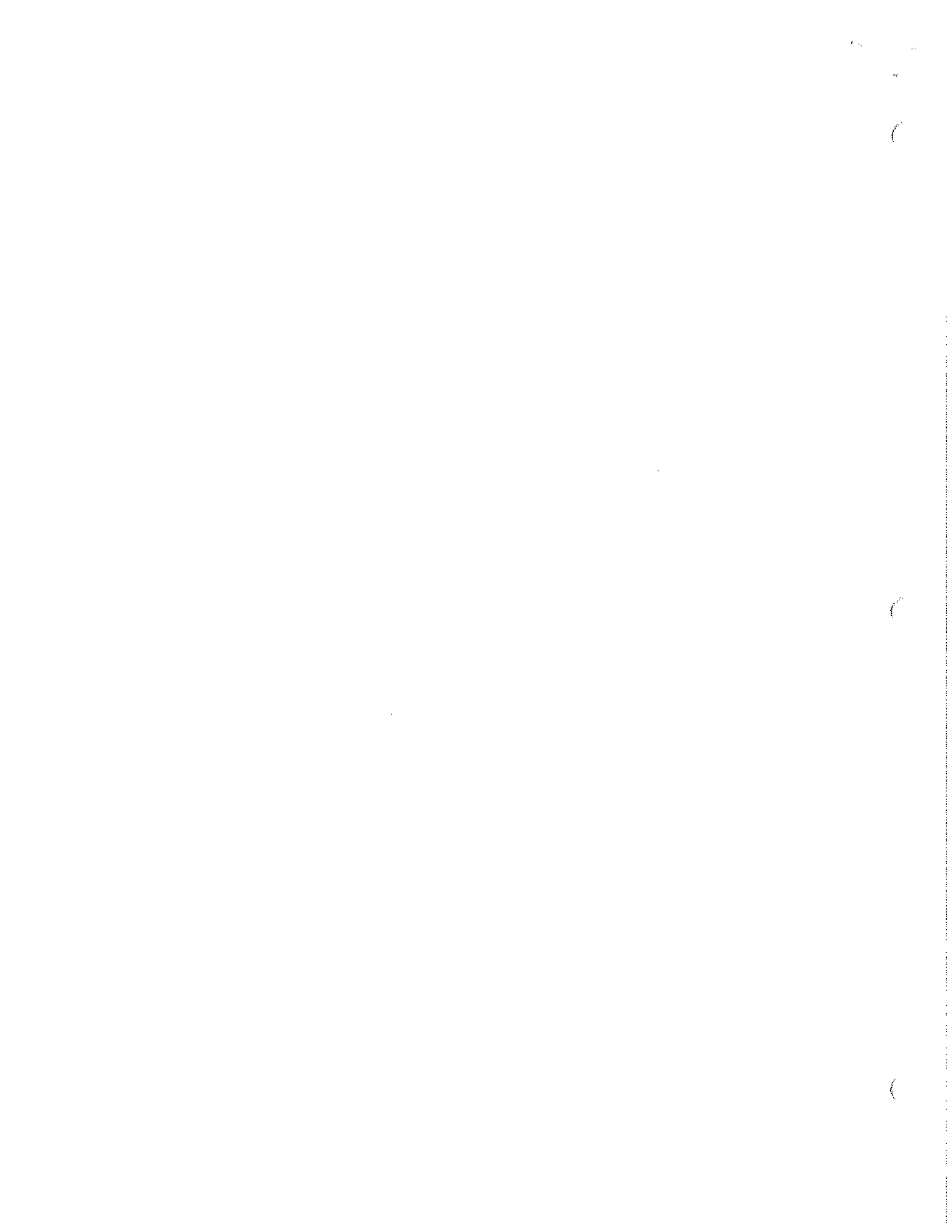
SNOWPACK Some very delicate instabilities exist and need only load by new snow or strong wind to avalanche. The surface layers formed in January are giving clean shears down 30-40 cm. Sun crusts and unconsolidated snow provide additional weak features in the upper snowpack. Shallow snowpacks are particularly weak.

AVALANCHES "Surprise" avalanches running on low angle slopes were not previously observed. High potential for avalanches in skiable terrain.

AREA 444, ROCKY MOUNTAIN PARKS
WEATHER Light snowfalls up to 20 cm total in eastern and central Rockies. Seasonal temperatures, but still warmer than average. Light winds have caused some wind transport. In northern areas there is a steep temperature gradient in the upper pack.

SNOWPACK Most snowprofile information shows numerous weaknesses, i.e., surface hoar on crust with additional snow, facets and depth hoar giving collapse and clean shears, slab formation in new snow and cool temperatures maintain a slow rate of settle. In the western Rockies the deeper snowpack is generally stronger.

AVALANCHES Avalanche activity has not been reported as widespread as could be expected from the previous snowpack information. Some new snow natural activity on very steep terrain and isolated soft slab activity on lee slopes.



SAMPLE

CANADIAN AVALANCHE ASSOCIATION
INDUSTRY INFORMATION EXCHANGE (INFOEX)

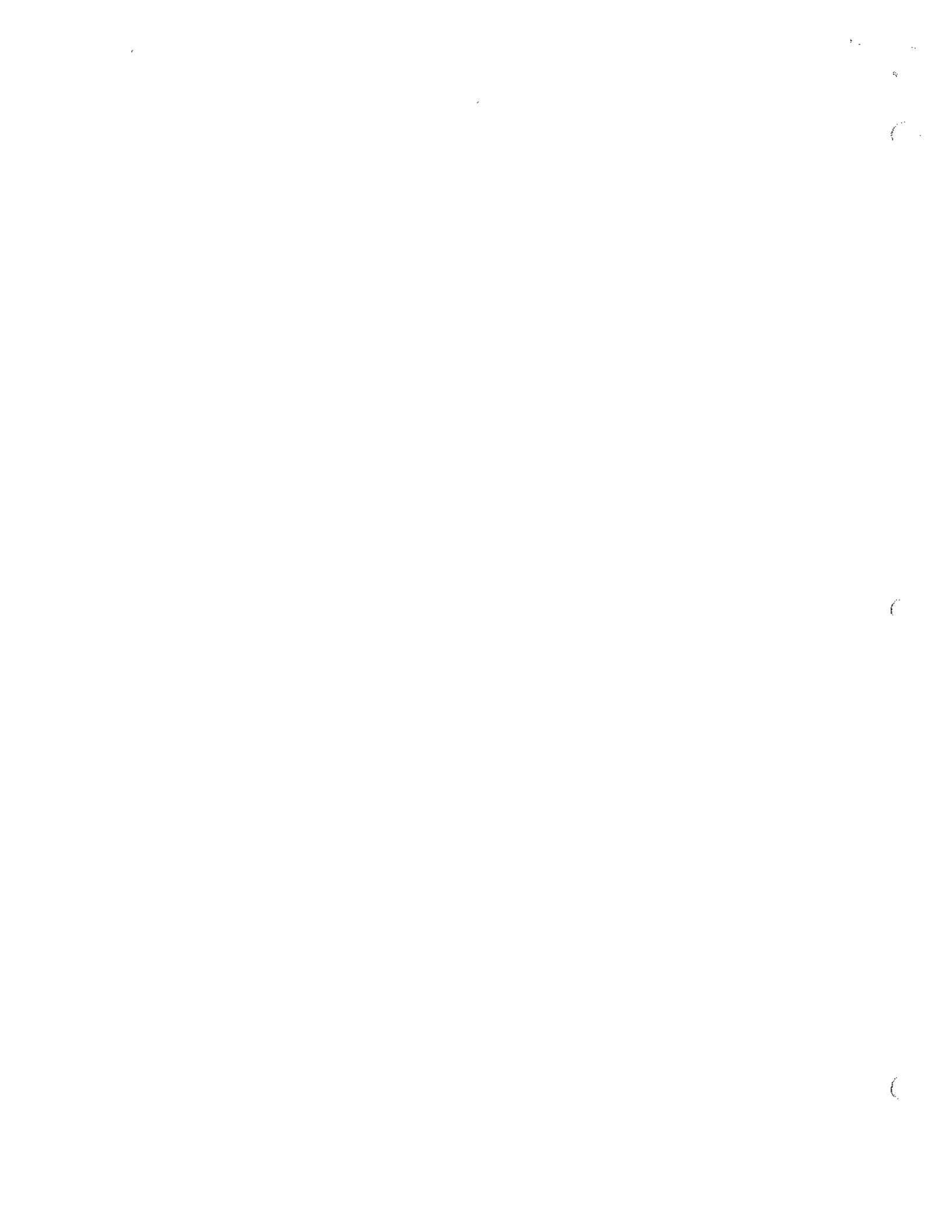
DATE 199

WEATHER STATIONS BY REGION

	<u>TIME</u>	<u>ELEV</u>	<u>PRECIP</u>	<u>MAX</u>	<u>MIN</u>	<u>WIND</u>	<u>HN</u>	<u>ST</u>	<u>HS</u>	<u>HN</u>
<u>—NORTH COAST—</u>										
Hwys Cassiar	0655	1120		-10.0	-19.0	CLM	1	1		
Hwys Telegraph Ck	0700	185		-7.0	-11.0	NE L	T	T		
Hwys Ningunsaw	0600	1675		-5.0	-5.5					
Hwys Bear Pass	1600	1040		-1.3	-1.5	NE 10				
CN Skeena	0935	1040	NIL	1.0	-3.5	E L	12	12	316	
<u>—SOUTH COAST—</u>										
Hwys Duffey Lake	0550	1320		0.5	0.0	W L	21	30	171	2
Blackcomb	1400	1860	* -1	-3.0	-4.0	SE M	3	23	247	
Whistler Mt	1400		* -1	-1.0	-4.0	SE 15	24	45	279	
Hwys Allison Pass	0700	1340		1.0	-1.0	CLM	2	2	120	1
Hwys Coquihalla	0745	1230		2.0	-0.5	SW L	6	9		3
<u>—COLUMBIA MTS—</u>										
Mike Wiegele	1800	1900	* -1	-2.0	-5.0	SE 45	13	33	305	1
Hwys Revelstoke	0550	610		1.5	0.5	CLM	0	0		
Silver Star	0800	1650		1.0	-2.0	S 20	6	2	125	
Glacier Park	0800		* 1	-2.0	-3.5	SW 25	19		282	
<u>—KOOTENAYS—</u>										
Hwys Kootenay Reg	0600	1100		2.0	1.0		0	0		1
Whitewater										
Hwys Kootenay Pass	1305	1775		0.0	-1.0	S M	39	40		3
<u>—ROCKIES—</u>										
Marmot Basin	1200	1850	* 1	-1.0	-4.0	SW 34	9	9	89	
Jasper Park										
Yoho Park										
Kootenay Park	0930		* 1	0.0	-5.0	CLM	5	5	58	
Banff North	0840	2010	* -1	-2.5	-6.5	SE 10	4	4	94	
Banff South	0800		* -1	-4.0	-7.0	SE 5	9	10	135	
Kananaskis	0800		* 2	0.0	-3.5	SW L	15	15	89	
Waterton Park	1600		VLR	5.5	1.0	SW 28	0	0	29	

FIELD OBSERVATIONS BY REGION

	<u>TIME</u>	<u>ELEV</u>	<u>PRECIP</u>	<u>MAX</u>	<u>MIN</u>	<u>WIND</u>	<u>HN</u>	<u>ST</u>	<u>HS</u>	<u>HN</u>
<u>—SOUTH COAST—</u>										
Tyax Heli										
<u>—COLUMBIA MTS—</u>										
CMH Cariboo	1600		* 2	2.0	-2.0	SW S	15		200	
CMH Valenmount	1600		* -1	2.0	-5.0	SW S	20		220	
Mike Wiegele	1400	1900	* 1	-2.0	-4.0	SE M	15			
CMH Monashees	1600		* 3	1.0	-3.0	SW L	15		250	
CMH Adamants	1600		* 1	1.5	-2.0	SW L	30		230	
CMH Gothics	1600		* 2			S S	16		280	
Selkirk Tangiers	1500	1950	* 1	0.0	-4.0	W L	20			
Kootenay Heli	1700	1800	* 1	0.0	-4.0	L	10			
CMH Galena	1600		* 4	1.0	-4.5	W L	35		230	
Great Canadian	1300	1100	* 2	1.0	-2.5		10	20	178	
CMH Bobbie Burns	1600		* 3	1.0	-3.0	SW M-S	25		200	
CMH Bugaboos	1600		* 3	1.0	-3.0	SW M-S	20		190	
R.K. Heli	1530		* 1	1.0	-3.0	SW 30	10	20		



SAMPLE

SNOW STABILITY REPORTS BY REGION

—NORTH COAST—

Hwys Cassiar: Shallow HN on SH. Stability good, some pockets of slab on SE asp.

Hwys Telegraph Ck: Stability good.

Hwys Ningunsaw: Shallow new layers on 40-50cm partially settled; stable base. Sluffs far above rd yesterday pm. Stability fair; pockets of slab on N and NE asp.

Hwys Bear Pass: Warm pack at low elevs. Size 3 ice trigger at George Copper. Stability poor to fair at low elevs; good at upper elev.

—SOUTH COAST—

Hwys Duffey Lake: HN instability; slab over lower density loose snow; no deeper layers are expected to release. Size 3, -80m; sev size 2's elsewhere. Stability fair, increasing stability; deep layers mainly strong; little snowpack below 900m.

Blackcomb: Unusually widespread cornice development; step fractures in firm and soft slabs. Class 2's expl-con. Stability poor, variable wind slabs released by expl and ski-cutting; poor in backcountry.

Whistler Mt: Above treeline, windslab sitting on a softer layer; unable to assess high alpine due to weather. Class 1 & 2 avalanches with expl-con; all failing in HN layers. Stability poor above treeline; fair below treeline; forecast for snow, high winds and warming could decrease below treeline to poor.

Hwys Allison Pass: A consistent shear approx 70cm from the surface; old SH below a MF crust. No new significant aval act. Stability good at the higher elev; fair to poor at the mid to lower elev.

Hwys Coquihalla: 22mm new precip at upper elevs; L-M SW winds overnight; firm MF crust below 30-40cm HN to mid mt; wind effect on lee and cross loaded slopes. One test control with bomb tram released class 1.5 above snowshed, no nat releases obs. Stability generally fair with pockets of poor on steep and loaded alpine slopes; good at mid to low mt elevs.

—COLUMBIA MTS—

CMH Cariboo: Lower Canoe 2200-1000m: 3cm graupel sluffs easily; 40cm variable density; storm snow settled and bonds well; shear at 40cm down on stellars and partially settled; shear at 80cm; otherwise well settled HS. One class 2 nat, NE asp, 2150m, slab, non-skiable terrain. Stability alpine poor not obs; subalpine good; treeline fair to good.

CMH Valemount: Crystal Pk/Front 2400-1300m: 45cm storm snow bonds well due to warm temps; shears exist 16cm down and 35cm down; windslabs exist in alpine and open areas. Num to 2.5, nat, N and W asp, 2500-2000m, slab 45cm in skiable and non-skiable terrain; one class 2 heli-trig; NE asp 2300m, slab, 45cm down; one class 2 skier-con, E asp, 2200m slab 30cm down skiable terrain. Stability all elevs fair.

Mike Wiegele: Mud Cr: Dense snow; slabs forming in subalpine, running easily. Widespread aval act; five skier-con, class 1-1.5's soft slabs, 30-50cm all asp, steep rolls. Stability alpine not obs, suspected poor due to windloading; subalpine poor.

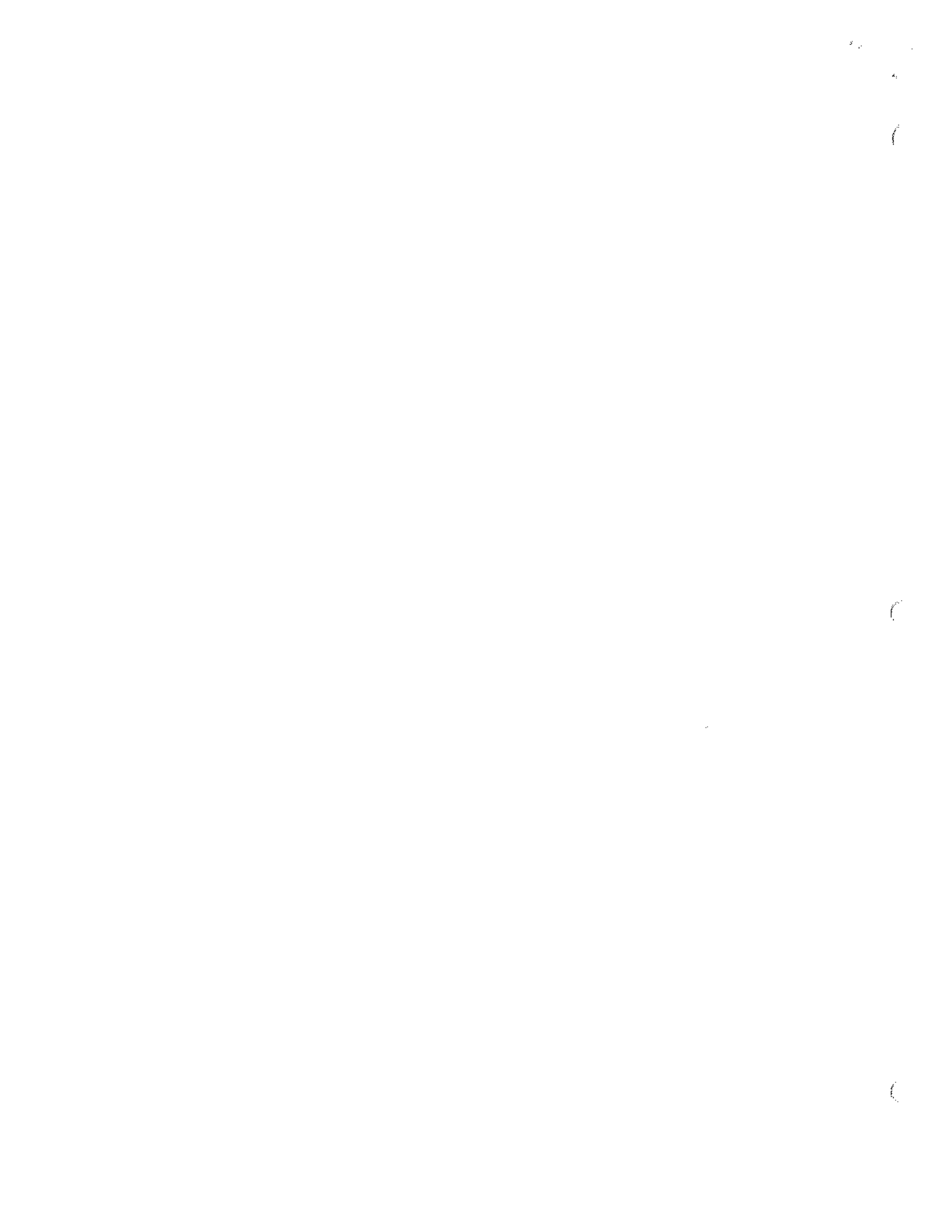
CMH Monashees: Soards 2100-1000m: Top 15-20cm HN is graupel and rimed stellars; 90cm of storm snow on Jan 19th SH layer to size 9mm; Dec 31st interface is 134cm from ground. One class 1, nat, N asp, 1900m, slab skiable terrain; sluffing in steep terrain. Stability alpine poor, not obs; treeline poor, subalpine good in skied areas.

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- CMH Adamants:** 30cm dense moist snow over dry low density partially settled and graupel which shears easy; below 1400m top 30cm is wet. One class 1, skier-con, W asp, 2000m, slab 30cm on skiable terrain; two class 2's, nat, S asp, 1100m, slab non-skiable terrain; one class 2.5, nat, S asp, slab. Stability poor all elevs.
- CMH Gothics:** Graham/McCulloch: 90cm soft slab over Jan 19th SH to 6-10mm; slab settled and stiffening with warm temps. One class 2, skier-trig, NE asp, 1980m, slab 90cm, 30 deg skiable terrain; one class 1.5, skier-con, NW asp, 1900m, slab, 90cm, small glade; one 2.5, skier-con, NE asp, 1950, slab, 90cm skiable terrain; one class 2.5, expl-con, N asp, 1900m, slab 90cm; num class 1 nat, all asp, all elevs, loose snow, surface and wet sluffs. Stability all elevs poor.
- Selkirk Tangiers:** 20cm HN (rimed needles, stellars) accompanied with high humidity and warm temps; mod shear exists between this layer and the old interface. Nil obs due to fog, but strong N - NW winds overnight caused cornices to develop. Stability alpine, not obs, but suspect poor; subalpine fair; treeline and below fair.
- Hwys Revelstoke:** Isothermal snowpack at lower elevs; SH. Size 1's and 1.5's, W and N asp, 700-1000m. Stability poor, low elevs; fair mid to high elevs.
- Silver Star:** Mod shear at 12cm on rounds and partially settled; mod shear at 37cm on old SH (12-15mm). No aval act obs. Stability good.
- Kootenay Heli:** Cognac/Upper Kuskanax: Temps throughout the snowpack as follows; 10cm=-0.5, 20cm=-0.5, 30cm=-3.0, 80cm=-2.5, 146cm down=-1.0; Rblock #4 at 86cm on SH in cut block; SH at 146cm fails after SH at 86cm; shovel tests at both layers mod. Two class 2's sympathetic to settlements; one class 1.5 sympathetic to settlement on SH, 84cm crown; some class 1's, 15-20cm HN. Stability alp and subalp poor to very poor.
- CMH Galena:** Home 2100-1400m: Moist HN shears 35cm down; rapid settlement obs; on S asp, easy to mod shear on SH on crust 77cm down. One class 1.5, skier-con, N asp, 2000m, slab on skiable terrain HN; sev 1.5, nat, all asp, all elevs, on HN. Stability all elevs poor.
- Glacier Park:** Updated info 1800: Heavy snowfall during the day along with an easy shear down 20cm on large stellars is propagating well and stepping down onto another shear at 37cm. Aval act associated with these instabilities has been mod with sz 3's. Stability at present is poor.
- Great Canadian:** 10cm HN bonding well, good settlement, previous HN instability not present; overnight snow sluffing when skied on steep slopes; running well. Steep unsupported rolls not breaking when ski cut; no aval obs, poor visibility. Stability alpine not obs; treeline fair; subalpine good to fair below 1700m.
- CMH Bobbie Burns:** Vowell/Malichite 2300-1400m: Shear 25cm down below soft slab; storm snow is unsettled; moist snow 1600m down. Num sz 1-3, nat, variable asp and elev; sev 1.5, nat, all asp, all elev, 25cm extreme and some full track paths. Stability poor all elevs.
- CMH Bugaboos:** Rimed stellars at surface; shears at 6cm on stellars, 40cm down on SH; Jan 1st SH is now 110cm down, warm temps in HS; wind transport in open areas. Num class 1, skier-prop, all asp, 2200m and below, slab, 10cm; two class 1, skier-trig, east asp, 1700m, slab, 40cm down skiable; two class 2, nat, NE asp, 2000m, slab, skiable terrain. Stability alpine very poor, treeline poor, subalpine fair where skied previously.



R.K. Heli: 10-20cm HN; well settled HN, lots of wind loading in lee; easy shears at 40cm and 70cm. Widespread aval act. Stability alpine poor (not obs), subalpine poor.

—ROOPENAYS—

Hayes Kootenay Reg: 31E: Heavy HN. Small avals effecting rd to centre line. Stability poor.

BB-Paulson: Lower elev HS turning isothermal; No aval obs. Stability fair to poor.

Sheep Cr: HS turning isothermal. No aval obs. Stability fair to poor.

Hayes Kootenay Pass: HN instability; 0700, v easy smooth tilt shears down 26cm. Control work produced class 2-3's onto the rd on steep SE asp in N Fork aval area; late pm, N Fork again, SE asp goes big, size 3.5, fracture line 300m/.9m deep; Char Cr released size 3.5, nat. Stability very poor.

—ROCKIES—

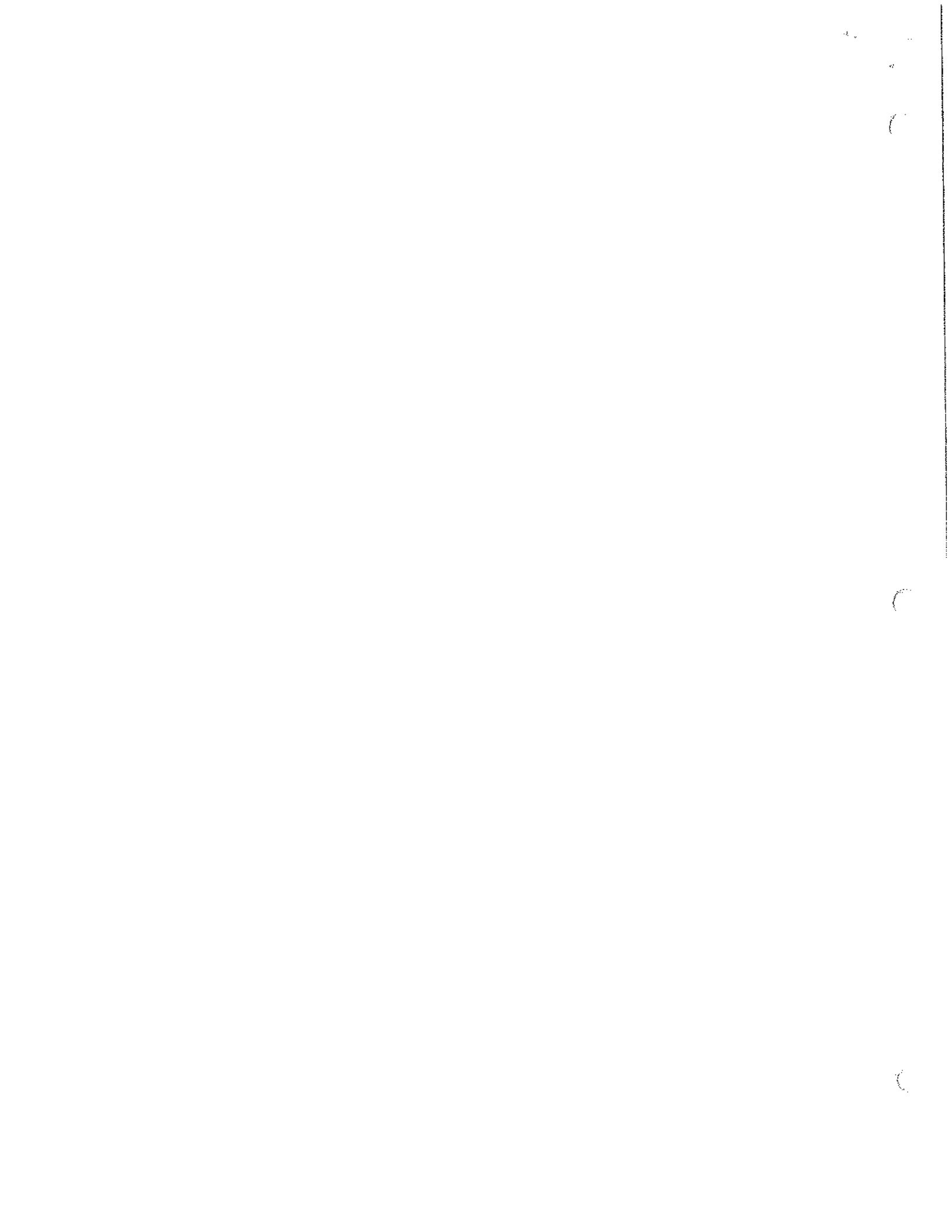
Marmot Basin: HN is bonding well except on steep terrain where sluffing is evident; no other changes in the snowpack. Num .5-1 sluffs triggered by skiing or expl-con. Stability above 2000m fair with pockets of poor expected with increase in winds; below 2000m good, areas of fair may exist at treeline on steep terrain.

Jasper Park: The resistance in lower pack has decreased; not obs buried SH; areas of unstable surface slab on lee slopes in alpine; below 2000m, the snowpack remains weak but stable; warm temps causing loose snow avals in surface snow at valley bottom elev. Iso class 1 surface sluffs on steep terrain in the alpine; mainly class 1 wet snow aval, some class 2 obs in pm. Stability below treeline good while temps remain below freezing; at lowest elevs stability may decrease to poor; above treeline stability fair with areas of poor along Divide; unstable surface slabs are present on steep wind loaded slopes.

Yoho Park: Base starting to break down in some areas of alpine and subalpine (10-20 cm DH) where the snowpack is shallow; in some areas along the Divide the 40-60cm of storm snow from last week is overlying SH 5-10mm; very easy shear on this layer; slab activity on shallow angled slopes where past storm snow and warm temps are overloading DH. Skier-con class 1 slab, on N and E asp below treeline; localized nat class 1 slabs to ground in shallow snowpack; on valley bottom slopes in pm. Stability subalpine fair to poor, easy shear on HN/buried SH interface; alpine suspect poor, surface slabs building due to windloading.

Banff North: At Pika plot (near Temple), 2200M, full profile: HS= 111cm; .9 cm new and partially settled with some rounds, F to 4F; over 30 cm 1F rounds; over 4 cm 4F facets to size 2 (old SH layer); over 54 cm P facets (some rounding); over 14 cm P facets and DH; shovel tilt test produced a mod-hard shear on partially settled size 1-2 at 92 cm, and an easy shear on large facets (old surface hoar) at 72cm; shovel test produced an easy shear again at 72 cm on old SH layer, and a hard break (no shear) in the DH layer, loading on the buried SH layer appears to be approaching critical in some areas; at Bow Summit weather plot (2030 m), 35 cm storm snow in past 6 days. No new activity observed today, however visibility was variable and generally poor; expect to begin seeing results if snowfalls and winds continue tonight. Stability fair with areas of poor on upper lee slopes presently, decreasing with additional loading.

Banff South: Easy shear down 48cm on SH to sz 15, 10cm of 4F DH on ground; significant wind transport by str SW winds. Expl-con produced 20-30cm soft slabs, class 1.5. Stability alpine fair to poor, subalpine fair.



Kananaskis: HN forming into a soft slab; mod shear 15-30cm deep; recrystallized lower layers strengthening somewhat; however facets and DH still prevalent; SH buried in many locations, but is not showing up in shovel test. No aval act obs. Stability fair; areas of poor on steep lee slopes at many elevs.

Waterton Park: Aval act heard but not obs (visibility obs) mid-day alpine N and E asp; obs size 1 moist release, nat, N facing subalpine. Stability, temps 15 degrees above seasonal norms; coupled with light to mod precip, producing poor stability in alpine, fair subalpine.

—END—

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