THE Avalanche REVIEW

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Dropping into the Right Blade.

skier: Alex Hunt

Deep Breathing

story & photos by Doug Krause

Cerro Entre Rios, Right Blade, September 9, 2004

I held my breath and watched the wisps of cold smoke settle back into the freshly laid track below me. The solitude was broken only by the distant clack of rockfall somewhere lower in the couloir. "That's odd," I thought. I don't usually hear much rockfall when I'm powder skiing. It made me uneasy. I waited, grew apprehensive, and still my partner did not appear on the apron. The minutes ticked by and still no human arcing into the runout. Now I was worried.

Two hundred feet below me the track disappeared where the couloir choked, turned and rolled to more than fifty degrees. Any slab or even a sizable slough triggered from that point would probably run full track and obliterate any skier in its path. I didn't want to go down there and risk that, but I had considered all my options and it was time to act.

The lower angle approach was perfect mid-thigh, low-density powder. I skied it in slow motion and crept towards the convexity, hugging the high rock wall that defined the crux on the right. Peering over the roll I could see a small crown running the width of the couloir, and I eased up to it trying not to pop the hang fire.

There was no danger of sluff on the bed surface; it was scoured clean, but the little pockets on either side of the track released with a dirty look, so I stayed in the track and picked my way down the meat of the couloir toward the apron. I rounded the corner and saw the long tongue of debris below me extending toward the flats. There was a lone ski poking out. My pace quickened and a few big fast turns brought me to the ski. As I attempted to pull it from the snow I spied a figure 500' below. He was off to the side of the deposition perched on a small rock outcropping gently cradling his broken arm. I wish we had spent more time talking about the line.

continued on page 27 ➡

The Avalanche Review
P.O. Box 2831
Pagosa Springs, CO 81147

in this issue

In a place where 10 remote weather stations would have been too few, we had none – we had two snow stakes and a hand-held anemometer.

—Matt McKee
***A Snapshot of Pimenton Mine Life*, p16**

THE Avalanche REVIEW

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The mission of the AAA is:

A. To provide information about snow and avalanches;

B. To represent the professional interests of the United States avalanche community;

C. To contribute toward high standards of professional competence and ethics for persons engaged in avalanche activities;

D. To exchange technical information and maintain communications among persons engaged in avalanche activities;

E. To promote and act as a resource base for public awareness programs about avalanche hazards and safety measures;

F. To promote research and development in avalanche safety.

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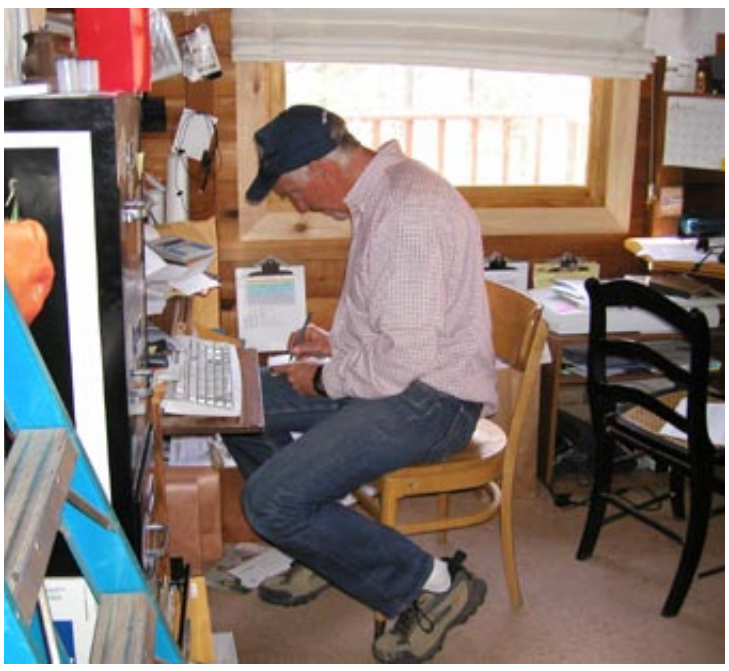
from the executive director

To Davos and Back Again

Mark Mueller looks much happier in his outdoors "office" (above), touring the Continental Divide in the East San Juan Mountains near his Pass Creek yurt, than he does inside the AAA nerve central (below).



I looked out my front window at the Parsenn and out my back window past the Swiss Institute for Snow and Avalanche Research (SLF) and beyond to the Fluela Pass. I was fortunate enough to attend the first European ISSW and represent the AAA a couple of months ago in Davos, Switzerland. It was an excellent event with the customary assortment of interesting talks and posters, as well as numerous field excursions and workshops. Our hosts were warm and welcoming. Many thanks to the SLF team for putting on a very memorable first European ISSW.

Modern avalanche research began in Davos in the 1930s and continues today with a large skilled team of researchers, practitioners, and students. Back in the day, one couldn't read anything about snow and avalanches (like Colin Fraser's *The Avalanche Enigma*, or Seligman's *Snow Structure and Ski Fields*) that didn't mention Davos, the Parsenn, and the Swiss Institute. To finally visit there was a dream come true for me, and I had to ample time to get outside during the field excursions and also hike on several free days to enjoy the Alpine grandeur. I haven't mentioned that the weather was splendid as well. You will find a more lengthy account of the conference in this issue.

Now, on to business: AAA operated in the black financially in 2008/09 for the first time in several years. This can be attributed to the recent increase in dues and the growing success of our AVPRO avalanche school. This has allowed us to better serve you, the membership, by allowing AAA to increase the size of *The Avalanche Review* to 32 pages. We are also able to co-sponsor more regional continuing professional development workshops this fall that are both affordable and local. I enjoy meeting many of you at these events in order to put a face with a name that I often see only as a line in our database. Our more secure financial position also lets AAA take advantage of unexpected opportunities that may arise and benefit the organization and the membership.

By the time you read this we will be well into the season that fuels our passion for the mountains and feeds our spirit – the crisp cold weather surrounded by exquisite white peaks and the feel of the snow under our feet and skis. I wish you all a safe and successful winter.

—Mark Mueller, executive director

from the editor

Mid-November and it's high pressure, cold, and clear. On north-facing slopes, we have a couple layers of base interspersed with depth hoar and cold smoke on top. What kind of avalanche animal will we be wrestling this winter? Another steel-hard rain crust overlain by facets? I hope not – too much running scared last year, too many accidents and near-misses in the season summaries.

Despite winter's false starts, the avalanche season has begun, as you can see by Scott Toepfer's note in Mailbag *(next page)*. In reading these Colorado accident accounts, I wonder if we as a species truly are doomed to repeat the same mistakes, over and over, year after year. Does human factor always trump science at the top of the couloir? I look forward to exploring some of the decision-making tools presented at the Davos ISSW in future issues of TAR and want to invite anyone who was there (and possibly not in attendance) to write up some of those presentations. Please contact me if you are interested.

I traveled to Colorado for the CSAW and AAA board meetings. I was also able to attend the USAW in Salt Lake, and we await an article on the NSAS in the Northwest, which by all accounts was very successful. I am impressed by the caliber of the presentations at these events, proud that the AAA has chosen to contribute our funds to further continuing education for our membership and other curious snow and avalanche enthusiasts. Perhaps heightened awareness and a higher level of common skills and tools can help us make better decisions?

In this issue we bring you several views of that first European ISSW, including Bill Glude's look at faceted melt forms and Bruce Edgerly's common-sense approach to the signal search. And the Avalanche Divas honor five European women avalanche pioneers.

You'll also find a few photo-rich, place-based articles: a piece about an interesting Mt Washington avalanche and season summaries from Mt Shasta and France. Mike Richardson shares some questions and answers he has been pondering on the topic of avalanche education. And as promised for several issues now, Matt McKee and Glenn Vitucci's snapshot of a season at the Minera Pimenton in Chile gets the centerfold. You'll be startled by the expanse of the terrain and astonished that their luck held long enough to make it home.

Finally, Doug Krause's musings on risk and consequence, steep couloirs and real choices, persuade the reader to adopt his attitude of realism and humility. But I am certainly enticed by the deep tracks in the couloir that sinks out of sight on the cover of this issue of TAR; it would have been hard to repudiate ego and say, "Go ahead; you first."

—Lynne Wolfe

corrections

Lisa Portune pointed out that *The Avalanche Review* incorrectly identified her as the author of the Chugach National Forest Avalanche Information Center's 2008/09 summary in the Season Roundup 2008/09 section. Carl Skustad was the author of the summary (TAR 28-1, p24-25).

metamorphism

Aleph Johnston-Bloom has left her job as the director of the Silverton Avalanche School to become an avalanche forecaster for the Payette National Forest in McCall, ID.

Aleph Johnston-Bloom

Mark Gober is a new forecaster in the CAIC Silverton office. Mark grew up in the Front Range of Colorado where he took an early interest in skiing. Once able to drive, he began to explore the backcountry and with that, realized the importance of getting educated about avalanches. This led eventually to a job at Copper Mountain where he worked for 10 years as a ski patroller, taking a greater role in snow work. Several seasons at Silverton Mountain helped him learn what is possible in terrain management. After interning for two seasons in the Silverton CAIC office, Mark joined the CAIC full time in 2009. When not on snow, Mark can usually be found on the oars on a desert river.

Mark Gober

New Pro Members

Jonathan Morgan, Alta, UT
Mark Staples, Bozeman, MT
Jay C. Pape, Bozeman, MT
Mike Janes, Juneau, AK
Nicholi Stoyanoff, Hood River, OR
Scott Williams, Index, WA
Kevin Jordan, Snowmass Village, CO
Sean Wisner, Valdez, AK
Justin Lozier, Vail, CO
Sue Miller, Victor, ID
Adam Naisbitt, Alta, UT
A. J. Linnell, Victor, ID
David Weber, Lander, WY
Henry Munter, Girdwood, AK
Chad Mickschl, Glenwood Springs, CO
Matt Kinney, Valdez, AK
Eric Murakami, Salt Lake City, UT
Greg Gagne, Salt Lake City, UT
Tony Jewell, Alta, WY
Mike Poborsky, Jackson, WY
Mike Smith, Nederland, CO
Randall Osterhuber, Soda Springs, CA
Sigi Vogel, Ketchum, ID
Matthew Borish, Bozeman, MT
Brett Kobernik, Salt Lake City, UT
Daniel Otter, Bellingham, WA

New Member Affiliates

Perry Turner, Kenmore, WA
Melanee Stassny, Girdwood, AK
Angela Patnode, Bozeman, MT
Keith Stebbings, Joseph, OR
Trevor Fulton, Moscow, ID
Jordan Pond, Valdez, AK
Kelly Robbins, Salt Lake City, UT
Justin Peacock, Golden, CO
Jaime Musnicki, Victor, ID
Roger Harvey, Votkinsk, Russia
Dale Mihuta, Cincinnati, OH
Aaron Parmet, Dillon, CO

New Certified Instructors

Don Carpenter, Victor, ID
Doug Krause, Silverton, CO
Jamie Wolter, Winter Park, CO

submissions

- Send photos of a crown, of avalanche workers plowing roads, throwing bombs, teaching classes, or digging holes in the snow.
- Learn something from an accident investigation?
- Developing new tools or ideas?

Write it up; sent it to us.

The Avalanche Review is only as good as the material you send: articles, stories, queries, papers, photos. Submissions guidelines available upon request.

SUBMISSION DEADLINES

Vol. 28, Issue 3 ..... 12/01/09
Vol. 28, Issue 4 ..... 02/01/10
Vol. 29, Issue 1 ..... 08/01/10

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mailbag

Date: November 1, 2009 8:13:10 AM MST
To: lwolfe.avalanchereview@gmail.com

Really busy here...We've had 6 or 7 incidents already in Oct. One had a double burial in a party of two; one dug himself out, got the other guy, not breathing & blue, but came around once airway opened. Flight for life rescue yesterday near Fremont Pass, shattered leg from a nasty ride. So seven or eight people already caught on real rides. May run out of USFS short forms if it doesn't slow down soon. —Scott

Scott Toepfer is a forecaster for the CAIC. He wrote this note while going over edits for his story on the Colorado Snow and Avalanche Workshop (see page 8).

what's new

Brooks-Range Snow Tools Exhibit Attention to Detail

Review by Craig Dostie

In any field, what separates the amateurs from the pros is the knowledge gained from experience. Part of the mark of each is the tools of the trade. In the avalanche forecasting business, that means carrying more than a shovel and probe, and it also means, where possible, carrying the best available tool.

For instance, any shovel is better than none, but all shovels are not created equal. Genswein's report on shovels last year in *The Avalanche Review (see TAR 27-3 & 27-4)* embarrassed most manufacturers, but neglected my favorite. Living in a house that sheds Sierra cement onto the walkways means I'm constantly forced to chop ice in the winter. The Brooks-Range Sharktooth™ Pro Long Neck Shovel is the only avalanche shovel I've ever used that has survived a complete season of this sort of abuse, including chopping ice off a metal grate (repeatedly). The teeth on the leading edge are a bit worn, but the blade is as solid as ever, and the extra-long telescoping handle not only saves your back, but lets you pile more force into every chop and throw each scoop further.

Their snow science tools exhibit the same attention to the details that matter. The Digital Snow Pro Study Kit comes with a digital thermometer, magnifying glass, brush, 100cm folding ruler, field book, crystal card, and pouch to keep it all organized. The display of the digital thermometer swivels for easy reading when stuck in a pit wall, and it can display readings in C° or F°. More importantly, it has an auto shut off so you don't waste precious battery power when you forget to turn it off. The magnifying glass is 5x with a scale in inches and millimeters on the perimeter of the target box and it folds up relatively flat.

The crystal card does more than provide 1mm, 2mm, and 3mm grids for estimating crystal sizes, it also is a great cheat sheet for snowpit tests and nomenclature for recording profiles. The card includes a slope meter, although the accuracy is dependent on a cord that may not hang perfectly straight. Replacing that with a straightened out paper clip should cure that flaw.

As you expand the 1m folding ruler you will notice that each section locks in either a straight or orthogonal position. Thus, besides providing a scale for documenting layers in the snowpack, you could also use the ruler for estimating slope angles with a bit of trigonometric understanding. The field book allows you to write in the rain or cold, with a 6-column grid pre-printed on each page. The only thing you need to supply is a pencil.

Even non-scientist types can appreciate the Pocket Snow Density Gauge™ for the ability to qualify their boasting back in the bar after a day of harvesting face shots. It's an aluminum tube that you hang from a simple mass balance scale calibrated to the weight of the tube. Using the serrated leading edge, drill the tube into the stratum of snow you want to measure, taking care to only touch it on the plastic thumb handle on the end, pull it out, hook it to the scale, and note the density. For storage, the scale hides inside the tube, and a pouch keeps it all together. The entire set-up fits either in your pocket or your shovel shaft.

In the snow saw department several models are available, depending on whether you're using it primarily for utilitarian reasons or analysis. All the saws are marked with centimeter and inch scales, plus 1mm, 2mm, and 3mm grids for crystal identification. Single length or extendable folding saws are available, in left- or right-handed versions that can be strapped to shovel handles or ski poles for extending their reach.

The utility saws, called Igloo Saws, are made of aluminum for light weight with offset blade teeth that leave a wide quarter-inch slot in the snow. Think of these as a ripping blade for fast cutting – perfect for cutting igloo blocks or a cornice.

The Scientist Saws are made of tempered stainless steel with offset thin kerf teeth for a finer cut, like a carpenter's finish saw. These come in three extendable, folding lengths, 35cm, 70cm, and 100cm. The only thing not to like about the Scientist Saws is their weight, but that's part of the price you pay for being a pro, right?

Craig Dostie is the former publisher and founder of Couloir *and* Telemark Skier *magazines. He crafts words as a freelance writer and marketing consultant in Truckee, CA.*

New Brooks-Range Products

Pocket Snow Density Gauge™ 100

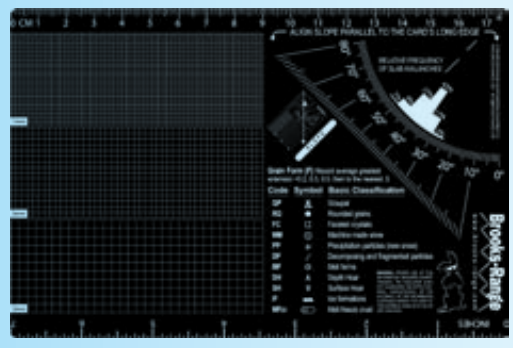
Brooks-Range has designed a compact backcountry snow density gauge similar to that currently used by the National Weather Service. The Brooks-Range snow density gauge is the optimum tool for field measuring of snow density. A specially constructed aluminum tube with a serrated cutter fitted to one end of the tube is scaled to accurately measure water density in the snowpack. The gauge operates on mass balance and its construction makes the gauge compact, lightweight, corrosion resistant, and unaffected by altitude. It is the perfect compromise between laboratory precision and rugged simplicity in a small, convenient, and easy to use design. Snow scientists, avalanche forecast observers, and backcountry skiers can use the snow density gauge to assess the rate of snow metamorphism, new snow quality, snow pit data, precipitation rates, slab information, and snow pack moisture content. Accuracy within 0.1% water; scale reads from 0% to 60% water (0-600kg/m3) in 1% increments. Weight: 3.5oz; MSRP: $49

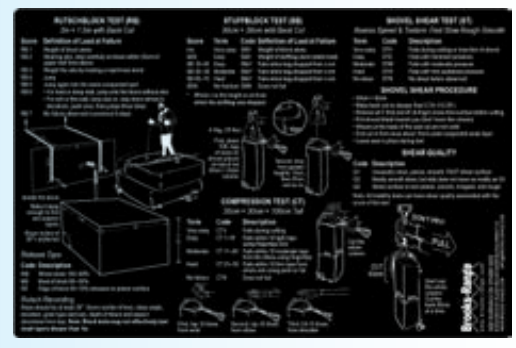
Scientist 100 Rutschblock Folding Snow Saw™

In conjunction with American Institute for Avalanche Research and Education (AIARE), Brooks-Range has developed the Scientist Rutschblock Folding Snow Saw. When extended, the saw is 44" (112cm) long with the handle. The blade measures 100cm *(also available in 35cm and 70cm blade lengths)*. It weighs only 17oz and when folded onto itself is only 15" (38cm) long. Lightweight and packable, the saw features an offset thin kerf that makes for a perfect "finishing saw" for snow study work. The handles of the saw can be connected to the Brooks-Range Backcountry Shovel shaft or to telescoping ski poles to increase the reach. 10% of the proceeds from this saw are donated to AIARE. MSRP: $159

Igloo Snow Saws™

The Igloo Snow Saw is available as a fixed saw or a folding saw. Both are made of high-quality anodized aluminum and are ideal for building shelters and cutting cornices in the snow. They are lightweight and packable, featuring aggressive "ripping saw" teeth that make quick work of any job. The Igloo Saws feature offset blade teeth that cut a 1/4" (6mm) wide slot in the snow, which prevents the blade from binding and freezing while sawing. The Igloo Folding Saw is 22.75" (58cm) long and weighs only 8.4oz (238g). The Igloo Fixed Saw is 19.25" (49cm) long and weighs only 4oz (113g). The handles for both saws can be connected to the Brooks-Range Backcountry Shovel shaft or to telescoping ski poles to increase the reach. MSRP: $24 for the Igloo Fixed Saw; $49 for the Igloo Folding Saw.

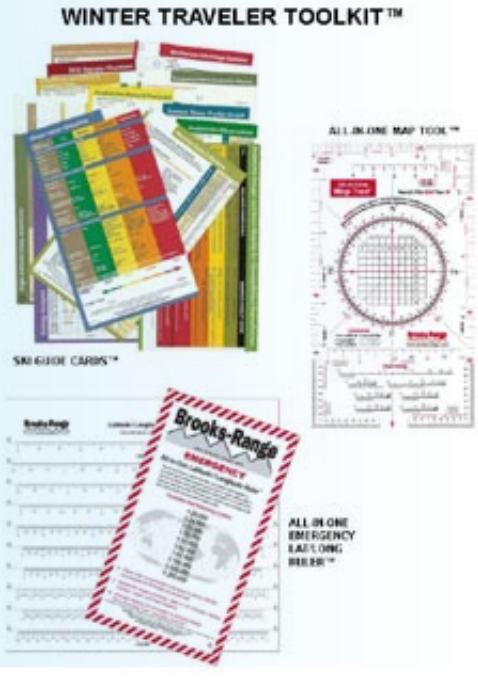




Snow Crystal Card

This snow safety tool helps adventurers make informed decisions about the snowpack. The card is printed with information on snow crystal types; is sized to easily fit in a field book, pocket or snow study kit; and is made from textured aluminum that preserves the shape of the snow crystal during analysis. The card also doubles as an inclinometer by using the attached string and weight. The Snow Crystal Card has a laser-etched 1mm, 2mm, and 3mm grid; inclinometer increments of 1°,; crystal and snowpit "prompt legends;" and a standard/metric ruler. MSRP: $11.95

Winter Traveler Toolkit™



Perfect for snowy environments, this kit includes: Ski Guide Cards (13 water-resistant avalanche/safety cards), the All-in-One Map Tool (a 4" x 7" non-glare, flexible map tool with 10 scales, Universal Transverse Mercator and slope indexes), and the All-in-One Emergency Latitude/Longitude Ruler (a 4" x 7" paper tool for providing lat/long position to air rescue teams in an emergency). MSRP: $53

Brooks-Range Avalanche Shovel and Snow Saws in Practice

Review by Jeff Jung

I like this shovel and all that it does. I put together a rescue sled using the shovel with some webbing and a cordelette; it seemed really solid. I'd consider it as option for a rescue sled rather than carrying a manufactured sled.

The one thing that I had trouble with was putting the shovel back together. One of the locking buttons kept slipping down the shaft of the shovel handle. It is a bit confusing putting it back together. When I first looked at the shovel, I thought the handle was too long and would not fit in the pack, but it worked, and I did appreciate the extra length when shoveling.

I also like the snow saw stashed in the shovel handle. It's nice to have the essential tools like ruler and grain-size graph right on the saw. This saves steps since those resources are right there where you need them without having to dig into your pack for them.

The snow saw with handle extension worked well with the ECT test, but it's probably not long enough cut the back of the block in the RBT test.

The folding saw was compact and fit right in the pack. I like the extension concept with this saw because it's fast and easy to put it together. I used it to cut the back of an RBT in soft snow, and it worked fine but might have some problems with heavier snow and the connection between the saw and the ski pole.

Another concern I had is the locking button. It seems like it might wear out after extended use. I use to have a folding saw like this, and I found that kind of wear was a problem after long-term use. A manufacturing solution to combat the wear and tear problem might include the addition of another locking button for back up.

Jeff Jung is co-owner of Rendezvous Ski Tours, a yurt system on the west side of the Tetons. He gets well over 100 days a year on skis, so if he tests a product, you know he put some time and effort into it.

Northwest Mountaineering Journal 2009 Issue Now Available Online

The *Northwest Mountaineering Journal* documents the events, people, history, and spirit of climbing and other mountain sports in the Pacific Northwest. The journal is published by volunteers from the mountaineering community in collaboration with The Mountaineers. The *Northwest Mountaineering Journal* seeks to serve as an edited, permanent, annual record of mountaineering in the Pacific Northwest.

The 2009 *Northwest Mountaineering Journal* is now available online at www.nwmj.org. The current issue features articles about alpine climbing, skiing, rock climbing, mountain rescue, bicycle mountaineering, peak bagging, and light-and-fast enchainments. It includes reports of new climbing routes and first ski descents from April 1, 2008 through March 31, 2009. It also contains highlights from North Cascades National Park.

New features in this year's journal include a built-in slideshow feature. The Archive page lists all *Northwest Mountaineering Journal* articles published since 2004.

A big thanks goes out to everyone who contributed stories, photos, and information for this issue, both for your contributions and for your patience as we assembled this issue over the past several months. We'd also like to thank the team of volunteers who edited the journal and The Mountaineers for their invaluable support.

The 2009 *Northwest Mountaineering Journal Team* includes Ralph Bodenner, Steve Firebaugh, Alex Krawarik, Matt Perkins, Rad Roberts, Lowell Skoog, Steve Smith, Curt Veldhuisen, Gary Yngve, and Aaron Zabriskie.

We hope you enjoy this issue as we begin looking forward to working on the next one.

Campbell Scientific Releases LoggerNet 4

Campbell Scientific recently released the newest version of their datalogger support software, LoggerNet 4. LoggerNet is computer software for Campbell Scientific dataloggers that supports programming, communication, and data retrieval between Campbell Scientific dataloggers and a PC. LoggerNet can support connection to a single datalogger, but really shines in applications that require telecommunications or scheduled data retrieval in large datalogger networks.

LoggerNet consists of a server application and several client applications integrated into a single product. LoggerNet runs on a PC using serial ports, telephony drivers, and Ethernet hardware to communicate with dataloggers via phone modems, RF devices, and other peripherals. The LoggerNet server stores the data in a cache and writes data to a variety of formats, including ASCII, binary, and XML.

This update features a new look and feel, with more user-configurable options to fit your working style; View Pro, a robust display tool that provides more ways to look at your data; Network Planner, a tool that allows development, modeling, and verification of PakBus networks; and upgraded RTMC, featuring functions added for building expressions, a new layout toolbar, and more maneuverability around the displays. LoggerNet 4 also supports FTP and SFTP.

A 30-day trial version of LoggerNet 4 is available at www.campbellsci.com/downloads. If you own a previous version of either LoggerNet or PC400, you can get a discounted upgrade to LoggerNet 4.

Mammut Unveils Avalanche Gear Updates

The Alugator Light and Expert shovels feature a different design and materials than the shovels reviewed in the articles by Manuel Genswein *(see TAR 27-3 & 27-4)*.

The Alugator Expert shovel has a three-position extendable handle with a D-grip. The shaft is removable and utilizes a detend in the shovel blade so it can be assembled quickly and easily with gloves on. The triangular shaft is shaped for optimum strength so that torque is absorbed on the shaft receptacle, not on the buttons themselves. The blade is crafted from tempered aluminum for great stiffness and strength, and the expert shovel's blade is Teflon® coated. The shaft receptacle on the blade is built into the blade itself, rather than extending above the blade. This accomplishes two things: it eliminates the shaft receptacle as a weak part of the shovel since it is supported by the full width of the blade itself, and it allows for a larger blade for a given packing size and weight. The shaft angle is also steeper than most shovels, allowing for easier and more efficient shoveling in confined spaces.

The Alugator Light shovel *(above left)* has an extending shaft with two positions, with a T-grip and a shaft construction similar to the Alugator Expert. Alugator Expert weighs 810g, and the Alugator Light shovel is 600g.

The Probe Light and Probe Plus are the same probe in two different lengths: Light 240cm and Plus 280cm. Both probes utilize 11mm aluminum tubing with a dyneema cord for a stiffer action in use and easy-to-access, push-button locking system and tapered-nylon ferrule-ends for faster deployment. Both shafts are graduated in 10cm increments.

At 320cm, the Probe Expert *(above left)* utilizes 12mm aluminum tubing, and has a steel cable inside with a large knurled screwlock closure for a more rigid action. The Probe Expert is graduated in 5cm increments. Weights: Probe Expert310g, Probe Plus 210g, probe light 180g.

Go to www.mammut.ch for more info. A firmware upgrade is also available and can be found at www.mammut.ch/newfirmware.html.

AIARE Sets Course Schedule

AIARE offers Instructor Training Courses (ITC) and Instructor Refresher Courses (IRC) in various locations this winter 2009/10 season. AIARE instructors are required to attend the one-day IRCs every three years. ITCs are required for those presenting AIARE courses.

ITC Level 1—
Dec 1-3..... Berthoud Pass, CO
Dec 8-10..... North Conway, NH
Dec 15-17... June Lake, CA
Dec 15-17... Jackson Hole, WY

ITC Level 2—
Feb 16-18 ... Silverton, CO
Feb 16-18 ... Park City, UT

IRC—
Nov 12..... Seattle, WA / indoors
Nov 20..... Bishop, CA / indoors
Nov 20..... Boulder, CO / indoors
Dec 4..... Berthoud/Vail/ field
Dec 11 ..... North Conway, NH/ indoors
Jan 8 ..... Snoqualmie, WA / field
Feb 19 ..... Park City, UT/ field

Go to www.avtraining.org for more info about AIARE winter instructor course offerings and for registration.

G3 Updates Web Site

G3 Genuine Guide Gear Inc., recently launched their new Web site at www.genuineguidegear.com. In addition to improved navigation and product browsing features, the updated site seeks to expose and share the design process, passions and philosophy that drive G3's innovation. Abundant product videos take the viewer behind the scenes at G3 to learn design rationale and product functionality from the engineers themselves. Review and comment features allow customers to provide constructive feedback for both G3 and gear enthusiasts, while the G3 Learning Centre is devoted to sharing product information through on-line manuals and videos.

Abstracts Requested for 2010 Intermountain GIS Conference

Do you use Geographical Information Sciences/Systems (GIS), Remote Sensing, LIDAR, etc, in your snow/avalanche research or work? Are you interested in sharing your work or hearing how others have been using spatial sciences to assist their work?

The Montana Association of Geographical Information Professionals (MAGIP) is interested in incorporating a snow science track at the 2010 Intermountain GIS Conference to discuss the use of spatial sciences in the snow science and avalanche fields.

The conference will be held April 19-23 in Bozeman, Montana.The snow and avalanche track will be held on Thursday, April 22. MAGIP will allow a one-day registration for this mini-conference. April 23 will be set aside for training workshops. Travel grants are available for students.

For more information regarding contributing to or attending the conference, contact Tara Chesley-Preston at tara.chesley@gmail.com. Watch www.magip.org for additional details.

LaChapelle Library Catalogued in Detail

Story and Photo by Don Bachman

The voluminous library of Ed LaChapelle, now located in Silverton, Colorado, was curated this past summer by Betsy and Richard Armstrong. The material had been cataloged and packed into 70 boxes by Ed's partner of 25 years, Meg Hunt, and brought out of the LaChapelle home in McCarthy, Alaska, by Ron Matous and Ruth Valsing in 2008 *(see story in TAR 27/1)*. The San Juan Historical Society graciously provides space for the collection in their modern archival building on Courthouse Square in the town where Ed and his wife Dolores came in 1972 to participate in the University of Colorado San Juan Avalanche Project.

The Armstrong's dog Charley refused to paw through the collection.

LaChapelle served as senior consultant for the San Juan Project (1971-1987), which was conducted by the Institute of Arctic and Alpine Research (INSTAAR) of the University of Colorado to develop a methodology for evaluation and prediction of avalanche hazard for the San Juan Mountains of Colorado. Principal funding came from the Bureau of Reclamation, acting in response to regional public concerns over proposed atmospheric precipitation augmentation through silver iodide cloud seeding.

LaChapelle's insatiable curiosity led to the utilization of the isotopic snow profiler for settlement characteristic determination and to the experimental extension of forecasting methods through infrasonic and microseismic instrumentation; neither technology translated, then, into operational viability. LaChapelle pioneered snow mechanics investigations and special event forecasting of natural and artificial avalanches that included potential characteristics and magnitude.

LaChapelle's repertoire of ideas included experiments in alternate methods of avalanche control through gas exploder devices, confirming that above-surface explosive shock is effective in large-scale disturbance to the snowpack. His curiosity was a vital and engaging motivation for those he mentored on the project and for his graduate students who went on to develop careers in snow- and avalanche-related endeavors.

At the project's conclusion LaChapelle returned to Seattle, but his wife, Dolores, felt the tug of the San Juans and made Silverton her permanent home. She remained there until her death nearly 30 years later, in January, 2007. Her practice as a deep ecologist was chronicled in several books she authored exploring the topic, and her memoir was portrayed in a now scarce and treasured book, *Deep Powder Snow – 40 Years of Ecstatic Skiing, Avalanches, and Earth Wisdom*.

Ironic connections are abundant in the LaChapelle saga. Ed and Meg were on their annual tour of the Rocky Mountains to ski and visit old friends, which usually included Bridger Bowl and Alta, when they received word of Dolores's passing. After diverting to Silverton from Missoula, Montana, to attend her memorial service, they gathered friends Art Mears and Paula Lehr along with Knox and Susie Williams to go skiing at Monarch Mountain ski area. After a morning of deep powder skiing, Ed suffered a fatal heart failure.

Just over two years later, after moving to Silverton with his partner, Ananda Foley, Ed and Dolores's son David LaChapelle died *(see story in TAR 28/1)* from cancer complications. David was an expert skier, wilderness guide, and prolific author on transpersonal psychotherapy and spirituality.

In the meantime, Bev Rich, San Juan Historical Society president, provided the home for the Ed LaChapelle Library. Also the San Juan County Treasurer, Rich is the daughter of Gene and Ester Orr who leased their home to the INSTAAR San Juan Avalanche Project in May of 1971 when they moved to Pagosa Springs. A lifelong resident of Silverton, she was a friend of Dolores for many years.

Curators Betsy and Richard Armstrong joined the San Juan Avalanche Project at Ed's suggestion in 1971, when Richard (who was a visiting graduate student of Ed's at the University of Washington and also a graduate student at INSTAAR) assumed the role of field project director through the duration of the project. Betsy researched and co-authored several publications on avalanche paths, statistics, and history of the San Juans. Richard, who had earned his PhD at the University of Colorado, and Betsy (MS Physical Geography) were avalanche forecasters for the USFS Avalanche Center. Betsy remained with the forecast center for a few years when it moved to Colorado, while Richard took a research position at the University of Colorado National Snow and Ice Data Center in Boulder, where he remains today as senior research scientist. Betsy is a publishing consultant and scientific editor and draws upon years of experience with museums and publishers while exercising her skills as an archival researcher.

Ananda Foley of Silverton inherited the LaChapelle material and graciously agreed to loan Ed's library to the San Juan Historical Society. It is probable that Dolores's and David's libraries may also be retained in Silverton: first at the archives building, then hopefully in a center developed specifically for furthering the memory of this remarkable family.

Moving and archiving the collection to Silverton was facilitated by the Center for Snow and Avalanche Studies (CSAS), now entering its seventh year as an independent snow research organization. CSAS is built upon the foundation laid by the San Juan Avalanche Project so many years ago and, among other activities, is providing information on seasonal impacts of dust on snow to the Bureau of Reclamation and Colorado water managers throughout the Colorado and Rio Grande River basins.

The Armstrong's curation of the LaChapelle Library has produced two products: the Collection Description Sheet and an Excel database containing nearly 600 descriptive notations of reports, books, photographs, notebooks, and journals. Materials unique to and personally defining of Ed and his long career have been catalogued in detail and repacked in their original shipping boxes. Those boxes will be shelved in a secure area within the archive facility. LaChapelle's collection of widely distributed scholarly journals and textbooks, which are undoubtedly also available in libraries throughout the country, will be further assessed for retention or distribution.

The collection, when shelved, will be open for supervised exploration at the San Juan Historical Society archive facility. Those interested in journeying to Silverton to seek out specific material may contact Don Bachman by email at avalpro@theglobal.net for the collection description and Excel spreadsheet.

Don Bachman was a forecaster for the San Juan Avalanche Project during 1971-75 and had a long career in avalanche forecasting, control and education – benefitting from Ed LaChapelle's mentoring. He is the Center for Snow and Avalanche Studies board president.

2009 Colorado Snow and Avalanche Workshop Stays True to its Roots

Story by Scott Toepfer

The Colorado Snow and Avalanche Workshop (CSAW) is a one-day meeting of snow and avalanche professionals that has been held in central Colorado since 2001. The original idea was to bring snow and avalanche workers together to discuss practical topics and current events affecting the field. The workshop was meant to be affordable with a mix of science and practice that would stimulate discussions in snowpits and patrol shacks for the rest of the winter. The workshop has always had a strong social component, as the best information transfer doesn't always happen in a lecture hall. This year's CSAW remained true to the original concept, bringing 420 participants to the National Mining Hall of Fame Conference Center in Leadville, Colorado, to listen to nine presentations and meet 10 commercial vendors.

For the second time in CSAW history, the Forest Service National Avalanche Center's annual meeting and American Avalanche Association's fall meetings were scheduled to coincide with the event. Having that many talented people in the same town made finding quality topics and speakers as easy as finding depth hoar in Telluride. The intersection of these three events proved to be a successful model for bringing high-quality presentations and a record number of participants to the workshop. Hopefully we can all look forward to similar events at other regional meetings in the future, as this year's CSAW was one of the best we've seen yet.

Ian McCammon of Snowpit Technologies gave an interesting presentation on slope angles associated with different kinds of weak layers. By looking at data from avalanche accidents that included detailed snow and terrain information, Ian was able to look at the range of slope angles for weak layers ranging from surface hoar to wet grains. Although the average over all of the cases was still near 38°, the typical value for individual weak layers ranged from 36° to 41°. *(see* 38° Revisited: A Closer Look at Avalanche Types & Slope Angles, *TAR 27-4, p26)* You don't want to bring a talented guy like Ian in and have him talk for only 20 minutes, so he also presented his recent work on communicating avalanche dangers to out-of-bounds riders near ski areas.

After years of the faithful tromping around the hills doing Rutschblock and Compression Tests, avalanche workers now have a fleet of tests at their disposal. Karl Birkeland of the Forest Service National Avalanche Center presented a review of recent developments in stability and propagation tests. Theo Meiners of Alaska Rendezvous Guides presented a combination of practical and theoretical ideas on avalanche dynamics and what to do if you experience them up close. Theo's premise is that the key to surviving an avalanche differs depending on where you are when the avalanche breaks and goes running down the hill. His observations have intrigued guides and scientists in both North America and Europe. *(see* Avalanche Survival Strategies for Different Parts of a Flowing Avalanche, *TAR 26-3, p12)*

Eric Lieberman, president of High Angle Construction, and Dan Miller, professor of civil engineering at Montana State University, spoke about avalanches and explosives. Eric's company builds Gazex® systems in North America. He discussed the current state of the system and lessons learned during 20+ years of use. Dan has been looking at how explosives interact with the snow to release avalanches. He has applied modeling techniques used in other industries to snow and showed some interesting simulations of explosions in snow during his presentation. With a strong background in snow science, a long career in the Air Force, and now new high-tech models from the explosive industry, Dan's work has the potential to help us understand one of the most important tools in our industry.

Doug Abromeit, director of the Forest Service National Avalanche Center, Scott Savage of Big Sky Ski Resort, and Ron Simenhois of Copper Mountain Ski Patrol discussed different sets of accidents. Avalanche fatalities within ski area boundaries have been few and far between over the last 50 years. With three deaths in one year and six since 2003, we need to look at these events to better understand them. Doug presented a review of some of these accidents with the aim of understanding them and preventing future accidents. Scotty and Ron took a look at accidents in the workplace. They reviewed accidents involving professional avalanche workers and described strategies to prevent repeated mistakes. *(see* Professional Avalanche Near Misses, *TAR 28-1, p16)*

One of the cornerstones of every past CSAW has been the winter weather forecast. At the 2007 CSAW, Joe Ramey of the Grand Junction National Weather Service was brave enough to stick his head on the block. This year, Joe was able to say last year's prognostications came fairly close to right on. There were a few shivers this year as he related how his finding for the 2009/10 season had some similar characteristics to the dreaded winter of 1976/77. Fortunately he gave his forecast a fairly low probability of success as any good weather forecaster will do. He also mentioned that *The Farmer's Almanac* is calling for a wet and cold 2009/10 winter.

CSAW 2009 ended with a social event hosted by Backcountry Access. "It's wonderful to see CSAW staying close to the original roots of affordability, great speakers, and that all-important social aspect," Knox Williams said after the party. "Even though CSAW is continuing to grow, the overwhelming audience remains the professional we first sought to serve with this really great event."

The staff of the Colorado Avalanche Information Center would like to thank everyone who attended and participated in CSAW 2009. It was great to have the support and participation of the National Avalanche Center and American Avalanche Association.

Scott Toepfer is a forecaster for the CAIC and took on the herculean task of organizing the CSAW.

aaa news

Recommended to AAA Governing Board:

Course Provider Oversight Utilizing Avalanche.org and Level 2 Course Leader Requirements

Story by Kirk Bachman and Sarah Carpenter

AAA Education Committee Co-Chairs: *Kirk Bachman and Sarah Carpenter*
Members: *Michael Jackson, Brian Lazar, Brad Sawtell, Kyle Tyler, Jake Urban*

For those organizations who teach avalanche courses, the *AAA Guidelines for Avalanche Education in the United States* have long served as a benchmark. In practice most organizations have utilized the guidelines to provide substance and structure to courses ranging from Avalanche Awareness through Level 1 and Level 2. The AAA guidelines provide a clear path for both the course provider and for the student to understand the stream of avalanche education for both the recreationist and professional in the United States.

Confusion in the avalanche-education marketplace often results among course providers and with the public when courses offered are not consistent with outcomes and content as outlined in the AAA guidelines. Often courses billed as Level 1 and Level 2 do not meet guidelines in one or several areas: course length, critical content and outcomes, appropriate terrain, or qualified instructors. These components are clearly identified in the AAA guidelines.

The Education Committee of the AAA has recommended that the Governing Board utilize avalanche.org to better manage the quality and consistency of avalanche education, through a screened review for listed course providers on the Web site. This process would be initiated by utilization of an education review process at avalanche.org for course providers to self-evaluate course offerings and then submit a course provider agreement with their self-evaluation form. Course providers currently meeting AAA guidelines will easily meet the self-evaluation criteria.

The 2009/10 season will serve as a grace period for all course providers to have avalanche.org listings and assess their programs. This ensures ample time to make necessary adjustments to established programs. Applications will be reviewed at the end of the 2009/10 winter season for inclusion at avalanche.org for the 2010/11 season.

COURSE PROVIDER COMPLIANCE AAA Guidelines for US Avalanche Education

Purpose: To address the quality of avalanche education and the consistency of training among course providers and their instructors and to address the quality and consistency of student outcomes according to the AAA guidelines.

Action: To approve and oversee the listing of avalanche education course providers on avalanche.org.

Benefit to US Avalanche Education: To promote a more consistent and practical progression of avalanche education in the US by applying the AAA guidelines in all course design and implementation whereby the consumer has a better understanding of the recreational and professional stream of course offerings.

Proposed Methods for AAA Oversight

- Description of and access to AAA guidelines on avalanche.org
- Educate course providers and public as to standards and responsibilities in conjunction with AAA guidelines and outcomes for students. This is also posted on avalanche.org.
- Educate course providers as to approved AAA logo and name use in their marketing materials.
- Post-course attendance self-evaluation checklist for course providers available for review by course provider and public.
- Create an online registration for course provider agreement (downloaded PDF submitted to ED Committee)
- There would be a very reasonable annual fee for site listings and to help maintain operation of avalanche.org and the education program. The intent of avalanche.org listings is to provide a service for course providers who are in compliance with AAA education guidelines.

A Self-Evaluation on Avalanche.org for Course Providers— AAA Guideline Compliance

1. Description of avalanche-education program:
- What level of training do you provide?
- Who is your target audience/primary market?
- Where are your courses conducted?
- How long have you been providing avalanche courses?

2. Submit a course syllabus from a previous course offered that is in compliance of AAA guidelines *(syllabi from each level you are providing must be submitted)*. Avalanche.org will only list course providers who have demonstrated that their courses are compliant with AAA guidelines.

3. Do you agree to run courses that meet AAA guidelines and consider:
- Course name and description
- Audience
- Outcomes
- Recommended content
- Ratios of field to indoor time: total course time/days
- Instructor qualification as to AAA *(lead instructor and additional instructors)*

4. Do your course offerings:
- Take place in/around avalanche terrain where avalanches historically occur?
- Take place in a representative layered mountain snowpack?
- Have terrain and snowpack suitable for teaching and practicing avalanche rescue skills?

5. Do you have the necessary permits and insurance for running courses?

6. Do you have a risk-management plan in place?

On another topic, the AAA Education Committee has been reviewing the career path to becoming a certified instructor. They recognize that this is an ongoing process and have discussed steps on this career path, starting with Level 2 course instructors.

Prior to this recommendation, a Level 2 course had to be under the leadership of a AAA-certified instructor. Under this update either a certified instructor or someone meeting the following qualifications may serve as a course leader for a Level 2. This change to the guidelines recognizes that some experienced avalanche instructors are qualified to lead these courses but are not yet AAA certified. The following qualifications are recommended for a Level 2 course leader as a standard in the *AAA Guidelines for Avalanche Education in the US*. We hope to put these into effect for 2010/11.

AAA Level 2 Course Leader Required Qualifications

- Instructor experience on three or more Level 2 courses
- Two letters of recommendation discussing Level 2 courses taught, professional leadership responsibilities and teaching ability (*One letter should be from a supervising course leader and one from a co-instructor/peer.)*
- Level 3 certificate or equivalent, such as CAA L2 or AVPro
- Four winters professional leadership experience in avalanche terrain *(min)*
- AAA professional membership

Required Continued Professional Development

Show active participation *(24hrs min)* in continuing education over the last two years. Continuing education is expected to be just that: an advancement of knowledge and understanding of advanced topics in snow and avalanche studies, teaching, guiding, etc. This CPD should be outside of your everyday work duties *(i.e., If you are a patroller, observing avalanche control routes at your own ski area is not considered CPD.)*. 12 hours of this CPD must be focused on education.

Continuing Education Examples

- Accident investigation, analysis, and write-up
- Shadow/observe avalanche-control routes
- Shadow/observe avalanche forecast center avalanche forecasters
- Attend/present at International Snow Science Workshops
- Attend a winter weather forecasting course
- Attend/present at regional continuing education seminars
- In-house avalanche-focused training
- Participant, instructor, or examiner on an AMGA or ACMG ski guide or ski mountaineering course or exam
- AIARE ITC
- Adult teaching seminar
- Teach in a different location and with different instructors from your normal colleagues
- Participation in any activity, work, or seminar that expands the instructor's previous avalanche knowledge base *(subject to review)*

Recommended Qualifications

- AAA-certified instructor
- AMGA/ACMG ski guide or alpine guide certification

Please contact Sarah Carpenter, sarahlovessnow@yahoo.com; or Kirk Bachman, kirk@sawtoothguides.com with any questions or feedback.

Kirk Bachman at the Williams Peak yurt after a day in the hills with dogs Gordon and Buster. *Photo by Sharon Kelley*

A new co-owner of the American Avalanche Institute, Sarah Carpenter's personal and professional hero is Rod Newcomb. Her current reading list includes TAR and the 2009 ISSW proceedings.

American Avalanche Association Fall Governing Board Meeting Highlights

The American Avalanche Association (AAA) Governing Board spring meeting was held in Leadville, Colorado, in October 2009. In attendance were 20 board members, committee members, and section representatives.

President's Remarks: Janet Kellam

Janet thanked Executive Director Mark Mueller for his continued great work, helping the AAA grow into a well-functioning organization. Membership and income have both increased dramatically under Mark's direction, and programs such as AVPRO have grown into self-sustaining ventures.

Treasurer's Report: Bill Glude

Bill discussed the AAA's financial situation, noting that the endowment continues to increase a bit. Total income was about $111,000, with expenses about $100,000, so all is currently well. AVPRO courses are now the top income generator, followed closely by dues. The recent dues increase came at a fortuitous time, as the AAA accepted more tasks that required funding. Donations were the third greatest income generator, thanks in large part to CIL/Orion's largest ever donation of $5,900 (which is directed toward professional education programs).

The largest expense is staff: the executive director, staff for the IT and Web buildout, and TAR layout and editing. Following that is TAR printing/mailing and AVPRO expenses.

Executive Director's Report: Mark Mueller

Mark noted that membership is slowly increasing, but was static from spring to fall 2009.

One thousand copies of the new SWAG have been printed, and 25% of those printed have already sold. The NAS ordered 200. Please look at the new SWAG for errors in spelling, formatting, and so on. The content is excellent, and there are 14 more pages than the previous edition.

Mark attended ISSW 2009 in Davos, Switzerland, to represent the AAA. He noted that Davos is in many ways the birthplace of avalanche study, and the visit was both informational and fun. The ISSW 2009 was very well organized and attended, with over 500 persons from Europe, North America, and Asia present – much more than expected. Mark also represented the AAA at the Avalanche Divas night, a very successful evening.

The French are interested in hosting ISSW 2013 in Grenoble. Under consideration for future ISSW events is a schedule for after 2013, when the rotation of ISSW sites will return to every other year, being hosted alternately in the US, Canada, and Europe.

COMMITTEE REPORTS

Research: Ethan Greene for HP Marshall

See sidebar story in box at right.

Education: Sarah Carpenter, Kirk Bachman, Jake Urban, Brad Sawtell

The Education Committee is now comprised of Sarah Carpenter, Kirk Bachman, Jake Urban, Brian Lazar, Kyle Tyler, and Michael Jackson. Kirk Bachman is the co-chair with Sarah.

As noted earlier, AVPRO courses realized a profit of about $10,000 this past season. There have been no scholarship applications received so far this season. For the 2009/10 season, one course will be held in Little Cottonwood Canyon, UT, December 12-20, and one in Telluride, CO, February 20-28. It's being considered that future courses will include one each season in CO, based on historical demand, and one that moves around the Intermountain West. The committee is working on filling out the AVPRO instructor pool.Currently a person must be a certified instructor, however there are many qualified persons available. They are also working on completing a risk management plan. Lastly, as the AVPRO course is primarily ski area oriented, there are no further plans to pursue certification of AVPRO by the AMGA for its level 3 avalanche education component.

A draft of AAA Level 2 Avalanche Course Leader Qualifications was introduced for discussion. The goal is to expand the course leader pool and not put in place difficult or onerous requirements to do this. This set of qualifications is viewed as a step to becoming an AAA-certified instructor. The responsibility for meeting and making sure these qualifications are met, on both course and instructor levels, is to be handled by the course providers – in other words, self-policing.

A draft recommendation on course compliance was introduced, to address the quality of avalanche education and consistency of training. It is intended to help course providers meet published guidelines and to make consumers more aware of these guidelines. This draft will be published on the Web site to be more visible to everyone.

In addition, a draft of a Self Evaluation for Course Providers document was introduced. This would be a downloadable form that course providers submit to the AAA for publishing on the AAA Web site. This is intended to help course providers evaluate their offerings, and help consumers be educated shoppers.

The course compliance and course provider self-evaluation programs will be introduced this season (2009/10). Following that, both programs will go into effect for all providers desiring a listing on the AAA Web site.

A discussion was held to consider a requirement of 30 hours of continuing professional development (CPD) every two years for AAA-certified instructors (CI). The CPD hours would be broken down as 15 academic hours and 15 experiential hours. Certified instructors who did not complete and document these CPD hours would not lose instructor status, but rather would become inactive instructors, as listed on the AAA Web site. Information on this CPD requirement will be listed on the Web site, and feedback will be gathered from CIs regarding this topic. See previous page *(page 9)* for more info.

Web-IT: Chris Lundy, Janet Kellam

A mockup of the new AAA Web site was very well received. The new site will launch in early 2010. Some of avalanche.org content, especially that pertaining to avalanche professionals, will shift to the AAA Web site.

Job openings in the avalanche industry may now be submitted via an online form. They are reviewed prior to posting.

Work to merge the CAIC accident database with a national database is ongoing with CAIC's Spencer Logan.

The Center for Snow Study at Alta is generously donating the avalanche.org Web site physical property and a one-time donation of $50,000 to the AAA, expressly for maintaining and upgrading avalanche.org hardware, software, and services.

Ethics: Lel Tone

Lel thanked the Education Committee for their hard work, as it provides the Ethics Committee with a framework from which to work.

One course provider in Washington state listed Level 1 courses that purported to meet AAA course guidelines and be taught by AAA professional members. There was question as to whether they were meeting hour requirements. They were really offering an avalanche-awareness course and by adding "extra second field trip day" later in the season or the following year, students could be awarded a "Level 1 certificate."

One course provider in Montana advertised that their Level 1 courses met AAA guidelines. Their instructor-to-student ratio did not meet specified guidelines, and the course hour requirements were not met.

In each case, contact was made to educate the providers in question and to clarify the guidelines posted on the AAA Web site.

Publications: Lynne Wolfe for Blase Reardon

The AAA will continue the pattern of building TARs on common topics and themes. TAR is now printing issues of 32 pages, on an as-desired or as-necessary basis.

Awards: Halsted Morris

Halsted noted that, thankfully, there were no new members to add to the AAA Memorial List.

Daniel Howlett ("Howie") and Dan Judd were recommended for Honorary Membership, based on their long and excellent work of creating and enhancing the WWAN and avalanche.org. The AAA will recognize Dan and Howie at the spring 2010 board meeting and at ISSW 2010 in Squaw Valley.

Membership: Stuart Thompson

See Metamorphism on page 3 for the names of new Professional and Affiliate Members and new Certified Instructors.

ISSW 2010: Lel Tone

The Dirtbag Report: the ISSW 2010 Steering Committee is working hard to make attendance more affordable. See ISSW 2010 box on the previous page *(page 9)* for the pricing structure.

OLD BUSINESS

Guidelines for the funding and grant process now include a deadline for submission of April 1 of each calendar year. Recipients of grant monies are required to submit an approximate budget with each proposal.

NEW BUSINESS

The 2009 Annual Meeting was held after the Colorado Snow and Avalanche Workshop (CSAW) at 7pm.

The AAA bylaws have not been updated since 1998; to accommodate methods by which the current board has been working, the following changes are proposed:

- ***Purpose of the AAA:*** primarily to recognize education as a major function of the AAA
- ***Registered address:*** the executive director's home address
- ***TAR:*** now published at least four times per year
- ***Qualifications for professional members:*** application clearly documented by applicant and reviewer
- ***Complimentary subscriber for TAR:*** now exceeds 20 copies per year
- ***Fiscal year:*** now July 1 to June 30

The executive director salary shall be increased to $21,000/year (a $250/month increase), and a $500 bonus to defray ISSW 2009 costs will be provided to Mark Mueller.

The spring 2010 board meeting will be held in Little Cottonwood Canyon, Utah, at Our Lady of the Snows Church, April 23-24, 2010.

—Rick Grubin

AAA Awards Research Grant

Below is a short description of the research grant awarded to: *Assessing and mapping surface hoar spatial variability in the Chilkat and Takhinsha Mountain Ranges of southeast Alaska*, Matthew Borish, M.S. student at MSU, scientific mentor: Karl Birkeland.

This research grant will fund Matthew to research the spatial variation of surface hoar at a mountain range (1000 km^2) scale. He will study patterns of formation and persistence, how crystal size varies with aspect, elevation, and location, and relate these observations to regional avalanche activity. The AAA graduate student research grant will contribute part of the necessary funds for this project, which has also received support from the Mazamas, the MSU Milton J. Edie Memorial Scholarship, the USDA Forest Service National Avalanche Center, and the Montana Association of Geographic Information Professionals. In addition to his graduate studies, Matthew is a heli-ski guide with Southeast Alaska Backcountry Adventures, which will provide in-kind support in helicopter time as part of their normal operations, allowing this study to cover an area much larger than would otherwise be possible.

Matthew's proposal will be funded, and any equipment purchased must go to his academic institution at the conclusion of the work, and that data from the weather station will be made available to the public.

—HP Marshall, AAA Grants Committee Chair

First Annual Pacific Northwest Winter Mountain Weather Workshop

Story by Charlie Rubin

Winter was distant on the horizon during the AAA meeting at the Whistler ISSW meeting last year when Mark Mueller mentioned that AAA had funding for local events. As I sipped my beer, I whispered to Lynne Wolfe, "Do you think anyone would be interested in a AAA-sponsored Pacific Northwest weather workshop?" While I don't recall her exact response *(editor's note: I am sure I was enthusiastic)*, I later asked Patty Morrison, Pacific NW AAA rep, if there was any interest in a workshop focusing on Pacific Northwest weather forecasting, and she gave me a thumbs up. Returning home, I asked Mark Moore at the Northwest Weather and Avalanche Center if he would be interested in teaching such a weather workshop. Mark agreed, but only if I took charge of all the logistics. I thought, "Why not? That's the easy part." Yeah, right.

The goal was to offer a winter weather seminar for avalanche forecasters, ski patrollers, and mountain guides that focused on Pacific Northwest weather patterns. Understanding weather patterns is a huge asset in avalanche forecasting and in communicating both weather and avalanche forecast information.

The workshop syllabus was based on the CAIC and CAA weather workshop lesson plans. After talking with other weather workshop organizers across the country, enrollment was limited to 24 participants. Formal meteorological education was not required for class participation. Differing from a traditional lecture format, I strove to create an informal workshop structured with group learning exercises.

The Pacific Northwest AAA and AIARE email lists were used to advertise the workshop. Within three days, 27 participants had enrolled, with Mark, Kenny, and Garth (all NWAC forecast staff and professional meteorologists) as the course instructors. Participants registered through the Pacific Northwest Workshop Web pages: first-come, first-served. The Web pages provided updates and course materials. In order to focus on the most useful topics for the participants, we solicited pre-course input by asking everyone to submit three questions about weather or mountain weather. So far so good!

The workshop was held September 19 at the Lake Washington School District, L E Scarr Resource Center, Redmond Town Center, Washington. In the morning session, Mark Moore presented a review of meteorological concepts, drawing upon his long-term experience as the director of the Northwest Avalanche Center. After a short lunch break, Mark, Kenny, and Garth led a review and discussion session. Next, Garth presented weather forecasting examples and introduced the "tool box" of Web resources that he uses for his weather forecasting.

Mid-afternoon, Kenny gave a short talk that explained the NWAC weather forecasts and how to prepare a site-specific/zone weather forecast (24hr). The students worked in small groups to prepare their own weather synopsis and short-term forecast for a given location, which gave the participants a feel for the effort, experience and expertise needed to prepare meso-scale forecasts.

FEEDBACK FROM WORKSHOP PARTICIPANTS:

"I really enjoyed how the Mt Wx forecasts are produced, then getting to apply the process ourselves."

"You said this would be a *refresher* for me. It was much more than that, and it really brought together an understanding of meteorology and the forecasting methods used by NWAC forecasters."

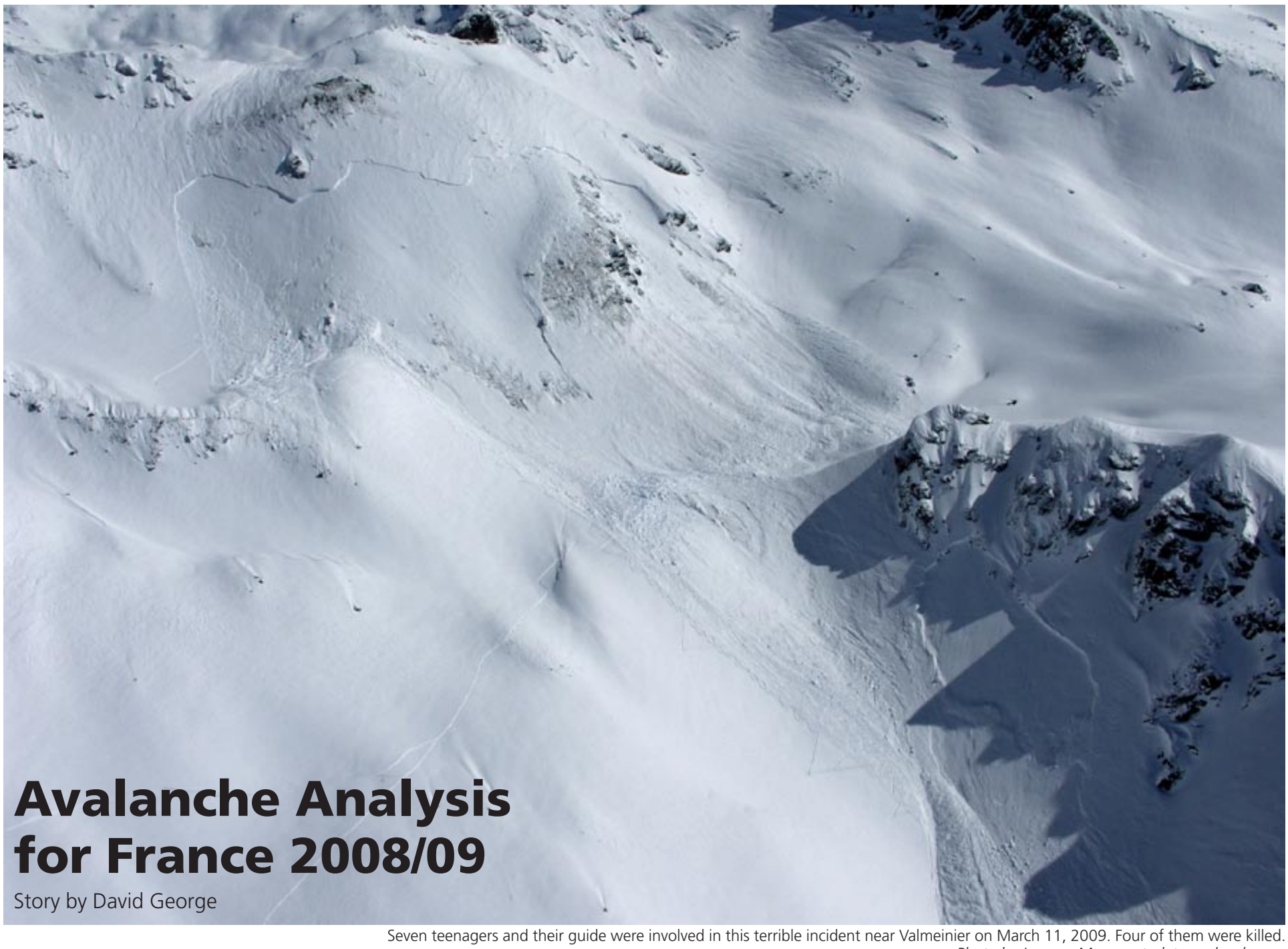
"For me, the level of instruction was dead on!"

"The weather seminar was great. Charlie Rubin did the leg work on getting the boys from the NW Weather and Avalanche Center to share some of their tricks of the trade. Mark Moore gave a great overview of mountain weather and some specifics to the Pacific NW weather. He explained El Niño and La Niña and much much more. Garth Ferber ran through his typical day on how he comes up with his forecasts. He introduced us to a lot of the weather models that are out there and how to start with the big picture and bring it down to a *nowcast*, or operational forecasting. Kenny Kramer lead us through scenarios of coming up with our own forecasts. Challenging, but good. Nice way to bring it all together. Overall, great stuff. Well organized. Only wish we had more time."

—Patty Morrison
AAA Northwest section representative

The workshop was hosted by the Northwest Weather and Avalanche Center, AAA, and Central Washington University. For the most part, participants included NW avalanche professionals and highly motivated recreational individuals, most of whom work or have worked as avalanche professionals in some capacity (for ski areas, highways, guiding operations, etc). Because of the enthusiastic student feedback received to date, we hope to schedule a second winter weather workshop next year, possibly expanded to two or more days with a larger cadre of instructors.

Charlie Rubin is a professor of geological sciences at Central Washington University and teaches Snow Sciences: The Physics of Avalanches *at CWU during the winter quarter. In collaboration with the Washington State Department of Transportation and Alpental ski area, he is investigating snow glide and failure using a variety of instruments including geophones, strainmeters, and weather sensors. For his day job, Charlie studies Asian earthquakes.*



Avalanche Analysis for France 2008/09

Story by David George

Seven teenagers and their guide were involved in this terrible incident near Valmeinier on March 11, 2009. Four of them were killed.
Photo by Jacques Manquest, data-avalanche.org

The 2008/09 ski season

in France saw 35 avalanche fatalities in 23 incidents. This figure is slightly above the median of 19 incidents per year, established since 1989. The season had good snow conditions from late November through to May with four major periods of avalanche activity. The majority of fatalities and accidents involved ski tourers and snowshoers. This continues a trend observed since 2006. Three major incidents involving touring parties in March accounted for 10 deaths.

The first skiable snow fell in the mountains at the end of October. The ski season in the Pyrenees got off to a good start with a meter of snow above 2000m in the western part of the region. The ski resort of Puigmal opened its first lifts in mid-November. However the far east of the range only had significant snow cover from the second half of January.

In the Alps a number of weather systems crossed the mountains from mid-November through mid-December with above-average snow cover over 2000m. Weather fronts moving in from Italy brought the heaviest snow to the Southern Alps and border areas.

The first avalanche death was a ski tourer close to the resort of Chamrousse near Grenoble. The sector is popular, especially early in the season. Equipped with a beacon, the victim was recovered by his companion in 15 minutes but was already dead. The rescue services flew a number of other missions that day. This provoked a plea for calm from one rescue worker who thought that backcountry enthusiasts were taking unnecessary risks, ignoring the dangers of early season snow.

The most serious period of avalanche activity occurred early in the season in the Queyras region of the Southern Alps. An alert was issued by Meteo France on December 14. There was 85cm of snow overnight in the ski resort of Montgenevre. Electricity and phones were cut to some villages. Numerous spontaneous avalanches blocked roads and damaged infrastructure including ski lifts and buildings. Les Abries used the radio of a local park ranger to communicate with the outside world. By the time the snowfall abated on the 17th some 250cm had fallen, and avalanche maps would have to be redrawn. The Fourche avalanche at les Abries was the biggest event since 1946. At Valpreveyre an unusually large avalanche on a south-facing slope destroyed a 300-year-old chapel. Apart from the deaths of two skiers only one other person was injured during this episode – in part due to good luck but also to improvements in emergency planning since the Montroc avalanche in 1999.

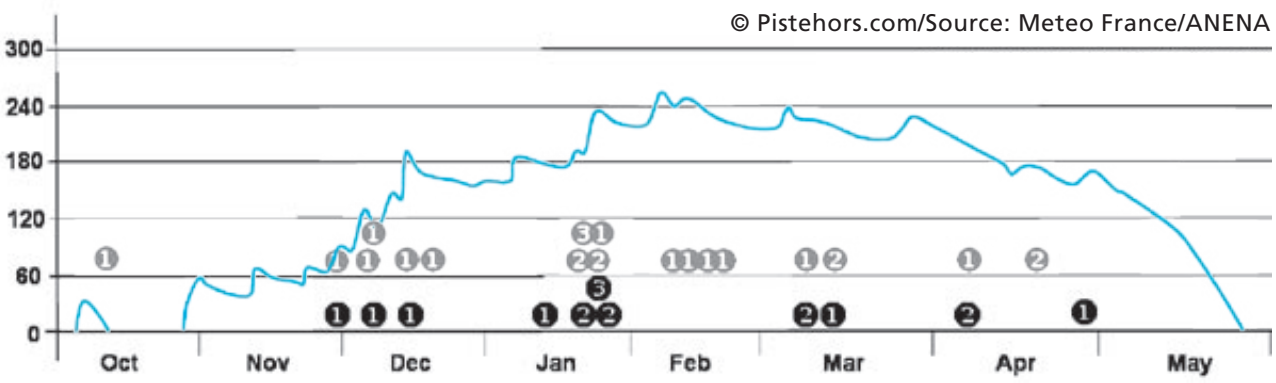
From mid-December to January 20, there was a long period of stable weather with spring skiing conditions on southeast- to south-facing slopes. Snow on shaded faces started to destructure in the cold. On January 20, fresh snow started to fall on this unstable base. This lead to a generalize risk of avalanches above 1800-2000m (risk 4). 37% of the reported avalanche incidents for the winter occurred during the following week. There were seven deaths on the 24th and 25th in five incidents at risk 4 and 3.

There was further fresh snow at the start of February for the beginning of the main European winter holiday period. The month was relatively sunny with temperatures slightly below average. Again the Pyrenees, Southern Alps, and Corsica saw the worst conditions. Ski resorts close to Nice and in the Pyrenees were cut off by avalanches and many road passes were closed. On the 11th there was over a meter of snow and the avalanche risk varied between 4 and 5. The episode claimed the life of a trainee guide on the 12th and a ski tourer on the 14th. The guide had set out alone without giving clear details of where he was heading. His body was eventually located after triangulating base station records for his mobile phone.

There were three major incidents affecting ski touring groups in the latter part of the season. On the March 7, a group of three ski tourers were killed by a large avalanche in the Belledonne range. The avalanche risk was 4 but the normal route follows a low-angled ridge and is relatively safe in such conditions. It seems the group had decided to tackle a steeper north face with a number of convex roll overs. On the same day an employee of the French Electricity Company was killed on touring skis while carrying out professional duties at a dam on the border with Italy.

On March 11, a high school group lead by a mountain guide were hit by a slide close to the ski resort of Valmeinier. The students were studying a snow-sports curriculum. The group was hit from above by a large slide while touring to a pass. The avalanche was triggered remotely; this phenomena is not widely understood by many recreational ski tourers in France. The avalanche risk was 3 although a local bulletin issued by the ski resort gave the risk as 4. Three students and the guide were killed.

Avalanche Incidents in the Northern Alps plotted against Snow Fall (Belledonne 2240m)
© Pistehors.com/Source: Meteo France/ANENA

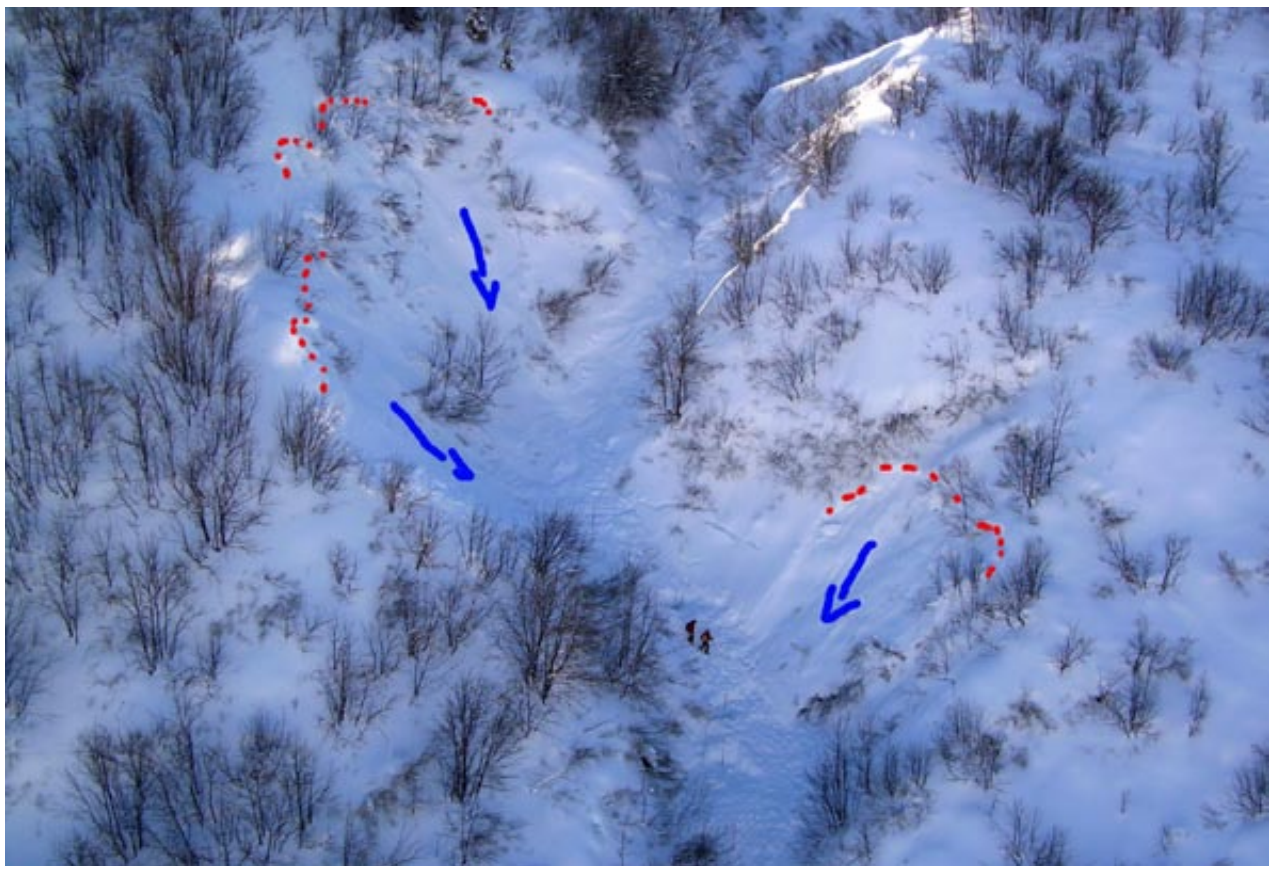


Gray = reported incidents. Black = fatal incidents.

There had been fresh snow and high winds over the previous days. However the students would need to have experience on the ground, adapting route choices to the conditions, and the route seemed to take these into account. Visibility was poor due to low clouds, and the group had strayed onto steeper terrain. According to one survivor, the guide had asked the group to spread out, but the seven members had trouble maintaining the required 20m group spacing which was inadequate given the size of the avalanche.

The final major incident occurred on the April 13 when three ski tourers were killed by a large avalanche in the Queyras range. The slide hit 12 out of a group of 16 skiers as they were climbing to the Pointe Joanne. The avalanche risk was 3. The area had 2m of fresh snow a week before, and strong winds on the preceding days had formed slabs at altitude *(incidentally the author had chatted with a couple of the victims a couple of weeks earlier while touring)*.

From mid-March conditions turned spring-like with above-average and sometimes record temperatures. Conditions were relatively stable with fresh snow at the end of March and again at the end of April. There was a rapid thaw in May, and the touring season finished ahead of schedule except in areas that had seen considerable snow over the winter.



In a dramatic accident, three teenagers were buried and two were killed in a gentle gully very close to Saint François-Longchamp ski resort on January 24, 2009. *Photo by PGHM Modane, data-avalanche.org*

Conclusions

Snow conditions during 2008/09 were better than average in the Northern Alps and exceptional in the Pyrenees, Southern Alps, and Corsica where 30-year records were broken. As can be expected in a long season with good snowfall, both avalanche deaths and incidents were above the long-term median (35 deaths compared to the median of 28 established since 2000/01). The good early season snow cover prevented a catastrophic situation from developing, such as that experienced in 2005/06, when a thin snowpack resulted in a persistent weak base.

The heavy snowfall in the Southern Alps and Pyrenees created several episodes where roads and buildings were hit by avalanches, but the authorities coped well with the circumstances.

There were a number of deaths involving guides, other professionals, and "experienced" groups. In total 11 French guides were killed last season in avalanche incidents and falls; a very high figure in what remains a dangerous career. The curriculum for French guides is being revised.

Ski touring groups seem to be well equipped with beacons, probes, and shovels and in a number of incidents were able to carry out their own rescues before the arrival of outside help. In contrast it is rarer for off-piste skiers, snowshoers, and climbers to carry beacons, and recovery often has to wait for the arrival of avalanche dogs or probe teams.

The touring incidents indicate areas where skills can be improved. In two incidents victims had not switched on their beacons. Checks at trailheads and practice sessions seem to be relatively rare among French ski tourers, although many clubs are insisting on practice sessions with each outing. There were other issues with route choice and group management as well as a lack of appreciation as to how slabs are formed and triggered.

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Flashback on the December 2008 avalanche crisis in the Queyras massif, Sebastien ESCANCE, *Neige et Avalanches*, No. 126, July 2009

Jarry, Frederic. When Should We Dig? *The Avalanche Review*, Volume 27, No 2, December 2008

Additional weather data from Meteo France: www.meteo.fr

Additional avalanche data from the ANENA: www.anena.org

David George runs the French Web site www.pistehors.com and is a regular correspondent to The Avalanche Review.

Avalanche control work had been completed hours before this huge, unexpected slab released above ski lifts and open pistes at Val Cenis on April 16, 2009. Luckily, there were no victims. *Photo by Alain Duclos, data-avalanche.org*

Looking back up at the flank (left) and skied-up bed surface (center), the group ascends the avalanche path. *Photo by Evan Osler*

"Springtime Avalanches Don't Happen Here"

A Nearly Deadly Avalanche in New Hampshire's Presidential Range

Story by Jonathan S. Shefftz and Evan Osler

Editor's note: The incident described here occurred in the spring of 2008, but publication was delayed due to space constraints. For more details, go to http://tuckerman.org/accident/20082009.htm and scroll down to April 11.

Westerners may scoff, or at least be surprised, but the northeastern United States does have real honest-to-goodness avalanche terrain. New York, Vermont, and Maine have all logged avalanche fatalities. But by far the most avalanche terrain and consequent fatalities are in New Hampshire's Presidential Range, centered on Mount Washington. The 6,288' summit may bring on more scoffing from Westerners as the highest point in northeast North America, but its harsh weather commands respect, especially as the 1934 recorded wind speed of 231mph has never been exceeded on record at any spot on the surface of the planet.

The US Forest Service Snow Rangers issue a daily avalanche bulletin which focuses exclusively on only two of Mount Washington's many glacial cirques:

- TUCKERMAN RAVINE, which is mainly frequented by skiers
- HUNTINGTON RAVINE, which is mainly frequented by climbers

The avalanche bulletin does not cover any of the other skiable areas on Mount Washington (or its many immediately adjacent peaks), but focuses so specifically on the two forecasted ravines that separate danger ratings can be issued for up to eight different ski lines in Tuckerman Ravine and eight different climbing routes in Huntington Ravine. The avalanche danger follows a fairly typical pattern throughout the winter and early spring: the summit weather observatory records a seemingly innocuous amount of new snowfall, then high winds strip vast swathes of above-treeline terrain and deposit it into the two ravines. This was the pattern that led to the 2007/08 season's sole avalanche fatality, a solo climber in Huntington Ravine on January 18 *(See* USFS Mt Washington Avalanche Center 2007/08 Season Summary, *TAR 27-2, p27)*.

"The vast majority of natural activity in our region occurs during an avalanche-producing weather event," the area's lead ranger explains. "Indirect or delayed natural releases are extremely rare to the point that the mountain could be considered a 'poster child' for direct avalanche regimes." (Christopher Joosen, *The Importance of Micro-Scale Avalanche Forecasting in Mount Washington's Tuckerman and Huntington Ravines*, ISSW Proceedings 2008.)

The few interludes of wintertime Low rating usually follow a classic New England thaw/refreeze cycle, when the entire mountain is locked down under a sheet of ice. But once spring has truly sprung, avalanche concerns often disappear entirely.

On April 6, 2008, the avalanche danger for both Tuckerman and Huntington Ravines was posted as Low. The final bulletin for the season was posted on May 26, and in-between, the posted danger never went above Low. Yes, that's right: 51 straight days of officially forecasted Low. Wet slab avalanches? Moving away from aspects that have been getting baked by the sun all day? Paying attention to foot/ski penetration? Glide avalanches? Nope, not here.

In some spring seasons, a major wintry event will bump the avalanche danger back up, but more often, any late-spring snowstorms seem to bond quickly. In 2008, on April 14, a Monday, the bulletin advised:

While the weather forecast is calling for spring weather this week, we have to work through a day of winter conditions today with some minor snow stability issues to think about. Over the past 24 hours the Summit recorded 2.6" (6.6cm) of new snow and Hermit Lake [at treeline] picked up 2.1" (5.5cm). The density of the new snow is just over 9% and has been accompanied by primarily WNW winds in the 40 and 50mph range (65 to 80kph). These winds have blown some new snow into both ravines creating concern about pockets of new wind slab.

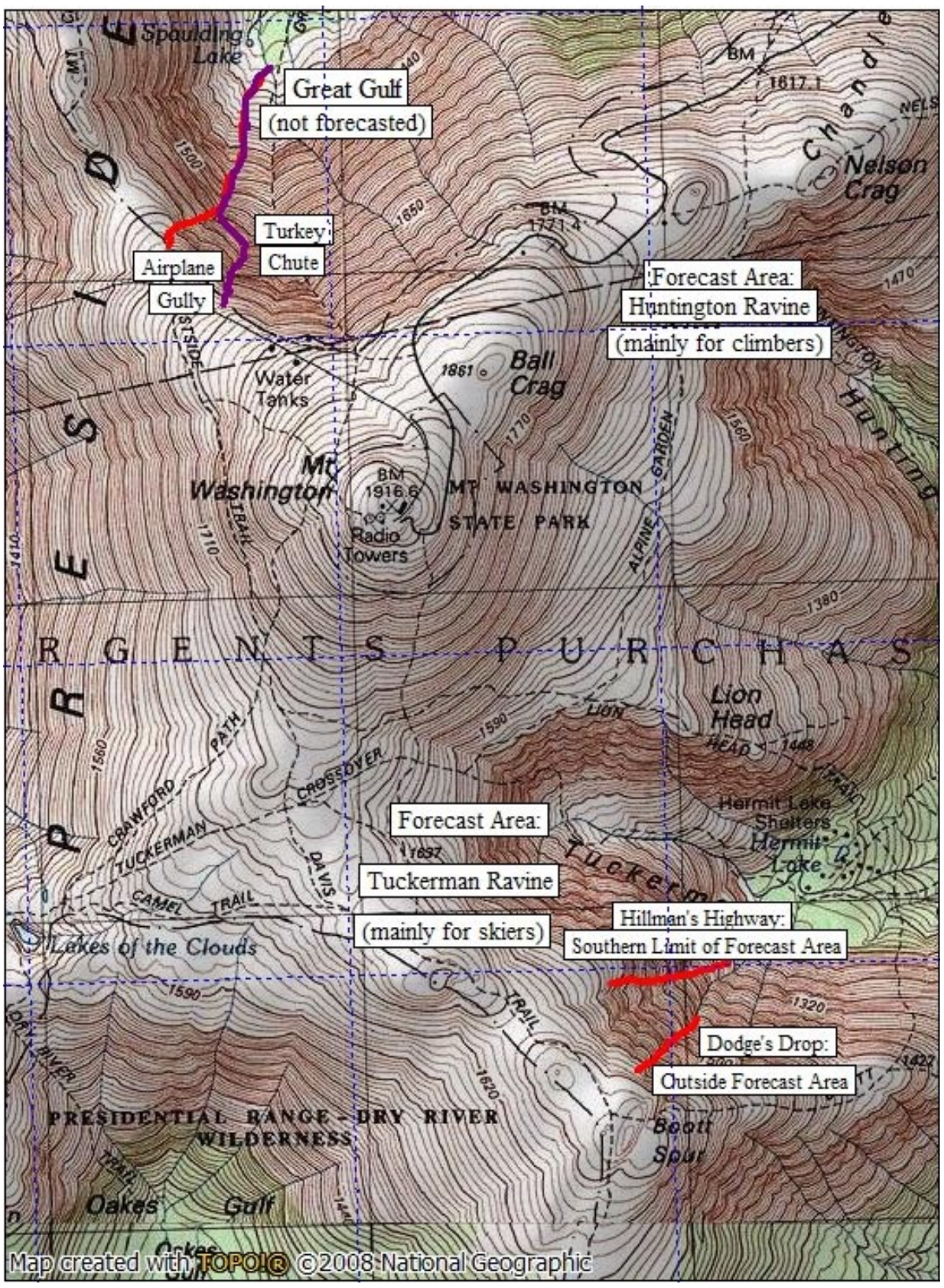
The focus today is on isolated pockets of unstable snow which fits into the Low rating, but as we like to remind people, Low doesn't mean no avalanche danger. The old surface is very easy to detect as it is gray looking compared to the pristine white new snow. This is still visible in most locations and it has a lot of texture to it from multiple freeze-thaw cycles and quite a bit of skier traffic. This is a good thing for today's stability. The areas where new slabs are the deepest will have the best chance for unstable snow. These are likely to be found under the Headwall and in the Lip and Sluice. This morning's field observations in the both ravines found the new pockets to be rather small as of right now.

The next day, on April 15, Tuesday, the bulletin advised:

As for stability, the 2.6" (6.6cm) of snow the summit picked up Sunday evening collected in sheltered lee areas. This new snow doesn't have me overly worried about its stability, as it seems to have bonded well with the underlying crust and will be receiving strong solar energy today. As the day warms and skiers lay down tracks I would not be surprised to see some sluffing of this new snow. Much of the rest of the [Tuckerman] ravine's surface is gray old crust leftover from the weekend.

The day after that, on April 16, Wednesday, any discussion of the new snow had disappeared from the bulletin, and indeed it most likely had disappeared from the two forecast areas. But just on the other side of the very same mountain, very different conditions were found, with nearly deadly results.

Evan carves turns just seconds before the slab failure initiated.
Photo by Chris Skalka



An overview map of the Mt Washington area, with the relevant couloirs marked in red and purple.

Evan's Account

On Wednesday, April 16, at roughly 11:30 in the morning, my partners Chris, Hollis, Rob, and I stood on the rim of Mount Washington's Great Gulf. We had ascended from the west by skinning along the Cog Railway tracks, where the springtime snow conditions were unremarkable. We now looked down at the line unofficially -- albeit nearly universally -- known as Airplane Gully (named after a 1990 small plane crash that killed all three of its occupants). Conditions appeared to be an untracked mix of rapidly corning old rain crust and creamy "newish" snow: the one to four inches of blown-in new snow was now nearly three-days old and had faced sub-freezing nights and at least some sun during the above-freezing days.

Rob went first and made slightly scratchy but edgeable turns on the old rain crust, down to the first rock band at the center of the gully. He stopped there out of the gully's main fall line and waited for me to go. I dropped into skier's left where the newer snow lay creamy and edgeable. We had waited up top for about 20 minutes to allow for more of the sun's softening, and my first few turns reflected the sun's mid-April strength.

I passed Rob and continued on my line, focused intently on keeping my rhythm on the steep low-40s pitch. Just as the line narrows from rock bands on both sides, a heavy pile of slough that I had set off in the course of my turns above swept me up all at once. It was moving fast, and it swept me off my feet without a hint of warning. Big pieces of debris interspersed with smaller stuff, getting all the more larger and more voluminous as it slid down the gully and through its choke point. Within a fraction of a second I knew I was in the midst of the moving snow, with very little that I could do about it (or me).

Now on my back facing downhill (with one ski already released) and moving fast towards a large rock band along with the snow, a number of thoughts occurred in a very brief period of time:

- So this is what an avalanche feels like.
- Swim!
- I am about to face immeasurable pain that will change my life…or even end it.
- This looks just like the scene from the movie Steep when the avalanche plows past Andrew McLean and his ski partners.

Somehow, miraculously, the snow swept me off the side of the outcropping rather than depositing me on it. I went airborne along with the snow as it continued downhill. The slough's impact then set off a true slab avalanche as it fell from the side of the outcropping to the more open snowfield below. Now in the snowfield and still moving rapidly, I was able to turn over on my stomach and somehow claw at the slope enough to kill speed relative to the pile. After significant struggling and some 300 to 400 feet of sliding I came to a stop, unscathed, as the avalanche lumbered on below. It stopped another 150 feet down, with my ski lying near it. My friends, certain from above that I was in very bad shape, came down quickly and were surprised to see me in fine shape (at least physically).

Many other skiers later came down Airplane Gully and nearby couloirs in Great Gulf without any similar slide activity. We were able to inspect my debris and slab avalanche's crown before their eventual obliteration by the many ski tracks being laid down.

Jonathan's Follow-Up

I was preparing to drive up to New Hampshire on Thursday to ski Great Gulf the next day when I received Evan's account via email of the previous day's avalanche. My reactions quickly went from shock (that Evan had nearly died), to relief (that he was just fine), to curiosity (as we were planning the ski the very same line that had nearly killed him).

Friday morning, my partner and I skinned up to the base of Tuckerman Ravine from the southeast along with several hundred of our newfound best friends. (The official Forest Service count for the next day, a weekend, would be 4,200.) At the bottom of the Lobster Claw couloir (so called for its distinctive split at the top) we switched to climbing mode. All of the snow we encountered along this route was so skier hammered as to provide no evidence of avalanche conditions or past activity.

At the top of Lobster Claw we switched back to skinning, traversing across the East Snowfield and then across and up the Northeast Snowfield. This untracked east-facing terrain, with pitches in the low 30s, exhibited only relatively small sections of new snow.

On the rim of Great Gulf, we chose the couloir known sometimes as Turkey Shoot/Chute (or Stinkbug, Diagonal, Spacewalk). Conditions were exactly as how Evan had reported the neighboring Airplane Gully two days earlier – except with two more days to bond.

Sure enough, to my inner snow nerd's delight, I set off a wet slab avalanche: very small and very slow, but nevertheless, the new snow was moving together on the old gray corned snow as its bed surface. The avalanche was entirely harmless, but I was fascinated to see a miniature version of what had nearly killed Evan only two days earlier.

Jonathan Shefftz lives with his wife in western Massachusetts, where he patrols at Northfield Mountain. He is an AIARE-qualified instructor, NSP avalanche instructor, and AAA affiliate member. When he is not searching out elusive freshies in southern New England, he works as a financial economics consultant and has been qualified as an expert witness in Administrative Court and US District Court. He can be reached at jshefftz@post.harvard.edu.

Evan Osler will confess under sufficient pressure that he grew up in the Boston area, but since graduating from Middlebury College he has somehow managed to find continuous professional employment in northern Vermont, where he regularly skis various secret backcountry glades (whose locations he will not reveal under any amount of pressure).

A Snapshot of Pimenton Mine Life: THE LA CUMBRE S

Story by Glenn Vitucci • Photos by Glenn Vitucci &

The avalanchistas' office.

STORY

& Matt McKee

In the spring of 2005 I was hired by Glenn Vitucci to work as an avalanche forecaster for a struggling gold mine located in the Andes. Although now I'm glad I had the experience, at the time I was terrified in my battle with the white death. What wasn't revealed to me until I arrived at the mine in Chile was that it was my job and legal responsibility to keep 120 miners safe from avalanches. We had 50 miles of high-elevation access road crisscrossed by numerous slide paths, all with unknown avalanche histories. In a place where 10 remote weather stations would have been too few, we had none – we had two snow stakes and a hand-held anemometer plus 20 beacons for 120 miners and support staff. Looking back on it four years later I am amazed that no one was killed; we had a few close calls, but between luck and skill we all survived that mess called Minera Pimenton.

Matt McKee now works for UDOT in the relatively civilized environment and multiple slide paths of Big Cottonwood Canyon.

The forecasters' quarters. Pimenton Mine CEO Steve Houghton. A casualty of avalanche-control work. La Cumbre camp: the only safe zone after 42 switchbacks in avalanche terrain.

This all took place after Matt finished his first (and last) 10-day shift (which lasted 25 days). He never did make it back to the mine. But he was in our apartment in Santiago at the time, recuperating and filling out reports for the insurance company. It was determined to reopen the road to the mine to allow the insurance people in to assess the damages and determine the claim.

This particular story is one of a few that I had from attempting to reopen the mine road.

It began with a call from Steve, our beloved CEO. "Glenn, we need you to go up to the camp at La Cumbre. There is a storm coming in and we don't have anyone there to do control work."

"What happened to Luis?" I asked.

"He was due his descanso (days off) from his road crew job."

Our avalanchistas would work for us when we needed them; the rest of the time they held positions as mechanics, electricians, road crew. Luis's other *jefe* let him go home before the storm came in so he wouldn't be stuck up in the mountains.

So, I agreed to go (I really liked Steve and thought I would / could do anything for him) with another of our avalanchistas if I could leave our field office in Los Andes by noon, before the storm really hit. The bonus was that Steve was finally giving our department a vehicle to use. There were two other trucks in our convoy.

We received the call at 3:30pm that the road was clear for us to go. We left Los Andes in hard rain, checked in at the goat herders' shack, and proceeded up the mountain. At around 8000' the rained turned to snow, and we ran into the road crew who claimed they had just finished clearing the road, yet there were six fresh inches of new. We chained up all four wheels.

We proceeded past turns 31, 32 as the hairpin turns became more hairpin. We switchbacked up the bowl (avalanche path) past turn 42. The road was blocked by avalanche debris 6' deep, 40' wide. We backed 30' up into the turn to head back down. But now there was 4' of avalanche debris blocking the road down. Which means…we missed getting avalanched by mere seconds.

The two of us pulled our gear out of the truck and walked across the debris to the second vehicle which had holed up inside of turn 41. We started down and across the bowl a few hundred yards to turn 40, back across to 39, and back across to 38. Coming around we see the road blocked 200' ahead by fresh avalanche debris. This again means we missed it by seconds. The four of us quickly cross the debris to the third truck, turned around and hauled our freaked-out little asses finally out of there back down to the rain in Los Andes.

After a few Piscos, I call Steve.

"I'm not sure I can do this much longer. I can't give you two weeks notice or even a month, because I know you would expect me to find someone to replace me. And I couldn't convince my friends to come down to this operation; I wouldn't do that to my friends. And I just couldn't do that someone I don't know either."

The next day Matt is called in to the main office in Santiago by Steve.

"Do you have any friends in Utah who could come down and take Glenn's position?"

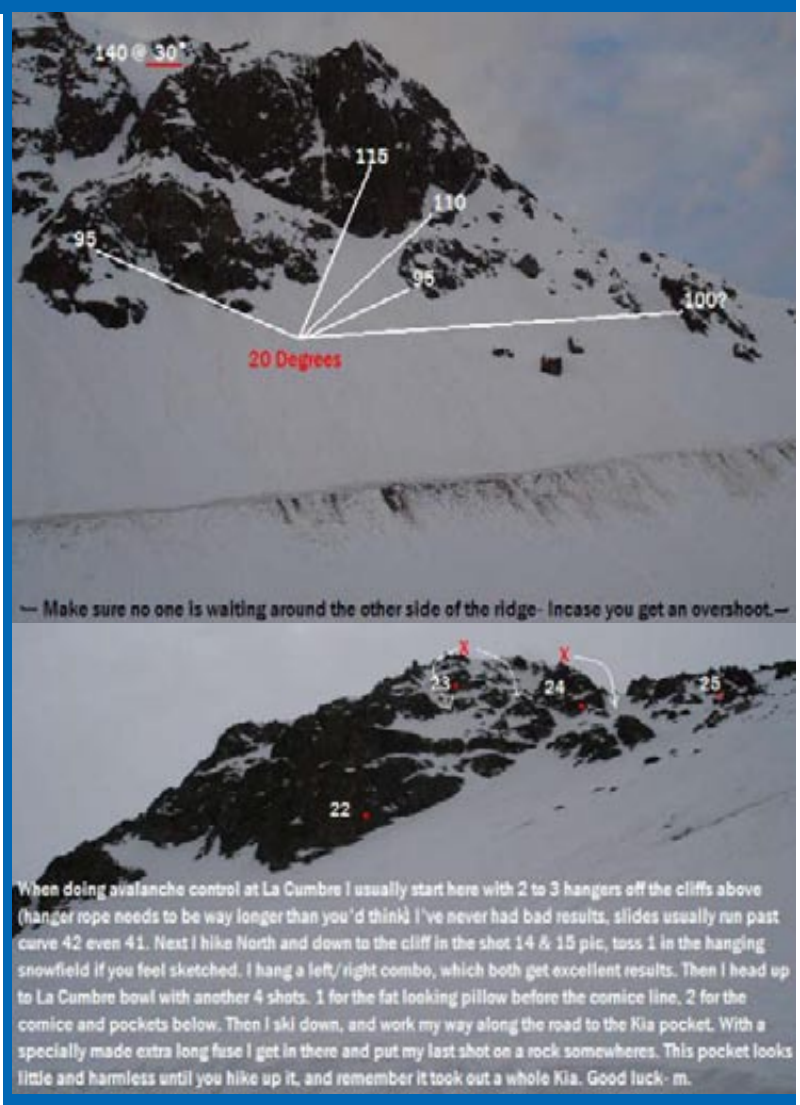
"Why do you want to replace Glenn? He came back a second year. He's crazy. Plus, I couldn't convince any of my friends to come here either."

I ended up staying the rest of the season. Matt was around a few more weeks, then released from his contract early as the mine never reopened that season.

I won't be back, but last I heard, Matt was ready to go, again. He's crazy.

Glenn Vitucci has given up avalanche forecasting for the relative safety of the real estate and ski patrol (at Grand Targhee Resort) fields.

Left: The mine, the above-ground facilities, and the access roads are clearly under fire from a number of paths



Above: Pimenton Mine control-work instructions.
Below: Evening shoot at Cruz de la Padre.

snow science

SEARCHING IN PARALLEL:
Harnessing Manpower in Transceiver Rescues

Story by Dieter Stopper, Franz Hohensinn, and Bruce Edgerly

Searching in parallel is a technique that can be used in avalanche rescue scenarios where manpower and leadership are abundant and the number of buried victims is unknown. It is especially applicable at ski resorts and by search and rescue teams. The technique involves using as many searchers as possible with the objective of narrowing each rescuer's search-strip width. The rescue leader adjusts the search-strip width according to the size of the debris area and the number of available searchers. Each searcher commits to the coarse and fine search only after their distance reading is lower than their designated search strip width. This eliminates redundancy and ensures that each searcher locates a different victim. If more than one victim is buried, then these search strips can be adjusted by the rescue leader, if necessary, after each victim is pinpointed.

Searching in parallel reduces the necessity of using complex multiple-burial search methods and technologies. It can be used to harness large pools of relatively unskilled searchers with only basic training in the technique. Searching in parallel is more feasible than in the past due to the simplicity of modern digital avalanche transceivers. It should be considered for use by rescue teams and in professional avalanche courses, but only after the basics have been mastered, such as single-victim searching, probing, and shoveling.

Searching in parallel must be coordinated by a strong leader who walks in front of the group providing orders. Dieter Stopper leads the exercise. *Photo by Michael Alterdinger*

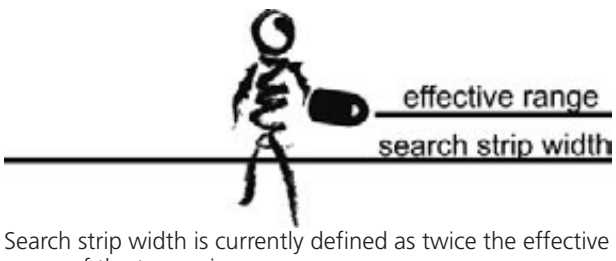
Research in Switzerland *(Harvey, et. al, 2008)*, Austria *(Stopper, et. al., 2008)*, and North America *(Edgerly, 2008)* has shown that complex multiple-burial transceiver searches are extremely rare, especially among recreational groups. In fact, interviews with rescuers involved in real transceiver searches have shown that the most challenging aspect of the search is shoveling, not beacon searching – even in cases involving more than one buried victim. In those cases, the beacon search is performed either as several beacon searches solved consecutively "in series" by a single rescuer or performed simultaneously "in parallel" by multiple rescuers.

Searching in series is quite intuitive and has been taught for many years. Shoveling is now being taught in many avalanche courses in both North America and Europe. Searching in parallel, however, is rarely taught. In professional courses (and guiding exams), great attention is often focused on one person searching for several victims, as opposed to several persons searching for one or more victims. Searching in parallel addresses the latter situation. It should be considered for use by professionals working in environments where manpower and leadership are abundant. These mainly include ski resorts, search and rescue teams, and guiding operations with four or more guests per group with basic beacon skills.

SEARCHING IN PARALLEL

Searching in parallel is often taught in avalanche courses mainly in the context of the signal search (formerly called the "primary search") with several rescuers available to search with transceivers. The object is to thoroughly search the area for either a transceiver signal and/or visual clues indicating the victim's location. The search must be performed systematically enough so that no likely burial areas are missed or are left outside the effective receive range of the rescuers' transceivers.

Traditionally, if more than one beacon-equipped rescuer is available, students are taught to keep a distance of 20 (or 40) meters between searchers, or the search-strip width of their transceiver. Search-strip width is currently defined as twice the effective (or "minimum") receive range of the transceiver. It can be thought of as the "diameter" of the beacon's worst-case receive range, while effective range would be the "radius." (The International Commission on Alpine Rescue (ICAR) has recently decided to change this definition, which will be covered in a future issue of *The Avalanche Review*.)



Search strip width is currently defined as twice the effective range of the transceiver.

Single searches

Starting at the last-seen area or the top, bottom, or side of the debris pile, the rescuers move through the area in this formation until a signal is detected. At this point, the rescuer who engages the signal then performs the coarse search (formerly called the "secondary search"), and the fine search (formerly called the "pinpoint search"). In some cases, such as guided scenarios, the most experienced beacon searcher will often take over the final phases of the search, while less skilled members prepare to probe and shovel or await further instructions from the rescue leader.

In most cases there is only one completely buried victim, so all resources are then focused on the excavation phase. However, there is currently no prevailing formal technique for teaching students how to continue the search in multiple burial situations once the first victim is pinpointed – or in situations where the number of buried victims is unknown.

Multiple burials

In actual avalanche incidents, searching in parallel for multiple victims has shown to be intuitive and effective *(Edgerly, 2008)*, especially when adequate manpower is available for excavating the victims. As long as the victims are not in close proximity, then rescuers naturally end up pinpointing and excavating the victims in parallel rather than in series. If the victims are buried within close proximity, however, then searching in parallel can be less intuitive. This issue can be overcome by adjusting the search-strip width between searchers to reflect the number of searchers and width of the debris area rather than using the standard search-strip width of 20 (or 40) meters. By reducing the search-strip width, then the probability will increase that different searchers will end up excavating different victims, rather than all the searchers being led to the same victim.

Adjusting search-strip width

When searching in parallel, generally the rescuers should be distributed equally in a line across the debris area. However, this depends on the scenario: in many cases a last-seen point or suspected likely burial area might dictate focusing on a particular zone. The goal is to take advantage of as many searchers as possible to enable the smallest possible search strips. One searcher should always be dispatched immediately, ahead of the rest of the team, to perform a "hasty search" for obvious surface clues and transceiver signals.

For example, if the debris area is 40-meters wide and five searchers are available, then one rescuer should be dispatched on a hasty search and the remaining four rescuers should be organized in a line with a distance of about 10 meters between them. The two outer searchers would keep a distance of about five meters to the edges of the debris area. Now the searchers advance in parallel (or en echelon) over the debris area.

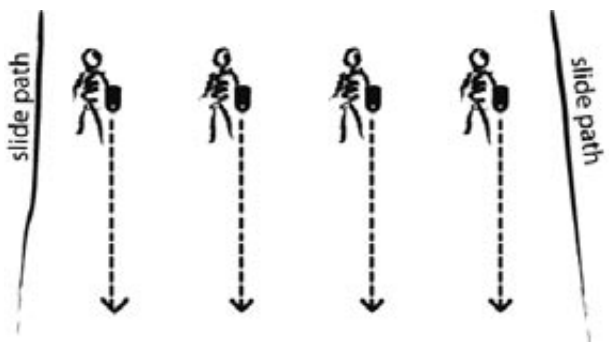
All searchers advance straight ahead until one searcher receives a signal with a distance reading less than or equal to their assigned search-strip width. For example, if the distance is 10 meters between the searchers and one searcher receives a signal with a distance reading of 45 meters, he will continue straight ahead until he receives a distance reading of 10 meters or less. From that point, he then commits to the coarse and fine search, following the flux line to the fine-search area. This prevents searchers from committing to the signal too early and therefore crossing into other rescuers' lanes, possibly missing areas within their own, now abandoned, lane. If enough manpower is available, then more than one person can commit to this signal: one to search and another to help excavate.

In the case that there are still victims to be found – or the number of victims is unknown – then at least one rescuer (more, if possible) should begin excavating the located victim. If adequate man-power remains, then the leader can then readjust the search-strip widths to

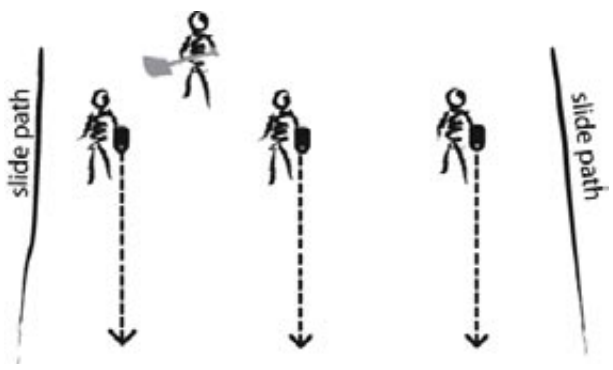
The designated search leader must keep the rescuers aligned and restricted to their search strips. They must not commit to the coarse and fine search until their distance reading is less than or equal to their designated search-strip width. *Photo of Austria Mountain Rescue Team by Michael Alterdinger*

take into account the remaining number of searchers. For example, if the debris area is still 40 meters wide, but there are only three rescuers still available, then the search-strip widths between them then become 15 meters instead of 10 meters. Or the 10-meter strips can be maintained, and the search strips on each side can be increased to 10 meters each.

Searching in parallel must be coordinated by a strong leader who walks in front of the group providing orders. The leader must avoid taking part in the rescue, if manpower allows. He or she must be willing to stop and restart the process if rescuers become disorganized. Preferably the team will have practiced the technique in training sessions so it is automatic when performed live in the field.



Once a victim is found, at least one searcher begins excavating while the others continue the search, using a readjusted search-strip width, if necessary.



Strengths and weaknesses

In field exercises organized by technical representatives from Backcountry Access, Inc. (BCA) and the Austria Mountain Rescue Team (Salzburg region), searching in parallel has been demonstrated to be extremely effective. In exercises in Colorado; British Columbia; Munich, Germany; and Dachstein Glacier, Austria, up to seven victims have been located in less than five minutes – and excavated within the critical time period of 15 minutes. Searchers were more likely to locate victims apart from each other, reducing redundancy in the search process.

There are, however, some limitations to searching in parallel. There must be enough searchers to adequately cover the debris area – preferably enough to reduce the search strips to 10 meters or less. If there is a lack of rescuers, then searching in parallel is not appropriate, as most of the manpower and time will be needed to excavate the first victim *(Jarry, 2008)* or – if rescue triage is performed – then to excavate the victim deemed most likely to survive.

In heavily traveled areas such as ski resorts and mechanized guiding terrain, manpower is in relative abundance. Therefore searching in parallel is quite feasible – especially in the modern era of digital transceivers, as relatively little training is required to search in this manner. Since no "grid" or "bracket" searching or sensitivity adjustments are required with digital beacons, then searchers can simply be instructed to move through the debris and call out the distance readings on their beacons.

Finally, for searching in parallel to be effective, there must be an experienced organizer. This person determines the search-strip widths and allocates manpower. Without a strong leader, it can be difficult to keep the rescue group coordinated. Leadership is a skill that requires aptitude, so it can be challenging to teach.

Editor's note: This technique works best with transceivers that isolate signals based on signal strength rather than marking, especially when signals are overlapping. Users with the Barryvox Pulse should use backup mode when searching in parallel.

CONCLUSION

Searching in parallel is a technique that holds great promise for situations in which manpower is relatively abundant. It is particularly suitable for use at resorts, by search and rescue teams, and at guiding operations where guests are taught basic transceiver skills. Development of this technique is especially appropriate considering the increase in in-bounds avalanche burials that occurred in North America during the 2008/09 season.

This technique has been demonstrated to be effective in exercises organized by BCA. However, it is still in development. The authors invite all avalanche instructors to test this technique in field training and learn more about its advantages and disadvantages. Searching in parallel should be considered for future use by rescue teams and in professional avalanche courses – but only after participants have mastered existing techniques for single-burial searches, probing, and shoveling.

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Bruce Edgerly is vice president and co-founder of Backcountry Access, Inc. (BCA), a leading manufacturer of snow safety equipment, based in Boulder, CO. He and Dieter Stopper presented "Searching in Parallel" as a poster at the 2009 ISSW Europe conference in Davos, Switzerland.

Dieter Stopper is the technical director for BCA in Europe. He is a certified UIAGM guide and former director of research for the German Alpine Club (DAV).

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This view of Mt Troy taken from Eaglecrest ski area near Juneau, Alaska, shows the results of a melt-freeze cycle before a storm: widespread soft dry slab avalanches and dramatic natural cracks up to a meter in depth. *Photo by Bill Glude*

FACETED MELT FORMS:
A Deadly & Unpredictable Weak Layer

Story by Bill Glude

Faceted melt forms are found in snow layers that have melted and refrozen. This article will not focus on the facets above and below melt layers that have been commonly described, though those are often found in association with faceted melt forms. This is an informal report on work still in progress. We are sharing preliminary results now because layers associated with faceted melt forms keep killing people, and we hope that other workers' observations and studies will help all of us to better understand the process.

We know of four situations where faceted melt forms are created:

Melt Layer Recrystallization

- The melt layer forms through thaw, rain on snow, or slush fall and is buried before it freezes, as precipitation turns to snow.
- As the liquid water in the melt layer freezes, the phase change releases heat. The locally intense vapor pressure gradient causes rapid facet growth *(summarized in Birkeland, 1998)*.
- This is a classic and dramatic weak layer setup that is very common in cold maritime snow climates.
- It is not well described in the literature that faceting often occurs in the top few centimeters of and sometimes throughout the melt layer, making for unusually weak, unpredictable, and variable bonding.

With hand lens or loupe, faceted melt forms usually appear angular to sub-angular, only crisp and sharp when fresh. They develop in any climate when colder weather follows thaws, rain, or slush falls. *Photo by Bill Glude*

Strong Gradient Across Frozen Melt Layer

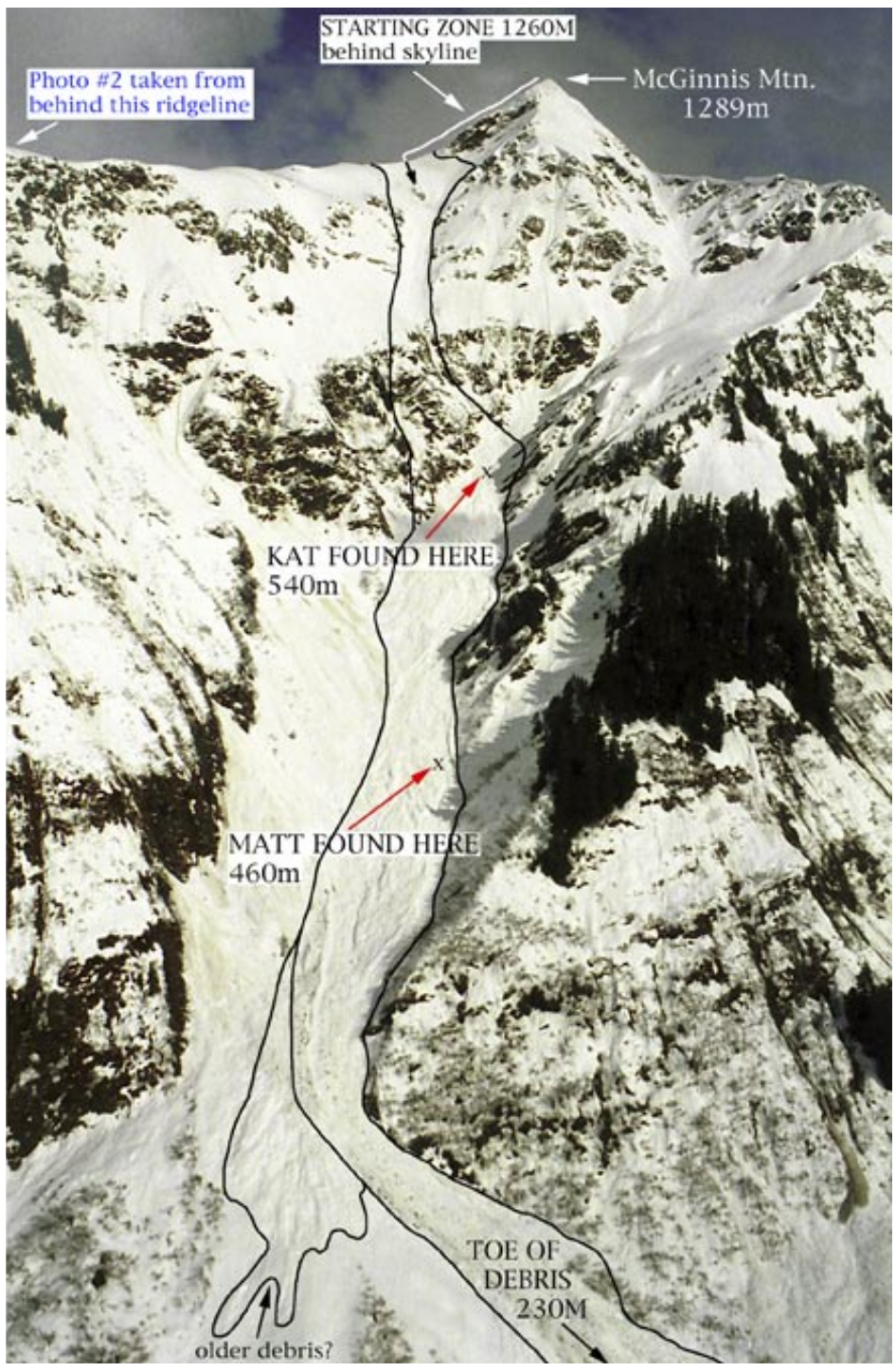
- The melt layer freezes while it is still on the surface. It is not buried.
- Cold weather creates a strong temperature and vapor pressure gradient across the layer, and it becomes faceted.
- The layer's bond to subsequent snow layers is again very weak and variable.
- This process is not well described in the literature.

Facets Below Melt Layer

- This weak layer is widely reported, and there are theories in the literature, but it is still incompletely understood.
- It is not well described in the literature that the melt layer often becomes faceted and weak, especially if it is thin.

Radiation Recrystallization

- Solar radiation warms the snow just below its surface to the melting point.
- The snow surface continues to lose heat via longwave radiation.
- Strong vapor pressure gradients cause rapid facet growth over a melt form crust.
- This is another weak and spatially variable snowpack setup.
- It is not well described in the literature that this process can create facets within the thin melt layer. It is rare in Alaska, so we have few observations. Low-latitude, high-altitude snow climates are ideal for study.



Aerial view of the runout from the 1999 case study of an avalanche that failed on a weak layer caused by faceted melt forms, killing two skiers. The consequences can be clearly seen: a long and rough ride over 140m-high cliffs into a deep ravine. *Photo by Steve Handy*

This article's focus is on faceted melt forms, facets that develop within the melt layer as or after it freezes, rather than above or below it. We will begin with some case histories, then discuss characteristics and conclusions drawn from our compilation of 130 field profiles, from our records, and from observations during the last 14 years of fieldwork, mostly in Alaska and Japan.

CASE: Juneau, AK, Apr - May 1999

There were no major thaws in the winter of 1998/99 until April 16-18, when a warm air mass brought sea level temperatures of 14°C and thawed even high-elevation, north-facing slopes. The crust had not refrozen when it was buried by new snow and temperatures cooled.

April 19-26 was showery and stormy. Snowfall in the mountains was 0.7 - 1.0m, and southeast storm winds in the 10m/sec range, gusting to 30m/sec, built soft slabs. The winds ended as post-frontal showers dropped the final 0.30m of light dry snow.

The weather broke to clear, calm, and cool on April 26, day eight. While the author was digging a test block for a heli-ski party just below the ridge of Mt Olds, a 0.75m-deep fracture propagated from the corner of the pit for 150m across the slope and released an R2D3 size slab, leaving him standing behind in the pit. The block tested AK4 Q1 on 45° *(see Glude and Mullen, 2008, for information on the AK Block test)*. Other parties reported AK4-6 Q1-2 results, rode freely, and did not trigger slides that day.

Looking for the source of the weakness, we found the top few centimeters of the melt layer were strikingly sugary, granular, and faceted. On April 27, day nine, heli-skiing snowboarder Matt Brakel triggered a meter-deep, R3D3 size soft dry slab on McGinnis Mountain. He and would-be rescuer Kat Winchell both went over cliffs and died as a result of the slide. Persistent instability continued for 25 days at mid-elevations and for at least 33 days at higher elevations. There were several more close calls from meter-deep, skier-triggered soft slabs before the spring thaw ended the cycle in May.

Natural release propagating into slope angles less than 25° on day 40 of 2000/01 layer.
Photo by Bill Glude

CASE: Juneau, AK, Jan - Apr 2001

A thaw in the second half of January ended February 1 with snow showers as the snow level dropped and sea level temperatures fell to -1 to -6°C. On the fifth day of the cooling trend as the top 0.20 m of the melt layer froze, we found melt-layer recrystallization above and faceting in the underlying melt layer. On day 11, after the first storm, we found widespread soft dry slab avalanches and dramatic 0.6m- to 1.0m-deep natural cracks.

On days 22 to 25, storms triggered a moderate natural cycle of 0.5- to 2.0m-thick, R2-3D2-3 size soft dry slabs. As the storm ended, instability and human-triggered slides were ongoing.

On day 26, a series of three skier-triggered hard dry slab avalanches released on the Hogsback, in the backcountry near Eaglecrest ski area. The largest avalanche totally buried a skier in a R3D3 size slide. Partner rescue was rapid and the skier was lucky to escape with no injuries.

We profiled this slide. It was triggered after at least 10 other riders descended the slope, in a thin 0.55m spot rather than the 1.25m-thick slab where the previous tracks were. The skiers involved had done numerous block tests in the area over the prior week without detecting any unusual weakness.

This faceted melt form layer was characterized by highly inconsistent behavior. Shear and slope tests often indicated good stability, yet the entire slope would massively fracture on the next person to load it. The usual risk-management protocols could not be trusted.

On day 28, a skier triggered an R2D2 size soft dry slab in the backcountry near Eaglecrest and rode out of the slide without getting caught. On day 29, a snowmachiner on Mt. Troy triggered and was caught in an R2D2 size soft dry slab, but rode out of the avalanche.

On day 33, a snowboarder triggered an R2D2 size soft dry slab in the Heavenly Valley backcountry near Eaglecrest, but rode fast enough to get off the slab and was not caught.

We investigated immediately after the slide. The rider triggered this avalanche after all the adjacent chutes had been ridden without incident, in a thin 0.60m spot near some rocks and small trees. Our test results near the trigger point on the 50° slope had highly variable strength scores, but all had Q1 energy scores. Tap compression tests ranged from CTV to 14 *(see Greene, et al, 2004, for coding)*.

The bed surface was similar to the Hogsback slides' bed: generally rough and highly spatially variable with sugary areas and hard, icy areas.

We theorized that the rough surface of these layers provides mechanical keying for new snow to bond well to, but the sugary texture propagates fracture widely once it is initiated.

An alternate theory is that faceted melt forms do not propagate fracture more readily at all, but the conditions that create them happen to create weaker facets or weaker bonds in the layers above and below. Though there are cases of faceted melt form cycles without neighboring facet layers, an effect that weakens adjacent snow is possible.

Continued on next page ➡

The final cycle of the 2000/01 layer came on days 38 to 49, when large, deep, 1.0m- to 3.5m-thick slabs released region wide during a clear weather wind-loading event. Ganesha Howell and Kent Scheler investigate slabs from this cycle. *Photo by Bill Glude*

FACETED SNOW

continued from previous page

We know that there is a strong correlation of faceted melt forms with unpredictable weakness, spatial variability, persistence, and human involvements, but at this point our theories on cause and effect are still speculative.

The final avalanche cycle, a widespread series of deep, natural, R2-3D2-3 size hard dry slabs, came in March on days 38 to 49. These 1.0m- to 3.5m-thick slabs were triggered by clear-weather northeast wind loading. Again, the pattern was highly variable. Some slides ripped out over 2.0m-deep into slope angles below 25° while adjacent 40° to 50° slopes remained intact. The weakness finally strengthened with spring warming in April, 60-some days after formation.

SIGNIFICANCE OF FACETED MELT FORMS

Faceted grains are common in our field areas, comprising 42% of the weak layers in a recent study of 357 large blocks over more than 120 field days *(Glude and Mullen, 2008)*. But most of those are near-surface facets not associated with faceted melt forms.

Faceted melt forms are much less common. Despite being weak layers in only 12% of the profiles with weak layers studied here (n= 510), they cause a disproportionate share of problems. They were involved in all three Juneau-area fatalities during our period of study, in 39% of the near-miss incidents (n=49) and 54% of the near-miss slides (n= 69). In the field we consistently noted them as exceptionally persistent, spatially variable, and difficult to evaluate and predict.

CHARACTERISTICS OF FACETED MELT FORMS

The average faceted melt form density measured in our data set for this study was 335kg/m3, with a low of 100kg/m3 and a high of 480kg/m3. The relatively high density of melt layers does not appear to limit faceting within the layer.

Air temperatures in our data set averaged -3°C, with a minimum of -20°C and a maximum of 3°C. Temperature gradients in the melt layers averaged 4.7°C/m, ranging from no gradient to one day that varied from 50.0 to 100.0°C/m.

This temperature data is limited because temperatures were taken when we were doing snow profiles. They were not targeted for conditions that create faceted melt forms. Overnight temperatures were probably lower, and vapor pressure gradients from phase changes were probably stronger.

The key finding is that mildly cool temperatures appear to be sufficient to develop and preserve faceted melt forms.

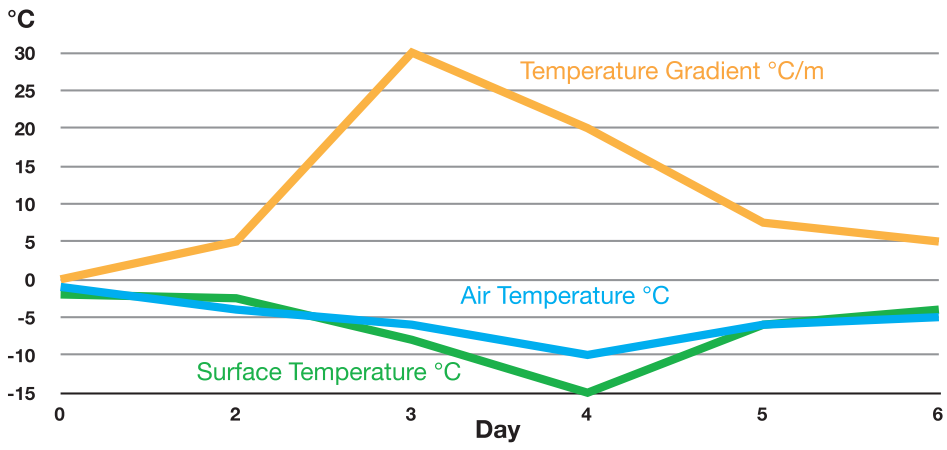
Faceted melt forms are very persistent. Our data includes skier-triggered avalanches 0.6m- to to 1.0m-deep on 33- to 35-day-old layers, natural releases 2.3 to 3.5m deep on 40-day-old layers, weak block tests (AK3 Q2 on 38°) on 99-day-old layers, and identifiably sugary faceted textures in 119-day-old layers.

DEVELOPMENT OF FACETED MELT FORMS

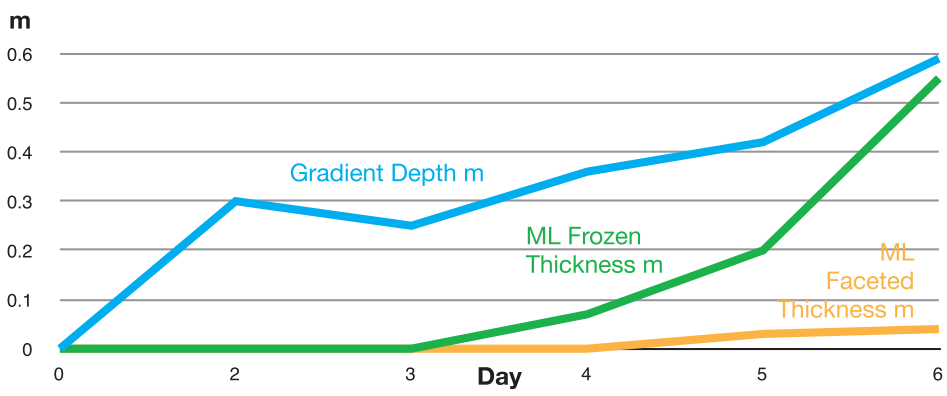
Faceted melt forms require thaw, rain, or slush fall to produce the melt layer, followed by below-freezing weather to make facets.

The author has long called coastal Alaska's colder, more-variable snow climate "high-latitude maritime" to distinguish it from the stereotypical maritime snow climate, but we also find these layers at low latitude in Japan. "Cold maritime" is a better term for ideal faceted melt form climates. Workers elsewhere should still be wary; faceted melt forms will develop in any snow climate when conditions are right.

Our best formation sequence record is from Juneau, Alaska, December - January 2003/04. On December 23, day zero, the air temperature was -1°C and no temperature gradient was yet present. The wet, unfrozen melt layer was an average 0.4m thick and its density was 360kg/m3. The slightly moist new snow and rounds averaged 0.3m thick and 110kg/m3 density.



Air and surface temperatures dropped, then moderated. The temperature gradient peaked on day three then decreased as the difference spread out over greater depth.



The temperature gradient penetrated steadily deeper. The melt layer (ML) began to freeze by day four, frozen thickness increased daily. Faceted melt forms developed by day five.

The grains in the faceted melt form layer rounded slightly as the temperature gradient moderated, but otherwise remained essentially unchanged until the layer was destroyed by thaw on January 15, day 23. It functioned as a weak layer in block tests but never had enough load to produce an avalanche cycle.

IDENTIFICATION

- Faceted melt forms develop in any climate when colder weather follows thaws, rain, or slush fall.
- Watch for those weather sequences!
- Search for facets in and around melt layers. Look for sugary texture.
- Rub suspected faceted melt layers with a gloved hand. If the top few centimeters is sugary and falls apart, do not trust that layer no matter what pit or slope tests tell you!

Search for facets in and around melt layers, looking for sugary texture. (*see microphotography of facets on page 20)* *Photo by Bill Glude*

- Check with a hand lens or loupe to confirm faceting. Shape is usually angular to sub-angular, will only be crisp and sharp when freshly formed.

STABILITY EVALUATION

- Facets in association with melt layers make evaluation and forecasting difficult.
- Facets may occur over, within, or under a frozen melt layer.
- Facets within the melt layer, as studied here, make prediction particularly difficult.
- Melt layers seem to bond much more weakly when they become faceted.
- Spatial variability increases.
- Test results are unreliable. Slope and block tests may indicate strength, yet large slabs release when the right spot is triggered.
- The trigger point is often near rocks, trees, or thin spots.
- The weakness is very persistent—
  - Five weeks: skier-triggered avalanches;
  - Six weeks: deep natural releases;
  - 13 weeks: weak block tests;
  - 17 weeks: still identifiable, sugary faceted textures.

NOTATION

The IACS suggests doubling up snow classification symbols for mixed snow types with the primary grain type first, like this: ○□ The secondary grain type can optionally be enclosed in square brackets for greater clarity.

This article is condensed from a full-length technical paper, available in its entirety on the research page at www.akavalanches.org.

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Beacon News: THE REALITIES OF REAL TIME

Story by Franz Kroell

It seems as if everyone's talking about "real time" transceivers these days. During these conversations terms such as "real-time processing," "real-time display," "fastest," and "instantaneous" are frequently heard, but far too often poorly understood. "Real time," however, is a technical term derived from the engineering and computer fields. As such, it is a word with a very real and very precise definition.

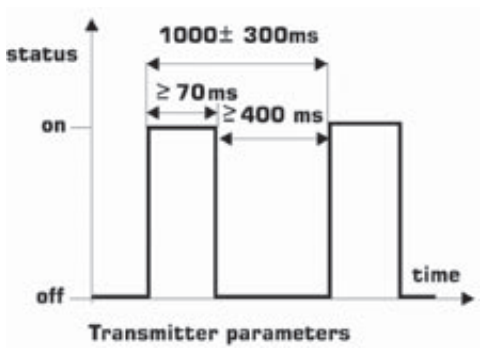
For professionals and amateurs to have informative and honest discussions regarding comparative transceiver performance, it is absolutely critical for the definition of real-time to be made abundantly clear. So, the most basic definition of a device or system considered to be capable of real-time processing is that it needs to be able to "…react to an external event within a given maximum time (GMT)."

Remember too what real time is *not*. It is not a measure of raw speed or the processing power of a computer chip. Rather, it is the overall response time of the device. Under any conceivable circumstances, the total response time of a real-time system (a transceiver) cannot be greater than the defined maximum time.

What Makes a Beacon "Real Time?"

For a transceiver to be classified as a real-time device, it needs to be able to convert (the reaction) a signal (the event) arriving from a transmitting beacon to visual direction and distance information faster than the frequency of the incoming signals (the GMT). With this in mind, know that all standard digital beacons have a response time between 40-70ms (milliseconds: 1 second = 1000ms). Again, this is the amount of time it takes for an incoming signal (a "beep") to be received, processed, and converted into a visual LED or LCD signal or light. Since the response times of all beacons are obviously less than the time it takes for one complete signal transmission to cycle, all modern beacons are classified as real-time devices.

Pulse Rate Constraints and the GMT



The transceiver standard EN 300 718 dictates that all beacons can only pulse, or transmit a signal, once per second (±300ms). The on-time phase of a transmitted signal must be 70ms at a minimum; the off-time phase (the pause between two signals) must be 400ms. The length of time of the entire signal cycle is the Given Maximum Time (GMT). This means that no matter how fast a beacon can process a signal, the more important factor governing the actual speed of a unit is the rate of signal transmission of the transmitting device. Even the fastest transceiver must wait for the next impulse before it can refresh the visual display of direction and distance. Hence, there is no appreciable advantage gained with a 30ms reduction in processing, or response time.

The Human Factor

It is important, and interesting too, to look at a more human angle to this issue. The time it takes for the average human to process a simple optical stimulus – such as a change in an LED or LCD – is between 250-300ms. Since all beacons respond to or process their incoming signals within the 40-70ms range, once the impulse is received, any differences between these rates is imperceptible. All transceivers refresh their visual display far faster than a human's ability to detect any differences between them. Again, though not part of how real time is defined, this further supports the fact that all beacons are real time.

Is There A "Distance Advantage?"

We hear claims too that "faster" transceivers deliver "distance advantages." In other words, will the 40ms unit get you to the victim any more quickly than a 70ms unit? And, will the latter leave you walking well past the buried victim due to a slower response time? The short answer (literally speaking) to both of the questions is NO. Let's take a mathematical look:

Speed	m/hr	÷	sec/hr	=	m/sec
Speed of searcher	4,000	÷	3600	=	1.1 m/sec

Theoretical advantage of response time reduction from 70 to 40ms	=	30ms
1.1m/sec : 1000ms x 30ms = 0.033m	=	**3,3cm**

After crunching the numbers – including the speed of the searcher divided by the number of seconds there are in a minute times the millisecond difference between the "fastest" and "slowest" beacons – you get a non-cumulative advantage of only 3.3cm. Simply put, the distance separating a 40ms unit from a 70ms unit through the entire distance of a search will only be 3.3 total centimeters – total. The fact of the matter is that 30ms is imperceptible in human cognition and the distance advantage is the width of a really nice steak – 3.33cm!

Artificial Speed

Is it possible to give the appearance of faster processing speeds? Yes. For example, one beacon manufacturer may choose to present one long, steady visual signal to the searcher. Another may choose to break that visual cue up into three shorter signals. While the second beacon may look as if it is working three times faster, in reality it is not. This is because the second and third of the shorter-duration signals of Beacon #2 are completely artificial and do not correspond to any new, or real, data. Remember, a transceiver cannot meaningfully refresh visual – or sound – cues until it receives another discrete signal from the transmitting device. Transceivers cannot magically fabricate data during the off-time phase of each signal.

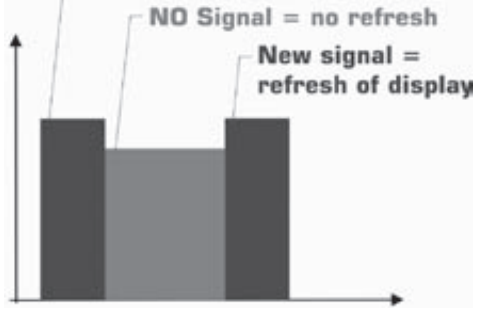
Instantaneous?

Is there such a thing as "instantaneous" displays of distance and direction readings? Until someone is able to produce a beacon that can convert an incoming signal to a visual display in zero milliseconds, the answer to this question remains NO. Additionally, there is no such thing as a "delayed display." These are marketing terms only.

A Very Simple Way To Think About All Of This

Think of it this way: if one person can eat a bite of food in 10 seconds, and another person can eat a bite of food in 15 seconds, both will finish their meal at essentially the same time. This is because each person is only given a bite of food once a minute. They both have to wait until the next spoonful is delivered no matter how fast they can chew and swallow.

During the time period when there is NO signal, there is also NO update of the displayed indication of the distance and direction to a buried victim. Only after the next "bite," or signal, is delivered can the unit process and display the information to the searcher.



The pace of the search is determined by the transmitter's pulse rate, not by the receiver's speed.

Summary

All digital transceivers, by definition and function, are real-time processors. Any differences between the response/reaction times of specific beacons models are statistically insignificant as they apply to the speed with which each transceiver updates the visual cues presented to the searcher. In fact the whole topic may best be described as "hurry up and wait," as all digital beacons are so fast they must sit and wait for the next transmitted beep before they can turn this new data into new direction and distance information – this is the very definition of real time.

In actuality, signal separating/masking beacons are arguably faster. This is because the vastly more sophisticated, multi-tasking capabilities this micro amount of time allows, helps the searcher (you) to "identify" and locate multiple signals (your friends) quickly and simultaneously. Simply put, they are processing substantially more data, doing more work, and providing a much more comprehensive and informative picture of a search area. And all in a very real-time time frame. This is a real-world, winter reality and the kind of true technical innovation that is worth talking about.

Franz Kroell, beacon product manager, ORTOVOX sportartikel GmbH, Taufkirchen, Germany wrote this article citing the work of Rolf Matzner, RPC Engineering GmbH, Greifenberg, Germany.

2009 Canadian Ski Patrol System & Canadian Ski Guides Association Transceiver Test

Story by F. M. Swangard, MD; Bob Sayer; and Steve Gunderson

There has been a great deal of change since the last transceiver test which the Canadian Ski Patrol presented in 1999. Transceivers have changed in their technical construction and as a result of these changes there has been a profound change in how they are used. A number of extra features have been added which may improve finding a buried person.

We tested the most common five new transceivers used in British Columbia against the Ortovox F1, an older single antenna transceiver, which is most commonly used in British Columbia. We first tested the transceivers with 15 certified ski guides who in their workplace used the Ortovox F1. Each guide used all six transceivers in a simulated avalanche. The times to find two buried transmitters were recorded. We then performed the same program with 15 high school students who had never used transceivers. We staged it so that the novice high school students were divided into three groups, each of which used the transceivers in a different sequence to rule out a learning advantage by using the transceivers in the same order.

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CANADIAN TRANSCEIVER TEST

continued from previous page

The results showed only a small difference in the times of the guides using the new models, with the Ortovox d3 being the fastest and the F1 the slowest even though the F1 is the transceiver they used most often. The results with the students were most interesting. Only four out of 10 (two of the three groups) were able to find the second buried transmitter within the seven minute time limit using the Ortovox F1. All students were able to find all the targets with their new model transceivers in their test group. The fastest times were with the Ortovox S1 which was slightly faster than the Ortovox d3, Mammut Pulse, Tracker DTS, and the Pieps DSP which finished in that order and quite close together. Clearly the new transceivers are much better in the hands of a novice or irregular user.

TRANSCEIVER	AVERAGE SEARCH TIME Knowledgeable Users	Naïve Users
Ortovox d3	1 minute, 13 sec	3 minutes, 21 sec
Tracker DTS	1 minute, 35 sec	3 minutes, 26 sec
Pieps DSP	1 minute, 36 sec	3 minutes, 34 sec
Ortovox S1	1 minute, 38 sec	2 minutes, 59 sec
Mammut Pulse	1 minute, 47 sec	3 minutes, 25 sec
Ortovox F1	1 minute, 56 sec	NA*

*Six out of 10 testers in this group failed to find the two targets within the allotted time (7 minutes).

Introductory Thoughts

- There are a number of types of equipment which may help if a person is involved with an avalanche but none replaces a transceiver.
- The minimal safety equipment a person must have in the backcountry in winter is a transceiver, a probe, and a shovel.
- A person should be prepared to be out overnight even if it is not planned.
- The shortest time taken to extricate a buried person, the better his chances of survival.
- The chances of a live rescue fall quickly after 15 minutes.
- In the winter of 2008/09, 24 persons died in avalanches in Canada with 144 deaths over the last 10 years, and British Columbia had the largest number of fatalities.

Materials and Methods

We received four transceivers from Mammut (pulse) and Pieps (DSP). Mountain Equipment Coop loaned us four Tracker DTS. Ortovox sent us four d3s and four S1s. We borrowed four Ortovox F1 transceivers from the Canadian Ski Patrol System, Greater Vancouver Zone. We also borrowed the Ortovox remote-controlled test system (five transmitters which can be remotely turned on and off) from Mike Wiegele Heli Ski Resort at Blue River.

The first session took place at Mike Wiegele Heli Ski Resort in Blue River, British Columbia, using the heli-ski guides as knowledgeable testers. These guides and their clients use the Ortovox F1. We created a simulated avalanche 30 x 50m in size and buried the transmitters across the run-out area. The transceiver manufacturers instructions for use of each transceiver was given to each tester prior to using each transceiver. We randomly turned on two of the five Ortovox transmitters then let each tester (guide) enter at the top end of the "avalanche" to start a search grid until a signal was received, at which time they were to follow the instructions from the applicable transceiver manufacturer. The time was measured from the entry until finding the second transmitter. Two different test transmitters were switched on for every test.

The second session took place at Hemlock Resort just east of Mission, British Columbia. We created a simulated avalanche 30 x 50m in size and buried the five Ortovox test transmitters across the run-out area at the base of the "avalanche." The 15 students were divided into three groups and each group had a different sequence of transceivers to test – to remove a learning effect, whereby the use of first transceivers could lead to improved times with the later transceivers. Using the transceiver manufacturer's instructions, the groups were given a 30-minute instruction course with practice prior to the testing of each transceiver. Two of the five test transmitters were switched on, and each novice tester was started at the top of the "avalanche," where a normal search pattern was followed until a signal was received, at which time the instructions from the applicable transceiver were followed. The time was measured from "avalanche" entry to marking of the second transmitter. Two different test transmitters were switched on for every test. A time limit of seven minutes was set to find the second transmitter. If this was not achieved the test was declared as "not found."

Results

In the hands of a knowledgeable user there was only a small difference in search times between the two-antenna and the newer three-antenna transceivers. The fastest was the Ortovox d3 (average: 1 minute, 13 sec), then the Tracker (1 minute, 35 sec), the Pieps (1 minute, 36 sec), the Ortovox S1 (1 minute, 38 sec) and the Mammut (1 minute, 47 sec). The slowest was the Ortovox F1 (at a still respectable 1 minute, 56 sec). The standard deviation (STDEV) shows how much variation there was in the times and a low number suggests a more consistent ease of use, ranging from the Ortovox S1 at :23, Ortovox d3 at :31, Tracker at :32, Pieps at :36, Mammut at :47, and the Ortovox F1 at 1:07. In the hands of an expert user, there appears to be little difference in the results using the multi-antenna transceivers, and all are faster than the F1 which is nearing two decades of use.

The results from the naïve users are very interesting! Six out of 10 testers failed to find the two targets using the Ortovox F1 in the allotted time. All the naïve users did much better using the two-antenna and three-antenna transceivers. The fastest was the Ortovox S1 (2 minutes, 59 sec), the Ortovox d3 (3 minutes, 21 sec), Mammut (3 minutes, 25 sec), the Tracker (3 minutes, 26 sec), and the Pieps (3 minutes, 34 sec).

Discussion

Both the guides and naïve users liked the ease of use and the marking of multiple burials on the screen of the Ortovox S1. The screen of the Ortovox S1 did not seem to be affected by the cold (at times -15°C to -20°C). The Ortovox d3 was very easy to use but not as easy to find multiple burials as the S1. Both the Ortovox model S1 and d3 also had the best attachment systems. The Mammut Pulse worked well when correctly set up. It seemed to have too many parameters to set and really needs a lock function to stop a desired setting from being changed. The authors also feel that the Pulse feature should not be used on ethical grounds because of questionable reliability. The attachment system is good. The Pieps DSP worked well but the on-off slider switch which sticks out from the transceiver seemed to present a risk of being easily broken. We also found the deactivation of the transceiver with the special probe presents a risk of abandonment of the buried person if the transceiver is turned off and the probe were to be removed by a person not knowing what had been done. We would advise not to use this feature. The attachment system was not as easy to use as the others. The Tracker DTS did better than we expected as a two-antenna transceiver being compared to three-antenna models. The pinpointing with this transceiver was more difficult than with a three-antenna transceiver. The authors expect that this company will update their transceiver in the near future. When this is done we recommend that they also update their attachment system, which was determined to be the poorest.

Conclusions

Any transceiver is better than none! The new three-antenna transceivers are faster in finding a buried person in an avalanche than the older single-antenna transceiver. This is especially true for the naïve user. Guides or guiding companies using anything other than three-antenna transceivers should consider upgrading. The simpler the transceiver is to use, the better. Extra functions such as the pulse detection with the Mammut and the probe switch with the Pieps may have serious ethical problems and detract from the primary goal: to find and rescue the buried person. The Test Box from Ortovox for the Ortovox S1 appears to be a very good way to assure full function of each S1 transceiver prior to its use. This will be especially useful for larger operations such as heli and snow cat companies and rescue organizations.

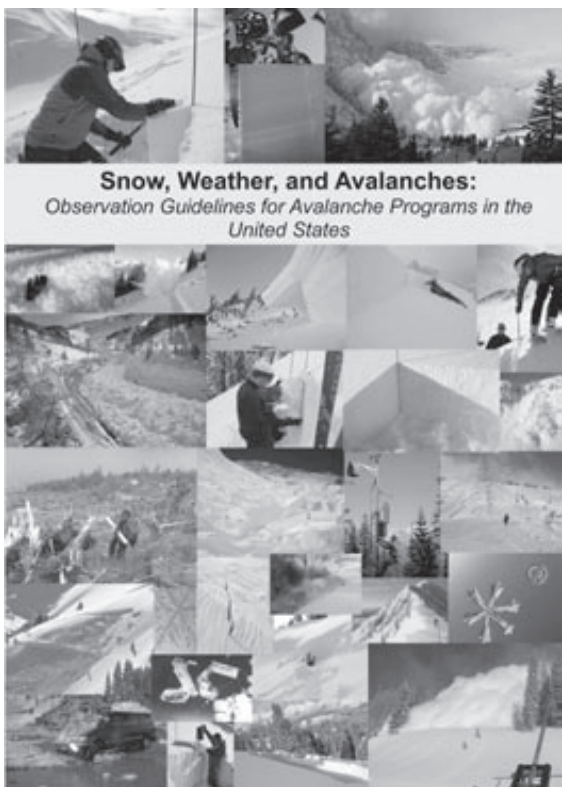
Disclosures

This study was not supported financially or materially by any of the transceiver manufacturers whose equipment was used in this study. The authors Swangard, Sayer, and Gunderson have no financial ties or conflict to disclose.

We would like to thank Ortovox, Mammut, Pieps, and Mountain Equipment Coop for loaning us the transceivers. We would also like to thank Mike Wiegele Helicopter Ski Resort and Hemlock Ski Resort for providing us with staff and mechanical support. Thanks also to the Canadian Ski Patrol System, Greater Vancouver Zone which provided testing, training, and support without which we could not have completed this program. We would also like to thank the Mennonite Educational Institute (a high school in Abbotsford British Columbia) and the 15 wonderful (naïve) test subjects who volunteered for this study.

F. M. Swangard, MD, is a Canadian Ski Patrol System life member and Canadian delegate to the International Commission of Alpine Rescue. Bob Sayer is president of the Canadian Ski Guide Association and associate delegate to the International Commission of Alpine Rescue. Steve Gunderson is a member and board member of the Canadian Ski Patrol System, Greater Vancouver Zone and avalanche training officer for British Columbia.

The Canadian Transceiver Test was published at this year's CISA-IKAR meeting on September 25, 2009, in Zermatt.



New SWAG Now Available

The new edition of AAA's *Snow, Weather, and Avalanches: Observation Guidelines for Avalanche Programs in the United States* (SWAG) is available. This update contains the latest International Snow and Ice Classification and definitive information on new snow tests such as the PST and ECT. Thanks to Ethan Greene for spearheading the updates in time for this snow season.

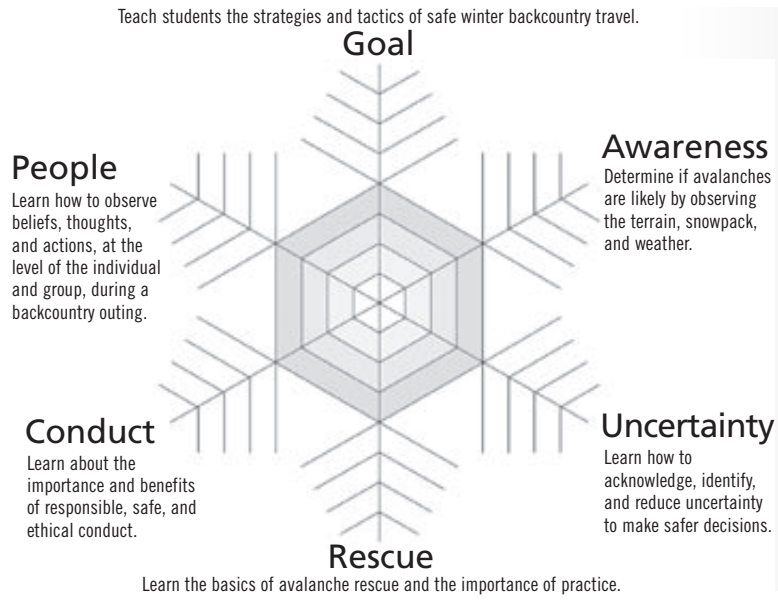
SWAG is available for sale online at www.americanavalancheassociation.org or it can be purchased from a AAA representative at one of the many continuing education venues this year.

education

Elements of Avalanche Education

Story by Mike Richardson

In this article I discuss the role of unmanaged simplification in the development of avalanche education and propose a partial solution that uses framing techniques to help students develop an integrated understanding of the elements of avalanche education. To that end, this article refines the framework for avalanche education originally developed by Halsted Morris and Dale Atkins.



I've seen clouds from both sides now.

Joni Mitchell

Avalanche Education

The avalanche knowledge system is composed of multiple domains that include meteorology, snow science, guiding philosophy, psychology, physics, and risk management. Each of these domains is highly complex yet important to anyone who travels in avalanche terrain during the winter.

Avalanche educators have a very challenging job when you consider time limitations and the complexity of the entire avalanche knowledge system. Given three days, how can you teach students the information that many people have spent decades acquiring? The short answer is that you can't. This forces educators to reduce the entire avalanche knowledge domain into simple principles and practises.

The Unintended Side Effects of Simplification

To address the competing interests of time and information, avalanche education has been heavily simplified by removing information. This method of removing information is referred to as *pruning*, and results in *information hiding*. While pruning certainly can increase *perceived* simplicity, there are negative effects as well because pruning takes the original information and creates an entirely different construct that is a mere sketch of the original. In technical terms, since there are tens of thousands of pieces of information in the entire avalanche knowledge system, using pruning as a technique to reduce complexity results in a curriculum that is full of holes.

This reductionist approach actually increases complexity in some cases by creating numerous unexplained abstractions throughout the subject matter. Sometimes this is very useful: students can learn about X without having to learn about Y. However, abstractions that are helpful at first eventually lead to roadblocks, or dangerous knowledge gaps, when an important relationship between X and Y remains hidden or unexplained.

To solve this problem, you teach the student about X separately from Y and then you teach the student about Z, which is the relationship between X and Y. But bear in mind, it is usually difficult to teach people about abstractions unless you take the time to explain the nature of the abstraction. Since class time is short and the amount of information is large, it is valuable to consider what information science and technical communication offer in terms of solutions. Both domains teach us that it is possible to use carefully selected keywords as *frames* that reduce confusion and vastly improve communication. (For reference, improper or manipulative framing is often referred to as *spin*.)

In formal terms, information specialists construct *meta-information*, which is *information about the information* to counter the negative effects of pruning. In useful terms, when you are dealing with the human mind, meta-information works by triggering helpful heuristics. Why teach students observation techniques? Students are taught observation techniques to maintain awareness. Using the word *awareness* frames the entire collection of observation techniques and triggers the student's built-in understanding of the relationship between observations and their sense of awareness. Because the word awareness triggers helpful heuristics, the teacher is not required to provide further explanation about the purpose of the tests, nor about the importance of maintaining awareness in the mountain environment. The frame of awareness also simplifies prioritization because some observations increase awareness while others do not.

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AVALANCHE EDUCATION

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Others have considered this problem. In his article in *The Avalanche Review*, 25/3, Morris writes about the search for simple, yet descriptive, thematic frames that link the elements of the curriculum in a manner that represents a logical sequence of events for backcountry travel. Atkins developed an *avalanche rose* of avalanche education subjects to provide frames that help students develop an integrated view of the course material. These efforts attempt to resolve the elements of avalanche education into a coherent unit.

Integration and framing are critical because the ultimate result of unmanaged simplification is teaching strategy that focuses strongly on individual elements without the context provided by the whole avalanche knowledge system. What happens if students cannot sort out the relationships between the elements of the curriculum? Both Morris and McCammon address the potential for serious problems that arise from confusion. It seems reasonable to conclude, as others have, that students will apply the items separately or not at all. In this case, we can refer to the curriculum inside the student's mind as *Rules of Thumb for Mountain Travel: The Abridged Edition*.

Rather than critique from the safety of my armchair, which while messily elegant is rather uncomfortable, I'd like to discuss a partial solution. According to Laura Adams, "a recurring theme in the literature [of decision science] is that effective decision-makers are distinguished by their ability to frame the problem well."

Perhaps the layout of avalanche education should include tools to help students frame the problems very clearly. If we examine the elements of human behavior, it's clear these framing tools should deal with thoughts and actions and beliefs. When you're dealing with avalanches, what exactly constitutes framing the problem well with respect to thoughts and actions?

Scrub in and get ready for some word surgery.

Framing *Thought*

Given the time constraints of avalanche classes and the complex subject matter, one must work carefully to select a framing element that is an unambiguous grand slam. Adams argues the critical importance of systems-thinking in understanding complex phenomena, and Tremper in his article on the North American Danger Scale, discusses the difficulty in identifying general framing terms that still have clear meaning. What word frames the elements of avalanche education from a systems-thinking perspective yet still has clear meaning to the average person?

After reviewing hundreds of documents from the literature, the term *uncertainty* came up repeatedly. Avalanche professionals interviewed by Adams adopted positive and negative strategies for dealing with uncertainty. Adams' results found that failing to manage uncertainty ([acknowledge], identify and reduce) leads to negative coping strategies such as denying the presence of uncertainty, explaining it away, or ignoring uncertainty and continuing toward an objective.

It may be controversial to suggest that *uncertainty* replace *decision-making* as an element of avalanche education, but I am going to suggest that exactly. Instead of using hard evidence, I will base my argument in common sense. First, the term decision-making is jargon that has no precise meaning to most people because you can't frame decisions in terms of decision-making. When you purchase a car you do not acquire information to make a decision; you acquire information to reduce your uncertainty prior to decision-making. Do you want a dead simple decision-making framework? Train students to make decisions that blend uncertainty, safety, and fun—in that order. These attributes are compatible with realistic human behavior.

Framing *Action*

Adams shows us that while it's awfully hard to know what experts *know*, and almost as hard to know what experts *do*, it is possible to learn a great deal from them. My interpretation of other work by Adams suggests that part of professionalism revolves around the conscious belief held by professionals that their conduct reflects their professionalism. Tremper discusses the importance of conduct when he writes, "Human [Factors]: Are you prepared for the job?" and includes attitude, judgment, communication, awareness, skills, and knowledge as critical attributes. Morris suggested framing these attributes as good actions and bad actions. *Actions* is a good word choice but I believe this term should have a strong link to behavior.

The Avalanche Handbook states experience is required to choose a site for a test profile. So how should a student frame this problem? What constitutes professional conduct when an appropriate site for a test profile cannot be identified? How does a professional conduct herself when information is scarce and uncertainty is high? These questions imply that professionals are expected to adhere to the standards of professional conduct, which exists separately from experience. For example: professionals do not regard the desire to avoid short-term losses, such as the effort and expense of the entire ski tour, as justification for a dangerous descent in poor conditions. Does this reflect their status as experienced decision-makers or does this reflect their desire to adhere to the standards of professional conduct?

This lead to my final point: there is critically important difference between experience and professional conduct: you can teach professional conduct in a class. Conduct provides to the student an important frame for their actions during a backcountry outing.

Elements of Avalanche Education

Inspired by the avalanche *snowflake*, the following is a proposal for the formal definition of the elements of avalanche education. The elements are interconnected by safety, which provides a link to the broader goals of reducing deaths, injuries, and unnecessary grief.

- **Goal.** Teach students the strategies and tactics of safe winter backcountry travel.
- **People.** Learn how to observe beliefs, thoughts, and actions, at the level of individual and group, during a backcountry outing.
- **Awareness.** Determine if avalanches are likely using observations such as terrain, snowpack, and weather.
- **Conduct.** Learn about the importance and benefits of responsible, safe, and ethical conduct.
- **Uncertainty.** Learn how to acknowledge, identify, and reduce uncertainty to make safer decisions.
- **Rescue.** Learn the basics of avalanche rescue and the importance of practise.

To paraphrase McClung and Schaerer, the process of backcountry avalanche forecasting should be founded on well-rounded principles that are accessible to everyone and easily taught and learned. The same is true for avalanche education, and as a result every word of this definition is written in plain English.

In her MS thesis on decision-making, Laura Adams points out that almost no work has been done on the helpful aspects of heuristics. It might be useful to identify these helpful heuristics, or uncover existing research, especially for heuristics related to estimation and error correction.

Notes

- Jargon serves as a convenient shortcut for industry insiders. It is not suitable for external communication.
- The field of systems-thinking considers systems not as separate parts but as a series of connections.
- I have repeatedly been absolutely awed by the outstanding research and other work undertaken by long-time members of the avalanche patch.
- *The Avalanche Handbook* states that it is important to consider realistic human behavior in decision-making frameworks. The book discusses an A-B-C format for decision-making that provides information on how to weigh the factors that go into decisions. Human Factors = 50%, Terrain = 25%, and Snowpack = 25%.
- Adams points out in her research that almost no work has been done on the helpful aspects of human factors.
- How many times have we collectively heard about the link between information and decision quality in advertisements? It is an indisputable fact that people do not pay attention to ideas they perceive as worn out. It is critically important to effectively market the concept of *making good decisions*, but I do not believe this concept can be effectively marketed or communicated to recreationists using a message that people already receive on a daily basis.
- The carefully selected terms frame the curriculum around familiar words and concepts. Most of these words represent aspects of the human element that are highly related to decisions in avalanche terrain.
- McCammon writes, "In the first, novices will learn concepts and skills that are scientifically accurate but difficult for them to apply. Their decision-making, when done properly, will consist of tediously sorting through large amounts of snowpack, terrain and weather information that they only vaguely know how to prioritize, only to arrive at an ambiguous answer. Most of them will quickly tire of this approach and will instead make their choices based on unconscious biases or unfounded intuition. They will use their avalanche knowledge more often to justify their decisions than to arrive at them."
- It would be interesting to know how many sub-items are below each element. This would provide an objective view of how the elements of avalanche education were weighted in the curriculum.
- Thanks to my family for enduring many technical discussions over the past 20 months and enabling my addiction to skiing.
- Thanks to my mother and father for offering a mountaineer's perspective. Au revoir, Chamonix.
- Author thanks www.turns-all-year.com and all the participants.
- N.J. DiGiacomo has written an excellent paper on selection bias. It is a must read.

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Author's Note: This article does not address beliefs due to my lack of familiarity with that subject.

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What could go wrong?

shadows: Doug Krause & Steve Mead

Deep Breathing *continued from cover*

The dictionary defines consequence as the "result or effect of an action." The potential results are defined by your actions. Once you pursue a given course can the result be modified by subsequent actions? Maybe. Often. Sometimes no way. If something goes wrong you are, at best, now a step behind.

An avalanche event need not be large to grab you and shake you and demand your attention and hurl you toward an undesirable result. It could be a hundred pounds of snow pushing down on your skis from above, accelerating rapidly and foiling attempts to regain control. It could be a few tens of pounds knocking you off balance at exactly the wrong moment. It could be a small bank slip releasing above you and pushing you headfirst into the gully only twenty feet below. When that happens will you be able to react at all, or was that first move the only chance you get? Did you weigh the potential consequences of this event prior to your actions? Too late now.

Professional avalanche workers make hundreds of decisions per day from the very simple to the very complex, and it is widely accepted that a great many of the accidents and near misses we experience are a result of preventable errors, human factors. Could part of the problem be as basic as treating complex decisions like they were simple ones? Making those big high-consequence decisions sure gets faster and easier the more you make them. It's not because the problems get any less complex – sure our understanding of them can grow more profound, but also we just get used to making serious life-and-death decisions on a constant basis.

So what can we do about this? Maybe part of the answer is as simple as taking a deep breath. In fact there have been numerous times when I've instructed a group of explosive-laden, highly charged individuals to do just that. It's important though to use that breathing time wisely because you are about to act and your actions will have consequences.

Decision-making algorithms are common in industries that make complex choices on a regular basis like EMS, the airlines, and the military. They're easy; just follow the steps to your decision. Of course, one must ensure there is a step to address every possible eventuality. That's a little harder, and I'm sure as the doctors, pilots and soldiers get longer in the tooth they start to behave a little more like us and rely less on a strict algorithm and more on previous experience. Sounds like a recipe for human factor. There's got to be a balance point somewhere.

I don't like making things more complicated. In fact I believe that simpler is generally more efficient; increased efficiency is a better way to get things done fast than running up a mountain to get first tracks or open a slope in time. That being said, may I humbly suggest that there is a better way of spending your deep breathing time than meditating on the interplay of spindrift and the dawn light. Why not come up with your own simple algorithm or set of questions as a way of refocusing on the decisions you're about to make and their potential consequences?

Why am I here?

That's the old communication issue and if you don't know you better ask your partner, your boss, or the good Lord – probably in that order. If you have to resort to the latter for an answer, perhaps you should rethink your plan or at least its timing.

Where am I?

How's your situational awareness, do you know what's going on with those violent explosions to your left or that buried weak layer? What's below you out of sight or around the corner or, most importantly, what don't you know?

So what do I do now?

It's time to act. A person without options really doesn't have much, so be sure to consider all the potential ways you could address where you are and why you're there. Understand why you are doing things in a particular way.

Ideally deep breathing exercises like these will help lead you to a long life full of sunshine and lollipops. Perform them often. Perform them ad nauseam. You've got to breathe right? Your actions will have consequences and the time to measure those is prior to action. If you spend lots of time in big dangerous places, good habits will save your life again and again. Taking the time to carefully consider your situation is a good habit, and you'll find it leads to good technique.

I ski a lot of high-consequence lines and one of the techniques I keep falling back on when the hairs on my neck are standing on end is minimizing exposure; skiing in a way that minimizes the chance of a negative consequence. When I ask myself, "What do I do now?" I usually come back with an answer that reflects my preference for beer at the end of the day as opposed to a long-bone fracture. You can feel good about the stability or the control work you've done or your rock star clients but none of those things eliminates the potential for a negative result of your actions. They just address the likelihood of a given action leading to a particular result. A bomber snowpack does not reduce the size of a cliff or the slope angle above it or the angry rocks below.

Cerro Entre Rios, The Bidet, September 9, 2009

The Bidet is all about commitment. There is a lower angle rib above the crux that can be descended with relative confidence, and if you make it through the crux, the couloir below is just good old fashioned steep skiing. You can waltz through

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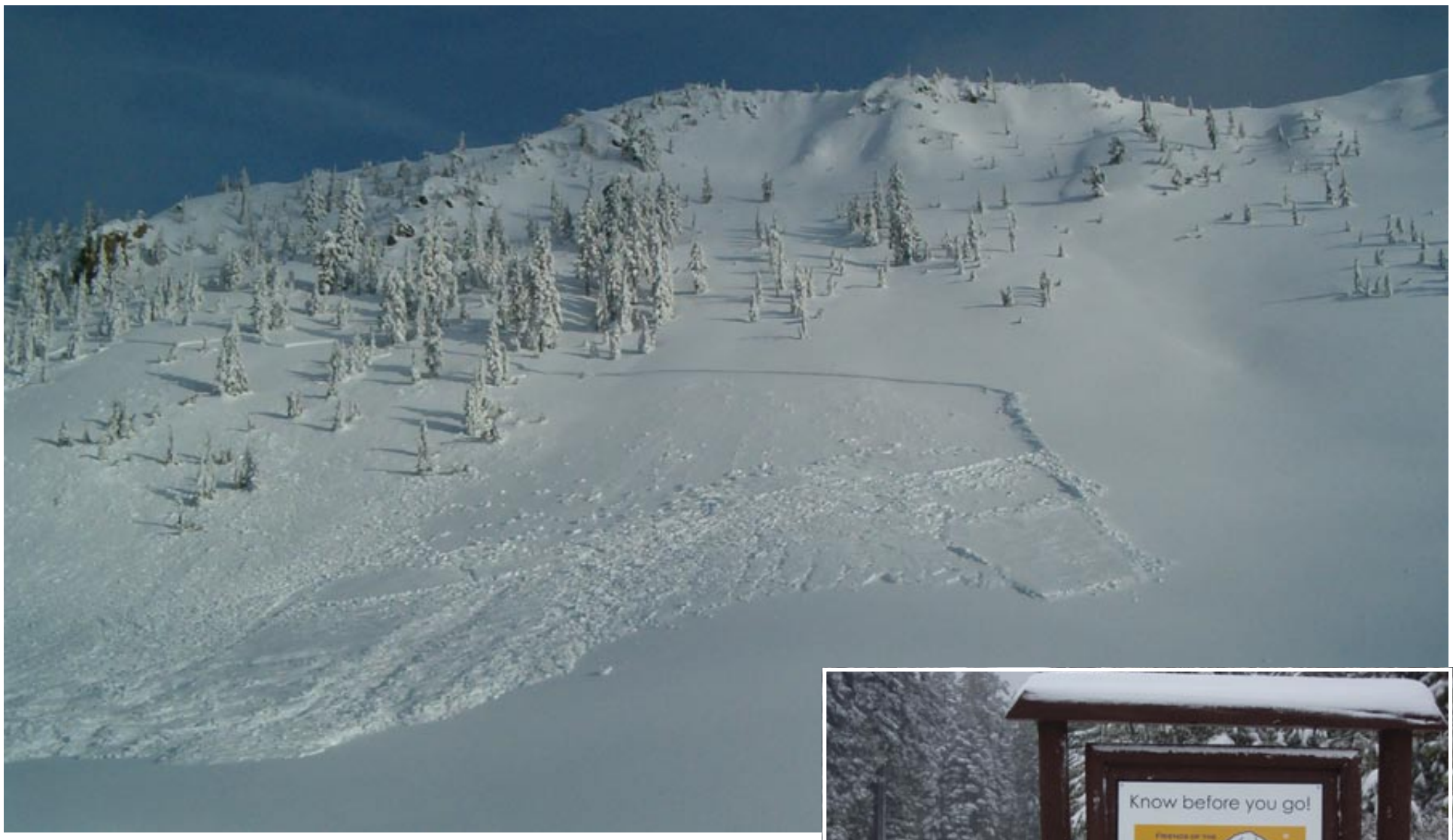

This natural avalanche occurred February 22 or 23 on the NW aspect of Grey Butte at an elevation of 7900'. 18" of snow containing 2.96" of water, fell with warmer, wetter snow on the top as temperatures warmed during the storm. This slope is a favorite high-marking area on Mt Shasta. *Photo by Shannon Gudgel*

right: Keith Potts, director of the Friends of the Mt Shasta Avalanche Center, poses next to one of the avalanche info road signs installed this winter on the main access road to Mt Shasta. The Friends group designed and purchased the signs. *Photo by Eric White.*

Mt Shasta Avalanche Center 2008/09 Season Summary

The eleventh season for the Mt Shasta Avalanche Center was just as busy as all of the previous years. The season started off with some major communication problems with our remote weather station network that involved moving to a new system and a new operating program, becoming operational in January. We also started a new Web site in January after a few weeks of working out the bugs from the beta site. In addition, we started our avalanche search dog program again, after a four-year hiatus, with two golden retriever pups. I was also able to provide informational videos on YouTube, linked to our Web page, showing snowpack stability and weather conditions in the backcountry.

This was also the second season in a row where we were a Type Three Avalanche Center, as opposed to our first nine years as a Type Two Avalanche Center, due to staffing cuts (one forecaster instead of two, no longer providing daily advisories). This year I provided advisories three days a week with only a few extra advisories issued during heavy storms and Avalanche Watches or Warnings. We issued four Avalanche Watch/Warnings with the National Weather Service during our largest avalanche cycle in February from the 14th to the 24th. We had several reported human-triggered avalanches with two partial burials and no fatalities or serious injuries.

During our forecast season our overall precipitation was around 85% of normal with the snow depth around 80-85% of normal. We received 777cm of snow between November to mid April. Normal snow fall during that time period is closer to 1000cm. Overall, temperatures seemed to be a tad warmer than normal.

This slide on May 10, 2009, occurred during a late-season avalanche cycle during Mt Shasta's busy climbing/skiing season. This slab on Casaval ridge at 9600' on a SE aspect was triggered by a snowboarder who rode the slide uninjured. Then his buddy went down next to the slide. *Photo by Forrest Coots, USFS climbing ranger*

While we did not have as windy a season as 2007/08, we did have a significant NW wind event in late March and early April continuing for over two weeks with 180km/h winds at timberline.

Our outreach program was able to continue at levels similar to those before our staffing cuts in 2007, reaching 437 people for 65 hours. Our Friends group continued their hard work in fundraising, even during the current economic crisis, funding a quarter of the total budget of the Mt Shasta Avalanche Center. We were also fortunate to receive some earmarked funding from our regional office, allowing an increase in staffing near the end of our season.

We were able to bring on another forecaster in early March and began training during the last six weeks of our forecast season. Additionally, I continued my surface hoar research project with a grant from AAA and assistance from Dr Ed Adams at MSU in Bozeman, MT.

A late season storm brought 60-120cm of snow to Mt Shasta during early May. As high pressure moved in after the storm, temperatures rose, as did the avalanche danger. This is also a time when hundreds of mountaineers are climbing and skiing on the south side of Mt Shasta to take advantage of 2100 vertical meters (7000'.) of corn snow. Although the Mt Shasta Avalanche Center was closed for the season, we still posted an Avalanche Warning with the National Weather Service from May 7 to May 11. Natural avalanches began to occur on Thursday, May 7. A few more naturals occurred on Friday. By Saturday, hundreds of climbers were in the popular Avalanche Gulch area on the south side of Mt Shasta, as well as many snowmobilers in the open riding areas. More naturals occurred on Saturday and a few human-triggered (snowmobile) avalanches with no injuries or fatalities. Peak use and warming temperatures on Sunday, May 10 brought more naturals, occurring at higher elevations than the previous days. By noon, the temperature was high enough to push the snowpack to its trigger point. From noon to 1pm, five human-triggered avalanches occurred within a square mile. Five lucky skiers and snowboarders were able to either ride off the slabs or stay on top of the debris with only two partial burials. Five Forest Service climbing rangers were on duty in the area with two avalanche search dogs on standby at the trailhead. The slides during this spring event were between 60-300m wide and traveled 180-300m vertically. Crowns were 30-60cm thick and most occurred on SE aspects between 2560-3050m. No injuries or fatalities occurred during this avalanche cycle.

We hope to continue with two forecasters next season and increase the number of weekly advisories. We also hope to continue to improve the way we distribute information on our Web site and increase our overall outreach.

As always, the Mt Shasta Avalanche Center wouldn't have survived without the patience and support of my wife and children; the stamina and efforts of our Friends group; and the appreciation, donations and participation of the citizens and businesses in our local communities. Thank you!

—Eric White

Photo by Rick Grubin

ISSW 2009:
Thoughts from a Practitioner

Story by Rick Grubin

The Glacier Express from Zermatt to Davos is billed as "the slowest express train in the world." Passing through 291 tunnels and crossing 91 bridges, cogwheel locomotives are required to climb steep mountain gradients and cross the Oberalppass. My wife and I were riding in what we termed the "ISSW coach" because each passenger was traveling to the ISSW 2009 in Davos. Most had just attended an ICAR meeting in Zermatt; others like us wanted to enjoy a famous and scenic rail journey. Having spent the previous three weeks hiking the high passes of the Tour du Mont Blanc and navigating the impossibly confusing walkways of Venice, the train ride was a welcome respite.

As the title of this article suggests, I gravitate toward the practice end of "A Merging of Theory and Practice." The presentations and posters discussing a snowpack's thermal conductivity profile and temperature gradient metamorphism as a classical coarsening process are interesting to my engineer's mind, but of little practical value for a ski patroller and guide/educator. ISSW 2009's format, which interspersed topics on theory and practice as well as presentations and posters, provided plenty of opportunity for practical learning. This article in no way covers all the presentations, papers, and posters that comprised the information a practitioner was exposed to at ISSW 2009; rather it's a representative sample, and in many cases topics were addressed by more than one presenter. Of all the presentations at ISSW 2009, the most compelling was a poster by Werner Munter entitled, "My Career as a Researcher." Munter stated that, after examining his many contributions to avalanche science, "I was compelled to start from scratch because no groundwork had been performed in my chosen subject. Progress could be made only by adopting an interdisciplinary approach, in which I replaced *snowpack stability* with *risk and uncertainty*. Only then could I develop strategies for dealing with uncertainty (decision-making under risk), which proved to be a philosophical problem, rather than one relating to snow science." Of everything I saw and heard and learned, this sticks with me the most.

Advantages of Accurate Terrain Data

When seeking avalanches – snow safety – is part of the job, intimate knowledge of avalanche starting zones and their individual terrain characteristics is critical. Chris McCollister's paper and poster entitled "Using LIDAR (Light Distancing and Ranging) data to more accurately describe avalanche terrain" makes clear the value of integrating experiential knowledge and digital mapping techniques. Using high-resolution elevation data to better understand slope characteristics, particularly slope angle, and identify the locations of known starting zones will hopefully be a future summer ski area project.


Small group sizes on many of the field trips created multiple opportunities for questions.
Photo courtesy ISSW09 SLF/Henzen/Heil/Sutter


John Stimberis at one of the ISSW socials with his date, the elusive wiener, who apparently has remained in Europe on extended vacation. *Photo by Bruce Tremper*

Human Factors, Decision-Making, and Risk Management

Risk management, decision-making, and human factors as key contributors in avalanche accidents have long been topics of interest at the ISSW. Ian McCammon discussed strategies for combating human factors in avalanche terrain, drawing from other professions where human factors play a critical role. This was interesting because the models of decision-making presented see varying levels of use in avalanche education. Beginning to understand their applications, strengths, and shortcomings was valuable.

Jan Mersch and Anton Kühlberger presented one particular method – recognition-primed decision-making, which stresses the role of experience when managing risk. They found that this model frequently mapped to actual decisions made in the field by guides, pointing to the value of intuition when managing risk.

Stephan Harvey and Paul Nigg discussed the notion that decision-making tools should not standardize making decisions, but rather standardize the *process* of making decisions. They argue that for all education levels, the same system for risk assessment should be applied; however, specific tools are used in different ways. Beginners use simpler tools and a rules-based approach, whereas more advanced users rely on more sophisticated techniques, in particular pattern recognition. This approach is the common denominator for avalanche education in Switzerland. Following on to this, Mersch and Wolfgang Behr argued that there are many approaches to risk management, and creating an integrated model of rules, knowledge, intuition, and self-reflection provides a means of harmonizing these many approaches.

Miriam Förster discussed leadership styles when making decisions in avalanche terrain. While her work is admittedly just starting, the notion of group or trip leaders adapting their behavior and style to specific situations and becoming aware of heuristic bias so it may be dealt with more objectively is work to look for in the future. These presentations provide thoughts and opportunities for both educational classroom presentations and modeling in the field.

Avalanche Forecasting and Dissemination of Information

Providing avalanche forecasts and bulletins and, perhaps more importantly, communicating critical information to consumers of these forecasts and bulletins, remains an ongoing concern. Bruce Tremper presented ideas on reaching avalanche-

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Swiss mountain guide Werner Munter was presented with an award in recognition of his life's work of ground-breaking contributions to avalanche science. *Photo by Bruce Tremper*

I was compelled to start from scratch because no groundwork had been performed in my chosen subject. Progress could be made only by adopting an interdisciplinary approach, in which I replaced snowpack stability with risk and uncertainty. Only then could I develop strategies for dealing with uncertainty (decision-making under risk), which proved to be a philosophical problem, rather than one relating to snow science.

—Werner Munter, *My Career as a Researcher*

DAVOS ISSW

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unaware users, specifically in the Wasatch Mountains of Utah; however, the ideas are applicable elsewhere. Drawing on some of McCammon's research of human factors and effective communication methods from other disciplines, the Utah Avalanche Center has experimented with both historical and new ways to reach backcountry users. From tried and true measures such as trailhead signage and peer pressure to more innovative ideas like mass media – billboards, radio and television, and the Internet – the UAC is working hard to have backcountry users become more educated. The UAC is also addressing the challenge of creating hazard level ratings that are meaningful to both lower- and higher-skill level user groups.

Similarly, Henry Schniewind discussed "Henry's Avalanche Talk," a business that aims to help backcountry users become more avalanche aware. Via multimedia presentations, avalanche-awareness courses, and Web-based information, Henry and his associates reach out to those who may not always appreciate the need to learn about safety by emphasizing that learning how to stay safe is also learning how to have fun. Perhaps the best way to convey how practical I found Henry's methods is to note that my 13-year-old daughter, who can't fathom why her father is willing to hike for turns, spent hours looking at henrysavalanchetalk.com and expressed interest in going on a hut trip!

l-r: Jim Bay, Karl Birkeland, Bob Comey, Theo Meiners, and Chris McCollister enjoy European beverages. *Photo by Bruce Tremper*

The Bridger-Teton National Forest Avalanche Center has issued daily general avalanche hazard advisories since the mid-1970s and is an essential resource for backcountry users in that area. Bob Comey of the BTAC noted that these advisories are necessarily general in nature, even with hazard-level ratings for specific elevations. Extreme terrain historically accessed only by experienced persons during stable conditions is now frequented by many varieties of users on a regular basis. The challenge is to communicate to such users that general avalanche hazard ratings cannot not be applied to this terrain – instead they must utilize slope-specific knowledge and advanced avalanche-hazard assessment skills. To address the limits of forecasts such as elevation limits, un-forecast weather events, spatial variability, and danger-scale interpretation, the BTAC is working to produce a short film addressing these limits. Expect to find the film linked to the BTAC's Web site in the future.

Combining the challenges of reaching consumers of avalanche bulletins and creating forecasts that encompass a greater terrain area, Christoph Suter and Stephan Harvey from the WSL Institute for Snow and Avalanche Research SLF in Davos looked at these problems from viewpoints of the forecaster and the user. They discussed working prototypes of mobile devices using integrated GPS, Location-Based Services, and Internet access to exchange data bi-directionally at virtually any time and place. Not only can backcountry users have access to the latest avalanche forecast and hazard-level rating, they can similarly provide local observations and data directly from the field. These types of applications could become a valuable tool with the proliferation of feature-laden handheld devices and cellular and satellite networks.

Avalanche Divas Hit Europe

Story by Christine Pielmeier

On September 28, 56 female snow and avalanche professionals from Europe and North America enjoyed an evening with a diverse program during the third Avalanche Divas Night Out. The Avalanche Divas aim to provide a meeting point and to support networking was well met. Furthermore, five female snow and avalanche experts of outstanding merit were honored during the evening.

The 2009 Avalanche Divas include (l-r): Glòria Martí (Spain), Cécile Coléou (France), Margherita Maggioni (Italy), Betty Sovilla (Switzerland), Nina Levy (Switzerland).

Glòria Martí from the Institut Geològic de Catalunya, Barcelona, Spain, has been a geologist with the Geological Institut of Catalonia since 1991. She developed and works in the avalanche forecasting program, avalanche mapping and databasing for the Pyrenees. She also teaches avalanche courses and is a member of the Working Group of European Avalanche Forecasting Services.

Cécile Coléou, CEN Centre d'Études de la Neige, Météo France, Grenoble, France, is a meteorologist. At CEN, Grenoble, since 1986, Coléou works as a researcher in snow modelling. She has served as head of the French Avalanche Forecasting Service since 2004. She teaches avalanche courses and is a member of the ISSW09 International Programme Advisory Board as well as a member of the Working Group of European Avalanche Forecasting Services.

Margherita Maggioni, Università di Torino, Italy, is a physicist whose professional snow work started in 2001 with SLF. Since 2006 she has been a researcher at the University of Torino where her main fields of interest are avalanche dynamics and snow cover evolution. She is a member of the ISSW09 International Programme Advisory Board.

Betty Sovilla, WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland, is a civil engineer who has worked as a researcher with SLF since 2000. For the last three years she has headed the SLF Avalanche Dynamics Group, overseeing the large-scale, avalanche-dynamics test site Vallée de la Sionne, Switzerland. Previously, she also worked for the Avalanche Center at Arabba, Italy, and consulted for the Italian National Electric Power Corporation.

Nina Levy, observation network SLF, Sedrun, Switzerland, has worked as a snow and avalanche observer for the Swiss Avalanche Forecasting Service and observation network since 1976. During the last few years, she has also been a field instructor in the SLF snow and avalanche courses.

The Avalanche Divas 2009 were nominated by the ISSW organizing committee, the ISSW09 International Programme Advisory Board, and the previously presented Avalanche Divas. A group of female SLF employees organized the 2009 event. It was sponsored by ISSW09, WSL/SLF, Helibernina, Black Diamond, Wild Roses, Pistil, Science City Davos, American Avalanche Association, Babes in the Backcountry, and Business Professional Women Switzerland.

Christine Pielmeier, Avalanche Divas 2009 coordinator, scientist, avalanche forecaster WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland.

AAA Executive Director Mark Mueller took the opportunity to mingle at the Avalanche Divas Night Out.

Avalanche Rescue

Presentations on various avalanche rescue methods and technologies are always prevalent at the ISSW, and so it was in Davos. Marcellus Schreilechner, Markus Eck and Michael Schober of Pieps presented findings on differences and shortcomings of various transceiver manufacturers' definitions and descriptions of search-strip widths. They noted that search requirements like turning and rotating are poorly defined, leading to published strip-search widths being defined in different ways. This, in turn, leads to frequently incorrect techniques by users. Basing their tests on recommendations from the ICAR in 2008, useful ranges and strip-search widths of various multi-antenna transceivers were empirically derived and compared to values published in transceiver manuals.

Bruce Edgerly, Franz Hohensinn, and Dieter Stopper discussed taking advantage of multiple searchers in a transceiver rescue. Basing their presentation on the premise that complex multiple-victim transceiver searches are rare, they argue that learning and teaching how to perform a parallel transceiver search is extremely important and is applicable for single and multiple burials. In single burials, the searchers spread out according to a standard search-strip width of at least 20 meters. In multiple burials, this search-strip width can be adjusted according to the size of the deposition area and the number of rescuers. Searchers are not to deviate from their search strip until a specific distance, corresponding to the search-strip width used by the group, is shown on their transceiver. By reducing the search strips by using multiple searchers, this technique can address the rare, but challenging, scenario of close-proximity burials.

Schreilechner, Eck, and Schober presented a poster on rescue equipment effectiveness and specific operational methods for avalanche double-burial incidents. Using two- and three-antenna transceivers and an electronic probe capable of deactivating an active transceiver, each tester completed a scenario with two active transceivers placed approximately 15m apart in a 50m x 50m site. Test results indicated specific searching techniques such as the Three Circle Method did not prove significantly beneficial, noting that few persons knew such techniques and were able to perform them under stress. The use of the electronic probe was shown to be advantageous, particularly the deactivating function. This functionality brought about the largest improvement in overall search time. Perhaps the most interesting conclusion drawn was that "experts can benefit more from efficient, modern equipment than beginners. The practical conclusion the user has to draw is that even with supporting and self-explanatory technical equipment, the search time for an avalanche scenario with a double burial can be improved with corresponding knowledge and training."

I had a great time in Davos, and look forward to future ISSW events in Europe. If you're ever in the Davos Klosters valley, a visit to the Monsteiner Brewery is highly recommended. It just might be as it's billed: "The last beerstop before heaven."

Rick Grubin is the member affiliate representative to the AAA board. He has also been doing an exemplary job as substitute secretary. He would like to thank his wife for agreeing to spend the last week of her birthday trip to Europe at the ISSW.

ISSW 2009 presentations were simultaneously interpreted into German, French, Italian, and English to the nearly 550 international participants, allowing the experts to speak and engage in discussions in their mother tongue. *Photo courtesy ISSW09 SLF/Henzen/Heil/Sutter*

ISSW 2009 in Review

Story by Jürg Schweizer

Almost 550 experts engaged in scientific research, natural-hazard management, and mountain sports attended Europe's first hosting of the International Snow Science Workshop (ISSW) to discuss topical issues and promising solutions concerning snow and avalanches. In view of the event's popularity, the varied conference program and the large contingent of practitioners, the organizers were delighted with the success of the ISSW's European premiere.

The International Snow Science Workshop (ISSW), which took place in Davos from September 27 until October 2, 2009, was attended by nearly 550 experts – many more than anticipated. For the first time in its history, the foremost snow and avalanche congress for practitioners was held in Europe. It was organized by the WSL Institute for Snow and Avalanche Research SLF and Science City Davos. Researchers, engineers, safety experts, mountain guides, education and training officers, and practitioners from 24 nations traveled to Davos, which is acknowledged as the cradle of modern avalanche science. The systematic investigation of snow and avalanches was initiated on the Weissfluhjoch above Davos in 1936.

The ISSW is not a conventional academic congress on snow and avalanches, but serves as a meeting place for researchers and practitioners. This underlying objective is reflected in the workshop's official billing as "A Merging of Theory and Practice." The ISSW in Davos was the fifteenth congress in the series and the most international one to date. It has been held in North America every two years since the 1970s.

An extensive range of presentations and discussions took place during the five-day event. Experts addressed the congress on current problems relating to avalanches and possible solutions. Academic lectures dominated the morning sessions, while the afternoon events, in the form of workshops and excursions in the Davos region, focused primarily on practical issues. About half of the more-than-100 speakers were practitioners – chiefly safety authority representatives, mountain guides, and avalanche forecasters. The afternoon workshops covered artificial avalanche release, avalanche forecasting and rescue, avalanche dynamics (computer simulation of avalanche movement), avalanche education, quantitative stratigraphy, and the role of snow as a natural resource for winter tourism. An extra whole-day workshop, on the subject of building on permanently frozen soil or permafrost, proved especially popular.

In most disciplines, remarkable progress has been made recently in the quantification of key processes, including snow metamorphosis and transportation by the wind. Modern visualization methods (computer tomography), image processing, and remote sensing now provide a far more detailed view of the snowpack than was possible just a few years ago, and new findings are certain to emerge in the near future. The capture of high-definition periodic images allows deformation and fracture processes in the snowpack to be quantified. For the first time, terrestrial laser scanners are capable of recording the complex patterns in which snow is deposited by the wind. Computer models simulating snow transportation, which is a key process in avalanche formation, can thus be validated.

Several presentations investigated the processes that take place in the snowpack and play a major role in the formation of wet-snow avalanches.

In France, where avalanche warning is the responsibility of the national meteorological service, the computer models used by forecasters when issuing avalanche bulletins are very advanced. Such models facilitate not only an assessment of the snowpack's current condition at various altitudes and in different aspects, but also the forecasting of its development in the next day or two. Besides model data, current data gathered in the field are also crucial. The primary interest here lies not in the data delivered by automatic measuring stations, of which there are very many nowadays, but in observations of the snowpack and avalanche activity. By way of special, latest-generation mobile phones with integrated GPS, mountain guides, for example, can now report such observations directly to the avalanche warning services. The SLF conducted a successful trial last winter. A significant improvement in avalanche warning is expected to arise from better communication of the information on which warnings are based. As illustrated by examples from the US, the use of visual elements in particular – such as pictograms, images, and even short films – can capture the attention of new user groups and make them aware of current avalanche problems. Similar projects have also been initiated in some European countries.

The focus on the prevailing avalanche problem (e.g., fresh snow or snow drift accumulations) is an important aspect of avalanche training – not least because of the recognition that proficient decision-makers in avalanche-prone terrain assess the situation primarily by identifying patterns and then adopt a course of action according to their findings. The experts at the congress were unable to agree on how avalanche training should be structured to counter the influence of the "human factor" – feelings, intentions, and attitudes – on decision-making. It became clear, however, that the assessment of the human factor depends largely on the accident analysis and the applied error model. The error model represents a hypothesis on the behavior that caused the avalanche to be released; in other words, on the key factor of human influence. The type of inappropriate behavior that predominates in avalanche accidents is, however, largely unknown. It must be borne in mind that the cause is not always an obvious lack of caution. Even when the prevailing avalanche danger is "considerable," the probability of release is in the range from 1:100 to 1:1000. If behavior is adjusted accordingly, the probability is even lower.

In the densely populated Alpine region, hazard-zone planning and the appropriate dimensioning of buildings and infrastructure facilities in danger zones are especially important issues. The congress took a much closer look at this topic, therefore, than the ISSW workshops held in North America. Presentations focused on the various computer models that simulate the movement of avalanches

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DEEP BREATHING

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the beginning of your relationship in relative security but when halfway down she asks, "Do you love me?" you better know what you're going to say and how you're going to say it. If you're unsure, it's too late. The hundred feet of serious exposure is steep and narrow enough that if something goes wrong, you'll soil your trousers and not even notice. You'll be too busy panicking in the seconds it takes to get flushed 1500' down the line and onto the apron. If you survive without trauma maybe then you'll notice the warm stench seeping through your Gore-tex. I seldom ski this mountain aggressively. It would be fun to fly through the top section and plunge fall line into the cup of the couloir's entrance, but the memories of what it looks like when things go wrong are too clear, and I'm old enough that I don't heal very quickly.

I press deep effortless turns into the rib of comfort and slow as things get more serious. It's already steep enough here that I can accelerate quickly into a ski cut and return to my happy place with a degree of confidence. There's enough room for two or three quick cuts before one must take the plunge. I've done this before, so it's not as freaky as it used to be. No one has triggered any slabs of note in the past few days despite skiing numerous big lines. I have two trusted partners in adjacent lines so things are about as comfortable as they ever get around here. That means I am very much afraid of something going wrong but managing my fear with objectivity and carefully considered action.

The final cut pops out a fresh wind slab, 20-30cms deep and full width. It's about the size of my living room, maybe a little bigger. I see the fracture race out in front of me just as I ski off the slab and onto what remains of the rib, now little more than a strip of loose rock that ends in a precipice above the rest of the chute. I turn to watch the slab pour down the drain, run down the couloir and out onto the apron below. "Hmm, no evidence of unstable slab anywhere except the one spot it lay waiting to smack me down. Just enough wind here last night to lay the hidden trap." I move through the crux and ski out the line to regroup with my partners below. They had just skied adjacent couloirs with similar exposure, elevation, and aspect without incident. Glad I teased my line instead of trying to knock it out of the park.

What's a pobrecito to do?

High consequence lines will always beckon. There will always be another slope to open or a strong group of clients in an apparently stable snowpack or a choice line to pluck when the timing seems right. Some people are good at ignoring potentially high consequences and just tearing into a line they feel good about. Some people don't think much about all the potential results of their chosen course of action and just go for it because that's their style. Maybe they don't stop and breathe enough. I have a hard time with those approaches and often wish I had skied a line harder after I'm safe and sound at the bottom.

I would rather add ten pretty good descents to my list than nine epic runs and one major trauma. My actions are the only input I have before the result, so I try to weigh them carefully. I try to keep my head in the game and my finger on the pulse because I know the mountain doesn't care. It just sits there and waits for me to decide which action I'm going to take. Inevitably a consequence of some sort will follow, but the result doesn't exist in a vacuum. It begins with me. It begins with you.

Doug Krause likes powder, beer, and meat and dislikes surprise avalanches and gout. He lives in Silverton, CO, and is trying to find ways to incorporate fewer facets and more tropical sand into his life.

ISSW REVIEW

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and their effects. Such avalanche dynamic models are much more detailed than they were 10 years ago. Progress in this respect has been achieved, in particular, by measurements taken in a variety of test sites in Norway, France, and Switzerland (Vallée de la Sionne, Valais), chiefly by releasing avalanches artificially. An innovation unveiled at the congress was the prototype of a wireless sensor that is carried along by the avalanche and transmits relative positional data, so that the movement inside the avalanche can be tracked.

It was encouraging that presentations were delivered not only by established researchers, but also by a large number of young scholars, eager to inject fresh impetus into the field of snow and avalanche science. Many practitioners, whose contingent constituted the largest group of attendees, were taking part in such a conference for the first time and expressed their great satisfaction with the event. A large number of delegates would not have attended, had the presentations not been simultaneously interpreted (German, French, Italian, and English). This enabled the experts, in particular those from the major Alpine countries, to deliver presentations and engage in discussions in their mother tongue.

Swiss mountain guide Werner Munter, who has made a ground-breaking contribution to avalanche science over a period of decades, was presented with an award in recognition of his life's work.

A meeting of the ISSW steering committee broadly welcomed the proposal that the ISSW be held in Europe regularly in the future. The successful debut made by the ISSW in Davos is thus likely to have a lasting influence on the congress.

Jürg Schweizer, ISSW 2009 Davos co-chair, WSL Institute for Snow and Avalanche Research SLF.