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In this Issue:

Editors Page

Welcome to the third issue of "The Avalanche Gazette". This spring issue took some time to assemble, perhaps more than winter issues did. It seems that as busy as everyone is during winter we're even busier in spring. In many cases we are catching up on things that we couldn't keep up with in winter or making a transition to summer work, or both.

As we were preparing this issue for "press" we received some very unfortunate news. Frank Tschirky of the Swiss Federal Institute (SLF) in Davos recently died in an accident in the Himalayas. No further details are available at the moment, but we hope that in our next issue we will be able to print something summarizing and recognizing his many contributions to avalanche safety and science. Among those contributions was the tracking of fatal accidents in Switzerland, which were summarized in this publication as well as on the SLF website. In addition to his work in the field of avalanche safety and risk management Frank was a professional mountain guide.

We have two articles which are part of our ongoing series on avalanche beacons and non-government avalanche centers. In addition, we have two articles which we hope will be the first in similar ongoing sequences. This months historical article is from the Rocky Mountain News in 1987 and summarizes major historical avalanche in Colorado. We plan to have other historical articles in future issues. We also have an article on avalanche education in this issue, which is another hot topic that we hope to continue to address.

In this issue, as in the last one, URL's (web addresses) are linked. We have been unable to make these appear like links (i.e. blue and underlined) so far due to some sort of software problem. However, anywhere there is a web-address written out it should be linked.

We hope to have another issue sometime during the summer. If we can round up some information from the southern half of the globe we will. Hopefully our friends in New Zealand will contribute some things during their winter.

Jim Frankenfield
Managing Editor

457 KHz ELECTROMAGNETISM AND THE FUTURE OF AVALANCHE TRANSCEIVERS

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ABSTRACT: The standardized frequency for avalanche transceivers, 457 kHz, presents many interesting, important, and confusing issues, especially related to receive range, flux lines, near field, interference, point sources, receiver design, searching, and specifying and measuring transmit power and receive range. Improved standards and the possible addition of a higher frequency will help in providing a sophisticated, yet uncomplicated beacon in the future for the expeditious rescue of avalanche victims.

1. BENEFITS AND DISADVANTAGES

An advantage of using the (656 m) long wavelength(λ) 457 kHz signal for companion rescue is that there is little attenuation or effect by objects such as snow, the body, metal, trees, and rocks. There is no "multi-path," which means that the signal does not bounce or reflect off of objects in the backcountry, which would present confusion in location systems. [Multi-path is what causes "ghost" images on a television set using an antenna (at about 50 – 200 MHz)].

For a small antenna as used in avalanche beacons, the (near) fields transmitted and received are predominantly magnetic. This is why objects like aluminum shovels don't significantly limit the transmit field strength of a beacon (unless it is placed so closely that it affects the Quality of the antenna and circuitry); the blade may only "block" the small part of the electric field. The earth and its grounding do not attenuate or affect the signal as much. Ferrous objects, however, do have an effect (e.g. steel towers, iron framework).

The boundary between near field and far field is related to the wavelength λ and is $\lambda/2\pi$ (see appendix). At 457 kHz, this distance is at about 100 meters (656m/6.28), so the operation for companion rescue is definitely within the near field. (For reference, the wavelength of a 60 Hz power line is 5 million meters or about 3000 miles and the near-field boundary is 833 km).

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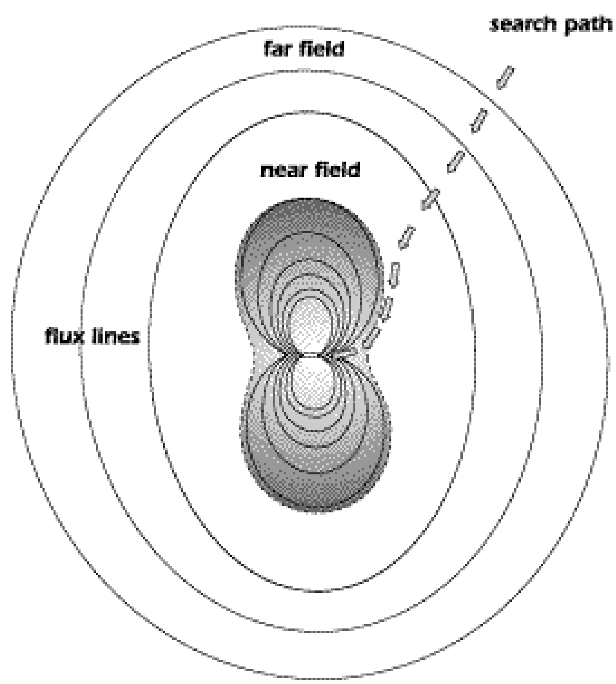
A disadvantage of the 457 kHz frequency is that, in its near-field application, the shape of the signal can be quite complex. In the near field, as compared to the far field, the flux patterns are dependent on the distance (r) from the transmitter, mathematical analysis is very complex, antenna size and type is important, field strength decreases by up to r^{-3} versus r^{-1}, magnetic and electric field dependence varies, and the fields are curved (a far-field application would directly point to the source). This curved shape looks like a figure eight or the wings of a butterfly. Another analogy is that the flux pattern in the near field appears like water coming from a fountain.



Near field/ far field. In the near field, the shape of the signal can be quite complex. A far-field application would point directly to the source.

2. FAR-FIELD EXAMPLES

The question is often raised why GPS (Global Positioning System) technology has not been applied in the field of avalanche rescue. Its frequency is 1.6 GHz, which gives a wavelength (λ) of ~0.19 meters or about 7 inches, which allows for small, efficient antennas. Because of this high frequency, the transmitting satellites need less than 50 Watts to provide usable signals down to earth. There are about 24 satellites in orbit and for the triangulation needed, several satellites are needed. The signals require line-of-sight orientation because the small wavelength signals are blocked by buildings, mountains, canyons, tree, etc. and are severely attenuated or limited by snow. Furthermore, a GPS receiver will tell you where you are, but there is substantial added technology to relay that information to a person searching for you.

Another example of a far-field application is the Recco system currently in use for locating lost individuals. It uses a 1.6-kg transmitter/detector to bounce microwaves at 917 MHz off a special reflector–a thin printed circuit card that doubles the signal frequency–that is attached to an individual's equipment or clothing. One limitation, due to its high frequency, is that the user should always have two reflectors so the body does not interfere with the signal.

3. ANTENNA AND TRANSCEIVER LIMITATIONS

Of course, the avalanche rescue transceiver for companion rescue needs to be a portable product. Therefore, the antennas are electrically small and the (battery) power available is very limited. These are two main reasons, along with the operation in the near field, for little increased range potential at 457 kHz.

For optimum antenna size, its circumference or equivalent height should be one half of a wavelength ($\lambda/2$), or 327 meters at 457 kHz. Therefore, the avalanche beacon antenna is a very small portion of the wavelength. There are things that can be done to increase the effective height of the loop antenna, such as adding a ferrite core and increasing the number of turns of the wire, but the efficiency is still less than 0.1 percent, and this is a limitation with both the transmitter and the receiver.

Transmission power for a beacon is less than 0.1 Watts. Compare this to AM radio stations, which are slightly higher in frequency – they have a power typically greater than 10kW (at least 100,000 times more powerful) – and the transmitting antennas can be hundreds of meters high.

Atmospheric and man-made noise, produced by such things as power lines and weather phenomena, is very high in the region of 457 kHz, and can be aggravated in an urban environment. For all types of receivers, extensive filtering and processing (e.g., mixing) is done to reduce this extraneous noise and to help isolate the beacon's transmission signal, which gets very weak quickly from the transmitter. This partially explains why so-called analog receivers appear to have more receive range: with analog transceivers, this filtering is done by the user's ear rather than the transceiver's microprocessor. Consequently, the usefulness of this weak signal at long range is heavily dependent on the ability level of the user.

This difference in receive range is due exclusively to the noise filtration process of the digital receiver, and has no relationship to the number of antennas used in receiving the signal, as suggested in other literature (Kroell, 2000). On the contrary, the number of antennas actually increases the search strip width. In the case of the Tracker DTS, which uses two receiving antennas, the search strip width is increased by a factor of 15 percent (Meier, 2000). Since search strip width defines the primary search path, not maximum range, this has a stronger effect on the primary search time than a beacon's maximum range.

However, while receive range and search strip width are often perceived as an important product benefit, they may have more marketing value than technical significance. The receive range of an avalanche beacon has no significant effect on the speed of a search or the probability of a live recovery – and can actually prolong the search when performed by recreationists (Atkins, 1999). On the periphery of an analog beacon's receive range, the searcher must cover a relatively large distance before making a determination on signal strength and direction. For recreationists, this can be extremely time consuming, resulting in unnecessary backtracking and signal interpretation. For this user group, it might very well be less time consuming to continue with the primary search until the signal data can be presented with enough resolution to make quick decisions. This is where the signal-to-systems can be seen as a major benefit: it eliminates the "gray area" which can frustrate novice analog beacon users at longer range.

4. ANALOG VS. DIGITAL TECHNOLOGY

A better term for analog beacons would be "audible-based." The human ear is a powerful signal detector out of noise. An example of this is that, in a noisy room it is possible to detect and hear a known voice. It is difficult for a digital signal processing system in the room to detect, recognize, and isolate the speaker, especially if the voice is as loosely defined as it is by the present international standards for an avalanche beacon transmitter. For example, the present broad standard for the on- and off- time may tell a listener or receiver that the speaker in the room is feminine, but a tighter definition would better describe the transmitter's specific speaking characteristics to allow isolation of a specific person.

The greater perceived range of the audible-based transceiver is not due to better design or necessarily better signal-to-noise ratio, but due to the power of the human ear. But the human ear is a very poor judge of loudness (volume) changes. That is why it is difficult to determine the direction of a transmitter based on audio level changes, especially at low signal levels and especially among non-professional users. However, the ear can recognize very fine changes in pitch.

A "digital" beacon can take several forms, but basically it takes the Radio Frequency signal that has been filtered, mixed, and amplified using analog technology and then digitizes this to allow a microprocessor to process it. This provides for many advantages, such as determination of direction (from a dual antenna system), distance calculation, audio interface improvements (such as pitch variation), improved algorithms for signal detection, multiple transmitter isolation and location, automatic sensitivity adjustment, digital filter implementation, and other user interface improvements.

5. STANDARDS

Beacon development is not just limited by electronic technology, but also by down-level standards that do not define the signal characteristics very well, specifically on- and off-times of the 457 kHz carrier. Modernizing these standards could significantly improve the future performance of avalanche transceivers. However, trying to standardize or explicitly define how the beacon should operate is counter-productive. User inferface issues are most efficiently addressed in the marketplace, based on the needs and wants of the consumer.

There is no one international standard. The European standard is ETS 300 718 (currently undergoing revision), with the EN 282 standard still being used in some cases. The only standard for avalanche beacons in the United States is set by the American Society for Testing and Materials (ASTM F1491-93); it sets only the frequency at 457.0 kHz, with no other requirements.

Standards should be modernized so that the signal is better defined to allow better digital signal processing and isolation. Also, product design is challenged by direct tradeoffs between traditional wants and assumptions, "feature bloat," and simplicity. For example, a standard that required a minimum receive range or search strip width might suit the needs of the snow safety professional, but would be counter-productive for the recreational consumer, who generally does not have the skills required to make use of a weak signal at longer range. These conflicts should not be addressed in the standards, but the product developer and (ultimately) the consumer are best suited to determine the best device at the lowest cost.

5. HIGH FREQUENCY AND ID LOCATOR

We propose to significantly improve beacon operation by adding a higher frequency signal to this 457 kHz carrier. With digital technology, this is now more feasible than in the past. This would increase the detection range and would allow giving each transmitter a unique identifier (ID) so that multiple victims can be even better isolated and located.

Since there is more power explicitly in a higher frequency, this would increase the detection range, but without the inherent limitations described above regarding the (non)usability of a weak signal in the near field by the recreationist. Since the operating range would be in the far field, the transmitter could be seen as a point source, initial detection would "point" in that direction, antenna systems could be more optimally designed, and there would be less effect from atmospheric noise. Finally, this higher frequency signal would allow giving each transmitter a unique identifier so that tims could be even better isolated and located. Of course, this frequency would have to be carefully selected based on issues related to snow depth, multi-path, human body effects, radio spectrum allocations, and other considerations.

Adding this higher frequency to the present 457 kHz carrier would not interfere with downward compatibility, or the ability of a newly designed transceiver to detect an "older" transmitter. The higher frequency would "ride" on the 457 kHz signal much like DSL or ISDN data rides on an analog telephone line. The 457 kHz signal would still be used for fine and pinpoint searching in the near field.

5. CONCLUSION

Avalanche beacon design has improved markedly in the past three years, but progress has been limited by the issues stated above. Constraints for future development are not just limited by technology, but by poorly defined standards for the signal and by the need for downward compatibility with existing beacons. Professional use is an important aspect of transceiver design, but one main goal should be to make effective avalanche rescue transceivers accessible to as many users of the backcountry as possible, especially those who are most at risk: recreationists. By leaving user interface issues up to the designers and allowing for a higher frequency in addition to the current 457 kHz standard, transceiver technology could see even greater improvements than the present, yet maintain downward compatibility with the transceivers of the past.

APPENDIX: RF Electromagnetism

There is a detailed and mathematical appendix available on the Backcountry Access website, for the technically inclined reader. You will find it at:

http://www.bcaccess.com/fdindreport/2000issw.html

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FYI...unique news from Europe

Steven Reinfurt

I thought this was kind of interesting from a historical perspective...

To date, there is still an old law in Italy that goes back in history many hundreds of years that basically made it illegal to cause erosion that had harmful effects to your neighbors farm, i.e. doing something that would cause erosion. This same law is now being carried over and applied to avalanches. If you trigger an avalanche you can be prosecuted, even if no one is harmed.

A Sud-Tirol Mountain Guide has been arrested for triggering an avalanche that no one was injured in. A Garmish resident (American) is not able to leave Europe at the moment because he was close to or triggered (?) an avalanche that killed his friend, a Garmish resident (German). The Italians are investigating the accident and may press charges against the American. (Ed. note - in Europe it is common practice for an incident in one country to be investigated by another country.)

In some ways this is a good law, in other ways is very unfair. There are times when back country touring triggers an avalanche that is, for the most part, not foreseeable. One can almost argue that a "avalanche expert" should be able to avoid any avalanche, but in reality, that is not the case. Until skiers/boarders have to have licenses to ski/board, this type of law seems a bit stringent. However, if one triggers an avalanche in a marked dangerous avalanche area then one might be liable for their actions - I think. If it's an unmarked, but easily reachable area that most any skier can reach, this becomes fuzzy logic. It truly depends on the individual case being evaluated.

The Eastern Sierra Avalanche Forecast Center

by John Moynier

Who are we?

The Eastern Sierra Forecasting Center is essentially a one person, part-time position with the help of a variety of local observers and agencies. It is now produced as a community service by through the Bardini Foundation, with assistance from the Mammoth Community Water District. The program was begun as an unfunded, public service project in 1995 with the assistance of local ski mountaineering guide Allan Bard, and Sue Burak, a longtime local backcountry skier, snow surveyor and snow scientist. When Allan was killed in a guiding accident in the Tetons, Sue and I decided to continue the program through the auspices of the non-profit Bardini Foundation. Sue recently left the area to continue her studies and Tim Villaneuva, chief guide with the Bardini Foundation, has taken her place.

Like most grassroots programs, the focus of our efforts has been centered on education and avalanche awareness for local backcountry users. To accomplish this, we broadcast a backcountry report including a general hazard analysis on the local radio station, and distribute printed bulletins throughout the community via fax. We also post bulletins daily on the Internet at www.csac.org. Finally, we offer a series of free avalanche awareness programs throughout the winter with optional field components provided for a nominal fee.

To develop the daily forecasts, we rely on the observations of many local backcountry enthusiasts to compliment our field observations and data. We access local weather and snow water equivalent information from numerous remote sensing sites in the area, and add our personal experience with local conditions to generate a forecast based on the Canadian/ American model.

We try to convey the method, as well as the result, of our analysis in the daily bulletins to further people's education. The Eastern Sierra bulletin has now become one of the most frequented sites on the CSAC web page, and correspondence regarding conditions comes into my office from all over the world.

Where are we?

When most people think of the Sierra Nevada, they may think of Lake Tahoe or maybe Yosemite Valley. In fact, the Sierra is one of the longest mountain ranges in North America, and stretches over four hundred miles, splitting California in two from near Mt. Lassen in the north to the Mojave Desert in the south. We are based in my office at the Mammoth Community Water District facilities located in the Town of Mammoth Lakes, at an elevation of approximately 8,000'.

The eastern Sierra region roughly covers the area between the Sierra crest and Highway 395 from Bridgeport in the north to Lone Pine in the south. The crest averages over 12,000' in our area, with 11 peaks over 14,000'. The Eastern Sierra escarpment rises up to 10,000' from the valley floor over much of the region, and there are literally hundreds of popular peak descents offering over 6,000' of vertical.

Most of the backcountry terrain in the Eastern Sierra is designated wilderness under the jurisdiction of the US Forest Service, with minimal mechanized intrusion allowed. In a few limited areas snowmobiles are allowed access to steep terrain, but with the notable exceptions of the Mammoth Mountain and June Mountain Ski Areas, most of the region is accessed almost exclusively by backcountry skiers, snowboarders, climbers and snowshoers. Even so, with over 20 million people living within six hours of the region, the area can see quite a bit of use.

Due to the extreme rain shadow effect of the Sierra crest, the Eastern Sierra is generally much drier and cooler than the western slope or Tahoe basin. As a result, the snowpack here often exhibits characteristics more typical of continental snowpack, especially early in the season. The area is known, however, for a deep snowpack, heavy snowfalls and big storms with a lot of wind. The average annual snowfall for the Mammoth Lakes area is close to 30 feet, with an average water content of over 44 inches at the 9600' elevation (Mammoth Pass), although there is considerable variability from year to year. Snowfall events in excess of 2" of water in 24 hours are fairly common and events with 3" or more in 24 hours are experienced at least once a season. The general storm pattern comes from the Pacific Ocean in a southwest trajectory and occasionally a "Pineapple Connection" storm will hit bringing 10 feet of snow or more in a single event. Mid-storm wind velocity averages 45 mph over the crest and gusts over 100 mph are fairly common. Winds approaching 200 mph have been recorded at the gondola building on top of Mammoth Mountain.

History

In the early 1980's, the USFS provided a basic avalanche forecasting program consisting of a few snow rangers, posted avalanche bulletins and a snow phone. However, by the early 1990's, the local USFS had gotten out of the forecasting business altogether, and there was no organized program available to replace it. In the early 1990's, the local backcountry community, including Danny Whitmore, Claude Fiddler, Rick Kettlemen, Walt Rosenthal, and Mike Rufer, began a small scale education program. However, no funds for a forecasting program were made available until the big winter of 1995. That year the Mammoth area received over 200% of our normal precipitation, and many inhabited areas were threatened by slides.

The Water District became involved due to the need to protect the safety of crews accessing facilities throughout winter, often during storms. As part of my position as environmental specialist, I was called on to use my background to provide a daily hazard analysis and management plan for District staff. In the fall of 1996 we were approached to provide a weekly radio bulletin on backcountry conditions. This soon evolved into a daily broadcast paid for by Kittredge Sports. That store also hosts the community avalanche awareness program and educational events, and secured the permit with the USFS to offer field classes.

In the fall of 1997, the Mono County Office of Emergency Services became aware of the program through preparations for El Nino conditions and asked to participate. They were soon joined by the neighboring Inyo County OES program, and the Town of Mammoth Lakes. These programs use our information to coordinate search and rescue efforts, as well as road closures and residential alerts in areas exposed to potential avalanche hazard. Through additional training this service to the community can be greatly expanded.

The Future

The success of our program has opened the door for potential funding by local government agencies, including the USFS, in the future. In particular, we are hoping to better reach the snowmobile community, which has definitely been pushing the envelope of safe travel in the past few years. We are hoping that this program can eventually become a self-supporting function of the Bardini Foundation, which hopefully would allow for additional part-time observers and instrumentation. Until that time, we hope to continue to provide this community service through the good graces of the Mammoth Community Water District and local fundraising efforts.

At this point, we are indebted to a number of other individuals and programs in the professional avalanche community including Norm Wilson, Karl Birkeland, Karl Klausen, Knox Williams, Steve Conger, Don Bachman, as well as the local ski patrol and backcountry community. We appreciate any and all suggestions, comments, criticism and helpful hints in terms of improving this program.

“Looking back in Time”

This issues historical article is from the Rocky Mountain Times (Denver, Colorado) and was published in 1987. It is from a collection of articles on loan to the CSAC Avalanche Center from Don Swaim of Colorado. It lists some of the worst tragedies in the state, many of which go back to early days of mining. For a more detailed look at the history of avalanches in the Colorado mountains, including a great deal on the ming days, we recommend the book “Living (and Dying) in Avalanche Country” which may be purchased online through the CSAC store, http://www.csac.org/store/

500 killed in recorded state avalanches

By MIKE ANTON
Rocky Mountain News Staff Writer

About 500 people have been killed by avalanches in recent Colorado history, according to Betsy Armstrong, former associate director of the Colorado Avalanche Information Center and the co-author of two books on avalanches.

The number of unrecorded deaths is unknown, she added. The majority of those occurred in the days when mining was a booming industry.

Between 1950 and July 1986, 88 people were killed by avalanches in Colorado - by far the most fatalities of any state.

Some of the worst avalanche tragedies in Colorado history occurred on:

- Feb. 2, 1883. Six men were killed when they were trapped in a boarding house for coal miners near Crested Butte.
- Dec. 26, 1883. Eight men were killed when snow filled a mine near Telluride.
- March 10, 1884. The most deadly single avalanche in the state claimed 13 lives when a slide wiped out a remote railroad telegraph office near St. Elmo in central Colorado.
- January 1887. Five people were killed in a boarding house near Silver Plume.
- Feb. 12, 1899. Two nearly simultaneous snowslides slammed into Silver Plume, killing at least 10 people.
- Feb. 28, 1902. Three avalanches that came within hours of each other claimed 19 lives at a mining camp near Telluride. Many victims were working to rescue survivors when they were killed by subsequent slides.
- March 17, 1906. Twelve miners were killed in a boarding house above Silverton.
- Jan. 21, 1962. Seven people in Twin Lakes were killed when their homes were destroyed by what is considered the states worst avalanche in recent times. The slide covered the road over Independence Pass with 8 feet of snow and traveled about 4,600 feet down a mountainside.

The worst avalanche disaster in U.S. history occurred on March 1, 1903, when 99 people were killed by a snowslide that swallowed two trains near a town east of Seattle in the Cascade Mountains. The trains had been stranded for several days by earlier slides.

What’s Wrong with Traditional Avalanche Courses?

We have known for many years that the more avalanche courses a person has taken, the more likely they are to be caught in and possibly killed by an avalanche. In the early 1980’s, Ray Smutek wrote a groundbreaking article called “Experience and the Perception of Avalanche Hazard” in which he addressed the problem of why experienced leaders seem to be more likely to get caught in avalanches. His contention was that, due to subtle subconscious conditioning over time of avalanches not happening (an educational process called negative event feedback), experienced leaders became less able to perceive terrain hazards over time. There was a tendency for them to gradually let down their guard until they were unfortunately caught by “The big one.” Therefore, he proposed that avalanche courses be altered to include better training on the perception of terrain hazards. His article was important, not only because it pointed out a disturbing problem with experienced leaders getting caught in avalanches but also because it *acknowledged that there was a serious problem with “traditional” avalanche training.* In the book “Snowy Torrents” (as well as the annual editions of Accident Reports in North American Mountaineering by the American Alpine Club), there are numerous accounts from survivors of avalanches who indicated that they had taken avalanche courses, recognized the presence of terrain hazards and slope instability out in the field — and in many cases even felt that an avalanche was about to happen but still did not turn around. For one reason or another, awareness was not turned in to action. The frequency of these incidents has made it clear that *not even the perception and awareness of terrain hazards is having an affect on reducing avalanche fatalities.* Having been a member of the Ski Patrol Rescue Team and an avalanche instructor for nearly twenty years, I believe there are at least four additional causes for the obvious failure of traditional avalanche courses in reducing avalanche fatalities. My experience with traditional courses, their instructors and their graduates is that:

1) Too much time is spent on avalanche survival, rescue procedures and the supposed importance of “practice transceiver searches.”
2) Too much faith is placed on a student’s ability to assess risk by learning complex topics such as snow pack physics.
3) Not enough time is spent on group dynamics, problem solving, decision-making and conflict resolution. Often overlooked skills include how to anticipate turn around decisions and improve group communication.
4) Virtually no time is spent on learning how to use topographic maps to select and navigate safer routes. This is sad because the single most important factor in reducing fatalities may be knowing how to choose a safe route prior to the outing. Also, it should be obvious that it does no good to select a safe route at home if the student cannot navigate that route precisely out in a snow storm.

I believe these problems all evolved from the history of avalanche instruction itself. Most avalanche instructors (including myself) received their original training through the National Ski Patrol and/or the Search and Rescue Community. This has led to a heavy emphasis on avalanche survival and rescue techniques. It is only natural that instructors would train their students the way they themselves were trained. The students in turn are often looking for a quick (and glamorous?) solution to the avalanche problem. Avalanche courses have therefore evolved into a love affair with Avalanche Transceivers and Transceiver Searches. I have heard more than one instructor boast that they had gotten their transceiver search times down to under three minutes. *The problem with this is that transceivers do not stop avalanches. Nor are there many cases in the records of transceivers stopping avalanche fatalities.* In the pages that follow, I will outline some of my concerns regarding each of the four problems noted above and suggest some alternate teaching strategies which may help reverse the poor track record of current avalanche courses.

I. PROBLEMS WITH TRANSCIEVER SEARCHES

I realize that what I’m saying may seem like blasphemy to many. Currently accepted dogma is that you and all your friends should each buy a $300 transceiver. Then you should all learn how to use them by hiding them in the fruit section of your local grocery store. The belief is that your transceiver will then help to save you should you or your friends be caught in an avalanche. This belief has been greatly reinforced by clubs (which may require them for fear of liability suits if they don't), outdoor stores (which profit from selling them), and avalanche instructors (who received their training from ski patrols and therefore tend to think in terms of rescue rather than avoidance). In opposition to this common view, I maintain that placing your safety in the hands of a transceiver is wishful thinking. The truth is that transceivers may not be reducing fatalities. In fact, they may even *increase fatalities* by giving their users a false sense of security. Even a brief review of avalanche incidents would reveal that transceivers have led to very few live recoveries. By contrast, they seem to be useful primarily in helping searchers recover the bodies. The record number of avalanche fatalities (16) in British Columbia this past winter (1997-98) serves as a case in point. The majority of victims were wearing transceivers, yet there was *not a single case of a transceiver leading to a live recovery.* Similarly in December of 1996 two young men were killed trying to climb a known avalanche slope in high avalanche conditions near Snoqualmie Pass, Washington. Rescuers found their bodies the next day by following the still-beeping transceivers worn by the victims. Both victims had been trained in how to use transceivers rather than how to avoid avalanches. I believe we owe it to the families of the above victims to take a long hard look at current avalanche training procedures. By downplaying the problems of real transceiver searches and overlooking avalanche avoidance options, avalanche courses legitimize risk taking and therefore may do more harm than good.

I believe the goal of avalanche courses should be to reduce fatalities. Fatalities are most likely to be reduced by teaching the concept of avoiding avalanche accidents to begin with. Examine the course content of a Driver Education Class This is an appropriate analogy since the consequences of getting caught in an avalanche are about the same as the consequences of getting caught in a major car crash. Consider how much time in a Drivers Ed class is spent on defensive driving skills (how to avoid a crash) and how much is spent on what to do after the crash happens. There is very little time spent on surviving car accidents (other than to wear your seat belt). While knowing how to use a transceiver has been likened to putting on a seat belt, the truth is that their safety record is completely different. Seat belts have been clearly documented for having saved many lives while transceivers have not. Seatbelts are simple to use with little than can go wrong, whereas transceiver searches are complex and a lot can go wrong. Recognizing the importance of avoidance over survival and rescue, Drivers Ed courses spend little time on how to rescue a friend caught in a car crash. Rather they emphasize, as they should, anticipating hazards and taking the necessary precautions to avoid those hazards. Don't get me wrong - I am not advocating that transceiver searches be abandoned altogether. I own a transceiver myself. I have taught and participated in many practice searches. My concern is that transceiver skills are being over emphasized while other far more important skills are being neglected or even completely over looked. Students are told of the benefits of transceivers without being told of their ineffectiveness in real avalanches. I'm also concerned that practice searches are done in a hopelessly unrealistic manner (see below). The result is that students leave avalanche courses with an overly optimistic view of transceivers. This view then encourages them to take risks they otherwise would not have taken. I'm aware of the argument in favor of using transceivers. I understand the need for a rapid rescue should a person be buried by an avalanche. But I've also spent hours digging in real avalanche deposition zones. I've spent entire days dragging victims out in body bags. I've seen first hand the shock and devastation endured by a family who had waited hopefully all day at a trailhead only to be told that their loved one was dead. In the two years I served on the Ski Patrol Rescue Team, we did not have a single live recovery. Telling your friends to play with their transceivers in the fruit section of their local supermarket underestimates the power of real avalanches, trivializes the difficulty of real transceiver searches and overlooks the dire consequences of what happens when their transceiver fails to save them.

Below are some of the important differences between practice searches and real ones:

1) Real avalanches tend to happen during bad weather (snowstorms, rain storms, high winds, etc.) which limit visibility and group communications. Practice searches by contrast tend to take place on calm sunny days, giving participants a false notion of easy communication and good visibility.

2) Real avalanches usually happen when the group is tired, cold, hungry and dehydrated. These conditions all affect thinking, memory, decision-making, communication and group dynamics. Often it was the very presence of these human factors which caused the group to get caught in an avalanche in the first place. By contrast, practice searches occur when participants are well rested, warm, well fed and well hydrated.

3) Real avalanches cause stresses on participants that practice searches simply cannot duplicate. In a real search there is often shock, disorganization, disagreement, and outright panic. Dazed and confused, searchers may even forget to turn their transceivers from transmit to receive (thereby giving false signals to other searchers). In practice searches, there is the assistance of a strong leader directing a calm, rational sequence of events that is often little more than a run through of "textbook" search steps.

4) Real avalanches, especially the destructive slab avalanches we often see here in the Northwest, run on a surface of ice and leave behind an ice layer that is as smooth and dense as ice at a skating rink. This ice, being tilted at an angle of 35 degrees, is very difficult to ski across and virtually impossible to walk on. Quite often searchers must ski or walk down non-released slopes on either side of the release. Yet I have seen countless practice searches done on sure-footed, soft snow slopes with a slope angle of less than 20 degrees (not to mention the even more ridiculous practice of doing searches in a city park).

5) In real avalanches, the snow in the deposition zone is often twenty to one hundred times denser than the unconsolidated surface snow. Any one who has done a search in a real avalanche deposition zone knows that avalanches, once they stop, set up like concrete. The snow literally becomes as hard as a rock. This increase in density greatly reduces transceiver signal range making it much harder to find the buried subject. By contrast, practice searches are often conducted with transceivers which are either buried casually in a foot or two of unconsolidated snow, or even worse, simply laying on the snow or ground. Both depth of burial and snow density dramatically reduce the strength of the victim's transceiver signal. This is the biggest drawback of practicing "in the fruit section." You get an overly optimistic notion of transceiver signal range. It may be 100 feet in the supermarket. but then less than 20 feet in a real search!

6) Perhaps the most overlooked difference between practice searches and real ones is what happens after the signal location is determined and the digging begins. With the practice search, the transceiver is quickly dug out and the students all celebrate their achievement. In a real search, however, the victim is typically buried in the deposition zone (or base of the avalanche slope). This snow has been super compressed into blocks which are virtually impossible to dig in. It may take an hour or more to dig down two feet. Rather than telling students to practice in the fruit section of supermarket, avalanche instructors should instead tell them to practice digging out in the parking lot. This would give students a much greater respect for the difficulty of digging in real avalanche deposition zones.

7) Even if the victim could be dug out quickly, the prospects for survival would not be great. The sheer weight of dense snow makes it difficult for buried victims to breathe (it takes only three minutes to die from suffocation). For example, in Washington only one victim has ever been found alive after being buried at a depth of greater than two feet. (The one survivor happened to have wound up in an air pocket created by a log.) Even if the victim winds up on the surface, they may still suffocate due to their lungs being filled up with snow during the avalanche.

All of the above should help to illustrate the huge differences between practice searches and real searches. These hard realities should also make clear the absurdity of practicing in the fruit section and "getting your transceiver search time down to under five minutes." If transceiver "practice" searches are utilized at all, students should be warned about the above noted differences and informed about how unsuccessful transceivers have been in actually saving lives. During the Avalanche Avoidance Course at Bellevue Community College, we too conduct "practice" transceiver searches. But while most avalanches courses practice transceiver searches in order to instill confidence in their use, we practice searches for the exact opposite reason. We want to show our students exactly why they should not place their faith in transceivers and transceiver searches. We do this by adding several twists to the traditional practice search. We arrange for virtually everything that can go wrong to go wrong. We bury the transceiver deep and pack the snow in densely on top of it. We arrange for students to make mistakes to illustrate group dynamics problems. We also clearly spell out the differences between our practice "scenario" and a real search. The goal is not for students to leave with a glowing appreciation of transceivers but rather with a clear and sober understanding of *how unreliable transceiver searches really are.*

I have many more concerns about practice transceiver searches, not the least of which is the mind-set it promotes in snow travelers that avalanches are something to be "survived" rather than something to be "avoided". I am also concerned about the false message that if you are caught, you needn't worry because your buddies will be able to save you. The cold truth is that a disturbingly high percentage of people who are buried in avalanches are killed by them - whether they are wearing a transceiver or not. Avalanche instructors, books and videos are fond of saying that "the best way to survive avalanches is to avoid them." However, students are given a confusing double message when more time is spent on rescue techniques rather than avoidance techniques.

II. RISK ASSESSMENT MAY IMPLY RISK ACCEPTANCE

My second concern has to do with how risk management is taught in traditional avalanche courses. I have heard many avalanche instructors talk about "assessing the risk factors so that you can make your own decision about whether or not to ski a hazardous slope." There are two problems with this approach. The first is that avalanches are very complex in nature. Having my degree in the Physical Sciences and having assisted in both physics and chemistry labs, it is obvious to me that the general public does not deal with complex topics very well. Errors and misunderstandings are common, anticipatable results. It is likely that students will miss critical data and therefore make poor and occasionally even disastrous choices. The second problem with this approach has to do with consequences. Avalanche hazard assessment is often discussed as if one were trying to come up with a weather forecast. This ignores the obvious fact that a blown weather forecast might only result in someone getting wet, whereas a blown avalanche assessment may result in a fatality. Given the likelihood of errors and the consequences of those errors, I question the wisdom of introducing too much complexity (such as snow pack physics) in to basic avalanche courses. I would maintain instead that there is "safety in simplicity" and argue that awareness of the possibility for a "weak layer in the snowpack" is better than an incomplete understanding of "temperature-gradient metamorphosis". Even if students did understand snow pack physics, this knowledge is practically useless since few students actually go out and dig a snow pit on their own. Even if they dug a pit, they are better advised not to rely on their own analysis. Avalanches are extremely complex and very difficult for professional experts to predict. It is foolhardy for amateurs to be betting their lives on a shaky "risk assessment".

I have also heard many avalanche instructors talk about the concept of an ***"acceptable level of risk'*** which varies from person to person. Peggy Luce, a friend and former student of mine who became the second American woman to climb Mt. Everest, described this as the "race-car driver syndrome." It is only by taking great risks that you become famous in the outdoor community. High-risk takers seem to be admired not only in America but especially in places like Japan and Europe. They are adopted as role models and looked up to by students and instructors alike. It is instructive to note that while Europeans may lead the world in transceiver technology and guide training, they also lead the world in avalanche and climbing accidents and fatalities. Is this, then, really the kind of example we ought to be following?

I have heard it advocated that climbers and skiers have the right to "choose their own level of risk" and it is not up to instructors to question the actual risk-taking process. But this position ignores the fact that taking risks with avalanches is a lot like playing Russian Roulette. If you play this game, it's not a question of if you'll be caught, it is only a question of when. Moreover, the consequences of getting caught could possibly be a fatality. I believe if this were more clearly pointed out to risk-taking students, they would be less likely to want to play the game. *A reduction in fatalities will not occur by teaching students how to play this dangerous game, but rather by persuading them of the importance of not playing the game to begin with.*

Many students (and instructors) have argued that it is "my life and therefore my decision to make." But even this position ignores the affect that your death would have on your friends and family. While on the Ski Patrol Rescue Team, I participated in several "avalanche rescues." We saved no one. Instead on every mission we did nothing but drag people out in body bags. This fact in itself was very depressing. But the hardest part of it all was delivering the bad news back at the trailhead and dashing any hope family members waiting there might have that their son, daughter, brother, sister or best friend was still alive. I know of whole families that, even ten to twenty years after the fatality, are still devastated by the event. The sudden, tragic loss of a loved one out in the mountains and the grief and second-guessing associated with it seem to be too much for many people to deal with. This experience has persuaded me that *climbers and skiers do not have a right to kill themselves and in fact have a responsibility to those who raised them and those who love them to anticipate hazards, take adequate precautions and avoid getting killed if it is at all possible.*

III. GROUP DYNAMICS...A PARTIAL SOLUTION

In 1994, Jill Fredston, Doug Fesler and Bruce Tremper wrote an article entitled "The Human Factor —Lessons for Avalanche Education." Their article was prompted by the "increasing number of avalanche accidents in which the victims have some level of avalanche training. By investigating avalanche accidents, we have learned that the human factor is a major contributor." In their conclusion, they stated "In teaching mountain travelers how to evaluate avalanche hazard, it is not enough to focus on the physical factors causing avalanches." *Their recommendations included placing more emphasis on teaching route selection, decision-making and group dynamics as critical elements in the human factor of avoiding avalanches.* Their thoughtful analysis makes it clear that more time should *be* given to group dynamics. Essential topics include communication of concerns versus suffering in silence, problem solving, decision-making (versus avoidance, denial and wishful thinking), and conflict resolution (how to anticipate, avoid and deal with group conflicts should they arise). However, this change alone will not reduce fatalities unless students are also taught practical skills for actually avoiding avalanches.

IV. IMPROVING ROUTE SELECTION AND NAVIGATION SKILLS

Which leads me to my final concern - Is it possible to avoid avalanches and still travel on snowy mountain slopes? I have heard some avalanche instructors maintain that it is not possible, that there is always some risk. I disagree with that position. I believe that it is possible to travel safely on some terrain most of the time with absolutely no risk (or at least substantially less risk than drivers face every day while driving their cars). Moreover, the basic principles of identifying safe terrain and choosing safe times are very simple and can easily be taught to beginning students to a high level of mastery (i.e. where they get 100% correct answers) in a fairly short period of time. These skills include how to select a safe route on a USGS 7 1/2 minute topographic map and how to stay on that route through basic navigation skills while actually out in the snow. I believe strongly that *the most important tool we have to avoid avalanches is a topographic map.* Sadly, map reading and snow navigation skills are hardly mentioned much less taught in current books, videos and courses on avalanches (other than courses like those we teach at Bellevue Community College).

The methods currently used to teach evaluation of slope angle are a good example of this problem. Current books, videos and courses talk about using inclinometers to measure slope angle. But inclinometers only work well if you are actually on the slope or exactly perpendicular to the slope of concern. Using equal length ski poles to measure slope angle also requires you to actually be on the slope. A far better method is to use a ruler (on the baseplate of most compasses) and examine possible route options on your map BEFORE YOU EVER LEAVE HOME. If you find a spot on the 7 1/2 minute map where there are two or more brown contour lines in one-sixteenth of an inch, you have found a slope that exceeds 33 degrees and warrants your attention. We have been teaching this simple method for evaluating slope angles as part of selecting routes for many years but I have not seen it even mentioned in any other course, video or book. Maps not only allow you to analyze your route and chose the safest option, but they also permit you to analyze possible hazards that are out of sight and upslope from you. Maps can also be used to distinguish ridges from valleys and determine slope aspect to the wind and sun as well as potential elevation and temperature changes. So why is it that map reading is not taught by traditional avalanche courses? Perhaps it is because instructors assume that students already know how to read maps. Even if this is the case, few students (or instructors) seem to be aware of how map reading can translate in to avoiding avalanches. I believe the real reason goes back to how avalanche instructors themselves were taught. Since map reading was not part of their original training, they do not see the importance of teaching it to their students. For the same reason, traditional avalanche courses fail to teach snow navigation, despite the fact that many avalanche fatalities could have been avoided if the victims had only been able to stay on route.

CONCLUSION

The true test of a successful avalanche course should not be whether students felt their instructor was knowledgeable or even whether students felt that they got their money's worth. Rather, it should be whether or not the students are all still alive ten years later. If the goal of avalanche courses is to reduce avalanche fatalities, then traditional avalanche courses have failed in that mission and major changes should be considered. In particular, we need to re-evaluate the current emphasis on transceivers and transceiver searches and the underlying message this sends to students about the acceptability of taking risks. We should make it clear that practice searches bear little resemblance to real avalanche searches and that transceivers do not stop either avalanches or fatalities. We need to stress instead the importance of avoiding avalanches and focus more classroom and field session time on those skills which will reduce fatalities. While adding sections on group dynamics and decision-making would be an excellent first step, by itself it is not enough. More time also needs to be spent helping students learn how to select and navigate safer routes. It should not be assumed that students already know how to read maps or can translate this skill into safe route selection decisions. Greater emphasis needs to be given to snow navigation. It does little good to choose a safe route at home if you cannot navigate that route out in a blizzard. Yet even students with years of experience in the mountains often don't have a clue how to navigate a route in a white-out. Finally, we should examine our own role models. Outdoor instructors need to emulate driver education instructors and school bus drivers instead of world-class climbers and racecar drivers. This may result in a course that is less glamorous, but it will help us achieve our goal of fewer fatalities.

I hope this article might lead to the kind of changes that will actually help rather than hinder the decision making process of backcountry travelers by giving them the skills they need instead of merely the skills they think they need. I realize some of the ideas stated in this article might seem radical (and even outright wrong) to some. I am very interested in feedback on this matter from students, avalanche instructors and other avalanche professionals. I therefore encourage you to write me with your concerns, both positive and negative. Thank you for taking the time to read this article and consider these ideas. I look forward to hearing from you. *Please feel free to call me at (425) 888-3031 or send your comments to: David Spring, 49006 SE 115th Street, North Bend, WA 98045. I can also be reached via e-mail at wildernessspring@aol.com.*

Avalanche Safety and Climbing

Jim Frankenfield
http://www.mountain-guiding.com/

Since the last issue of the Gazette had a few articles concerning avalanche safety and snowmobiling and since the spring is a popular time for climbing it seemed that an article on avalanche safety and climbing would be appropriate for this issue.

There are several things that differentiate the hazard assessment process of climbers from that of skiers, snowmobilers and snowboarders. I hope that this article will help climbers recognize some of the important factors which may not have been explicitly covered in their avalanche course, especially if it was oriented towards skiers. And perhaps it will also encourage educators to include some of these factors in their course programs when some of the students are climbers, or even to offer climber-specific courses.

The factors discussed here are those which came to mind while writing this article. While I believe these are the most important ones the list is surely not complete. Readers who are experienced climbers are encouraged to discuss additional factors they feel are important either in a letter to the Gazette or in an article of their own.

Length of Exposure Time

Climbers are often moving uphill on potential avalanche slopes, or on climbs below such slopes (as is common with ice climbing). This means that they are exposed to hazards for a much longer time than is typical of skiers or snowmobilers. The length of time can be difficult to predict in some cases and can be prolonged by the team growing fatigued, equipment problems or other complications. These potential problems are usually unforeseen.

Lack of Access to Starting Zones

While many avalanche courses emphasize making observations while traveling to the top of a slope via a safe route and then collecting information in or near the starting zone this is rarely an option for climbers. Climbers are beginning at the bottom and may be hundreds or even thousands of feet below the starting zone(s). While there may be some opportunity for observations while approaching the bottom of the slope it is likely to be hindered by the darkness of an “alpine start”, and any information collected will need to be extrapolated and combined with weather factors to draw any conclusions about the higher elevations.

Changing Plans can be Difficult

Skiers and snowmobilers can often change their plans relatively easily once in the field, if they choose to do so. They can ski or highmark a different aspect slope than originally planned, keep to lower angle terrain, or choose a different destination entirely. Climbers may sometimes have some of these options but in many cases they are limited. Once an approach is completed it may not be feasible to choose an alternate route if the planned route is deemed too risky. Once on a climbing route there may be very few, if any, alternatives other than retreating. (And sometimes even retreat is difficult and/or time consuming.)

Goal Orientation

Climbing is an inherently goal-oriented activity. In many cases climbers have a goal they set, and their work schedule may only provide limited opportunities to pursue that goal. Often they set out with a goal in mind based on the fact that the weather seems to be good but fail to consider the snow stability or the implications of the apparently good weather for the safety of the route.

The Decision Making Process

Due to the above factors the decision making process is clearly different for climbing than for other activities.

Climbers are faced with the need to make a decision well in advance, in the planning stage and/or in the early hours of the morning in darkness. They need to consider the implications this decision may have over the next several hours or longer. Snow stability is not the only factor that requires several hours or more of foresight, the potential for changes in the teams rate of progress and the time involved in any possible “escape routes” (including retreating) must be kept in mind as well.

Because they will not have many first hand observations, and certainly not from higher elevations, climbers will need to base their route and timing decisions on weather factors more than anything else.

The “human factors” will often include different factors for climbers, factors which should be accounted for to the greatest extent possible. Goal orientation and risk propensity may vary within the team, especially if it is a relatively large group. Team members attitudes and thought processes may be effected by cold winds and darkness during the early hours when key decisions must often be made. Such conditions can be overly intimidating, especially for less experienced climbers. This often results in a feeling of insecurity and overly conservative decisions. It can also lead to a hesitancy to fully participate in a group decision. It is important to make an effort to involve the entire team as much as possible when making key decisions.

The Importance of Planning

While most recreational incidents could be prevented in the planning stages this is especially important for climbing. What time of day should the team be beyond certain key slopes or landmarks? What options exist (on both the ascent and descent) if the team is running late or conditions differ from expectations? How much time do these options require (i.e. when must decisions on using the options be made)? These factors should be re-evaluated constantly while climbing but if they are poorly addressed in the planning stages there will be a greater likelihood of problems (from avalanches or from other things).

If you are teaching avalanche safety to climbers make an effort to convey the importance of these things. Spending time on stability testing in starting zones and snow physics isn’t going to help your students nearly as much as these things will.

Incident Updates for 2000-2001

Switzerland, Compiled by Frank Tschirky; SLF, Davos

Editors Note: As this issue was being prepared we learned that Frank had recently died in an accident in the Himalaya. See the Editors page (pg 2) for additional comments. This table was completed by using information from the SLF website (www.slf.ch) which Frank had been compiling.

27 people (as of May 21, 2001) - 6 out-of-bounds skiers, 1 out-of-bounds snowboarder, 1 helicopter skier, 3 climbers, 13 backcountry skiers, 1 icefall climber, 2 rescuers

Cantons: UR = Uri, VS = Valais, GR = Grisons, BE = Berne, SZ = Schwyz, TI = Ticino, NW = Nidwalden

Date	Location	Canton	Activity	Description	Fatalities
11/11	ski resort of Gemsstock, Andermatt	UR	4 people out-of-bounds (skiers and snowboarders)	3 caught, 2 partly buried 1injured, 1 person dead	1
11/12	Pte des Grands, Trient	VS	3 helicopter skiers	1 person caught and completely buried; ski visible on the avalanche debris (burial time: just 7 minutes!)	1
01/13	Arête des Ombrintses, Chandolin	VS	1 out-of-bounds snowboarder	1 person caught, completely buried (burial depth: 200 cm); found by an avalanche dog; died in the hospital"	1
01/13	Piz Padella, Celerina	GR	1 climber (solo) with snow shoes	"1 person caught, completely buried; missing on 16.01.01; found on 17.01.01 (by transceiver search with a helicopter)"	1
01/16	Täschehorn, Setzehorn, Blitzingen	VS	"1 backcountry skier (solo) descending"	"1 person caught, completely buried; small burial depth, ski-pole vissble; missing and found on 17.01.01; big air-pocket"	1
01/28	Mittaghorn, Stiereberg, Gsteig	BE	"3 backcountry skier ascending"	"3 people caught, 2 people partly buried, not injured; 1 person completely buried (burial depth: 85 cm, burial time: 45 minutes), found by transceiver search, died in hospital"	1
02/03	Eisfälle Plat de la Lé, Zinal, Ayer	VS	6 ice climbers	"1 person caught and completely buried; found by rescue team one day later"	1

Date	Location	Canton	Activity	Description	Fatalities
02/03	Eisfälle Plat de la Lé, Zinal, Ayer	VS	6 rescuers	""6 people caught by a second avalanche when searching the buried icefall climber; 3 people partly buried, 3 people completely buried; 4 people not injuried, 2 people killed""	2
02/04	Rinderhorn, Leukerbad	VS	"2 backcountry skier ascending"	"2 people caught, 1 person partly buried, not injuried; 1 person completely buried, found by transceiver search through companions"	1
02/04	Forstberg, Chäseren, Oberiberg	SZ	"1 backcountry skier (solo) ascending"	"1 person caught, completely buried (burial depth: 150 cm); found by transceiver search through rescue team"	1
02/06	"Tête de Balme, Skigebiet Le Tour, Trient"	VS	9 out-of-bounds skier	"4 people caught and completely buried; 1 person not injuried, 1 person injuried, 2 people killed (depth of 1 person: 450 cm)"	2
02/11	Pizzo Rotondo, Bedretto	TI	3 backcountry skier	"3 people caught by a huge avalanche and completely buried; last missing person found on 13.02.01"	3
02/22	Salinas, Alp Sadra, Fuldera	GR	7 backcountry skiers ascending	"7 people caught (remote triggering from the bottom of a slope); 4 partly buried and not injuried; 3 people completely buried, all found by transceiver search through companions; 1 person not injuried, 1 person killed, 1 person seriously injuried (died on 26.02.01)	2
02/23	Ski resort of Ernergale, Mühlebach, Goms	VS	2 out-of-bounds skiers 1 out-of-bounds snowboarder	1 person (skier) caught, fell down 600 m, not buried, died of injuries	1
02/24	Mördergruebi, Ski resort of Hoch Ybrig, Oberiberg	SZ	2 out-of-bounds skiers	1 completely buried (burial depth: 200 cm); found by probing through rescue team, burial time: 5 hrs , 50 minutes	1

Date	Location	Canton	Activity	Description	Fatalities
02/27	Erzböden, Älpli, Arosa (Ski resort of Parpaner Rothorn and of Arosa)	GR	6 out-of-bounds skiers	2 people caught and completely buried; both found by transceiver search through companions; 1 survived; 1 died (230 cm)	1
02/27	Wandeli, Schwalmis, Emmetten	NW	3 backcountry skiers descending	2 people completely buried both found by rescue team;	1
03/05	Surettalückeli, Splügen	GR	7 backcountry skiers descending	2 people completely buried; both found by transceiver search through companions; 1 survived; 1 died (250 cm)	1
03/13	Hübschhorn, Simplon	VS	2 backcountry skiers ascending	1 person completely buried; carried about 1500 m; found through companion search (visible parts, beacon); died of injuries	1
03/19	Piz Valdraus, Lavazgletscher, Medel	GR	4 backcountry skiers ascending	4 caught, 3 completely buried, 1 person partly buried; this person found all 3 others by transceiver search; 2 people survived, 1 person died (guide)	1
05/19	Piz Palü, Nordcouloir	GR	2 climbers, ascending	2 persons caught, 1 p. found dead close to deposition, 1 p. not yet found (21.5.01)	2

Scotland, Compiled by Blyth Wright Co-ordinator SAIS
SportScotland Avalanche Information Service

Along with the table Blyth sent the following comment:

I am still chasing a few incidents, but attached is the table is it at the moment. No incidents reported in April, which is pretty amazing considering the amount of snow we had.

2000-01	Time	Involved	Buried	Dead	Injured	OK	Comment	Area
25-Nov-00	11:00	4	0	0	0	4	Climbers	North Cairngorms
28-Dec-00	14:10	2	1	0	0	2	Walkers	North Cairngorms
3-Jan-01		3	0	0	0	3	Climbers	Lochaber (Ben Nevis)
13-Jan-01		2	0	0	0	2	Walkers	North Cairngorms
14-Jan-01	14:30	1	0	0	0	1	Climber	Angus Glens
16-Jan-01	12:00	6	0	0	0	6	Walkers	North Cairngorms
16-Jan-01		1	0	0	0	1	Ski tourer	North Cairngorms
21-Jan-01	12:30	1	0	0	0	1	Walker	South Cairngorms
21-Jan-01	12:00	2	0	0	2	0	Walkers	Glencoe
21-Jan-01		2	1	2	0	0	Climbers	Angus Glens
10-Feb-01	11:20	1	0	0	0	1	Ski tourer	North Cairngorms
10-Feb-01		2	0	0	1	1	Climber	Torridon
10-Feb-01		1	0	0	0	1	Climber	Black Mount
10-Feb-01		1	0	0	0	1	Climber	Black Mount
10-Feb-01	13:00	2	0	0	0	2	Walkers	Tyndrum
11-Feb-01	14:05	3	1	0	1	2	Walkers	Glencoe
23-Feb-01	16:30	1	0	0	1	0	Climber	South Cairngorms
24-Feb-01		5	0	0	1	4	Walkers	Ross-shire
24-Feb-01		2	0	0	0	2	Climbers	Ross-shire
X-Feb-01		3	0	0	0	3	Walkers	Loch Ericht
12-Mar-01	12:00	1	0	0	0	1	Climber	North Cairngorms
21-Mar-01	8:00	1	0	0	1	0	Climber	Ben Nevis
21-Mar-01	11:30	3	0	0	0	3	Climbers	North Cairngorms
21-Mar-01	11:30	6	0	0	0	6	Climbers	North Cairngorms
22-Mar-01	12:30	2	0	0	0	2	Avalanche Observers	North Cairngorms
27-Mar-01	19:30	2	0	0	0	2	Climbers	Creag Meagaidh
	Totals	**60**	**3**	**2**	**7**	**51**	**26 events**	

US Incidents, Compiled by Jim Frankenfield

33 people (as of May 20, 2001) - 1 hunter, 2 snowboarders, 10 skiers, 15 snowmobilers, 1 snowshoer, 2 hikers, 2 climbers

Fatalities	Date	State	Vicinity	Activity	Description/Notes
2	Apr 28	Utah	Salt Lake	Climbing	glide avalanche, early in day
1	Apr 11	Washington	Mt Baker	Snowmobiling	high-marking, 6600' S, 9-10 am
1	Apr 04	Montana	W Yellowstone	Snowmobiling	high-marking, 10,000' (3000m)
1	Apr 04	Montana	Bozeman	Skiing	2-3' crown, 36 degrees avg.
1	Apr 03	Colorado	Summit Cnty	Snowmobiling	alone, terrain trap
1	Mar 18	Alaska	Talkeetna	Snowmobiling	2 buried, 1 recovered alive
1	Mar 18	Colorado	Routt County	Skiing	victim had no beacon
2	Mar 10	Utah	Uinta Mnts	Snowmobiling	no beacons or shovels
1	Mar 05	Wyoming	Tetons	Snowmobiling	no details available
1	Feb 27	Utah	Park City	Skiing	out of bounds, The Canyons
1	Feb 25	Colorado	Crested Butte	Skiing	triggered on convex roll
1	Feb 23	Wyoming	Teton County	Skiing	small slab, carried over cliffs
2	Feb 22	California	Squaw Valley	Skiing	2 teens skiing out of bounds
1	Feb17	Washington	Cle Elum	Snowmobiling	6500', steep NE aspect
1	Feb 07	Wyoming	Jackson	Skiing	went over cliff band
2	Feb 03	Alaska	Eureka	Snowmobiling	very large slide, deep burial
1	Jan 29	Washington	Lk Wenatchee	Snowshoeing	surface hoar over ice, low elev.
1	Jan 17	Montana	Jackson	Snowmobiling	equipped with safety gear
2	Dec 31	Montana	Bozeman	Hiking	narrow funnel path, 1600' vertical
1	Dec 29	Colorado	Cameron Pass	Snowboarding	600' vertical, buried 1 ft deep
1	Dec 25	Wyoming	Teton County	Skiing	3rd of 3 skiers to cross the path
2	Dec 17	Montana	Marias Pass	Snowmobile	snowmachine stuck, terrain trap
1	Dec 14	Utah	Willard Peak	Snowmobile	stuck in drift on a road, in path(s)
1	Dec 09	Alaska	Cantwell	Snowmobile	highmarking, machine just freed
1	Dec 09	Wyoming	Teton Pass	Skiing	terrain trap, skiing alone
1	Dec 01	Wyoming	Teton Pass	Snowboard	buried 1 hr 5-6 ft deep
1	Nov 27	Wyoming	Near Cody	Hunting	terrain trap (cliffs)
33	**Total US Fatalities**				

About the Authors, Contributors and Editors ...

John Hereford is the designer of the Tracker DTS avalanche transceiver and founder of Rescue Technology, Inc. of Boulder, Colorado. He is an electronic design engineer and an avid backcountry skier. John holds a bachelor's degree in electrical engineering from the University of Colorado at Boulder.

Bruce Edgerly is co-founder and Vice President of Backcountry Access, Inc. of Boulder, Colorado. He is an experienced backcountry skier and former contributing editor at Powder and Couloir magazines. He holds a bachelor's degree in engineering from Brown University and a master's degree in business administration from the University of Colorado at Boulder. The Backcountry Access website is http://www.bcaccess.com/

John Moynier has lived in the High Sierra of California since 1978 and has worked as a backcountry skiing and climbing guide for most of that time. He is certified as a ski mountaineering guide by the AMGA and serves as an examiner for their program. Among the numerous books and articles which John has published is the booklet "Avalanche Aware - Safe Travel in Avalanche Terrain". This book is available online from the CSAC store, http://www.csac.org/store/

David Spring is one of the Northwest's most experienced wilderness instructors. Having taught courses in avalanche avoidance, backcountry skiing and glacier climbing at Bellevue Communty College for over twenty years, he has compiled a remarkable safety record. He has conducted over 400 courses and led over 1000 outings without a single mishap. More importantly, no graduate of any of his courses has ever been killed on any of their subsequent mountain outings. To the contrary, on numerous occasions students have credited the skills and information they gained in David's courses with having "saved their life" when confronted with an unexpected wilderness emergency. David has a degree in Science Education from Washington State University and has served as Training Advisor to the Cascade Nordic Ski Patrol and instructor for the Ski Patrol Rescue Team (a division of King County Search and Rescue).

Blyth Wright is the co-ordinator for the SportScotland Avalanche Information Center (SAIS). Their website, *http://www.sais.gov.uk/* , has the distinction of being the first on the net. It is the only known avalanche related website with a slightly longer history than the CSAC.

Frank Tschirky is an Avalanche Forecaster and Mountain Guide who works in the Avalanche Warning and Risk Management section of the Swiss Federal Institute for Snow and Avalanche Research in Davos, http://www.slf.ch/

Dr. Steven A. Reinfurt is a Professional Member of the American Mountain Guides Association *(AMGA)*, *American Association of Avalanche Professionals* (*AAAP, now AAA*), ski industry consultant in U.S. and Europe, Certified Senior *NSPS* professional Alpine and Nordic patroller and advanced avalanche/mountaineering instructor trainer. He works extensively throughout the Alps in avalanche control & education, ski area risk management, search and rescue, and was co-responsible for creating the *AAAP European Section* jointly with the *Innsbruck Institute for Avalanche Research.*

Jim Frankenfield is the Executive Director and founder of the CSAC and is responsible for assembly and distribution of the newsletter. In addition to running www.csac.org he guides and teaches recreational avalanche courses, specializing in custom arrangements and small group/class sizes. His avalanche-related background is posted on his professional services website, http://www.mountain-guiding.com/avalanche/