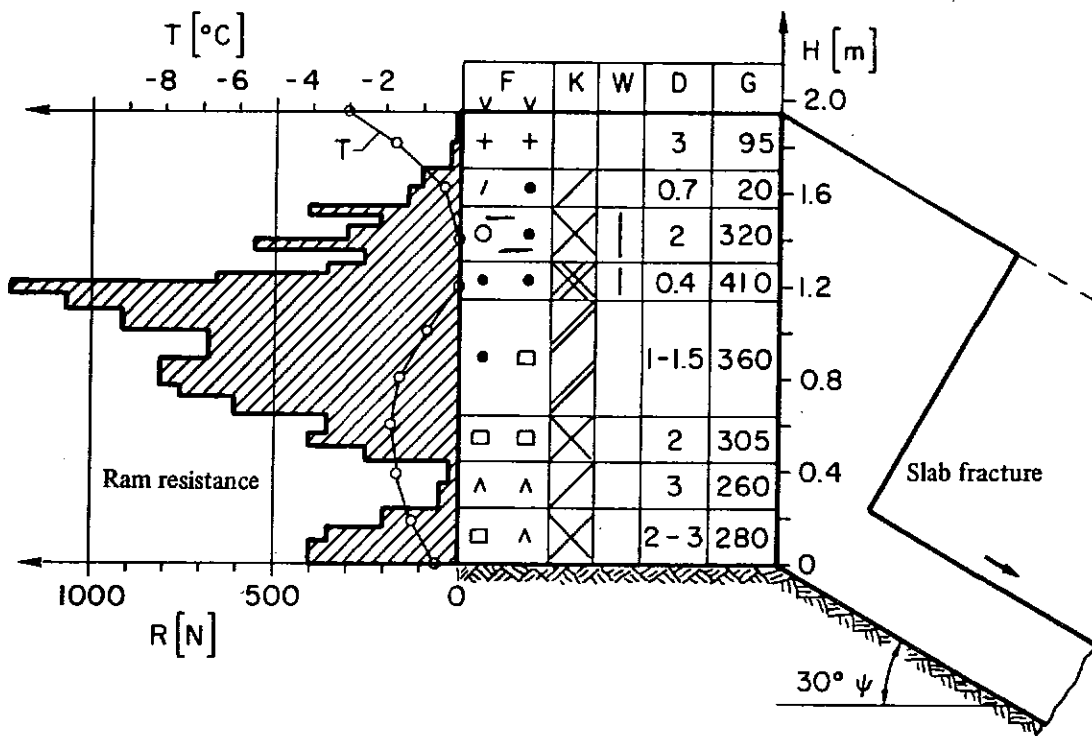




UTAH AVALANCHE FORECAST CENTER

ANNUAL REPORT

1989-90



U.S.D.A. FOREST SERVICE WASATCH-CACHE NATIONAL FOREST

N.O.A.A. NATIONAL WEATHER SERVICE

337 N. 2370 W. SALT LAKE CITY, UT 84116

MAY 1990

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The Utah Avalanche Forecast Center is a cooperative effort between the USDA Forest Service, Wasatch-Cache National Forest, and the NOAA National Weather Service. Copies of this report can be obtained by writing or calling:

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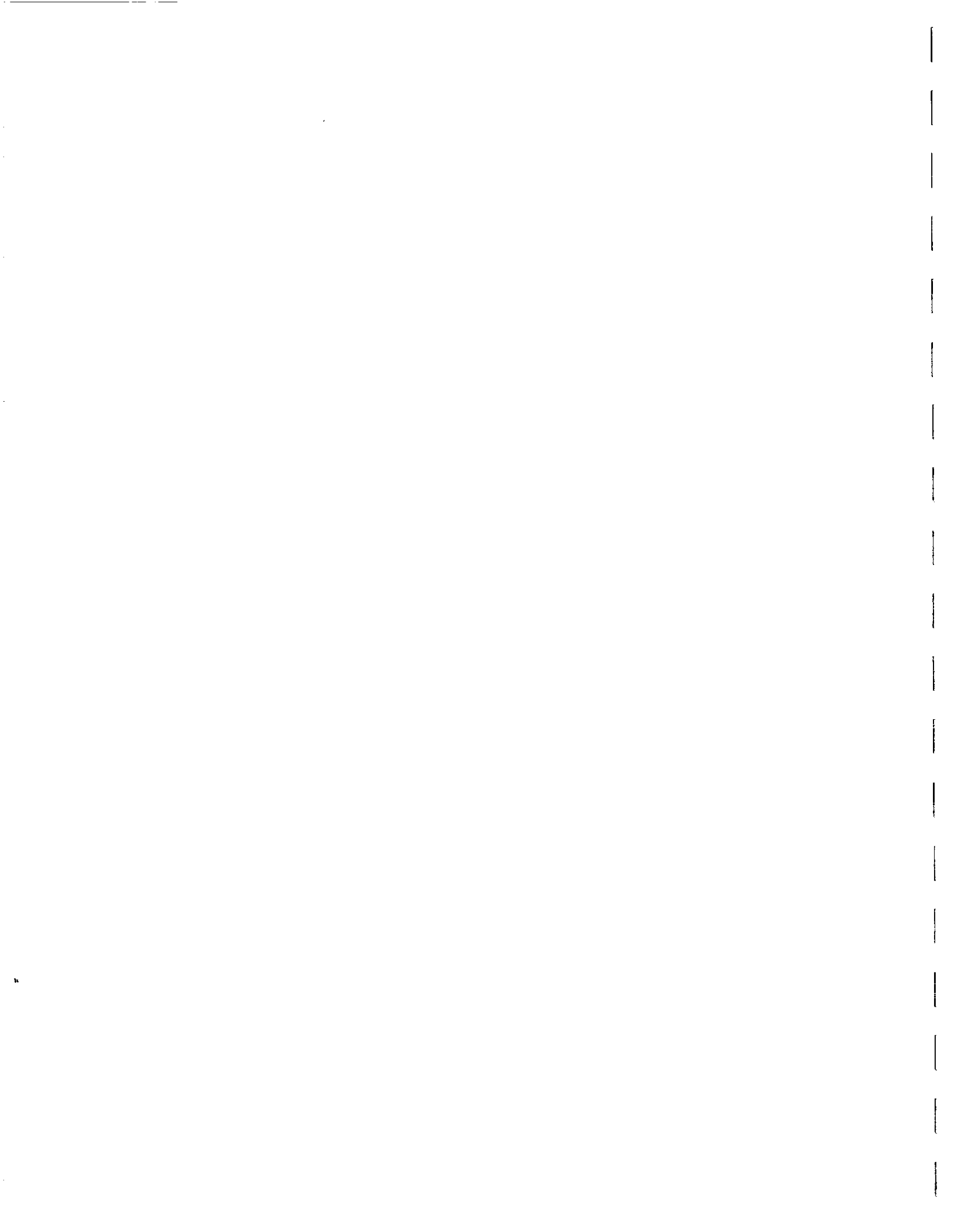
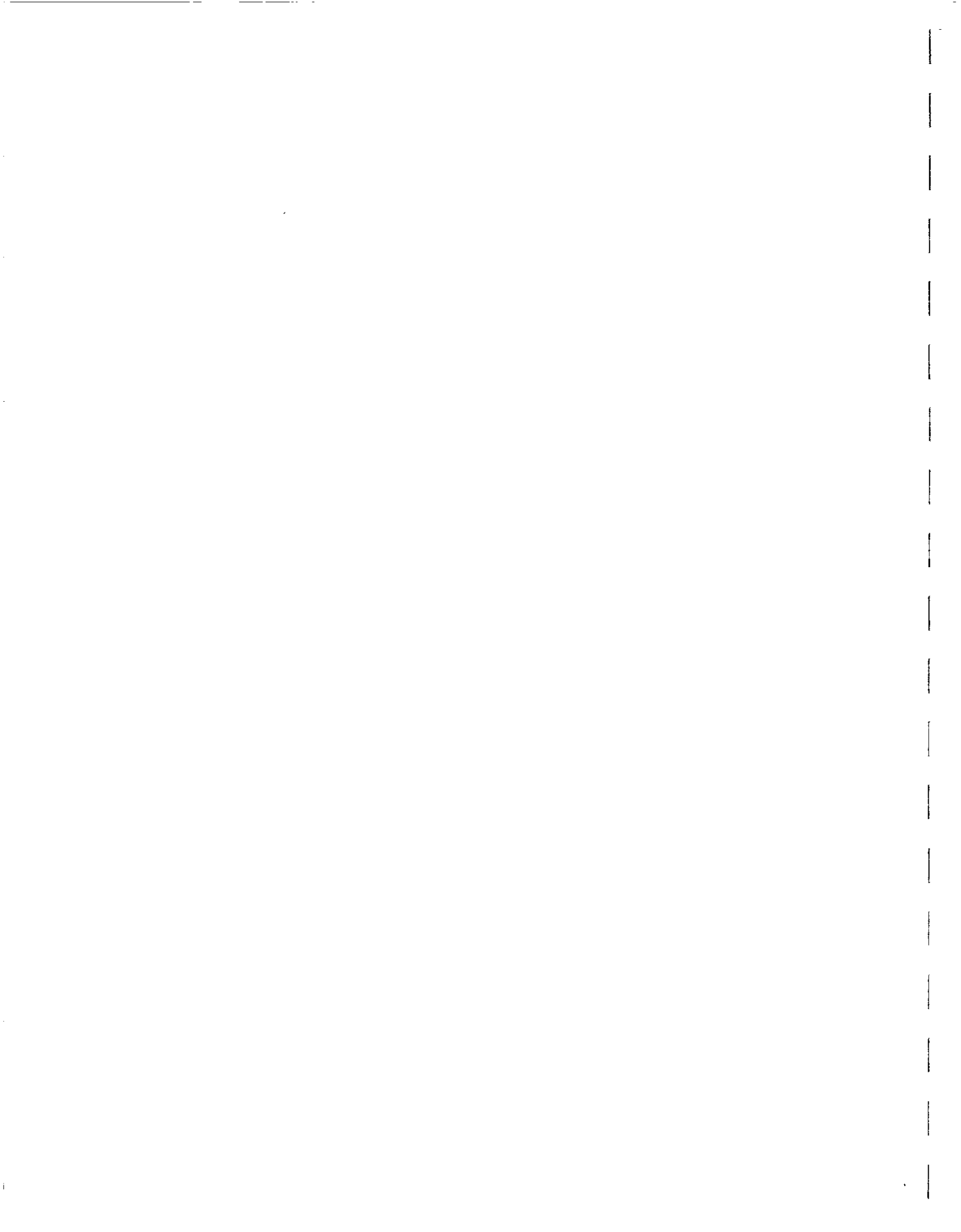


Table of Contents

Utah Avalanche Forecast Center	1
Season Highlights	2
Introduction	4
Changes This Season	4
Season History - Northern Wasatch Mountains	7
Season History - La Sal Mountains	8
Budget and Fund Raising	9
Avalanche Incidents and Accidents	10
Volunteer Observer Program	14
Avalanche Education	14
Media Contacts	15
Geographic and Avalanche Characteristics of the Northern Wasatch	17
Climatology of the Northern Wasatch	22
Characteristics of Each Mountain Weather Station	26
Appendix	
Tables	28
Examples of Avalanche Advisories	32
Examples of Mountain Weather Forecasts	35
Examples of Avalanche Warnings and Special Advisories	36
Letters of Support	40
News Articles	42



The Utah Avalanche Forecast Center

The Utah Avalanche Forecast Center is a cooperative effort between the Wasatch-Cache National Forest and the National Weather Service. It is under the administration of the Salt Lake District of the Wasatch-Cache National Forest with offices located at the National Weather Service at the Executive Terminal Building at the Salt Lake Airport. The UAFC has three charters:

- Issue backcountry avalanche advisories to the public via a network of avalanche hotlines.
- Issue mountain weather forecasts for both the public and the cooperators in the UAFC information network, which includes the ski areas, the Utah Department of Transportation, and any other agencies in need of an accurate mountain weather advisories.
- Provide avalanche education to the public, through avalanche awareness multimedia lectures and short field courses. The UAFC also provides avalanche information to any interested party, which includes numerous requests from both the local and national media.

Backcountry avalanche forecasting in Utah is functionally separated into two entities--the Wasatch Mountains of northern Utah and the La Sal Mountains of southeastern Utah.

In northern Utah, the forecast covers primarily the northern Wasatch Mountains from the Utah-Idaho border near Logan to about Spanish Fork canyon south of Provo. Although very little use--and thus very little information--comes from outside this area, we also advise the public upon request for areas such as the Oquirrh Mountains, the Stansbury Mountains, the Uinta Mountains and Mt. Nebo area. The staff for this northern area includes director, Bruce Tremper, Brad Meiklejohn, Tom Kimbrough, and Dave Ream.

The second backcountry avalanche forecast area is the La Sal Mountains near Moab. In its second year of existence, Mark Yates operates this center which is funded by the Manti-La Sal National Forest. This season report includes a season summary from both of these centers, although it concentrates on the Wasatch section because it receives a vastly higher amount of use.

The public accesses these forecasts via recorded telephone messages in the following locations:

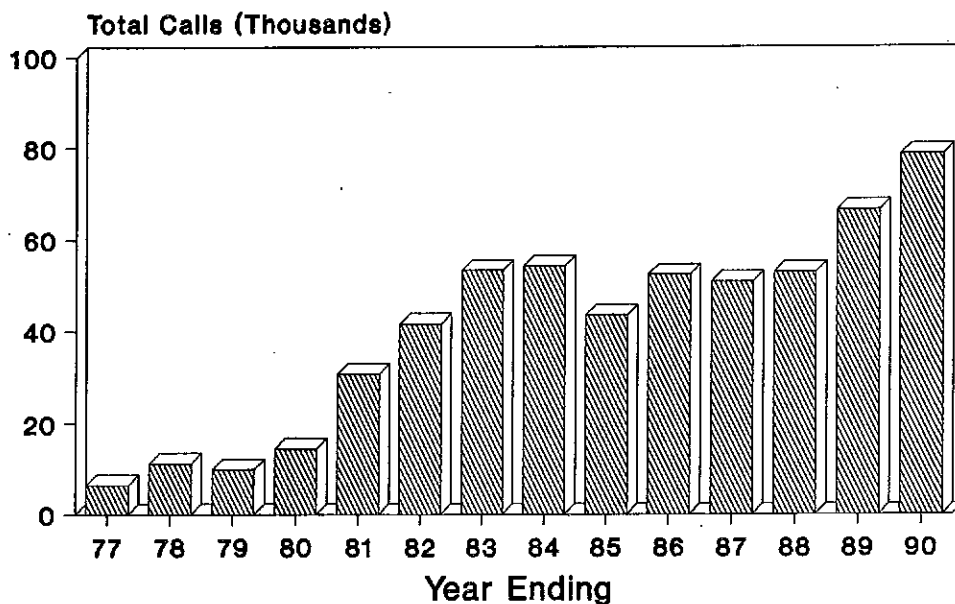
Salt Lake City 2 1/2 minute forecast (7 lines)	364-1581
Salt Lake City 5 minute forecast (2 lines)	364-1591
Park City (one line)	649-2250
Logan (one line)	752-4146
Ogden (one line)	621-2362
Provo (one line)	374-9770
Moab (one line)	258-7669

Season Highlights

The winter of 1989-90 was the tenth season of operation for the Utah Avalanche Forecast Center (UAFC). Some of the highlights were:

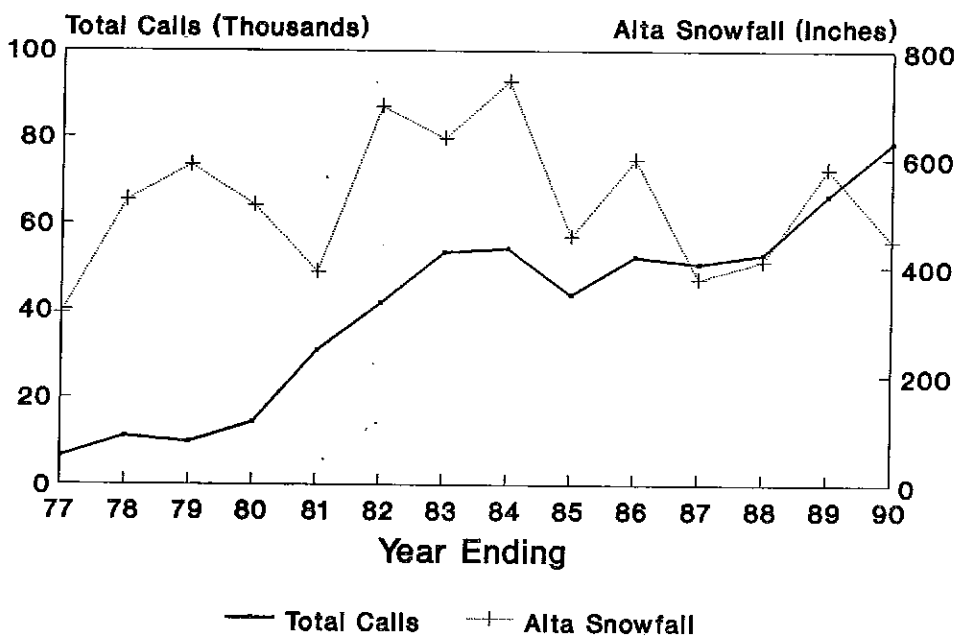
- * For the third consecutive year, no avalanche fatalities occurred in Utah. Over three calendar years have elapsed since the last avalanche fatality in Utah, an event unknown since the early 1960's.
- * The call rate for recorded avalanche and mountain weather information continued to rise, reaching record numbers once again. 80,297 calls were received for the entire network, with 52,898 calls on the Salt Lake City recording line alone. Overall, there was an 18% increase in the call rate over the 1988-89 season.
- * UAFC education efforts reached 2,566 people directly through avalanche slide shows, workshops, and seminars, several thousand through the local media and several million through the national media.
- * 30 media contacts by the UAFC throughout the winter resulted in 20 newspapers stories and three television pieces, including a 5 minute piece on "Good Morning, America." These media contacts provided contact with millions of people in the local, state, and national audience.
- * We continued to increase the amount of information available to the public, lengthening our recorded advisory from 2.5 minutes to 3 minutes, and adding three new access lines to the system.
- * We started a new community service on radio station KRCL, 91 FM, with a morning avalanche advisory, live on the air at 7:55 AM each day.
- * Fund raising efforts continued to be successful. A total of \$27,656.75 was raised through grants and donations from business and private individuals. (A Challenge Cost Share Grant provided \$19,000 in matching funds, a private donation to the Wasatch Interpretive Association for the UAFC provided \$5000, \$1525 was collected at a fundraiser, and an additional \$2,131 was raised through contributions from businesses and individuals.)
- * We improved our network of mountain weather stations, adding one new station on top of Mt. Ogden, and upgrading the existing ones at Alta and Snowbird.
- * The UAFC continued to make effective use of our Observer Network, receiving 232 reports from 9 individuals, at a total cost of \$2980.

Total Calls to UAFC Recording 1977-1990



The total call rate for the UAFC continues to rise. This season's calls totaled over 80,000

Calls versus Alta Snowfall



Call rate versus annual snowfall at Alta. The call rate continues to rise at a rate independent of the amount of snowfall.

Introduction

"Normal" is a word which nature does not understand, only coming to the idea through a series of oscillations. The winter of 1989-90 could not be described as exceptional in any way, but neither was it normal. The total snowfall for the season at Alta was 448 inches, nearly 40" below the 45-year average of 485 inches. Winter started slowly, picked up some speed, and then died an early death. Some minor records were set, such as the amount of water in a 24 hour period, but there were few memorable storms.

The avalanches of the winter of 1989-90 were not normal either. No homes were wrecked, no cars or buses knocked off the roads, and most importantly, no one was died as a result of avalanches. But the threat of deadly avalanches was a constant throughout the winter, and a thousand deaths were died in close calls and near-misses. More people were caught in avalanches (34) and partially buried (14) than in any of the previous five years, and yet still there were no deaths. How can this be? The odds dictate that someone should have been killed in an avalanche this past winter, or at sometime in the past three winters.

At least part of the credit belongs to the Utah Avalanche Forecast Center (UAFC), now in its tenth season of operations. The UAFC is the focal point for all avalanche-related work in Utah, playing a key role in the effective transfer of information between agencies, and more importantly, in passing the information on to the public. The UAFC provides public with the most detailed avalanche and mountain weather information available in the country, if not the world.

But how does this explain the high accident rate in a winter such as this past one? It doesn't. The UAFC does not tell people when they should or should not go into the mountains. We simply provide the information we have available to us, with our analysis of the situation. We expect people to make their own decisions, and for the most part they make them intelligently.

One indication of the effectiveness of the UAFC is that, in many of the backcountry avalanche incidents this season, the avalanches were triggered from a position of relative safety. By relative, I mean that the slides were triggered with a ski cut, or a dropped cornice, or while only one person was high on the slope. All of these situations are better than having a slide release while an entire party is in the middle of the slope. Reasoned decisions are being made in the backcountry by people who have the knowledge and skills to ski safely in avalanche terrain.

Throughout its ten-year history, the UAFC has educated the population of the Wasatch Front about avalanches, mountain weather, route selection, avalanche rescue, stability evaluation, and most recently, safe skiing. The UAFC has done this through lectures and workshops, television and newspaper stories, and most importantly, the daily avalanche report. With respect to avalanches, the backcountry users of the Wasatch Front are, as a group, the most savvy population in the country.

The staff of the Utah Avalanche Forecast Center are proud of the safety record of recent years, and determined to find new ways to improve the program over the next ten years

Changes this Season

New Phone Lines

Three additional telephone lines were added to our Salt Lake network to make access to the public recordings easier. There are now 7 lines coming in to a multi-line announcer for the shorter recorded message, while we now have two access lines for the longer recording. These additions appear to have relieved some of the congestion, although it is still possible to get a busy signal on many mornings.

The call rates on both lines did rise substantially over previous years, and record numbers of calls were recorded for January, February, and March.

**Increased
Message
Length**

We further increased the length of our public recordings from 2.5 minutes up to 3 minutes. However, it seems like we have more "filler" that needs to be read each day, and which takes up nearly 30 seconds of each recording.

**Early Corn
Report**

The most popular UAFC change from the public point of view was the creation of the "Die Hard Corn Report." The most frequent request from the public in the past was that we put the forecast on earlier in the morning. This is difficult to do, considering all the other tasks, but Tom Kimbrough had the brilliant idea that we could put out a quickie forecast first thing in the morning. This is especially useful to the public in the morning, when they want to know whether the snow froze overnight and they are trying to leave before sunrise. The product is easy to put out, ranges from 60-90 seconds in length, and just covers the basics. If there is sufficient demand, we may use this same format during the winter as well.

**KRCL
Radio**

The UAFC continues to seek new ways to spread the avalanche word to the public, and the latest addition is a spot on the community radio station KRCL 90.9 FM. Each morning, at 7:55 AM, the UAFC forecaster of the day would do a live 3-5 minute spot, covering the current avalanche situation and the expected mountain weather. This "radio show" is similar to that which the UAFC has done on KPCW in Park City for 6 years. Both programs are well-received, and seem to be an easy way to reach a large segment of the population.

**Little Cot-
tonwood
Snow
Ranger**

We were very fortunate this year to have Dave Ream on loan to the UAFC from the Salt Lake Ranger District. Dave proved to be a valuable asset, and quickly assimilated all the tasks required to become our much-needed fourth avalanche forecaster. Having Dave freed more time for the remaining forecasters to spend time in the field or to work on projects.

Dave is very talented, and has all the necessary qualities of an avalanche forecaster. He is extremely hard working, and did a very good job of falling into place as a competent weather and avalanche forecaster.

**Satelite
Monitor**

The best physical addition to the UAFC office this year is a new satelite monitor, with which we can closely follow weather changes from our office. In the past, we had to run down the hall to the National Weather Service office to view the monitor. This piece of equipment has helped our weather forecasting significantly, especially for spot forecasts throughout the day.

**Weather
Station**

At the tail end of the season, we were finally able to complete a lengthy project of installing a new weather station on Mt. Ogden. We have long been eyeing this site, as it has excellent exposure for winds. Additionally, this site will fill the large gap in our weather stations which exists between Logan Peak and Park West.

The site is atop the 9572' peak, and due to its proximity to the Great Salt Lake, we feel the winds recorded at this site will be quite high. There is now a large tower on the peak which is used for radio and telephone communications by a number of agencies, including the Forest Service, which leases the site to Motorola.

We have installed at the site, in cooperation with the National Weather Service, a Campbell Micrologger and modem, a thermistor, and Hydrotech wind speed and direction sensors. The latter are the most rugged instrumentation available, and we think this site may test the equipment. We have not had the chance to fully test the equipment in winter conditions, but are anticipating the chance to do so next year.

We feel that these remote weather stations are a key to the success of the UAFC program, and that we should continue to improve the network throughout the Wasatch. The next additions should be a station in the southern part of the range, near Provo Peak or Cascade Ridge, as well as precipitation gauges in the Logan mountains.

**Challenge
Cost
Share**

As part of the Forest Service, the UAFC received \$19,000 in Challenge Cost Share funds from the USDA Forest Service. This will go towards two different projects. First, to upgrade the program of avalanche education by creating several avalanche education videos and conducting an "Avalanche Awareness Week" during the Winter of 1991, and second, to install some new weather stations and upgrade the existing ones. Although, most of the work on the avalanche education project will occur next season, we made significant progress on instrumentation.

In cooperation with several of the ski areas and with the National Weather Service, we purchased, and are installing new weather monitoring equipment at several locations. Our primary objective is to install a new station on Mt. Ogden which we will be able to access through the Forest Service Radio Telephone System. At this time, we have the necessary equipment and are working on the installation.

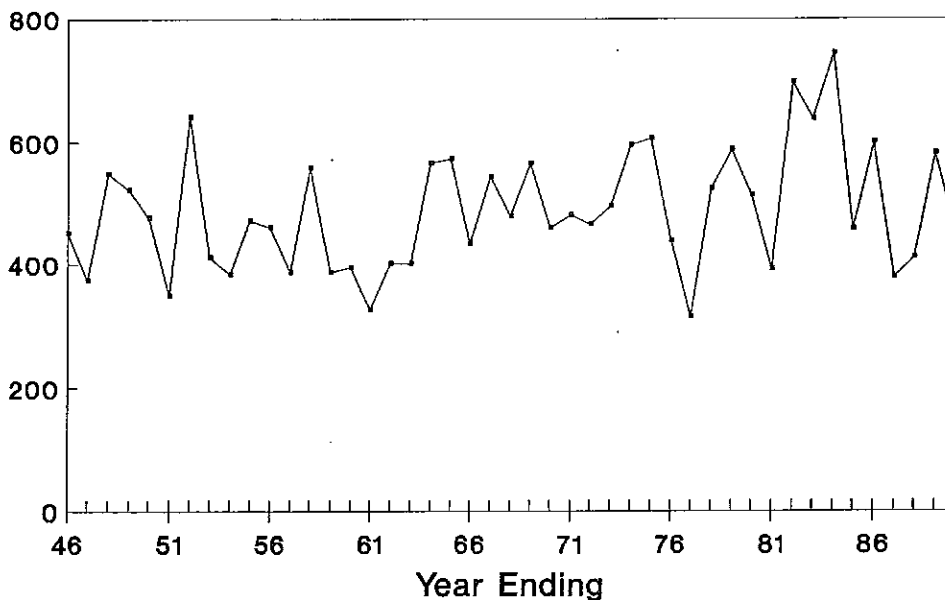
We also purchased microloggers for Alta and Snowbird which will be installed for the 1990-91 season.

**Special
Avalanche
Advisories**

In past years, during especially hazardous conditions or when hazardous conditions needed special exposure (such as on weekends or holidays) we would issue avalanche warnings. However, for times when a full warning was not warranted or when the hazard was confined to a limited area, we needed an intermediate step--something not as strong as a warning. Using an idea from the Colorado Avalanche Information Center, the UAFC this year issued Special Avalanche Advisories on 6 occasions. We used these special advisories in advance of developing storms, before several weekends and holiday periods, and for severe avalanche conditions in a limited area.

These advisories were disseminated through the same network used for avalanche warnings, and allowed fast and widespread exposure to local, state, and national media.

Alta Snowfall 1946-90



The annual snowfall at Alta plotted for the past 44 years. This season was 92 percent of average for snowfall. It was less than that in most other areas.

Season History - Northern Wasatch Mountains

Early Season

This winter seemed like a razor blade commercial. "More close shaves than ever before with Wasatch Avalanche Dragons!" The local Powder Pigs, and the UAFC forecasters along with them, may have set a record in the number of backcountry human-triggered slides, with only a few injuries, and somehow, no fatalities. The avalanche dragons were especially restless but, as Brad Meiklejohn remarked in one of his forecasts, "they are not partial to the taste of the new synthetic fabrics, so they now spit their victims out faster than a two year old at medicine-taking time."

The avalanche dragon's truculence began when the first winter storm put down several feet of snow at the end of October, with clear weather following for the next four weeks. The avalanches, hearing the first ring from the alarm clock, punched the snooze button, and rolled over for a few more weeks of hibernation. Thanksgiving arrived with not many thankful skiers, but a blockbuster of a storm hammered the Wasatch before the holiday weekend was over. The storm broke Alta's record for the amount of water in a 24 hour period, and the records go back 50 years! Naturally, 4.03 inches of water woke the sleeping beasts, who emerged in their usual early-season, ill-tempered state.

During this storm, a skier hiking with downhill gear in the mountains near Logan was reported missing. While it is possible he may have been caught in an avalanche, he actually headed into the mountains the day before the storm struck. It is more likely that he became lost or injured, then overcome by exposure during the storm. At this writing, his body has not yet been found.

Over the Thanksgiving weekend, up to 6 feet of new snow fell on the Wasatch. There was widespread avalanching, and for three days the UAFC issued avalanche warnings. Our local edge-pushing powder hounds listened well to both our warnings and to the dragon's snarls, and stayed out of trouble.

However, the next weekend Tom Kimbrough was surprised by a class 4 slide while digging a snowpit. Fortunately, this incident on Wilson Ridge resulted only in a lost ski pole.

Two weeks of clear weather began December, but several days of light snow followed by a windy night kicked off one of the most exciting weeks of an overly-exciting winter. From the 17th to the 23rd, there was an avalanche incident each day. Fortunately, the avalanches were in a playful mood and after batting their prey around, like cats with mice, they let them all go, without injury.

Santa Claus arrived and departed with no powdery presents for the Wasatch, but, with the New Decade, we entered an extended stormy period. There were no big storms, nothing to compare with the Thanksgiving blizzard, but with only a couple of short breaks, small disturbances kept moving through until mid March. This pattern was made-to-order for avalanche incidents. The skiing was generally quite good, and though constantly present, the avalanche dragons were often well-hidden.

Mid Winter

There were about 30 skier-versus-avalanche match ups in January. On the 11th, Brad Meiklejohn released a class 4 slide in the backcountry near Park West ski area. The snow collapsed while he was walking on a flat ridge, and the slide sympathetically released below him. On the 15th, in perhaps the closest of all the close shaves, several teenagers downhill skiing at Brighton crossed the area boundary signs and one almost didn't come back alive. After triggering a slide which completely buried one of them, the group--which had no beacons, no shovels, and no avalanche awareness--somehow, probed with their skis, found their lost friend, blue, but still alive. Another person was buried to their neck the next day in almost the same spot.

This pattern of small storms and persistent deep slab instability continued on into February. Whenever we began to think the snowpack was beginning to settle down, another few inches of snow would set off yet another series of deep releases.

On February 3, it was Bruce Tremper's turn. While he and his partner were standing behind a line of trees and with a big bush between them and the edge of a drop-off, a hidden cornice broke and tumbled them over a 20 foot cliff. The small amount of snow washed them down a steep slope and Bruce was partly buried. His partner lost both skis and Bruce sprained a knee during the fall, which kept him out of action for a month.

St. Valentine's Day became a real heart-thumper when a slide triggered by a helicopter skier overran

St. Valentine's Day became a real heart-thumper when a slide triggered by a helicopter skier overran another group in a location that had long been considered safe. Several people received minor injuries and one person was completely buried. The Powderbird Guides moved into action like superheros to the rescue, and the buried person was out within 8 minutes.

The Valentine week's storms tracked further south than usual, blasting the Provo area mountains. With a very weak snowpack on the ground in the Provo area, this storm produced the largest avalanches seen in the Wasatch this winter. One slide came off Loafer Mountain descending 5,000 vertical feet and came within 100 feet of a subdivision house. Another slide in the Spanish Fork vicinity was as much as 2 miles wide. All together, there were over a dozen class 5 slides which ran over 4,000 vertical feet.

At the same time, but on the other end of the size scale, a tiny slide in the mountains above Ogden caused the most serious avalanche related injury of the winter. Two 20-year-old's, again with no avalanche training or equipment, headed up looking for a place to make some turns. While walking down a very steep slope of hard snow, they released a slide only 6 inches deep. One of the men was slammed into a tree, badly breaking his femur. His partner splinted the femur with ski poles and dragged him down and out a narrow canyon bottom which eventually turned into a stream. After plunging down through the water for several hours, they climbed up on a ledge, exhausted and hypothermic. They were spotted by a helicopter's search light in the nick of time.

This eventful period was followed by two weeks of clear skies and warm temperatures in late February which finally put an end to the exasperating and persistent deep slab avalanches.

March began with another series of little storms and a new set of avalanche problems. A widespread layer of surface hoar was buried by snow on the first of March, and as snow continued to pile up, this became the new weak layer. Activity peaked at mid-month with a large skier-triggered slide in Stairs Gulch, and several more large avalanches were started by explosives tossed from a helicopter. There were a few people caught during this period but there were no serious injuries.

Spring

Now it was truly Spring! Warm, sunny days and cool nights combined to produce a fine vintage of corn skiing. Unfortunately true to form, most folks headed to the canyon country or started rock climbing and bicycling. With daffodils and tulips blooming, only the most determined skiers could avoid the lure of the warm weather sports.

A last burst of avalanche activity occurred after 7 inches of snow on April 9. The new snow, some wind, and a density inversion, combined to catch a number of ski patrollers off guard, sending them for short rides on the dragon's back. As the slides were small and with few people out backcountry skiing, there were no serious problems.

As temperatures steadily warmed, Wasatch avalanche forecasters began to wonder when the wet slab avalanches would start to run on the depth hoar that caused trouble all through the middle of the winter. But despite episodes of heat, a continuing series of weak disturbances provided enough relief from the heat wave to keep the lid on big wet slides. On April 21, with the snow going fast, our forecast program shifted to an "as needed basis".

Lots of luck, some hard work by the UAFC staff, and plenty of awareness among the Wasatch backcountry users, combined to give Utah it's third fatality-free winter in a row.

The complete season history chart compiled by the Utah Department of Transportation for Alta is included in the Appendix.

Season History - La Sal Mountains

by Mark Yates

The second season of the La Sal Avalanche Forecast Center has come to an end. We again supplied a recorded phone message, giving the public detailed information on avalanche hazard, mountain weather, snow recreation and road conditions. We updated this once per day in the evening. The call rate increased dramatically, despite the unusually low snow year, to 1,693 calls averaging 11 per day. This season, we also included information on the water content of the snowpack, as compared to average. The telephone number is still (801) 259-SNOW. It was another successful year despite a near minimum

record snowpack for the first half of the winter, with the remainder of the season fluctuating around 50 percent of average.

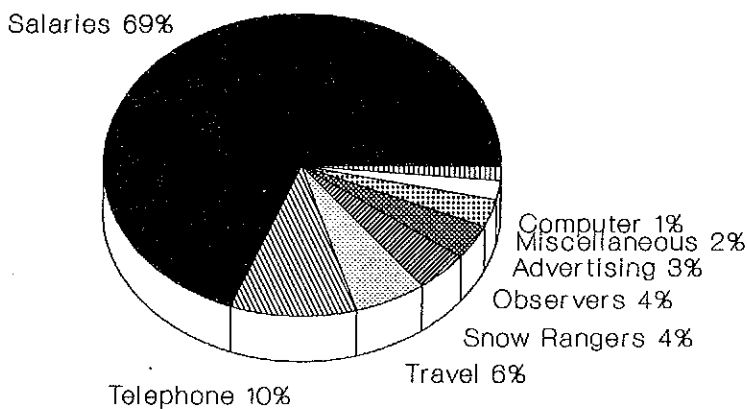
The drought that began early March of last season, continued through all of November, December and the first half of January. Only 10 inches of snow came down at the weather station at 9,600 feet during this period. Temperatures were warmer than average, winds rare, and skies mostly fair, as high pressure strongly dominated.

All was not lost during the snowless months, however. I completed a winter recreation guide for the public, and I mapped the majority of the La Sal's avalanche terrain. Finally, we aired the educational video Avalanche Awareness, A Question of Balance on the local television station.

Finally, January 15th through the 19th saw a good storm cycle dropping 19 inches and opening our season. At this time the parking area was established and signed, the use register installed and full daily forecasts begun. Recreation was limited to primarily road and meadow areas until we saw a couple more storm cycles build up the snowpack in February. Two big snowfalls the first half of March made conditions very good for all types of winter recreation on most of the terrain, including excellent ski mountaineering. Avalanche activity was also much lighter than normal and the slab slides we did have were generally small.

Budget and Fund Raising

Utah Avalanche Forecast Center Budget Breakdown



Total Budget \$68,500

The expenditures from the normal annual operating budget

The Utah Avalanche Forecast Center is under the Salt Lake District of the Wasatch-Cache National Forest. It is also part of the Center of Excellence for Avalanche Related Activities which is also located at the Salt Lake District.

The Forest Service provides \$67,500 in cash funding. This number represent only a slight increase from the previous season. Because the demand for our services continues to increase, we continue to look for additional sources of funding. The Friends of the Utah Avalanche Forecast Center provided \$1525

from a fund raiser this season; and an additional \$2131 came in from other private contributions. The National Weather Service provides generous in-kind support with the donation of office space, long distance telephone service, weather forecasting products, weather forecasting, and office supplies--services which would cost a staggering amount to duplicate on the private market.

Finally, we were awarded a total of \$19,000 from Forest Service Challenge Cost Share funds from the Intermountain Regional Office for avalanche education and the upgrading of mountain weather stations. In addition to that, \$5,000 was donated to the Wasatch Interpretative Association from a private individual for additional avalanche education efforts. We will use this donation in addition to the Challenge Cost Share monies to create avalanche awareness videos and conduct an Avalanche Awareness Week during the 1990-91 season.

The chart on page 9 shows how the regular operating budget is spent. This does not include funds from private sources and Challenge Cost Share projects.

Avalanche Incidents and Accidents

A total of 65 people reported to us that they had inadvertently triggered avalanches in the backcountry this season. On those, 34 were caught and carried by the avalanche, 14 at least partly buried, 2 totally buried and no one was killed. This marks the third season in a row where no person has been killed in an avalanche in Utah. Since the average is somewhere around two deaths per year for Utah (depending on what time period you use) this three year hiatus is quite remarkable. You would have to go back in the records almost 30 years to find three consecutive years without an avalanche death.

Plain luck undoubtedly accounts for some portion of it. However, with around 60 avalanche incidents happening each season, there must be more involved. First, the backcountry public--especially the ones triggering the slides--are becoming increasingly savvy about avalanches. Local Utahns account for most of them, and you would expect that for people who live in or very near an unlimited supply of hazardous avalanche terrain, most have taken at least some avalanche course. Most wear beacons and shovels, with our survey two seasons ago showing that about 90 percent did. Most call the avalanche forecast every day before heading out.

We think our avalanche forecasts play a significant role in keeping the fatality rate down. Our forecasts differ from those you can find in some other parts of the country. First, we have the luxury that most of the use is concentrated into a small area, thus we can keep very close track of the snowpack.

Second, we give as much detail on our forecasts as possible. Instead of issuing a blanket hazard rating for a large area, we assign hazard ratings according to aspect, elevation and slope steepness. We also give clues to instability to look for on each particular day. On almost any day, there's safe places to go and we tell the public where we think these places are and where they're not.

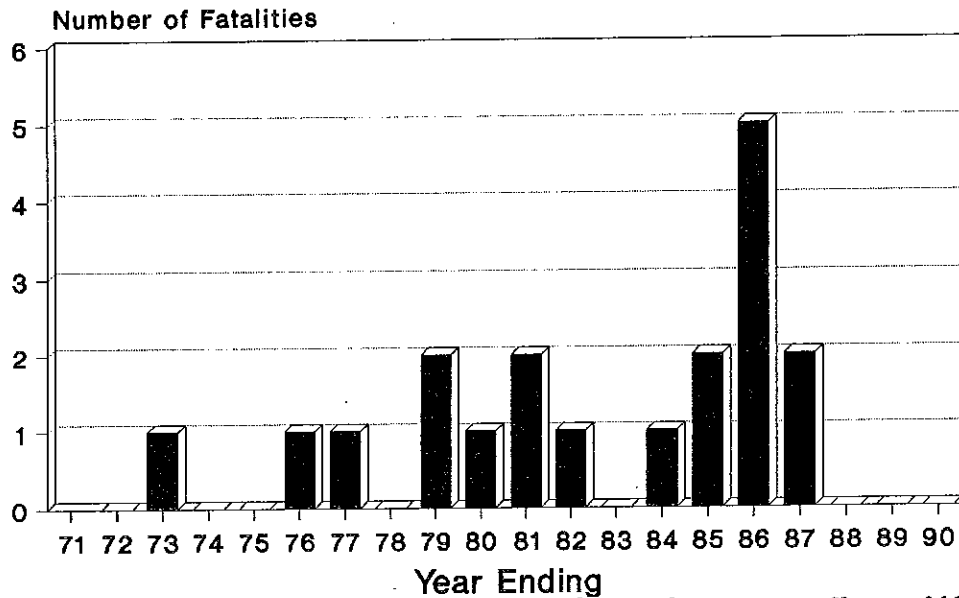
Finally, we use a spoon-full-of-sugar-makes-the-medicine-go-down philosophy and make the advisories entertaining, humorous, and humanistic. They don't sound like a government recording. This keeps people calling on a regular basis and thus they can follow the changes in the snowpack on a day to day basis and become educated about avalanches in the process.

The statistics say that winter backcountry use continues to rise. So if the fatality rate stays low for enough more years to show an irrefutable pattern, this means that our forecasts, as well as avalanche education, account for most of the success.

Avalanche incidents often occur on a "pyramid scheme" where a seemingly large number of people trigger avalanches, of those about a third of those get caught, of those, about a third get buried, and of those, about a third get killed or injured. This season saw only one serious injury--a broken femur--and only some sprains and bruises for the rest. There were certainly some close calls, though including two complete burials and the one lad who broke his femur and nearly died of hypothermia. For a summary of these accidents, see the section titled "Season History", and also see the listing of each accident on page twelve.

Avalanche Fatalities

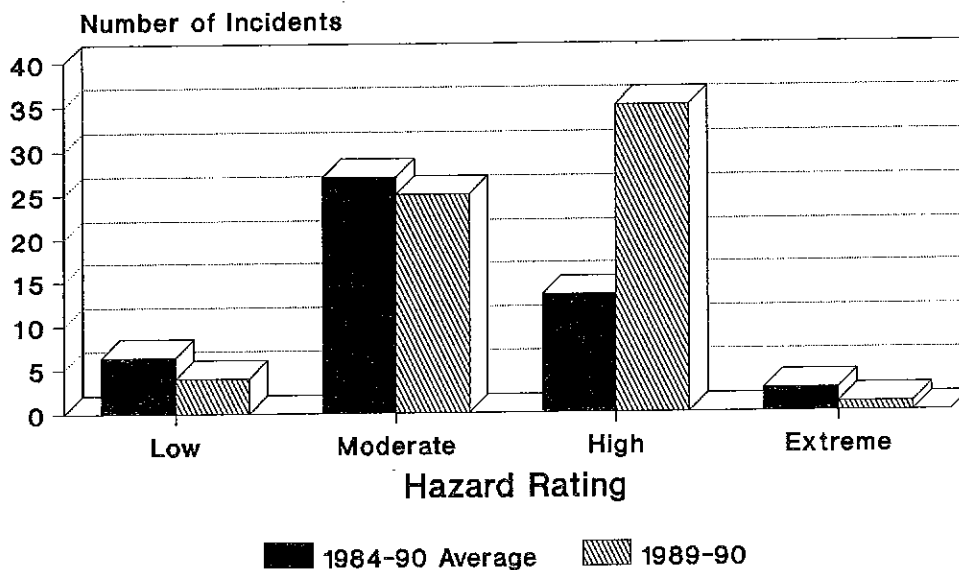
Utah 1971-90



There has been no avalanche fatalities during the past three seasons. You would have to go back almost 30 years in the records to find a similar three year hiatus from avalanche fatalities in Utah.

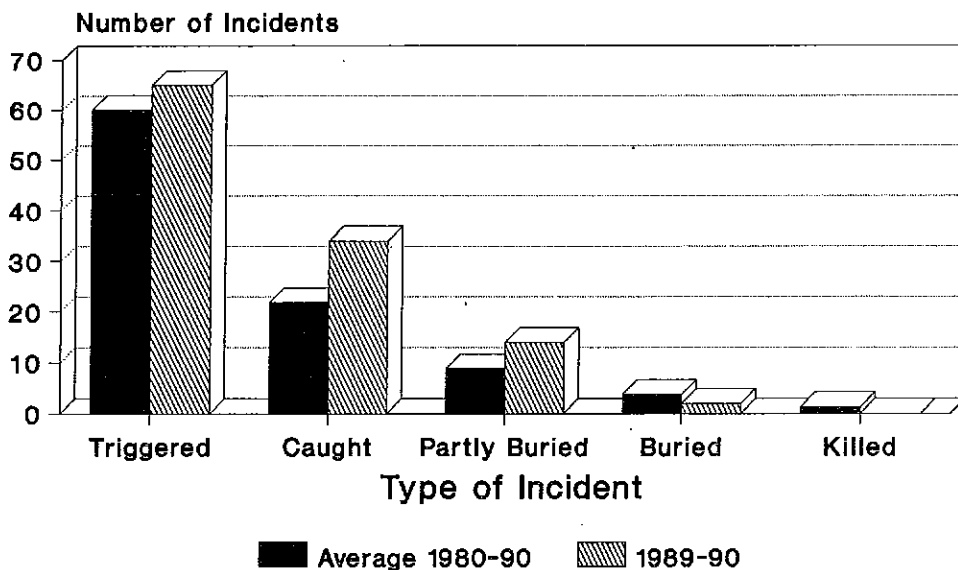
Avalanche Incidents

Number versus Hazard Rating



More avalanche incidents occurred in areas rated as "high hazard" than in previous years. This may be because during so many days this season, the snowpack remained marginally stable, just enough to call it a high hazard but not so unstable to make it very obvious to the average backcountry traveler.

Avalanche Incidents by Type 1980-90 Average versus 89-90



Avalanche Incident Summary 1989-90

Date	Location	Details
11/25	Alta Backcountry	1st human-triggered slide.
12/2	Millcreek/Wilson Ridge	4 people caught while cutting test block.
12/10	Brighton/Tuscorora	Small slab intentionally released.
12/14	Alta Backcountry	2 small slabs released by a snowboarder.
12/15	Park West/Home Run	Slab released with a ski cut.
12/17	Gobbler's Knob	1 skier caught and carried, minor injuries.
12/18	Sunset Peak	Slab released with cornice drop.
12/18	Reynold's Peak	1 skier caught and buried up to neck.
12/19	Park West/Square Top	1 skier caught and carried.
12/19	Alta/Emma Ridges	2 separate skier-released slides.
12/20	Alta/Emma Ridges	1 skier-released slide.
12/22	Alta/Emma Ridges	Skier-triggered slide.
12/23	White Pine/Tri-Chutes	Slide released with a ski cut.
1/1	Park West/No Name	Slide triggered intentionally.
1/2	Tri County Peak	Slide released with cornice drop.
1/2	Summit Park	Slide triggered by kids playing near a home.
1/3	Park West/Sound of Music	1 skier caught, not carried.
1/7	Maybird	Skier triggered slide.
1/8	Snowbasin/Dean's	Slide triggered sympathetic to snowpit.
1/9	Park West Backcountry	Slide released with cornice drop.
1/11	Park West/Todd's Bowl	Slide released to ground sympathetic to nearby party.

Avalanche Accident Report Tony Grove area, Logan Utah

by

Bruce Tremper
Director, Utah Avalanche Forecast Center

Overview

The body of 24 year old Mark Miller, a skier who had been missing since November 25th, was finally found by two springtime backcountry skiers. The evidence indicates an avalanche fatality--although not unquestionably so--the first avalanche fatality in Utah for nearly three years.

Friends last saw Mark Miller hiking alone On November 25th with alpine skiing equipment into the Tony Grove area in Logan Canyon of northern Utah. About a foot of new snow had fallen the day before. Much of the new snow fell on bare ground, but some fell on a thin layer of recrystallized snow still remaining on the more northerly facing slopes--snow left over from the first significant snow of the season nearly a month before.

Miller did not return that evening. Two friends drove up to Tony Grove Lake that night around midnight, found his car there, and searched for him with headlamps following his tracks up a ridge south of Tony Grove Lake. But a large storm was just arriving in the Logan area mountains--one of the largest storms of the season. They lost his tracks as they ascended the ridge due to new snow and increasing winds.

Early the following morning, a small hasty party on snowshoes searched through the blizzard with hazardous avalanche conditions, but still they found nothing. Two days after the accident, larger search parties searched the area and continued for over a week with nearly 100 searchers at one point. One searcher with trained rescue dogs said that the dogs seemed to indicate near the slope where he eventually was found, but the owners wisely called them back as it was a hazardous avalanche path which was loading up rapidly during the storm. The search was finally called off a week later, and smaller parties continued for another two weeks.

Then in the Spring on May 22nd, Two Logan area skiers were out with their pet dogs when the dogs began sniffing around the area. The skiers, suspecting that the dogs had found the missing Mark Miller, began digging and found his ski poles, then just uphill of that, the body, buried under 5 1/2 feet of snow. They went to notify the sheriff.

The sheriff's team found the body laying on its right side, facing uphill, right arm outstretched pointing uphill, the left elbow cocked straight up in the air almost behind his head, and legs out straight. He still wore a hat and sunglasses. They did not find his skis, but I went in the following day and found them less than two feet away from his boots, both skis laying parallel across the hill and the heel ejected from the uphill ski.

Because all his equipment remained so close to him and he still wore a hat and sunglasses, it first seemed unlikely that it was an avalanche accident. Typically, an avalanche spreads equipment out over the slope and quickly tears off hats, glasses and gloves. However, the medical examiner found no broken bones, no bumps on the head, etc, which might indicate that he fell and was injured while skiing the rocky, shallow snowpack. They concluded that he "died of suffocation from being submerged in the snow."

So perhaps the best conclusion is that he was pushed over in place by a fairly small avalanche and died of asphyxiation. He obviously did not ride the slide very far as it would have spread his equipment out more. He must have been standing near where he was found when he triggered a small slide which came down from above, knocked him down and buried him. After that, the storm laid down 2-3 feet of new snow which kept rescuers from finding him until spring. This report concludes that this is most likely an avalanche fatality but not unquestionably so.

I. General Information

Date: November 25 1989
Time of accident: Unknown. (no witnesses)
Exact location: North facing slope about 1/3 mile south of Tony Grove Lake, Logan Canyon, Utah. Elevation is about 8500'
Victim: Mark Miller, age 24
Address: 487 E. 600 S.
Logan UT 84321
Condition /injuries: Death by asphyxiation as ruled by county medical examiner.

Accident summary

Mark Miller was an expert skier and known to ski extreme terrain at times (such as cliff jumping at Beaver Mountain). He had also skied in this area as many as 12 times the previous year. Also, and most important, he had never taken an avalanche class, did not carry avalanche rescue gear, and was alone. Since about a foot of new snow fell the day before, he headed into the backcountry near Tony Grove Lake on alpine ski equipment. It had been a dry month. Although there was some snow in early October, the first significant snow of the season fell around October 28th, when 36 inches of snow fell at Alta and probably half that amount fell at Tony Grove Lake. For most of November, little weather occurred and the snow remaining on the north facing slopes recrystallized into weak faceted snow.

Then, almost a month after the first significant snow, one of the largest storms of the season slammed into Utah on the weekend that Mark Miller turned up missing. However, the storm started out slowly with perhaps a foot of new snow the day before he went skiing, then most of the snow came the days following. So the snow conditions at the time of the accident was probably a foot of new snow overlying perhaps a foot of old recrystallized snow.

He had walked on foot, following the tracks of some snowboarders leading up the ridge from Tony Grove Lake where he parked his car. Todd Hibner, a friend and associate, saw him last on the ridge and Miller told Hibner that he was heading towards the Mt. Naomi area to go skiing. This was the last anyone had seen of him.

Rescue

When he did not return home friday evening, two friends, Troy Knowles and Scott Fostock, drove up to Tony Grove Lake around midnight and found his car. They followed the tracks using headlamps but by that time, the large storm had begun to snow and blow hard. They lost his tracks partway up the ridge.

The following day (saturday, November 26) two people--one from the sheriff's office--

-searched the area and being hampered by the large storm found nothing. Then on Sunday, two days after the accident, a larger search party composed of local search and rescue teams, several volunteers, and rescue dogs combed the area. However, the large storm which continued to blow hard and drop two or more feet of snow since the previous night, and this continued to hamper the rescuers. Alta reported 60 inches for the storm's total with 36-40 inches of snow reported in the Tony Grove area.

At one point, the rescue dogs indicated on the slope where he was eventually found, but the rescuers wisely decided not to proceed onto the slope because of the extremely hazardous conditions. Another rescuer, Kevin Kobe, thought he had seen the remains of a small avalanche which was then buried by the new snow on that same slope. However, when he returned to the site after the body was found, he was quite sure that the toe of the avalanche ended above where the body was found. The search was finally called off more than a week later without finding any clues.

Finally in the spring, May 22nd, Scott Datwylder, a Logan area sport shop owner, and the Logan Herald-Journal photographer Dan Miller (no relation to the victim) were spring skiing in the Tony Grove area. Their two pet dogs began sniffing and digging on the slope. Suspecting that they had found the body of the missing Miller, they dug down and found a ski pole about 4 feet deep. Moving uphill, they found the body buried about 5 1/2 feet deep. They did not find his skis. They then went and notified the sheriff.

After the sheriff removed the body and performed additional investigations, the following day I visited the site with Kevin Kobe. Since they had not found his skis, we probed around the site and quickly located his skis within about two feet of where the body was found.

Body position and equipment location:

The victim's body was found laying on his right side, facing uphill, head facing west, right arm outstretched pointing up the slope, left arm bent with the elbow pointing upward and cocked almost behind his head as if it had been pushed in place. His legs were out straight with his head slightly downhill from his feet. The upper arm was 3 feet 4 inches deep and the deepest part of the body was 5 feet 2 inches deep in a total snowpack depth of 6 feet 6 inches. He was still wearing a hat and sunglasses but the sunglasses were pushed slightly down over his face. His poles lay below him within about 4 feet of the body. I found his skis slightly uphill and on the left side (looking uphill), both skis parallel, about two feet apart, and the nearest one about two feet from where his boots were. Both tips were facing the same direction--to the right looking uphill--and the heel was released on the uphill ski, as if he had released it by falling forward. He was wearing his pack, jacket and a glove on his right hand.

Weather and Snowpack Data:

The first significant snow of the season fell around October 28th, when 36 inches of snow fell at Alta and probably half that amount fell at Tony Grove Lake. For most of November, little weather occurred and the snow remaining on the north facing slopes recrystallized into weak faceted snow.

Then, almost a month later, one of the largest storms of the season slammed into Utah on the weekend that Mark Miller turned up missing. However, the storm started out slowly with perhaps a foot of new snow the day before he went skiing, fairly nice weather on the day

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

In the second section, the author outlines the various methods used to collect and analyze the data. This includes both primary and secondary data collection techniques. The primary data was gathered through direct observation and interviews with key stakeholders.

The third section details the results of the data analysis. It shows a clear trend of increasing activity over the period studied. The data indicates that the majority of transactions occur during the middle of the day, with a significant peak in the afternoon.

Finally, the document concludes with a series of recommendations based on the findings. It suggests that the current processes are largely effective but could be improved by implementing more robust data security measures. Additionally, regular audits should be conducted to ensure the integrity of the records.

of the accident, deteriorating weather the evening after the accident, then by far, most of the snow came the day after (saturday) and on sunday morning. So the snow conditions at the time of the accident were probably a foot of new snow overlying perhaps a foot of old recrystallized snow. Although this doesn't seem like a lot of snow or an especially obvious avalanche condition, it is enough to cause at least a small avalanche--large enough to bury a person.

Terrain:

This accident occurred on a very obvious avalanche path about which most of the local backcountry skiers say, "I've always wanted to ski that slope but never had guts enough to jump in."

Vertical descent: The path runs about 500 vertical feet with about 380 vertical from the top to where the body was found.

Slope steepness: near 40 degrees on top and about 30 degrees where the body was found.

Aspect: North (10 degrees on the compass).

Elevation: 8360 feet (where body was found).

Shape of path: Slightly concave and gully-shaped with large trees on one flank.

Medical Report

The medical examiner reports no broken bones, no bumps on the head, no hematoma, or no other injuries to the body to indicate any blunt trauma. He seemed to be healthy at the time of death. So by default, the medical examiner has attributed the cause of death as asphyxiation--and due to the setting, asphyxiation by avalanche.

Conclusions:

There's no way to prove whether this was or was not an avalanche accident, but the evidence suggests that it most likely was. However, for an avalanche accident, it is very unusual in several respects. First, all his equipment ended up very near to his body--all within about a five foot radius. His hat remained on along with his sunglasses (no retainer). Most avalanche accidents occur with a violence which scatters equipment out very quickly. Although exceptions to this do occur, they tend to happen with small slides or ones which don't travel very far. (For example, you would commonly find all the equipment near the victim in a small slide which catches the victim in a terrain trap such as a gully.) So he obviously didn't trigger the slide from the top. It must have been a small slide which caught him in place.

After I examined the site, and before the evidence from the medical examiner came in, I had doubts that it was an avalanche accident. It seemed more likely that he hit a rock on the shallow snowpack, ejected out of his bindings, landed on a rock striking his head. The on-sight evidence pointed to that: it appeared that he was traversing to the left (or had just made a left hand turn) then ejected forward from his left ski releasing the heel, and twisted from his right leaving both skis pointing the same direction, then fell diagonally downhill with his head away and downhill from the skis, then his poles flew just downhill 4 more feet.

It is possible that he could have just fallen in the snow and for some reason couldn't get up and was suffocated by the snow. However, he was healthy, a good skier and there's no medical evidence to explain why he couldn't get up.

In another unusual aspect, the day after the accident, one of the rescuers (Kevin Kobe)

noticed the scar of a slide which was then buried by the new snow in the area where the body was eventually found. However, he is quite sure that the slide did not descend as far down the slope as where the body was found.

The critical data in this case includes, 1) the medical evidence which rules out other causes of death besides asphyxiation, and 2) the position of his elbow pointing upward as if it were supported by snow. He was probably standing very near where he was found when he collapsed the layer of depth hoar and triggered a small slide which came down from above and pushed him over where he stood, and he probably didn't slide very far afterward.

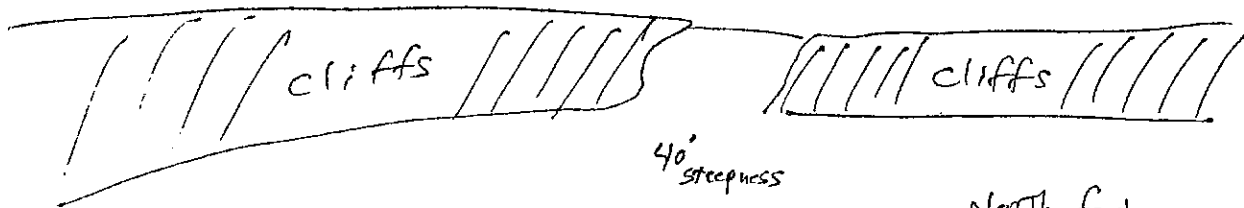
In my mind, this accident has enough oddities surrounding it that I can't positively conclude that it either is or is not an avalanche accident. This report concludes that it most likely was an avalanche fatality but not unquestionably so.

How could he have avoided this accident? First, if he had more avalanche knowledge (he had taken no avalanche classes) he would have avoided this slope. Second, if he was skiing with a partner and both had beacons and shovels and skied it one at a time, he would most likely still be alive.

It must have seemed like an innocent slope at the time. Yes, it was steep, but it had very little snow on it. Many people get sucked in by the "there's not enough snow to slide" trap. It was early season with the first skiable snow of the season and passions run high when ski fever sets in. In this case, he paid a high price for not having his "avalanche eyeballs in" and skiing with a partner and good rescue gear. The tragedy of this accident resembles most others in that it was easily avoidable.

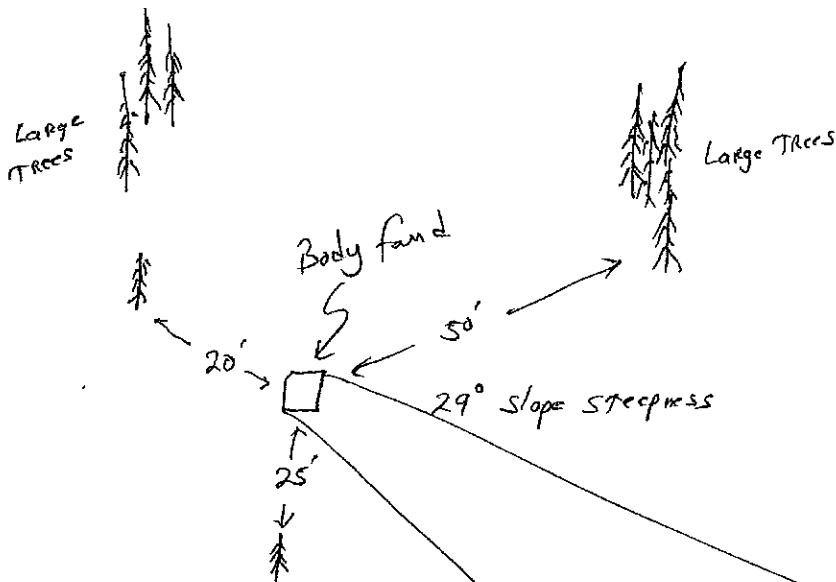
Oblique view of Slide path (looking South)

Small opening



40° steepness

North facing slope (10° on the compass)



heel released on uphill ski
6" of snow beneath each ski

Top of slope

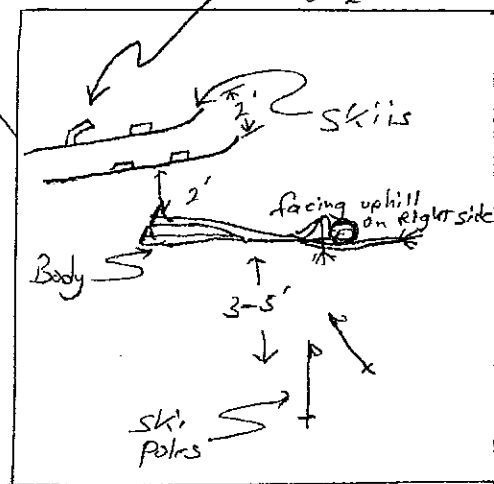
8740' elevation

40°

35°

380' vertical

30°



Body found

8360' elevation

Slope Profile



United States
Department of
Agriculture

Forest
Service

Wasatch-Cache
National
Forest

Salt Lake Ranger District
6944 South 3000 East
Salt Lake City, Utah 84121
(801) 524-5042

Reply to: 1580

Date: July 17, 1990

Dear Friend:

It is with pleasure that the Wasatch-Cache National Forest and the National Weather Service jointly present the annual Utah Avalanche Forecast Center (UAFC) annual report. Enclosed is a copy for your review. This report summarizes the season's weather, avalanche activity, education efforts and other highlights of the winter avalanche season throughout the state.

The UAFC is a cooperative effort between the USDA Forest Service and the NOAA National Weather Service and has three basic charters:

- Issue backcountry avalanche advisories to the public via a network of recorded telephone hotlines.
- Provide avalanche education to the public through avalanche awareness multimedia lectures and short field courses. The UAFC also provides avalanche information to any interested party, including numerous requests from both the local and national media.
- Issue recorded mountain weather forecasts for the public and a more detailed forecast, available via computer bulletin board, for both private and public cooperators in the UAFC information network.

The UAFC is under the administration of the Wasatch-Cache National Forest's Salt Lake Ranger District for northern Utah, and the Manti-Lasal National Forest for the La Sal Mountains near Moab. The National Weather Service provides services of: weather forecasters, weather forecasting products, office space, long distance telephone, and mailing.

The UAFC receives over 80,000 calls per season to the 14 recorded hotlines serving the northern Wasatch Mountain communities of Logan, Ogden, Salt Lake City, Park City and Provo, plus the La Sal Mountain community of Moab. This call total is over twice that of any other avalanche advisory service in North America. Although there has been an increase in the long-term national trend for avalanche fatalities, here in Utah it has leveled off, and in recent years, has significantly decreased. We believe that the efforts of the Utah Avalanche Forecast Center plays a significant role in decreasing avalanche fatalities in Utah.

Sincerely,

MICHAEL SIEG
District Ranger
Salt Lake Ranger District

BILL ALDER
Meteorologist In Charge
National Weather Service Forecast Office



Caring for the Land and Serving People

FS-6200-28b(4/88)

1/14	Brighton/Mary Chutes	1 out-of-bounds skier caught, totally buried. Probed with skis and dug up.
1/14	Silver Fork	2 slides, one released at one snowboarder, another released below another boarder.
1/14	Timpanogos	3 slides released intentionally.
1/15	Brighton/Mary Chutes	1 backcountry skier buried to neck.
1/15	Park City/Dutch Draw	Slide released sympathetic to helicopter skier.
1/20	Alexander Basin	1 slide triggered by a backcountry skier.
1/21	Upper Mill B South	Slide released with cornice drop.
1/27	Red Pine	1 skier caught, nearly totally buried in small slide.
1/28	Dutch Draw	Skier-released slide.
1/28	Pointy Peak	Small slide released by igloo builders.
1/30	Park West Backcountry	1 skier caught, carried, lost gear.
1/30	Daly Bowl	Intentionally released slides.
1/31	No Name Bowl	1 skier caught, carried 10' before they arrested on the bed surface.
1/31	Home Run Bowl	1 helicopter skier released slide.
2/1	olverine	Skier triggered slides.
2/3	Patsy Marley	Snowboarders released wet slides.
2/3	Raymond Glade	2 skiers caught, carried, partly buried. 1 person injured, gear lost. Slide released when cornice failed.
2/8	Day's Fork	1 skier caught and carried, gear lost.
2/8	Snake Creek	Skier triggered slide.
2/9	Main MacDonald	1 helicopter skier triggered slide.
2/10	Red Pine	1 person caught, buried to shoulders.
2/11	Raymond Peak	1 person caught, carried.
2/14	Mineral Fork	5 people caught, 3 partially buried, 1 totally buried in helicopter accident. 3 injuries.
2/16	Brighton/Mary Chutes	Skier triggered slide.
2/17	Park City Backcountry	Skier triggered slide above town totally buried a car.
2/19	Layton/Kay's Canyon	2 snowshoers caught, partially buried. 1 broken femur.
3/3	Red Pine	2 tourers caught and partially buried.
3/3	Patsy Marley	Skier triggered slide.
3/4	Logan/Cherry Peak	Skier triggered slide.
3/5	Big Cottonwood	2 intentionally released slides.
3/5	Red Pine	1 skier caught and carried.
3/6	Home Run	Skier triggered slide with cornice.
3/9	Flagstaff	Snowboarders released wet slide.
3/14	Maybird	4 skiers caught, 1 head injury.
3/14	Stair's Gulch	Slide released at skier's tips.
3/14	Mineral Fork	2 skier triggered slides.
3/15	Timpanogos	3 small slides released by skiers.
3/16	Flagstaff	Wet slide released by snowboarders.
4/1	Wellsville Mtns.	Skier triggered slide.
4/10	White Pine/NPC	2 helicopter guides took rides, and numerous other slides were ski cut.

Volunteer Observer Program

Once again, the UAFC made use of a very effective network of backcountry observers. A total of 9 individuals were active in the network, and the UAFC received 232 observations through the season. This number represents 60% of all the observations logged by the UAFC, including those made by the staff. The total cost of the program for the season was \$2980, which works out to about \$13 per observation. We feel this is a very efficient and cost-effective program, and is an excellent way to connect the community to the UAFC program.

Of particular importance to the program this season was Bob Athey, who provided the UAFC with nearly 60 separate observations. Bob is a veteran tourer of the Wasatch, and spends more days on skis than anyone else. To have Bob as a member of our network was a tremendous asset, and his observations were always valuable.

OBSERVER	NOV	DEC	JAN	FEB	MAR	TOTAL
LOGAN						
KEVIN KOBE	2	6	14	10	5	37
BRYAN DIXON	0	0	0	1	0	1
RON STAGG	2	4	8	6	4	24
OGDEN						
BRIAN SMITH	1	2	0	2	2	7
BRAD BODILY	1	2	3	3	3	12
JOHN PHELPS	1	2	6	1	0	10
SALT LAKE/PARK CITY						
GREG DOLLHAUSEN	5	10	12	10	10	47
RIP GRIFFITH	1	10	14	9	6	40
BOB ATHEY	1	10	9	17	15	52
TOTAL 1989-90	14	46	68	59	45	230
TOTAL 1988-89	19	31	35	25	26	136
TOTAL 1987-88	33	31	33	37		134

Avalanche Education

DATE	FORECASTER	GROUP/TOPIC	TIME	NO. OF PEOPLE
11/15	TREMPER	NATIONAL AVALANCHE SCHOOL	20	250
12/8	MEIKLEJOHN	UNIV. OF UTAH DEPT. OF METEOROLOGY	3.5	30
12/9	MEIKLEJOHN	SIERRA CLUB	2.5	75
12/14	MEIKLEJOHN	BRIGHTON HIGH	2.5	60
12/14	MEIKLEJOHN	PARK CITY SCHOOL	5	50
11/12	KIMBROUGH	ALTA SKI PATROL	7	75

1/6	KIMBROUGH	AMERICAN AVALANCHE INSTITUTE	11	14
1/7	MEIKLEJOHN	AMERICAN AVALANCHE INSTITUTE	13	16
1/9	MEIKLEJOHN	AMERICAN AVALANCHE INSTITUTE	15	24
1/10	TREMPER	PARK CITY MIDDLE SCHOOL	5	200
1/13-14	TREMPER	ALASKA MTN. SAFETY CENTER	30	24
1/15	MEIKLEJOHN	ALASKA MTN. SAFETY CENTER	16	24
1/22-24	MEIKLEJOHN	ALASKA MTN. SAFETY CENTER	58	30
1/26	TREMPER	QUAIL HOLLOW ELEMENTARY SCHOOL	4	500
1/30	TREMPER	FOREST SERVICE/ PLEASANT GROVE	5	12
2/3,4	REAM	UNIV. OF UTAH DEPT. OF REC. AND LEISURE	16	22
2/9	TREMPER	CANYON VIEW ELEMENTARY	5	300
2/10,11	MEIKLEJOHN	CANYONLANDS FIELD INSTITUTE	34	10
3/14	TREMPER	WILDERNESS MEDICINE SYMPOSIUM	7	200
3/20	MEIKLEJOHN	JORDAN BOY SCOUTS	2	50
3/28	TREMPER	JORDAN MIDDLE SCHOOL	4	600

TOTAL		21 TALKS	265.5	2566

Media Contacts

The UAFC has been fostering contacts with the state and local media for years, and during periods of high instability, coverage is usually timely and accurate. This season, there were 20 separate newspaper articles directly quoting the UAFC, with two major feature articles and one front page color story.

All together, there were 30 contacts between the UAFC and the media, including USA Today, CBS News, the Weather Channel, and Good Morning America. The last resulted in a nationally aired piece, while an excellent special was filmed and produced by Park City Television and aired in Park City twice per day for a month.

In addition to these contacts, the UAFC provided daily avalanche and mountain weather reports to radio stations KRCL in Salt Lake City and KPCW in Park City.

UAFC MEDIA CONTACTS 1989-90

DATE	FORECASTER	AGENCY	TOPIC	TIME
11/26	KIMBROUGH	USA TODAY	AVI WARNING	10 MINS.
11/26	KIMBROUGH	S.L. TRIBUNE	AVI WARNING	10 MINS.
11/27	TREMPER	CBS NEWS, N. Y.	AVI WARNING	15 MINS.
11/27	TREMPER	DESERET NEWS	AVI WARNING	10 MINS.
11/27	TREMPER	CHANNEL 4	AVI WARNING	10 MINS.
11/28	KIMBROUGH	DESERET NEWS	AVI WARNING	5 MINS.
11/28	KIMBROUGH	KSL RADIO	AVI WARNING	10 MINS.
12/2	KIMBROUGH	KSL RADIO	AVI WARNING	10 MINS.
12/2	KIMBROUGH	DESERET NEWS	AVI WARNING	10 MINS.
12/2	KIMBROUGH	TRIBUNE	AVI WARNING	10 MINS.
12/3	KIMBROUGH	KSL RADIO	AVI WARNING	5 MINS.
12/3	KIMBROUGH	DESERET NEWS	AVI WARNING	5 MINS.
12/3	KIMBROUGH	TRIBUNE	AVI WARNING	5 MINS.
12/12	TREMPER	DESERET NEWS	FORECASTING	8 HOURS
1/11	TREMPER, MEIKLEJOHN	GOOD MORNING AMERICA	AVALANCHE FORECASTING	10 HOURS
1/11	MEIKLEJOHN	S.L. TRIBUNE	AVI WARNING	10 MINS.
1/19	MEIKLEJOHN	U. OF U. CHRON	AVALANCHES	30 MINS.
1/23	KIMBROUGH	TRIBUNE	AVI CONDITIONS	5 MINS.
1/25	TREMPER	TRIBUNE	CENTER OF EXCEL	2 HRS.
2/2	MEIKLEJOHN	KSL	MTN WEATHER	30 MINS.
2/5	TREMPER	TRIBUNE	ACCIDENTS	10 MINS.
2/9	TREMPER	DESERET NEWS	AVI FORECASTING	8 HRS
2/15	TREMPER, MEIKLEJOHN	WEATHER CHANNEL	AVALANCHES	3 HRS
2/17	MEIKLEJOHN	TRIBUNE	AVI WARNING	5 MINS.
2/18	TREMPER	TRIBUNE	AVI WARNING	5 MINS.
2/18	TREMPER	KSL	AVI WARNING	1 MINS.
2/19	TREMPER	TRIBUNE	AVI WARNING	15 MINS.
3/1	TREMPER	PARK CITY TV	AVI AWARENESS	6 HRS.

Geographic and Avalanche Characteristics of the Northern Wasatch Mountains

This season, Brad Meiklejohn composed a summary of the geographic boundaries of the various areas for which we forecast, and summarized their avalanche characteristics and the climatology of each area. It was then edited by Bruce Tremper. Although it was originally written as an in-house paper, the information contained here will no doubt be valuable to others. So we are including it here as a special supplement to the season report.

Logan Area Mountains

The Logan area mountains are technically two separate ranges, the Wellsvilles to the west and the Bear River Range to the east. For the purposes of the UAFC, the northern boundary to the Logan area is the Idaho border, while in the south the boundary lies on a line from Sardine Canyon east of Brigham City along the north slope of James Peak.

The Wellsvilles are purported to be the steepest mountains in the world, based on rise compared to base width. This range is essentially a single ridgeline, with steep bowls and slopes on both the east and west sides. The highest peak on the ridge is Box Elder Peak at 9372', with the second highest, Wellsville Cone, lying close by.

The snowpack remains shallow in the Wellsvilles compared to other parts of the Wasatch, partly due to elevation, partly due to exposure to wind, and partly due to ridge orientation. The ridge trends in a northwest-southeast direction, which does not favor a northwest flow pattern. Winds blow frequently and strongly from the west.

Few people visit this range in mid-winter, although it has excellent powder terrain. Many access routes are a bit exposed, but it is possible to ski in this range throughout the winter. The east side of the range has more suitable terrain, and better snow cover, but a few lines off the northwest side of Wellsville Cone seem worth exploring.

Spring skiing is popular in this range because the east side has beautiful, steep bowls that offer up to 2000' continuous vertical for corn skiing.

Big slides occur commonly in the Wellsvilles, mainly because of the uniformly steep and open slopes. The southern section of the Wellsvilles, adjacent to Sardine Canyon, does see significant use, especially snowplayers such as sledgers, and does have dangerous avalanche terrain. In this area, you can often see slides from the road.

But most people in the Logan area instead travel east into the Bear River Range. This area contains the highest peaks in the Wasatch north of Gobbler's Knob, with several summits nearly reaching 10,000', and excellent ski touring terrain.

The range naturally splits itself into three sections; first, the area south of Logan canyon where Logan Peak and Millville Peak lie. Second, the main Bear River Range ridge, which extends northward from Logan Canyon into Idaho. Third is the section to the east of Logan Canyon which includes Beaver Mtn. and Swan Flats.

This area has seen some major avalanche activity, including the largest known avalanche in Utah. This slide occurred in Woodcamp Hollow in February of 1986, during an avalanche cycle referred to as the "Valentine's Day Massacre". This slide recorded an exceptionally low alpha angle (12 degrees), and according to Art Mears, was the largest slide of that cycle in the entire Western U.S.

You can often see avalanches along the Logan canyon highway, most commonly on the east side of the road. Steep slopes drop directly to the river and to the road in many places, and can block both the road and the river. Extended warm periods can bring these slide paths out as both wet-loose and slab avalanches. Avalanches have hit the road in other areas, including some of the large south facing paths in the first 5 miles of the canyon.

The areas of highest backcountry use include: Steam Mill Peak, Bunchgrass Bowls, Logan Peak, and Swan Flats. All of these areas offer excellent skiing terrain, with some of the shortest approach times. The Logan mountains offer more difficult to access than many other portions of the Wasatch, with approaches of 2-3 hours rather common.

All of the above listed areas have significant avalanche terrain, ranging from terrain traps to large avalanche paths. The snowpack throughout the Logan area is often quite similar to the snowpack in the Central Wasatch, although usually of less depth. In some years, the storm track will shift southward for an extended period, leaving the Logan area in a long dry spell.

Much of the terrain lends itself to snowmobiling and combined with the avalanche ever-present avalanche hazard, several incidents have occurred over the years. Snowmobiles use the areas around Logan Peak, as well as reaching the Bear River ridgeline near Naomi Peak. They also commonly travel the back roads gentler terrain on the east side of the range between Bear River summit and the Monte Cristo area.

No avalanche fatalities have ever occurred in the Logan area mountains, although there was a missing skier in the 1989-90 season who, as of this writing has not been located. However, this skier turned up missing the night before the storm began in earnest and most likely, he was injured or got lost and was then overcome by exposure.

Ogden Area Mountains

The geographic boundaries of the Ogden mountains run from Bountiful Peak in the south to Logan Canyon in the north, and including James Peak and the Monte Cristo area to the east. Technically, the Bountiful Peak/Sessions area is on the Salt Lake Ranger District, but functionally the UAFC puts the Bountiful Peak area into the Ogden forecast area.

The Ogden portion of the Wasatch has some of the most abrupt rises along the entire Front. The range rises dramatically from the shores of the Great Salt Lake throughout this portion, and very few canyons interrupt this western scarp. The eastern side of the ridgeline drops off more gradually. Most of the population along with most of the winter use concentrates onto the east side. Although James Peak and Durst Mtn. lie closer to Ogden than Logan, are essentially a southern extension of the Bear River Range, and have a slightly different climatic regime. These peaks stand lower than other parts of the Wasatch, with the peaks topping below 9000' in some areas, with the highest peaks ranging from 9500-9800'.

You can divide the Ogden area mountains into four different massifs, each divided by east-west canyons. The northernmost massif runs from Sardine canyon in the north to North Ogden pass in the south. The highest peaks in this block are Ben Lomond and Willard Peak. This area has perhaps the best backcountry skiing terrain, every bit as good as the heavily used Salt Lake area mountains. It's excellent powder terrain provides recreation for all ability levels and all avalanche conditions. Most people access this area from the base of Culter Ridge on the east side of Ben Lomond.

Large avalanches do occur in this area, with smaller slides very common. The winter of 1985-86 saw a large slide come out of Black Canyon which destroyed 100 years old trees. Large avalanches occur most frequently on the east face of Ben Lomond, with observed fracture lines up to 1 mile wide.

Avalanches occasionally close the North Ogden pass road, as a number of slide paths hang above the road on the east side of the pass. This situation is totally uncontrolled, and in the past cars have been hit and knocked off this road. The road is essentially self-closing, and does so nearly every year.

Between North Ogden pass and Ogden canyon the peaks rise to only 8000'. Avalanches do occur in this section, primarily on the north facing slopes south of the pass, and few people seem to use this area. Nordic Valley, in this section, lies at such a low elevation that it has no significant avalanche problems.

Ogden canyon itself also is affected by avalanches, most commonly by wet loose snow slides from the north facing slopes during sudden mid-winter or spring thaws or rains. Many steep slide paths drop directly onto the road all the way from the mouth of the canyon to near the reservoir dam, and have closed the canyon for extended periods of time.

South of Ogden canyon, the Snowbasin section extends southward to Weber canyon. Three avalanche fatalities have occurred in this section, two on the east side adjacent to the Snowbasin Ski area, and one on the west side in Taylor canyon. Most people access this area by leaving the Snowbasin area boundaries.

South of Weber canyon is the Francis Peak/Bountiful Peak section, which extends down to the Sessions Mountains. Because of the poor access, this large area sees little use except around Bountiful Peak. Snowmobiles heavily use the Bountiful Peak area, and the helicopter skiing company sometimes uses the Sessions Mountains and off the Francis Peak ridge. The terrain north of Francis Peak is virtually unused, but there is some excellent skiing here, with considerable avalanche potential.

Several avalanche accidents have occurred in the Francis Peak section, but there have been no avalanche fatalities. Most recently, two young men were caught in a slide in Adam's canyon east of Layton, and one suffered a broken femur. Avalanches have knocked vehicles off the Farmington canyon road, and in 1989 a low-elevation slide ran onto a subdivision road in Centerville after a major canyon wind event.

The eastern section of the Ogden area runs from Durst Mountain in the south to James Peak in the north and includes the Monte Cristo area to the east. Considerable backcountry ski use occurs in the James Peak area adjacent to Powder Mountain. However, all the area is private property, and access to these areas requires that you park on and cross private property. Powder Mountain has threatened citations on those using this terrain, and the Forest Service has no apparent influence in the situation. Many backcountry skiers continue to flock to this enticing area either unaware or in defiance of the no trespassing signs. In the Salt Lake area mountains, you can find many no trespassing signs around the numerous old mines--signs which are almost universally ignored. Salt Lake area skiers traveling to the James Peak-Powder Mountain area often return with anger and resentment over the strict enforcement at the hands of the Powder Mountain management.

Powder Mountain is a unique area in its own right. Although few avalanches affect the ski area proper, much significant avalanche terrain exists just outside the boundary, especially hanging above the access road. The Powder Mountain mostly-volunteer staff maintains a fairly casual avalanche control and boundary policy. There has been numerous reports of people being involved in small avalanches both within and outside the area boundaries and two seasons ago, a sheriff's car was buried by a slide on the access road while he was on patrol during the night. One out-of-bounds skier was killed at Powder Mountain several years ago.

Avalanches often hit the Powder Mtn access road, and again the control done is mostly passive. Some explosive work is done, but often post-facto. In 1986, numerous large slides covered the road up to 30' deep and 200' long in avalanche debris. Slide paths drop directly onto the road from both sides, with the larger avalanches coming out of the north facing paths.

Finally, the Monte Cristo area, east of the pineview valley, ranks as a veritable snowmobile mecca. Thousands of people use this area each winter. Unfortunately, many of the popular hill climbing areas are also large slide paths. No avalanche fatalities have occurred during these games of "high mark" but we probably won't have to wait long. Whiskey Hill and Beer Drinker's Hill are two such places, and snowmobilers have been involved in slides up to 6' deep and 100 yards wide on these paths.

Park City Area Mountains

The Park City mountains comprise the Wasatch just to the west of Park City extending from Lamb's Canyon in the north to Snake Creek drainage in the south. On occasion, we include information on the Uinta mountains in this region.

Avalanches do affect some of the roads in this section, but not to a serious degree. Lamb's canyon (which is closed in winter) has been covered by slides, and cars parked on the roads above the town of Park City have been hit by slides.

The primary area of concern in this region is the ridgeline that runs north-south between Park City and Park West ski areas. This area sees a tremendous amount of use, with the greatest concentration of adjacent to Park West. Park West maintains an open boundary, while Park City tightly restricts out-of-bounds access because of the private land on its borders.

Much of the backcountry ski terrain on the Park City side of the ridgeline lies on private land, and as such, most backcountry skiers are trespassing. A form of benign neglect controls the situation, and so far few problems have occurred. Conflicts between the helicopter ski company and backcountry skiers have no satisfactory resolution since the helicopter company has permission to use the private land.

Lying on the east, and downwind, side of the Wasatch, the Park City section generally receives less snow than the western side of the range. Thin snow means weak snow because of faceting metamorphism and instabilities tend to persist for long periods of time. Early-season instability seems to last further into mid-winter here than in other sections of the range.

Tremendous amounts of windloading also occur along and just off of the main ridgeline. The wind usually scours the west facing slopes in Big Cottonwood and Millcreek and deposits the snow in windslabs and cornices throughout the large east facing bowls.

Four avalanche fatalities have occurred in the Park City mountains, one involving a backcountry skier

in Todd's Bowl north of Park West, and three in-area skiers, one at Park West and two at Park City. The incident rate seems to be rising disproportionately in the Park City mountains. A large and growing population have recently discovered backcountry skiing here and they seem to tend toward the "ski to die" mentality, more than on the Salt Lake side of the range. This wish has not come true mostly through serendipity. Many people who have been buried in slides who live in the Park City area, continue to do the same things over and over.

One unresolved problem remains that the phone prefix in Brighton is the same as for Park City. This means that a caller for recorded avalanche information from Brighton will get information relevant to the Park City area. We have made an effort to let groups in both areas know when different conditions may exist.

Provo Area Mountains

We get less information from the Provo area mountains than from any other part of the Wasatch. The only regularly reporting station is the Sundance Ski Area on the southeast end of Mt. Timpanogos. However, with even the elevation of the top of the ski area 2,000-3,000 vertical feet below the highest mountains, the data doesn't mean much. Very little use occurs in this portion of the Wasatch, so the lack of information is not so critical.

The geographical boundaries to the Provo area include from near Box Elder Peak in the north to Spanish Fork canyon in the south. Technically, the range extends farther south to Mt. Nebo and although we limit our forecasts to end at Spanish Fork Canyon, they should be just as valid for Mt. Nebo. To the east, the mountains taper to foothills in a less definite boundary. Ant Knolls, Sandy Baker, Wallsburg Ridge, and Daniel's Canyon all lie at the eastern edge of the Provo section.

Avalanches affect both Provo canyon and Daniel's canyon, but only rarely. In a major avalanche cycle, the slide paths off the south end of Timpanogos can reach the highway (Slide canyon, etc.), but even in the winter of 1986 when these paths did run, they did not reach the road. At least once a winter, avalanches overrun the Provo canyon road near the Deer Creek reservoir as they drop onto the road from short, steep north facing slopes. The access to Sundance lies in a steep stream bed which is also frequently hit by small sluff and wet slides.

Very few backcountry skiers use the Provo area mountains. The Wasatch Powderbird Guides do use this area, for both powder skiing in mid-winter and corn skiing in the spring. But in general, poor access keep all but the very hardy from these mountains in the winter.

Two known avalanche fatalities have occurred in the Provo area mountains, and a third is questionable. One fatality occurred in Rock Canyon east of Provo in 1968, and another in 1986 in Water Hollow in the South Fork of the Provo. A third, on Mt. Timpanogos in 1988, has never been confirmed, but the evidence suggests it could have been avalanche-related.

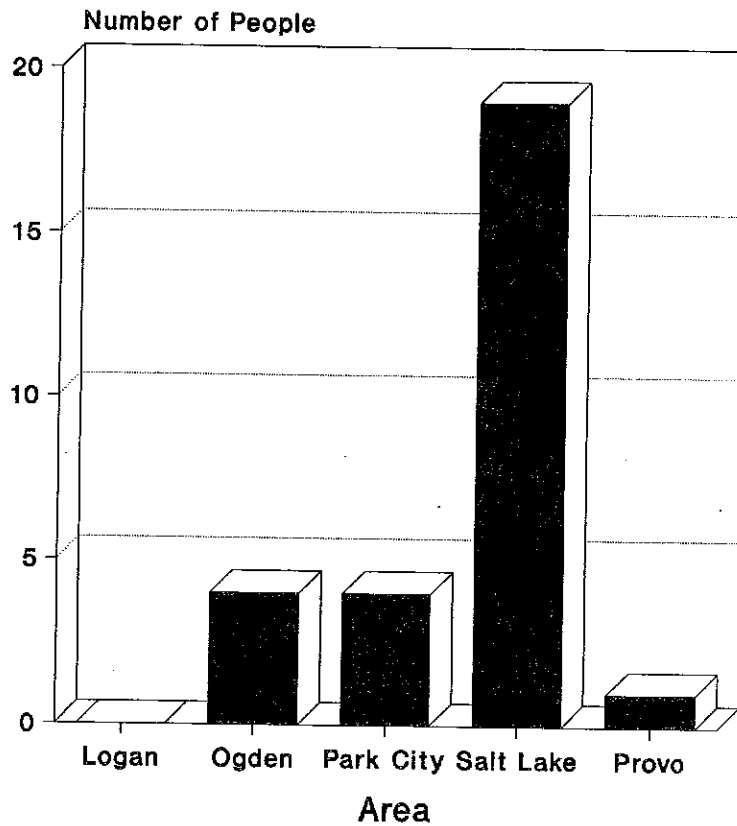
Some of the largest slide paths in the Wasatch are found in the Provo mountains, and huge avalanches have occurred here in recent years. The winter of 1986 saw a cycle of major avalanches throughout the Provo mountains, and these slides destroyed large tracts of timber throughout the range. Avalanches also destroyed a home near Sundance, and caused the Provo canyon road to wash out when the Provo river was dammed by avalanche debris. Historically, avalanches have reached the valley floor off a number of the peaks in this region, particularly off of Spanish Fork Peak in the Mapleton area. In the winter of 1989-90, several large slides were seen to descend the west slopes of Loafer Mountain, dropping 5000' vertically and nearly reaching the valley floor and coming within 100 feet of a subdivision house.

The Provo area mountains commonly have a more shallow snowpack than is found in the northern and central Wasatch, and as a result, the snowpack often remains weaker and more unstable. The snowpack often resembles that found in the Park City mountains, with roughly comparable avalanche activity.

Salt Lake Area Mountains

The Salt Lake section of the Wasatch--the primary focus of the Utah Avalanche Forecast Center--sees by far the greatest amount of backcountry use for several reasons. First of all, many ski areas exist providing well plowed roads to upper elevation in many of the canyons and the resulting access to the backcountry is the best found not only in the Wasatch, but perhaps anywhere in the country. Secondly, the snow conditions are often the best in the Wasatch, as typically more snow falls here than in other sections. Finally, more skiers, and especially backcountry skiers, live in Salt Lake City than in other areas. For these reasons, the UAFC tends to focus on this region more than on the others.

Avalanche Fatalities 1940-1990



The number of avalanche fatalities by area.

The geographical boundaries to the Salt Lake Mountains run from near Box Elder Peak in the south to the Sessions Mountains in the north, from the Park City ridgeline in the east to the Salt Lake valley in the west. The Stansbury Mountains, a separate range to the east of Salt Lake City are technically in the Salt Lake Ranger District, and although our regular forecasts do not expressly include this area (because it sees little use) we often give out information out over the phone to people who call our office. The Oquirrh Range, also to the west, sees an extremely small amount of use and very little information comes from this area.

The Salt Lake mountains are centered around the Tri-Canyons, which include, from north to south, Millcreek canyon, Big Cottonwood canyon, and Little Cottonwood canyon. Heavy backcountry use occurs in all these areas, and it would be difficult to pick out any particularly favored locations. However, for backcountry skiers, Big Cottonwood canyon seems to have the most touring options.

There have been 30 avalanche-related fatalities in Utah in the 50 years since 1940, and 19 of these have been in the Salt Lake section of the Wasatch. Of the remaining 11, 4 occurred in the Ogden section, 4 in the Park City section, 2 in the Provo section, and 1 in Helper.

Of the 19 avalanche fatalities in the Salt Lake section, 13 have been backcountry users, 4 people have died in developed ski resorts, 1 miner was killed, and 1 person was killed in a slide on a developed highway. Finally, of the 13 backcountry fatalities, 7 were in Big Cottonwood, 3 were in Little Cottonwood, 2 were in Parley's Canyon, and 1 was in Millcreek.

Avalanches affect Big and Little Cottonwood canyon highways to differing degrees, and have covered the Millcreek road in several locations. The largest slides to have affected the Millcreek road were above the gate which is closed in winter, and ran during a mid-winter thaw. Slides have also hit the road and homes in the Pinecrest area of Emigration canyon, and a home has been hit in Johnson's Hollow in Emigration canyon. Avalanches appear to threaten homes at the base of Mt. Olympus, as well as the mouth of Big Cottonwood Canyon; however, an especially large cycle would be required to have this happen.

The Salt Lake section of the Wasatch is sometimes referred to as the "Central Wasatch", and this term has never been clarified. The term "Central Wasatch" is often used in the context of snow depth and snow stability, with the implication that the snow is deeper and more stable in the "Central Wasatch" than in other sections. Although generally true, several places exist within the "central Wasatch" section with shallow and weak snowpacks.

Without question, more snow falls in Little Cottonwood canyon than any other place in the Wasatch. As a result, the snowpack tends to remain deeper, and hence more stable in Little Cottonwood canyon than that found in other areas. This effect slops over into some of the surrounding areas to a greater or lesser extent. So, if the term "Central Wasatch" is based on snow depth, the area might be as follows: all the drainages within Little Cottonwood, and all the drainages eastward from Cardiff Fork to the head of the canyon on the south side of Big Cottonwood. Outside of this area, the snowpack is often noticeably more shallow and weak, and in many ways, resembles that found on the Park City side. In particular, all the Millcreek drainages tend to receive less snow, as does Mineral Fork, which commonly has some of the worst avalanche conditions in the Wasatch.

Climatology of the Northern Wasatch Mountains

General Storm Patterns

The biggest snow producing storms for the Wasatch come in a northwest flow, from systems which commonly do not look impressive as it approaches. The biggest snow producers seem to develop over the Wasatch, often with no guidance to distinguish a 6" system from a 30" system. Snowfall rates can exceed 5-6" per hour, but only on a northwest flow.

The term "northwest flow" is used loosely, and it has a variety of interpretations. The prevailing storm track, or jet stream, is the trajectory that systems follow as they move from west to east. This "flow" is also referred to as the "long wave pattern". Within the long wave flow, short wave systems travel like waves on a rope. The measured wind direction at a representative ridgetop location, will vary as a short wave system approaches, arrives and departs. Typically, the variation will first turn southwest, then west and finally northwest as the short wave passes. The stronger the shortwave, the more dramatically the winds will turn.

For example, even with a long wave flow from then southwest, a short wave traveling along it could turn the ridgetop winds southerly as it approaches and northwest as it departs. This situation does not product nearly as much precipitation as when the long wave flow comes from the northwest. Part of the explanation may be that, geographically, few upstream obstructions to systems exist as systems approach from the northwest, while to the southwest and west, the peaks of the Sierra represent substantial barriers which ring out much of the moisture before it reaches the Wasatch.

A northwest flow has a tendency to cause precipitation to linger longer on the Wasatch, especially in Little Cottonwood, longer than one might expect from the weather charts alone. If a northwest flow exists with speeds of 20-30 mph with 50-70% RH, orographic snow may keep falling at Alta, even long after precipitation has ceased at other resorts. You usually have to wait for a drop in windspeed, a change in wind direction or for the flow to turn anticyclonic for precipitation to finally end in Little Cottonwood Canyon.

Daytime heating can magnify this, especially in spring and fall as convective showers can rapidly build out of otherwise clear skies. One of the best forecasting tools for this situation is the stability index, (especially less than 3) and moisture at the 700mb level off the balloon sounding. Significant precipitation amounts often occur in the mountains especially in springtime from these instability showers while the

valley remains completely clear and sunny.

Because the systems have to travel over nearly a thousand miles of dry land to reach Utah, they often break up into double or triple structured fronts. This seems to result from the rugged topography decoupling the surface front from the trailing colder air, with the colder air finally catching up. In these instances, rapid clearing (or "sucker holes") can follow the initial front, with the temptation to call the storm off.

In many situations, a rapid clearing is a result of negative vorticity advection (NVA), or descending air on the backside of a front, and this can precede, as well as follow, a vigorous system. Often a large sucker hole indicates an approaching front. However, with a dry airmass, often no second wave ever arrives and it's hard to know exactly when to call the end of the storm.

Closed lows, or large troughs, often do not produce as much snow as they might first appear. They approach ominously, with strong south winds and a vigorous front, but with disproportionately short-lived precipitation. These systems then settle in for the duration, with light to moderate snowfall rates for the next several days. With the center of a closed low directly overhead, it's like being in the hub of a wheel with strong weather occurring all around you--everywhere except there in the eye of the storm. All the storm has to do, however, is to move slightly in any direction and the precipitation will begin. But the precipitation pattern varies dramatically whether it moves north, south, east or west. For example, if the center moves south, it cuts off all the precipitation and if it moves to the northeast, it can bring in a northwest flow with significant precipitation. Tracking these systems can fray even the calmest nerves. The best tools include watching representative ridgetop wind directions and satellite loops.

Wind

The Wasatch mountains have an almost perfect setup with respect to wind - it rarely blows after it snows. Strong winds can occur in the Wasatch, but more commonly they precede a storm. Most commonly, the day before a storm arrives, the winds blow from the southwest--the stronger the winds, the stronger the system. They can exceed 100 mph along the ridgetops, and often move large amounts of snow. In addition, these winds blow other debris around, such as tree needles, and can pick up desert dust, which results in a reddish-brown snow layer. These dust or debris layers often serve as good marker layers in the snowpack for the rest of the year.

The winds will blow quite hard until frontal passage, at which time they commonly decrease and shift to the northwest. They often decrease to around 20 mph and, if from the northwest, represent ideal conditions for good orographic lifting and snowfall. In some instances, with very strong prefrontal winds, the systems pass through the Wasatch too quickly to produce much snow. Huff, puff, and no fluff.

With closed lows passing to the south or with a strongly diving trough, the flow shifts to the north after the front passes, and these cold winds, when strong, can transport lots of snow. In a storm situation, the shift to a northerly wind signals a halt to the snowfall, as the wind then blows parallel to the range, killing any orographic lifting.

Easterly ridge winds occur in two situations: 1st, when a closed low passes to the south and east of Utah, a return flow from the southeast, then east, then northeast can occur. Occasionally, this flow can come out of the north, and rarely out of the northwest. The flow is often not very strong, and usually transports a lot of snow.

The second situation for easterly winds occurs when high pressure lies to the northeast over Wyoming and low pressure lies to the southwest over Nevada. This results in a surface pressure gradient which creates the so-called canyon winds. If the upper level winds also blow from the east, it can intensify the winds to very strong levels. They are known as canyon winds because of the strong winds at the base of the canyons. However, if you travel up the canyons, they actually decrease, and often people in the cities decide not to go skiing because of the "blizzard" while the ski resorts remain dead calm and clear all day. The winds topographically focus themselves near the canyon mouths, but don't blow very hard through the canyons themselves. These winds are not only pressure driven, but density driven, as cold air from the interior spills down over the range. They blow strongest where in the most linear sections of the Wasatch Front, especially near Ogden and Centerville. Where the range is more complex, with deeper canyons, such as near the Tri-Canyons, these winds don't blow as strongly.

In a canyon wind situation, the winds along the highest peaks can blow quite strong, and you can often see plumes of blowing snow from the valley. The canyon winds blow in a diurnal character--usually stronger in the evening as radiational cooling enhances the pressure gradient.

CHARACTERISTIC PRECIPITATION PATTERS FOR VARIOUS AREAS

Logan Area Mountains

The Logan area mountains seem most favored by a northerly storm track and a northwest flow on that track. At times, storms affect only this portion of the Wasatch while missing the Salt Lake mountains entirely.

Ogden Area Mountains

With such an abrupt front, and rising directly off the shores of the Great Salt Lake, the main portion of the Ogden range often has rather severe weather conditions. High winds and riming occur commonly along the higher ridges, with associated lightning especially around Mount Ogden. The gradient winds referred to as "canyon winds" often blow strongest along the Front in the vicinity of Centerville. The entire section from Francis Peak to the Sessions experiences this phenomenon to some degree, but they blow hardest here because of the linearity of the ridge in this area and the narrowness of the canyons. Snowbasin also experiences high winds commonly, and has the nickname of "Blowbasin", but does not experience the canyon winds.

The entire Wasatch Front in the Ogden area, is favored by a west to southwest storm direction. Often the heaviest precipitation falls in prior to frontal passage. This area does not do well in a northwest flow and can receive as much as 20 times less snow than areas favored by northwest flow such as Alta. Some lake effect enhancement occurs in this section because the lake is so close and occurs more often on a west to southwest flow.

The James Peak/Powder Mtn area seems to be favored for a northwest flow, and often has significantly more snow than the Snowbasin area from a given storm. A northwest flow favors Powder Mountain, similar to the nearby Logan area mountains. Powder Mountain claims the second greatest annual snowfall in Utah, but it ranks much farther down the list according to other published data.

Park City Area Mountains

Different storm directions favor different parts of the Park City side of the range. Park City and Deer Valley do the best on a prolonged southwest flow, such as is typical from a slow moving low on a southern track, as moist air can more up American Fork and Provo canyons unimpeded. Park West, in contrast, does better on a west to northwest flow. On occasion, the entire east side can pick up precipitation on an east flow as a slow moving southern low moves to the east of Utah.

Strong winds from any direction affect the main ridgeline, with the primary loading orientations from southwest to northwest. Strong southwest winds can be a problem for the Park City area gondola, and gusts up to 100 mph have been recorded here.

Salt Lake Area Mountains

Local climatic differences nowhere express themselves better in the Wasatch than in the Salt Lake section. Alta, well-known as a "White Hole", receives more snow than all its neighbors. On an annual basis, Snowbird, only 2 miles down canyon, receives 80-90% of that which falls at Alta. Brighton seems to pick up some slop-over from storms which dump on Alta.

People argue about the reason for the "efficiency" of Little Cottonwood and here are some of the arguments. First, shape of the canyon: With the canyon broad and wide at the base, it rises and narrows consistently through its length, and boxes out at the top. The canyon configuration effectively channels storms, and low level convergence probably has some influence. Second, on a northwest flow, the highest peaks in the Wasatch lie just upstream, namely Twin Peaks, Dromedary, and Mt. Superior, all above 11,000'. The snow which forms as it rises over these large barriers falls out of the streamflow directly onto Alta and Snowbird.

Also, no doubt some channeling occurs as the air moves up the drainages on the north side of the Big/Little Cottonwood canyon, such as Mill B. This helps explain the strong preference shown for storms with sustained airflow from the northwest, particularly from 290-310 degrees, which is otherwise unexplained in the east/west oriented canyon. It seems unlikely that the Point of the Mountain, which is over ten miles south the mouth of the canyon, has any influence in turning and channeling the flow.

Other explanations include the "Lake Effect", which certainly has some influence in certain situations. The longest fetch across the Great Salt Lake does lie in a northwest direction upstream from the mouth of Little Cottonwood, but this still doesn't explain why most snow falls in Little Cottonwood instead of other areas as well. The "lake effect" as narrowly defined, occurs when cold unstable air flows

over a relatively warm lake. This combination occurs most often during the fall and spring. During these times, the increase in precipitation occurs for several reasons: first, the airmass picks up moisture from the lake; second, the salt from the lake water and the dust off the salt flats help to nucleate the snow crystals; but probably the most importantly, a warm lake combined with cold unstable air creates powerful instability showers--a wintertime equivalent of summertime thunderstorms caused by daytime heating. Some have suggested that "lake effect" only adds low level moisture which falls over the valley without reaching the mountains, however, with a strong northwest flow, the orographic lifting usually produces significantly more snow in the mountains than in the valley. With a weak flow, the amounts are about the same.

The favored storm pattern for the Salt Lake area mountains, and for Little Cottonwood in particular, is one in which a broad trough lies well to the east of Utah, with its base south of Utah, making cyclonic (counterclockwise) flow over Utah from a northwest direction. Short waves moving along this northwest flow pack a punch stronger than the uninitiated would suspect. It often pushes the snowfall rates to over 4" per hour.

The classic components include: cold northwest flow with 700 mb windspeeds of 20-30 mph, a minimum of 70% RH at 700 mb, and a cyclonic flow which saturates the air down to around 8,000' elevation, the lower the cloud deck, the heavier the precipitation. With higher or lower windspeeds, substantially less precipitation occurs.

In this situation, most of the precipitation in Little Cottonwood falls post-frontal, with only minor amounts pre-frontal. Just the opposite happens in other parts of the range including the Provo, Park City and parts of the Ogden area mountains. Little Cottonwood canyon piles up only minor amounts of snow on a southwest flow, however, this pre-frontal snow is often warmer and heavier.

Rain almost never falls at Alta as freezing levels seldom rise that high during mid winter. The typical rule of thumb for the rain/snow line in the Wasatch is to subtract 1000' to 1,500' from the freezing level, more with stronger precipitation rates.

In comparison, Big Cottonwood canyon has an entirely different shape than Little Cottonwood, and therefore storms affect this canyon differently. Big Cottonwood canyon rises steeply through a narrow canyon in its lower third with high peaks rising on both sides. Then, the canyon then flattens and broadens for the remaining two-thirds, and the surrounding peaks decline in elevation. In fact, according to the height of the ridges and peaks, they trend toward significantly lower elevations after the first third of the canyon, and the streamlines of the orographic airflow probably levels off or begins sinking in the upper section. This causes storms with a northwesterly flow, to drop more snow in the lower (aptly-named Storm Mtn) section, with noticeably less above Reynolds Flat where the canyon flattens out.

For these reasons, the ski resorts located at the upper end of the canyon prefer a westerly flow, at which time they receive about the same amount or more as Little Cottonwood. A southwest flow also favors the head of Big Cottonwood, especially for Brighton. In these cases some spillover probably occurs as the air flows up from American Fork.

On a clear night, temperatures often plummet in Big Cottonwood as the cold air descends from the mountains into the broad valley with a very constricted down canyon opening. In contrast, the broad-mouthed Little Cottonwood effectively drains cold air down valley.

Provo Area Mountains

A southwest flow favors the Provo area, especially when well-developed lows take a southern track through the state. The southwest flow can dump a tremendous amount of moisture in this area, while very little falls in the Cottonwood canyons. In a short wave situation, most of the precipitation falls pre-frontal, with very little in a northwest flow regime.

Characteristics of each Mountain Weather Station

- Logan Peak** Logan Peak is probably our best stations for wind data. It sits at 9,700' on a gently rounded mountain, thus no upwind terrain influences its readings. The winds recorded at this site often don't blow as strongly as others stations because of its lower elevation and lack of jet effect from surrounding terrain. The wind direction, speed and temperature seem to very accurately reflect the free-air conditions at that level. is site can be useful in observing frontal passages.
- Snowbasin** The current station sits well below the ridge, in the middle of the area, and offers little useful data. The direction doesn't mean much because of the amount of swirling which occurs within the basin. The site is exposed to southwest winds, and frequently shows speeds up to 30 mph from that direction.
- Ogden Peak** We have just installed this site and do not yet have a feel for its characteristics. It sits at 9,500' on a high mast which in turn sits atop a very pointed peak on a very exposed ridgeline. We suspect the wind will blow very hard at this site and that the direction will very closely represent the free air directions. Of all the stations, riming will affect this one more than any of the others. Therefore, if you see steadily falling windspeeds during a storm you should always suspect riming.
- Park West** On the Park City/Park West Ridge (9,200'), this site offers some decent wind information, but rarely shows winds over 20 mph. The site itself is well-exposed, but it does not seem to represent well the free air winds.
- Park City** Park City has two sites, one at the top of the Jupiter lift (10,000'), the other at the Summit station which is about 2/3 of the way up the mountain (9,000'). The Jupiter site, just below Tri-County peak, has a fairly good wind exposure, but again does not seem to represent the free air wind speeds. They may move the tower to a slightly higher, more exposed location, and if they do, it would be a much better site. It does not seem to be sheltered for any directions, but the speeds seem a bit low. This site is better than the Park West site, and is the 4th best station.
The Summit station is too low to represent ridge winds, so is of limited value. It does show southwest winds well, and winds at this site and along the gondola line can be quite strong.
- Solitude** This site sits just below a ridgeline (9,800') and is not well-exposed to the wind, and the data is of questionable value. The primary wind reading is from the west, and this seems to be controlled by the north-south orientation of the ridgeline.
- Cardiff** This anemometer sits at 10,300', the third highest site, on an exposed ridgeline across Little Cottonwood Canyon from Snowbird and Alta. Mt. Superior blocks it from a west and northwest wind but it seems to accurately reflect a north or south wind and to a lesser extent, an east wind. This is a good site, with fair representation of free air winds, and probably ties for the 2nd best station with Alta.
- Alta** This site sits at 10,400' on a somewhat exposed north-south tending ridgeline above the top of Germania lift. The site is blocked from a variety of directions, especially southwest and northeast but it is surprisingly accurate considering its location. The most common direction reading is from the northwest, and speeds at this site are usually 10 mph or more less than at Snowbird. A 20 mph reading represents a significant wind.
- Snowbird** This site ties with Logan Peak for the best site in the Wasatch. It sits as the highest, at nearly 11,000' and it is well-exposed for most directions, with the exception of southwest. A southwest wind is often deflected around the back of the Twin Peaks, and shows as a south to southeast wind. Winds at this site often blow twice as strong as any others, and in some instances may blow stronger than the free air as

a result of topographic acceleration. At other times, because of its altitude, a jet max can touch down at this site, with exceptionally strong winds in an otherwise calm situation. This site also has de-riming heat lamps but it still rimes up during strong storms especially strong wet southwest flows.

Sundance

This site is very sheltered by Mt. Timpanogos, and the data from it is relatively useless. Even the temperatures seem too high during daytime heating.

Again, the most representative stations for observing free air winds include first, Snowbird and Logan Peak. Tied for second, include Alta, Cardiff, and possibly Park City (Jupiter). Honorable mention goes to Park West, Solitude. Last and almost completely useless include Sundance and Snowbasin. We hope that the Mt. Ogden site will be tied for first, but we need to watch the data for a season to know.

Appendix

MONTHLY CALL RATE - SALT LAKE SHORT RECORDING

	NOV	DEC	JAN	FEB	MAR	APR
1979-80	714	1,514	4,274	2,967	3,389	1,313
1980-81	2,200	4,800	6,257	7,277	6,887	3,135
1981-82	1,761	6,879	8,522	5,485	6,361	3,416
1982-83	2,741	6,804	7,614	7,731	9,911	5,339
1983-84	3,216	10,708	7,073	7,032	5,983	4,396
1984-85	2,827	5,704	5,260	8,399	7,122	3,021
1985-86	4,119	4,703	6,298	10,628	6,225	3,706
1986-87	3,903	3,911	10,022	8,201	8,364	3,406
1987-88	2,390	6,534	10,201	7,297	9,208	3,780
1988-89	6,200	11,484	8,603	9,678	9,050	3,472
1989-90	3,854	7,626	14,126	12,528	10,831	3,933

YEARLY CALL TOTALS

	SLC 3 MIN	SLC 5 MIN	LOGAN	OGDEN	PROVO	PARK CITY	MOAB	TOTAL
1976-77	6,522							6,522
1977-78	11,258							11,258
1978-79	9,924							9,924
1979-80	14,469							14,469
1980-81	30,736							30,736
1981-82	33,099							41,610
1982-83	40,355		4,357	1,890	3,671	3,042		53,315
1983-84	39,647		5,300	2,725	4,076	2,577		54,325
1984-85	32,476		4,652	1,706	2,278	2,386		43,498
1985-86	36,535		5,469	5,464	2,292	2,562		52,322
1986-87	38,841		4,693	2,587	2,518	2,121		50,760
1987-88	39,614	4,020	2,500	2,500	2,500	2,500		53,000
1988-89	48,488	8,033	2,500	2,500	2,500	2,500	1,100	67,621
1989-90	52,898	10,947	5,000	2,500	2,500	5,000	1,693	80,297

	CALLS	ALTA SNOW (IN.)
1976-77	6,522	314.5
1977-78	11,258	524.5
1978-79	9,924	588.0
1979-80	14,469	514.0
1980-81	30,736	391.0
1981-82	41,610	696.0
1982-83	53,315	637.0
1983-84	54,325	743.5
1984-85	43,498	457.0
1985-86	52,322	599.0
1986-87	50,760	378.0
1987-88	53,000	410.3
1988-89	67,621	581.5
1989-90	80,297	448.0

BACKCOUNTRY AVALANCHE INCIDENTS

YEAR	TRIGGERED	CAUGHT	AT LEAST PARTLY BURIED	TOTALLY BURIED	KILLED
89-90	65	34	14	2	0
88-89	64	9	1	0	0
87-88	39	6	(1)	(1)	0
86-87	50	18	6	3	2
85-86	66	27	12	5	5
84-85	79	39	15	6	2
83-84	M	24	M	M	1
82-83	M	M	15	M	0
81-82	M	M	M	M	1
80-81	M	M	M	M	2
79-80	M	M	M	M	1
78-79	M	M	M	M	2
77-78	M	M	M	M	0
76-77	M	M	M	M	1
75-76	M	M	M	M	1
74-75	M	M	M	M	0
73-74	M	M	M	M	0
72-73	M	M	M	M	1
71-72	M	M	M	M	0

1989-90 Avalanche Incidents by Hazard Category

HAZARD	TRIGGERED	CAUGHT	AT LEAST PARTLY BURIED	BURIED	KILLED
Low	4	0	0	0	0
Moderate	25	19	8	1	0
High	23	10	4	0	0
High w/Warn	12	5	4	1	0
Extreme	1	0	0	0	0
Totals	65	34	14	2	0

INCIDENTS BY HAZARD CATEGORY

	LOW	MODERATE	HIGH	EXTREME
4 YEAR AVERAGE 1984-88	4	25	14	3
1988-89	16	37	11	0
1889-90	4	25	35	1

SUMMARY OF FORECAST HAZARD RATINGS

YEAR	HAZARD CATEGORY				WARNING DAYS	TOTAL DAYS
	LOW	MODERATE	HIGH	EXTREME		
80-81	49 28%	73 42%	47 27%	6 3%	32	178
81-82	92 48%	67 35%	31 16%	3 2%	34	195
82-83	61 36%	81 48%	22 13%	4 2%	25	168
83-84	69 39%	83 48%	20 12%	1 1%	16	173
84-85	52 30%	90 52%	30 17%	2 1%	17	174
85-86	44 28%	82 53%	25 16%	4 3%	19	155
86-87	33 19%	81 47%	55 32%	3 2%	14	172
87-88	73 44%	54 33%	37 23%	0 0%	8	164
88-89	67 41%	54 33%	41 25%	0 0%	9	162
89-90	60 34%	61 34%	53 30%	3 2%	14	177
10 YEAR AVERAGE	60 35%	73 43%	36 21%	2 1%	18	170

We issued the first avalanche advisory of the season on October 26th, and the last one was issued on the 20th of April, for a total of 230 advisories on 177 days. Avalanche warnings were issued on 14 days. Avalanches were recorded on 100 days, or 56% of the days in the 177 day season.

There was a drop in the number of low hazard days, along with a rise in the number of high hazard days, and for the first time in three years, we used the extreme hazard category. These facts tell some of the story of the character of the 1989-90 season. We experienced several protracted high hazard periods, including most of January, when only 5 days were rated at low or moderate.

NUMBER OF DAYS EACH HAZARD CATEGORY WAS USED

	LOW	MODERATE	HIGH	EXTREME	WARNING	DAYS W/ AVAL.	NO. AVAL.
OCTOBER	5	1	0	0	0	1	1
NOVEMBER	23	2	4	1	3	6	155
DECEMBER	7	12	12	0	0	17	120
JANUARY	1	4	26	0	8	29	370
FEBRUARY	2	17	7	2	3	20	415
MARCH	13	14	4	0	0	20	290
APRIL	9	11	0	0	0	7	60
TOTAL	60	61	53	3	14	100	1411

Examples of Avalanche Advisories

ZCZC SLCWRKSNW SLR
TTAA00 KSLC DDHHMM

GOOD MORNING, THIS IS BRAD MEIKLEJOHN WITH THE BACKCOUNTRY AVALANCHE AND MOUNTAIN WEATHER INFORMATION AT 7:30 AM ON FRIDAY, JANUARY 19.

THE UTAH AVALANCHE FORECAST CENTER IS A COOPERATIVE EFFORT BETWEEN THE FOREST SERVICE AND THE NATIONAL WEATHER SERVICE.

FIRST OF ALL, I WANT TO CONGRATULATE YOU ALL ON BEING SO WELL-BEHAVED. EVERYONE HAS BEEN CHOSING GOOD LINES AND PLAYING IT CONSERVATIVELY. GOOD JOB. IT IS SCARY OUT THERE, AND ALL WEEK LONG I'VE BEEN LOOKING OVER MY SHOULDER EVERY OTHER TURN.

THERE CONTINUE TO BE MONSTROUS SLIDES IN THE WASATCH, AND YESTERDAY THEY WERE IN THE AMERICAN FORK DRAINAGE. THE HELICOPTER SKI COMPANY THREW SOME EXPLOSIVES, AND GOT FULL-DEPTH SLIDES UP TO 300 YARDS WIDE, AND ONE SLIDE RELEASED 1/4 MILE FROM WHERE THE SHOT WENT OFF.

I WAS DOWN IN THE PROVO MOUNTAINS YESTERDAY, AND SAW CLOSE TO 100 DIFFERENT AVALANCHES WHICH HAD RUN WITH THE LAST STORM. WE WERE ALSO GETTING COLLAPSES WHICH WAS SHAKING THE SNOW OFF OF TREES A HUNDRED YARDS AWAY. FORTUNATELY WE FOUND A SLIDE THAT HAD RUN EARLY IN THE STORM AND FILLED BACK IN, AND HAD A RELAXING RUN IN GREAT SNOW.

THERE WAS AN AVALANCHE FATALITY YESTERDAY NEAR WEST YELLOWSTONE, MONTANA ON LION'S HEAD PEAK. A SNOWMOBILER WAS CAUGHT AND BURIED, AND LATER FOUND BY A RESCUE DOG FROM BRIDGER BOWL. THIS IS THE SECOND AVALANCHE DEATH IN THE U.S. THIS WINTER.

FINALLY, IN THE RUBY MTNS IN NEVADA, THE HELICOPTER COMPANY THERE THREW AN EXPLOSIVE AND GOT A FRACTURE THAT RAN FOR FIVE MILES, UP AND OVER RIDGES, AROUND CORNERS, AND ACROSS VALLEYS. NOW THAT'S SENSITIVE.

WHEN WILL ALL THIS STOP? THERE IS SOME SIGN OF STRENGTHENING OF THE SNOWPACK IN THE CENTRAL WASATCH WHERE THE SNOWPACK IS 5-6' DEEP. IT IS A SLOW PROCESS, THOUGH, AND MAY NOT HAPPEN QUICKLY.

WE STILL FEEL THERE IS A HIGH HAZARD OF HUMAN-TRIGGERED AVALANCHES ON EAST, NORTH, AND WEST FACING SLOPES ABOVE 9000' WHICH ARE STEEPER THAN 35 DEGREES. THE EAST WINDS YESTERDAY MAY HAVE MADE THE WEST FACING SLOPES ABOVE 10,000' VERY DANGEROUS. IT IS POSSIBLE TO TRIGGER A SLIDE FROM AN ADJACENT LOWER ANGLED SLOPE. ALSO, MANY SLIDES HAVE BROKEN OUT LOW, SO DON'T TRUST A RIDGETOP SNOWPIT.

THERE IS A MODERATE HAZARD ON EAST, NORTH, AND WEST FACING SLOPES BETWEEN 8000'-9000' FEET AND BETWEEN 30-35 DEGREES OF STEEPNESS,

WHILE SOUTHEAST TO SOUTHWEST FACING SLOPES HAVE A LOW HAZARD.

THE SKIING IS GREAT IF YOUR NERVES CAN TAKE IT.

MOUNTAIN WEATHER:

IT LOOKS LIKE CLEAR SKIES THROUGH THE WEEKEND, WITH ONLY A FEW FLURRIES ON THE EAST SIDE THIS MORNING. HIGHS WILL REACH THE MID 20'S AT 8000' TODAY, WITH RIDGETOP WINDS BECOMING LIGHT AND VARIABLE THIS AFTERNOON.

IF YOU WOULD LIKE MORE DETAILED INFORMATION CALL 364-1591.
IF YOU SEE ANYTHING OF INTEREST, CALL US IN OFFICE AT 524-5304 OR
1-800-662-4140.

I WILL UPDATE THIS FORECAST BY 7:30 SATURDAY MORNING.

THANKS FOR CALLING.

MEIKLEJOHN
NNNN

ZCZC SLCWRKSNW SLR
TTAA00 KSLC DDHHMM

GOOD AFTERNOON, THIS IS TOM KIMBROUGH WITH BACKCOUNTRY AVALANCHE AND MOUNTAIN WEATHER INFORMATION AT 4:30 PM ON WEDNESDAY, JANUARY 3, 1990.

THE UTAH AVALANCHE FORECAST CENTER IS A COOPERATIVE EFFORT BETWEEN THE FOREST SERVICE AND THE NATIONAL WEATHER SERVICE.

HERE WE GO AGAIN...TODAY PEOPLE STARTED GETTING OUT INTO THE BACKCOUNTRY AND AT LEAST ONE PERSON TRIGGERED A SLIDE. THIS ONE WAS ON THE RIDGE LINE SOUTH OF PARK WEST. THE PERSON PUT A SKI CUT ACROSS THE TOP OF THE SLOPE AND WHEN IT DIDN'T GO, HE STARTED SKIING DOWN. HE FELT THE SLOPE RELEASE BEHIND HIM AND WAS ABLE TO CUT OUT OF IT TO THE SIDE. THIS WAS A 35 DEGREE, NORTHEAST FACING SLOPE. IT PULLED OUT 1 TO 2 FEET DEEP, ON THE OLD WEAK, FACETED SNOW THAT FORMED IN DECEMBER.

A FEW SLOPES SLID DURING THE STORM BUT LOTS MORE DIDN'T AND ARE JUST WAITING FOR SOME BOLD POWDER SCOUNDREL TO START CUTTING TRACKS DOWN THE FALL LINE. WITH THIS TYPE OF INSTABILITY AND WITH THE COLD TEMPERATURES WE HAVE, THE SNOWPACK WILL BE SLOW TO ADJUST TO IT'S NEW LOAD.

WE HAVE LIFTED THE AVALANCHE WARNING THIS AFTERNOON BUT WIDESPREAD AREAS OF UNSTABLE SNOW STILL EXIST. THE HAZARD OF HUMAN TRIGGERED AVALANCHES REMAINS HIGH ABOVE 8,000 FEET ON NORTHWEST, NORTH, AND EAST FACING SLOPES, STEEPER THAN 35 DEGREES.

YOUR CLUES TO THE INSTABILITY WILL BE COLLAPSING AND WHOOMPING

SOUNDS IN THE NEW SNOW.

ON SOUTHEAST THROUGH SOUTHWEST FACING SLOPES, THERE IS A SUPPORTABLE CRUST UNDER THE NEW SNOW. THESE AREAS WERE VERY GOOD SKIING TODAY AND WITH THE COLD TEMPERATURES SHOULD STILL BE GOOD TOMORROW.

MOUNTAIN WEATHER

WE ARE MOVING BACK INTO THE BASIC PATTERN WE HAVE HAD CONTROLLING OUR WEATHER FOR MOST OF THE WINTER: A STRONG RIDGE OVER THE WEST COAST. FOR THE NEXT COUPLE OF DAYS, WE WILL BE ON THE EAST SIDE OF THIS RIDGE WHICH WILL BRING OUR WEATHER DOWN FROM THE NORTHWEST. A WEAK DISTURBANCE WILL MOVE OVER THE RIDGE THURSDAY. MOST OF THE ENERGY ASSOCIATED WITH THAT SYSTEM WILL BE NORTH OF UTAH, BUT THERE SHOULD BE ENOUGH MOISTURE TO PRODUCE SOME CLOUDS AND POSSIBLY A FEW FLAKES. TEMPERATURES WILL REMAIN COLD WITH LOWS TONIGHT NEAR ZERO. NEXT WEEK LOOKS DRY.

LOGAN, OGDEN:

HIGH - ABOVE 8,000, NW, N, E, STEEPER THAN 35 DEGREES.

PROVO:

HIGH HAZARD - ABOVE 8,000 FEET, NW, N, E, STEEPER THAN 35 DEGREES.

THERE ARE NUMEROUS SPONTANEOUS AVALANCHES VISIBLE ON TIMPANOGOS.

IF YOU WOULD LIKE MORE DETAILED INFORMATION CALL 364-1591
IF YOU SEE ANYTHING OF INTEREST, CALL US IN OFFICE AT 524-5304 OR
1-800-662-4140.

WE WILL UPDATE THIS FORECAST BY 7:30 AM, ON THURSDAY.

THANKS FOR CALLING.

KIMBROUGH
NNNN

Example of Weather Advisory

VIZCZC SLCWRKMTN SLR
TTAA00 KSLC DDHMM

UTAH AVALANCHE CENTER MOUNTAIN WEATHER ADVISORY

MARCH 11, 1990
1400 HRS

SYNOPTIC DISCUSSION:

NEW SNOW AMOUNTS IN THE MOUNTAINS AREN'T MUCH MORE THAN ON THE BENCHES

IN SLC. MOST AREAS HAVE 5-10 INCHES OF SNOW. FOR MOST OF THE MORNING, THE VALLEY WINDS WERE BLOWING OUT OF THE NORTH WHILE THE RIDGETOP WINDS WERE BLOWING OUT OF THE SOUTH CREATING SOME GOOD SHEAR WHICH--ALONG WITH THE FRONTAL ACTION--INTENSIFIED THE PRECIPITATION. NOT MUCH AVALANCHE ACTIVITY YET. AFTER THE COLD FRONT PASSES, THE WINDS HAVE BACKED OFF TO 5-15 MPH THE LIGHTNING HAS STOPPED AND SNOWFALL INTENSITIES HAVE DECREASED.

THIS STILL LOOKS LIKE A GOOD STORM. IT SHOULD SNOW WITH VARYING DEGREES OF INTENSITY THROUGH TUESDAY AND NOT CLEAR OUT TILL ABOUT WEDNESDAY. THE MODELS ARE FORECASTING THE 700 MB LOW TO SET UP NORTH OF US AND CONTINUE TO BRING MOIST AIR INTO US FROM THE WEST AND NORTHWEST THROUGH TUESDAY. THE SATELLITE LOOPS SHOW THE BACK SIDE OF THIS FIRST BAND TO BE OUT ON THE NEVADA-UTAH BORDER AT THIS TIME AND SHOULD ARRIVE HERE BY EARLY TONIGHT. HOWEVER, THERE'S STILL LOTS OF LOW LEVEL MOISTURE WHICH SHOULD BE ENOUGH TO KEEP THE PRECIPITATION GOING FOR AWHILE BUT PERHAPS NOT QUITE THE INTENSITY. THEN THERE'S ANOTHER WAVE IN CENTRAL NEVADA WHICH APPEARS TO BE STRENGTHENING AND MIGHT JUST FILL IN THE GAP AND WE MIGHT NOT EVEN GET A BREAK. THE MODELS, ANYWAY, FORECAST THE 700MB RELATIVE HUMIDITIES TO DROP OFF A BIT OVERNIGHT AND MONDAY AND RISE AGAIN ON TUESDAY WITH STRONGER NORTHWEST FLOW ON TUESDAY. THE RIDGETOP WINDS HAVE TURNED NORTHWEST AT LOGAN PEAK AND IN THE OGDEN AREA AND ARE JUST BEGINNING TO TURN IN THE SLC MOUNTAINS. THEY ARE BEING HELD UP A LITTLE IN THE SLC AND PROVO AREA MOUNTAINS BECAUSE THE SOUTHERN PART OF THE FRONT HAS STALLED A LITTLE AND INTENSIFIED. BUT THEY SHOULD EVENTUALLY TURN NORTHWEST BY ABOUT SOMETIME TONIGHT. WHEN THEY DO, THIS SHOULD INCREASE THE PRECIPITATION INTENSITIES IN THE COTTONWOOD CANYONS. HOWEVER, THE RIDGETOP WINDSPEEDS SHOULD REMAIN FAIRLY LIGHT SO I'M NOT EXPECTING HEAVY PRECIPITATION IN THOSE AREAS BUT MODERATE INSTEAD. WIND DIRECTIONS SHOULD REMAIN NORTHWEST THROUGH TUESDAY AND WINDSPEEDS 10-20 MPH AND INCREASING ON TUESDAY. STORM TOTALS SHOULD BE 2-4 FEET BY TUESDAY NIGHT.

EXTENDED:

RIDGE BUILDING ON WEDNESDAY-THURSDAY.

	SUN NITE	MON	MON NITE
FREE AIR (10,000')			
WIND DIRECTION (DEG)	280	310	300
WIND SPEED(MPH)	5-15	5-15	10-25
TEMPERATURE(F)	15	15	14
SURFACE(8,000')			
TEMPERATURE	20	25	18
SNOW DENSITY(%)	7-9	6-9	5-8
CLOUD COVER	OVC	OVC	OVC
CLOUD ELEVATION	5K	5K	6K
WEATHER	S	S	S
LIGHTNING	NOT LIKELY		
SNOW LEVEL	VALLEY FLOOR		

QUANTITATIVE PRECIPITATION FORECAST (INCHES OF SNOW):

	TODAY 5AM-5PM	TONIGHT 5PM-5AM	TOMORROW 5AM-5PM
POW.MTN/SNOWBASIN	3-6	3-6	3-6
PARK WEST	5-10	5-8	5-10
PARK CITY/DEER VALLEY	3-6	3-6	3-6
BRIGHTON/SOLITUDE	6-12	5-10	7-12
ALTA/SNOWBIRD	6-12	6-12	8-14
SUNDANCE	3-6	3-6	2-5

TREMPER
NNNN

Examples of Avalanche Warnings and Special Avalanche Advisories

ZCZC SLCSABSLC
WOUSOO KSLC 031430??CSW

UTAH AVALANCHE FORECAST CENTER
NATIONAL WEATHER SERVICE SALT LAKE CITY, UTAH

AN AVALANCHE WARNING IS IN EFFECT FOR THE NORTHERN WASATCHMTNS. FROM THE UTAH/IDAHO BORDER TO SPANISH FORK CANYON.

THIS IS A BACKCOUNTRY AVALANCHE FORECAST AND DOES NOT APPLY TO DEVELOPED SKI AREAS AND HIGHWAYS.

A HIGH BACKCOUNTRY AVALANCHE HAZARD EXISTS ON NORTH, EAST, AND WEST FACING SLOPES STEEPER THAN 30 DEGREES ABOVE 8000. MOSTLY UNSTABLE SNOW EXISTS ON THESE SLOPES AND NATURAL AND SKIER-TRIGGERED AVALANCHES ARE LIKELY.

8-12" OF NEW SNOW HAS FALLEN OVERNIGHT, ACCOMPANIED BY STRONGWEST TO NORTHWEST WINDS. THIS ADDITIONAL WEIGHT IS EXPECTED TO CRITICALLY OVERLOAD WEAK LAYERS IN THE SNOWPACK. ANY AVALANCHES WILL BE LARGE AND DANGEROUS.

BACKCOUNTRY TRAVELERS SHOULD AVOID AVALANCHE PATHS AND RUNOUT ZONES.

THIS WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

RECORDED AVALANCHE FORECASTS FOR THE NORTHERN WASATCH MOUNTAINS ARE AVAILABLE BY CALLING 801 364 1581.

MEIKLEJOHN....USDA FOREST SERVICE

NNNN

CSW

TTAA00 KSLC DDHHMM

UTAH AVALANCHE FORECAST CENTER
NATIONAL WEATHER SERVICE, SALT LAKE CITY, UTAH

1600 HRS, TUESDAY, JANUARY 2, 1990

AN AVALANCHE WARNING IS IN EFFECT FOR THE SALT LAKE AND PARK CITY AREA MOUNTAINS. ONE TO TWO FEET OF NEW SNOW HAS FALLEN SINCE YESTERDAY, PRODUCING WIDESPREAD AREAS OF UNSTABLE SNOW ON MANY SLOPES. THERE IS A HIGH HAZARD OF HUMAN TRIGGERED AVALANCHES AT THIS TIME. BACKCOUNTRY TRAVELERS SHOULD AVOID SLOPES STEEPER THAN 30 DEGREES.

THIS ADVISORY DOES NOT APPLY TO DEVELOPED SKI AREAS OR STATE HIGHWAYS WHERE AVALANCHE CONTROL IS CONDUCTED.

FOR MORE DETAILS, CALL YOUR LOCAL NUMBER TO RECEIVE RECORDED AVALANCHE INFORMATION. IN THE SALT LAKE AREA, 364-1581.....IN PARK CITY, 649-2250....IN LOGAN, 752-4146....IN OGDEN, 621-2362....IN PROVO, 374-9770. TO CONTACT OUR OFFICE....524-5304.

KIMBROUGH

UTAH AVALANCHE FORECAST CENTER (USDA FOREST SERVICE/NATIONAL WEATHER SERVICE)

NNNN

ZCZC SLCSABSLC CSW
TTAA00 KSLC DDHHMM

UTAH AVALANCHE FORECAST CENTER
NATIONAL WEATHER SERVICE, SALT LAKE CITY, UTAH

1500 HRS, FRIDAY, JANUARY 5, 1990

SPECIAL AVALANCHE ADVISORY

DANGEROUS AVALANCHE CONDITIONS EXIST IN MANY AREAS OF THE WASATCH MOUNTAINS, FROM SPANISH FORK CANYON NORTH TO THE UTAH-IDAHO BORDER. SIMILAR SNOWPACK CONDITIONS IN COLORADO RESULTED IN THE DEATH OF SKIER NEAR VAIL, COLORADO ON JANUARY 2.

A HIGH HAZARD OF HUMAN-TRIGGERED AVALANCHES EXISTS ABOVE 8000' ON NORTHWEST, NORTH, AND EAST FACING SLOPES STEEPER THAN 35 DEGREES. THIS DANGEROUS SITUATION WILL BE VERY SLOW TO IMPROVE.

PERSONS WITHOUT GOOD ROUTE-FINDING AND SNOW STABILITY SKILLS ARE ADVISED TO REMAIN ON LOWER ANGLED SLOPES.

THIS ADVISORY DOES NOT APPLY TO DEVELOPED SKI AREAS OR STATE HIGHWAYS WHERE AVALANCHE CONTROL IS CONDUCTED.

FOR MORE DETAILS, CALL YOUR LOCAL NUMBER TO RECEIVE RECORDED AVALANCHE INFORMATION. IN THE SALT LAKE AREA, 364-1581.....IN PARK CITY, 649-2250.....IN LOGAN, 752-4146.....IN OGDEN, 621-2362.....IN PROVO, 374-9770. TO CONTACT OUR OFFICE....524-5304.

MEIKLEJOHN

UTAH AVALANCHE FORECAST CENTER (USDA FOREST SERVICE/NATIONAL WEATHER SERVICE)
NNNN

Letters of Support



December 19, 1989

Mr. Bruce Tremper
Director
Utah Avalanche Forecast Center
337 N. 2370 W.
Salt Lake City, UT 84116

Dear Bruce,

I am delighted to write this letter of support for the Utah Avalanche Center Forecast service. As a regular back-country skier and as a person deeply concerned with community services, I am an enthusiastic supporter.

I use the avalanche recorded message almost every week. Though I have been formally trained in avalanche avoidance, I always learn something new when I call. Your carefully crafted messages not only warn the back country user about current conditions and precautions, they also provide a valuable education. Several calls over a season by the back-country user provide a valuable education related to immediate conditions. This is something that even a classroom session has difficulty providing.

I would like to encourage any potential contributor to consider what a critical and essential public service you provide. Indeed, I believe that many lives have been saved through your information. You have also contributed significantly to Utah's tourist industry by assuring people from out of town that Utah's backcountry can be reasonably used with good sense and good information.

If any of your potential contributors would like more information or an enthusiastic pitch from me, have them call.

Best personal regards.

Sincerely,

A handwritten signature in cursive script, appearing to read "Ted Wilson".

Ted Wilson
Director



Hinckley Institute of Politics
253 Orson Spencer Hall
Salt Lake City, Utah 84112
(801) 581-8501



April 4, 1990

Avalanche Forecast Center
337 North, 2370 West
Salt Lake City, UT 84116

Gentlemen:

Just a few words to identify myself. I have been an avid skier since my childhood in New England and came out to Utah to join the faculty of the School of Medicine in 1956 and have had season ski passes at Alta since that time. Over the years, I have had personal (obviously survivable) experience with 2 slides and started or avoided a number of others both here and when heli-skiing in British Columbia. Suffice to say, I have great respect for their potential and the challenge in risk assessment they pose.

You may have encountered my son of the same name who is assistant manager of Salt Lake REI.

So much for the pre-amble. I listen to your report daily, whether I plan to ski that day or not. You enable me to keep track of the snow pack and provide the best information on mountain weather available.

However, your reports are more than informative and this is where all of you should have high praise.

The format of your reports and the personal style of your staff are remarkable for their intellectual quality, common sense, and above all good humor. Of all the technical reports I have encountered, whether from public or private sources, yours is the finest I have ever heard and their quality holds up so well day after day throughout the season. They are never dull or perfunctory.

Enclosed is my check for \$100.00. Sorry to have missed the festivities at the Green Parrot. Keep up the good work. Every best wish.

Sincerely,

Lincoln D. Clark, M.D.
Professor of Psychiatry
Professor of Pharmacology
Staff Psychiatrist, University of Utah Medical Center
and Western Institute of Neuropsychiatry
Department of Psychiatry

LDC/jw

School of Medicine
50 North Medical Drive
Salt Lake City, Utah 84132
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Newspaper Articles

Avalanche forecasters probe the slopes

■ Skiers' nemesis:
The Wasatch's slopes have lots of avalanches and skiers. Forecasters test the snow's stability.

By Robert Rice
Deseret News staff writer

Give the Greatest Snow on Earth a good dose of gravity and witness one of the greatest forces of nature ever: the avalanche.

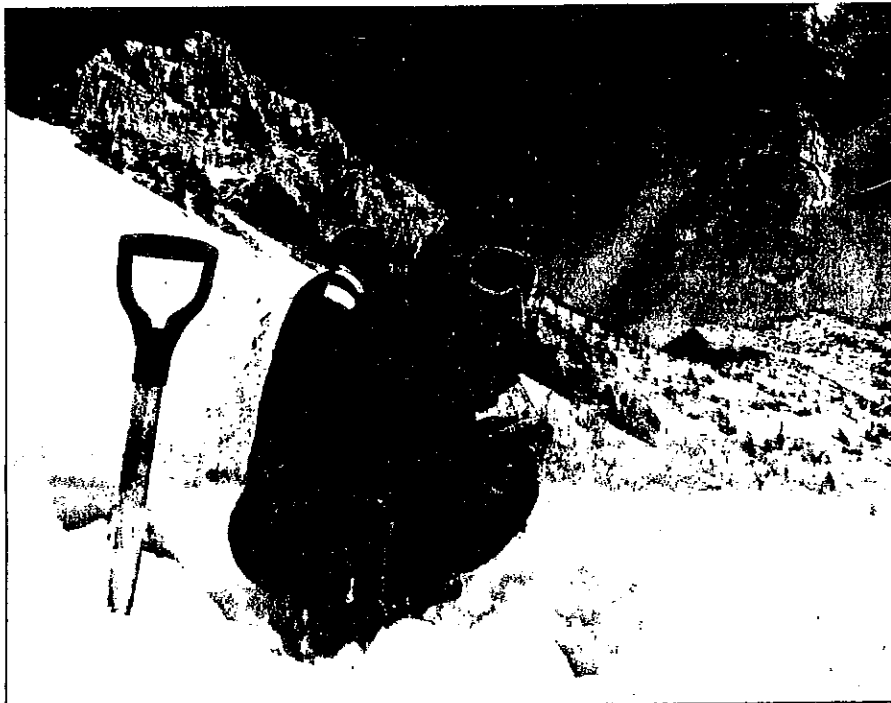
At least 686 avalanches thundered down the slopes of the Wasatch Mountains last winter, not a single one of them unnoticed by Bruce Tremper, director of the Utah Avalanche Forecast Center.

Tremper and a staff of three forecasters probe the snows of the Wasatch Mountains to prepare a daily forecast of avalanche conditions available by telephone for back-country skiers.

Avalanches have brought death to 14 in Utah since 1980 — the last death in a 1987 slide — a statistic that should startle caution into back-country adventurers and a figure that instills a sense of awe and duty in Tremper.

"There's nothing like an avalanche. They're the ultimate as far as power and beauty, and sometimes even mysteriousness, is concerned," he said while on his skis below Cardiac Basin in Big Cottonwood Canyon 10 miles east of Salt Lake City.

Please see SNOW on A2



PHOTOGRAPHY/TOM SMART

Avalanche forecaster Bruce Tremper inspects snow crystals through microscope at Cardiff Pass, above Alta.

SNOW

Continued from A1

"But they're not that mysterious. You can figure them out. They don't have to be a mystery," he said.

Demystifying the deadly force takes on new significance in the Wasatch Mountains, where avalanche conditions are relatively bad and where a high density of skiers test their back-country skills.

"The Wasatch are unique because you have the maximum interaction between people and avalanches ... you have a lot of people and you have a lot of avalanches," he said.

Keeping the two from interfacing is a seven-day-a-week job for the forecast center, jointly funded by the U.S. Forest Service and the National Weather Service, and housed at the Salt Lake International Airport.

Seated behind a computer terminal wired to 18 ridge-top weather sensors in the Wasatch, Tremper can monitor temperatures, snow depth, wind speed and direction to aid in measuring the likelihood of an avalanche.

But the real work comes when Tremper and his team of forecasters don skis and lug packs high up into the Wasatch Mountains in search of

Avoiding an avalanche:

- Take an avalanche safety course. The American Avalanche Institute offers one Jan. 4-7. Call 658-0361 to register. The Alaska Mountain Safety Center offers another Jan. 13-15. Call 495-7318 to register.
- Practice what you've learned in avalanche school. "Dig lots of pits" and "base your decisions on data."
- Call the Utah Avalanche Forecast Center before embarking on a back-country tour. Salt Lake, 364-1581; Provo, 374-9770; Ogden, 831-2362; Logan, 752-4146; Park City, 949-2260; Brian Head, 877-9012.
- Wear an avalanche beacon that broadcasts a signal in the event of an avalanche burial. Also, pack a shovel for rescue and digging snow pits.
- Travel a safe distance apart when skiing in a group. Don't permit a snow slide to capture an entire group.
- After skiing a steep slope, ski out of the way lest another skier trigger an avalanche above you.
- Choose a safe route of ascent and descent.
- Don't rely solely on a forecast from the Utah Avalanche Forecast Center. Make your own informed observations.

the signs of an impending slide.

This week Tremper strapped climbing skins on his cross-country skis to ski to Cardiff Pass at 10,000 feet above sea level above the town of Alta. Finding a steep slope attractive to skiers, Tremper pulled a shovel from his pack and started digging.

"What we're really trying to do is be a kind of Sherlock Holmes of the snow," he said, adding he looks for clues to determine where snow is unstable and where it is stable, and therefore relatively safe to ski.

The direction a slope faces with respect to the sun, its elevation and its steepness play an important role in how stable a slope is. And the profile of a "snow pit," dug by Tremper, also reveals a great deal.

This day, Tremper digs a three-

foot deep pit and strikes ground. The profile he has exposed reveals a semi-weak zone of snow some 12 inches below the surface. Peering through a microscope, Tremper finds ball-bearing-like snow crystals that contribute to the snow's weakness, and to a small degree of instability.

Digging with the shovel to form an eight-foot long isolated column, Tremper performs a Nutsch Block test to determine the relative strength of the snow. The snow column sustained Tremper's weight but collapsed under a hard jump, telling Tremper the snow in the immediate area is "probably" safe to ski.

Tremper digs several more pits that afternoon, recording snow temperatures and studying snow profiles. He predicts that continuing

cold temperatures could lead to an increasingly unstable snow pack in the immediate future.

The data collected by Tremper, together with the several more trips into the back country and dozens of snow pits dug each week will help the forecast center assemble a forecast for the day.

A call to the forecast recording in Salt Lake City, Provo, Ogden, Logan, Park City and Brian Head will provide a description of the snow's stability and may comment on the likelihood of a human-triggered avalanche.

Forecasts this week placed the possibility of a human-triggered avalanche at low but still cautioned against skiing steep slopes on high-elevation, northwesterly through northeasterly facing slopes.

"But we're not giving the gospel," warned Tremper.

"By calling our forecast, you just get a general idea. The rest you have to do alone. All we can do is give you the big picture."

Tremper recommended taking a credible avalanche safety course to polish avalanche safety skills. In the back country, "dig lots of pits" and "base your decisions on data" when choosing a slope to ski.

"The kind of people who are killed in avalanches are expert skiers but don't know much about avalanches," he said.

THE TREASURE MOUNTAIN TIMES

Vol. 1, No. 4

January 30, 1989

Treasure Mountain Middle School

SCIENCE STUDENTS LEARN ABOUT AVALANCHES

by Tami Francis
CRAACK!!!

Is the sound of thousands of pounds of snow rushing down a mountainside. Many people have been stuck in the position of

being in an avalanche. Bruce Tremper, who works for the Avalanche Forecast Center, came to TMMS on January 10 to talk to the 8th grade science students about dangers

of back country skiing. Mr. Tremper talked to students about the tragedies of backcountry skiing and ways to prevent an avalanche from starting or being caught in one.

He says even as a professional, he himself was caught in an avalanche once.

He described his feelings as he thought he was going to die. He tried to get out, but there were no possible way he could. He said it was like being thrown in a dryer with a couple of scoops of snow. He had snow up his nose, in his mouth, and every place else. Fortunately, he was able to dig himself out and returned home safely.

Thanks to Ms. Schneider and to Bruce Tremper for educating students about avalanches. Remember, if you go into the backcountry, have someone there you can trust. Think AVALANCHE, and be careful.

TMMS HELPS NEEDY

by Erin Price

Toys, candy, clothes, and gifts. All this and much more were donated by TMMS students to needy families over the Christmas break. The items were donated by 7th and 8th grade students, along with many shops on Main Street, including Minors Only, Leather & Lace, Pastabilites Pleasures, the Candy Mine, Dolly's and Leanne's. Many of the stores donated clothes books and money.

The Student Council went down to Salt Lake City before the vacation and delivered the items to the Salt Palace for nine families.

Souces tell us the families were pleased,

and they had a very good Christmas.



Student Council members take boxes of food to needy families.

INDEX

More News.....	Page 2
Editorials.....	Page 3
Features.....	Page 4&5
Writer's Cramp.....	Page 6
Sports.....	Page 7
Puzzles.....	Page 8

The Salt Lake Tribune

Recreation

Thursday Morning—February 8, 1990
Section D Page 5

Snow Safety Crews Work to Manage Avalanche Hazards

By Tom Wharton
Tribune Outdoors Editor

When snow begins to fall in prodigious amounts along the Wasatch Front, avalanche control crews prepare for a long morning of work.

It is dark when U.S. Forest Service winter recreation forester John Hoagland reaches the Salt Lake Ranger District office at 5 a.m.

He soon heads to Little Cottonwood Canyon to join other forest rangers and employees from Alta and Snowbird. Large World War II vintage artillery cannons are prepared for firing.

The forest service employees are in charge of firing the old guns used to shoot down potentially dangerous avalanches.

Meanwhile, Utah Department of Highway crews are also working on slide paths which threaten the highway. They must make certain an avalanche won't come down and bury a car full of unsuspecting skiers.

Ski patrol members from the two resorts make certain that all avalanche hazards within the boundaries of their resort are eliminated before the first paying customer hits the hills.

And, down in Salt Lake City, Bruce Tremper, director of the Utah Avalanche Forecast Center, begins working with the National Weather Service so he can update the recorded information winter backcountry users like nordic skiers, snowmobilers and sledgers can use to determine the danger of being in the forest after a big snowstorm.

Before the day is over, Tremper will issue two avalanche advisories and two mountain weather forecasts.

If conditions are bad enough, he will also use media outlets to alert the public to severe avalanche conditions.

This team of federal, state and ski area employees must be performing its tasks well. Utah has not experienced an avalanche fatality since 1987. Considering the history of the avalanche prone Wasatch Front, especially Little Cottonwood Canyon, that safety record is impressive.

On an average winter weekend, 20,000 cars carrying 40,000 people drive up Little Cottonwood Canyon. These folks may not know it, but they are statistically 30 times more likely to be hit and killed by an avalanche than on any other highway in North America.

Still, only one person — a UDOT snow plow driver in 1952 — has been killed by an avalanche on that highway since 1952.

Since millions of people who depend on backcountry and developed skiing for their winter recreation or their livelihood are directly threatened by avalanches, the U.S. Forest Service has developed great expertise on controlling these deadly snow slides.

In December, Doug Abramett was named director of a new Center of Excellence for avalanche control in Salt Lake City. In addition to continuing to work on making backcountry travel in Utah canyons even safer, Abramett will use expertise gained in Utah to train other forest service employees throughout the United States on avalanche control techniques.

"There is a lot of history that goes with Alta," said Abramett shortly after taking his new job. "We have one of the biggest avalanche control sys-

tems in the country."

Still, it is a system not without problems. The old artillery pieces used to control avalanches in the Cottonwood Canyons are slowly running out of ammunition, which is no longer manufactured. Estimates are that there may be enough left for only 10 more years.

And, in the federal system, there wasn't much room for people with experience in controlling avalanches to advance.

"John Hoagland and I started a concerted effort to try to get the program back on its feet and insure that, in the future, we would have an avalanche control program," said Abramett. "We need to maintain expertise because, in essence, the forest service has started the whole avalanche control program in the United States but, in the last few years, it kind of slipped. It's real difficult to maintain expertise. We were afraid that, if we didn't do something, we'd lose the edge on our expertise."

Those are the reasons for the center of excellence. And, if those controlling avalanches continue to do their job, chances are few will notice them.

That job entails forecasting avalanche danger, making certain that the big slides are controlled and, perhaps most important, educating the public on the importance of knowing about avalanche danger.

"More people are killed by avalanches in Utah than by any other natural hazard, including lightning," said Tremper. "We try to keep avalanches and people separated."

Historically, avalanches were a

great cause of death. In Europe, the big slides wiped out entire towns. Though modern zoning laws prevent that from happening now, the 10,000 or so avalanches which occur annually along the Wasatch Front still pose a threat to the safety of people who play and work in the canyons.

"These days, 95 percent of the people who get caught in an avalanche trigger the avalanche themselves and it catches them," says Tremper. "That's where we come in. Because people are out there tromping around the hills, they are going to trigger the avalanches. So, we give people the information and try to sleep them clear of hazardous areas. Two days after a storm, some places are real safe and some are really dangerous."

Tremper doesn't particularly care for avalanche safety checklists. He thinks the phenomenon is so complicated that the only way to insure safety is to understand the principle behind avalanche danger. Predicting avalanches is so complicated that such predictions can't be pinned down to a classical model on a computer.

"The problem comes when a person's skills traveling in the backcountry are ahead of or above their avalanche skills," he explains. For example, an expert skier has the ability to get into steep, dangerous avalanche terrain. If he doesn't have the route-finding snow stability skills, then he doesn't have the skill to avoid avalanches. Our typical victim is someone who is ignorant of avalanche conditions but is a good skier."

The steeper the terrain, the more dangerous it can be. A slope that is steep enough to slide is usually be-

tween 30 and 45 degrees, exactly the kind of slopes best for skiing.

The next thing needed for an avalanche is a strong layer of snow sitting on a weak layer of snow. Almost all avalanches are like a dinner plate sliding off a table. In this case, they are a cohesive piece of snow that breaks out. The big question is how strong is the snow underneath the slab. A lot of snow in a short period of time will overload the strength of those weak areas and avalanches are more likely.

Rangers like Hoagland recommend that expert skiers purchase a set of "Pieps" avalanche transceivers which can be used to "home in" on a skier buried in an avalanche. Skiers can practice by burying the Pieps in three or four feet of snow and then trying to find it. Lightweight shovels are also an essential part of backcountry skiing.

Few people buried by an avalanche survive much longer than 15 minutes. Chances are, if you have to go find a ski patrolman or a ranger to rescue your friend, your friend will be already dead by the time help arrives.

Self-rescue is imperative. Every backcountry ski group should be prepared to rescue a member of their party buried in a slide.

Most important, if you plan on skiing the backcountry, take an avalanche safety course from the Sierra Club, Wasatch Mountain Club or from private schools which offer such courses. The forest service or The Salt Lake Tribune's Recreation Roundup can usually alert you when such classes are offered.

How far are good skiers willing to stretch their luck in search of great

powder?

"Expert skiers, who know a fair amount about avalanches, are willing to push it right to the edge," says Abramett. "It's a dangerous game, obviously, but most make their analysis of the situation and then go right to the precipice to ski."

Those who have been caught in an avalanche and survived or have watched a massive slab of snow slide off a mountain are never quite the same.

"They have amazing power," said Tremper about avalanches. "You think about the snow like you do the ground. It is something that doesn't move. Then, all of a sudden, you see the whole thing slide or you get in a slide. You never, ever, are able to look at snow the same way again."

"For years, I was worried because it always seemed like I was going around with a sense of doom hanging over my head," he continued. "I was nervous about something bad happening. I thought something was wrong with me. But I read a book about eskimos by Barry Lopez and they have a word for the natural world. It is nice and benevolent to them most of the time but, when you live close to the natural world, at any time, it can rear up and smack you if you happen to be in the wrong place."

Those natural hazards will always be around for Wasatch Front skiers, especially those who seek untouched powder.

But the team of experts who work to make the mountains safe in the winter hope that they can at least help make backcountry adventures a little safer.

Cornice 'Elevator' Nearly Buries Utah Avalanche Center Chief

It was a moderate-hazard day, but Bruce Tremper was not thinking of that Saturday as he and skiing companion Mark Appling rode a cornice over a cliff and tumbled down an avalanche slope like a pair of old socks caught in an electric dryer.

Tremper, director of the Utah Avalanche Forecast Center, was skiing the Raymond Glade area on the north side of Mount Raymond with Appling, Appling's sister Dana and Diane Redden. They had already made three runs and had hiked back to the top to look at skiers making tracks on Gobbler's Knob.

"It was the last place I ever expected a cornice. I've been a winter mountaineer, with my father, my whole life," Tremper said. "There were two large trees on the ridge and there was a bush between us and the edge of the cornice. Mark [Appling] had sat and had lunch in that same spot [on a previous trip]."

"Diane walked up to us and the cornice

fractured. It was a weird thing. We were over a 15-foot-wide gully. I couldn't have been more surprised. It was an odd situation. If you are an experienced person — you get caught by the weird things."

"When the cornice hit the bottom of the 20-foot cliff it had enough shock to gouge out a small avalanche. It wasn't a big avalanche as avalanches go," Tremper continued. "It was on a steep slope, about 50 degrees at the top and 35 degrees at the bottom. The slide was about 20 to 30 feet wide and ran 300 yards down the hill."

"We got carried through a line of trees at the top but fortunately it was at a slow speed," said Tremper.

While he was being thrashed by the soft slab avalanche, Tremper remembers thinking Dana hadn't had much beacon practice and he hoped she could remember how to use the avalanche transceiver to find someone buried under a slide.

"Diane grabbed the bush and didn't go



Craig Hansell

over the edge. I ended up buried up to my neck and Mark was still on the surface. It stripped off our mittens and hats. Mark lost his shovel and both skis. My left leg was still in my ski and it dug me down like an anchor. It was buried about four feet deep and my knee was [wrenched] in an uncomfortable position frozen in concrete.

"I still had my shovel but it was buried with me so we had to dig out with our bare hands. It took about 10 minutes to get us out," Tremper said. "It was kind of a nasty

accident but I'm alive."

For Tremper, who spends about as much time skiing Utah backcountry as anyone, it was the first avalanche ride he has taken since the early days of his snow-safety career 13 years ago at Bridger Bowl, Mont. Saturday's incident must have been especially traumatic for Dana Appling, Mark's sister and Tremper's girl friend. She was still on the ridge watching people she cares about being flushed off the hill and through a stand of trees.

"It was a small thing [getting close to the cornice] that grew into a larger thing — an insignificant decision that can turn into something life-threatening. That is the great thing about the mountains. You can live 100 years and see something new every day."

"I can't count the number of people I've talked to who say they've [safely] stopped there a number of times," said Tremper.

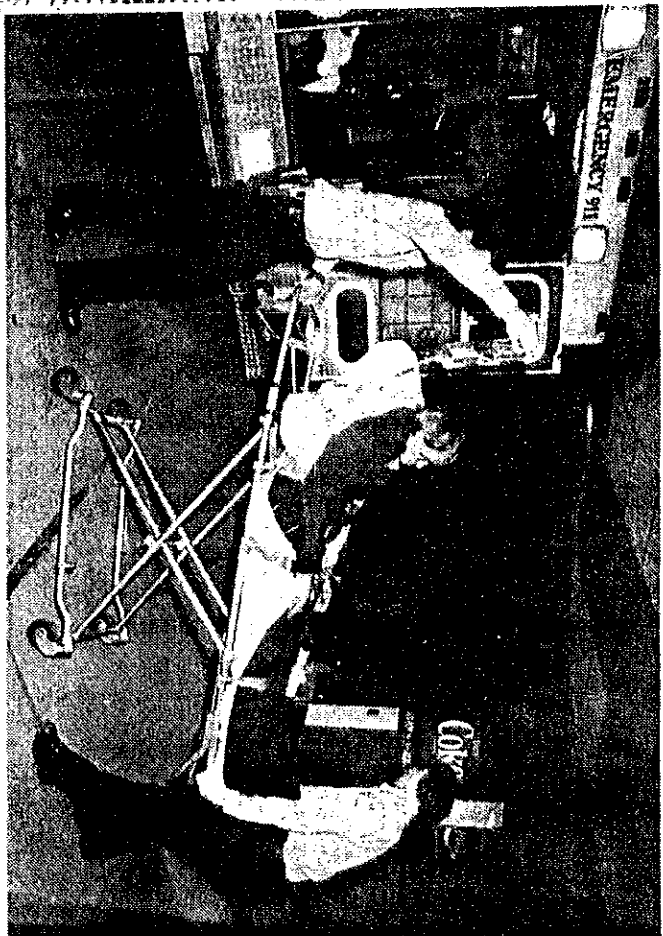
After they dug themselves out and used

Tremper's rope to get Dana off the cliff, Tremper and Mark shared one pair of skis to do the single-ski shuffle out to the highway.

There have been 32 backcountry skier-triggered avalanches this season, including a couple of total burials. If Utah's backcountry-skiing community can be careful through Feb. 15 it will mark three seasons without an avalanche fatality. Normally Utah has more than two avalanche fatalities annually. You have to go back to the 1980s before you can find a three-year period without one.

Tremper said he thought the death-hour avalanche cycle was passed in Big and Little Cottonwood Canyons but the Park City, Park Westridge and other areas with a thinner snowpack were still "scary stuff."

Utah's snow-safety community can point with pride to its accomplishments educating Utah backcountry skiers and providing a solid hazard evaluation to keep them from harms way.



Todd Van Buren is wheeled into North Davis Hospital for treatment of exposure to

cold after a snowslide. His friend suffered a broken leg when buried by the avalanche.

—Inland Staff Photo by Rick Eggen

1 Partially Buried

2 Snowshoers Survive Davis Area Avalanche

By Robert Green
Tribune Staff Writer

LAYTON — Two Davis County men snowshoeing the south fork of Kays Creek Canyon spent Tuesday morning huddled in wet, freezing clothing after an avalanche roared down a southern exposed mountain and partially buried one man, breaking his leg.

Both men suffered hypothermia and exhaustion before Davis County Search and Rescue teams transported them to safety, said K.D. Simpson, chief deputy and a Lifeflight paramedic at the scene.

Scott Jaime, 20, Sunset, suffered a fractured femur when an avalanche erupted right above him and carried him into a pine tree about 30 yards below. He was taken to North Davis Hospital and underwent surgery. He was listed in stable condition Tuesday night.

His friend, Todd Van Buren, 21, Syracuse, was treated for hypothermia and released.

The two men embarked on a snow-

shoeing and skiing excursion in mountains near Fernwood Park Monday afternoon, and were expected to return by 6 p.m.

"After being caught in the avalanche, I first thought I'd be able to grab onto a pine tree," Mr. Jaime said. "But the force was terrifying. It tumbled me around in every direction and wrapped me around the pine tree."

Partially buried, he called to his friend for help. His leg was separated and the pain was severe, Mr. Jaime said.

Mr. Van Buren uncovered his friend and splinted a ski pole to his broken leg. He then fashioned a toboggan out of snowshoes and started pulling the injured man down the canyon. The only way out was down river, he said.

Although equipped with backpacks, food and extra clothes, Mr. Van Buren left most of the gear at the avalanche site. He could only afford weight for emergency items.

After dragging his friend along a

See B-2, Column 5

2 Davis Snowshoers Survive Avalanche Near Kays Creek

Continued From B-1
creek about four hours, wet and freezing, Mr. Van Buren became exhausted. He stopped and tried to build a fire. Nothing would burn. He waited for rescue teams. "I told my father where we'd be going," Mr. Van Buren said, "and I knew someone would be looking for us."

When the two failed to report home by 11:30 p.m., a Lifeflight helicopter was dispatched to the scene, said Chief Simpson.

"We found them at the bottom of a ravine about two miles up the canyon," Chief Simpson said. "One guy was lying down, obviously hurt, and the other man was waving at us."

It took rescue teams an hour to walk through 3-to-4-feet of snow

from the helicopter's landing site to the injured men. By the time rescue teams finally arrived, about 1:30 a.m., the men's clothing and boots had frozen into blocks and had to be cut off, Chief Simpson said.

The victims were placed in sleeping bags and fed hot fluids to prevent hypothermia, Chief Simpson said. A rescue crew of 12 men rigged up a mechanical rope system to transport the lame man out by stretcher. Mr. Jaime was finally flown out at 5:30 a.m., Mr. Simpson said.

"Todd deserves a lot of credit for clear thinking under stress," Chief Simpson said. "The situation would have been critical if they'd had to spend the entire night without help up there."