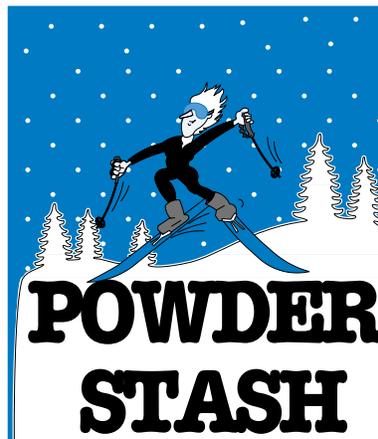


THE Beacon

This year winter came in like a linebacker smelling a crippled quarterback, hard and fast. Avalanches were hitting highways in the San Juans before November even started. The northern mountains were not far behind either. I of course knew that if I tried to pour the foundation for my house during the first week in November winter would come down on me just like the previously mentioned linebacker. So without the hassles of building my foundation, I was free to start looking into the backcountry.

No sooner had the snowpack reached big smile proportions than high pressure returned and the moisture pipeline dried out. This of course provided a worst-case scenario for the snowpack. Now that white gold turned to depth hoar—what most avalanche forecasters anticipate and dread in the same breath. Depth hoar in and of itself is not generally a problem; it's what rests on top of it that becomes the



by Scott Toepfer

big issue. So for December we skied recycled powder and I got to try my first turns on a pair of really fat skis. Even though I was able to ski some amazingly bottomless depth hoar, they still weren't fat enough for some of the biggest depth hoar crystals I've seen in awhile.

After a couple weeks of nice weather, the pipeline reopened and winter returned with a fury during the Thanksgiving break. Winds roared for weeks, snow fell by the truckload, and our weak foundation (not my house foundation) crumbled like potato chips. Avalanche forecasters saw it coming; many backcountry enthusiasts didn't. After several years of mediocre snowfall, powder junkies could not quench their

habits. Our first article for this issue of *The Beacon* will recap the avalanche season of 2000-01. From 1970-88 the number of people caught in slides averaged 35 per year. The number of people caught per year during the 90's averaged 64. The decade of the

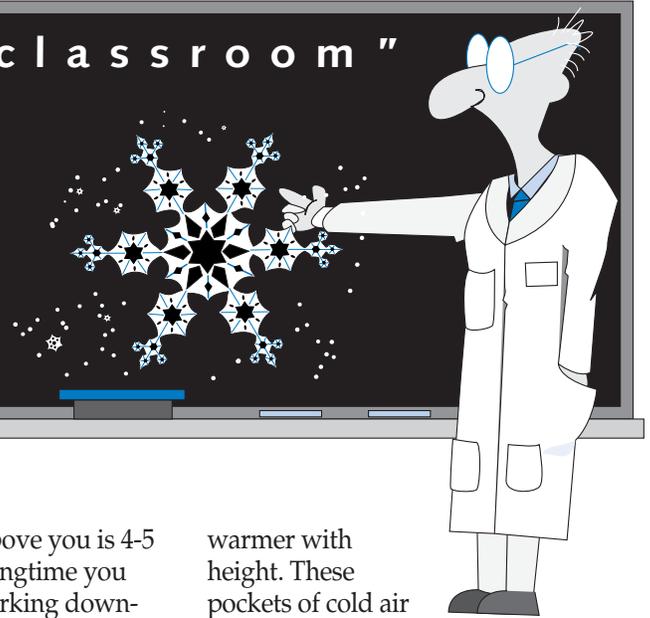
continued on page three



Northern end of the Mosquito Range. (photo: Scott Toepfer)

Inversions

by Scott Toepfer



Temperatures generally fall as you go higher in elevation. This is called the environmental lapse rate. The average environmental lapse rate is 3.6 °F per 1000 feet (6.5 °C per kilometer). In other words, if you were to ascend 3,000 feet (nearly a kilometer), the temperature would normally drop about 11 °F. It can vary, however, depending on whether the atmosphere is saturated with water vapor (cloudy) or if it is dry (bluebird day). When the air is warm, temperatures may drop only 2 °F/1000ft, and at colder temps it is nearer to 5 °F/1000ft. If you are climbing a peak during the winter, you can forecast a fairly good guess that the temper-

ature 1,000 vertical feet above you is 4-5 degrees colder. In the springtime you can use this in reverse working downward: if you are at 13,500 feet waiting for the temperature to warm the snow-pack up to a perfect corn surface, 2,000 feet below it may be well into the melt phase and wet avalanche activity may be imminent.

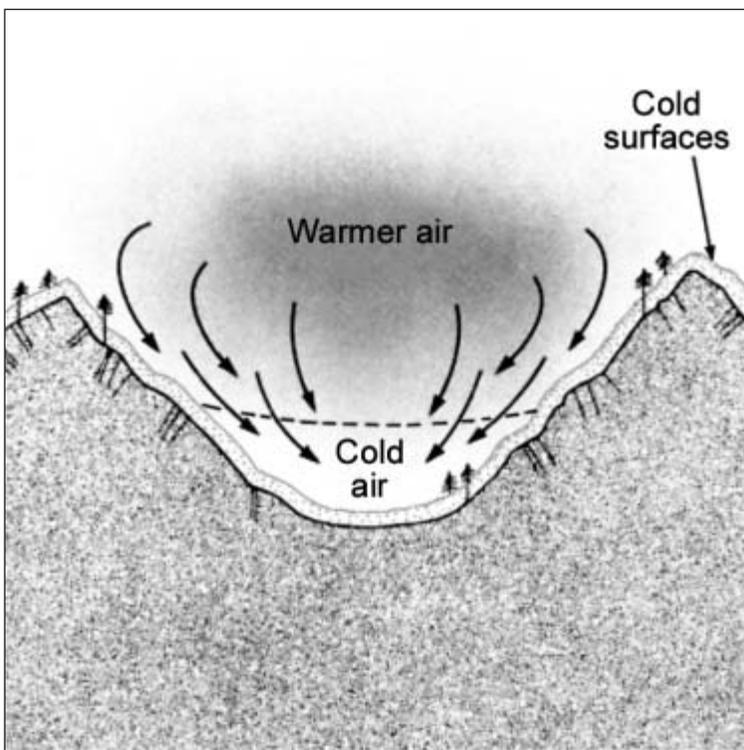
For those who live in mountain valleys, this cooling with height may not always be the case. Places like Silverton, Fraser, Alamosa and Gunnison are often colder than the summits of the surrounding peaks. This phenomenon is known as a temperature inversion, in which temperatures actually get

warmer with height. These pockets of cold air can extend for as little as 50 feet, but they have been measured over a mile and a half in height above the earth's surface. Just this last winter while riding chair 7 in Telluride there was a noticeably warmer temperature before we even reached the first lift tower, less than 50 feet off the valley floor.

What causes this reversal in temperatures in mountain valleys? There are several different possibilities, but only one really applies to our mountains in Colorado. It is the Nocturnal Surface Inversion. This occurs when radiation loss from the surface (snow or ground) causes temperatures to rapidly drop. The colder, denser air then pools in depressions and valleys. (Other types of inversions are Advection Inversions, when warmer air moves horizontally over a colder surface, and Frontal Inversions, when two air masses of different temperature interact, and the colder, denser air wedges under the warmer air.)

In places like Fraser, Alamosa, Silverton, and Gunnison there are five necessary ingredients to get a good inversion going. They are:

- 1) Long nights, when outgoing earth radiation far exceeds incoming solar radiation.
- 2) Clear skies, which let terrestrial heat loss radiate into space (whereas cloudy nights trap radiation and keep temperatures warmer).



Temperature inversion in a mountain canyon. Inversions are the result of nocturnal cooling of the snow surface by radiation loss.

- 3) Dry air, which goes with clear skies and lets radiation heat escape. (Ask anyone from a tropical climate what they notice most about the high country in Colorado. It's the dry air.)
- 4) Calm air, which allows little mixing of the different layers in the atmosphere.
- 5) Snow cover, which, being white, reflects a great deal of the incoming solar radiation back into the atmosphere during the day and also acts as an insulative blanket over the warmer earth.

Certain areas are more prone to this temperature inversion phenomenon.

Colorado has a few of the better known "ice boxes" of the nation. After looking at the requirements for a nocturnal inversion, it becomes a little more obvious that inland/continental sites are more likely to see these cold spots. It's drier here so we have a large number of clear nights; we frequently have snow cover at many of these mountain valleys, and during the three or four main winter months, November through February, the nighttime hours exceed the daylight hours. Most of our record low temperatures have come during periods of strong inversions.

If you are planning a winter camping trip and want a little warmer spot, don't set up the tent in places that follow the

river bottom or in low depressions. Miniature temperature inversions can form in even the smallest hollows. These are also areas where depth hoar will flourish to the greatest extent. Temperature gradients will naturally be the highest, so the biggest depth hoar grains can often be found in these little miniature climate zones. This may also contribute to some extent in compression zone failures during early season avalanche cycles. There are times when a collapse failure in the runout or bottom of an avalanche path can propagate in shear up the bed surface to the avalanche crown. It is quite amazing how all this weather, terrain and snowpack tie so intricately together in avalanche country.

Powder Stash

continued from page one

single digits is starting on a most inauspicious note, with the number of people reported caught already at 110 in early April.

There are certainly some legitimate reasons for this increase. We have a much larger and better-trained group of observers so we would expect to hear of more incidents. The number of people going into the backcountry is increasing dramatically, so simply put, the more triggers, the more avalanches that catch people. But the strangest part is the small number of fatalities compared to people caught. There were a number of close calls, but why so few fatalities?

I have some theories: First, more people have gotten an avalanche education and know what to do when caught to reduce their risk of getting killed. Second, snowmobilers generally wear lots of clothes as well as a helmet. This probably creates a lot of air space around the body, possibly making the person caught just a bit more buoyant. We know that snowmobilers have an advantage with helmets, which may create an air space and may possibly allow carbon dioxide to escape out the back. And third, of course, sometimes it comes down to plain dumb luck.

Some of these theories would be difficult to prove; frankly it would be hard to find a large group of volunteers willing to jump naked, or even fully clothed, into a moving avalanche to test this theory. One thing I do worry about is that people may start to view avalanches as a carnival ride, a very disturbing possibility. In this issue we recap a number of interesting and tragic avalanche incidents that took place during the 2000-01 winter season.

Our next article has the good Professor Flake exploring a common phenomenon in mountain valleys, the temperature inversion. Maybe my car is just becoming more temperamental, but it seems like we had an abnormally high number of days when we woke to cold valley temperatures. Temperature inversions are not uncommon, but certain atmospheric requirements are necessary to bring the really cold temperatures.

Once again the Friends-of-the-CAIC program was a success, for you and us. Our original goal was 1000 Friends, and we are get-

ting there. This year we had 660 Friends who were generous in their contributions and supported what we do. If there is anything you would like to see us try in the future please let us know, and again, thanks for your support.

Finally a little food for thought. A friend of mine once told me, "If you wouldn't ski it alone, why would you drag a bunch of your friends into it?" ❄️



The dreaded glop. One of the perils of spring skiing with fresh powder. (photo: Scott Toepfer)

Year-end Avalanche Wrap-up

by Scott Toepfer

There were times this winter when we came to the office and looked at the number of messages waiting on the answering machine and just shuddered. And the growing number of people caught in slides stunned the four of us in the office. Here's a summary of the avalanche season.

OCTOBER

The avalanche season started in a hurry this year. In October, 17 avalanches were reported. All ran in the southern mountains with the exception of one large loose natural slide on Mt. Massive near Leadville. Six ran naturally, snowboarders and skiers triggered two, and the rest ran during control work at Wolf Creek. No one was caught in any of these slides.

NOVEMBER

During the first real month of winter, 173 avalanches were reported to the Center. Of these, 96 came from the northern mountains, and the largest ran naturally for 1,000 vertical feet at Breckenridge on the 30th. In the central mountains only 16 slides were reported, and many of these were from Highlands Bowl at Aspen Highlands. There was a big push to open Highlands Bowl to the public this year, so the ski patrol was quite active in their work at stabilizing the starting zones. A couple of the slides in Highlands Bowl were triggered with explosives and ran 1,100 vertical feet on the 21st and 22nd. In the southern mountains there were 61 reported slides. Top-length honor went to one on Red Mountain Pass that ran 1,700 vertical feet and caught three people. This avalanche was chronicled in a story titled *A Tale of Avalanche Survival* in the second issue of *The Beacon* this year.

In all there were 10 avalanche incidents in November that caught 16 people, partly buried 3, injured 3, buried 1, but killed none. Some of the more interesting incidents were:

Nov 7th, Grays Peak near Loveland Pass: A climber was caught, injured and evacuated by helicopter.

Nov 19th, Telluride: Two ski patrollers were caught in a manmade snow avalanche.

Nov 22nd, Aspen Highlands: Four people boot packing in Highlands Bowl triggered a small slide; one grabbed a tree and stopped, but the other three, including one patroller, were swept varying distances down the hard bed surface, the longest about 300 feet.

Nov 29th, Front Range: Four people were caught in separate slides ... three backcountry skiers near Loveland Pass and a ski patroller at Berthoud Pass.

DECEMBER

Climatologically December is one of the driest months of the year in Colorado. There were no real surprises this year either. Still, 739 avalanches were reported to the center for the

month of December, mostly because of a large cycle in the middle of the month in the northern mountains. There were 432 avalanches reported from the northern mountains, 174 from the central mountains, and 133 from the southern mountains. We have always estimated the number of reported avalanches to be about 10 percent of what actually occur.

The longest reported slide for December was on the 7th, when the "Stanley" ran to the edge of U.S. 40 on Berthoud Pass. Honorable mentions go to a huge slide on the 15th on Ruby Mountain near Irwin Lodge in Gunnison County, which was 2,500 feet wide and 2,000 vertical; and in the southern mountains, the "Fairview" path on State Highway 110 outside of Silverton ran 1,600 feet.

In December there were 17 reported avalanche incidents that caught 34 people, partly buried 5, completely buried 4, and killed 1. Here are some of the avalanche incidents from December:

Dec 3rd, Herman Mountain near Eisenhower Tunnel: A young woman took a 1,200 foot ride and escaped totally unscathed. An interesting anecdote to this incident is that this path is at mile marker 218 on I-70 and the incident occurred at 2:18 in the afternoon. On the same day at about 2:18 in the afternoon at mile marker 218 on Loveland Pass a skier triggered and was caught in a slide in what are known as The Steep Gullies.

Dec 7th, Breckenridge: Two ski patrollers were caught in two separate slides. The interesting note to these is that each of the paths had been shot with explosives 8 times, and had been ski cut 5 and 8 times, respectively.

Dec 11th, Rocky Mountain National Park near Dream Lake: A guides' training course became a good news, bad news event. The bad news was that 11 guides were caught in the runoff of a small avalanche that was only 150 feet wide and running only 30 vertical feet. The good news is that all were experienced in rescue.

Dec 17th, Diamond Peak on Cameron Pass: Another good news, bad news incident when two snowboarders were caught and buried in an avalanche. The good news was that one person managed to dig himself out and then dug his partner out. The bad news was that one man's dog perished in the slide.

Dec 29th, Diamond Peak near Cameron Pass: Tragedy finally hit when a lone man hiking up the east face of Diamond Peak was buried and killed in a slide. The debris overran a spot that two snowshoers from Minnesota had been standing on two minutes earlier. They had been filming the lone hiker moments before the slide ran and had turned to leave as he neared the ridge. The debris stopped just a few feet away from where they stood. The hard slab avalanche was 250 yards wide, averaging 3 feet deep, and ran 760 vertical feet.



Spring tour in the Gore Range. (photo: Scott Toepfer)

The victim was carried about 600 vertical feet and was buried about 1 foot deep. The end of his snowboard was found sticking out of the debris after the victim had been buried for over 3 hours. Colorado was no longer dodging the bullet.

JANUARY

January was a quiet month for avalanches when compared to the first half of the season: Only 291 avalanches were reported statewide. The northern mountains, with 52, were particularly quiet, but the depth hoar continued to grow. The central mountains were not much busier with 83, and the San Juans reported 156. The largest of these was near Ashcroft on a path known as Orient Express off Mace Peak on the 28th. This path ran 1,200 vertical feet. This came during an active cycle in the Gothic/Ashcroft area from the 25th-28th. Even though only 4-6" of new snow fell in the area during this time period, there was a 12-hour period on the 25th when 3" of snow fell with winds of 20 mph. Also, there was a similar avalanche cycle during this same period along the Highway 550 and Highway 110 corridors in southern Colorado when 50 slides were reported, but in this instance 45" of snow fell at Purgatory and 29" at Telluride.

For January there were six incidents with six people caught. Only two people were partly buried and no one was injured.

Jan 1st, Loveland Ridge on Loveland Pass: The New Year began with a bewildering event. Four snowboarders were set to ride a slope. The first rider put nice tracks down the slope, while the second made a huge GS turn to the riders' right and triggered a slide 150 feet wide and 100 feet long. The second rider started back-peddling on the moving debris that

slowed him enough to drop out the back of the slide. The other riders cheered the event, which indeed had the elements of a carnival ride, but one that is not regulated for safety. None of the riders had avalanche gear, and they apparently ignored a recent slide which ran just to their right.

Jan 28th, Durango: Two hikers in an area known as the "Test Track" witnessed a skier and a snowboarder working their way to the top and stopped to watch their descent. The skier made good tracks along a sharp ridgeline while the snowboarder moved below a line of trees and was sucked into a gully where he triggered a small slide, only 20 to 25 feet wide, but in a nasty terrain trap. The slide ran to the ground for 175 to 200 feet but only partially buried the rider. The skier and snowboarder ended up on two very different routes and lost track of each other. Luckily the snowboarder was not injured and was able to dig himself out.

FEBRUARY

Where January had been quiet, February was a rock concert. In Colorado 751 avalanches were reported. The northern mountains were the most active with 272, while the central and southern mountains had 249 and 230, respectively. There were a number of slides vying for top honors in February. The longest ran nearly 4000 vertical feet to the valley floor of Conundrum Creek on the 23rd in the Elk Range. In the northern mountains on the 13th the Stanley Path on Berthoud Pass ran once again and left 100 feet of Highway 40 buried 20 feet deep after running 2,200 feet. The Cabin Slide near Gladstone in the San Juans produced a near miss when on the 11th it ran 1,300 vertical feet and came within 100 feet of the cabin.

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Year-end Avalanche Wrap-up

continued from page one

Andy Gleason wrote an article in the Winter 1999 (Volume 3, Number 2) issue of *The Beacon* about this slide hitting the cabin on March 29, 1998. The longest slide in the southern mountains was on the 11th when Temptation Gully, an infamous path into Bear Creek just off the Telluride Ski Area boundary, ran full track to the valley floor, a fall of 2,800 feet.

It will be hard to pick out just a few of the 24 avalanche incidents to touch on from the month of February. In all 27 people were caught in slides, 8 were partly buried, 4 buried, 1 injured, and 1 died. So far this year, 83 people had been caught, far above the 1990s average. Here are the lowlights:

Feb 9th and 10th, Ptarmigan Pass near Vail Pass: Five people were caught and partly to completely buried in five separate incidents. Of these the most serious was a skier completely buried but rescued by members of their party.

Feb 16th, Molas Pass on Highway 550: A skier and a snowboarder were hiking up a small slope in an area known as West Lime Creek just off the highway. Their goal was to build a jump. CDOT had shot this area earlier in the week and so the two men assumed the path was stable. They triggered a small slide 150 feet wide and 1-4 feet deep that ran 300 vertical feet. Both were caught, and the snowboarder was buried head first, 5 feet deep with just a foot sticking out of the debris. His partner was not buried and had the only shovel and was able to dig his friend out alive.

Feb 18th, Cameron Pass: Four skiers dug a snowpit and did stability tests, and three members decided to ski a shallower, safer adjacent slope. The 4th skier skied the steep shot and was caught and buried in the slide that ran 600 vertical feet

and buried him 3 feet deep. A textbook beacon search allowed a quick recovery in about 5 minutes.

Feb 25th, Peru Gulch in Summit County: A south slope on Cooper Mountain ran naturally and fell about 1,200 vertical. Two skiers touring on the summer road saw the large slide release above them. They had about 5-10 seconds to get out of the way before they were engulfed in the debris. Both were buried and both had an arm sticking out of the snow. One man was buried horizontally about 2 feet deep but managed to dig himself out after 20 minutes. He saw his friend's arm sticking out of the snow and was able to dig him out in another 5 minutes, alive and very thankful.

Feb 25th, Ohio Pass area, Anthracite Range near Crested Butte: A group of five people were skiing when tragedy struck. A Crested Butte woman triggered a slide on a steep convex roll and was carried into a tree. All members of the group were experienced backcountry users and reached the woman in 2-4 minutes. Unfortunately she had been killed outright from trauma. It was the winter's second avalanche death.

MARCH

Avalanche activity did not slow down in March, and neither did the number of people caught in slides. For March, 608 avalanches were reported: 319 from the northern mountains, and 2 of these were in the running for biggest of the month. The first was in the upper west fork of Clear Creek near Jones Pass; it was 1,200 feet wide, and 1,000 vertical, leaving an estimated 20 feet of debris at the valley floor. The second was a hard slab in the Jenny Creek area west of Eldora (Yankee Doodle Basin) that was 1,000 feet vertical by 1,000 feet wide.



March 19th
slide (Mishka)
that caught
three people
near the
Eisenhower
Tunnel.
(photo: Scott
Toepfer)

In the central mountains, 141 avalanches were reported, the largest being in the Sievers Ridge Cliffs near Aspen that ran for 2,400 vertical feet and came within 100 feet of Maroon Creek. Finally 147 slides were recorded in the southern mountains. Many of these ran over 1,000 vertical feet, but the largest ran naturally in Oh-My-God Bowl near Telluride on the 1st. It fell 2,000 vertical feet and had a crown depth of 4 feet.

In all there were 17 incidents involving people, 23 of whom were caught, 5 partly buried, 3 injured, 3 buried, and 1 killed. Some of the more notable events were:

Mar 1st, Breckenridge: A ski patroller was caught and carried 600 feet over rocks and was buried to his neck. The area had just been shot with 15 rounds from an avalauncher. He had a minor femur fracture, damaged knee and bruised ribs.

Mar 4th, Loveland Pass: Three snowboarders were caught and buried to their necks when an unsuspecting snowboarder traversed above them, triggering a slide.

Mar 18, Farwell Mountain north of Steamboat: A back-country skier was caught, buried and killed in a small slide. The victim did not have a beacon and was found by a search dog about 3 hours later. This was the winter's third avalanche death.

Mar 19th, west side of Eisenhower Tunnel: Three college friends were hiking up an avalanche path known as Mishka

and triggered a slide that completely buried two and the third to his neck. All three managed to dig themselves out (see photo on page six).

Mar 25th, Telluride: A first-year patroller was caught in a small slide and carried into some timber where she was buried to her neck. Normally she would have been charged a case of beer but her supervisor felt she had already paid enough with the experience.

Mar 29th, Steep Gullies at A Basin: A snowboarder was caught in a slide but grabbed a tree. The force of the slide ripped his board from his feet and injured his ankle.

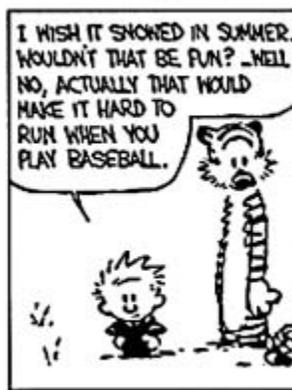
APRIL

We have to go to press well before April is complete, so we do not have April statistics to report. Unfortunately though, we have time to report on the fourth avalanche death of the winter. On April 3, a snowmobiler riding alone on the west side of the 10 Mile Range in Summit County was buried in a slide that released on the steep side of a gully above him. Four hours later friends followed his track, saw the avalanche, and found the victim by probing. Evidence showed that he was probably trying to dig out his stuck snowmobile when the avalanche ran. ❄️

Calvin and Hobbes by Bill Watterson



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