INTRODUCTORY

AVALANCHE

AWARENESS

INTRODUCTORY AVALANCHE AWARENESS

The printing of this course material resulted from a concensus of opinions formed at the Avalanche Instructors Seminar at Lake Louise on November 13th and 14th,, 1982.

The original material was a marriage of two courses available through BCIT and the Canadian Ski Patrol System.

We are indepted to ~~Clair Israelson~~ Chris Stethem for compiling the document as it currently exists.

The seminar was sponsored by:

Alberta Mountain Council

CAA Canadian Avalanche Association

Credits are acknowledged to:

The Alpine Club of Canada

Association of Canadian Mountain Guides

BCIT British Columbia Institute of Technology (Industry Services Department)

Canadian Ski Patrol System

March, 1985

INTRODUCTORY AVALANCHE AWARENESS COURSE

Canadian Avalanche Association
Education Committee

INTRODUCTORY AVALANCHE AWARENESS COURSE

COURSE OBJECTIVES

At the end of the course students should be able to:

1. Identify the basic hazardous situations.
2. State the methods of enhancing personal and group safety in avalanche terrain.
3. Perform effectively in a search and rescue situation in the backcountry and assist in an organized rescue.

TRAINING TECHNIQUE

A two part course:

1. A minimum of seven hours classroom training, one day or three to four nights duration.
2. A one day field session during which the key points of classroom discussion are illustrated.

KEY NOTE: Instructors are urged not to get lost in technical detail. RECOGNITION and AVOIDANCE of the hazard is the key message.

EXAMPLE OF TIME ALLOTMENT FOR A CLASSROOM DAY OF SEVEN HOURS

1.	INTRODUCTION	1/2 HOUR
2.	INTRODUCTION TO AVALANCHES	1/2 HOUR
3.	AVALANCHE TERRAIN	1 HOUR
4.	FORMATION OF AVALANCHES	1 HOUR
5.	RECOGNITION OF HAZARD	1 HOUR
6.	SAFETY MEASURES IN AVALANCHE TERRAIN	1 1/2 HOURS
7.	SEARCH AND RESCUE	1 1/2 HOURS

CLASSROOM DAY OUTLINE

1.0 INTRODUCTION

A. Describe course objectives emphasizing recognition and avoidance.

B. Outline descriptive avalanche accidents, discuss with group.

C. Bring out student experiences; participation.

1.1 INTRODUCTION TO AVALANCHES

OBJECTIVES

At the end of this lesson the participant should be able to:

1. Describe the avalanche phenomena
2. Describe potential avalanche forces
3. List local resource agencies.

1.2 Phenomena

a) avalanche types - slabs (new snow and deep slabs)
- loose
- powder

b) motion - potential speeds
- types of motion (flowing, turbulent)

c) moisture - dry
- wet

1.3 Forces

a) hazard to people - emphasize
b) destructive power - vegetation, structures
c) interruption of transportation routes.

1.4 Resource Agencies (List local)

a) parks
b) highways
c) ski areas
d) hazard report phone numbers
e) search and rescue
f) police
g) transport - ground and air

2.0 AVALANCHE TERRAIN

OBJECTIVES

At the end of this lesson the participant should be able to:

1. State the effects of slope incline and slope aspect (wind, sun) on the formation of avalanches.
2. State the effects of terrain configuration and anchorage on the formation of avalanches.
3. Recognize typical avalanche slopes.

2.1 Slope Incline and Aspect

a) Incline - slope angles for avalanching
- difficulty of judging slope incline

b) Aspect - orientation in regards to wind
- indicators of wind direction
- lee slopes (most dangerous)
- orientation in regards to sun; changes in conditions on different aspects

c) Elevation - changes in conditions at different elevations.

2.2 Terrain Configuration and Anchorage

a) Configuration - convex, concave
- size of slopes
- gullies, bowls
- cliff bands

b) Anchorage - surface roughness (scree or boulders?)
- vegetation

2.3 Avalanche Slope Recognition

a) typical starting zones
b) gullies, bowls
c) avalanche paths in timber, vegetation damage
d) avalanche deposits
e) runout distance

3.0 FORMATION OF AVALANCHES

OBJECTIVES

Key: Recognize that CHANGES in conditions are critical.

At the end of this lesson the participant should be able to:

1. Recognize layering - new snow layers
   - old snow layers
2. Note key factors in instability - snowpack development
3. Note key factors contributing to stability.

3.1 Layering

a) new snow layers, old snow layers
b) accumulation of layers, variation in type, thickness
c) hard and soft layers - WEAK LAYERS
d) changes on the ground - metamorphism.

3.2 Snowpack Development

a) basic metamorphism (CHANGES) - a summary only, follow from early winter to spring melt

b) thin snowpacks and clear, cold weather - formation of depth hoar, deep instability;
thick snowpacks - insulation from changes due to weather in deep snowpacks

c) surface formations - clear skies and surface hoar
   - crust (sun, thaw, rain, wind)

3.3 Current and Past Weather

a) precipitation - rate of snowfall (critical factor)
   - total snowfall (amounts over time) note accumulation on vehicles, around camps
   - rain (warming, weight, lubrication, weakness)

b) wind - strength (25 km/h critical)
   - direction, i.e. snow transport to where? (lee slope loading, crosswind loading of gullies, bowls)
   - wind in combination with snowfall
   - fair weather wind

c) temperature - effects on strength of snow (warming, melt - loss of strength)
- snow settles more quickly at temperatures near 0°C, hazard lingers in colder climates
- current changes in temperatures especially increases -> often increasing hazard
- clear, cold - formation of depth hoar and surface hoar
- melt and freeze conditions

d) resources - sources of weather data on resource list
- Forest Service, B.C. Hydro, Ministry of Environment, Parks Branch
- newspaper, radio
- motor association, highways reports.

3.4 Triggers of Avalanches

Note the importance of the recognition of variations in the strength or degree of instability under various conditions and the types of triggers.

a) natural (weather factors) - new snow loading
- wind loading
- changes in snow strength (temperature)

b) man - skiers
- climbers
- snowmobilers
- etc.

c) intentional triggering - explosives

4.0 RECOGNITION OF HAZARD

OBJECTIVES

At the end of this lesson the participant should be able to:

1. Describe field indicators
2. Describe field tests
3. List resource information
4. Illustrate basic hazard factors.

4.1 Field Indicators of Stability

a) avalanche activity
b) wind effects
c) indicators of precipitation
d) temperature, sun effects

4.2 Field Tests

a) pole probe test
b) shovel test
c) ski track observations, pie test
d) test snow profile

4.3 Resource Information (Local professional operations)

a) hazard evaluations
b) snow, weather and avalanche observations

4.4 Basic Hazard Factors (Summary)

a) previous weather and snowpack
b) current weather, field observations
c) terrain exposure, alternatives
d) discuss example situation

5.0 SAFETY MEASURES IN AVALANCHE TERRAIN

OBJECTIVES

At the end of this lesson the participant should be able to:

1. State steps in trip preparation
2. State methods of group safety
3. State safety factors in route finding
4. Describe what to do if caught, or if one of group is caught in an avalanche.

5.1 Trip Preparation

a) plan route - dangers, alternatives
b) leadership, compatibility
c) camp safety
d) equipment, knowledge of use
e) local knowledge
f) parks registration

5.2 Group Safety

a) weather and hazard forecast
b) equipment check
c) group communication
d) leader, tail end man, travel as a group
e) avoid danger, safe alternative
f) daylight travel
g) heed warning, closure
h) be prepared to turn back if warranted

5.3 Basic Route Finding

a) emphasize avoidance of hazard
b) avoid terrain traps
c) travel for level of group
d) ridge travel
e) describe examples of safe routes

5.4 What to do if Caught (Self Help)

a) reaction, escape
b) actions of safe persons
c) avoid panic
d) initiation of rescue

6.0 SEARCH AND RESCUE

OBJECTIVES

At the end of this lesson the participant should be able to:

1. State reasons for self help in back country
2. Describe back country rescue
3. Describe transceiver search
4. Participate in organized search and rescue.

6.1 Self Help

a) time for survival
b) time for organized rescue

6.2 Back Country Rescue

a) calm, methodical process
b) evaluate hazards
c) search technique
d) transceiver search
e) extended search, outside help
f) first aid and evacuation for victims

6.3 Transciever Search

a) equipment use, maintenance
b) technique of use
c) search patterns
d) efficient use of rescuers
e) use with probe and shovel

6.4 Organized Search and Rescue

a) organization
b) equipment, transportation (over snow, air)
c) leadership, delegation
d) search techniques
e) planning
f) avalanche dogs
g) behaviour around helicopter

NOTE: the most important aspect of this lesson is to emphasize self help for the back country traveller. Organized search and rescue procedures are introduced to help students perform more effectively as a search and rescue team member.

FIELD DAY OUTLINE

1. Quiz

   a) review of key points of classroom discussion throughout the field day

2. Avalanche Rescue Beacon Practice

   a) function of equipment
   b) individual, group search
   c) single, multiple burials

3. Avalanche Terrain

   a) recognition of terrain features, traps
   b) safety measures

KEY NOTE: RECOGNITION and AVOIDANCE of hazardous terrain is the most important element of the field day.

4. Recognition of Hazardous Snow Conditions

   a) in conjunction with terrain
   b) field tests of snow stability
   c) field indicators of conditions
   d) different aspects, elevations

5. Search and Rescue

   a) back country rescue techniques
   b) emphasize self rescue
   c) organized search and rescue
   d) group control

FIRST-AID FOR AVALANCHE VICTIMS

1. Clear snow from mouth, nose, chest area.
2. Immediate artificial respiration, C.P.R.
3. Apply oxygen.
4. Search for further injuries.
5. Remove carefully from pit.
6. Treat further injuries
7. Prevent hypothermia
8. Check for frostbite, treat
9. Evacuate victims.

FIELD INDICATORS

1. AVALANCHE ACTIVITY

- slabs
- sluffing

2. WIND EFFECTS

- cornices
- drifts
- rime
- wind scour

3. PRECIPITATION EFFECTS

- snow accumulated
- rain soaking
- lubrication
- melt/freeze

4. TEMPERATURE EFFECTS AND SUN

- melt/freeze
- lubrication
- snowballs

5. CURRENT CONDITIONS

- all of the above

FIELD TESTS

1. SKI POLE TEST
   - layers
   - consolidation
   - moisture

2. SKI TEST
   - consistency
   - subsiding
   - moisture

3. TEST SNOW PIT
   - layers
   - bonding
   - moisture
   - shovel test
   - layers - strength/weakness

TRANSCEIVER SEARCH

1. Ensure compatibility of units and proper function before trip.
2. Practice before trip.
3. Search – turn all units to receive
   - maximum volume
   - define search areas, pattern
   - maintain quiet
   - stop every 10 paces and rotate unit

4. Signal received – rotate for maximum signal
   - turned down
   - final seach patterns
5. Pinpoint location – use of probe
   - shovel
6. First victim located – switch their units to receive
7. All victims located – switch rescuers to transmit

PREPARATION FOR SAFE WINTER RECREATION

- analysis of route ⟶
  possible dangers?

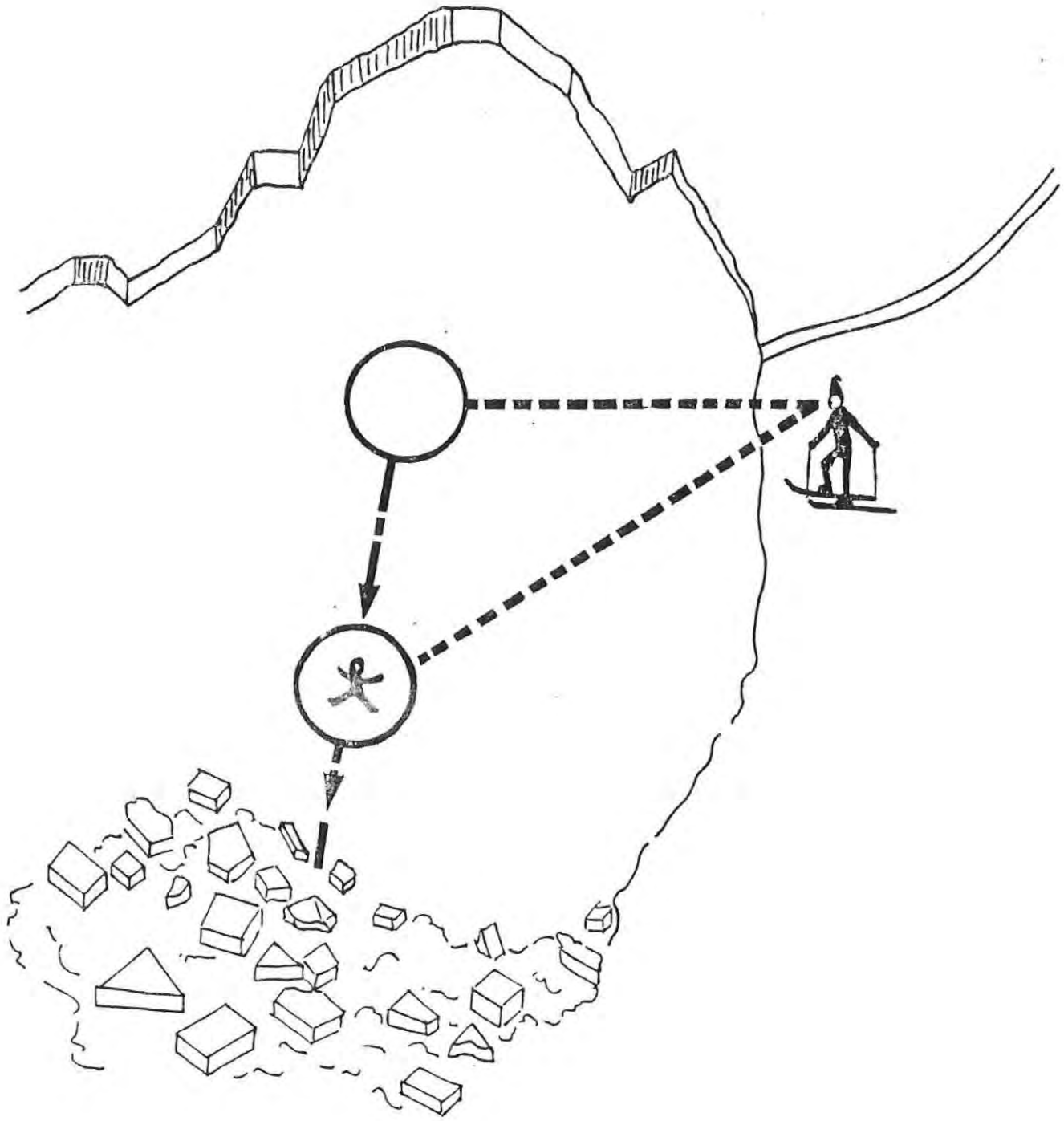
- relate route to level of group, group fitness
- group compatibility, responsible leadership

- plan the timing of your trip and camp-site location with regards to avalanche safety

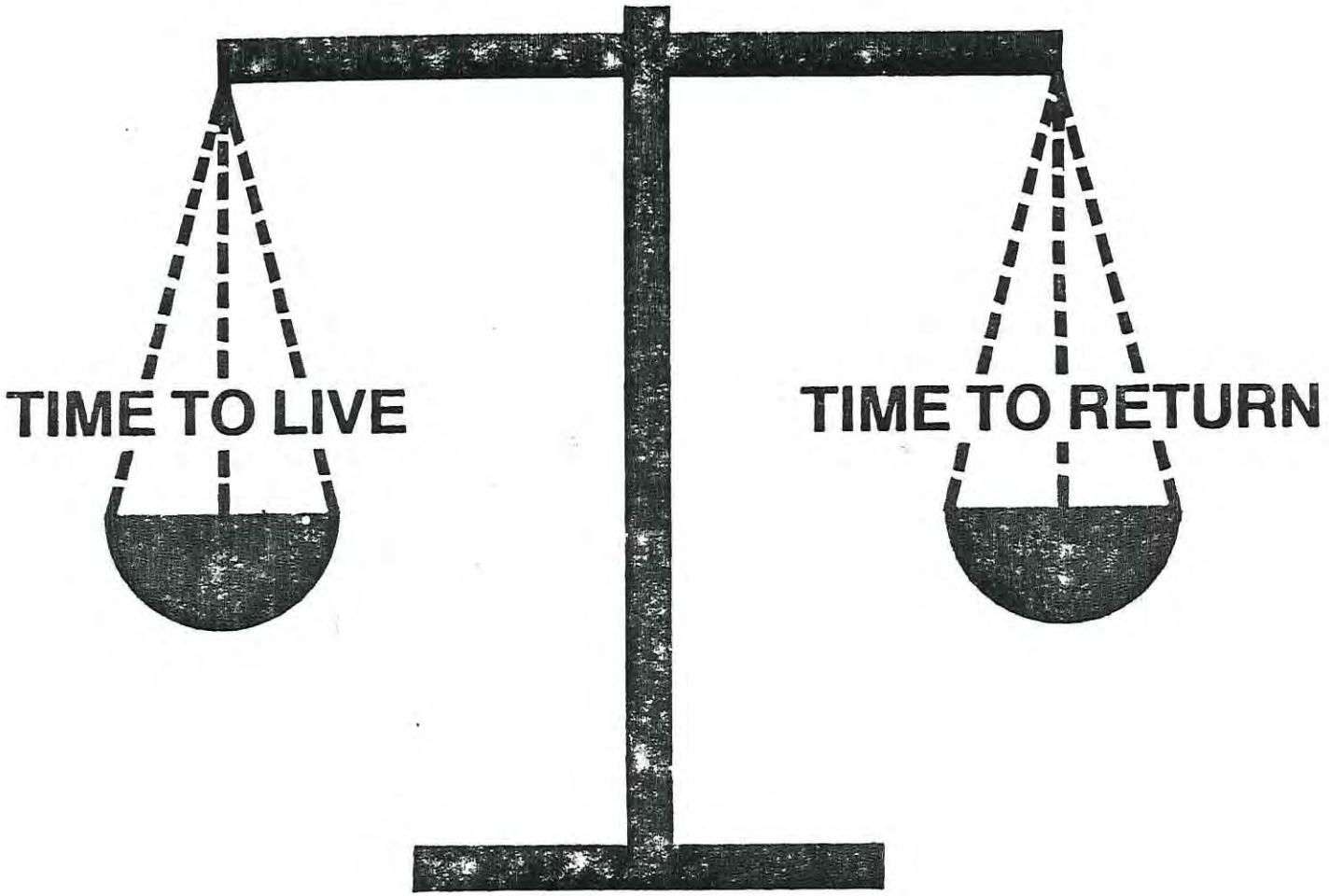
- carry the proper rescue equipment, first aid kits, and know how to use them

- ask locals who are in the know:
  - highways
  - parks
  - ski areas

- register out or tell a friend of your plans



SELF HELP



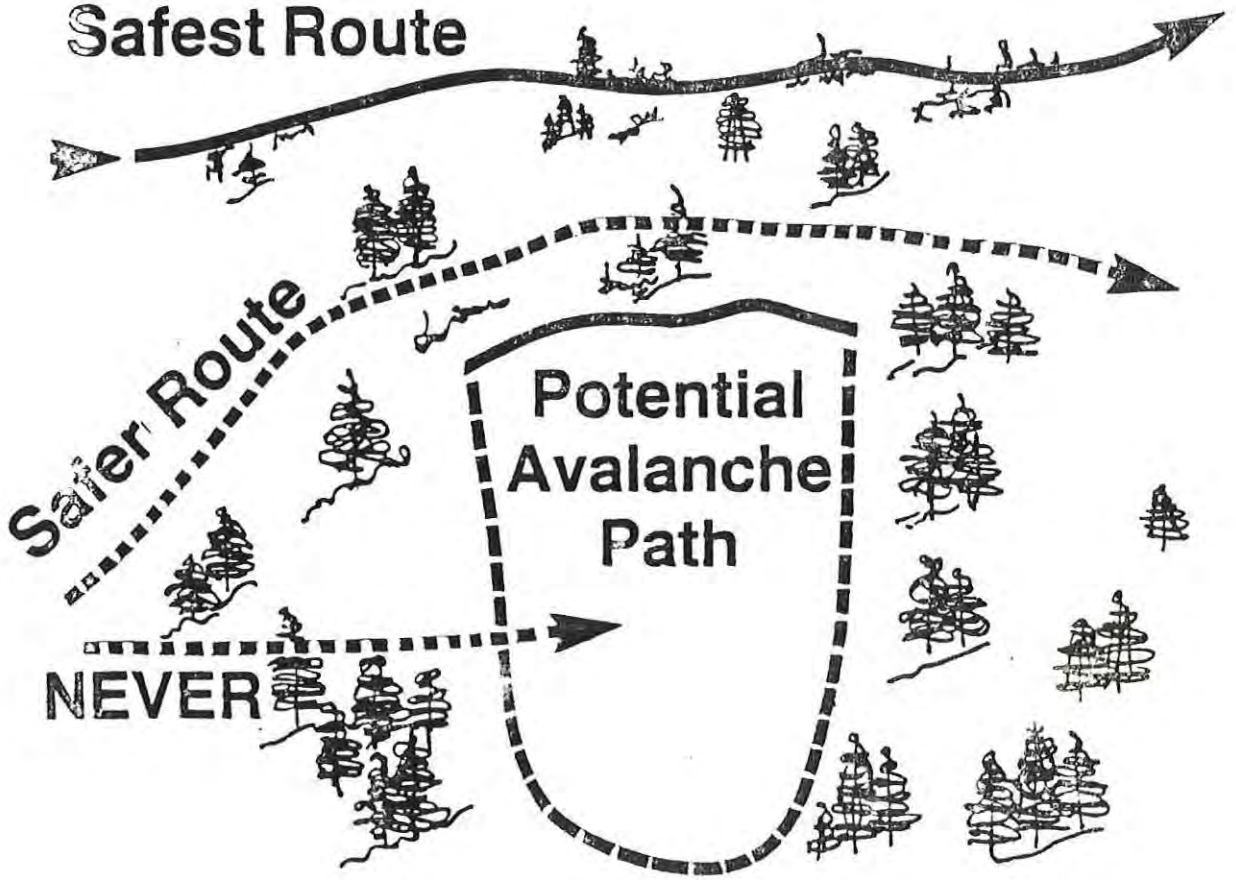
IF YOU ARE CAUGHT IN AN AVALANCHE

1. Call out
2. Attempt to ski to safety
3. Discard poles, skis, pack
4. Swim to stay on surface
5. Cover face

IF YOU ARE BURIED

6. Air pocket
7. Can you free yourself?
   Arm, leg to surface?
8. Save strength, wait for rescue
9. Don't waste time shouting unless someone is right above you

ROUTEFINDING



CROSSING HAZARDOUS TERRAIN

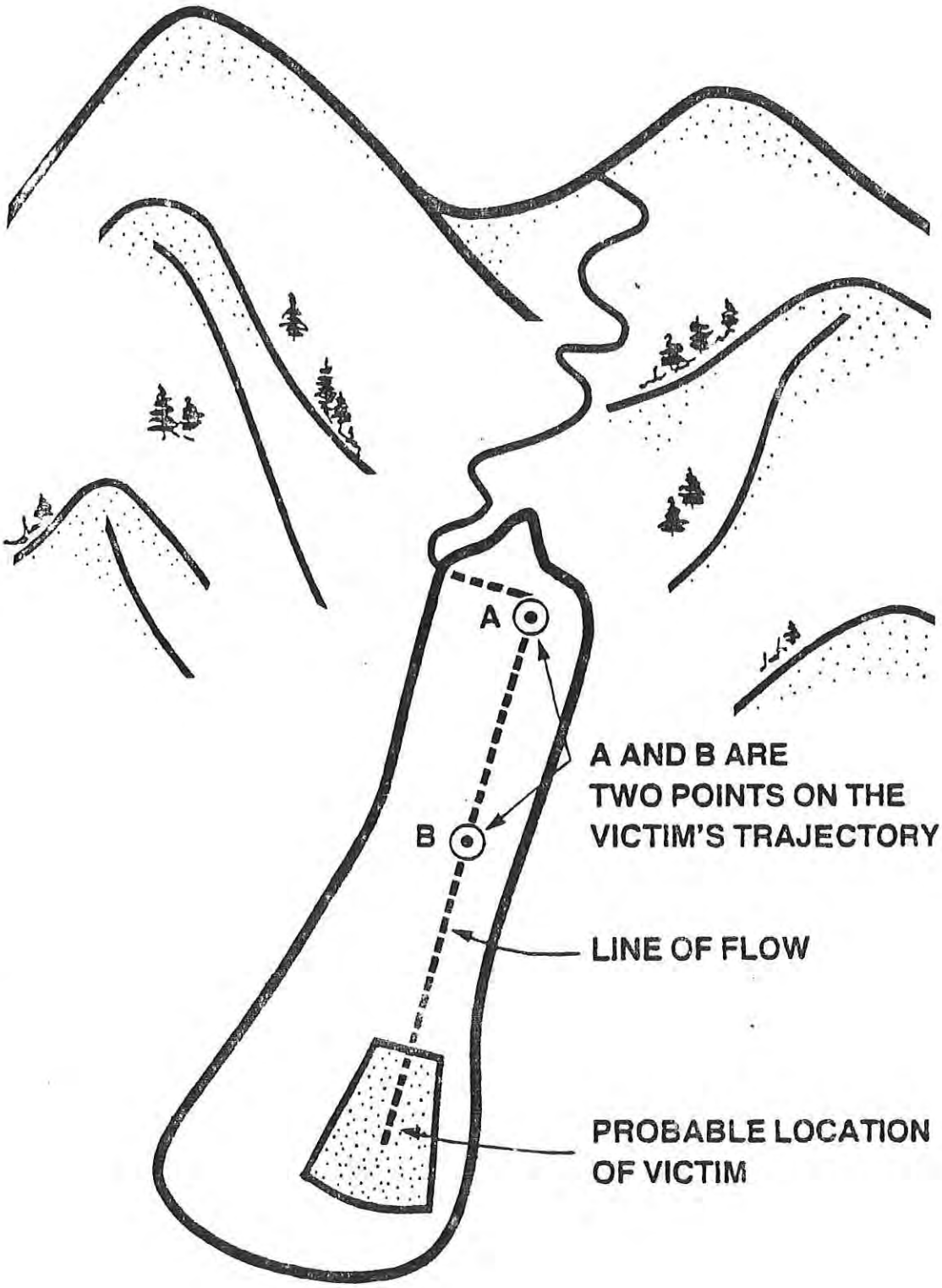
- Choose possible escape route(s)
- Prepare equipment, clothing
  - remove ski pole loops
  - undo ski safety straps
  - fasten clothing
  - undo pack waist strap
- Use natural protection, travel to islands of safety
- Cross one at a time
- Careful observation

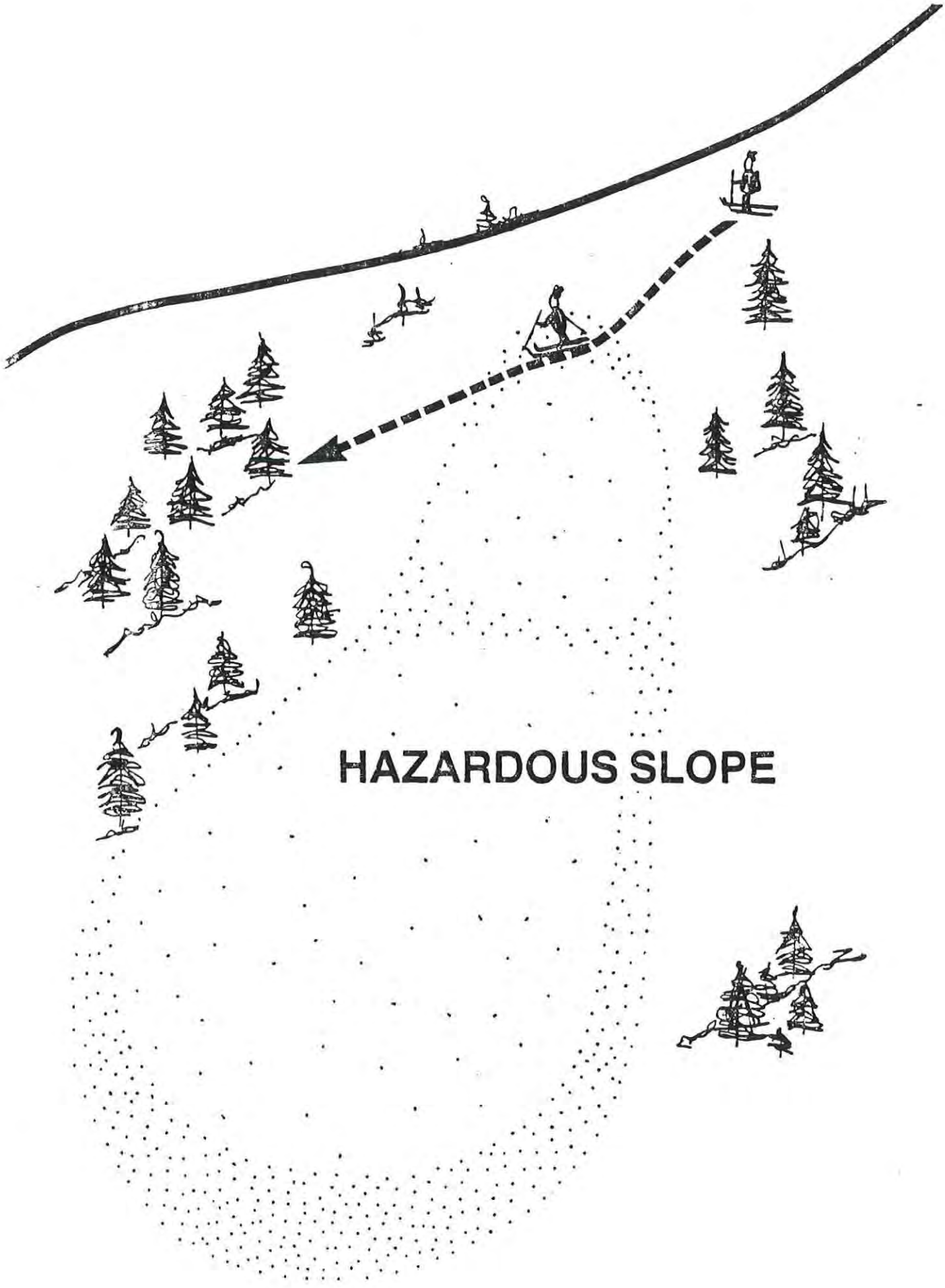
GROUP SAFETY

- Weather service information and forecast
- Check equipment ⟶ transceivers on?
- Appoint Tail End Charlie
- Keep group together
- Avoid dangerous areas
- Use caution ⟶ be prepared to turn back
- Travel in daylight hours
- Pay attention to warnings, closures

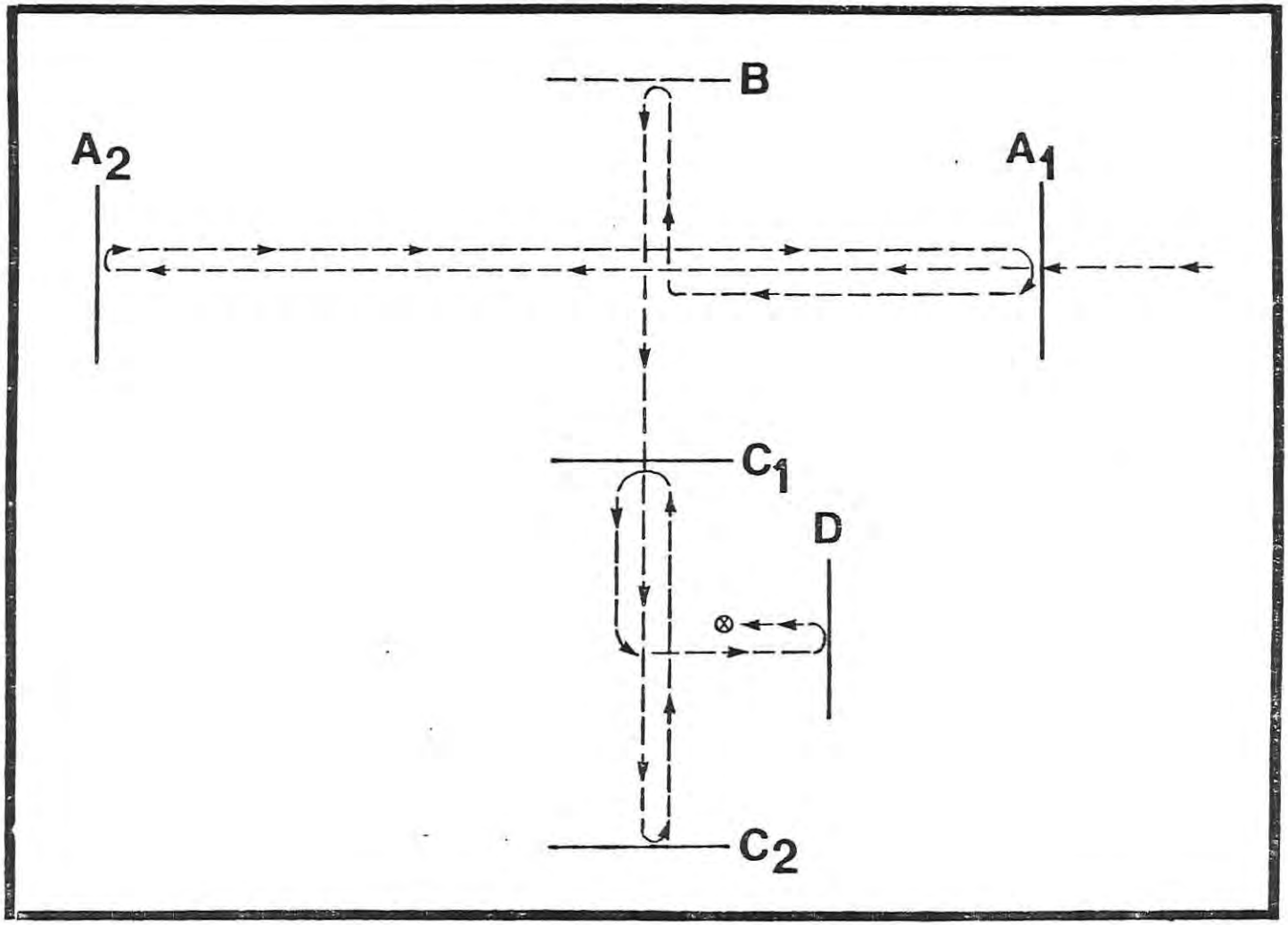
BASIC EQUIPMENT

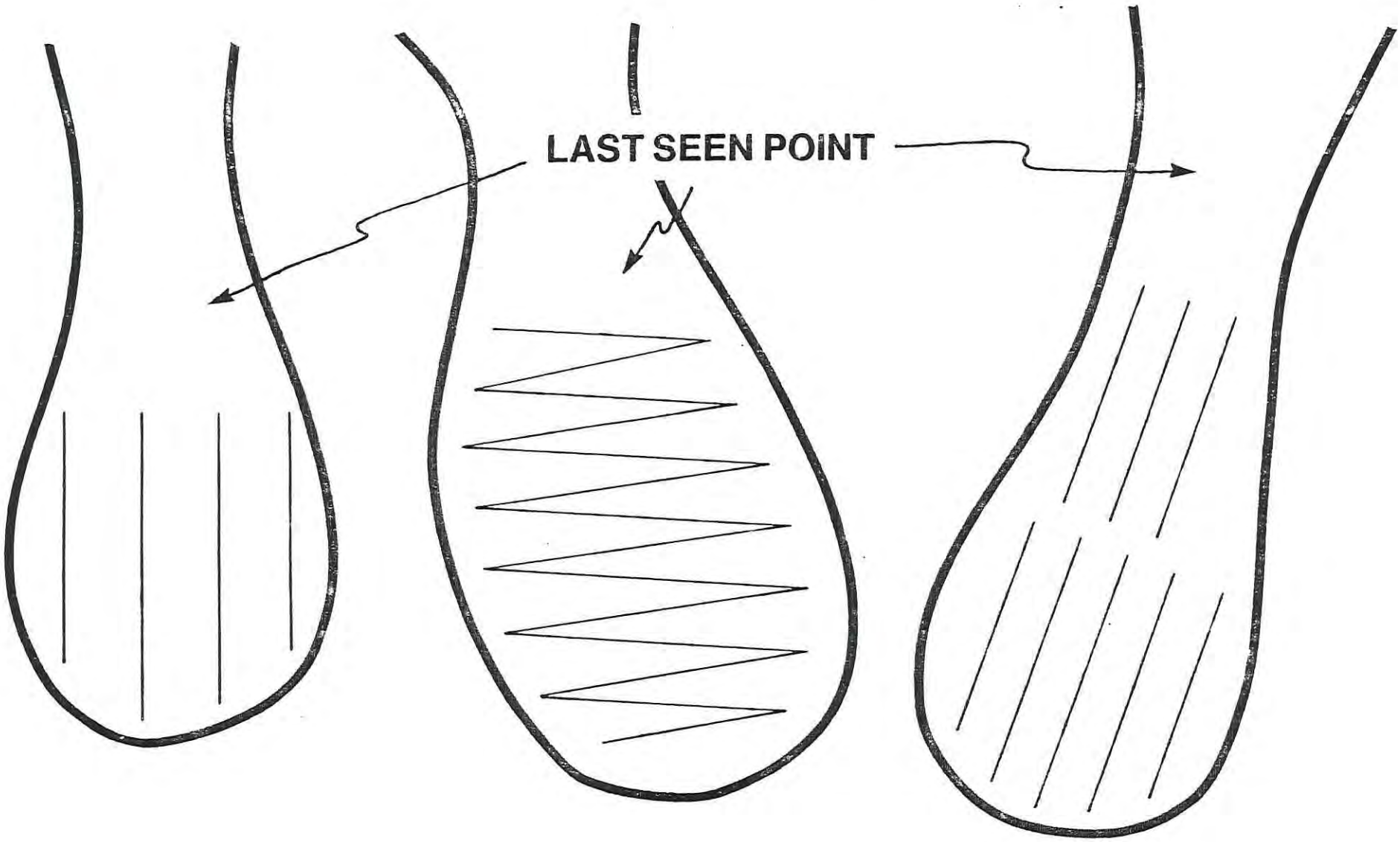
1. rescue transceiver
2. probe
3. shovel
4. marking tape or wands
5. first-aid kit
6. extra dry clothing
7. bivouac gear
8. improvised toboggan
9. rope
10. repair kit


A
B
A AND B ARE
TWO POINTS ON THE
VICTIM'S TRAJECTORY
LINE OF FLOW
PROBABLE LOCATION
OF VICTIM


HAZARDOUS SLOPE

FINAL STAGES OF SEARCH BY TRANSCEIVER

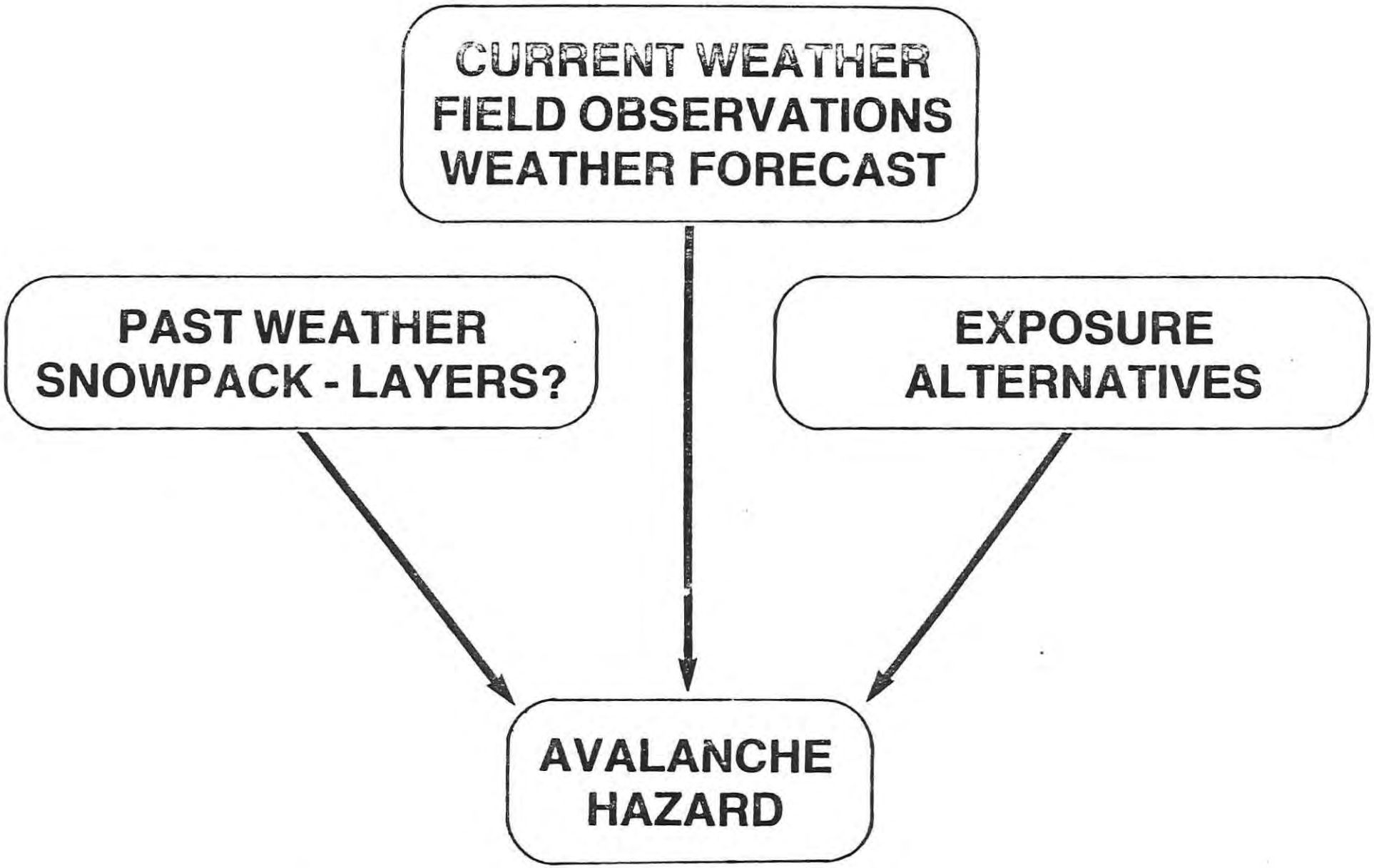




Sufficient searches to cover avalanche

Single searcher on large avalanche

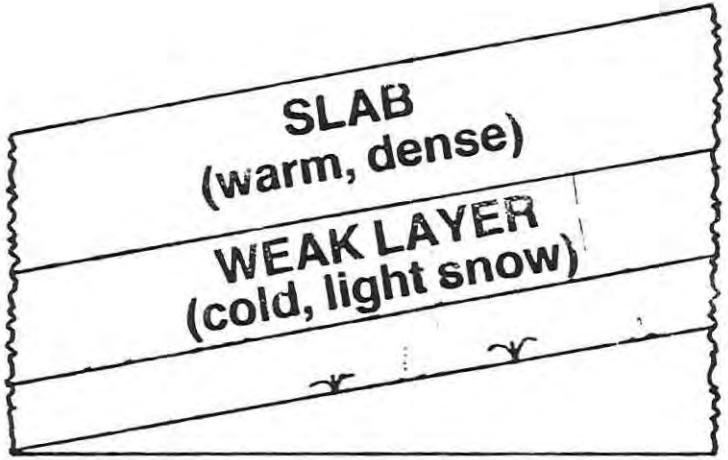
Two search parties on a long deposition zone

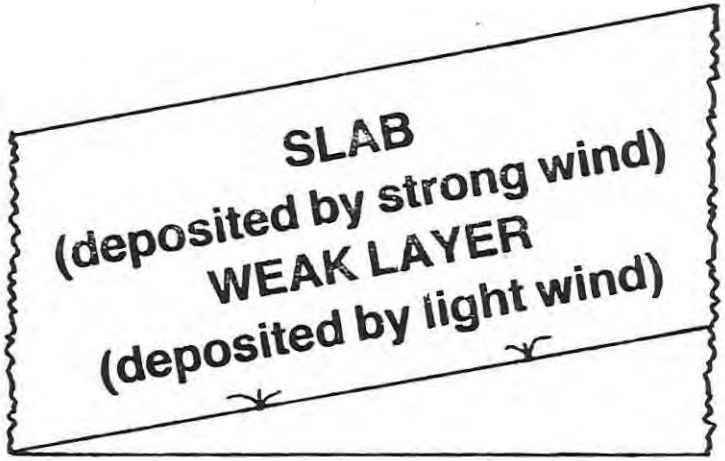

CURRENT WEATHER
FIELD OBSERVATIONS
WEATHER FORECAST
PAST WEATHER
SNOWPACK - LAYERS?
EXPOSURE
ALTERNATIVES
AVALANCHE
HAZARD

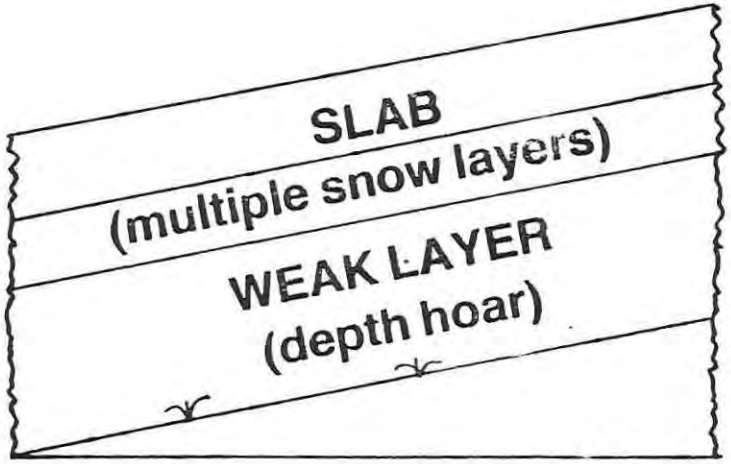
PRIOR DEVELOPMENT OF SNOWPACK

Ask local persons:

- thickness of snow cover over season?
- extended periods of clear and/or cold weather?
- ice storms, rain storms?
- any unusual or extreme weather patterns?
- any observations of avalanche activity?







LAYERS WITHIN THE SNOWPACK

CURRENT WEATHER

1. WIND
   - strength, direction

2. PRECIPITATION
   - total snowfall during storm
   - intensity
   - rainfall

3. TEMPERATURE
   - trends during storm and after storm
   - sudden changes in temperature, especially increases
   - extended periods of temperature above 0C
   - exposure of slopes to sun's radiant energy

FORMATION OF AVALANCHES

Prior Snowpack Development (Layers)

↓

Strength/Weakness

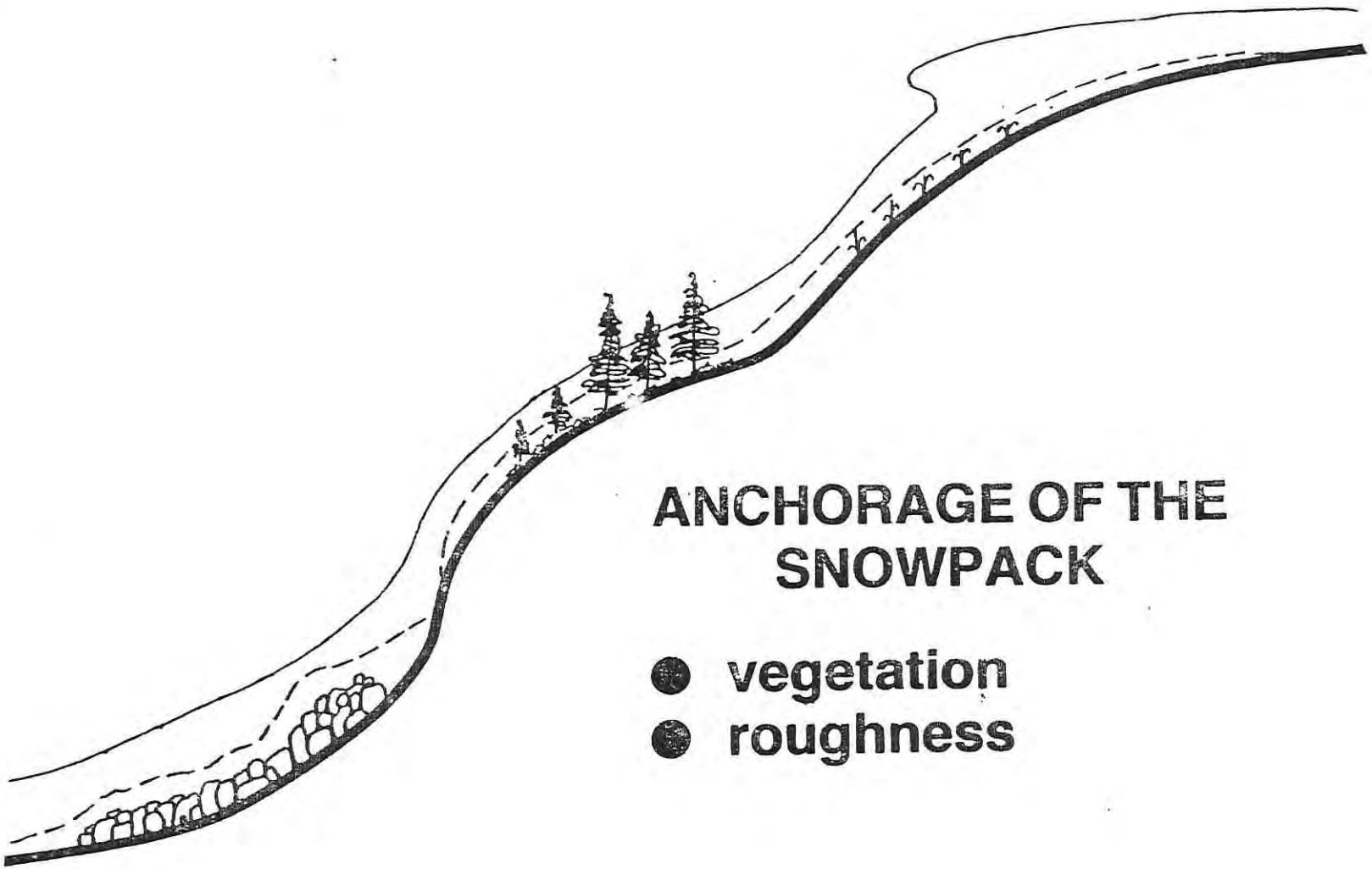
↓

Current Weather

1. **Wind**
2. **Precipitation**
3. **Temperature**

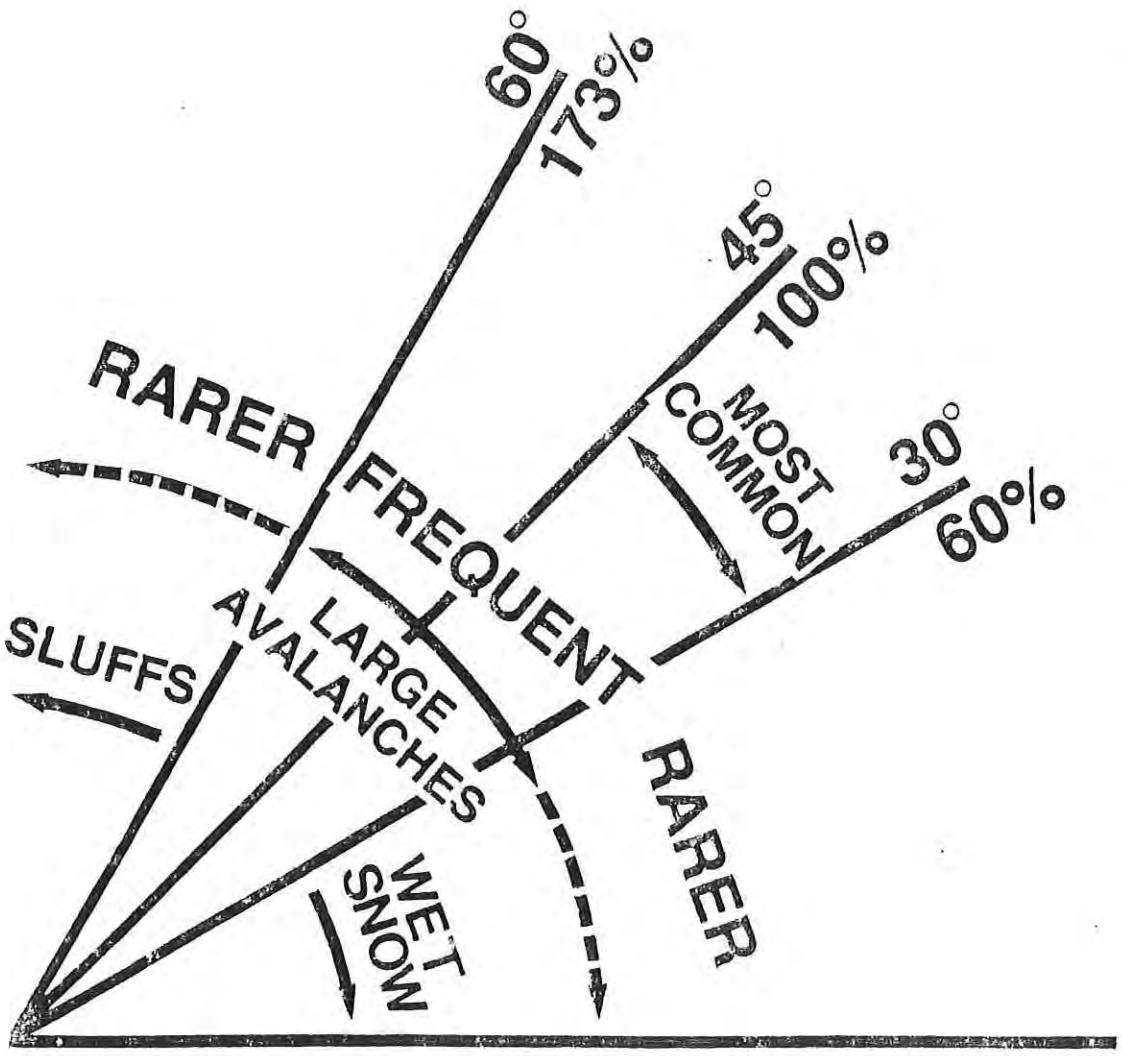
↓

Potential Avalanche Formation



ANCHORAGE OF THE SNOWPACK

- vegetation
- roughness


60°
173%
45°
100%
30°
60%
RARER
FREQUENT
MOST COMMON
SLUFFS
LARGE AVALANCHES
WET SNOW
RARER

AVALANCHE TERRAIN FACTORS

1. Slope orientation in regards to prevailing wind.

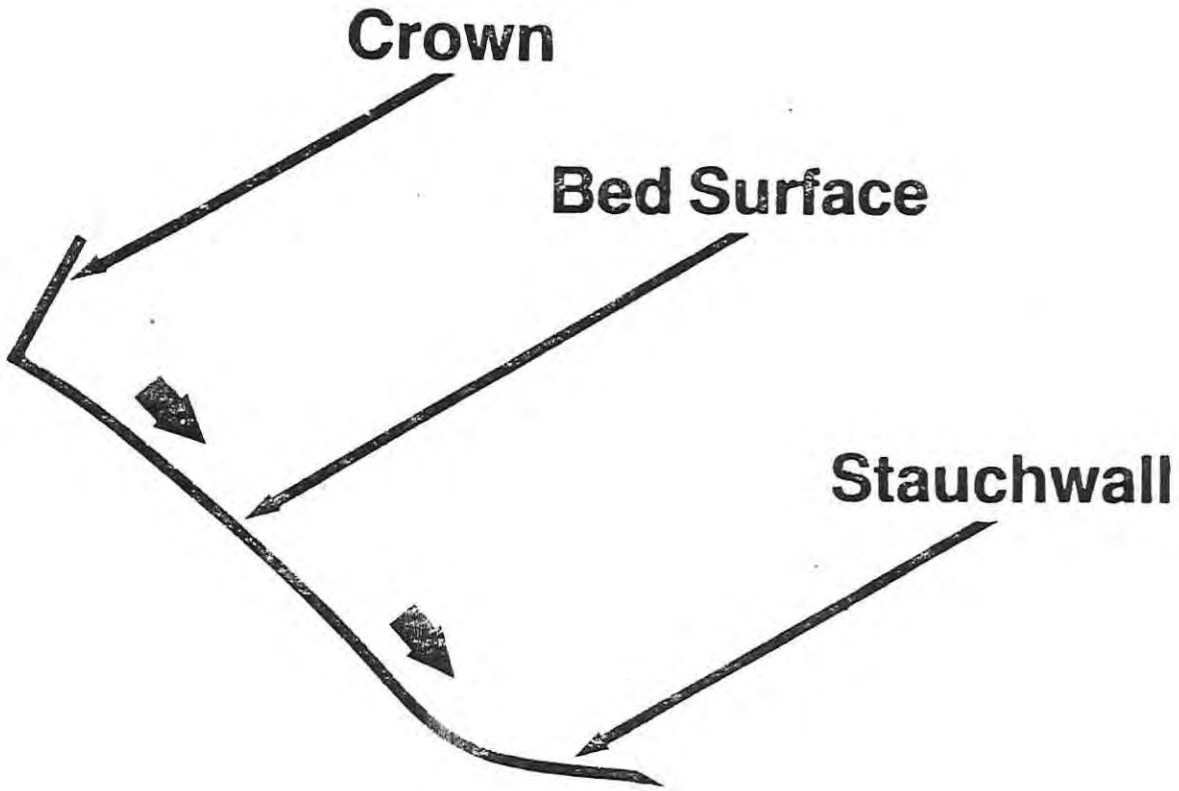
2. Slope incline.

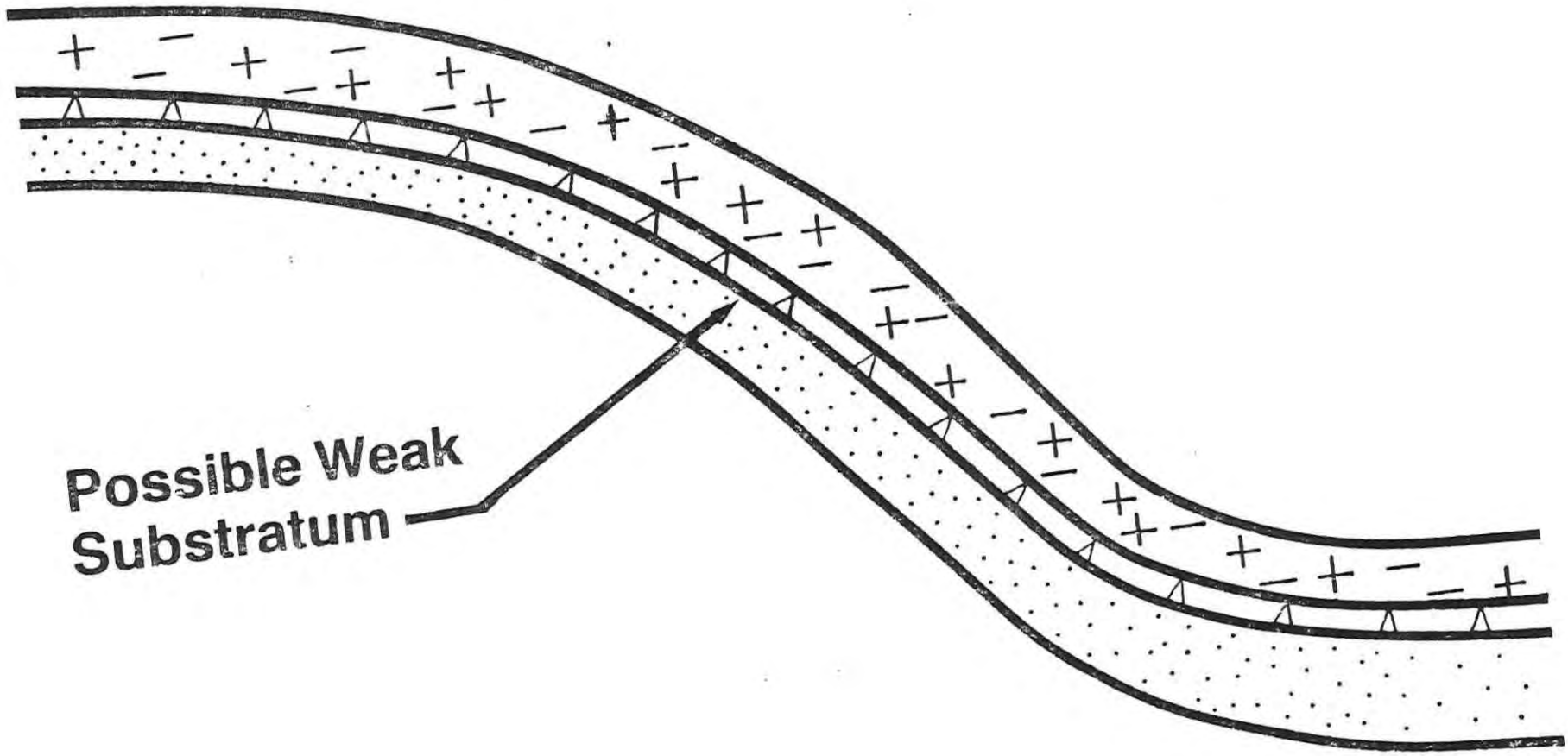
OTHER FACTORS

3. Slope configuration.

4. Slope orientation in regards to the sun.

5. Anchorage
   - ground surface roughness
   - vegetation


Crown
Bed Surface
Stauchwall


Possible Weak
Substratum

CAUSES OF DEATH

1. Suffocation
2. Injury
3. Exposure

Less than 50% chance of survival if buried for more than half an hour.