RUNOUT DISTANCES—*from page 2*

dense avalanche flow, thereby strongly affecting velocity and runout. We also have many observations of avalanches changing form considerably during descent as they encounter different types of terrain and snow type. Because avalanches often do change form over the path, this suggests the material properties, friction, and the representation of these factors in any model may also change as an avalanche descends. A physical model that may be appropriate in the upper part of the path may be inappropriate in the lower path.

As diagrammed in Figure 5, values of the assumed friction terms alone can produce wide variation in the predicted stopping position of an avalanche. One set of assumptions may stop the avalanche at point "A," while other different assumptions may predict a stop at "B" or "C." This means that results derived from the use of physical models may be somewhat subjective because the stopping position (and velocities) depend upon selection of friction terms even though we may have no clear knowledge of whether we are using the proper terms, the proper values for these terms, or even the proper model!

Although use of a physical model may be very appealing to some, (terrain, friction, and material properties are plugged in and the computer spits out velocity and runout extent!), the assumptions used in the models are largely

continued on page 7

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Applications of Dendrochronology in Avalanche Studies

by Katherine Hansen-Bristow and Karl Birkeland

INTRODUCTION

Recognition of an avalanche path by observation of a clear swath down a mountain slope is certainly an indication of a potential avalanche hazard (Figure 1). The frequency, magnitude, and geography of that hazard, however, is critical for decision-making associated with human safety, structure location, or zoning boundaries. Avalanche activity may be underestimated if only historical records are used simply because the avalanche occurred unobserved or occurred prior to human settlement in a particular area. The use of dendrochronology (the application of tree ring dating to reconstruct past events) has proven quite successful at supplying additional information about the history and degree of hazard of avalanche events. Through the use of tree rings, a yearly date of "indicators" of injury or impact due to an avalanche can be determined. By understanding the frequency and type of various avalanche events, we can begin to define the geographic extent and the path width of the avalanches. This article will begin with a brief overview of dendrochronology before discussing tree evidence of avalanche activity, site selection and field techniques for sampling an avalanche path, and how the type of avalanche can be determined from available tree evidence. Many studies have utilized dendrochronology as an aid in the characterization of avalanche activity. The following discussion relies heavily on techniques and methods described previously by Arno and Barrett (1988), Burrows and Burrows (1976), Butler (1987), Carrara (1979), Dexter and Armstrong (1984), Fritts (1976), Shroder (1978), and Stokes and Smiley (1968).

Figure 1. A large swath cleared through the forest is an indication of an avalanche hazard.

OVERVIEW OF DENDROCHRONOLOGY

Yearly records of events (such as climate, disease, injury, or avalanches) are found in tree rings within the trunks of woody species in seasonal climates. A tree ring is usually the result of a single yearly flush of growth which initiates in spring and ceases in the fall. Differences in seasonal growth of woody cells provides distinguishable boundaries between rings. A spring flush produces cells that are large, porous, of low density and have relatively thin walls, imparting a lighter-toned appearance to the ring. Towards the end of the growing season, the cells are smaller and more dense, walls are thicker, and a darker-toned appearance is detectable in the ring. Each yearly ring, therefore, consists of a combination of light "earlywood" and dark "latewood."

A cross-section of a tree trunk should show a series of concentric annual rings. The amount and density of woody tissue produced each year are dependent on environmental factors and on tree age (width of rings tends to decrease with increasing age). Growth limiting factors can cause irregularities in annual increments of growth. If factors are highly limiting, an annual increment of growth or ring may not extend around the entire tree. If stress occurs during the growing season, it may temporarily produce what appears to be dark latewood, resulting in two "apparent" growth layers, or one "false-ring" within one year's growth. Frequently, therefore, and especially in harsh climatic environments, a simple count of growth rings from the outside of the trunk into the center cannot be used to accurately determine the year in which a ring was formed.

A method termed "cross-dating" has been developed to assure accurate dating of individual rings. This method, described in detail by Stokes and Smiley (1968), matches patterns of varying tree ring widths from a number of trees in an area by the development of a "skeleton plot" of ring width patterns. A skeleton plot is constructed on graph paper where the horizontal axis is time in years and the vertical axis is relative thinness of certain growth layers of one tree on an arbitrary scale (usually 1 to 10, with 10 being the thinnest). Cross-dating is the correlation or matching of patterns of ring-widths of various trees displayed on the skeleton plots. Not all trees in one area will cross-date; however, those which have experienced similar growth factors and avalanche histories should. Where growth patterns appear mismatched, by one or more years, problem yearly rings can be identified and correctly assigned yearly dates. A modified skeleton plot for cross-dating of avalanche events has been developed by Shroder (1978), and should be referred to by those who wish to use tree rings for dating avalanche events.

Most conifer trees in temperate environments display obvious seasonal rings and are therefore useful in dendrochronology. Some species of juniper do have unique growth patterns that tend to cause difficulties if only cores are being collected. Some deciduous trees, such as aspen and maple, have diffuse-porous wood making annual ring counts difficult. Initial sampling of species, or a literature review of problem species, will demonstrate the potential of certain species for dendrochronological studies. Shrubs often are useful for avalanche studies, especially if they inhabit a slope where trees do not. Caution should be taken, however, as shrubs are often flexible enough to not be detrimentally affected by snow movement.

TREE EVIDENCE OF AVALANCHE ACTIVITY

Damage to trees and woody shrubs in avalanche areas is predominantly the result of snow impacting the tree or from the associated wind blast. The vegetation is traumatized by these impacts and suffers internal and external structural and morphological changes. Evidence of traumatization that can be observed and measured include changes in ring width and wood type, tilting, scarring, bark indentations or unusual growth curvatures, trunk breakage, branch trimming, tree burial or exposure, tree removal, nudation or the production of bare ground, and tree succession.

Subsequent growth within the tree and within the entire avalanche zone attempts to minimize the trauma and returns either the tree or the zone to a more normal pattern of growth. Often, however, the damage is severe enough that only mere survival is possible. Individual tree responses include the production of reaction wood and of callous margin growths or scabs, the sprouting of new branches, and changes in ring-widths, while the ecosystem responds through succession by new trees. In almost all cases, there are multiple indicators of

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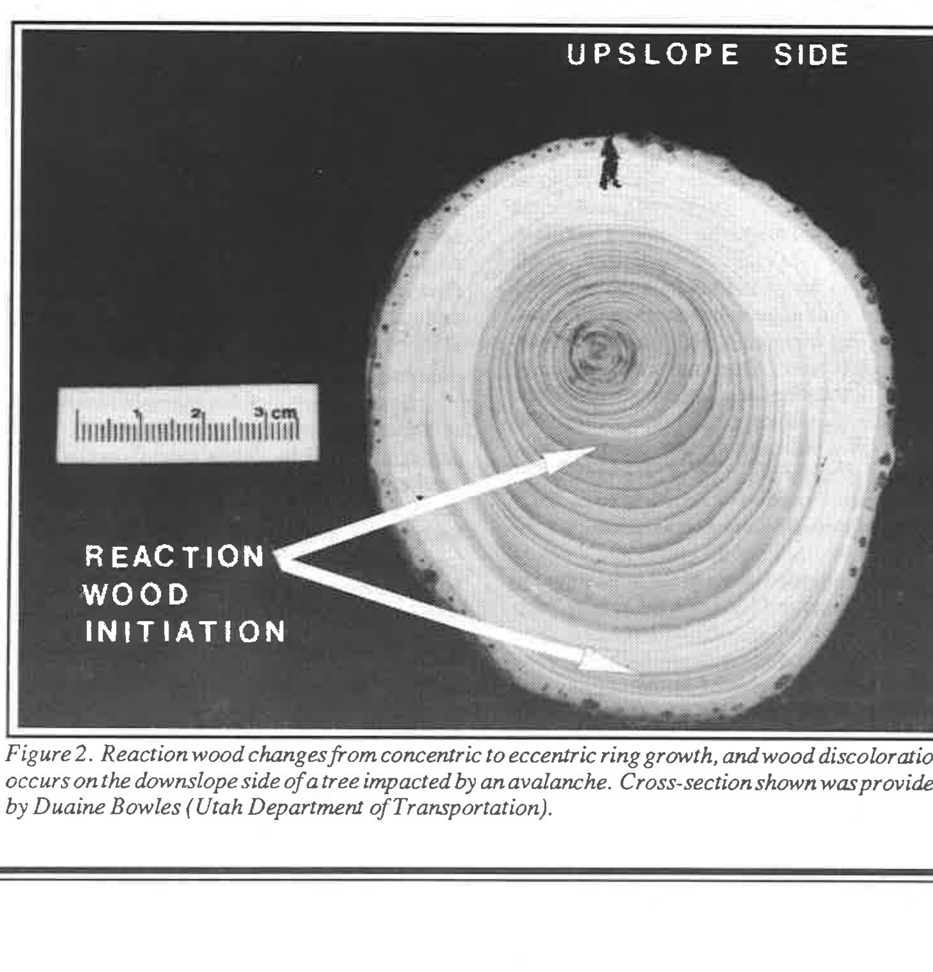

Figure 2. Reaction wood changes from concentric to eccentric ring growth, and wood discoloration occurs on the downslope side of a tree impacted by an avalanche. Cross-section shown was provided by Duaine Bowles (Utah Department of Transportation).

The Avalanche Review, *Vol. 7, No. 4, January 1989*

Regional Roundup
December 1988

by Brad Meiklejohn

Those wishing to contribute information to the Regional Roundup should contact their regional AAAP representative who will then forward the information to *The Avalanche Review*.

UTAH

The 50th aniversary of Alta started out in appropriate fashion, with a record 150" of snow falling in the month of November. The faucet was turned off when December rolled around, and the snowpack began to shrink and rot. The snowpack is over three feet deep in most places, so depth hoar formation has been minimal, but recrystallization has weakened the top of the snowpack. The early-season snowpack has been one of the strongest ever seen in the Wasatch, and there have been few avalanche accidents. On the 24th of November, a backcountry skier triggered a hard slab which ran on a buried surface hoar layer. This slide strained him through some trees, ate his poles, but spat him out unharmed. A small storm the second week of December brought 6" of snow and east winds over 60 mph. There was a surprising amount of activity from this event, with several patrollers taking rides, an in-area slide with public on the hill at one of the resorts.

La Sal Avalanche Forecast Center

The latest addition to the avalanche forecasting business made its debut on December 1 in Moab, Utah. Mark Yates is the La Sal Avalanche Forecast Center, and he has a contract with the U.S. Forest Service to provide snow, avalanche, weather, and travel information to people who are interested in traveling into the La Sal Mountains. Mark will be issuing recorded messages on a daily basis, updated in the evenings for the following day.

This program is part of an effort to make Moab as popular a winter destination as it is in the summer. The La Sal Loop Road will be plowed this winter, providing good access up to 9000'.

WASHINGTON

The Northwest Avalanche Center has not yet filled its staff vacancy and is laboring under the added work load. Pam Speers-Hayes gave birth to the next generation of avalanche forecaster, a baby boy named Ben, who is already at work on his meteorology degree.

Lee Redden reports abundant snowfall during the last half of November which enabled most ski areas to open. Avalanche activity was generally minor surface slides, however there was at least one person totally buried. On Nov. 20, about noon, on East slope of Alta Vista at Mt. Rainier, a skier triggered a 6-8 inch deep, 150 feet wide slab. This person was caught and carried 30 feet downslope and deposited on the surface. Another member of the same party who had removed his skiis and was walking down the slope when it fractured was carried 300 feet and totally buried. Fortunately, the victim was only buried 5 inches deep and was able to dig himself out.

Very little new snow since the Thanksgiving weekend combined with warm temperatures has produced a fairly homogenous snowcover. Some isolated deep snowpack releases were triggered by heavy rain or the warm temperatures.

COLORADO

Unless the snows start back up again soon, Colorado will have the usual weak, recrystallized snowpack. November brought regular storms, building a stable snowpack quickly. December has been dry so far, and the snowpack has settled to less than three feet in many areas. Faceted crystals are starting to take over, from the ground up and the top down.

To date, there have 6 people caught in slides, 2 partially buried, and 1 vehicle caught. Most of these were new snow slides, but one post-control slide caught a patrolman three hours after the slope had been shot.

ALASKA

If you remember from last month, the snowpack in Alaska was described as "an accident waiting to happen." Well, it happened.

The first avalanche fatality of the winter occured on the 6th of December in the Kenai Mountains. Three very experienced mountaineers and strong skiers chose to ski the north face of Tin Can Mountain, an imposing slope that is 40 degrees in steepness over 700' of its 1800' drop. The slide broke out 9 inches to 3 1/2 feet deep, catching two of the men. One of them, Todd Frankiewicz, was carried the full length of the path, through some rock bands, and buried under 2' of debris. His partners recovered him in 40 minutes, but he was not alive.

Todd was a very experienced backcountry skier as well as a mountaineer. He was a member of the 1986 Mt. Logan expedition, the first party to climb Mt. Logan in winter. It was the kind of slope where "he should have known better." Those who know the area only ski the slope in very stable conditions, and the conditions were far from stable at the time of the accident.

Numerous other avalanche incidents and accidents occurred through November and into early December. Doug Fesler noted that there were slides that he had never seen run before, and others that had not run in years. Doug felt the episode they were seeing was a one-in-ten year event. One slide on the 4th of December near Palmer destroyed a three-pole power structure, shearing two poles at ground level and sucking a third, buried by 10', right out of the ground.

Reid Bahnson, snow safety director at Alyeska, described the weather as a roller coaster — warm Hawaiian air one day, Arctic air the next. Reid recently announced he was leaving Alyeska at the year end, leaving a gap that will be hard to fill. If anyone feels they can, and wishes to have three 105's to play with, they should contact Alyeska Ski Area.

CALIFORNIA

Rain turning to snow began on November 22nd, with precipitation for the next five days. The skiing was horrid at first, but became very good. At Alpine Meadows, the five day snow total was 66 inches, with 19.5" of water. Widespread Class 2 slides on every path and some Class 3's on unusual slide paths. Two weeks of cold, clear weather followed, with strong east winds. It is presently warm with spring skiing on south aspects. The cold spell formed some TG on north aspects.

TREE EVIDENCE—*from previous page*

avalanche effects within the vegetation. Because other processes such as slope instability, snow or soil creep, disease, or animal activities can cause similar effects and responses within the vegetation, close observation at a site and recognition of more than one indicator of avalanching is required for study accuracy. Because not all responses within the trees will be identical, it is, again, critical to observe responses within many trees.

Tilting and Reaction Wood

Tilting or inclination downslope is caused by snow impacting the uphill side of a tree. Many tilted trees can be observed as survivors along the margins of avalanche tracks or at the toe of run-out zones. In response to tilting, tree trunks undergo a curving process to straighten to a vertical position. The curving process requires a strengthening of the wood, accomplished by the production of reaction wood which causes preferential compression on the trunk. Reaction wood can be observed as wider than normal rings on one side of a trunk. Its production, which initiates the first spring or growth period following an avalanche, causes an abrupt change from concentric to eccentric ring growth (Figure 2). The newly formed reaction wood is dense, thick, and discolored.

Reaction wood forms in different parts of the trunk for different trees. In angiosperms, such as the deciduous aspen, reaction wood is called tension wood and is found on the uphill side of the trunk. The tension wood appears as long, dense cells, grey or yellowish in color. In contrast, in gymnosperms, such as conifers, reaction wood is called compression wood. Compression wood is found on the downhill side of the trunk and can be recognized as short, thick-walled, dense cells, reddish- and yellowish-brown in color. Often narrow rings can be found on the underside of angiosperms and the upper side of gymnosperms in response to tilting. In areas where more than one track may affect the tree, the direction of tilt identified by the location of reaction wood might be useful in identifying which source area produced the avalanche.

Reaction wood is one of the most common event responses and is one of the most reliable to date. Samples should be collected from numerous points along the trunk both above and below the tilt or point of initial curve. The impact from the avalanche can almost always be assumed to have occurred in the winter or late spring immediately prior to the first ring with reaction wood.

Occasionally the response is delayed, and an increase in ring-width may occur. Conversely, if the tilting is particularly severe, growth retardation may result. Single tilting events are usually fairly easy to date, while multiple or gradual tilting events produce complex reaction wood, often the result of compounded trunk curvatures. There exists a need for further study on the response of different tree ages and species in terms of the amount and width of reaction wood to different amounts of tilt. Branches should not be used to date avalanche-induced tilt as they typically always have reaction wood in response to normal growth processes countering gravity.

Figure 3. Impact of snow and debris on upslope side of trees may cause bark abrasion and scarring.

Scarring and Callous Margins

Scarring occurs from extensive corrosion or abrasion of wood or bark (Figure 3). The damage, caused by debris carried in the avalanche (such as rocks or other trees), disrupts the growth-producing cambium beneath the bark. The avalanche-carried debris usually impacts the uphill side of a tree, but it can also be carried along the side of a trunk. Scars may also occur from rockfalls, and must therefore be used in avalanche studies with some caution.

Tree response to scarring is a gradual covering with a callous margin or tree scab and eventually younger wood and bark. The scab, somewhat bulbous in nature and normally discolored, is quite evident in a cross-section of a trunk (Figure 4). The ring immediately subsequent to the scar is normally assumed to have been produced during the growth period following the avalanche. Recognition of the new growth is facilitated by the occurrence of the new but asymmetric rings meeting the older and scarred wood at an angle. However, since scarring produces a disruption of the normal growth pattern, narrow or missing rings (an absence of growth during at least one year of that area on the trunk) might result. Ideally, a cross-section or a minimum of two wedge-sections or three cores should be collected, similar to the sampling techniques described by Arno and Barrett (1988) for sampling fire scars. This may not be possible in avalanche terrain, where protection of trees is necessary to reduce the potential hazard. In these areas, a core sample should be collected at the point or height of the scar on the trunk to intersect the place where the new asymmetric rings are healing over the scar.

Trunk Breakage, Branch Trimming, and Sprouting

Breakage of trunks typically occurs in the center of an avalanche. Branch trimming, although found throughout the avalanche path, is particularly useful in detecting the track margins and edge of forests.

Trees whose tops have been become or broken may or may not survive. For those that don't, an assessment of the time of the avalanche can be made by cross-dating a core from the dead tree with a living tree or with a master chronology (Stokes and Smiley, 1968). The amount of decay within the dead tree may also provide a rough estimate on the timing of the avalanche event. The presence or absence of green or brown needles, bark, branches, or wood rot all serve as indicators. Because decay rates are variable with species, climate, and geography (among other things), rates should first be determined for a nearby site with a known disturbance date (i.e., a logged area or a road construction site). If the trunk of the topped tree or a tree whose branches were broken remains alive, sprouting may occur from previously suppressed buds. The sprouts often assume a vertical growth and may have diffuse branching (all of which are indicative of avalanche activity). Deriving an absolute date from the center or core at the base of the branches should provide a fairly accurate assessment of timing of growth following the avalanche. Caution should be used, however, as there may have been a lag of a few years before growth initiated.

As a result of trunk breakage and branch trimming, those trees which survive may display a subsequent change in ring-width. Where damage is particularly severe, a tree may suffer a marked decrease in ring-width. In some places where branches or trees are removed more incoming sunlight may promote or enhance ring width increase in surviving trees. Although the change in ring width may appear obvious upon inspection, comparison with a master chronology is required in order to rule out other width changing factors (i.e., climate, disease, age, etc.).

Changes in Ground Cover and Succession

In large avalanches, entire trees may be swept from a site along with soil, rocks, and other debris. Nearby trees may experience a growth surge as a result of their competitive neighbors being removed. This occurrence, like that described previously from trunk and branch breakage, may be detected in ring width changes. Gradual succession or colonization of the site is often the most common response (assuming new trees survive subsequent avalanches) (Figure 5). Although not all succession will occur at the same time, and some trees may have survived the avalanche, a stand of fairly even-sized trees should re-colonize the site. Several samples must be collected to assess these possibilities. By determining the ages of the oldest class of tree on the site, a minimum date of avalanche occurrence is derived. Lag time or a delay in succession must be accounted for in determining an absolute date of the event.

continued on next page

TREE EVIDENCE—*from previous page*

Debris removed from or deposited around trees by avalanches produces poorly understood structural and morphological changes in those trees. Roots may be exposed and/or trunks may be submerged. Both suppression and sprouting may have resulted from these local environmental changes.

SITE SELECTION AND FIELD SAMPLING

Avalanche tracks that will yield the greatest amount of dendrochronological information will usually be those displaying a variety of impact forms or indicators. Initial reconnaissance of the area is critical to observe available evidence, determine the boundaries of the path (from the distribution of damage), and to determine the distribution of different aged stands (evidence of multiple events). The actual sampling sites should be carefully chosen according to the information desired. For example, if data pertaining to a complete history of the entire avalanche area is required, then multiple, across-slope transects should be sampled, along the entire elevational change of the zone. If large-scale avalanches are the predominant concern, sampling along the outside margins of the track, into the forest should prove adequate. Undamaged trees along the edge of avalanche paths should provide a minimum date for the occurrence of the last major event. Additionally, successional stands may yield supplementary information concerning these events. Avalanches which had the longest run-out could be detected at the base of the run-out zone. Random sampling is not recommended because strong cross replication of an event from within and among as many trees as possible is desired. Sites should be selectively chosen for sampling where growth has obviously been affected by avalanches. This selection will provide the maximum signal in tree response as affected by avalanches, and hopefully will minimize extraneous, non-avalanche produced "noise" in the data.

Using a large-scale map, carefully document where your sample points are. Take good field notes or draw a picture of all of the trees sampled, including tilt direction and degree, species, height, density, location on trunk of sample point, slope angle, and fall line. This will enhance an interpretation of the data and will allow the development of a spatial analysis of the avalanche history.

Precise sampling techniques vary with individual paths and with the specific injury or indicator being sampled. Specific sample strategies for each impact were described in the previous section. The most information concerning avalanche events will be derived from a complete cross-section of a trunk. This, however, kills the tree and should be done sparingly, if at all, in avalanche terrain. If you do cut down a tree, take many cross-sections from throughout the trunk to maximize data availability. Notch-cut or wedge sections yield a great deal of information as well, but also frequently result in tree death. The collection of tree cores is not damaging to the tree; to avoid poor information, a minimum of two cores need to be collected per tree. Tree cores are collected with increment borers, and are stored in straws to carry to the laboratory. It should be noted that for trees affected by multiple avalanche events, determination of valid event dates is hard even with cross-sections and very difficult with cores.For age dating of trees, sample as close as possible to the base of the tree. This will allow maximum ring counts. Undamaged trees should be cored in order to establish a master chronology to compare with trees with avalanche-induced ring width changes.

LABORATORY ANALYSIS

All core and cross-sections require initial preparation prior to observation and ring counting. Cores must be mounted in grooved boards for stability. All samples are sanded with successively finer-grained paper until a smooth surface displays easily seen individual tree rings under minimal magnification. Rings are observed and counted and dates assigned to each. Useful in some cases, a master chronology year of ring widths changes within the tree can be developed from skeleton plots for the site using undamaged tree samples with the methods outlined by Stokes and Smiley (1968). This would allow correct interpretation of ring width changes resulting from increased or decreased growth caused by avalanches. In comparing samples from different trees, an index number expressed as a percentage of tree response can provide further validity of a particular year having an avalanche event. The total number of trees with a minimum of two responses to avalanches is divided by the total number of sampled trees that were alive in that particular year (Shroder, 1978). If there is not a strong cross replication (an index number of 40% has been suggested) of responses for a given year, that year, as a probable avalanche year, should be rejected. Use of historical literature may also help to validate responses and help to determine an acceptable index number.

DETERMINING AVALANCHE TYPE FROM TREE SAMPLES

The type of avalanche can be determined from tree responses in some cases. Wet snow avalanches can cause extensive damage across a track and in the run-out zone. Large trees are often uprooted, and heavy debris may be moved in these events and wedged into or onto tree trunks. In contrast, dry or powder avalanches provide unique stem and branch breakage high above the ground level (exceeding the depth of snow in the path). Often this type of damage is most detectable near and even outside the boundaries of a path. Smaller avalanches tend to tilt or break small trees along the edge of the track, while in the track, damage in the form of scarred bark and broken branches can be detected on the uphill side of trees. Obviously, large avalanches will exceed the boundaries of smaller ones, both on the margins of the path and within the run-out zone.

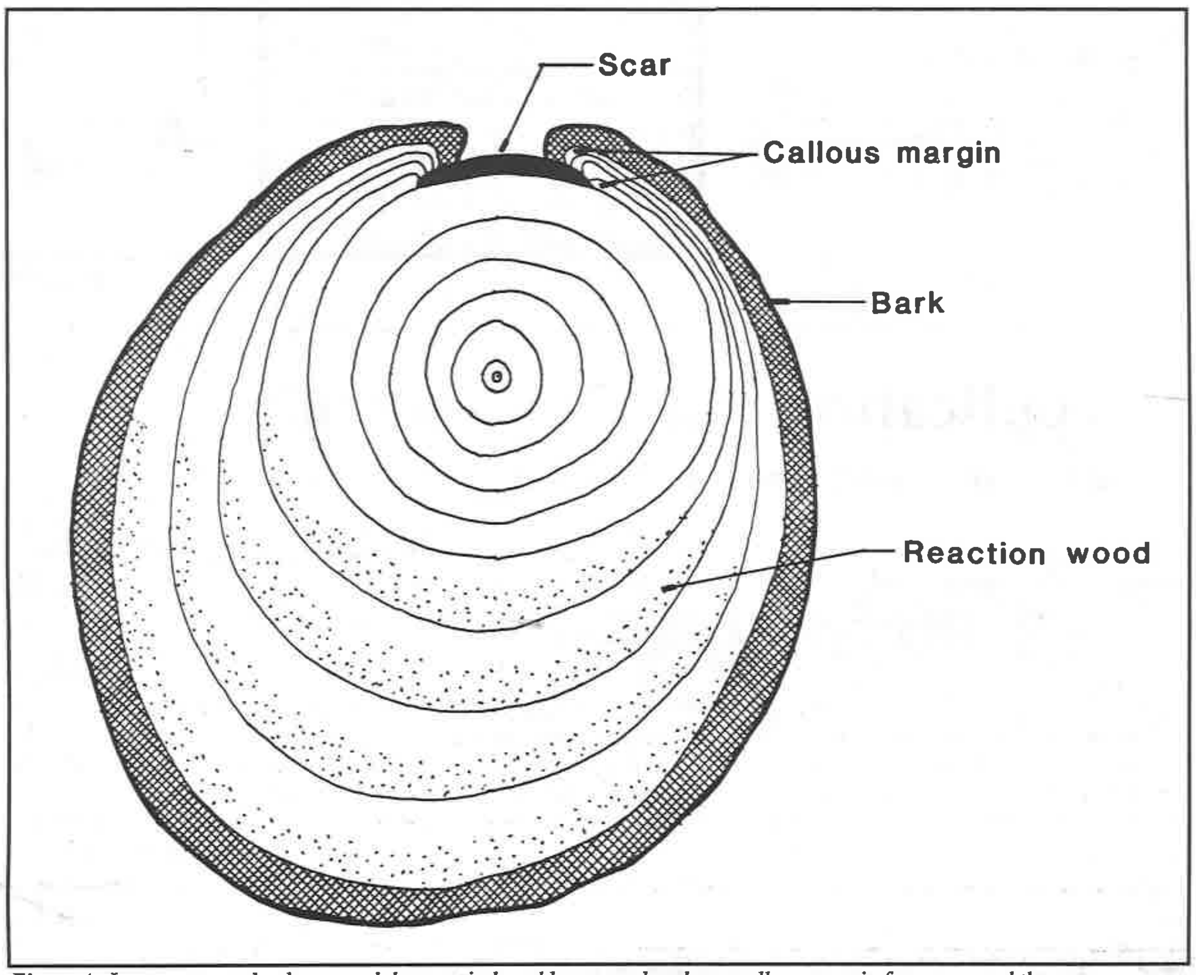

Figure 4. In response to bark or wood damage induced by an avalanche, a callous margin forms around the scar.

LIMITATIONS OF DENDROCHRONOLOGY FOR DATING AVALANCHES

There are limitations in the use of dendrochronology to date avalanche paths. These limitations, some of which were presented by Carrara (1979), include:

1. Trees too young to have recorded an avalanche event. Tree ring records in many areas of the western United States may only have recorded the last 100-200 years of activity.

2. If there are few or no trees in the runout zone, it will be more difficult or impossible to use dendrochronological techniques to assure accurate dates.

3. The record of past avalanches may be eliminated by more recent, larger avalanches. Larger avalanches may destroy all the trees that had previously recorded a smaller event.

4. Limitations exist in the use of dendrochronology in reconstructing avalanche events because of the sampling methods. As stated previously, taking cross sections of trees yields the most information, but kills the trees. Tree coring is an alternative that leaves the tree undamaged, but occasionally may not yield adequate information. Trees are protected against cutting in many avalanche areas (such as Little Cottonwood Canyon, Utah) because their removal may increase the avalanche hazard. Collecting cross sections is not possible and/or desirable in all situations.

Despite these limitations, dendrochronology has still proved to be a valuable tool for dating past avalanche events.

CONCLUSION

The use of dendrochronology to determine the timing, magnitude, and geography of avalanches provides a technique for realizing the past and future hazard potential of an area. Of critical importance is adequate sampling within the field, replication of indicators in the laboratory, and a clear understanding of both avalanche dynamics and tree-ring response. The technique is especially useful where historical data tends to either be lacking, is not totally reliable, or where the record extends only a short period back in time. It should be understood, however, that the dendrochronology record is just one indicator of avalanche activity. These techniques need to be combined with historical records, where possible, and with analytical calculations of avalanche potential, based on terrain factors, to produce detailed maps displaying the geography and frequency of snow avalanches along a path and into the run-out zone.

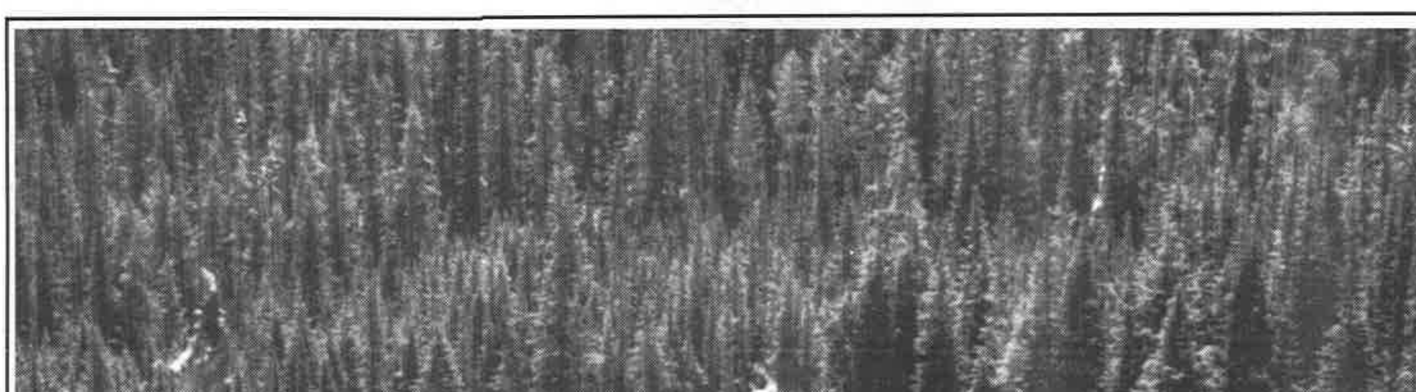

Figure 5. Succession, as evidenced by many young trees, may occur in an avalanche path after a large event has destroyed part of the forest.

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TREE EVIDENCE—*from page 5*

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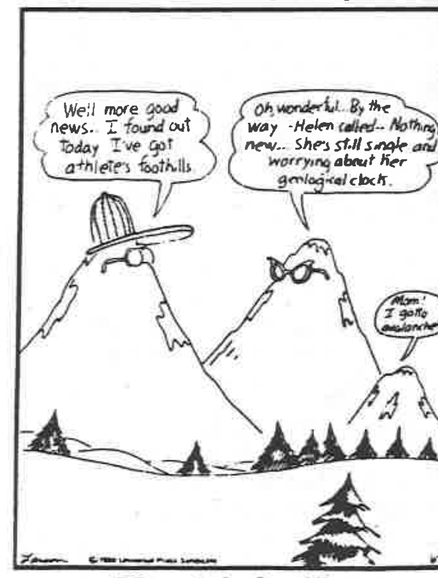
In the next issue of The Avalanche Review:

Avalanche Control

THE FAR SIDE by Gary Larson



Mountain families

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The purposes of the association are to:

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(c) Contribute towards high standards of professional competence and ethics for persons engaged in avalanche activities.

(d) Exchange technical information and maintain communications between persons engaged in avalanche activities.

(e) Promote and act as a resource base for public awareness programs about avalanche hazards and safety measures.

(f) Promote research and development in avalanche safety.

Article VIII. Membership

Section 1. The membership of this Association shall include all those elected and qualified in accord with the bylaws of the Association, at the time of such election. The membership of the Association shall consist of Members, Subscribing Members, Student Members, Honorary Members, Emeritus Members, Sustaining Members, and Life Members. All members will receive a year's subscription to *The Avalanche Review.*

Section 2. Members. To qualify as a full member, you must have been employed in professional avalanche work for at least two (2) consecutive, full avalanche seasons, and/or be an academician or scientist having carried out research in avalanche related studies for at least two (2) years.

Section 3. Subscribing Members. Anyone can be a subscribing member no matter how casual their association with avalanches. A Subscribing Member shall enjoy certain privileges of membership among which is the right to vote in Local Sections. They shall not hold office or vote in the Association at large, nor have the privilege of advertising their affiliation with the Association on professional cards or in professional reports or otherwise.

Section 4. Student Members. To qualify as a Student Member, you must be enrolled full-time in an accredited college or university and shall enjoy all the privileges of a Subscribing Member.

Section 7. Sustaining Members. A Sustaining Member shall be an association or other organization, or individual interested in furthering the application of avalanche science to the solution of avalanche problems or safety, and in maintaining high professional standards within avalanche applications; and desirous of supporting the Association. Sustaining Members, or a designated representative, shall enjoy all the privileges of membership in the Association, save that they shall not hold office or vote.

Section 8. Life Members. A Life Member shall meet all the requirements of a Member as stated in Section 2 hereto, and shall enjoy all the privileges of a Member. A Life Member shall pay dues once, as required in Article VI, Section 5, at the time of application and shall be exempt from further annual dues requirements.

MEMBERSHIP QUALIFICATIONS

Avalanche Education and/or Work Experience: Year(s)

College or University: Degree/Major Year

Student Applicant:
Expected Date of Degree:________________ Major:____________________

LOCAL SECTION PREFERENCE

Local sections are divided by geography and snow climate. One representative from each section will hold a position on the Governing Council.

____Northwest (Wash. and Ore.)
____Sierra (Calif. and W. Nevada)
____Rockies (Colo., N.M., Arizona)
____Alaska
____Eastern
____Intermountain North (Montana and N. Idaho)
____Intermountain South (Utah, Wyo., S. Idaho, E. Nev.)

ACTIVITY PREFERENCES

The following are appointive positions. List preferences 1,2,3 in areas you will serve.

____Publications Committee
____Research/University Committee
____Membership Committee
____Backcountry Safety
____Financial
____Symposium
____NWS Liaison
____Other:
____Education Committee
____Ski Area
____Highway/Industry
____History and Data
____Public Relations Committee
____Heli-Ski
____Search and Rescue

What would you like to see the American Association of Avalanche Professionals accomplish during the following two years?