

S K I M O U N T A I N E E R I N G

THE MOUNTAINEERS, INC.
Seattle, Washington

*UW Spec. Coll.
Accession 3272*

Published by
The Mountaineers, Inc.
Seattle, Washington

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*This book was prepared for
the 2nd year of the
ski mountaineering course.*

THE MOUNTAINEERS, INC.
Seattle, Wash.

SKI MOUNTAINEERING COURSE---REQUIREMENTS AND PROGRAM

PURPOSE OF COURSE

To increase mountaineering knowledge and improve skiing skill so as to make possible the safe penetration of remote areas and the ascent of high peaks on skis, and to increase the joy of the ski-mountaineer in his sport because of greater skill and confidence.

LIMITATION OF COURSE

Persons wishing to become Ski-Mountaineers must necessarily learn how to ski first. Because this course will not teach the elements of skiing technique, it will be necessary for beginners to learn to ski elsewhere. However, the improvement of and correction of technique is a part of this course.

REQUIREMENTS FOR ENROLLING IN THE COURSE

Membership in the Mountaineers.
Payment of 50¢ to cover cost of notebook.
Be able to pass Class 4 ski touring test---Four successive uphill traverses and uphill kick turns, and four successive downhill traverse and downhill kick turns on a 30 degree slope (or steeper) without falling.

REQUIREMENTS FOR GRADUATION FROM THE COURSE

Attend 7 out of the 9 classroom sessions.
Pass the final examination.
Attend 3 practice trips, including the overnight camping trip and the roped skiing practice.
Pass ski touring test--4 successive linked downhill turns on a 30 degree slope (or steeper) without falling, and be in control at all times.
Complete two extended ski tours, one of which involves roped glacier skiing.

PROGRAM OF COURSE

Session 1, Clubrooms	Introduction to Ski Mountaineering	Tues. Oct. 27, 1942
Session 2, Clubrooms	Skiing Principles	Tues. Nov. 3
1st Practice Trip	Improvement of Ski Technique	Sun. Nov. 8
Session 3, Clubrooms	Snow Craft and Avalanches	Tues. Nov. 17
Session 4, Clubrooms	Weather Waxing	Tues. Nov. 24
Session 5, Clubrooms	Route Finding & Party Management	Tues. Dec. 3
2nd Practice Trip	Improvement of Ski Technique	Sun. Dec. 13
Session 6, Clubrooms	Snow Camping	Sun. Dec. 15
Session 7, Clubrooms	Emergencies	Tues. Jan. 5
Session 8, To be announced	Rope Practice	Tues. Jan. 12
Session 9, Clubrooms	Glacier Skiing	Tues. Jan. 19
Session 10, Clubrooms	Final Test	Tues. Jan. 26

ACKNOWLEDGMENT OF THANKS TO THE CLIMBERS' COURSE

For the successful example set during the past seven years
For the loan of much organized mountaineering material

NECESSITY OF REPETITION OF SOME CLIMBERS' COURSE MATERIAL

To make the ski-mountaineering course complete, since many will take it who have not previously had the climbers' course.
To emphasize the application of general mountaineering knowledge to ski mountaineering rather than foot mountaineering.

SUGGESTION

To members enrolled in this course who have not had the Climbers' Course, it is recommended that you enroll at the first opportunity to further your knowledge of mountaineering.

COMMITTEE

Mountaineer members responsible for organizing this course are:
Fred Beckey, Elov Bodin, Lyman Boyer, Doris Brightbill, Joe Buswell, Harry Cameron, Ann Cederquist, Bill Degenhardt, Jack Hossack, Mary Hossack, Ella Knutson, Dave Lind, Ken Prestrud, Jean Rathbun, Helen Rudy, Roland Sherman, Roy Snyder, Burpee Stevens, Jim Wasson, Art Winder.

CLUBROOM SESSIONS

Meetings will start at 8 P.M. Sharp. Notes will be handed out and discussed by a lecturer for about 3/4 hour. Thereafter, a set of practice problems will be turned over to each enrollee, for answering and discussing within the class period. These papers will not be graded, but are for the purpose of illustrating the points brought out in the outline notes. At the end of the period, correct answers will be given to all the problems. Problem sets will be handed in at end of period for the purpose of taking attendance. They will be returned at the next session.

NOTEBOOK

You will need a loose leaf note book in which to keep notes, and also a pencil at each meeting.

PRACTICE TRIPS

Detailed information on the practice trips will be announced at the clubroom session just prior to the weekend of the practice trip.

GRADUATION PARTY

Graduation ceremonies and awards will take place sometime after June 30, in order to allow all concerned to take part in the required glacier tour.

FINAL WARNING TO HIM WHO WOULD ENTER

This course is given with the full knowledge that war time restrictions may make it impossible for one to pass all requirements for graduation; however, those requirements which are passed this year or were passed last year will count toward ultimate graduation which the committee hopes will not be in the too distant future.

HISTORY AND ELEMENTARY PRINCIPLES OF SKI-MOUNTAINEERING

DEFINITION:

Ski-Mountaineering is the ascent of snow covered peaks or the penetration of snow covered areas partially or wholly by means of skis.

HISTORY OF SKI MOUNTAINEERING

History provides an interesting and useful background to the study of a new field, and ski mountaineering is no exception. Perhaps, it is of more interest to the ski mountaineer since this sport is still very young as far as our present experience goes. For this reason a short outline of the history of skiing will not be out of place.

- I. The ancient tribes of Europe and Asia developed the ski as a necessary means of transportation.
 - A. The Aryan tribes of central Asia appear to be the first to use snowshoes which were more like skis than snowshoes.
 1. Stubby skis of the mountain people remained with but slight changes as the tribes migrated westward at middle latitudes.
 2. Tribes migrating to the north or sub-arctic regions came to use long narrow skis suited to the cold weather and flat terrain.
 - B. The oldest skis are some found in Sweden dating approximately 4000 years old.
- II. Modern skiing, as we know it, was due to mountaineering men who discovered from the Scandinavians its usefulness for mountain travel.
 - A. About 1825 the Norwegians discovered skiing as a sport aside from a necessity.
 1. They developed the Telemark and Christiania turns as suited to their terrain.
 2. The slalom was of Telemarkian origin, however, the turns may have been stick turns.
 3. Jumping and crosscountry racing were, perhaps, the very first skiing sports.
 - B. A French mountaineer Henry Duhamel in 1878 introduced skiing to the Alps; however, a Norwegian had made ski excursions as early as 1868.
 - C. M. Zdarsky developed the first system of skiing principles suited for safe travel over mountains.
 1. The skis were shortened to approximately the present dimensions.
 2. A low crouch and turns, steered with a pole, made the system safe for steep slopes.

History of Ski Mountaineering (Continued)

- D. Paulke altered the Norwegian to suit the alpine needs stressing balance and control without poles. (He made the first ski crossing of the Bernese Oberland in 1897.)
- E. Bilgeri developed the first complete system of technique for alpine skiing.
 - 1. Taught controlled skiing for high mountain travel.
 - 2. Introduced 2 poles for balance.
 - 3. Described and taught the present stem turns.
 - 4. Schnieder with Bilgeri further expanded the Bilgeri system to suit the needs of mountain troops during World War I on steep icy slopes.

III. The inherent usefulness of the ski as a means of mountain travel has been demonstrated in many regions.

- A. Since the time of the first winter mountaineering trip on skis in the Swiss Alps about 1893, almost all of the peaks have been climbed wholly or in part on skis.
- B. Ski touring technique in the U.S. has been most highly developed in the Sierras of California due to the excellent terrain and weather.
- C. Skis have been used on many small trips in the Rockies and other ranges of the U.S., as well as on major expeditions to the Himalayan ranges, and most recently, in the B.C. coast range.

REQUIRED SKILL AND KNOWLEDGE FOR SAFE SKI-MOUNTAINEERING

Mountaineering knowledge of weather, natural dangers, camping, methods of meeting emergencies, and safety techniques.

Special knowledge of snowcraft at all seasons.

Skill in the use of skis.

Common sense.

Physical condition and some ambition--ski-mountaineering is not for the lazy.

SKI-MOUNTAINEERING IS FUN

For mountain-lovers, it makes mountaineering an all-year-round recreation.

It makes accessible the beauty of snow covered landscapes.

It combines the fascinating sport of mountaineering with the equally fascinating sport of skiing.

The use of skis converts tiresome footslogging across soft snowfields into easy ascents and thrilling descents.

The real urge to go ski-mountaineering--just like the urge to go "boot" mountaineering--is indefinable, but positive. Probably no one who hasn't tried it will ever know how much fun he is missing.

SAFETY

Safety in ski-mountaineering is of prime importance, since an accident in a remote area can quickly lead to great discomfort, perhaps tragedy. The following rules must be observed:

SAFETY (continued)

1. Never go alone.
2. Always leave word with some one as to where you are going.
3. Carry proper equipment.
4. Ski always in control--recklessness cannot be tolerated.
5. Do not attempt trips above your capabilities.
6. Avoid exhaustion--accidents usually happen to tired skiers.
7. Always follow your leader's instructions.
8. Watch for and avoid thinly covered rocks.
9. Don't ski with anything in your mouth.

PHYSICAL CONDITION

Good physical condition is essential for ski-mountaineering.

1. It leads to considerably more enjoyment.
2. An exhausted skier is easily injured.
3. An exhausted skier cannot do his share of trail breaking.
4. An exhausted skier becomes a burden on the rest of the party, who must necessarily take care of him.

Methods of building up the necessary wind and muscle.

1. Best way is to start with easy trips, either mountain-climbing or skiing, gradually building up to tougher ones. Such trips, taken only once a week for a several-months-period, will be all the conditioning necessary.
2. Handball and basketball and other gymnasium games will help but do not build up endurance.
3. Lots of good food and plenty of sleep before a tough trip will markedly increase stamina. Don't start on a tough trip unless you know that you can make it.

MANNERS AND GOOD SPORTSMANSHIP

Ski-mountaineering is always done in the company of others. Manners and good sportsmanship on the part of all the members are necessities for a successful party. The rule for good manners is to think of others first--let your actions be guided by a spirit of consideration for others. Some suggestions:

1. Don't complain--about the weather or the grub or the leader or anything else except in a humorous vein.
2. Be on time.
3. Bring sufficient equipment of your own.
4. Have your equipment in good repair--you have no business delaying the party while you fix it.
5. Yelling "track" does not entitle you to the right of way.
6. Do not ski recklessly--if you get injured, you will seriously interfere with the enjoyment of the people who pack you out.
7. Help your driver to load equipment on the car.
8. Do not ski off downhill far ahead of your party--it's very unsociable, and you may be needed to help in case of accident.
9. Do your share of trail-breaking.
10. Don't walk on the skis of the man ahead.

SKIING EQUIPMENT

The same equipment used for ordinary skiing is usually quite satisfactory.

Skis should be as light as possible, but with metal edges.

Poles should not be too short or too light, as there is danger of breaking them.

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center of clumps of trees. Don't be ashamed to carry kindling

SKIING EQUIPMENT (continued)

Boots should be of very good quality, as water tight as possible. If your boots leak, take extra socks.

Bindings should be well fitting to boots; nearly any type will do; downpull attachment is recommended.

For spring conditions where considerable hiking must be done to reach the snow, fit your bindings to a pair of nailed climbing boots, and get a shorter pair of skis.

Drill a $\frac{1}{4}$ inch hole in the tips of the skis, and carry a string with which to tow them or make an emergency toboggan.

Equip your bindings with an ankle strap, so that you will not have to chase ski downhill if binding comes loose. This is important especially if you are trying to get out of a crevasse.

Packsack should be of the Bergan type, of medium or large size. This is the only type of pack that will not roll and throw the skier off balance. A small pack is not recommended, since at best it only saves a pound of weight, and will not carry the essential equipment.

Climbers or climbing wax are always needed.

PROTECTION AGAINST EXPOSURE

Standard woolen ski pants are excellent for ski-mountaineering.

Park should come below hips, have a large hood to cover most of face, and should be made of wool. Cotton, even if allegedly "waterproofed" will eventually soak through, then gets cold. Wool gets wet but stays warmer. Park made of raincoat material will keep the rain out, but cause most people to perspire excessively.

Parka and several light sweaters give more warmth for the weight than will a heavy coat or mackintosh.

Don't dress so warmly that you will perspire.

Take extra clothes even in sweltering weather. You will need them if you should have to stay out overnight, or in case of sudden storm.

Skiing with bare legs is not recommended but if you do, take along something to cover up the legs in case exposure turns severe.

Take two pairs of fingerless mittens, leather or canvas for protection, wool inside for warmth.

Take change of socks on every overnight trip.

Always take ski cap or stacking cap for protection of head and ears.

Remember that warmth is energy. Dress properly so as to retain it.

Leave a complete change of clothes in the car so that when you return wet from rain or sweat, you can change immediately.

Always take sunburn paint in the spring.

Sunglasses are necessary to prevent snowblindness. Recommended type are of celluloid with side shields, well vented in front to prevent fogging.

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SKI TECHNIQUE FOR SKI-MOUNTAINEERING

ENERGY--LEVEL AND UPHILL

Ski-mountaineering requires maximum economy in the use of energy. Nearly every healthy person can develop enough energy for long trips, if it is economically used.

Conditioning
Short Trips
Long Trips
Health during past week
Food and Sleep

The pace for long-distance travel must be slow enough to avoid a pounding heart or gasping breath; the pace for shorter distances may be faster, depending on slowest of party.

Rhythmic, steady motion is the key to progress.

Breathing should be deep and steady, synchronized with pace, especially at high altitudes.

Relax all muscles as much as possible.

Use the rest-step when necessary.

Wherever possible, slide the skis instead of lifting them.

When you start a trip, warm up slowly by adapting a slow pace and wearing extra clothes.

After 15 minutes, stop to remove extra clothing and adjust packs.

On the trail stop for short "breathers" of about 2 minutes every half hour. If longer, body becomes chilled. If one cools off too much it is necessary to repeat warming up process.

On long rests, take off the pack and put on extra clothing.

On level going, use long gliding steps, keep skis sliding.

On uphill going, use shorter steps, don't try long glides.

Keep rhythm same but adjust length of pace for changes in gradient.

Remember that if you are gasping for breath, you are going too fast.

NECESSARY SKI TECHNIQUE FOR LEVEL AND UPHILL

Ability to walk on skis with easy, rhythmic pace.

Ability to do both uphill and downhill kick turns on slopes of thirty degrees and steeper.

DESIRABLE SKI TECHNIQUE--LEVEL

Ability to do one or more of the cross-country racing steps for easy and rapid going on the level. The secret is to properly synchronize the steps with light pushes on the poles.

NECESSARY CLIMBING DEVICES

To make the skis go readily uphill, proper wax, canvas climbers (the so-called sox), sealskins, or mohair "skins" must be used.

NECESSARY CLIMBING DEVICES (continued)

Canvas climbing sox are practical, being cheap and easy to put on, but on steep side slopes the rear edges will not hold, since the sox cover the edges of the skis.

Sealskins or mohair "skins" are excellent climbers and will even slide slowly downhill, but are expensive.

Proper waxing is most satisfactory and will both climb and slide.

Advantages of proper waxing over climbers:

1. Lighter weight.
2. Can both slide and climb, which is a great advantage in rolling country.
3. The edges hold better on steep side hills.
4. Climbers require time to put on and take off.
5. Climbers, when removed, are wet or icy and uncomfortable to carry.
6. On the level, climbers must be walked; waxed skis will slide.
7. Climbers and wax have equal speed uphill.

Advantages of climbers over waxing:

1. Skis can be waxed for maximum speed downhill.
2. Guesswork as to which wax to use can be eliminated.
3. Climbers are better on varying snow.
4. Climbers eliminate fussing with wax while on tour.

SKI CLIMBING TACTICS--LEVEL AND UPHILL

Don't climb too steeply; extra pushing on poles and backward slips use up extra energy. Climb on the steepest grade on which climbing seems easy; this is usually about 20 feet vertically for 100 feet of horizontal distance, or about on an 11 degree slope. Thus, to climb 1,000 feet, the skier will have to travel 5,000 feet or about one mile horizontally, regardless of which route he chooses.

To save energy, use as few kick turns as possible. However, long traverses on steep slopes are fatiguing because one foot is higher than the other; under these conditions traverses should be about 500 feet long. Take every advantage of slope contour to gain elevation on traverse.

Side-stepping is used for steep, narrow slopes; uses much energy.

Herringboning is used for steep, short, narrow slopes; it uses the maximum amount of energy.

Half-side-stepping is used on traverses where it is necessary,

SKI-CLIMBING TACTICS--LEVEL AND UPHILL (continued)

to gain altitude rapidly. Uses more energy than traversing, less than sidestepping.

Loosen cables before starting a climb (touring hitch).

Poles should be used mostly for pushing, only incidentally for keeping balance.

Keep the snow rings of the poles back of the feet and close to the skis to arrest backward slips.

Keep knees pressed towards hill to control edging, shoulders out (same for downhill traverse).

ENERGY--DOWNHILL

Maximum economy in use of energy is important.

Best method is to keep as relaxed as possible--tenseness is very tiring (also causes accidents).

Don't go too long before stopping to rest.

Get your breath back before starting again.

Don't forget to breathe while you ski downhill; deliberately take a few deep breaths before starting and keep up a steady rhythm.

If you begin gasping for breath, stop and rest.

If you are tired, slow down and save time with fewer falls.

STRAIGHT RUNNING AND TRAVERSING ON SKIS

This is used more than any other technique--skill is essential.

On hard snow, skis should be 6-12 inches apart, one foot 3 to 6 inches ahead of the other. Weight evenly on both skis.

On soft, deep snow, keep skis together, with thighs pressed against each other for bracing effect. One foot should be 3 to 9 inches ahead of the other.

Transitions from steep to flat slopes are difficult. Sink gradually down into a crouch as you travel from the beginning to the end. Keep the knees pressed well forward.

Traversing across the face of a steep hill is difficult to do correctly. Uphill ski should be slightly ahead with weight on downhill ski. Skis should be transversely about level, not edged sharply into the hill.

Controlled slide-slipping is very necessary. Use the traversing position, side slip by flattening the skis to the slope, control the speed with the edges. Keep the weight on the lower ski.

When running from slow snow into fast snow, lean forward and be ready for sudden acceleration.

Tell fast snow from slow snow by color, texture, location in sun or shade.

USEFUL SKIING TURNS FOR SKI MOUNTAINEERING--DOWNHILL

Kick-turn is the only absolutely necessary turn, and can be used anywhere in any kind of snow, but is too slow for long trips.

Stem turn is the most useful turn, and mastery of it is really essential for long trips. Can be used in any snow except breakable crust. This is a slow turn.

USEFUL SKIING TURNS FOR SKI MOUNTAINEERING--DOWNHILL (continued)

Stem Christiana can be used in same places as stem turn, is a faster turn and more fun. This one should be learned.

Step turn is useful at slow speeds and on flat slopes, and can be used in any snow.

The telemark is useful under the limited conditions of deep, heavy snow on slopes less than 25 degrees.

Tempo turn, or parallel Christiana is the most fun in perfect snow, but is otherwise not very practical.

Pole Christiana is not recommended by experts although very useful with heavy pack and poor snow.

The Open Christiana is not recommended, as the "scissors" position is dangerous.

In breakable crust, the only safe turns are the kick turn and the jump turn.

For ski mountaineering, turns must usually be executed in untracked snow, which is more difficult than the practice hill.

The technique of turning will be taught only incidentally in this course. Best way to learn is to take lessons from a competent instructor. Complete descriptions of all turns may be found in many textbooks in the Mountaineer library.

Best way to improve your turning technique, after you have mastered the essentials, is to alternate between practice hill work and practice in untracked snow.

MANAGEMENT OF POLES--DOWNHILL

Never put your ski poles in front of you when running. They may catch and injure you. The only exception is for jump-turns, stick-christianas, or gclandersprungs.

Let your poles drag comfortably behind you with arms relaxed.

CONTROLLED FALLS

By this is meant an intentional fall for the purpose of making a sudden emergency stop, or to stop when out of control, or to control speed when no other method is possible.

Certain principles about falls should be learned to prevent injury:

Fling your poles sidewise and back of you as you fall.

Fall on the seat, throwing yourself backwards and slightly to one side of the skis, keeping the knees and hands out of the snow.

Manage the skis so that the tips do not bury themselves in the snow.

NOTE: It's no use buttoning your pockets after they are full of snow.

UNCONTROLLED FALLS--HOW TO MINIMIZE THE DANGER OF INJURY

Some unintentional spills are inevitable, but the danger can be minimized.

The critical moment comes at the instant you know that you cannot save yourself from a spill. Think and act quickly, as follows:

Try to fall in the same position as in the controlled fall.

UNCONTROLLED FALLS--HOW TO MINIMIZE THE DANGER OF INJURY (c)

The danger of injury lies in the skis getting stuck in the snow while you keep going.

Fling your poles out sidewise.

Don't try to arrest your fall with your hand and arms.

If you are headed for a "header" give a slight jump to pull your skis out of the snow, and try to convert the header into a somersault.

TECHNIQUE OF GETTING UP FROM FALLS

Much energy is used up by beginners in struggling to rise from a spill.

If on a side hill, roll over on your back, and get the skis below you and parallel to the slope. Plant both of your ski poles in the hill slightly above you, and with their aid stand up on your skis.

If on the flat, sit up and plant your ski poles in the snow, one on either side of you, then lift yourself as though you were chinning yourself.

If you fall headfirst into a hole, holler for help!

ANGLES OF SLOPES

Because the steepness of slopes causes vast argument, here are some examples:

10 degree slope--a little flatter than the rate a skier climbs.

20 degree slope--ideal slope for easy skiing (Paradise practice hill).

30 degree slope--pretty steep, like the upper part of the "lane" at the Meany Ski Hut.

35 degree slope--very steep, like the steepest part of "Panorama Point" at Paradise Valley.

45 degree slope--snow will rarely lie any steeper than this. On top looking down, it seems like a vertical wall.

CARRYING OF SKIS

On shoulder when carrying no pack. Skis should be strapped together and some padding on long trip is desirable. Tips either forward or aft. They may also be carried thus with pack and sometimes may be balanced on pack--HOSSACK method!

Thrust tails of skis through pack strap under armpit, balance skis and strap tips, which are forward, together. Skis may also be dragged, when there is snow, by means of cord through holes in tip.

Skis may be strapped either horizontally or vertically to pack, depending on room on trail.

Skis on car should be placed with tips to rear--this will save gas and help prevent skis from being blown off.

QUESTIONS

1. Ime Toughie went up the middle of Panorama sidestepping the whole way. He (a) saved energy by not doing any kick turns; (b) was just getting warmed up and went ahead to Muir easily; (c) should have taken the Ski Mountaineer Course. (Pick One)
2. If you were going on a three day tour, you would travel as far and fast as you can the first day in order to rest and ski the last two. (True or False)
3. Trips are not worthwhile during the months of October and November because you can wait for snow to come by the road, you get too tired, and besides it will probably rain anyway. (T or F)
4. If you were going on a 3 mile trip with 5,000 feet of climbing, would you take:
 - (a) A rapid pace with frequent rests.
 - (b) A slow steady pace with no rests and easy breathing.
 - (c) A faster pace with few long rests.
5. If you were going to the following places would you rely upon wax or climbers to get there:
 - (a) Climb Mt. St. Helens
 - (b) Silver Peak Basin.
 - (c) Paradise to Naches Pass.
6. Indicate the proper technique for each of these conditions:
 - (a) Level country
 - (b) Sudden dip
 - (c) Bottom of steep hill
 - (d) Turn on breakable crust
 - (e) Long side hill traverse
 - (f) Skiing from wet snow on to ice
 - (g) Straight running in deep snow
 - (h) Down a short, narrow (6' wide) steep hill, icy snow.
 - (i) Straight running hard snow.

 - (1) Jump turn
 - (2) Thighs pressed together, skis together, one slightly ahead
 - (3) Weight on down hill ski; uphill ski ahead; knees in, weight out.
 - (4) Shuss
 - (5) Sideslip
 - (6) Feet apart, weight low.
 - (7) Force weight forward.
 - (8) Lean forward, one foot well ahead
 - (9) Racing step.
 - (10) Sink into crouch, weight forward.
 - (11) Fall down.
7. Checzit, the Swiss expert, is a member of a party on a day ski tour. They left the cars at 7:00 A.M., having just eaten breakfast. The party has been climbing all morning and will continue to do so until 1:00 P.M., when they should arrive at their goal, a basin

QUESTIONS

7. (continued)

offering fine ski slopes; they plan to return to the cars about 5:00 P.M. It is now 10:30. Cheezit, on a rest, feels a little weary and wonders if he should (a) keep on plugging for the next hour and a half and then eat all his lunch when the noon whistle blows; (b) eat all his lunch now to lighten his pack; (c) save his lunch until three o'clock and then spread out his food in front of his starving companions to hear them groan; (d) eat a little now, a little more at the time they come to the basin and finish up with a snack at three o'clock before starting back?

8. It is four o'clock in the afternoon. A party is on a week's tour. The weather is clear and cold. They have been skiing all day with full packs, including complete winter camping equipment. Everyone, although a little tired, is in good condition. The area to which they are going for the week's skiing has an open faced forest service shelter which can be reached in five hours. Tonight the moon will be full. You are the leader. Would you (a) stop now and camp for the night, finish the trip in the morning; (b) go on until darkness (6:30) and then camp - finish in the morning; (c) go all the way to the shelter tonight - build a roaring fire in front of it and sleep in luxury tonight, enjoy a full day skiing in your new area in the morning.

9. Leather ski bindings are best because when you get hungry you can chew on a strap. (T or F)

10. Knew Sno, picking himself up after a fresh fall, said, "I always fall on a traverse because I don't get all my weight on the uphill ski." His technique is correct. (T or F)

11. Head Overheels says "If I see an icy patch coming, I go into a deep crouch forcing my weight and knees forward. This is the cause of Head Overheels' many falls. (T or F)

12. The "Original Dixieland One Step" is a method of traveling on the level on skis. (T or F)

13. "It's all right for me to stay up all night" says Sonnie Nightlife, "cause I can sleep tomorrow." Would you advise this for Mountaineers planning a hard trip? (Yes or No)

14. "Self-polishing ski wax which you can put on with a cloth and dries in a jiffy to leave a shining smooth surface that's easy to keep clean" would be a wonderful thing (T or F)

15. "Don't Shuss in where angels fear to stem" was a hit moving picture? (T or F)

SNOWCRAFT

Snowcraft, i.e., the study of the behavior and forms of snow is of great interest to the ski-mountaineer. There are many practical rules, but also some fundamental facts about snow which are known. This outline will consider the fundamental facts and principles of snowcraft and let the reader apply the rules to fit the situation.

- I. The formation of snow in the atmosphere will be discussed under the topic of weather; however, the underlying principles of sublimation is the basis of much of snowcraft.
 - A. Sublimation is the process by which solid water (ice) is converted to vapor without first becoming liquid.
 - B. At a given temperature the quantity of water vapor in the atmosphere is fixed.
 - C. The principle governing snow formation and aging is this: If the temperature of the air and vapor is below the freezing point for water, snow will form. (Note; Atmospheric fogs are an exception).
 - D. The shape of the ice surface governs the rate of evaporation - sharp surfaces evaporate more readily than do flat ones.

- II. As soon as snow falls, an aging process known as firnification begins. Firnification is the process converting new snow to glacier ice, which may be carried to this conclusion or may be stopped on melting.
 - A. Ice evaporation or sublimation is more important than melting for the changes taking place in snow.
 1. In polar regions sublimation and wind erosion only remove the snow cover.
 2. Even in very damp regions melting hastens the process but does not replace it.
 3. Wind accelerates the evaporation by continually changing the air in contact with the snow crystals.
 4. Evaporation and condensation take place beneath the snow surface.
 - a. Sharp points of ice tend to evaporate more readily than internal contours.
 - b. As a result, the crystals tend to become round and subangular, and small crystals grow to large ones.
 - B. The process of firnification follows a definite pattern as follows:
 1. After new snow falls, the flakes interlock or canopy as long as the spikes exist.
 2. Immediately, the spikes begin to disappear, being re-crystallized in the depressions.
 - a. Density increases severalfold.
 - b. Snow becomes subangular losing its coherence.
 3. Old snow develops when the small uniform grains grow into larger grains which become compact and firm.
 - a. Snow is again firm.
 - b. Speed of process depends on the slope and atmospheric conditions.
 4. Melting and refreezing hastens the formation of large rounded granules.
 5. In dry climates sun and wind evaporation completes the process by supplying the vapor for the growth of large grains.

Snowcraft (continued)

6. In all stages the snow becomes more dense and compact due to change in the shape and subsequent packing of the particles.
 7. The final stage is the compressing to glacier ice or the melting and runoff.
- C. Wind packing results from the same processes as does firnification accelerated and altered by wind.
1. Characteristics of wind-packed snow depend on the conditions of formation.
 - a. Wind crust is a thoroughly compact tough snow mass iced together by the action of wind born moisture. There is no uniformity in size and the particles are more angular than round.
 - b. Wind slab is a deposit of drifted snow which is consolidated into a hard mass by wind-born moisture also, but is unanchored to the masses below it. The grains are generally subangular and cemented together into iced-up aggregates.
 2. The causes of wind packing explain the formation of wind crust and slab.
 - a. Friction due to the wind will pulverize snow flakes, and the heat generated may melt down the ends of the spikes.
 - b. Condensation of moisture from wind between snow particles takes place in all wind packing.
 - (Cold dry wind evaporates snow.)
 - (Damp wind coalesces grains by condensation.)
 - (In wind slab the condensation of moisture causes the expansion of the snow mass.)
- D. Wind drifting and erosion produce changes in snow structure aside from packing.
1. Wind currents transport and deposit snow masses in the form of cushions, slab and even cornices.
 2. Erosions about huts, trees and rocks are the result of strong eddy currents picking up snow and transporting it away.
 3. The ridges and pinnacles of wind-swept snow in an open field always have their steep faces toward the wind.
- E. An understanding of cornice formation is important for avalanche protection.
1. A cornice is formed when a snow laden wind stream meets an upcurrent of air on the lee side of a ridge. The snow is deposited in the calm region between the streams and cemented in place.
 2. Part of cornice development may be due to canopying of the flakes.
 3. The remainder is due to wind-slab formation on the top face.
 4. The size of a cornice depends on: size, shape, inclination of windward slope, and direction and intensity of the wind.
 5. Crevasse bridges are due mainly to canopying of snow across the opening.
- F. Stratification and type of snow layers depend on past weather conditions.
1. Succeeding snow falls will represent different stages of firnification depending on the following aging conditions:
 - a. Type of snow at time of fall.
 - b. Subsequent melting and freezing.
 - c. Wind conditions.

Snowcraft (continued)

2. Drainage of melt water to more compact layers means the formation of definite layers of ice crusts.
3. The anchorage and lubrication of a stratum depends on the amount of thaw water in that layer.
4. The quantity of thaw water depends on the outside temperature, sun intensity, and angle of slope.

III. The actual snow surfaces and snow conditions which the skier meets will be tabulated as follows:

- A. The snow forms and properties representing the stages of firmification are:
 1. New snow - snow still having long spikes which may canopy to form a stable mass.
 2. Settled snow - new snow having lost its spikes (the powdered snow of skiers).
 3. Early firm snow - sun melted spring snow.
 4. Dry firm snow - snow having formed large crystal grains by successive melting and sublimation, e.g. corn snow.
- B. Snow forms due to wind action are:
 1. Wind slab - formed by freezing-up of drifted snow cushions on a lee slope. It forms a dome shaped mass which has no bonding to the lower snow layer.
 2. Wind crust - formed by wind blowing on a mass of snow, thus it exists on a windward slope and is firmly anchored.
 3. Wind erosion forms - scavler and sastrugi are the ridges and masses left on an open field by wind during erosion.
- C. Snow surfaces due to freezing, evaporation and melting are:
 1. Sun crust - formed on the surface by freezing of sun-melted snow.
 2. Rain crust - formed by the freezing of rain soaked snow.
 3. Film crust - a very thin layer of ice on the surface of soft snow which is easily broken down.
 4. Marble crust - hard iced-up snow, probably formed by freezing of water soaked wind slab. It is chalky white in appearance.
 5. Perforated crust - crust evaporated in pockets and in advance stages to a lacey network of ice bridges which is easily broken. Usually no melting occurs.
 6. Sun cups - formed in the same manner as perforated crust with the surface developing into a series of snow peaks and ridges.
- D. Surfaces due to sublimation and freezing are:
 1. Hoar frost - crystal deposits on snow surface due to the crystallization of water vapor from still air.
 2. Rime - formed by freezing of supercooled fog particles on striking any surface.

AVALANCHES

I. AVALANCHES DEFINED.

Avalanches are the sliding and/or fall of snow and/or ice down a mountain slope.

There are two types of avalanches:

- Ground avalanches in which all snow slides off leaving ground bare.
- Superficial avalanches which is the sliding of masses of snow over other layers of snow. Superficial avalanches are the most common.

II. CONDITIONS WHICH GOVERN AVALANCHE DEVELOPMENT.

A. Nature of the Terrain.

1. Narrow river valleys of Northwest, with their steep slopes favor the development of avalanches.
 - a. Avalanches pile up in narrow valleys, spread out in flat valleys.
 - b. All slopes over 20 degrees should be suspected. Wet snow avalanches will slide at 15 degrees.
2. The contour of the slope is an important factor.
 - a. A concave slope, unless the snow is wet, is usually safer than a convex slope because weight of snow itself tends to compress and stabilize it.
 - b. In the Northwest a wide variety of contours may be found in single slope causing danger of one dangerous slope converting otherwise safe slope into potential danger spot.
3. Steep gullies form natural avalanche tracks.
4. Steep ridges with strong winds increase formation of cornices.
5. Ledges on which snow catches and collects are a frequent source of avalanches, when snow from the ledges fall onto slope below.
6. Natural laws of avalanches are not so readily applied on slopes cut artificially, such as roads, etc., as the natural contour of the slope is destroyed.
7. Some steep slopes never avalanche, even though in otherwise favorable conditions, due mainly to action of moisture laden winds.

B. The Nature of the Underlayer.

1. Natural underlayers.
 - a. Rocks, as rockslides, form substantial retarding influence to sliding snow, until they are entirely covered by snow layer.
 - b. Slabby rocks, frequently found in the Cascades form dangerous underlayer at all times. Sometimes natural heat of rocks cause snow to melt on rock surfaces, making snow support fragile and easily broken away.
 - c. Upthrust nature of Cascades makes formations of slab one side of ridges, steep cliffs on the other.
 - d. Frozen bare earth is dangerous.
 - e. Heather and grass slopes, especially if grass is long, is poor undersurface for snow.
 - f. Vine maple and alder will hold snow securely as long as trees project above snow surface. After trees are bent down by weight of snow they act as natural shoot-the-shoots.

- g. Abundance of timbered slopes is distinct advantage in Northwest, as trees hold slopes from sliding. However, do not be under the delusion that because you are in timber that you are always safe from avalanches falling from above.
2. Snow underlayers which may be considered dangerous.
 - a. Unbreakable crusts--rain, sun and marble.
 - b. Wind slab--new snow may disguise this danger.
 - c. Loose snow--additional weight of new layer may precipitate sliding depending upon condition of the under-surface of first fall.
 - d. Hoar Frost--provides weak bond between snow layers.
 - e. Old wet snow--is apt to lubricate bond between falls of snow. Any wet fall of snow on crust is dangerous as it lubricates underlayer especially if crust has been rained on.
 3. Snow underlayers which may be considered safe.
 - a. Loose snow if falling snow is of same general character.
 - b. Wind crust is usually safe.
 - c. Ridged and scooped surfaces, and sun caps. Conditions favoring the formation of these surfaces do not favor avalanches.
- C. NATURE OF THE SNOW.
1. Dry snow.
 - a. Dry snow avalanches depend upon great masses of snow. As very little of this type of snow falls in this section, there is very little danger of genuine avalanches. However, when powder snow falls upon hard crust, there is the danger of small slides on steep slopes.
 2. Damp snow.
 - a. Moisture tends to adhere snow, and even heavy falls of damp snow will not tend to avalanche until affected by thawing conditions.
 3. Wet snow.
 - a. Wet snow will easily avalanche due to the over-weighting of snow by water.
 - b. Depth of snow will be slight in comparison to its weight. Wet snow is sometimes ten times the weight of the same volume of powder or damp snow.
 4. Internal conditions of snow determine its safety.
 - a. After falling, snow undergoes physical changes which will tend to form avalanche conditions. Refer to furnification processes under Snowcraft.
 - b. Through becoming wet, the weight obviously becomes a factor, especially with heavy accumulations. Water increases mass of snow.
 5. How snow becomes wet.
 - a. Thawing.
 - (1) By direct action of the sun.
 - (2) Due to high Northwest humidity, condensation takes place causing heat to be set free from snow surface, thereby raising surface temperature.
 - (3) Cloudy skies check surface heat radiation. This will vary with angle of slope and height of clouds.

- b. Fog or mist.
- c. Capillary action.
- d. Chinook Winds and rain.

- (1) most important condition of all in point of danger due to quickness with which avalanche conditions are created. It has been known to affect snow in an hour's time to such an extent as to create really dangerous conditions. Do not venture into potentially dangerous avalanche areas if weather conditions indicate possibility of Chinook. Danger is minimized during Chinook as no respectable skier will venture forth on tour under those conditions.
- (2) Freezing weather following Chinook will solidify slopes again, but following next fall of snow avalanche conditions may again appear in the new snow.
- (3) Rain upon snow increases danger of strata being lubricated before next fall.

D. Location of avalanche slopes.

- 1. Elevation--avalanches may be expected at any elevation at which snow falls in any quantity. Those elevations--around 4000 to 5500 feet--where snow falls heaviest are naturally the most dangerous. Lower slopes also receive most rain.
- 2. Orientation.
 - a. South and west slopes receive the heaviest precipitation as well as most thawing and rainy weather and should therefore be more often suspected.
 - b. Many valleys run east and west, and north slopes under these conditions should also be treated with respect.
 - c. Slopes that receive most sunshine. Sunny slopes will avalanche first in warm weather. Shady slopes may be dangerous for several days.
- 3. Physical characteristics of the avalanche slope.
 - a. The contours and steepness of the slope.
 - b. The nature of the underlayer--slabby rock, heather and grass slopes, alder and vine maple slopes should be treated with care.
 - c. Steep walls, especially if snow lodges on the ledges.
 - d. Corniced ridges.
 - e. It is important to know that the heavier the snow layer the flatter the slope required to hold the snow mass.
- 4. Special characteristics of wet snow avalanches is that they frequently follow the same tracks year after year. However, due to varying conditions, wet snow avalanches may fall at any given place given proper conditions.
- 5. Narrow valley bottoms are dangerous in avalanching conditions as snow piles up in heavy masses in valley bottom.

E. The time element.

- 1. Under Chinook conditions, avalanche danger is present at any time during day or night.
- 2. Cloudy skies bring danger of sliding snow during warm period of day.
- 3. Under ordinary thawing conditions (sun, etc.), danger may exist from the time sun first hits snow.

- a. On slopes hit by sun throughout day, maximum danger is usually around 2 o'clock in the afternoon, when sun's rays have most effect on snow slope.
- 4. When sun hits slope, it may bring down avalanches due to expansion and weakening of snow support. This is true of both snow and ice avalanches.
- 5. When sun leaves slope, it may bring down avalanches by release of stress by expansion due to freezing.
 - a. Continued thawing lubricates snow particles and under strata. When shadow passes over slope, the surface freezes leaving slope in uncertain state of equilibrium, and may be set off by undue stresses.
- 6. The season of the year.
 - a. The fall season brings special danger of frozen underlayer of ground surfaces over which new wet snow will slide easily and other natural undersurfaces.
 - b. The nature of the snow stratification determines the danger during the winter season, together with weather conditions.
 - c. The quantity of snow deposits, together with the amount of thawing and the configuration of the slope figure into spring and summer avalanches. Danger from falling cornices is increased as they have multiplied their weight through increased water content.

III. CLASSES INTO WHICH AVALANCHES FALL AND THEIR CHARACTERISTICS.

A. Dry Snow Avalanches.

1. Causes:

- a. Large quantity of snow. As very little dry snow falls in Northwest, the danger from dry snow avalanches are considerably less than those caused by wet snow.
- b. Low internal cohesion. The snowflakes are so light they "float" rather than adhere into solid mass.
- c. Low external adhesion. Poor anchorage to strata beneath.
- d. Angle of slope. Any slope above 22 degrees is possible danger.
- e. Orientation with respect to sun.

2. Characteristics.

- a. Gradual release by harmless looking snow slide, or sudden release when support breaks away.
- b. High velocity with little noise.
- c. Much pulverization and with air blast accompanying.
- d. Avalanche tip is light and fluffy.

B. Wind Slab Avalanches.

1. Causes:

- a. Little or no adhesion to lower layers. Some slabs are actually dome shaped, with support only at outer edges.
- b. Wind slab is unstable because of stresses set up during formation.
- c. Breakage of slab, through external influences, destroys all anchorages since slab collapses.

2. Characteristics:

- a. Usually found only in winter.
- b. Consists of great blocks of snow.

- c. Particularly dangerous because frequently entire slope will peel off. (Meany Hill wind slab avalanche of (1931))
 - d. Will slide on relatively level slope.
- C. Ice Avalanches.
- 1. Causes:
 - a. Natural movement of glacial ice causes pressure from behind, forcing section of ice over slope or cliff,
 - b. Sun striking ice wall will cause sections to fall from weakening or melting of supporting structure. In reverse, freezing of ice after warm day will expand supporting structure causing its weakening.
 - 2. Characteristics:
 - a. Ice falls in various quantities, from small slivers to huge masses.
 - b. Usually announced by "thudding" noise, as well as "roar" as ice falls.
 - c. may start other avalanches by falling onto dangerous snow slopes beneath.
- D. Wet Snow Avalanches - Northwest Weather Conditions Make These Our Chief Danger.
- 1. Causes:
 - a. Great weight of snow layer. The deeper the layer the greater the danger.
 - b. Low internal and external cohesion due to lubrication of water.
 - c. Sudden changes in weather and temperature.
 - 2. Characteristics:
 - a. Frequently preceded by rolling sun balls.
 - b. Snow slides in waves; series after series of avalanches.
 - c. Little pulverization is present: snow rolls as balls with a swirling motion.
 - d. As soon as avalanche stops, it freezes solid.
 - e. Due to tremendous weight immense damage can be done.
 - f. Travels at comparatively slow speed.
 - g. In the Northwest tracks through forest may indicate frequently recurring avalanches.

IV. SOME FACTORS CAUSING THE SETTING OFF OF AVALANCHES.

- A. Changes in temperature and settling of snow through gravity causes changes in stresses in the snow mass.
 - 1. A drop in temperature causes changes in size of snow crystals and therefore makes for less cohesion.
 - 2. Temperature rises may cause expansion of snow.
 - 3. Settling of snow increases moisture content, and thereby the weight.
- B. Outside influences in the starting of avalanches.
 - 1. Skiers crossing the slope.
 - a. Due to the length of skis and the fact that a track is made that cuts the entire slope, the danger of skiers starting avalanches is greater than that of a man crossing the same slope on foot.
 - b. If snow layer is thin skis will break entire support of slope.

- c. If snow layer is thick or heavy the danger lies more in the lack of internal cohesion in the snow itself rather than the setting off the entire layer. Under these conditions the danger of crossing the slope on foot or ski is perhaps equally great.
 - d. Undercutting the slope. This is the greatest danger as wet snow avalanches slide in waves, and the upper section will slide over the lower part of the slope.
 - e. The pressure of skiing turns will set off avalanches.
2. A cornice, ice avalanche or snow falling from rocky ledges.
 3. Snow falling from trees.
 4. Natural heat around rocks will weaken the snow support.
 5. Ploughing out of roads break the natural contour and support of the slope.

V. SOME GENERAL PRECAUTIONS.

- A. A knowledge of past meteorological conditions is essential to know the nature of the snow strata. Dangers of avalanche conditions depend not so much on nature of terrain as on the conditions of the layers underneath.
- B. Learn from experience where you may expect "normal" avalanche conditions and have such sections carefully marked on map.
- C. Study weather forecasts. In the Northwest this service is poor, as forecasts come from San Francisco, so that sudden weather changes are recorded too late to be of practical value. It is best to learn weather for yourself.
- D. Northerly storms usually mean weather will clear shortly. Southerly storms usually mean a period of sustained bad weather and therefore heavy precipitation.
- E. A record of snow depths.
- F. Study of snow sections.
 1. Sounding with ski pole.
 - a. If pole is pushed readily into snow (handle first) it will indicate that internal cohesion of snow is poor, either through thawing, from cold, or dampness.
 - b. If strata underneath cannot be penetrated, determine from upper layer possible danger of lubrication between the strata.
 2. Snow sections may be studied in hole around trees, with very little digging, or by observing heavily scooped surfaces.
 3. Study of snow sections can give you exact details of weather trends in areas in which weather reports are not available.
- G. Note variations of snow surfaces in regard to location and orientation.

VI. TACTICS ON AVALANCHE GROUND.

- A. Where ever possible, avoid avalanche slopes, especially.
 1. Short slopes over steep cliffs.
 2. Long steep slopes.
 3. Slopes under cornices and cliffs.
 4. Steep gullies, especially if they branch above into two or more divisions.

KNOW YOUR SLOPE--KNOW YOUR WEATHER

B. Crossing avalanche slopes (suspected)

1. Where ever possible cross slope as high as possible, except under a cornice. Follow the ridge if possible.
2. Avoid direct traversing, if possible. If descending, run straight at a sharp diagonal across slope. If ascending do not switchback. Take off skis and climb straight up on foot. Unless it is essential for the welfare of the party the sensible thing to do would be to turn back rather than ASCEND avalanche slopes.
3. Do not turn on dangerous slopes if possible. Do not ever jump turn. The faster your turn, if you have to do it, the greater the impact on the slope.
4. To walk or ski.
 - a. If terrain is difficult, and slope steep it is best to walk. Feet will compress snow and tend to keep or increase its cohesion. Take long steps and take care not to make definite channel across slope. If snow layer is shallow the feet will bite through into harder strata beneath. If snow layer is deep, danger is probably equally great on ski as on foot.
5. Roped or unroped.
 - a. If slope is wide the rope should not be used. Skiers should keep at least 200 feet apart and if possible should not run in the same track.
 - b. If slope is narrow, such as a gully, and good anchorage is to be had by all means rope up.

C. Some suggestions:

1. The importance of having a capable leader to make decisions as to safety of the slope and technique to be applied.
2. Don't cross a suspected slope merely because there is already a ski track across it. Conditions may have changed since the passage of the last skier.
3. If an avalanche has already fallen on a slope it is not necessarily safe. The fallen snow may have been the support for the snow above. The present avalanche track may also provide a natural shoot-the-shoots for succeeding slides.
4. Being in the woods does not necessarily mean you are safe from avalanches. Trees prevent slides from starting, but they can't stop the one that started higher up.
5. Skiing alone in avalanche territory should not be done. You shouldn't have started out alone in the first place.
6. Avoid traveling horizontally across bad slopes. The vertical or diagonal line puts less stress on the slope.
7. If traveling avalanche slopes in misty or foggy weather it is not necessarily essential to travel close together to avoid being lost. Unless it is also snowing heavily you can watch the ski track of the man ahead of you. Conditions that you meet should be the deciding influences.
8. In the Northwest sun balls rolling down a slope do not necessarily mean avalanche conditions. After falls of damp snow, it is frequently safe to cross even steep slopes after sun balls start rolling. However, it is important to know your conditions.

9. It is possible to run over superficial wet snow avalanches which involves a light coating of snow. Do not attempt it if snow bulk is large.
10. Before crossing suspected slopes, loosen ski bindings, and remove wrists from ski pole straps, so that they can be easily discarded in case you get caught in an avalanche.
11. An avalanche cord is a heavy cord, usually red, trailed behind the skier in crossing suspected slopes. This string floats on the surface of the snow if the skier is overwhelmed and aids greatly in locating the victim afterwards. As it is a good thing to have some heavy twine in your ditty bag anyway, it might be a good idea to make it a red cord and use it as described above.
12. A man on skis will start more avalanches than a man on foot.
13. Members of a party should be separated by at least 200 feet when crossing an avalanche slope.

Snow Craft and Avalanche Questions

1. Is there any danger of a slope of 20° avalanching in the Northwest?
2. Mitzie Murgatroid and her party are caught in a wet snow avalanche in the early afternoon. The slide is discovered 3 hours later and as the rescue party is equipped with skis and poles, will Mitzie get home in time for her date with Fritzie at 9:00?
3. A convex slope is safer than a concave slope, generally.
4. Frathbinder Stoddlebopper and guest were skiing on a 25° slope when suddenly a powder snow avalanche came down on them. Frathbinder tried to outrun the slide while his guest took off her skis and started beating around with hands, feet, etc. Who told the story to the coroner?
5. Which of the following can cause wet snow avalanches?
 - (a) depth of snow
 - (b) weight of snow
 - (c) speeding up of ski lift
 - (d) price of powdered eggs in China
 - (e) angle of slope
 - (f) low cohesive qualities due to water in snow
 - (g) General MacArthur
6. Wet snow is sometimes 10 times heavier than damp snow.
7. Sadie Zilch is skiing at about 10,000 ft. She has her avalanche cord out. Is she being over-cautious?
8. There has been no new snow for 5 days and the temperature has risen above and fallen below the freezing mark continually. Today the temperature is 24° and the sky is overcast. If Archie skied on the Southern slopes and Starchie skied on the Northern slopes, who is going to borrow base wax from whom tomorrow?
9. Slutch McGonigal, during a powder snow storm in which the wind is blowing fiercely, has just skied over the lee side of a ridge. The slope is between 45° and 50° and the valley floor is 3000 ft. below. Everything going according to theory, where will Slutch be in 2 minutes if the slope is open?
 - a. (1) In a little honkey tonkey village in Texas.
 - (2) Back on the windward side of the slope.
 - (3) On the outskirts of town.
 - (4) On the valley floor with the avalanche he brought with him.
 - b. What type of snow did he meet?
10. In December, Donovan is skiing on Nisqually glacier. He comes to a crevasse over which there are 2 bridges. One is of new snow which has drifted to a depth of 4 ft; the other is last years snow which is only 10 inches thick. If Donovan has taken the Ski Mountaineering Course, which bridge will he use? Why?

11. You are skiing in late April when suddenly you come upon a patch of spring powder. You realize it has not snowed for two weeks and the temperature has been above freezing most of the time. The situation is explained by which of the following?
 - (a) You are skiing on a Northeast slope.
 - (b) M.G.M. is shooting a ski scene and has brought snow from Southern California.
 - (c) You are below a steep cliff and the sun has not hit the snow.
 - (d) You just think its spring powder.
 - (e) Two happy little norons have developed an O so Peachy spring powder machine.

12. During the night a fog settled over the ski area and the next morning I put on my skis and had the best conditions I have ever had during my skiing career. Am I trying to kid somebody? Explain.

13. What types of avalanches are liable to start on less than an 18° slope?
 - (a) Wet snow
 - (b) Dry snow
 - (c) None
 - (d) Ice
 - (e) Wind slab
 - (f) All types

14. If you are out hunting for avalanches, between what elevations are you going to find the majority?
 - (a) 3,000 - 4,000
 - (b) 26,000 - 28,000
 - (c) 4,000 - 5,500
 - (d) 5,500 - 6,800
 - (e) sea level - 1,000
 - (f) 7,000 - 9,000

15. You are skiing at an elevation of 8,500 and believe a Chinook wind is in the offing. Do you have to worry about snow conditions at that altitude?

16. What is liable to cause a wet snow fall on weekends?
 - (a) A Democratic majority in Congress.
 - (b) Ice particles falling thru warmer air strata.
 - (c) You don't live right.
 - (d) The heating action of friction as the snowflakes pass thru the atmosphere.
 - (e) We live in the humid sub-tropical zone.

17. The heaviest snowfall in the Northwest occurs in March.

18. Damp snow becomes faster as the temperature lowers.

QUESTIONS (continued)

19. Bill Scissorbill and party on a calm evening find a deep snow trench on one side of a large tree trunk and decide it is a fine place to pitch their tent. During the night a howling storm came up. What happened to Bill's tent?
20. At a medium elevation, after a period of warm, dry sunny weather, which of the following conditions should exist at on a 30° East slope about 12 noon and why?
 - a. Dry powder snow.
 - b. Sun crust over new snow.
 - c. Damp new firm snow.
 - d. Perforated crust over corniced snow.
21. There has been a heavy fall of new snow. Our route climbs up a series of open ridges and gullies across which there is a light wind blowing. Where should the route lie?
22. A strong southeast wind has been blowing for 2 days. The temperature at 5000 feet is 30° . What kind of snow surface will you find on the following trips?
 - a. High trip on ridges above timberline.
 - b. Up and down traverse at timberline.
 - c. Trip in the trees at about 4500.
 - d. Will a, b, or c give best skiing.
23. The snow surface at Stampede has a thin film crust and all the stumps are covered with a sheet of ice.
 - a. It has rained and frozen at night. True or False
 - b. A cold fog was blowing in from the east. True or False
 - c. It has been clear weather. True or False
24. Which of these, wind crust or wind slab, will avalanche on the lee side of a corniced ridge?

WEATHER

I. TYPES OF PRECIPITATION

A. Dew and hoar-frost

1. Earth radiates heat away during night and cools the air.
2. When air reaches dew-point, dew condenses on earth, grass, sticks, etc.
3. If earth temperature is below 32°F. the moisture sublimates directly as hoar-frost.

B. Fog

1. Not generally considered as a form of precipitation but a certain amount of moisture is precipitated in this manner.
2. Under certain conditions sub-cooled particles of moisture in fog freeze on the windward side of trees, snow surfaces, etc. forming a deposit called rime.
3. Three main types of fog, frontal, radiation and advection, all formed by air reaching its dew point and moisture condensing on minute particles of ice.
4. In arctic regions or in cold weather fog may be composed of minute particles of ice.
5. Clouds are really masses of high fog. Many clouds are composed entirely of ice crystals.

C. Rain

1. Drops range in size from 1/50 of an inch to 1/8 of an inch.
2. All rain results from moist air rising. Very small ice particles are formed in the rising air currents and as they become larger they fall through the clouds. They become larger by water vapor sublimating directly onto them and by freezing to themselves any droplets of sub-cooled water they may contact and at this time are in the form of snow. As they fall below the freezing level they melt and turn to rain.

D. Snow

1. Formed in same manner as rain but continue to fall as snowflakes.
2. Heaviest snowfall around high mountains is between 2,500 and 9,000-foot elevation.

E. Sleet, Graupel and Hail

1. Usually referred to as hail, though there are slight differences in the appearance of these three forms due to difference in their formation. In general they are formed in a manner similar to the formation of snow but due to melting and freezing they look more like frozen raindrops. Sleet actually is that, i.e., frozen rain.

II. GEOGRAPHIC CONDITIONS IN PACIFIC NORTHWEST

A. Latitude and location in regard to Pacific Ocean.

1. In this latitude, storms usually travel eastward due to prevailing westerly winds.
2. Air traveling over ocean becomes warm and is saturated with moisture.
3. Japanese current, due in part to prevailing westerly winds, makes ocean water in North Pacific warmer than it would otherwise be.

B. Olympic Mountains to westward and Cascade and Rocky Mountains to eastward form natural physical barriers to movement of air masses.

- B.
 1. Olympic Mountains remove a large part of moisture from westerly winds.
 2. Cascade Mountains act as a barrier against continental influence of eastern Washington.
 3. Rocky Mountains form second defense against extremes of temperature of interior of continent.
- C. Extreme height of higher peaks and ridges above the main range of Cascades causes considerable turbulence of air masses.

III. TEMPERATURES

- A. The average temperatures at Seattle, Tacoma and Everett during the winter months ranges around 40° F.
 1. Fluctuations in temperature caused by direction and force of wind and amount of moisture in air masses.
- B. Temperature usually drops with altitude.
 1. During periods of precipitation the temperature usually drops 2½° F. per 1,000 feet of elevation rise.
 2. During "dry periods", i.e., when it isn't raining, the temperature usually drops 5° F. per 1,000 feet of elevation rise.
 3. May have temperature inversions under certain conditions, i.e., warmer at higher elevations than at lower heights. Only occurs during calm weather.

IV. WINDS

- A. Mechanism of winds extremely complicated. In general they are caused by differences in air temperature between two localities.
 1. Temperature of air affects its density, or weight, and results in high and low pressure areas.
 2. When winds are confined to small areas, a mile or two in extent, the surface winds blow from high to low pressure.
 3. When high and low pressure areas are greater distances apart, the wind usually blows at right angles to the pressure gradient due to rotation of earth and certain other factors.
 4. Conformation of land affects direction of wind and frequently causes surface winds to blow in a different direction than the wind in the upper layers of air. Sizable mountains are frequently surrounded by atmospheric eddies, whirls, downdrafts and updrafts of considerable force.
 5. Winds at different elevations frequently blow in different directions due to causes other than mentioned above.
 6. Our "weather" is really the result of the movement of air masses, i.e., winds, and if we can foretell the direction the wind will blow and from where the air in the wind has come from we can foretell the weather.
- B. Prediction of wind direction and weather extremely difficult in this area.
 1. Lack adequate information due to scarcity of weather reports from Pacific Ocean.
 2. Mountainous country causes all sorts of local winds which vary quickly in intensity and consequently cause frequent changes in the weather.
 3. Temperatures in our skiing areas fluctuate around 32° F. and slight changes in temperature make considerable changes in skiing conditions due to the fact that 32° F. is the temperature at which water freezes.

WINDS (continued)

- C. Types of winter weather usually associated with certain winds.
1. Southwest winds usually bring heavy precipitation as the air masses have traveled considerable distances over ocean and are saturated with moisture.
 2. West to Northerly winds bring clearing weather with occasional snow flurries.
 3. North to easterly winds bring cold clear weather as air masses contain little moisture.
 4. South winds are frequently relatively warm. In some instances they are unusually warm and, in this area, such a wind is called a "Chinook wind". Chinook winds cause rapid melting of snow resulting in danger from avalanches.

TOURING AND WAXING

I. JUDGING CONDITIONS.

- A. Knowledge of conditions essential for waxing.
- B. As weather conditions affect snow surfaces the following items should be checked before going on tour.
 - 1. Temperatures.
 - a. Note at what time and elevation readings were taken.
 - 2. Humidity.
 - a. There will be precipitation usually if humidity exceeds 100.
 - 3. Wind direction.
 - 4. The barometer may also be consulted but it is not considered a reliable guide in this area. Lowering barometer frequently means clearing weather, rising barometer stormy weather.
 - 5. Weather trends.
 - a. Will determine whether weather will be stable or uncertain.
 - b. Be prepared for sudden weather changes and therefore changes in snow surfaces.
 - c. Check snow conditions before last snowfall.
- C. A varied assortment of snow surfaces may be found on a single tour, due to
 - 1. Elevation.
 - a. As clouds are pushed higher against the mountain ranges they strike colder air currents which cause different types of precipitation. Thus you may find rain at 3000 feet, wet snow at 3500, damp snow at 4500 and powder snow at 5500.
 - b. In settled or old snow definite boundary lines frequently exist between different snow surfaces.
 - 2. Location.
 - a. Snow surfaces vary according to position of slope and angle to sun.
 - (1) In both ridges and valleys you may find wet or granular snow on one side and damp or powder snow on the other.
 - b. On ridges you may find at times three varieties of snow, such as spring or granular snow on the sunny slope, wind pack on the crest and powder snow on the sheltered side.
 - c. In valleys or on ridges after new snow falls there will be loose snow on sheltered sides and wind crust on exposed side.
 - d. Surfaces between shaded and sunny slopes, open and wooded slopes.
- D. From study of snow surfaces encountered on tour it may be possible to check direction and elevation.
- E. Some general precautions to take while on tour.
 - 1. While ascending slopes, check snow surfaces for reference for the return run.
 - 2. Proceed cautiously while descending unknown slopes, particularly if foggy or cloudy. Check snow surfaces before crossing these areas.
 - a. Avoid fast running in unknown conditions, it will save you spills on suddenly striking slow sticky surfaces, or prevent going over a cornice or on to unsuspected avalanche slope.

I. JUDGING CONDITIONS (continued)

- B. 2. b. Evaporation of snow will cause soft spots around natural obstacles.
 - c. Last snow strata may lightly cover natural obstacles.
 - d. Sudden running from wet snow into damp or powder snow will cause icing of skis.
- BE SURE OF YOUR CONDITIONS----BE SURE OF YOUR SLOPE.

II. WAXING.

A. Reasons for waxing.

1. Increases ability to maneuver.
 - a. Proper waxing increases control of your skis.
 - b. Skins or socks would have to be removed for glacier travel or on slopes liable to avalanche.
2. Safety.
 - a. Edge control.
 - (1) Ski socks cannot be edged properly and therefore would be unsafe in hard snow, or when traveling roped through crevassed areas.
 - (2) Can edge in sealskins. Only one type of skin has been developed on which skier can run with the Sohm skin, but it takes considerable time to apply them.
 - b. With climbers you lose ability to run away from impending dangers.
3. Comfort
 - a. Properly waxed skis will climb as easily and readily as climbers.
 - b. Waxed skis easier to lift and slide, thereby lessening possibility of fatigue.
 - c. No wet or frozen climbers to fuss with.

B. Proper wax to use is governed by 3 factors.

1. Temperature of the air.
2. State of the weather.
3. Nature of the snow surface.
4. Region to be traveled.

C. Wax types.

1. In general, hard waxes are good running waxes and some will climb also in new dry or damp snow.
2. Soft waxes run in clogging snow and some will climb. Others climb well in dry snow.
3. Klister types are for thoroughly wet snow.
4. Skare types are for frozen snow: crust.
5. Speed waxes are usually hard and are for downhill running only. Come in useful in waxing in combinations.

D. How to wax.

1. A good base wax is essential.
 - a. A pine tar base (Skare is good) is best for your skis if you go in strictly for touring. Burned into wood with blow torch or other heat it provides substantial base for other waxes. (Not for laminated skis.)
 - b. Lacquer or graphite base is now the prevailing idea in ski bases. Forms hard surface on bottom of ski and is especially good for downhill running, but needs base wax to hold touring wax.
 - (1) For touring it is advisable to wax first with Skare, thinly, before putting on your running waxes.
2. Follow directions for waxing for that particular wax only.

II. WAXING (continued)

- D. 3. Thumb and palm of hand are best implements for applying wax.
 4. Rub wax from tip of ski back evenly.
 5. Apply wax with skis as cool as possible and still keep wax workable. Let skis cool to air temperature after waxing. When they cool, place them on the snow before using them. If possible, run skis first through unpacked snow.
- E. Waxing on tour presents more problems than same operation at home or at lodge.
 1. Skis should be dry and warm for waxing.
 2. For camping overnight.
 - a. If possible, bring skis into tent with you.
 - b. Wipe skis off carefully and place in sheltered spot.
 - c. If skis are used as tent poles, be sure they are thoroughly dry (if possible) to prevent icing.
 3. Always carry a wax scraper (knife is o.k.) and a cloth with which to clean and dry skis.
 4. Carry wax in trousers pocket to keep it soft and workable.
 5. Carry sufficient variety of your own waxes to meet any condition of snow surface conditions encountered.
- F. Waxing in combination provides adequate climbing and sliding for conditions not specifically covered by any particular type of wax.
 1. Effective combination is Skare base with climbing or downhill wax.
- G. Experience is the best way to learn waxing.
 1. Select fine varieties of waxes and learn how to use them correctly.
 2. Find out for yourself what wax works best under given conditions.
 3. Waxes may not always be suited to local conditions as specified by the wax maker.
 4. Learn to apply thick or thin, according to conditions.
- H. To summarize.
 1. Proper waxing increases the enjoyment and safety of ski touring.
 2. Be prepared to wax for varying conditions.
 3. Learn from experience what waxes to use, and how best to utilize them.

SIMPLIFIED SUMMARY

THE ART OF WAXING

Learning to wax properly will save many discouragements in uphill climbing and downhill sliding.

Cheese a good brand. Get all types; a complete set.

Base laquering is not essential but does help to protect skis.

Base waxing is essential on all skis, as an adhesive medium for the wax and to the ski itself.

Use cold snow wax in temperatures below 32° and dry snow. Watch out for damp snow in cold temperature and vice versa.

Use wet snow wax in temperatures just above 32° and damp snow, not wet snow.

Use klister wax in snows that are damp to wet.

Use Speed wax only for downhill sliding and lift riding; on any kind of snow.

Use skare & klister on crust snow, solid crust only.

METHOD OF APPLICATION

A. Base Jobs.

1. Linseed oil can be soaked in over a period of months and will make the ski permanently waterproof.
2. Pine tar is very good and soft wood skis and fairly good on nickery skis if it is heated in. Two or three applications at the beginning of the season is sufficient to last the whole season provided one uses running waxes at all times.
3. Varnish is fairly good but not very fast if used as speed wax.
4. Shellac makes a good base but will chip off.
5. Laquer: Many patent types are very good. This type base is preferred.

B. Base Wax.

1. Pine tar used as a base job needs no base wax.
2. Klister is fairly good if applied thin and left to dry for weeks before using.
3. Skare is the best: Apply thin. Rub out well; can be used immediately but is better if left to stand for a few days in a warm place, thereby letting it harden.

Over these bases you may now apply:

C. Running wax.

Generally speaking, the method of applying wax in all cases and with all types is dab it on evenly all over the ski. Rub out evenly and smoothly.

D. Testing and Using Results and Corrections:

If proper wax is used with the proper temperature and snow condition and the result in using is:

1. Slipping:
Correction is to apply more wax.
 2. Sticking and gobbing up:
Correction is to remove some wax or rub a little paraffin, speed wax or bees wax on.
- If neither of the above corrections work, then you have the wrong wax for the wrong snow condition.
- Don't forget: The snow may vary in the trees; in higher altitudes and in general, away from "just outside the lodge or car door". Don't be fooled. Good judgment and general good old common sense will steer you on the right track most of the time.

WEATHER QUESTIONS

1. In this area, eastern slopes get more snowfall than western slopes. True or False
2. At Mt. Rainier the heaviest snowfall is at the summit. True _____ False _____
3. If temperature at Paradise Valley (approximate elevation 5,500 feet) is 30° F. and a light snow is falling, what would you expect the temperature to be at Camp Muir (elevation 10,000 feet) _____
4. Same question as #3 except that the weather is clear. _____
5. Most northwest snow is caused by _____
 - a. Cold northerly winds bringing snow from Canada and Alaska
 - b. Rising of moisture laden southwest winds.
 - c. The sun is farther away from the earth in the wintertime.
6. Temperatures in this area would be much colder in winter if there was less precipitation. True _____ False _____
7. It is possible for the wind to be blowing in one direction at the surface of the earth and be blowing in the opposite direction at the 5,000 feet level. True _____ False _____
8. Snow is composed of frozen rain drops. True _____ False _____
9. It has been stormy and blowing southwest for several days and the wind has just shifted to the Northwest; would you expect the storm to get worse _____ or to abate _____.
10. You look in the ski report in the newspaper and note that the maximum temperature at Paradise Valley (5,500 feet) was 5 degrees warmer than the minimum temperature at Snoqualmie Pass (3,200 feet). What is the reason:
 - a. The report is wrong.
 - b. Cold air from eastern Washington is coming over the pass.
 - c. Paradise Valley is farther South than Snoqualmie.

WAX CHART

Compiled December, 1934 - Revised October, 1941

Crust or Frozen Snow	SKARE								
Spring Snow					Thin Klister			Heavy Klister	
Raining									
Very Wet Snow								Klister	
Old or Cloggy								Northland	
Damp Snow					Thin Klister			Heavy 3 Star	
New Damp or Cloggy Snow				Red	Ostbye Gold				
				Dunzinger	Klister Thin			Klister Heavy	
Powder Snow				Black					
New Dry Snow	OSTBYE MIX			Dunzinger					
Temperature	10	20	28	30	32	34	36	40	50
	Under Freezing					Over Freezing			

EXAMPLE: Temperature 31, new cloggy snow -- Use Red Dunzinger

APPROXIMATE GROUPING OF WAXES FOR COMPARISON

Wax	New Dry Snow	New Snow Near Freezing Point	Cloggy Snow	Wet Snow	Crust	Base Wax	Speed Wax
A. & T.	601	#8	601	602	603	Durolac & #6	604 & #9
Cascade	Dry Snow Wax	(Thin)		Klister		Marvelac	Streak
Dunzinger	Black	Red	Red	Klister		A-21	Blitz
Eastwood	Green	Dry Snow Wax	Wet Snow Wax	Klister	Skare	Baselac	Blue
Northland	1 Star		2 Star	3 Star		Skilac	5 Star
Ostbye	MIX	Medium	VOX	Klister	Skare		Schuss
Schneider	Hard		Medium	Soft		Speedlac	Parafin
Sohms	Blue		Orange	Gold		Durosport	Red
Wilby	Yellow	Red	Blue			Silverlac	

Other base waxes: Ski-Pro, Vitric, Skigliss, Skarelac, Wizard Lacquer.
 Other speed waxes: A-X Graphit Parafin, Pfeiffer's Topspeed Silver, Medium hard and perfect parafin.

ROUTE FINDING AND PARTY MANAGEMENT

Definition

The art of finding one's way in unknown territory.

The art of finding one's way in known territory and adverse conditions.

This is important because of what happens if traveller is unskilled in route finding.

(a) Party because temporarily or permanently lost.

(b) Results in traveling over excessive distances.

Equipment

The map is the most important tool. There are three kinds:

(a) Road map - shows features of general area and accessible roads. Obtained at service stations.

(b) Forest Service or Mountaineer map - shows trails and distances between points on these trails. Shows location of shelters and land marks such as lakes, rivers, etc. Obtained from Forestry Service.

(c) Contour map - shows absolute terrain of land and also some trails. Maps are usually over twenty years old and hence modern trails are not shown. The altitude at any point can be easily found by using the contour lines on the map. Obtained at book and map stores.

The compass is an instrument used for establishing direction.

Essential for use under conditions where visibility is poor, as in fog, woods, storm and is desirable at all times.

The compass is most valuable when used with a map.

The Taylor compass which costs about a dollar is recommended.

The aneroid altimeter is optional equipment.

Used for determining altitude.

Works on principle that air pressure decreases with altitude.

Use of Equipment

Road map - Find proper roads and distances to starting point.

Forest Service map - Location of trails, peaks, directions, landmarks and approximate altitude of same.

Contour map - North is usually at top of map, orient the map to point North.

Determine the elevation from contour lines - A contour line is a line connecting all points of the earth's surface having the same elevation.

The elevation of climb or descent is found by comparing the contour line at the start with that at the end.

The steepness of slope is determined by the horizontal distance between contour lines.

The position of ridges and valleys are shown by contour maps.

It shows position of glaciers, lakes and streams.

Maps should be mounted on cloth to preserve them and also they should be kept in waterproof containers.

The horizontal distances from point to point may be scaled.

One can determine which landmarks can be seen from a given point.

One can determine which direction any point lies from a given point.

Compass

Based on the principle that a magnetic needle points in a fixed direction.

Contrary to common belief, a compass at Seattle does not point North but N 23° E. Compass must be used with caution in certain areas where local mineral deposits may pull the needle off its fixed direction.

The angle between North and needle is called the angle of Declination.

To use compass, hold it level, steady needle down, turn compass scale so that the needle points 23° E of the North point on compass scale. Hold case fixed in this position, sight along proper mark on compass scale to establish desired direction.

Aneroid altimeter

Use is easy - just read your elevation off the scale.

When the altitude is determined, you can spot your position on the contour map.

Principles of Route Location

Uphill

Look for the easiest way. Avoid gullies and steep slopes.

Pick locations where snow is best. Do not blindly follow the summer trail as it frequently is not the best.

Look for flat or convex slopes, if possible, to keep weight on center of skis.

Select a route which travels upward on easy traverses, with as few kickturns as practical.

Avoid level travel as this produces no runback.

When climbing uphill, ski parties may make from 500 feet to 1500 feet per hour depending on snow, terrain, elevation and condition of party. An average party can figure on 800 feet per hour in average conditions.

Downhill

Select route providing best skiing - follow best snow and usually steeper slopes than uphill track.

Rate of descent on skis varies from 5 minutes to 1 hour per 1,000 feet drop, depending on terrain, snow conditions, skill and condition of party. Average party in average conditions should figure on 30 minutes per 1,000 feet drop.

General

Avoid dangerous spots such as crevasses, avalanche slopes, cornices, falling rocks from cliffs, and open creek trenches. steep avalanche gullies. Where necessary to cross dangerous spots, select route to cross at safest spot and hurry so as to remain as briefly as possible in danger zone.

In the woods, follow ridges or valleys, but valleys are bad unless creeks are snowed under. Avoid steep side hill because of small gullies to cross and difficulty avoiding trees.

Planning a Trip

Select first the object, keeping in mind the time of year, expected type of snow, strength and size of party.

Study the three types of maps - locate all possible routes, possible main base lines - imaginary lines connecting two peaks, or a large stream valley.

Find spot for closest help in case of emergency.

Inquire of others who have made the trip. Find out approximate

Planning a Trip (continued)

time involved, best possible trail, approximate time to reach starting point and good ski areas.

The knowledge of somebody else's mistake may make your trip successful.

The Trip Uphill

Check all equipment before starting.

Establish base lines and take compass bearings. Take bearings, if possible, on points that will be visible the whole trip.

See if the route you had planned is the most feasible one now that you are on the land.

Have at least two maps in the party and have them along with the compass easily accessible.

Keep the party together both for safety and for sociability.

The pace should be the fastest of the slowest member. Members known to be weak or slow should not be allowed to go on tough trips.

The leader should occasionally order "men or women forward."

Plan trip down on way up so that you will have the maximum skiing pleasure. In poor visibility, plan to return following your upward tracks.

In heavy snow use "ring-around-the-rosie" method of trail breaking.

Advantages of this method:

(1) Every member takes a fair share of trail breaking.

(2) No one gets tired because he only breaks trail for 20 or 30 steps.

(3) The party is able to travel faster.

(4) The weaker members can travel in the rear and miss the hard and tiresome work of trail breaking.

Do not be ashamed to take off skis at a bad or dangerous spot.

Orient yourself at frequent intervals. This applies to the whole party as well as the leader because each member should know how the trail lies. Turn back if conditions look dangerous. It might not only be dangerous for you but also for the party which has to look for you.

Unknown territory in bad weather is not recommended.

At no time should one ski alone.

The Trip Downhill

The success of the trip may depend upon the leader's ability to keep the party together despite different skiing speeds.

The party should be kept together both for safety and sociability.

All the better members should be put in the rear guard with a captain appointed.

The rear guard should ski together and not pass up any of the rest of the party.

The leader downhill should be a good route finder but preferably not a first class skier.

About every half mile the leader should stop and count noses.

In fog or storm, he should do this more often and also count the rear guard.

The Trip Downhill (continued)

An exception to keeping the party together is backtracking on a clear day when the party may split up into twos or threes each going its own pace. Even under these conditions, the rear guard must stay behind.

The advantages of this method:

- (1) The members of the rear guard are happy because they are skiing with skiers of equal ability.
- (2) The slower skiers are not unhappy, scared or rushed because of being behind.
- (3) The strong skiers are in the rear and in case of accident to the party, they will arrive without being chased.
- (4) The party has more fun and can watch the good skiers ski.
- (5) The party travels down just as fast as its slowest skier, hence it gets down just as fast anyway.
- (6) The members of the rear guard get more skiing in at the higher levels where the snow is better.
- (7) No one gets lost.

The route and trip should be planned for the members' pleasure because ski mountaineering is skiing for pleasure.

PROBLEMS FOR ROUTE FINDING & PARTY MANAGEMENT

1. Any blooming idiot can ski in the mountains. (T or F) _____
2. Standing at point C it is possible to see point F (T or F) _____
3. Point D is higher then point F. (T or F) _____
4. It is possible to travel from point C to F without losing altitude. (T or F) _____
5. The compass needle points 23 degrees E of N (T or F) _____
6. The declination of a compass is its act of refusing to be accurate. (T or F) _____
7. An aneroid altimeter is a handy gadget on a ski tour because with it one can (mark one)
 - a. Measure the steepness of slope
 - b. Verify one's location
 - c. Tell the time
 - d. Predict the weather
8. A river valley could be defined as a base line (T or F) _____
9. Sadie Stiz and George Mark find themselves unable to keep up with the rest of the party on a bright sunny day in May. The leader should do which of the following.
 - a. Send them back to camp following the ski tracks left by the party
 - b. Put them at the head of the party
 - c. Put them in the rear of the party
 - d. Leave them in a safe spot, continue the trip and pick them up on returning
 - e. Take the whole party back to camp
10. Which one should he do if it was a
 - a. Cloudy day in May?
 - b. Cloud day with a southwest wind in March?
 - c. Clear day with a north wind in January?
11. On a ski mountaineering trip, the last one down is a Niggerbaby (T or F) _____
12. A party is caught in a sudden snow storm above timberline in May. What should the leader do?
 - a. Head for the nearest telephone and call Mama
 - b. Eat Lunch
 - c. Follow tracks back
 - d. Continue trip
 - e. May a bee line for timber.
13. What would the leader do if the snow storm happened in January?
14. Party returning to camp in new territory wishes to avoid tiresome climb over pass by taking new route. Which route would you follow?
 - a. Keep on going down as long as the base camp was below you
 - b. Take a lower pass and then ski to camp
 - c. Forget all about other plans and return over former tracks
 - d. Take an airplane to camp
15. On awakening at your 4000 foot elevation camp, and finding it misty, you would do which of the following?

(Con't)

- a. Abandon your trip because it will be misty higher up and you might lose your way
 - b. Rub your eyes hard and see if the mist disappears
 - c. Start up using your map and compass hoping to get above the mist, but turning back in time to get out of the mountains in daylight
 - d. Forget the whole thing and go back to sleep
16. Seven Skiers, A,A,A, and B,B,B, and C,C,C, with "A" skiers first class, "B" skiers average and "C" skier weak, how should the party proceed up hill?
 FIRST _____ LAST _____
17. How should the party proceed down hill?
 FIRST _____ LAST _____
18. Skiers on ski mountaineering trips should be approximately of the same ability? (T or F) _____
19. An aneroid altimeter is not essential. (T or F) _____
20. true north is usually toward the top of a map (T or F) _____
21. Which is generally the easiest skiing: Mark one _____
- A. Ridge running
 - b. Side-hill gouging
 - c. Valley pounding
22. Which of the above is the safest.
23. Contour lines close together means that the land is flat (T or F) _____
24. All ski tours should be on Mt. Shuksan because when you get hungry there is a Baker near by. (T or F) _____

THE MOUNTAINEERS, INC.
Seattle, Wash.

CAMPING

"The More in the Head the Less on the Back"

This section of the Ski Mountaineering course is devoted to winter camping, that is, camping on snow under conditions typical of winter in this region. It is the objective of this lesson to inform the skier as to the equipment essential to this phase of the sport and to provide instruction in its use.

The skier who sets out for an overnite stay in our winter hills will be concerned primarily with two things--Food and Shelter. For purposes of classification these two topics could be broken down as follows:

- Food-Food and drink
 - Cooking equipment
 - Cooking fires
 - Cookery
- Shelter-Packs
 - Sleeping equipment
 - Tents
 - Misc. shelters
 - Warming fires
 - Misc. equipment and notes

For purposes of instruction, however, it appears more useful to approach the subject of Food and Shelter from the viewpoint of the skier who actually undertakes a trip. We will therefore set up two new headings, namely,

1. What to take
2. How to use it

1. What To Take:
 - a. sleeping equipment
 - b. tent
 - c. food
 - d. cooking equipment
 - e. axe
 - f. Pack

a. Sleeping equipment

Essential

Sleeping bag-

Down if you can afford it. Wool for second choice. No others practical.

Bag tapered at foot will save weight.

Must be long enough to cover shoulders but "shorties" should cut down bag to suit.

Drawstring at top helps to keep out drafts.

Hood with drawstring or snaps keeps out drafts and protects ears, etc.

One piece bag is lightest but separate cover has advantages. Double sleeping bags are warmer and lighter than two separate bags.

Can use a lighter bag in a good tent.

a. Sleeping Equipment (continued)

Desirable

Mattress - Preference in this order

- | | |
|-------------------------------|------------|
| (1) Air rings (invalids) | (5) Cork |
| (2) Air pillow | (6) Paper |
| (3) Air mattress (3/4 length) | (7) Boughs |
| (4) Sponge rubber | |

Boughs alone are adequate, and all of first six varieties are better with a foundation of boughs.

Take some string along to tie tube on air pillow (2) if you have "Dime Store" variety.

Sponge or foam rubber (4) hard to get and bulky to pack.

Cork (5) should be in pack size squares glued to cloth backing.

Paper (6) is the corrugated kind used for packing.

b. Tent

Best tents are as follows:

- Sierra
- Meade
- Zipper
- Appalachian
- Misc. and tarps

Must be absolutely waterproof as it is impossible to avoid rubbing roof. A wet tent is heavier than a waterproof tent. Must be snowproof. If snow cannot be kept out you are as bad off as though the roof leaked.

Must have a floor to keep wind out. Guy ropes must be arranged to anchor tent thoroughly.

Use rubber bands in main guys to prevent damage to tent.

Must be fireproof to permit use of Primus inside tent.

Floor should be cheap fabric and not waterproof.

Zippers must be rustless material.

Must have ventilators to reduce condensation when cooking.

Should be big enough for occupants and all gear, plus room to cook.

Don't carry tent poles - use skis, ski poles, ice axes, etc.

c. Food

Cooking is definitely a part of the fun of camping but don't overdo it.

Selection

Choose food by the amount necessary and the distance it must be carried.

Food requirements can be divided generally as follows:

- (1) Trail lunches
- (2) Overnight trips
- (3) Long trips

(1) Trail lunches.

Nobody ever starved to death in one day.

Anything goes, take what you like.

Take foods which will stay moist.

Some things freeze readily or lose their taste when cold.

(1) Trail lunches (continued)

Chocolate gets dry and crumbly. Oranges freeze easily. Whole wheat bread dries out rapidly. Try fruit and nut breads instead.

Peanut butter is dry stuff to swallow. Jelly and jam sandwiches aren't much good in cold weather.

Take plenty of candy and sweet stuff - it is the only part of your lunch that provides any energy that day.

Water is scarce in winter - carry fruit juice or a canteen. A thermos bottle of hot coffee, tea, soup, etc. is worth taking.

Take a lemon for addition to drinking water.

Use plenty of butter in sandwiches.

Carry gum and fruit drops.

A mixture of raisins and nuts are good for munching along the way.

A trail lunch for a second day can be taken from home but it must be made up of 'squirrel food' as sandwiches and similar fresh stuff will not keep palatable.

(2) Overnight trips

A typical overnight trip includes the following meals:

Dinner - 1st night

Breakfast - 2nd day

Trail lunch - 2nd day

Perhaps trail lunch 1st day and lunch at car 2nd evening.

Note that this schedule calls for only one major meal to be cooked in camp.

Breakfast ordinarily requires very little cooking.

A one dish dinner is recommended. Try cooking this at home and reheating in camp.

Use 'dry' foods instead of 'dehydrated'. Dehydrated fruits and vegetables will not cook in time for Saturday night meal.

Try cooking vegetables at home and reheating in camp.

Write out a menu and take it along.

Ham and bacon are usable in many ways. Try various sausages for a change.

If the distance is not too great it is possible to carry all fresh or 'wet' foods.

(3) Long trips

On trips involving two or more nights out, it is imperative to use dry and dehydrated foods. Care must be used to include some fruits and fresh food, as severe digestive troubles can develop in the course of several days if the diet is not reasonably balanced. Bread cannot be carried so recourse must be had to pan breads or to making biscuits from Bisquick, etc. Better yet-skip the breadstuffs.

d. Cooking equipment

Kettles - aluminum best, tin o.k. - get three nested

Frying pan - army or Scout type

Cup - tin, enamel or plastic - no handle or open type

Spoon - soup size

Knife - steel camp type

Fork - not essential

d. Cooking equipment (continued)

Plate - Use top of frying pan or use paper plates

Salt and pepper shakers - closeable type or old spice cans

Misc. - Paper napkins for all purposes, small piece of soap and rags for washing and drying dishes.

e. Axe

Pocket axe - rather small for cutting logs

Hatchet - about same as above but heavier

Camp axe - best all-around tool

Suggested Foods and Menus

Lunches

Oranges, apples, dates, figs, seedless grapes, bananas, raisins, dried apricots, etc.

Utah celery, raw carrots

Sandwiches (well buttered)

Rye Krisp or Oat-tak (well buttered)

Dark nut or fruit bread

Cookies, drop cakes, etc.

Fruit drops, lemon drops, etc.

Cheese

Canned juice

Tea or coffee in thermos

Water in canteen

Chewing gum

Overnight

Breakfasts

Oranges, grapefruit, bananas, canned fruit, canned juices, wheat flakes, corn flakes, bran flakes, etc.

Oatmeal (pre-cooked), Malto-meal, Dynamite, Roman meal, etc.

Bacon, ham, sausage, Spam, steaks, chops, etc.

Eggs: boiled, scrambled, fried.

Butterhorns, toasted bread or rolls, hot biscuits, etc.

Tea, Nes-cafe, chocolate, etc.

Jam, jelly, honey, etc.

Dinner

Canned or dried soups

Canned or fresh vegetables, rice

Steaks, chops, meat balls, salmon, tuna, chipped beef, wieners, sausage, chicken noodles, 'chicken legs', corned beef hash.

Bread, rolls, hot biscuit, hard breads.

Canned fruits, bananas, jello, pudding

Cookies, cake

Tea, Nes-cafe, chocolate

Main dishes to cook at home

Beef stew cooked with little liquid

Macaroni & cheese

Spaghetti

Goulash of all kinds

Tuna and noodles

Ham and noodles

Chicken and Noodles

Salmon and noodles

Hash

Misc.

Bouillon cubes make a good hot drink and add flavor to many dishes. Jello and prepared pudding can be made quickly in cold weather. Use tea balls.

Unless you like to cook, try using concentrated or 'squirrel' foods' which do not require cooking.

Dry Foods

rice	lima beans	cornmeal
spaghetti	noodles	tapioca
macaroni	potato chips	pudding powders
navy beans	hard breads	cereals

Dehydrated Foods

soups	fish
eggs	fruits
milk	potatoes
meats	mixed vegetables

f. Packs

Trepper Nelson

Will carry heavy load but not good for downhill skiing. Tends to shift and pitch. Most have bulky band. Be sure flap is big enough to cover top when packed full.

Rucksack - (Bergen type)

Best for skiing but not suited to bulky or heavy load.

Rucksack - (Wicker frame)

Not recommended. Frame warps. Does not fit as well as Bergen type. Most of them too small.

Rucksack - (frameless)

OK for skiing. Most are too small and not suited to heavy load.

Food Containers

Paper milk cartons	Old spice cans
Brchms paper cartons	Oiled silk or refrigerator bags
Coffee cans	Flour and salt sacks
Lipton tea cans	
Cloth food bags - square bottom, drawstring, waterproofed	

Methods of Packing

Make out a list beforehand. Use this to assemble food and equipment, checking off items.

When everything is assembled, put it in the pack, checking off list again.

Pack food, etc., inside nested kettles, frying pan, cup.

Cut meat to size, separate with butcher paper and wrap thoroughly.

Put extra clothing in a cloth bag.

Put parka in a separate cloth bag.

Put air mattress in cloth bag.

Put kettles in cloth or paper bag.

Put frying pan in cloth or paper bag.

Drain water off canned vegetables and repack in waterproof carton or bag

Methods of Packing (continued)

Roll sleeping bag tight as possible.

Put sleeping bag, air mattress, and extra clothing in bottom of pack.

Put crushable things on top.

Put things needed during trip - wax kit, maps, camera, etc. in outer pockets.

Put jacket or parka on top where it is accessible during stops.

Put trail lunch, cup, canteen in outside pockets or on top.

Keep cans and other hard objects away from back.

Use guard on axe. If it will not fit inside pack strap on outside. This also applies to ice axe. Carry latter spike up.

Put odds and ends of small equipment - jackknife, matches, compass, etc., in small bag and carry in outside pocket of pack or near top. This is better than in pockets of clothing, especially for girls who have no pockets anyway.

2. How to Use It

So now you are on the trail and it's getting on toward sundown or you are nearing the selected camp spot. From getting over the trail and enjoying the scenery your attention now turns to setting up camp and getting dinner. In the morning you will want to get breakfast with a minimum of delay. This is where a definite plan to be followed will save time and tempers. In a large party, join into small groups before leaving town or the cars. Decide beforehand who is to perform the various tasks and let these individuals carry the appropriate equipment. Four is about the maximum number for which commissary can be planned without cooking equipment getting cumbersome.

Now that you have arrived, what's next? The following outline should help:

- a. Selection of camp site
- b. Setting up shelter
- c. Fires
- d. Cooking
- e. Miscellaneous

a. Section of camp site.

Look for shelter from the wind. Inside a clump of trees is good.

Look overhead to see if snow bombs or branches will fall on camp. Stay out of avalanche tracks. If no trees are available get in the lee of a ridge, rock, anything. Remember-- where the wind has swept the snow away it is sure to blow again. If water is available so much the better, but it is not essential as you can melt snow.

If you didn't bring a Primus or Kindelstix, you will have to be sure of a supply of wood. Not a great deal will be needed unless a friendship fire is planned.

Some boughs for a mattress would be nice.

When everyone in the group has agreed on a site, get to work - set up tents, cut boughs, make beds and get sleeping quarters shipshape, one man to cut wood and make fire, one man to get out food and cook dinner.

b. Setting up shelter.

Before pitching the tent tramp the snow down firm and even. Put the tents for each group close together so things can be passed from one to another without going outside. Put the tents endwise to the wind.

b. Setting up shelter (continued)

If trees are not handy for supporting tent rope, lash a pair of skis together at the tips and set them in the snow 'A' fashion. Other skis driven into the snow will serve to anchor the ridge rope. For side guys drive skis or poles into snow or bury them parallel to tent 'deadman' fashion. Don't stretch the tent too taut but see that all anchors are secure.

Keep tent ventilated as thoroughly as possible at all times. Brush snow off before entering tent. Don't let snow pile up on roof.

A layer of small boughs on floor will save wear and tear. The following shelter are alternatives for a tent-

1. Igloo- an igloo or snow house requires snow of the proper consistency and a lot of time. Instead of building an entire house, excavate a hole and put a roof over it. The trick is in closing the arch.
2. Snow cave- this is easier to build than an igloo. Use the lee side of a cornice or drift. Sometimes there is enough snow piled up against a creek bank. Dig in and stamp down a floor. Hang a tarp or poncho over opening. If you use a fire inside the roof may drip.
3. Snow pit-Tough digging but feasible. Use tarp for roof - ski and poles for support.
4. Tree hole- select a good size thick branched tree whose lower branches are buried in snow so that the whole tree looks like a teepee. Dig an entrance into center of tree and cut off buried limbs next to trunk. Tramp them down until there is head room and sleeping room. Do not disturb the outer branches as they will shed falling snow. A fire inside will bring down drips.
5. Bough shelters- there are a variety of these, ranging from simple wind breaks to huts. Take your choice.
6. Snow wall- same as bough shelters.
7. Tarps, ponchos, etc.-OK for spring weather but not so good when snow is flying.

Suggestions on bed making:

All varieties of mattresses are better with a foundation of boughs. Boughs are adequate by themselves. When laying boughs start at one end of bed, lay convex side up, with butt end down and tip overlapped shingle fashion. Use small nips to smooth out rough spots. Try it out before you go to bed.

Keep snow out of boughs.

When using air ring or air pillow, place it inside bag cover under hips. Put spare and removed clothing under shoulders and ribs.

If a rucksack is available put foot of bag in it.

Don't step across anyone's bed, including your own, as you are sure to drop snow and dirt on it.

c. Fires

Two kinds of fires can be considered:

- (1) a warming fire which will keep you warm and
- (2) a cooking fire which won't.

(1) Warming fires

Open or bonfire- use a base of green or wet logs, stump, rocks, etc.; build up log cabin or teepee fashion. Dry wood

(1) Warming fires (continued)

wood in any quantity is hard to find in winter. Look for snags or dead leaning trees. Dead branches can be found in the center of clumps of trees. Don't be ashamed to carry kindling material such as waxed paper, etc. Ski wax burns well. Keep a supply of wood drying out near the fire. A lazy man's fire can be made by setting a short standing snag afire.

Reflector- a warming fire is more effective if it is built to reflect the heat in one direction, especially if toward a rock wall, bank, tarp, etc. Such fires can be built in several ways-

- Drive in supporting stakes and stack up back logs.
- Build up a lean-to of long poles laid parallel with short separator sticks inserted at right angles at the windward end. With this arrangement the long logs dry out gradually and can be pushed up.
- Two or more small fires will keep you warm on both sides- mostly from dodging smoke.

(2) Cooking fires

Canned heat (Sterno) - flame must be screened-not enough heat to do serious cooking but will boil water and heat precooked foods.

Kindelstix-OK for small quantities. Keep fire concentrated. Plan cooking to avoid delays and wasted heat.

Meta fuel - no personal knowledge.

Alcohol stove-about equal to Primus. Generally are small size. Fuel harder to carry altho not so likely to contaminate food.

Primus- only small or medium size should be considered. Can use alcohol, white gasoline, Kerosene, paraffin oil. Small type with windshield is very good. The trick in starting a Primus is to use little or no pressure. Canned heat is a good primer. When carrying it to high altitudes, open the relief valve momentarily every 4 or 5 thousand feet to prevent leaking.

Wood- the desired cooking fire is small enough to get within frying pan distance, and provided with means for holding pots. The best method is to build the fire between two parallel or slightly divergent logs. Very few of the woods in this part of the country make good coals, except high altitude varieties such as juniper. With wood which will not make good coals, the answer is to keep the fire burning slow. Round sticks do not burn well unless small size. Scatter the fire to put it out when through cooking and save the chunks for next time. The cook should regulate the fire. Keep a stick handy for use as a poker or to discourage "helpers."

- d. Cooking- Efficient camp cookery depends on observance of the following simple rules-
- 1.- Have a planned menu and stick to it.
 - 2.- Lay out all food and equipment within reach.
 - 3.- Have at hand a sufficient supply of good wood.
 - 4.- Don't let anyone else touch your fire.
 - 5.- Plan the starting times of all dishes so that they are ready and hot in the proper sequence.
 - 6.- No kibitzers.

It takes a lot of heat to melt snow so don't waste the water. Melt snow the night before so as to have water for breakfast-even if it freezes you will save time.

Food burns easily in tin kettles.

Don't do any more dishwashing than necessary. After the last meal give the dirty pots a quick once-over and take them home to wash. This is better for tin pots anyway as they will be properly dried out and so avoid rust.

Try broiling meat instead of frying.

To bake biscuits in a closed frying pan-bury it in hot ashes or coals. If the pan has no lid-cook on bottom first and then prop by fire.

Dry foods must be first soaked soft. Fruits especially should be simmered instead of boiled.

Start noodles, macaroni, spaghetti, and rice in lots of water and keep boiling.

Season fried and boiled meats just before cooking is finished. Learn the cooking times of various foods-note them on the menu. It is traditional that the cook never eats a meal- he just snacks along.

A green pole driven into the snow and propped up by a chunk of wood will serve to hold kettles or they may be straddled over two logs.

A piece of hooked wire is handy for moving hot kettles altho a notched stick is OK.

Don't set hot dishes on the snow unless you want them to cool. Use tea balls and make it in the cup.

When frying steaks, try out pieces of fat until pan is hot, sear steak quickly on both sides, then cook on moderate heat to desired stage. Season just before removing from pan.

e. Miscellaneous

Hints on sleeping warm and comfortable.

Take off your clothes, especially if damp. If you insist on wearing them to bed, at least loosen them to avoid restricting circulation.

Wool sox help to keep your feet warm but don't use those you wore during the day as they are sure to be damp. Use your spare pair and leave them on in the morning.

A wool nightcap or helmet is mighty comfy. It will keep your hair free of down and unmussed, if it matters.

Your boots make a good pillow but they should be stuffed with paper or something to prevent freezing out of shape if it is likely to be so cold.

Newspapers are almost as good as a blanket when placed inside the sleeping bag cover.

If your blood is extra thin, use an inner bag made from a light weight wool blanket.

Keep the top of the sleeping bag closed so that air will not be drawn in and out of it as you turn over. Keep drafts from blowing over your body as much heat is lost this way. (A DIET HIGH IN FAT AND SUGAR RAISES HEAT PRODUCTION)

A large wool scarf will act as a blanket when wrapped around your middle.

It is much warmer in a tent than in the open.

Heat several rocks-one for feet, one behind knees, one for stomach. Wrap in paper, sox, or clothing you have been wearing.

Fill canteen with hot water, wrap in paper or clothing and put where it will do the most good.

Double sleeping bags are at least twice as warm, providing there is sufficient room.

Unroll your sleeping bag ahead of time, shake it thoroughly to fluff up the down and let in air, pile it loosely until bed time.

Open the valve on your air mattress before arising. Your weight will expel the air and by that time you will be glad to get up.

Be sociable, snuggle up to the other fellow, you will both sleep warmer.

1. Cooking over a large fire is better in cold weather because it keeps you warmer. True or False.
2. A pair of long woolen underwear is a good thing to take on a snow camping trip in place of flannel pajamas. T. or F.
3. Because of the extra weight, it is not worthwhile to carry extra sox on a ski camping trip. True or False.
4. A snow cave or igloo is warmer than a tent. T. or F.
5. You are unable to get away before 3 P.M. Saturday, whereas the rest of the party is leaving before noon to camp in Denny Basin. Someone has talked you into including Co-op dried potatoes in your Saturday nite menu. Should you (1) make a deal with someone in the early party to carry them up to base camp and put them to soak (2) pack them in a watertight can with water so they will be soaking during your trip in to camp (3) boil them furiously for one hour after you get to camp to soften them (4) french fry in deep fat..
6. You have built a roaring big fire on ten feet of snow. Your base of green logs burns thru and the fire starts to sink into the snow. Would you
 - (1) pile on more wood to keep it above snow level
 - (2) put new base logs under it
 - (3) get into the hole with the fire and follow it down
 - (4) Build a new fire.
7. A couple of ski-teers prepare to cook a special deluxe dinner of T-bone steak, french fries and the fixins. A half hour later we find them huddled disconsolately around a hole in the snow attempting to broil steaks on the end of 6 foot poles. That hapened.
8. Suppose you had loitered too long on the trail and darkness was ~~fast~~ shortly. You have complete equipment, including tena and Primus. Assuming you had to do it alone, indicate the order in which the following tasks should be done. What camp task would you take up first; second; third; fourth; fifth; sixth.
 - (1) cut boughs for bed
 - (2) get water
 - (3) pitch tend
 - (4) make bed
 - (5) lay out food and cooking equipment
 - (6) cook dinner
9. Which camp-site is best:
 - (1) on a ridge, with a view
 - (2) lee side of a cornice
 - (3) thick timber
 - (4) deep gulch
 - (5) center of a thicket
10. If your clothes are very damp what should you do with them at nite:
 - (1) Wear to bed so they will dry out
 - (2) Dry out over Primus
 - (3) Use for mattress
 - (4) Put between sleeping bag liner and top cover.

11. Sleeping bags carry better when tied on the outside of the pack. True or False
12. You can increase warmth by pulling the cover over your head and breathing the air inside your sleeping bag. True or False.
13. Would you recommend a heavy breakfast of ham and eggs before starting out on a 5,000 foot ski climb. Yes or No
14. When you start out at 4:00 A.M. in the morning, it is better to:
 - (a) go without breakfast till you warm up and eat a cold breakfast after about an hour on the trail
 - (b) Eat a cold breakfast before getting out of your sleeping bag.
 - (c) Get up one hour earlier, cook and eat a warm breakfast.
15. For snow camping, one should dress a little more heavily than for ordinary skiing trips. True or false
16. A warming fire should not be a large fire. True or False
17. Bill Garry discovers at the end of a long cold ski climb that his fair weather lunch has frozen. Is there any way he can moisten his dried out bread?
18. You are going on an overnight skiing trip and plan to camp at 6,000 feet elevation requiring backpacking of all equipment up 2,000 feet in 6 miles. What is the best solution to the mattress problem.
 - (a) pack in a 4 lb. air mattress
 - (b) plan on using boughs, even though trees are pretty scarce at 6,000 feet.
 - (c) newspapers
 - (d) corrugated cardboard
 - (e) a minimum amount of cardboard plus a few boughs.
19. You are camping at about 3,000 feet elevation in the middle of winter. Depending on the temperature, everything will either be soaking wet or covered with ice. What is the best source of dry wood for starting a fire?
 - (a) Whittle out the inside of a down log with a knife or axe?
 - (b) Kindling carried in the pack
 - (c) Find dead branches next to the trunks of large trees which have been protected from the weather by other branches above.
 - (d) With an axe, cut the underside from a leaning tree.
 - (e) Avoid the issue and use Kindlestix carried in the pack.
20. Joe Glutz is equipped with a tarp and wants to make a snow house as a base camp for a week's stay. Mark order of preference on the following methods, campsite being at 5,000 feet elev.
 - (a) Construct a dome shaped igloo on a level site, using the tarp for a floor.
 - (b) Dig a pit in the snow, use a tarp for the roof, boughs for the floor.
 - (c) Compromise, using the snow dug out of the pit to form the walls of the igloo, use the tarp for a floor.
 - (d) Select a side hill site, dig out a flat floor, using the excavated blocks to build up side walls, use tarp for a floor, roof, and boughs for the floor.
 - (e) Dig snow cave, using tarp for floor.
 - (f) Use the tarp as a tent, and boughs for the floor.
21. For the third day of a 3-day trip, should Peter Plunger take a trail lunch of: (a) top sirloin steak, (b) dried fruit, cheese, and chocolate, (c) sandwiches, canned fruit juice and sardines.

22. Shyster Smith has miscalculated. Used to sleeping in someone else's tent, he finds this time that the tent is full. The party is at 5,000 feet elevation, and wet snow is falling heavily with a strong Southwest wind. If you were Smith, would you (a) build a lean to of boughs, (b) dig a pit in the snow, covered with boughs and floored with boughs, (c) tie your sleeping bag vertically to tree trunk, pretend you are papoose, (d) build a rock shelter wall, (e) build a snow shelter wall, (f) find a large tree whose branches under the snow form a sort of a room, enlarge it, floor it with boughs, and crawl in.
23. There are several methods of preventing a fire from sinking into the snow (a) build on stump, (b) build on flat rock, (c) dig down to ground, (d) build on floor of green boughs. Which would be the best choice under the following conditions:
- (a) at 7,500 feet, in November
 - (b) at 8,500 feet in December
24. For frying a steak over a small cook fire, which is best:
- (a) hold a frying pan in hand,
 - (b) use two parallel green stick,
 - (c) use two parallel flat rocks,
 - (d) ask someone else to fry steak on a commission basis.

ARTICLES

The equipment most necessary to meet emergencies is a cool head and presence of mind.

Other equipment will be taken up under the different classifications.

A. BODILY INJURIES

Equipment: First aid kit containing tape and more tape, compress, triangular bandage, aspirin, saline tablets, ammonia.

1. Fractures.

Not only compound or easily identified breaks, but all severe sprains and strains should be treated as fractures.

Don't: a. Try to set the fracture.
b. Move the injured member without support.
c. Let the patient get cold.

Do: a. Get patient to shelter.
b. Treat for shock: warm drink, inhale ammonia gently, place in reclining position with head slightly lower than feet.
c. Keep the patient quiet.
d. Put on splints, improvise from ski-poles, branches, etc., well braced with bandages or tape. Do not use traction splint if joint is injured.

2. Sprains, Strains.

All sprains should be treated as breaks unless the pain is not too severe and has largely disappeared within 15 or 20 minutes, and there is not undue swelling and discoloration.

Exercise mildly after pain has subsided.

3. Bandage tightly the more severe sprains, over boots if necessary with triangle bandage, roll gauze, etc.
c. Loosen bootlaces as they will not give much support and will cause pain if swelling occurs.
d. Where possible apply hot and cold compresses.

3. Dislocations.

a. Do not try to replace.
b. Bandage tightly so as to brace against movement.
c. Treat for shock.

4. Wounds.

a. Avoid infection, clean the cut, apply mild antiseptic.
b. Put on a compress.
c. If arterial bleeding, apply a tourniquet.
d. If head injury, get to Doctor as rapidly as possible.

5. Frostbite.

a. Do not apply heat or get near a fire.
b. Apply compresses, cold at first then warmer; do not rub with snow as the frozen part is very susceptible to abrasion.
c. If patient has become unconscious through cold and exhaustion, massage, slap, use ammonia, rouse to consciousness, then exercise.

6. Sunburn and sun blindness.

a. For sunburn, apply grease, etc., to keep the air away from the burned area. Some oils work on some people, not on others.

6. b. For snowblindness, cover the eyes with bandage. Avoid it by cutting down the amount of light reaching the eye through colored glasses or use of small slit in opaque eye covering.
7. Exhaustion.
 - a. Let patient rest a short time and apply stimulants such as hot drink, sugar, saline tablets, milk of magnesia tablets.
 - b. If merely tired, concentrate on rhythmical breathing.

B. AVALANCHE RESCUE

Equipment. Fifty foot red avalanche cord.

1. If caught in an avalanche.
 - a. Keep your head.
 - b. Loosen your ski bindings, get the pole straps off your hands before you cross any slope likely to avalanche.
 - c. Have avalanche cord tied on and trailing before you cross bad slopes.
 - d. Try to get out of the path by skiing or running off to the side.
 - e. When caught, kick off your skis, use a swimming motion to keep on top of the slide.
 - f. When you feel yourself stopping, beat your arms vigorously about your head to create an air space. The chief danger from avalanches is from smothering.
 - g. In the case of smaller slides, an ice axe plunged in the snow may be used as an anchor.
2. Rescue procedure.
 - a. If you are the witness of the accident, endeavour to mark two places carefully in your mind, the point where the victim was standing when hit and the point in the moving snow where he disappeared.
 - b. If you have been able to do this, the victim will be somewhere in line with and below these two points. Select a snow block on the surface of the avalanche where the victim was last seen, watch this till it stops then mark it.
 - c. Since a body is heavier than snow and an object buried in a moving mass of snow will travel slower than an object on the surface, the victim will often be found about two thirds of the distance between this point and the point where he was last seen.
 - d. Make a search for the individual's equipment, avalanche cord, etc. A boot protruding from the snow is often a good sign there is someone near.
 - e. Line the party up across the slope and begin systematically probing in the snow. Stagger the probes, being sure to probe every four feet. Begin at the bottom and work up.
 - f. Don't give up. It is possible for a person to live for days though buried. If a small party, after a preliminary search, send for help.
 - g. Keep the party silent during the search so as to hear signals from the leader and possible cries from the victim.
 - h. If unconscious when found, give artificial respiration. Treat for frostbite and shock.

C. LOST

Equipment: Map, compass, flashlight, extra clothing, matches, knife, pencil and paper.

Important point: Keep a constant check on your route so that the instant you are lost you know it. The dangers of being lost for an hour or so without knowing it are obvious.

- Do:
- a. Endeavor to locate yourself by map and compass. The compass is always right regardless of how unreasonable it seems.
 - b. Try to retrace your steps by means of ski tracks, memory.
 - c. Mark your course by bits of paper, notes, blazes, stones, etc.
 - d. Try to remember last shelter point, cabin trees or rocks.
 - e. Conserve your food.
 - f. KEEP YOUR HEAD -- CONSERVE YOUR VITALITY.
It is far more important that you keep yourself in condition to face any hardships that may come than that you find your way back immediately.
 - g. Give emergency signals by flashlight or shouting (groups of three is universal call for help.)
- Don't: a. Dash off madly in all directions.

D. RESCUE PARTIES.

Equipment: Toboggans, stretchers, first aid equipment, food, tent, blankets, stimulants, dry clothing, lanterns, candles.

1. Establish a centrally located headquarters where searchers may make preparations, report, find rest, food and shelter. The central headquarters should have good communications with the city, but smaller sub-headquarters farther up on the mountain may be established.
2. If it seems advisable to form a large party, immediately notify the District Ranger and telephone party leaders;
 - a. Names and details of emergency.
 - b. Location of headquarters.
 - c. Equipment necessary.
 - d. Number of persons needed--provide for cooks, etc.
 - e. Number of persons at present on hand.
3. Ascertain the route of the lost party, the time they left and who last saw them.
4. Map out an area in which the lost party most likely will be.
5. Search.
 - a. Proceed to the point where last seen and search possible routes.
 - b. Search for traces of their route.
 - c. Survey the area from an elevation and arrange signals.
 - d. Examine valley floors and passes.
 - e. Check recent avalanches for traces.
 - f. Mark your own route in case you yourself get lost and on the chance the lost party may cross it. Ski tracks may serve for this.

E. BIVOUACS

Bivouacs are forced emergency camps without overnight equipment.

Equipment: Extra clothing, matches, candle, knife, flashlight.

KEEP WARM:

- a. A windbreak is the important thing.
 - b. In intense cold do not allow yourself to go to sleep. Keep exercising, slap yourself. Biff! Wack! in bivouacs.
 - c. Try to make for the shelter of timber.
1. Bivouacs in timber.
 - a. Look for natural shelters to get out of the wind. Natural depressions are often found in the snow around trees. Build walls around clumps of trees with boughs.

- b. Make a shelter. Dig a pit in the snow in some favourable place such as the side of a steep snow slope. Make roof or sides out of boughs or skis and tarp. Make a floor of boughs to keep feet dry and warm.
 - c. Build a fire. Place it on some sort of foundation so that it will not sink out of sight in the snow, such as stump, log, rock, etc. The center of rotten Douglas Fir stumps have a core of hard pitch which makes excellent tinder in any weather.
2. Bivouacs on ice.
- Equipment: There should be at least one unit of protection to each party traveling on a glacier, such as tent, tarp, or Zeltsack.
- a. Look for natural shelter; seracs, shallow crevasses, bergschrunds, ice caves. Roof with tarp and skis.
 - b. Make a shelter. If soft snow, dig pit and roof over with skis and tarp.
 - c. Loosen all articles of clothing that bind: shoes, belts, collars. If you have to remain still, remove shoes and put feet in rucksack.

F. BROKEN EQUIPMENT AND USE OF EQUIPMENT IN RESCUE.

Equipment: Spare tip (one to six people) repair kit (screw driver, pliers, soft wire), soft brass for ski splints, spare straps, avalanche cord.

1. Broken articles.
 - a. Skis usually break near the tip. Can be repaired by use of spare tip or by splicing broken pieces, using tape, soft wire or straps.
 - b. Broken poles can be spliced if necessary.
 - c. Broken bindings can be repaired with wire, pliers, laces, etc., plus a little ingenuity.
 - d. Broken glasses. A spare pair should be carried. Can be improvised with cardboard or tape.
2. Use of equipment in emergency.
 - a. Mark all your equipment with your name. In any case any of it is used in emergencies, this will insure its return.
 - b. Four skis can be used to make a toboggan or an Indian Travois. Two skis and four poles can be used to make a sled. Skis should have a small hole drilled in the tip (size of avalanche cord) to make it easier to bind them together.
 - c. Climbers, tape, etc. can be used to bind patient to toboggan. It is especially important that this be done and that toboggan or sled be built rigidly, when patient suffers from fracture.
 - d. Stretchers may be made with skis by thrusting them thru arms of a buttoned up coat or jacket.
 - e. Patient should be carried head first down slope in most cases as this is part of treatment for shock. Avalanche cords should be used to control toboggan or sled.
 - f. Element of time is important. Do not make improvised toboggan if you have time to obtain more efficient help, or if patient can be carried to shelter by other means.
 - g. Bamboo poles are more useful in emergencies than steel.

CHECK LIST - SKI-MOUNTAINEERING EQUIPMENT

For One Day Trip

Skis with edges (cable bindings)	Lunch
Ski poles (no sharp points, fairly long)	Toilet tissue
Ankle straps	Wool ski clothes
Packsack	Good quality boots
Climbers or waxing kit	Avalanche cord (50')
Parka or jacket	Jackknife
Extra sweater or wool shirt	Junk bag containing:
One pair leather mitts	matches dipped in parafin
One pair wool mitts	Copper wire
Ski cap with ear flaps	Candle
Complete change of clothes to leave in the car	Parafin
Sun glasses	Spare ski tip (one for 6 people)
Sunburn dope	first aid kit
Watch	Miscellaneous leather straps for repairs
Compass	lots of adhesive tape
Maps	Flashlight
Altimeter (optional)	Zeltsack (optional, one for 6 people)
Cup	

Additional Equipment for Overnight Camping

Sleeping bag	Large Bergen type pack
Mattress	Food
Tent or tarpaulin	Cooking equipment (optional)
Axe (optional)	Cup
Kindlestix or oiled paper	Spoon
Primus stove (optional, depends on trip)	Knife
Matches	Fork
Toilet tissue	Plate

Additional Equipment for Glacier Skiing

Climbing rope (7/16" manila, new each season, 100' for each two skiers)
Ice axe
2 rope slings (1/4" manila, 6 feet long)
Crampons (optional, depends on trip)
Ice pitons and carabiners (optional, for rescue work)

NOTE: For climbing on rocks or ice, some additional equipment needed.
Refer to Climbers' Course.

QUESTIONS

1. Aunt Fanny Sitzmarked swooped gaily down the hill. "Look" she cried, "ain't I graceful?" When she landed, she was very uncomfortable, one ski tip being wrapped around her neck and her ankle feeling like a truck had just run over it. Would you first:
 - a. Lift her into a comfortable position.
 - b. Examine possible injuries.
 - c. Remove her skis.

2. One man in a well-equipped party of ten has a broken leg on a hillside at 2 P.M. There is a dry lean-to nearby and the road and cars are five miles away, both being at the same elevation. Would you take patient to the hut or the cars? Write a brief answer on the back of this sheet giving reasons for your decision.

3. One bright afternoon you are up on the Emmons Glacier and lose your sun glasses. You have forgotten your extra pair. Suggest two substitutes. Write answer on back of sheet.

4. The following are indications that a sprain or strain is present rather than a break:
 - a. Swelling True or False
 - b. Pain subsides quickly. True or False
 - c. Discoloration. True or False
 - d. Ability to use member. True or False

5. When picking a spot to bivouac, one should camp:
 - a. On a ridge so as to see rescue parties.
 - b. In the timber near a stream.
 - c. In a pass.
 - d. On a trail.
 - e. In a tree, away from bears, mice, etc.

6. To warm your feet:
 - a. Tighten your shoelaces and stamp your feet. True or False
 - b. Remove your shoes and put feet in rucksack. True or False
 - c. Remove shoes and toast feet by fire. True or False

7. In a bivouac you are cold and tired, should you:
 - a. Try to go to sleep True or False
 - b. Remove shoes and put feet in rucksack. True or False
 - c. Sit closer to the fire. True or False

8. To make a fire quickly, the best kindling is (Number in order of choice)
 - a. Dead boughs with dry needles still in place.
 - b. Squaw wood-dead limbs still on trees.
 - c. Pitch wood from fir stumps.
 - d. Kyndlostyx.

9. Persons caught in an avalanche will usually be found--
 - a. Above the place where they were caught.
 - b. The same place in the avalanche where they disappeared.
 - c. Somewhere between the point they were hit and the end of the avalanche.
 - d. At the point they were hit.

10. Would you rather be caught in an avalanche of:
 - a. Powder snow
 - b. New wet snow
 - c. Wet spring snow.

11. On a proposed 8 to 10 hour trip with six people, indicate the articles one does not need to take:

light tent or tarp	flashlight
spare ski tip	primus stove
sleeping bag	pink of Whisky or Brandy
extra sweater or wool shirt	First Aid Kit with plenty of tape
pocket knife	camp axe

12. When crossing a steep slope you see a small slide starting above you. Should you:

- Point the skis downhill and schuss
- Take off your pack and look for your avalanche cord
- Pay no attention, it might stop
- Leave pole strap on hand for bracing and balancing
- Detach skis from feet
- Judge its course and head out to the edge.

13. You are talking to a man who was caught with a fellow skier in an avalanche. Oscar tried to beat the avalanche to the bottom and when caught rolled himself up in a ball so as to protect his head from chance rocks. Hans had removed his skis, poles and pack before being hit and then tried to swim in the snow. What is the name of the man you are talking to?

14. Three persons are returning home from a ski ascent in moderately difficult country. They are three hours from home at elevation of 7000 feet at 3 P.M. when "A" severely sprains his ankle. Party is only fairly well equipped having one extra sweater apiece, matches, cord and first aid kit, but no tarp, zeltsack, extra food or flashlight. Timberline is at 5500 feet. How will "B" and "C" proceed? Write answer briefly on back of this sheet.

15. The cable of your binding breaks! POP SNAP! You have no pliers nor wire, extra straps nor cords. What is best solution?

- a. Use one of your shoestrings, half of other on each boot.
- b. Strap your belt around the toe-irons and boot-heel.
- c. Use the drawstring from your packsack.

16. You emerge from a brief high-velocity exploration trip under the snow to find that your right ski is broken clean in two, under the binding. With two miles to go in 18 inches of soft snow, would you:

- a. Throw the good ski away and walk home
- b. Ski home on one ski.
- c. Tie a branch on one foot and ski on the other.
- d. Put a climber on the good ski and tie the front end of the busted ski onto your foot about midway.

17. You notice your partner's nose and ears appear dead white. Should you:

- a. Tell him True or False
- b. Help him rub white portions with snow. True or False
- c. Have him warm exposed parts by placing hands on them. True or False
- d. Borrow some of his Clown White. True or False
- e. Cover frosted parts with scarf or cap ear slaps. True or False.

18. You fall in soft snow and break your safety strap and binding, losing one ski 500 feet downhill; should you:

- a. Remove other ski and flounder down to recover lost ski, delaying whole party 30 minutes. True or False.
- b. Call for bids on salvage job. True or False.
- c. Ask for help from more experienced skier, leaving main party to advance slowly and having lunch ready when helper returns. True or False.

19. Danny the "Diver" comes to the end of one of his famous windmill turns with both steel ski poles neatly bent double. When he straightens them out they break. Should he get himself home by using a deep crouch with the lower halves of the poles or can you suggest two other methods of repair. Use back of this sheet.

20. The leader is some distance ahead, the rear guard some distance behind and the party is following home on its morning track. The middle section unintentionally takes a branching ski track and does not realize it is lost till nearly dark. Consultation with a map shows a possible trail out that may take 3 hours. To follow back on the party's tracks will take 4 hours. Which is best? Why? Answer on back of this sheet.

21. You get lost. It is snowing wetly. You find dry wood but discover your matches to be soaking wet and you left your parafin dipped matches home. How are you going to keep warmest?

- a. Keep walking all night.
- b. Dig a hole into a snowbank, line it with branches, crawl in.
- c. Huddle together with other members of party. Shivering will create friction, hence warmth.
- d. Have you any better ideas.

GLACIER SKIING

REASONS FOR GLACIER SKIING

Glaciers present opportunities for skiing later in the season than would otherwise be the case.

Glaciers must sometimes be crossed en route to the desired terminus.

Frequently glaciers present best approaches to the summits of peaks.

Glacier skiing highly enjoyable to some, requiring more varied, skillful skiing, and avoidance of obstacles.

A ski-mountaineer should be able to safely ski on glaciers in case of an emergency.

CHARACTERISTICS OF GLACIERS

Glacier is formed of ice in various stages of transformation from snow to ice. Glaciers form at high elevations from large snowfall and low temperatures, slowly move downward by the pressure of their weight and melt away at lower end. At about 8,000 feet in early spring, cross section of glacier from top to bottom shows: new snow, old snow, solid neve' from previous year, grainy ice, solid ice. Higher up there will be relatively more snow and neve'; lower down there will be relatively more ice.

Downward movement of ice over and around irregularities in its bed causes crevasses: cracks don't usually form in ice fields where there is no movement. The junction of 2 glaciers is generally well-crevassed.

Types and Locations of Typical Crevasses:

1. Bergschrund forms at the top of glacier where moving ice pulls away from ice and snow attached to the rock walls of the glacier cirque: usually large and deep.
2. Marginal crevasses are formed at edge of glacier because ice in center moves faster than ice on sides. Normally these are not large and run diagonally upstream from edge of glacier. Crevasses form at right angles to glacier movement.
3. Longitudinal crevasses run up and down glacier; usually found on top of longitudinal ridges in the glacier; infrequent occurrence.
4. Transverse crevasses run crossways of glacier; usually found on top of humps or ridges of glacier; frequent occurrence and sometimes very large; probably the most dangerous type.
5. Seracs are ice pinnacles formed by intersection of lateral and longitudinal crevasses. Usually found in ice falls.
6. When glacier passes over a steep drop in its bed, an ice fall is formed with all types of crevasses.
7. When glacier goes around a curve in its bed, numerous crevasses of many kinds may be expected.
8. Ice wells and ice caves sometimes found at lower terminus, caused by melting.

Remember that the glacier doesn't know that there are any rules about crevasses and will crack wherever a mechanical stretching action occurs. Safest rule: expect any kind of a crevasse anywhere; use close observation to select your path. Crevasses are bridged with snow during the winter, because of wind action forming cornices on the crevasse edges. Bridge is weak at first when snow is powder, stronger after it becomes thicker, and stronger still after much thawing and freezing in the spring have converted the powder snow to crust, then progressively weaker toward the summer as it becomes thinner and finally collapses from thawing. Slope of a glacier may be as much as 45 degrees above the bergschrund, and over ice falls: may be as flat as 1 degree. Skiing not practical when slopes exceed 35 degrees.

moraines are accumulations of rock debris on the edges (lateral moraines) and terminal moraine) and possibly the center of the glacier (medial moraine). Crevasses are nearly as frequent on medial moraines as on glacier. Lateral moraines are safer.

SOURCES OF DANGER TO SKIERS ON A GLACIER

Fall into a concealed crevasse (relatively frequent occurrence).
Fall into a crevasse whose presence is known by reason of the collapse of weak snow bridge (relatively rare occurrence).
Fall into crevasse because of snow collapsing when skier stands too close to edge (rare).
Uncontrolled slide down steep slope into crevasse.
Caught in avalanche from steep slopes above, or one started by yourself.
Caught by fall of serac (very rare).
Caught by bad weather - get lost and freeze.

FREQUENCY OF FATAL ACCIDENTS TO GLACIER SKIERS

Arnold Lunn states the following figures for twenty-five years of Glacier Skiing in the Alps:
Total killed by falls in crevasses - 9; on the ascent, unroped - 4; on the ascent, roped - 2; on the descent, unroped - 2; cause unstated - 1.
Apparent that had rope been properly used, crevasse accidents would have been limited to 3 at the most, out of probably several thousand glacier skiers.

METHODS OF AVOIDING DANGERS ON A GLACIER

Avalanches must be avoided by means discussed elsewhere.
Fall of seracs is uncertain and infrequent; beware in hot weather, and watch for poor foundations, or tottery condition.
Concealed crevasses can frequently be recognized by slight depressions of the snow over the crevasse, by slight discolorations, or inferred extensions of visible crevasses under the snow. Test for concealed crevasses by plunging with ice axe or reversed ski pole; detour around them, unless you are anxious to make the "falling body" test for the strength of snow bridges.
Falls into crevasses, visible or concealed must be limited to short, harmless drops by proper use of rope.
Uncontrolled slides down steep slopes can be limited by use of rope and belay from partner, ice axe or ski-tail anchors, and arrest of slide by use of ice axe pick.
Never bunch the party.
Never allow more than one on a snow bridge at a time.
Don't attempt to ski on ice - use crampons.
If weather turns foggy take compass bearings and mark route.
Turn back if weather gets worse. Avoid being caught on glacier in storm.

HOW TO TIE ON THE ROPE

Use 7/16" or 1/2" Manila Climbing Rope.
For downhill skiing, skiers spaced 60'--100' apart. Only two on rope.
For uphill skiing, skiers spaced 40'--100' apart.
Tie single loop around waist with bowline, or double loop around waist with Bowline-on-bight. One loop over shoulder not recommended. Waist loop as loose as possible, but must not slip over hips or shoulders.

Tie half hitch or two for safety in front of the bowline.
Using Prusik knots, tie two rope slings to the rope in front of waist loop knot for use in crevasse rescue, anchors, and belays. Pass the loose ends of slings down through your waist loop, tie loosely around waist or stick them through belt, or in pocket. Keep one sling in hip pocket(extra).

FUNDAMENTALS OF ROPED GLACIER SKIING

Always keep the slack out of the rope in order:

1. To limit possible falls to 3 or 4 feet.
2. To prevent "Falling Body" from gaining speed, causing severe jerk on rope which may break rope or the victim's ribs.
3. To aid in preventing rope entanglement with ski tips.

Do not carry a coil of the climbing rope in your hand.

Party must travel so that there is no danger that two members may fall in same crevasse. This means that rope should be at right angles to line of crevasses.

Do not use an old, worn rope.

Always expect a break through--then you won't be surprised.

Remember, when you put on the rope, it's for safety. Don't nullify the safety angle by skiing at high speed.

Go slow--if the leader on your rope falls in, you will have a better chance to stop the rope.

Always ski in control.

ROPED SKIING -- UPHILL -- EASY TERRAIN

Walk uphill as in ordinary skiing, all following leader's pace.

Only difficulty comes on turns. Skiers following in same track will cause slack in rope after the first man kick turns and starts new traverse. To prevent this, all skiers stop together at same time, and kick turn in order, top man first, then each starts out on new track. In certain cases this is impossible and special attention must be given to avoid slack in rope.

Two on rope is easiest, and safe enough in easy terrain.

ROPED SKIING -- DOWNHILL -- EASY TERRAIN

Two on the rope is the most practical, three on rope is safer.

Man in front should be the poorest skier of the party, last man the best.

The last man on the rope is the leader, and gives orders when to turn, stop, slow down, etc.

The party proceeds slowly, under complete control, all turning at once, where possible. If skiers do not turn at same time, slack will form in rope with resultant jerking.

Some jerking on the rope is inevitable, and frequently leads to bad tempers--be careful of yours.

After a jerk, the first man should speed up a trifle, last man slow down a trifle, otherwise slack will form in the rope again, leading to another jerk. The rope may parallel to the fall line, be horizontal or diagonal, depending on the lay of the crevasses.

First man skis normally, pole in each hand, follows leader's instructions as to pace, route, etc.

Second and last man put both poles in one hand, use the other to flip rope away from ski tips.

Party moves much more slowly than on practice hill of same slope--for safety's sake.

ROPE SKIING ON DANGEROUS TERRAIN -- BOTH UPHILL AND DOWNHILL

Should be three on rope for safety, or better yet, 2 ropes of 2 staying close together.

All skiers ski with ice axe in one hand, one or both ski poles in the other. Some prefer to put ski poles in pack, use axe only.

Only one man moves at a time, slowly and steadily, ready at all times to arrest a slip with his ice axe. First man across a slope should make a good track.

Other members on rope anchor themselves, one or two giving a belay to the moving man.

Several types of anchors and belays, as follows:

1. Fasten slings or rope loop to ice axe, thrust axe in snow up to head, give should/belay to moving partner.
2. Sit on slope, thrust tails of skis in snow up to foot, give hip belay to partner. Rope to partner passes between skis.
3. Sit astride lower lip of crevasse or ice ridge, give hip belay to partner.
4. Belay rope around serac or ice pinnacle.
5. Belay rope around ice axe thrust in snow, with knee helping keep axe down. Not recommended if snow is powdery or soft.

When giving a belay, brace yourself against the direction from which the strain will come.

Don't rely on ice axe anchor or ski tail anchor unless snow is firm.

If there are only "x" feet between the belay and the danger spot, the moving skier must not advance more than "x" feet from his belay, then anchor and bring his partner forward.

SPECIAL PROBLEMS IN ROPE SKIING

1. Going downhill cross narrow bridge thus: No. 1 anchors and gives a strong belay to No. 2, who approaches in line of bridge with strong stem; when he gets to bridge, pulls skis together, runs bridge straight without braking, makes controlled fall or quick stop turn on lower side. On gentle slopes no belay needed, both skiers keeping on the move. Once across, best belay No. 1 can give to No. 2 is to proceed downslope, keeping slack out of rope, while No. 2 runs bridge. Going uphill cross bridge thus: No. 1 crosses bridge with sidestep or herringbone, being careful not to stamp skis hard for fear of breaking bridge, while No. 2 remains on lower side, giving strong belay. Once across No. 1 anchors, gives belay while No. 2 crosses, or proceeds slowly upslope if terrain easy, keeping taut rope on No. 2.
2. Narrow bridge over one crevasse with open crevasse just downslope and parallel the first. Going downhill proceed as in (1), except that No. 1 stops at lower end of bridge (across crevasse), anchors and belays partner across. Going uphill, proceed exactly as in (1).
3. Zig-zag path through interfingering ends of crevasses--going downhill danger lies in fact that skiers can't turn together. Resultant slacking and jerking of rope if rope handled badly may jerk skiers into crevasse. Party reduces speed, gives careful attention to rope so that under no conditions will the rope tend to pull No. 2 into one of the crevasses. Last man should travel as close to the lower lips of crevasses as possible. If conditions are bad enough, skiers move one at a time with belays. Going uphill, skiers carefully keep slack out of rope, using anchors and belays when necessary.

STRENGTH OF SNOW BRIDGES

Strength depends on condition of the snow rather than thickness of bridge. Skiers have been known to break down 14-foot thick bridge of powder snow, whereas a one-foot thick bridge of hard frozen crust may be enough. Condition of snow and thickness of bridge being equal, a bridge over a 10 foot wide crevasse is only approximately one-fourth as strong as one over a 5 foot crevasse.

A man on skis is much safer on a weak bridge than a man on foot, since his weight is spread over a greater area.

Bridges become stronger as powder snow turns into crust under the action of freezing and thawing, hence bridges are strongest in April and May.

Bridges are strongest when frozen, thus early morning and late evening, and cold weather --weakest when thawing badly, thus in afternoon or in warm weather.

Bridges weakest in Oct., Nov., Dec., Jan., when constructed of powder snow and thin.

Bridges also weak in Summer, when melting has reduced the thickness of the bridges and when thawing is heavy and prolonged.

CREVASSE RESCUE

Danger comes when the lowest man on the rope falls in--he may pull his partner in after him. When the highest man falls in he can't pull partner uphill.

When lowest man falls in, topmost man must immediately fall, with skis below and athwart the line of the rope, and dig in with hands, skis and poles or ice axe to stop slide.

Victim about to fall in crevasse should emit a heartfelt yell to his partners to "hold".

When rope stops, top man anchors with ski-tails or ice axe tied to slings. If alone, he can, by alternate use of rope and slings, untie the rope from himself, tie it to the anchor, and go to the aid of the victim with the slings.

Victim in crevasse releases ski from foot--safety straps prevent loss of ski--puts sling under foot, slides prusik knot up rope, takes weight off waist--does same thing with other sling, gradually walking himself up out of the crevasse by alternate movement of the slings. Use pocket sling to support shoulders.

Alternate method of rescue is the modified Bilgeri system, one foot in sling, the other in loop of rope dropped from above; by alternately lifting feet, so partners above can pull in slack on one rope at a time, victim walks out of crevasse. Best method of rescue if two or more rescuers. If victim is unconscious and unable to help, some other member of party must descend into crevasse on rope and lift the victim out by using a modification of the Bilgeri system. Use of this rescue method required because impossible for even several strong men to pull one man out of crevasse because of friction.

USE OF ICE AXE IN GLACIER SKIING

To arrest slide roll over face down with ice axe underneath, one hand around head, the other on handle, pick just below shoulder. Press pick gradually down into snow, hold until slide arrested.

Always use guard over head of ice axe when skiing.

When thrust into snow for an anchor, axe handle should be vertical, not normal to the slope, or it may pull out.

Keep handle soaked in linseed oil to withstand moisture.

Carry axe tied on to outside of pack, where easy of access.

WHEN TO PUT ON THE ROPE

Always use the rope when on a glacier, unless it is absolutely certain that no crevasses exist. Some recommend taking chances on unroped skiing in order to get more fun. Chances of breaking through in April and May are slim, but only an expert who knows what he is doing should accept even a small risk.

REQUIRED PREPARATION FOR GLACIER SKIING

Ability to do stems, stem christies, and kick turns on steep slopes without falling, also steep traverses.

At least one day's practice on roped skiing on the practice hill.

Practice on crevasse rescue, belays, roping.

Knowledge of glacier structure.

Knowledge of snowcraft, avalanches, weather, and route finding.

Elementary knowledge of first aid.

ADDITIONAL EQUIPMENT REQUIRED FOR GLACIER SKIING

Climbing rope, 7/16" or 1/2" manila, new each season, 100 feet to each two skiers.

Steel edges on skis.

Safety straps on ski bindings--to prevent loss if binding comes loose.

Ice axe, 7" pick, spike separate from ferrule, hickory handle, wrist strap and glide ring, guard for pick.

Three rope slings, 1/4" manila, 6 feet long, spliced connection.

Crampons, optional, depends on trip.

Ice Pitons and Carabiners (optional, for rescue work).

Compass and map-- wands optional.

ROUTE FINDING ON GLACIER

Travel at right angles to crevasses whenever possible.

Avoid humps in glacier, crevasses are usually thicker there.

Follow hollows and valleys, crevasses less frequent and smaller.

When traversing travel near lower lips of visible crevasses.

Follow uphill tracks when coming down.

Make through reconnaissance of glacier from high point before starting trip to pick best route and to avoid cul de sacs because of intersecting crevasses.

In fog leave wands to mark back track.

Airange route to get best snow:

1. In spring, best skiing produced by cold clear night which freezes crust. Snow best for skiing just as crust begins to melt in morning and just before it freezes in late evening. Apt to be mushy and soft in afternoon. Firm crust sometimes found on North slopes early in morning in April, May, and June.

2. Cloudy night apt to be warm, prevents freezing of crust, apt to be poor skiing next day.
3. In Pacific Northwest, spring rain frequently falls from low clouds with ceiling about 8,000 feet. Above this level snow may be very good.
4. In winter, quality depends on the weather, and not on the time of day.

When Party consists of several "ropes", all should remain together, strongest rope as rear guard.

In heavy fog, storm or darkness, all "ropes" should be tied together to prevent separation and for added safety.

Observation, judgement, and timing are important in glacier skiing just as they are in climbing. A good ski-mountaineer will pay attention to these points as well as his technique to get the most enjoyment out of glacier skiing and reduce the dangers present in the mountains.

GLACIER SKIING QUESTIONS

1. Glacier flows from west to east. How should party ski on rope, descending glacier, when crevasses are longitudinal? Transverse? How in relation to marginal crevasses if skiing from edge downhill toward center?
2. What would be the minimum safe and efficient number for a ski ascent of a major peak in Washington?
3. A good skier and a good climber (poor skier) are together on rope. Who should lead on ascent? Descent?
4. On a steep, icy, slope, what is best method of crossing for a party of three?
5. The heavier of 2 equal skiers should lead on the descent of a dangerous glacier. T or F.
6. Outline rescue procedure when a skier falls into deep crevasse and is helplessly injured. 3 rescuers.
7. What type of belay and anchor would you use for your friend who is crossing a snow bridge when: 1. snow is very soft; 2. fairly firm. 3. very icy.
8. Which of the following bridges would you cross on a ten foot crevasse? Rank them in order of safety.
 1. 5 foot thick frozen spring snow.
 2. 10 " " powder snow.
 3. 8 " " wet, thawing spring snow.
 4. 2 " " frozen spring snow.
 5. 3 feet of loose, wet snow atop narrow ice bridge.
9. When sliding toward a crevasse, uncontrolled, you should swing ice axe like hatchet into snow with both hands on handle to stop. T or F.
10. You fall into crevasse 15 feet. Only 1 person above. How would you escape? What should your friend do?
11. A party of three are climbing steep slope. A large crevasse must be crossed on a bridge and then a traverse to left 20 feet be made before continuing up. Outline sequence of movements, belays and anchors. Snow is quite firm. How far should each person go at a time?
12. Draw a map on back of sheet. Draw and locate:
 1. Bergschrund, medial, terminal, lateral moraines; ice well; transverse crevasses; longitudinal crevasses; marginal crevasses; ice fall; seracs.
13. Give 5 reasons why June is better than December for glacier skiing.
14. It's been a cold night in May - the weather promises to be fine. When will the best downhill running be?
What time of the day will snow bridges be safest? weakest?
When will the best skiing above 9000 feet be?
15. You have just crossed a snow bridge and are giving a belay to your partner as he crosses. While on the bridge he slips and plunges into the crevasse. Should you:
 - (a) Hold your belay very tight, and stop the rope with a jerk when slack taken up?
 - (b) Let the rope slip a little as the slack takes up so as to stop slide gradually.
 - (c) Cut the rope with a knife.
 - (d) Jump in yourself, figuring you have no chance to save him anyway, and that the jerk will pull you in too.
16. Would you cross above or below 2 transverse crevasses while traversing an avalanche slope?

17. A roped skiing party of four are suddenly enveloped in a blizzard while descending a glacier. The uphill tracks are lost and the visibility 30 feet or less. Outline your procedure for getting party to safety on back of sheet. How could this have been avoided and safeguarded before the blizzard came?
18. It is unnecessary to rope, crossing snow bridges on a descent following your uphill tracks for they were already tested on the ascent. T or F.
19. While high on the Kautz glacier on a ski ascent of Rainier, you notice heavy storm clouds to the southwest, that are rolling in. Should you;
 - (a) Signal for help.
 - (b) Ski rapidly down, abandoning the rope in favor of greater speed to arrive in safety before the storm arrives.
 - (c) Bivouac where you are and enjoy the view.
 - (d) Keep going toward summit, hoping to get there soon and return before the storm comes.
 - (e) Observe terrain, crevasses, landmarks, and route carefully and then descend.
 - (f) Take compass bearings on route and point of exit.
20. When leaving skis to complete an ascent on foot, you should:
 - (a) Leave them lying in snow so wax won't melt.
 - (b) Bury or hide them behind a rock so others can't molest them.
 - (c) Stand them on end.
21. The ice axe should be carried in the hand while glacier skiing when: (Mark those true)
 - (a) Skiing down a long, open slope with a few crevasses.
 - (b) Testing for crevasses on descent.
 - (c) When climbing through an icefall.
 - (d) When descending a steep, icy slope, no crevasses.
 - (e) When descending a steep slope above a large crevasse.
 - (f) Crossing a snow bridge.
22. There are two skiers descending a glacier with very few crevasses. They should unrope to secure greater speed and more fun. T or F.
23. An east slope will offer a better descent than a west slope at seven P.M. in May on a day which has been relatively hot, the weather having been clear for five days. T or F.
24. You are first on a rope of 2 descending. Your partner jerks a bit on rope, slightly. You should:
 - (a) Speed up. (b) Fall down. (c) Slow up. (d) Execute a quick stop turn.
25. Why is slack kept out of the rope?
26. What are the advantages of tying prusik knot slings directly on the rope ahead of time? How many slings should each skier have?
27. Outline briefly the steps you would go through after falling into a crevasse in escaping by the prusik knot system.