Field Manual

for the

United States Antarctic Program

First Aid
Emergency Action Principles

1. Survey the Scene

- Is this scene safe?
- What happened?
- How many people are injured?
- Are there companions that can help?

2. Do a Primary Survey of the Victim (ABCs)

- Check the **A**irway (head-tilt/chin lift).
- Check the **B**reathing (look, listen, feel).
- Check **C**irculation (carotid pulse).

3. Radio for Rescue / MEDEVAC

- See **Radio Emergency Action** on next page.

4. Do a Secondary Survey of the Victim

- Interview the victim and/or companions.
- Check the victim's vital signs.
- Do a head-to-toe exam.

Radio Emergency Action

Sending a Distress Message

In an emergency, stay calm, assess the situation, and use the following steps to call for help:

1. Select the correct frequency.
2. Speak clearly. Take your time.
3. Call "MAYDAY, MAYDAY, MAYDAY."
4. Listen for a reply.
5. When a reply is received, tell them who you are, where you are, and the nature of your emergency, and that you are trying to make contact with the closest permanent USAP station in your area. Give any information which may assist the rescue.
6. If no reply is received:
   - Check your equipment.
   - Repeat your call at regular intervals -- allow listening periods between calls.

Action on Receipt of a Distress Message

1. Listen carefully. Write down the message(s) and time.
2. Listen for an acknowledgment from a major station.
3. If another station does not acknowledge the distress call, acknowledge the distress call and retransmit the distress message to the closest permanent USAP station in your area, using the words:

   "MAYDAY Relay, MAYDAY Relay, MAYDAY Relay. This is. . ." (repeat your station call sign three times).
4. Give distress message as broadcast by station in distress.
5. Give assistance to station in distress if possible. Advise your base station of what you are / are not doing.
6. Continue to listen in.

Cancellation of MAYDAY messages

If help is no longer required, don't forget to announce cancellation of your distress or urgency call!

Avoid Unnecessary Traffic At All Times!

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Mimi Fujino created from first-hand experience all illustrations, except those as noted. She also helped develop the production standards and procedures for this manual.

Brooks Montgomery, Tim Cully and Marian Moyher worked on the Peninsula-Area information with researchers experienced in those locations to develop those sections of the manual.

Bill McCormick edited this 6th edition (2001-02 field season) of the Field Manual. Jim Mastro did the layout, based on an original design by Lisa Mastro.

Cover photo courtesy Dr. Daniel Costa (© Dr. Daniel Costa 2001).

Introduction

The United States Antarctic Program (USAP) supports researchers working in Antarctica, whether in the Continental region (McMurdo Station, South Pole Station, and inland field camps), the Peninsular region (Palmer Station and island field camps), or on USAP research vessels (*R/V Nathaniel B. Palmer* and *R/V Laurence M. Gould*). Though each of these different areas poses unique environmental challenges, the USAP abides by safety requirements and waste handling and environmental protection policies that are standard throughout the program. In addition, much of the equipment that the USAP issues to researchers is the same at all locations.

This edition of the Field Manual for the USAP has been revised to include both common and area-specific information. When a chapter contains information specific to both regions, the chapter will begin with common information, followed by McMurdo-area information and then Palmer-area information.

If you are new to the program, this manual will help prepare you for the time you will spend in Antarctica. Read it thoroughly before packing and leaving, as you will find helpful and important information regarding planning and preparation, clothing, extra equipment you may wish to take, and what to expect in the field.

(NOTE: If you are deploying to remote locations in Antarctica, you should have a strong background in cold weather survival or, at the very least, you should employ a safety-survival guide with previous Antarctic experience. A remote field camp in Antarctica is not the place to learn cold weather skills.)

Finally, this is intended to be a reference manual and it should be taken into the field with you. Many chapters contain information on the equipment you will be issued, some of which is very specific to polar work. Also, detailed information on trouble-shooting radios, Zodiacs, and snowmobiles is included. Systems that are unique to working in polar environments, such as roped travel with Nansen sleds or crevassed area travel with snowmobiles, are discussed, and valuable advice is provided on rescue techniques.

Use of this manual, and adherence to the guidelines set forth within it, will enhance both your safety and productivity while working in Antarctica.

RPSC Field Support Staff welcomes any comments or feedback on this manual.

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Chapter 1
Extreme Cold Weather (ECW) Clothing

1.1 USAP Clothing Issue

Refer to the USAP Participant Guide for a list of the clothing you will receive before deployment to Antarctica at the Contractor Warehouse in Punta Arenas, Chile, or from the Clothing Distribution Center (CDC) in Christchurch, New Zealand, before deployment to Antarctica.

The USAP provides basic ECW clothing. If you are going to be in the field for an extended period, you should supplement the issue clothing with additional items such as extra thermal underwear, light-weight wool or thermax socks, 100-weight pile top and bottoms, extra wool, poly-pro and pile gloves.

Prevention—How to stay warm:

- **You need fuel to burn.** Eat before you go out, stay hydrated, and take extra food and water. That's your internal furnace.

- **Dress in layers.** Start with polypropylene underwear, no cotton (cotton clothing gets wet and stays wet; it is dangerous in the cold). Intermediate layers should be polar fleece, down, or wool: Bibs, pants, sweaters, down vests etc. Your outermost layer should be windproof (and depending on where you're working, waterproof). When you're working up a sweat, take layers off. When you stop, put the layers back on, bundle up, pull up your hood, put your back to the wind, and trap all that heat you've generated. As you've most likely heard, you can lose a great amount of your body-core heat through your head and neck. Warm hats, neck-gaiters, face masks, and balaclavas, with goggles or glacier glasses, make a tremendous difference in staying warm on the trail. In a marine environment always wear a Float Coat or Float Coveralls when working around the water or on marginal sea ice.

- **Exercise is heat.** The quickest way a person can warm up is by exercise. If you're cold, get moving. Get to a shelter/ set up a shelter.

1.2 Dressing for the Cold: Layering

In general, the rule of thumb for living in a cold environment is to get lots of insulation between you and the environment, and to remove that insulation layer by layer when you get warmer. You need a clothing system that allows you to shed layers quickly and easily before you get damp from perspiration. Several thinner garments will serve this purpose better than one bulky overcoat.

- **Long Underwear:** Your first layer should be your long underwear. It should fit snugly against your skin and be made of a nonabsorbent material. This layer works by wicking away water and keeping your skin dry. Synthetic fabrics such as polypropylene work the best, whereas wool and silk are the best natural fibers. Cotton is a poor choice because it absorbs water and holds the water next to your skin where it will cool you off.

- **Mid Layers:** The next layers are important because they serve to absorb the moisture out of your long underwear and transport it to the environment through evaporation. Once again, synthetics are best here, but wool is a good substitute. Shirts, sweaters, and trousers are what you will likely be wearing when you are active. Pay close attention to the fit, as the mid layers work by trapping air and preventing it from circulating and carrying away your body heat.

- **Insulation Layer:** Thickness is warmth. For sedentary activities or extremely cold conditions, an outer garment with several inches of loft is recommended. Down, Polarguardô, Holofillô Thinsulateô and Primaloftô are the types of insulation that the USAP uses in the ECW gear. For personnel working in the Peninsula area it is important to understand that down loses most of its loft when wet and takes a long time to dry, so you must be careful to avoid getting down garments wet. Synthetic insulation is a better choice for working in potentially wet conditions.

- **Shell Layer:** The most important part of your layering system, and the most used besides your long underwear, is your windshell. Studies conducted by Recreational Equipment Co-Op show that in still air, windshells worn over any garment can add up to 25 degrees F of warmth. In windy conditions, windshells can increase warmth by 50 degrees F or more.

  Personnel working in the McMurdo system are issued a windshell that is windproof but not waterproof. Because of the dry climate, the non-waterproof fabrics are superior because they allow your perspiration to escape more easily. Personnel working in the Peninsula area are issued a waterproof/breathable windshell because of the potentially wet conditions encountered there.

1.3 Cold Weather Clothing Accessories

Conditions in Antarctica are frequently extreme. Remember that you need to pay particular attention to protect your head, neck, and extremities with layers comparable to your other clothing. If you'll be doing work that requires much use of your hands, consider requesting chemical heat packs for inside your gloves and mittens. For work that must be done without heavy gloves or mittens (for dexterity), use the polypro glove liners you are issued.

Important!!: Make sure to bring plenty of high-SPF sunscreen for your field season. Sunscreen in not provided by the USAP.

1.4 Clothing for Deep-Field Deployment by Aircraft (McMurdo Area)

The USAP has basic required standards for clothing that is worn on all flights. All USAP personnel must wear the CDC-issue clothing on flights to and from McMurdo Station and all South Pole flights.

The USAP has made one exception to the basic clothing standard for flights: For personnel going into the deep field, flight clothing can be personal items which are equivalent to or better than the required standard clothing. The USAP recognizes that deep-field personnel may decide to purchase their own clothing for extended periods of field work and has made the exception for these personnel only.

To board a deep-field flight with clothing other than the standard issue, you must have a “Deep-Field Boarding Pass.” Field Safety Training instructors will review clothing procedures during training courses and shakedowns and will ensure that any personal clothing items that researchers wish to substitute for the standard clothing meet or exceed the standard issue. The instructors will then issue the boarding pass. You will not be allowed on a flight with clothing other than the CDC-issue clothing unless you have a deep-field boarding pass.

1.5 Special Clothing Considerations for Peninsula Operations

During the austral summer months, conditions in the Antarctic Peninsula are characterized by wet, windy weather. Palmer Station can expect to receive about 28 inches of precipitation a year and half falls as rain. During an average summer, precipitation is recorded approximately 22 to 24 days each month. Another consideration is for the often wet conditions one encounters while boating or working aboard a research vessel.

For these situations, a waterproof outer layer is important. The standard USAP clothing issue includes two types of waterproof garments. One is a water resistant / waterproof breathable shell which works well when primarily working on land. The second is the Helly Hansen (HH) non-breathable PVC rain jacket and bib pant. The HH rain wear is generally preferred by researchers spending a fair amount of time working from Zodiacs, where one is likely to get soaked from sea spray. Others prefer the HH gear while working in particularly wet conditions on land such as in penguin colonies where conditions can get rather sloppy. (See Figure 1-1).

Figure 1-1: Very dirty Helly Hansen rain jacket and pants. (photo by Marian Moyher)

Although the issue clothing is of the high quality and generally works quite well under most conditions, some researchers prefer to supplement the issue clothing with personal garments that work best for their activities. For example, a windproof Anorak pull-over with a large kangaroo pouch pocket and side hand warmer pockets may work best for one group. In addition, some researchers provide their own hiking boots. Be aware that whatever type of boot you choose, make sure they are broken-in prior to deploying, provide good ankle support, and use a high quality vibrum lug sole. The rocky terrain on the islands is notoriously rough and very slippery. Other popular items that are often supplemented are the pile fingerless glove/mitten combination (Glomits) and a pile ear band.

Chapter 2
Science Support Services

2.1 Science Meetings

Each science group will have a meeting the day after arriving at McMurdo, Palmer, and the research vessels. Representatives from the NSF (or the NSF designated Station Science Leader at Palmer Station) and from various RPSC support areas will meet with your group to discuss logistical support for the season. During the science meeting, you'll receive information on the status of your cargo and equipment. You'll also discuss your objectives for the season. On the vessels this meeting will be in conjunction with the ship orientation and safety meeting.

During the Science Meeting, each project will be asked to name one team member who will be responsible for returning all project equipment to the various work centers. This team member will be required to complete a check-out form which must be signed by the various work center supervisors before the team member redeploys. The completed form will be turned over to the NSF Representative (or the NSF designated Station Science Leader) on station or the Marine Project Coordinator on the vessels.

2.2 McMurdo Science Support Areas

Field Support: The Berg Field Center (BFC) staff issues equipment and food to field parties and also conducts deep field camp resupply. After your initial science meeting, it's best to meet with the BFC supervisor to locate your cage space.

Laboratory Support: The Crary Science and Engineering Center (CSEC) houses the McMurdo science laboratory facilities. Specialized laboratories, computer facilities, the Aquarium, the Dive Locker, and office space are allocated within the CSEC. The CSEC staff coordinates laboratory support for science groups, as well as fish hut movements, construction requests, and aquarium space requirements. Scientific equipment (including all items identified in your SIP for procurement) is issued from the CSEC stockroom. Other facilities in the CSEC include a science library, a seminar room, and a small field staging area.

Helicopter Support: The Senior Helicopter Coordinator develops the daily helicopter flight schedule, communicates daily with all helicopter-supported field groups, and is the point-of-contact for all helicopter-supported field camp resupply requests. The Coordinator is located at the helicopter hangar.

Mechanical Support: The Mechanical Equipment Center (MEC) staff issues and maintains snowmobiles, generator sets, gas-powered ice augers, rock drills, chain saws, portable dive compressors, and 12-V batteries and battery chargers. The MEC staff also maintains a fleet of “pool” pickups and tracked vehicles for use by the science community and provides training and a field maintenance course for issued equipment.

Antarctic Driver’s Licenses are required for operation of any vehicles. You must have a valid driver’s license from your home state in order to receive an Antarctic Driver’s License and drive in McMurdo. To be issued an Antarctic Driver’s license for tracked vehicles, you must attend a briefing at the MEC and successfully complete a test drive. If you intend to operate light vehicles, vans, or pickups while in McMurdo, you must attend a briefing by the VMF at Crary Lab. You will then receive an Antarctic Driver’s License for light vehicle operation.

Fixed-Wing Support: The Fixed-Wing Coordinator is the point-of-contact for all fixed-wing aircraft concerns. This person helps you plan cargo loads for put-in flights, plans the daily fixed-wing flight schedule, communicates daily with field parties, and coordinates all resupply and schedule changes for remote fixed-wing-supported field groups. The coordinator is located in Building 165.

Science Construction Support: All science construction support requests should be listed on your SIP; however, if you have late-identified (i.e., while in Antarctica) construction requests, submit a work order to the CSEC Laboratory Supervisor. On-ice construction support requests will require approval by the resident NSF representative.

Science Cargo Support: If you have questions about the arrival, shipment, or retrograde of your cargo, contact the USAP Cargo Supervisor, who is located in Building 193. USAP Cargo is responsible for handling all science project cargo and is the principal contact with the cargo system.

2.3 Palmer Science Support Areas

Field Support: Palmer Station does not have a dedicated science field support area or personnel. Instead, the contractor warehouse in Punta Arenas (PA), Chile, houses the field equipment used in the peninsula system. All field equipment identified on your SIP is issued from the warehouse. While at Palmer Station, any resupply or additional items can be requested through the Administrative Coordinator and will be shipped on the next available vessel. There can be a two month delay before the vessel's arrival, so it is best to plan ahead and thoroughly check out all gear before departing PA. In addition, all USAP clothing is issued from the PA warehouse.

Laboratory Support: The Biolab building houses the Palmer Station science laboratory facilities. Specialized laboratories, computer facilities, the aquarium, the dive locker and limited office space are allocated by the Palmer Laboratory Supervisor. The laboratory staff coordinates all laboratory support for science groups, as well as construction requests, dive technical services, and field support. Scientific equipment, instruments, and supplies (including all items identified in your SIP for procurement) are issued by the laboratory staff. Other facilities available at Palmer include a small science library and boathouse.

Mechanical Support: Station facilities personnel maintain a limited stock of snowmobiles, generator sets, gas powered ice auger, rock drills, Zodiacs, and deep-cycle marine 12-V batteries and chargers. Use of these items should be requested in the SIP, and on-site support should be coordinated through the laboratory supervisor.

Science Construction Support: All science construction support requests should be listed on your SIP; however, if you identify construction requests while you are on the ice, please contact the laboratory supervisor. On-ice construction support requests will require approval by the NSF representative.

Science Cargo Support: All science cargo will be received off the ship and turned over to you by Palmer Station logistics personnel and the laboratory staff. If you have any questions or problems with cargo, please contact the laboratory supervisor.

Station Science Leader: The Station Science Leader (SSL) is designated by the NSF/OPP whenever there are researchers on station. The SSL is responsible for the performance and behavior of science personnel at the station. In the absence of the NSF representative, the SSL is responsible for the coordination of the USAP research at the station and in the local operational area. It is the joint responsibility of the SSL and the RPSC Area or Station Manager to work cooperatively to ensure that the research programs are successful. The SSL is guided by the Antarctic Treaty and obliged to ensure that all USAP personnel comply with the Antarctic Conversation Act. During his or her tenure on station, the SSL may have the opportunity to host personnel from other nations maintaining research stations in the Antarctic Peninsula. Once a month, the SSL compiles the science monthly report for distribution to the NSF, RPSC and all grantees involved in peninsula research.

Chapter 3
Basic Field-Party Preparation

3.1 McMurdo-Based Groups

For those researchers, and other USAP participants, leaving from McMurdo to work in field camps, the following chapter provides general guidelines for deployment preparation. The McMurdo Section: 3.1 is set-up in a typical daily schedule, however your actual schedule will vary depending on previous experience and the number of people in your group.

3.1a Day 1

Arrival in McMurdo:
After your plane lands in Antarctica, a shuttle will transport you from the airfield to the McMurdo Station Chalet, which is the administrative building for the National Science Foundation (NSF) and for the NSF support contractor. Chalet personnel will give you an orientation briefing, assign housing, and arrange a date for your science meeting.

3.1b Days 2, 3, & 4

Science Meeting:
Each science group will have a meeting the day after arriving in McMurdo. Representatives from the NSF and from various support areas will meet with your

group to discuss logistical support for the season. During the science meeting, you'll receive information on the status of your cargo and equipment. You'll also discuss your objectives for the season and meet the McMurdo personnel who will help support your research project.

Field Communications and Radios:

- Establish a Field-Party Communications Plan at the Field Operation Communications Center (FOCC)(radio call sign “Mac Ops”), which is located on the second floor of Building 165. This communication plan establishes your radio call sign, your radio-frequency assignments, and your daily health and safety check-in schedule.

- Pick up your field radios and attend radio training and a demonstration at the Field Party Shop, located in building 159. ALL FIELD PARTY MEMBERS are highly encouraged to attend the radio training, which takes approximately one hour to complete.

Vehicle Maintenance Facility (VMF):
Antarctic Driver's License For Light Vehicles:
A short presentation will be conducted by VMF personnel at the Crary Lab on the operation and maintenance of vans and pickups. This briefing is mandatory if you intend to drive a pickup or van while in McMurdo. (You must also have a valid driver's license from your home state.) At the conclusion of the briefing, you will be issued an Antarctic Driver's License for light vehicles.

Mechanical Equipment Center (MEC) -- Maintenance Training and Antarctic Driver's License:

- A half-day field maintenance training should be completed before your equipment shakedown. Schedule this field maintenance training with the MEC Supervisor or Lead Snowmobile Mechanic.

- Antarctic Driver's Licenses for tracked vehicles are obtained from the MEC. Once again, you must have a valid driver's license from your home state to be issued a tracked vehicle license. You must also attend a mandatory briefing and pass a test drive of the tracked vehicle(s) you intend to operate, whether Spryte, Tucker, Pisten Bully or snowmobile.

Berg Field Center (BFC) Equipment:

- The BFC issues equipment and food to field parties. This is also where you obtain field supplies for environmental protection. If you will be working in the Dry Valleys, this is where you will get personal urine bottles and containers for handling human waste and gray water. You are required to wash out urine bottles before returning them to the BFC. Spill kits are available, as well as absorbents for glycol/water (gray) and fuel (blue). The BFC also has containment units for mechanical equipment and fuel transfers, and containers and labels for the return of waste from the field.

- Each science team that requests a substantial amount of field equipment from the BFC will be issued a “cage space.” Locked cages are on the ground floor of both the BFC and USAP Cargo buildings and must be shared either concurrently or consecutively with different groups. Cage space is limited, so remember, when you go into the field someone else may use the space you were working in.

- Your cage location and lock combination will be given to you at the science meeting. Field equipment allocated to you as outlined in your Research Support Plan (RSP) will be pre-staged in your cage. Assign one person from your group to check over your issued field equipment inventory to ensure that it is complete. Notify the BFC if there are any discrepancies. Select one person to be your BFC point-of-contact. He/she will be the only person from your group to make changes, return, or exchange your issued field equipment.

- If you requested rock boxes (via your SIP) for sample retrograde, BFC personnel will tell you where you can pick them up. Prior to field camp put-in, you will need to stencil your name and university address on top of the boxes and put banding around the circumference of each box. (**Note:** Banding and stenciling materials are available at USAP Cargo.) You can use the empty rock boxes for camp put-in by filling them with food and equipment.

Food:

- Food is issued to USAP field parties who are working and living at remote locations. Use the Food Room "planning sheet" (given out during the science meeting) to select food for your group. The Food Room staff will help you to determine quantities needed, but it is important that the entire field party review the list and make requests on this form.

- The Food Room staff will help plan food amounts for both put-in and resupply. New groups should rely on the Food Room staff's experience and use the resupply system. It is difficult to keep foods frozen in the Dry Valleys. Some groups have initially taken an entire season's supply of food into the field, where much of it spoiled. Please let the Food Room staff help you in this planning process.

- When planning food for the season, we suggest you use regular food stock to cover the length of time you expect to be in the field. Take an emergency back-up of 2 to 4 weeks' dehydrated food (depending on how remote the location) in case the pull-out flight is delayed because of weather or some other problem.

- After your group has selected food for the field, designate one person to be in charge of organizing the food for camp put-in. It will take a minimum of one entire day to gather, package, and weigh the (boxes of) food for your group.

Alcohol:

- If you plan on taking more than two bottles of liquor into the field with you, you must fill out an alcohol request form at least 72 hours prior to your flight. This allows time for your order to be pulled, as well as time for you to pick it up and put it into the cargo system if you are flying on an LC-130. The forms, as well as a price list will be given to you at your science meeting. You will have to pay in cash (no checks) at the time you turn in the form. You **may** have one opportunity during the field season to do a liquor resupply order, but this depends on your field location. If you plan to do a liquor resupply, you must arrange for payment prior to going out into the field.

Attend Environmental Briefings:

- All USAP participants who will be going to the Dry Valleys are required to attend the Dry Valleys Environmental Code of Conduct orientation at FSTP. It will be scheduled as part of your required Field Safety Training. Those going to the Dry Valleys should also obtain a copy of the *Dry Valleys Code of Conduct*. Project specific information will be provided at your Science In-Brief.

- All USAP participants are required to attend a waste management briefing shortly after arriving on station. Information about the briefing times will be provided at your initial station orientation. For more information on waste handling, see Chapter 15.

Attend Outdoor Safety Orientation:
If you plan on doing any hiking, skiing or other recreational travel while you are in McMurdo, you will need to attend a safety orientation. This orientation is comprised of a half-hour video, followed by a question-and-answer session and updates on the status of various recreational routes. These are usually held twice a week at the Crary Lab. Watch the scroll for exact times.

3.1c Day 5

Begin load planning and packing for put-in. Any items that you will not need prior to deploying can be packaged and turned into the cargo system. Do not pack the items you will need for your shakedown. If you are flying by Helicopter, see Chapter 6.1 for more information. If you are flying by LC-130, see Chapter 7, section 7.2, and if by Twin Otter, see section 7.3.

3.1d Days 6, 7, & 8

All Field Safety Training courses, including the Helicopter Course, must be completed prior to field deployment. All new personnel in the USAP, regardless of their skill level and experience, must attend an overnight two-day field-safety course. Deep-field groups must also do an equipment shakedown. Returning personnel can opt for a proficiency test in lieu of the overnight training course. See Chapter 5 for detailed Field Safety Training information.

3.1e Days 9 & 10

Finish all of your packing. All Hazardous items must be turned into USAP cargo at least 48 hours prior to your flight. If you are flying on an LC-130, your cargo must be packed and in the system at this time.

3.1f Day 11

Put-in day! (Mother Nature and aircraft operations permitting, of course!)

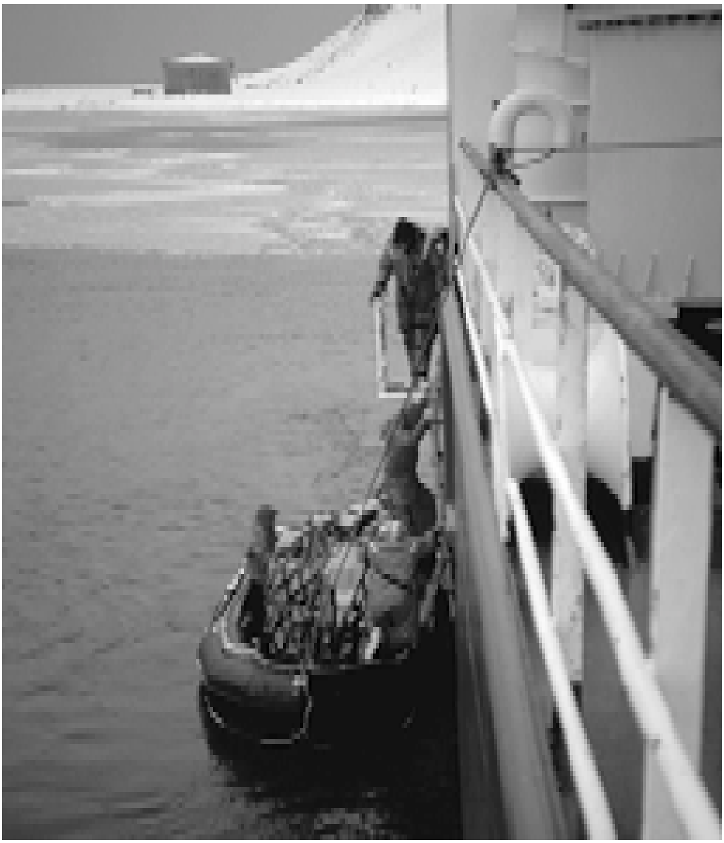

Figure 3-1: Zodiac offloading supplies from side of Polar Duke Research Vessel. (photo by Tim Cully)

3.2 Peninsula-Based Groups

This section provides general guidelines for basic field-party deployment preparation after arrival at Palmer Station and for research-vessel-supported field groups in the Peninsula area.

Personnel working at vessel supported field locations in the Peninsula area must plan time in Punta Arenas, Chile, to go through and repackage equipment and supplies. Keep in mind that all equipment and supplies should be packaged into small enough waterproof bundles for easy transport from Zodiac to shore. Small-sized bundles, which are easily handled by individuals, are necessary to safely move supplies to shore. On occasion, pack ice and rough seas may make put-in difficult or hazardous, so plan extra time to off load supplies.

Some scientists doing research in the Peninsula work from remote field camps, such as Copacabana camp on King George Island, and Cape Sherriff on Livingston Island. These remote camps are all unique yet share many similarities. The facilities used and type of research being done may vary from camp to camp, but many important issues remain common to all camps. For example, safety, communications, problems dealing with delays at put-in, supply offloading and human waste management are all issues that must be addressed prior to deployment. See Chapter 8: “Boating Safety” and Chapter 17: “Sea-Ice Safety” for additional information.

3.2a Field Communications

If you require the use of an HF radio for work in the Peninsula area, the radio equipment will be sent to Punta Arenas where you will pick it up. In most cases you will be provided with a PRC-1099.

Vessel-supported field groups must test HF radios prior to field deployment. Be sure to check both your primary and backup radios. If you have a problem with the radios, the vessel Electronics Technician can assist you

Figure 3-2: Punta Arenas warehouse.
(photo by Tim Cully)

or make any repairs.

After arriving at your field site and before the research vessel can leave, establish communications with Palmer Station. Field parties are required to make contact with Palmer Station on a daily basis. You will need to set up a mutually convenient time (Mean Greenwich Time) for the daily call with the Palmer comms tech. The primary frequency for the daily check-in is 4125 kHz.

Be aware that during the daily call the comms tech may ask you to switch to another frequency to pass information. This is done to keep the primary channel open in the event of another emergency call. If direct communication with Palmer is poor you may have to relay through another station. Parties have used the research vessel “Laurence M. Gould” (if in the area), the Polish Base, Arctowski or the British Base, at Rothera for this purpose. Operations Manuals are issued with the HF radios.

See Chapter 9: “Field Radios” for more detailed information about field radios.

3.2b Field-Safety Training

Field parties working from Palmer Station must complete the Boating and Islands Survival Courses before going off-station to conduct field research. Vessel-supported field parties must complete the Islands Survival Course prior to deployment to the field site. See Chapter 5 for detailed Field Safety Training information.

3.2c Field Equipment

All field equipment is stored in the Punta Arenas contractor warehouse (see figure 3-2). The field equipment items identified on your SIP will be staged in the warehouse. Upon arrival at Punta Arenas, assign one person from your group to check over your issued field equipment to ensure that it is in good working order. Notify the Contractor Representative in Punta Arenas if there are any discrepancies.

Vessel-supported field parties must repackage their gear into bundles that can easily be handled during the transfer from ship to shore by Zodiac, often in rough conditions.

3.2d Food for Field Parties

Personnel working at Palmer Station may request field issue food from the galley. In addition, you may request box lunches from the galley staff when working off-station for the day.

Vessel-supported field groups who are living and working at remote locations will be sent a food planning sheet. Contractor staff in the states will work with these groups prior to the field season to adjust quantities, etc. Perishable food items will be purchased in Chile by the Contractor Representative.

When planning food for the season, we suggest you use regular food items to cover the length of time you expect to be in the field. Take an emergency back-up of 2 to 4 weeks’ dehydrated food (depending on how

remote the location) in case the pull-out vessel is delayed due to weather or some other problem.
After your arrival in Punta Arenas, designate one person to be in charge of organizing the food for put-in. Keep in mind that food will have to be off loaded from a Zodiac by hand, often in rough conditions.

3.2e Mechanical Equipment

For Palmer Station based groups, any mechanical equipment requested on your SIP can be obtained by contacting the Laboratory Supervisor on station.

For vessel-supported field groups, mechanical equipment requested on your SIP will be sent to Punta Arenas and staged in the contractor warehouse. Check all equipment and spare parts to ensure they are complete and in good working order prior to deployment to the field. If you discover a problem with the equipment, the Contractor Representative will assist you in getting the problem fixed.

3.2f Field-Camp Liquor Rations

Personnel working at Palmer Station may purchase liquor and soda on station. Field parties deploying to other field sites by vessel may purchase liquor and soda in Punta Arenas prior to boarding the ship. USAP participants are responsible for purchasing their own liquor and soda, so make sure to bring sufficient funds to pay for this expense. You may request help from the Contractor Representative to assist with your liquor and soda purchase for the field season. No resupply for these items will be available.

3.2g Safety

Safety is an important issue at field camps. The safety equipment recommended below can be requested in your SIP. Your safety takes precedence over all else. It is recommended that at least one member of the camp be certified in first aid, preferably at the Wilderness First Responder level. Should someone become seriously ill or injured, it could take up to a week to get that victim to a medical facility. A well-stocked field camp medical kit is also necessary.

Another serious safety issue is fire. Structures in the Antarctic burn rapidly because of the extremely dry climate. Even in areas where precipitation is common, fire is still a potentially serious hazard. Losing your shelter in a remote setting can be a life threatening situation. Therefore, it is important to set up a survival cache at least 200 to 300 meters up-wind from the camp. The cache should contain enough tents, sleeping bags, pads, stoves, lanterns, fuel, utensils, HF radio, first-aid kit, extra clothing, dehydrated food, and water for each person in the field party. Depending on the remoteness of the camp, you should have enough of these supplies to last 2 to 4 weeks. Also, make sure that your camp is equipped with a sufficient number of ABC- type dry chemical fire extinguishers. A fire extinguisher should be placed at each exit, in the food preparation area, and near the generator.

If you use a kerosene heater, never leave it on while sleeping! Only use the heaters when someone is present in the hut. Be sure the hut is adequately ventilated to handle the carbon monoxide emitted from the heater. If any member of your party complains of excessive sleepiness, dizziness, headache, or confusion while the heaters are running, suspect carbon monoxide poisoning (CMP). Refer to Chapter 24 for more information on CMP.

When hiking away from camp, you must travel in groups of at least two and always carry a handheld radio with an extra battery. If one of you becomes injured, the other can assist with first aid or go for help depending on the situation. In the case where your camp is located near a glacier, never attempt to cross it unless you have the proper training and equipment. A crevasse fall can end a perfectly good career.

3.2h Safe Water Handling

No matter how you obtain water in the field, it can become contaminated if not handled safely. Coliform bacteria have been detected in field camp water. Although coliform bacteria may not be harmful, their presence indicates that pathogenic bacteria, which may cause serious illness, may also be present. You can minimize or eliminate the risk of contamination by following these safe-water-handling guidelines:

- Protect your drinking water source from exhaust or microbial contamination.
- Designate certain pieces of equipment (gloves, shovels, containers, ice axes) specifically for collecting snow or ice for drinking water and use them for no other purpose. Or, sterilize general use equipment with chlorine or boiling prior to snow and ice collection.

- Maintain the capacity to disinfect water in the field; use filters or iodine kits.
- Clean and disinfect your drinking water storage containers regularly with dilute chlorine.
- Use chlorine to sterilize any water you produce in the field. 2-3 mLs of chlorine solution (household bleach-5.25%) will sterilize the water in a 10-gallon carboy or preway pot.
- Use bleach to sterilize dishwater.
- Designate a hand-washing area in your camp.

3.2i Human Waste Management

The NSF policy requires that there be no discharge of human waste to ice free areas or freshwater systems either directly onto the land or into any pits, trenches, or similar devices. All human waste will be disposed of in such a way that it is either discharged directly into the sea or containerized for retrograde. See Chapter 15.

Chapter 4
Standards of Conduct in the Field

The Principal Investigator (PI) or field-team leader of each research group is responsible for ensuring that his/her group acts responsibly in the field. All field personnel should read the *Antarctic Conservation Act of 1978* (Document No. 95-154) and the *United States Antarctic Program (USAP) Participant Guide*. Both documents are available from the National Science Foundation (NSF).

When the Protocol on Environmental Protection to the Antarctic Treaty enters into force, Specially Protected Areas, Sites of Special Scientific Interest, and some historic sites will be combined into a single category of protected area, Antarctic Specially Protected Areas (ASPA's).

An additional category, Antarctic Specially Managed Areas (ASMA's), will be created for areas where activities pose risks of mutual interference or cumulative environmental impacts. This category will also include sites of recognized historic value that do not require strictly controlled access. Entry into an ASPA will require a permit, while entry into ASMA's will not.

Specially Protected Areas (SPAs) are areas of unusual scientific or historic interest. Entry into these areas is prohibited unless there is a scientific purpose. To enter an SPA, you must obtain a permit from the NSF. To apply for a permit, contact the NSF/OPP prior to departing for Antarctica. Allow three to four months for processing the necessary permits.

Sites of Special Scientific Interest (SSSI) are sites where scientific work is being conducted (or planned) and there is a risk of interference. Permits are not always required for entry into these sites and, in some cases, permission may be obtained in McMurdo or at Palmer Station from the NSF. However, you should apply for permits before leaving for Antarctica. All entrants must read and comply with the management plan specific for each site.

Violation of the regulations for Specially Protected Areas and Sites of Special Scientific Interest may result in a $10,000 fine or imprisonment for up to one year.

4.1 Appropriate Field Conduct in Antarctica

USAP scientific and operational teams that are deployed to sites remote from USAP main stations should conduct their activities in a safe manner. The field-party leader will be responsible for the conduct of all team members in the field and shall ensure that each team member is familiar with the risks involved and proficient in dealing with those risks.

4.2 Environmental Conduct in the Field

Research in Antarctica must always be carried out in a way that minimizes impacts on land, water, and ice. Be prepared to make this extra effort. You have an important responsibility to maintain the integrity of Antarctica for the future.

Guidelines for Personal Conduct

- Respect Antarctic flora and fauna. Interferring with any native mammal or bird without an ACA Permit is prohibited. If an animal reacts to your presence, then you are too close.
- Prevent spills or drips of any kind. Take materials with you for this purpose.
- Report any spills, and clean them up using Spill-response Kits.
- Track all releases to the environment during field work, including wastewater discharged.
- If an Environmental Assessment was prepared for your field work, follow all mitigating measures.
- Minimize your impact from walking and camping. Leave nothing behind.
- Do not take rocks, crystals, or other geologic specimens as souvenirs.
- Sort, label, and carefully store all solid and liquid waste.
- Set up your human waste facility early during camp set-up.

- Stay out of Specially Protected Areas that exist near your field activities, unless you have a permit.
- Do not introduce plants or animals into the Antarctic.
- Do not litter.
- Store your gear and supplies in a way that prevents release to wind or water.
- If you need information, supplies, or other environmental support while in the field do not hesitate to contact the contractor Environmental Representative in McMurdo.

After Your Field Season:

- At your out-brief provide all information about environmental releases, as required by the ACA.
- Provide suggestions for better environmental management and support of field operations.

Chapter 5
Field-Safety Training

5.1 McMurdo Field-Safety Training Requirements

Field-safety training and equipment shakedowns must be scheduled during your stay in McMurdo prior to your field deployment.

All new personnel, regardless of their skill level and experience, must complete an overnight two-day field safety course that includes cold weather camping skills, cold weather first aid, and emergency shelter building. For deep-field groups, this requirement is in addition to the equipment shakedown trip.

We strongly advise that deep-field groups include a safety guide/mountaineer who has previous Antarctic “deep- field” experience. This person should have considerable crevasse rescue experience, back country medical training, and Union Internationale Des Association De Guides De Montagne (UAIGM) or equivalent guide experience.

The NSF realizes there are some mountaineers and researchers in the program with extensive Antarctic Field Experience. Those individuals may be exempt form particular training courses. Researchers may formally request exemption from Field Training for themselves or personnel in their group on their SIP.

Field Support personnel will work with NSF to determine training requirements for individual groups. Training requirements will be indicated in each projectís Research Support Plan.

Training and shakedown time in McMurdo is intended to increase your groups overall skill level. Training includes how to use equipment and systems that are unique to working in polar environments, such as roped travel with Nansen sleds through crevassed areas and setting up and securing polar tents in high wind. This training is not intended to teach novices how to be mountaineers in two days.
Remote groups working in the field without a mountaineer/safety guide must demonstrate an acceptable level of proficiency as follows:

In glacial terrain, each member must be able to hold a fall, put in equalized anchors, escape from the system, rappel to the victim, improvise a chest harness, prussik out of a crevasse, prepare the crevasse edge, rescue a victim with a 2:1, 3:1 or 6:1 rope hoist, and be able to perform advanced first aid.

Each field group must do an overnight equipment shakedown trip. This is mandatory and will be tailored to your group’s specific needs. The equipment shakedown and field-safety training course may be combined in one overnight course for Dry Valley groups. Remote groups must plan for three to four days of field-safety training/equipment shakedown in McMurdo prior to field deployment.

5.1a McMurdo Field-Safety Course Descriptions

USAP personnel who are returning and who have previously attended the Snowcraft I course must attend the half day refresher course called the Push Course. The following skills are reviewed in this course:

- Cold weather injuries: prevention and treatment.
- Risk Assessment/Risk Management overview.
- Tent set up and anchor options.
- Stove operation and troubleshooting.
- VHF and HF radio set-up and operation.
- Survival bag review.
- Spill Kit review.

Returning personnel who also require the Helicopter Training or Dry Valleys Environmental Orientation will have these presentations incorporated into their Push Course.

Snowcraft I: Snowcraft I is an overnight course designed to familiarize personnel with cold weather camping procedures. Topics are addressed at the fundamental level and assume no previous knowledge of outdoor skills. The topics covered include cold injury prevention and treatment, terrain awareness and hazard analysis (crevasses, weather, emergency scenarios), layering and thermal regulation, snow shelters and use of field stoves, ski travel, ice ax introduction, environmental awareness (clean camping techniques), movement on snow, and spill response clean-up in the field.

Snowcraft II: The Snowcraft II course is a review of cold weather camping procedures, as well as an introduction to basic mountaineering techniques. The course is designed for science parties and support personnel who will be working in glacial terrain and may be exposed to crevasse danger. This course builds on a preexisting base of outdoor skills gained by personnel who have attended Snowcraft I training or other outdoor training programs. Topics include basic crampon technique, self-arrest and use of the ice ax, roping up and roped travel techniques, crevasse rescue (self-rescue and pulley systems), terrain awareness (walking tour through crevassed terrain), overnight shelters, and spill response clean-up in the field.

Crevasse Rescue: Crevasse rescue is a course that builds on the basic glacier skills learned in Snowcraft II. The course is designed to teach and demonstrate the acceptable level of proficiency of a glacier traveler. Each member must be able to hold a fall, put in equalized anchors, escape from the system, rappel to the victim, improvise a chest harness, prussik out of the crevasse, prepare the crevasse edge, and rescue the victim with a 2:1, 3:1, or 6:1 rope hoist. The course can also be tailored to address roped snowmobile travel and snowmobile extraction.

Dry Valleys: Personnel who are new to the program and working in the Dry Valleys will attend the basic Snowcraft I course and on day-two will receive instruction on camping, movement, and emergency procedures in rocky, windy, dry-cold environments.

All personnel going to the Dry Valleys must view a video that provides information on protecting that unique and fragile environment. The *Dry Valleys Code of Conduct* video is brief yet extremely important. An FSTP Instructor will answer questions afterwards and provide updated information.

Helicopter Training: Personnel who will be using helicopters must attend the Helicopter Training Course. This brief training, about 45 minutes, focuses on how to safely operate in and around helicopters. The two part course is required each season. First, a Helicopter Safety video will be shown. Then an FSTP Instructor will provide additional information and instruction.

Field Party Shakedown: This is a mobile course designed to test the equipment issued to your group and to offer a review of the travel and camp procedures that you intend to use. This can be taught by either the FSTP staff or your group's field mountaineer (when the mountaineer's qualifications meet or exceed those required of the FSTP staff). Generally, the field mountaineer and the FSTP staff work together on group instruction. This course assumes previous field experience in Antarctica or comparable regions and does not address the fundamental subjects covered in Snowcraft I (the course may be combined with the icefall phase of Snowcraft II). The topics covered vary from group to group and may include sledging and the use of snowmobiles, rope systems for glacial terrain, crevasse rescue, campsite evaluation, environmental impacts, and radio procedures.

Sea Ice: This is a one-day course designed for all personnel working on or crossing over the sea ice.

Topics are taught at a fundamental level and assume no previous knowledge of sea ice conditions or cold weather survival skills. The topics covered include ice dynamics (the type and nature of ice cracks), crack profile and the use of Kovacs augers for profiling, safe crossing standards for vehicles, alternative shelters, the use of camp stoves, radio communications, check-out/check-in procedures, and spill response clean-up in the field.

High-Altitude Lecture/Demonstration: This lecture/demonstration is designed to familiarize personnel going to high elevations on the continent with altitude sickness, which is a potentially lethal disorder that is often preventable. This presentation is available to all personnel going above eight thousand (8,200) feet. Taught at a basic level, the lecture's goal is to give personnel a working knowledge of the prevention, diagnosis, and treatment of acute mountain sickness and high-altitude pulmonary and cerebral edema. The instructor will focus on actions that contribute to successful acclimatization and will also discuss possible responses to altitude-related emergencies, including evacuation. A demonstration of the operation of a Gamow Bag, a portable hyperbaric chamber, will also be given.

Radio Training: Radio training is included with the field-safety courses. Instruction for set-up and use of HF and VHF is offered. Field personnel should make sure to check out their radios from the Field Party Communications Shop (see Chapter 9, section 9.3) prior to the course so radios can be tested during the course.

5.2 Peninsula-Area Field-Safety Training Requirements

Field-safety training courses must be successfully completed prior to heading out into the field. All USAP personnel at Palmer Station who intend to travel off station via zodiac are required to attend a Boating Course and the Islands Survival Course. In addition, personnel who will work on the sea ice must take a Sea Ice Safety Course.

USAP personnel who are returning to Palmer Station may take an abbreviated course that allows them to demonstrate their proficiency in lieu of attending a full Islands Survival Course again.

The NSF realizes there are a handful of researchers in the program with extensive field and boating experience. Those individuals will meet with the Station Manager and the Boating Coordinator to discuss appropriate training. Comments and concerns that help support personnel to further refine training and safety practices are encouraged.

Researchers may formally request exemption from Field Training for their group on their SIP. The Palmer Laboratory Supervisor will work with NSF to determine training requirements for individual groups. Training requirements will be indicated in each project's Research Support Plan.

5.2a Peninsula-Area Field-Safety Course Descriptions

USAP personnel who are returning to Palmer Station may take an abbreviated course, which reviews the skills below, in lieu of attending a full Islands Survival Course again. To be exempt from the Islands Survival Course, returning USAP participants who are planning on boating must first demonstrate proficiency in the following areas (using island survival cache gear):

- Set up a tent on rocky terrain, emphasizing wet and windy conditions.
- Operate an MSR stove.
- Discuss the prevention and treatment of hypothermia.

Zodiac Safety Training: The Palmer Station Boating Coordinator teaches Boating Safety. The Boating Safety Course includes a short safety video, followed by reviews of outboard engine operation, minor engine repair, survival bag contents, boat features, check-out procedures, and an area orientation. Students will also receive hands-on practice in the safe operation of Zodiacs, proper island landing and mooring procedures, and man-overboard drills. In order to pass the course, the students will be required to read local boating and access regulations, as well as demonstrate proficiency in the handling of a Zodiac.

Sea Ice Safety Training: The Sea Ice Course covers the station guidelines and checkout procedures; safe sea-ice travel; cold injuries and first-aid; emergency procedures;

and an explanation of the risk assessment/ risk management plan that will be required of all projects that wish to travel on the sea ice.

Islands Survival Course: All research vessel support field groups and Palmer Station personnel intending to use Zodiacs must attend the Islands Survival Course. The course is taught at a basic level and focuses on setting up a survival camp using island survival cache gear. Topics to be covered are risk assessment and risk management plan, camp site analysis, mountaineering tent set-up under adverse weather conditions, anchoring tent guy lines in snow and on rocky terrain, stove operation, methods to stay warm and dry, cold injuries and first-aid, and emergency procedures. You will need to allocate several hours for this training.

Chapter 6
McMurdo Area Helicopter Transportation

Figure 6-1: USAP Helicopters. (photo by Jack Hawkins)

The USAP operates a fleet of four helicopters in the McMurdo area. Two of these are the model AS350B2 aircraft, known as either “squirrels” or “A-Stars,” and two are Bell model 212s, civilian versions of the Huey (see figure 6-1). The USAP operates this fleet under the civilian Federal Aviation Regulations. The helicopters are single-piloted, which means the pilots are responsible for all aspects of the aircraft’s operation. All USAP personnel must attend a helicopter training course prior to boarding the aircraft for the first time. Helicopter training is part of the Field Safety Training Program.

6.1 Helicopter Pad (Heli-pad)

The administrative and logistics functions for helicopter transportation are located at the Heli-pad. The helicopter hangar is used for aircraft maintenance and also houses various administrative offices. The smaller silver structure located to the side of the Hangar is the Passenger Terminal. This is where you report for your flight. **Note:**

- Never drive onto the Heli-pad without radio clearance.
- Never walk onto the Heli-pad itself without escort.
- You can walk to the Passenger Terminal without clearance or escort.

Seven helicopter support staff members work with passengers and their cargo to plan flight schedules and manifest cargo. One of five Heli-techs will brief you in the passenger Terminal and later escort you to your Helicopter. The Senior and Assistant Helicopter Coordinators have offices in the Hangar.

6.2 Preparations: Flight Requests and Cargo

You will attend a Science In-brief on day two of your arrival in McMurdo. After going over your schedule with the Senior Helicopter Coordinator, a pager will be issued to your group. Unsettled weather can cause sudden changes to flight schedules. The pager will greatly expedite notifying you of flight delays, changes or cancellations.

Three days before your flight, confirm your helicopter flight request with the Senior Helicopter Coordinator. Your request must include estimated cargo weights, the number of people needing to fly, and a list of hazardous cargo. Unexpected or emergency helicopter requests should be communicated to the Senior Helicopter Coordinator as soon as possible.

Two days before your flight, turn in all hazardous cargo to USAP Cargo.

One day before your flight, bring all non-hazardous cargo to the Heli-pad. Special arrangements can be made for gear or equipment that needs to be used until the day of the flight. All equipment must be weighed, numbered, and marked with the following information:

- Science group number and item number (e.g., GO-078-O/1, GO-078-O/2, etc.)
- Location for delivery (e.g., Lake Hoare)
- Weight (in pounds)

List all items, including weight and estimated cube, on a manifest form. Be sure to include on the manifest form each piece of cargo that you are dropping off. Give the completed form to one of the Heli-techs when turning over your cargo. A Heli-tech will prepare your cargo load(s) and a final manifest, which will be given to the pilot for your flight the following day. You will also want to schedule a transportation time that will get you to the Heli-pad a minimum of 30 minutes prior to your flight; 45 minutes early is preferable.

The Heli-pad staff will determine which of the two types of aircraft will be used for your helicopter support. The aircraft have different load carrying capacities, depending upon on your destination, cargo weight, and fuel onboard. The type of aircraft assigned to your project may be affected by other flight requirements scheduled that day.

6.3 Hazardous Cargo

Hazardous cargo is handled differently than non-hazardous cargo; it is first sent to USAP Cargo instead of being dropped at the Heli-pad. A listing of common hazardous equipment and materials is in Appendix A of this manual. Identify any and all hazardous material in your field supplies, including science supplies, BFC equipment, and MEC equipment.

Deliver your hazardous cargo to USAP Cargo at least 48 hours before your flight. Record each piece of hazardous cargo on a manifest form. It is then the responsibility of USAP Cargo to package all hazardous materials in accordance with USAP hazardous cargo regulations. The Heli-pad staff will transport your hazardous cargo to the Heli-pad.

When transporting hazardous cargo from one field site to another, be sure to provide the pilot with a copy of the hazardous cargo manifest. Notify the pilot of any changes to the hazardous cargo manifest, as well. The pilot requires this hazardous cargo documentation on all flights. This important information relates directly to safety and environmental concerns.

Save all hazardous shipping containers and reuse them for transporting hazardous items in the field. Burn off excess fuel in stoves before transport, and only transport fuel in certified containers. The pilot or heli-tech will load hazardous items in specific areas of the helicopter.

6.4 Resupply Cargo

To reduce your initial put-in flight hours, use the resupply system during the season. If you will be moving camp locations during the season or using helicopter support for day trips from your camp location, resupply is an economical use of helicopter time to receive additional food, fuel, and equipment since the helicopter is coming to support your group and may have room in the cargo compartment for the requested items.

The following is how you must prepare your resupply. You will store the resupply in your allocated cage space at the BFC. You must inventory each box and mark the outside of the box or tag the item using the following information:

- Science group number and item number (e.g., GO-078/1, GO-078/2, etc.)
- Weight (in pounds)
- HAZARDOUS (if appropriate)

Give copies of the resupply inventory to the BFC Supervisor and the Senior Helicopter Supervisor, and take a copy with you into the field. By following this plan, it will be easy for you to pass resupply information to the Heli-pad staff. You simply have to ask for Box #, and so on, in your cage.

When asking for hazardous resupply from the field, please give two days notice for the BFC staff to deliver the resupply to USAP Cargo for proper packaging for the resupply flight.

6.5 On the Day of Your Flight

On the day of your flight, check the flight schedule early. The schedule will appear on the local area network (LAN) under Operational Info/Helicopter Operations. If a member of your party was issued a pager at the Science In-brief, it is critical that it remains switched on for the day of a scheduled flight. This will enable the Senior Helicopter Coordinator to quickly notify you of any schedule changes. If your group doesn’t have a pager, it is important that Heli-pad staff know where to contact you on the day of your flight. Changes to flight schedules often occur and are generally the result of deteriorating weather.

You must be at the Heli-pad 30-45 minutes prior to the flight. This means that ALL personnel and equipment must be there by that time. It is also required that you be dressed in ECW issue clothing and footwear from the CDC. In consideration of your own safety, you won’t be allowed to board a helicopter unless you are properly attired.

6.6 Helicopter Loading and Unloading

In McMurdo, the Heli-pad staff will work with the pilot to load and unload the helicopter. At field locations, your group must work with the pilot to perform these tasks. The pilot is ultimately responsible for passenger safety and will determine if the aircraft can be loaded or unloaded with the rotors running. At certain times, the pilot may request that Heli-pad staff accompany the aircraft into the field to help safely load or unload cargo for field parties.

6.6a The Boarding Process at the Heli-pad

A Heli-tech will lead you to the helicopter when the pilot is ready for boarding. At the helicopter, a final safety briefing will be given by either the pilot or a heli-tech, and locations of survival bags will be pointed out. Once you are seated, strap yourself in and connect your helmet to the helicopter intercom system. Do not talk to the pilot during take-off or landing.

6.6b Survival Equipment

Thirty-five pounds of survival equipment for each passenger will be included on each flight. It is in your best interest to ensure that this equipment is on board before take-off from McMurdo. The Heli-pad staff will assist with placing the survival equipment/bags on the helicopter. A pilot will not be allowed to leave you at a field site without a survival bag.

6.7 Estimated Flight Times

Following are flight time estimates (one way) for planning flights:

Allen Hills	1 hour
Cape Crozier	35 minutes
Cape Bird	30 minutes
Dry Valleys	30-45 minutes
Koettlitz Glacier	30 minutes
Marble Point	30 minutes
Minna Bluff	30 minutes
Mount Erebus	30 minutes

6.8 Clothing for the Flight

The following items must be worn for every flight:

- Bunny boots or plastic insulated climbing boots
- Thermal insulated long underwear (top/bottom)
- Wind pants with pile pants underneath
- Pile jacket
- Parka with hood or jacket layering system
- Mittens or gloves with liners
- Bear paws (shove them in your pocket or have them close by)
- Hat
- Sunglasses

Additional Items to Pack for Day Trips:

- Sunscreen
- Water bottle

- Thermos with hot liquid
- High energy food
- Ear plugs

Keep in mind that there is a chance you may get stuck in the field overnight. You will be dropped off with survival bags, but you'd be wise to pack some extra food (e.g., chocolate/trail mix), extra warm clothes, reading material, and a toothbrush.

6.9 Day Trips

If you plan to be left in the field for the day, you must have at least two people, survival bags, proper clothing, and a VHF Radio. After you are dropped off, the pilot cannot leave until you have communicated with him on the VHF radio.

If you are traveling to the Dry Valleys, and away from established camps, you must have personal urine bottles and plastic bags for human waste.

6.9a Radio Equipment

All groups departing for the field will need VHF radios that have the Field Party Frequency Plan. During the pilot brief, discuss which channel you will use for helicopter/field team communications ("Helo Ops").

For a field camp put in, you must have the following radio equipment:

- HF Radio(s)
- Handsets

- Antennas
- Batteries and recharging capabilities for the duration of your stay in the field
- Back-up radio (complete)

After the pilot drops you off, and before he/she can leave you in the field, you must establish communications with McMurdo (“Mac Ops”). If you cannot establish communication because of radio malfunction, you’ll be flown back to McMurdo. (**Note**: Be sure to test your radio equipment before deploying to the field.)

6.10 Daily Communications

Every field group must make daily radio contact with the Field Operation Communications Center (FOCC) (Call sign “Mac Ops”). Established field camps with phones can simply call in. Those camps using HF radio communication have various options if radio contact with McMurdo is poor: you may relay between another field group, South Pole, or Scott Base. The required daily check-in is extremely important, and various levels of SAR response will be initiated if a field party fails to make its daily check-in. (See Chapter 9: Field Radios for more detailed information.)

Each morning starting at 8:30a.m., a member of the Heli-pad Staff will have HF radio communications with all helicopter supported camps in the Dry Valleys and Ross Island area. The day’s flight schedule, weather, resupply, and other information is passed at that time. You will be asked to provide a local weather observation between 7:00-7:30a.m. on the day of your flight.

Also, if you have changes or information to pass about your support for that day, you must contact the Heli-pad staff at that time. This information is best received before 7:30 a.m. and is important for the helicopter pilots and operational plan for that day. Again, established camps with phones will conduct all of the above communications over the phone. Before returning from the field, all field groups need to contact Housing in McMurdo, via HF radio or phone, to make arrangements for accommodations.

Figure 6-2: Field camp retrograde. (photo by Paula Adkins)

6.10a Field Resupply

In camps that have phone access to McMurdo, field groups can call individual departments for resupply items. These departments will notify the Heli-pad of the resupply. However, all resupply requests communicated via radio must be communicated directly to the Heli-pad staff. The Heli-pad staff will coordiate the requests directly with the appropriate work centers, which will then supply the weight of the item(s) to the Heli-pad staff for load planning and delivery.

6.10b Schedule Changes

New flight requests and changes to schedules must be submitted three days before the flight. You may pass written requests to the Heli-pad staff via a pilot, or communicate verbal requests over the radio. Before camp put in, you must confirm with the Senior Helicopter Coordinator a plan of your entire season, from put-in to pull-out. This plan should include estimated dates for camp moves, day trips, close support, and resupply.

6.11 Retrograde from the Field

The most efficient way to retrograde material from the field is to use resupply flights, camp moves, and day-use helicopter flights to retrograde waste and extra field gear. This will eliminate the need for excessive dedicated flights for your pull-out.

During the daily HF radio/phone communications with the Heli-pad staff, field groups can pass information concerning retrograde so it can be incorporated into the flight schedule. Remember that the helicopters can retrograde sling loads back to McMurdo or for staging at Marble Point, so don’t let packaging, boxes, and barrels pile up at camp... Retrograde it early! (See figure 6-2). Please refer to Chapter 15: “Waste Handling in the Field” for proper packaging and labeling of retrograde items.

Figure 6-3: How NOT to approach a helicopter

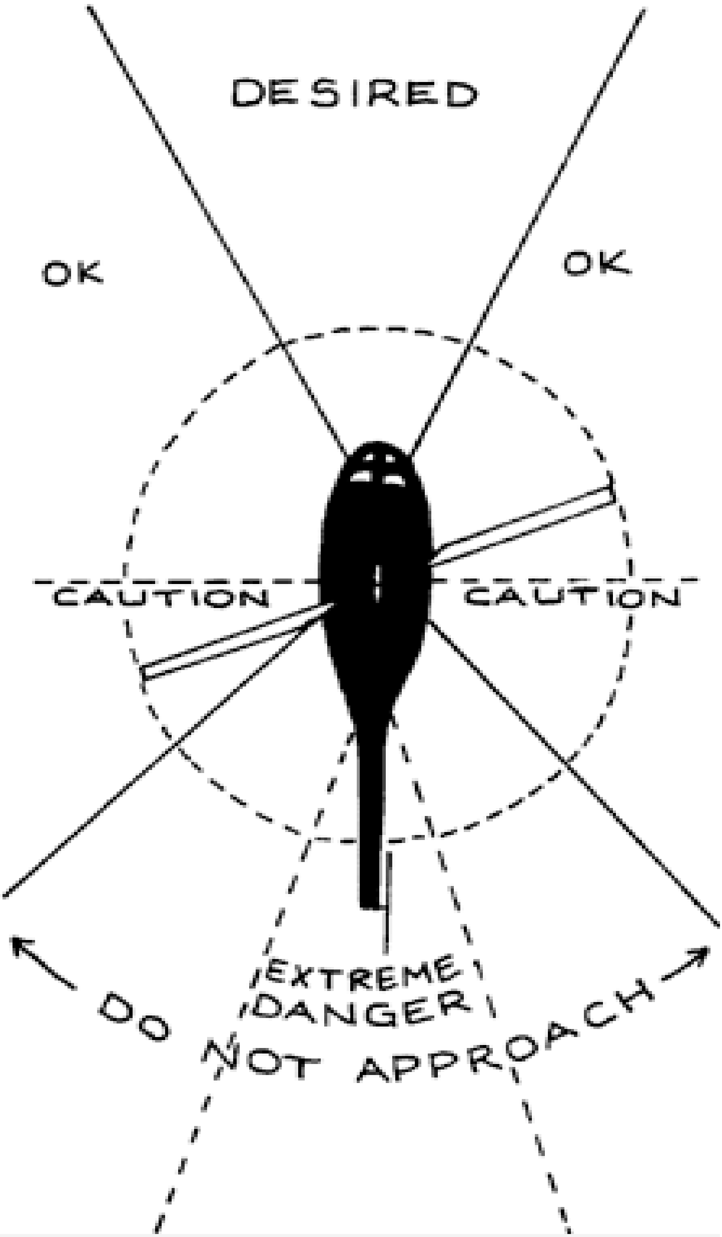

Figure 6-4: Helicopter danger zones

6.12 Camp Pull-Out

If you have retrograded material and equipment throughout the season, your camp pull out should be relatively easy. It’s best to leave two team members in the field to accompany the last pull-out flight. They can ensure that all the equipment is picked up and that nothing blows away.

6.13 Helicopter Safety Guidelines

- NEVER approach a helicopter until you receive a thumbs up signal from the pilot.
- NEVER walk near the tail rotor. Always approach from the front of the helicopter.
- Carry long loads such as bamboo poles, Scott tents, or survey rods low and level to the ground.
- Remain seated with seat belts fastened at all times.
- Wear helmets.
- Do not smoke in or near the helicopter.
- Assume the crash position when warned by the Pilot.
- In the event of an emergency, remain in the aircraft until all motion has stopped.
- Know the location and operation of emergency exits.
- Know the location of first aid kits
- ALWAYS obey the Pilot’s orders.
- Know the location of aircraft survival equipment.
- Any movement on the Helicopter Pad must be

authorized by the Heli-pad staff either on the pad or in the hangar.

(See Figures 6-3 and 6-4 on the previous pages.)

6.14 Planning Information for Helicopters

Since weight is critical in determining cargo capacity, each passenger will be weighed before the flight. In addition, all cargo will be weighed and its volume (cube) determined.

6.14a Bell 212 Helicopter

The Bell 212 helicopter can hold up to 9 passengers (with only personal gear; with that many passengers, the cargo compartments will be required to accommodate survival bags.

Fuel	Payload*	Operating Radius	Endurance w/ 30 minutes fuel reserve
Full internal fuel (1,400 lbs)	2,500 lbs	125 miles	2 hrs. 30 min.
Full internal & 1 aux fuel cell	2,000 lbs	160 miles	3 hrs. 15 min.
Full internal & 2 aux fuel cell	1450 lbs	200 miles	4 hrs.

*Payloads account for pilot and his/her survival equipment aboard aircraft already.

Planning for Cargo Using the Bell 212 Helicopter

- Cargo Hatch Door Size: 7’8" x 4’2"
- Cargo Compartment Size: 7’8" x 4’2" x 7’11"

6.14b A-Star 350 Helicopter

The A-Star helicopter can comfortably hold 4 passengers with minimal gear (approx. 1000 lbs), but 3 passengers are preferred since this allows considerably more space for cargo.

Fuel	Payload*	Operating Radius	Endurance w/ 30 minutes fuel reserve
Full internal fuel (940 lbs)	600 lbs	160 miles	2 hrs. 30 min.

*Payloads account for pilot and his/her survival equipment aboard aircraft already.

Planning for Cargo Using the A-Star 350 Helicopters

- Cargo Hatch Door Size: 5’6" x 3’6"
- Cargo Compartment Size: 16" x 20" x 27"

Chapter 7
McMurdo Area Fixed Wing Operations

Figure 7-1: LC-130 at Remote Field Camp. (photo by Tim Cully)

7.1 Flight Schedules

Before you start planning and packing to go into the field, it is very important to find out when you are scheduled to leave, and whether you will be flying on an LC-130 or Twin Otter aircraft. This information will determine how you pack, and how quickly the cargo needs to be turned in. You should receive the information during your science meeting from the Fixed-Wing Coordinator.

The Fixed-Wing Coordinator develops the daily LC-130 and Twin Otter flight schedules, makes daily communications with all fixed wing remote field camps, and is your point-of-contact for any flight related questions or schedule changes. The Coordinator is located on the second floor of building 165.

7.2 Planning for LC-130 Transport to the Field

7.2a Load Planning

Ski-equipped LC-130 Hercules aircraft are used for remote field party put-ins. Each aircraft has a different polar operating weight (as much as 2,500 pounds between aircraft), which can pose a problem when planning the cargo load for your put-in flight. You will not know until the day of your flight which aircraft you will be flying on and, therefore, what the aircraft operating weight will be. As a general rule, the put-in Allowable Cabin Load (ACL) should be planned for the aircraft with the lowest load capacity. Exceptions can be made on a case-by-case basis. Contact the Fixed-Wing Operations Coordinator for load-planning advice.

To prepare for a multiple flight put-in, you must plan to put enough food, fuel, and equipment on the first flight in case the second flight is delayed. There have been rare cases where a field party waited two weeks for a second flight that was supposed to arrive on the same day as the first flight! Be flexible and attempt to develop alternative plans for your field work within a “worst case” scenario.

Plan your put-in loads so you can accomplish field work if the second flight is delayed. We suggest that on the first flight you take your scientific equipment, half your food, half your fuel, and half your snowmobile issue. This way you can start working in the field if there is a delay in the second flight.

7.2b Aerial Reconnaissance (Recce)

It may be determined that an aerial reconnaissance (recce) is required prior to the put-in flight. It may be possible to airdrop fuel, food and other supplies during the recce misson to reduce the weight of the put-in flight(s). Consult the Fixed Wing Coordinator if you would like more information on this possibility.

Note: Each bundle of food or fuel that is airdropped has approximately 200 pounds of assorted equipment that must be returned to McMurdo (i.e., parachute, straps, cardboard, and plywood).

The recce flight will be conducted at various altitudes, and as low as 200 feet, to look for crevasses and other surface hazards. It may be determined that a field team member will go on the recce mission. The Fixed-Wing Coordinator will advise the Field team of the date and time of the recce mission and the corresponding flight brief with the flight crew. During the flight brief, the Aircraft Commander (AC) will discuss the objectives of the mission and the role of each member on board the aircraft. Please bring any maps and photos of the put-in location to the flight brief.

As for all Antarctic flights, you will need to wear your

USAP-issued Extreme Cold Weather (ECW) gear or FSTP-certified equivalent and carry your emergency bag of spare clothing. (See Section 1.4 for information on FSTP-certified equivalent clothing.)

7.2c Equipment Packing

When packing your equipment for LC-130 put-in, put essential camp set-up items together and make them easily accessible. The weather may be marginal during your put-in, making it difficult to unpack and sort through equipment without having some of it blow away in the contrail.
Make sure all essential life sustaining equipment is on your first put-in flight. Do not forget radios, sleeping bags, stoves, fuel, matches, food, and tents.

Boxes, triwalls, banding equipment, and pallets are available in the USAP Cargo building (Building 73).

7.2d General Cargo

All cargo must be turned over to USAP Cargo at least 72 hours prior to the flight.

USAP Cargo personnel will help you weigh boxes once they are packed. You must mark each box with its weight and cube. After all of your cargo has been turned over to the USAP Cargo, please contact the Fixed-Wing Coordinator to discuss cargo priorities. The priorities determined by you and the Fixed-Wing Coordinator will be used by the Movement Control Center (MCC) to build pallets in accordance with the Available Cargo Load (ACL).

USAP Cargo will turn over all your cargo (including hazardous) to MCC, along with the proper documentation. The MCC Cargo Yard is responsible for palletizing all cargo for LC-130 flights and then transporting the cargo to the airfields. The Fixed-Wing Coordinator, field team members, and MCC personnel will conduct a "pallet party" in the cargo yard to ensure that the pallets are built in accordance with the cargo priorities, science objectives, and proper cargo building principles.

7.2e Hazardous Cargo

All hazardous cargo must be packaged and flown in accordance with military regulations. A list of common hazardous cargo is in Appendix A of this manual.

Identify all of your hazardous equipment (including science supplies, BFC equipment, and MEC equipment) and turn it over to USAP Cargo, where personnel will package all hazardous materials in accordance with military regulations.

7.2f Frozen Food

Frozen food must be packaged and stored in the BFC Food Room freezer until your cargo is turned over to the MCC. Once turned over, the frozen food is stored in galley freezers. A few hours before your flight, cargo personnel will transport your frozen food to the aircraft.

If the flight is delayed or canceled, it is wise to ensure that all frozen food is returned to the galley freezer. It's in your best interest to follow up on critical things to ensure that they are done.

7.2g Bag Drag

You'll have a "bag drag" (i.e., a weigh-in of field personnel and their baggage to determine aircraft load) at least twelve hours prior to your flight. Normally "bag drag" is the evening prior to an early morning flight. At this time, you must "check in" all your personal gear (i.e., clothes and all personal items you want with you in the field). These checked-in items will remain with Strip Cargo in the event of a flight cancellation.

You will be allowed one hand-carry bag when you board the plane. Make sure to put shoes, clothes, and a toothbrush in this bag, in case the flight is canceled. Your radios and weather kit must also be hand carried. This is to ensure that the radios will be warm and that you can establish communications with another Field Camp before the plane leaves you in the field.

7.2h The Day of the LC-130 Put-In Flight

1. **Check the Flight Schedule:** Air Services posts bag drag Information, the flight schedule, and any updates on the Transportation Channel. This information is also posted at MCC and outside the dining facility in Bldg. 155.

2. **Attend the Pre-flight Briefing:** The PI and/or the most experienced field-team member should attend the preflight briefing at the airfield passenger terminal or other location prearranged with the aircraft commander. Weather consider-ations and alternative put-in sites may be dis-

cussed. To enhance flexibility, questions such as "Is it possible to traverse to the work area if put-in at a different location?" may arise.

3. **Report to the MCC:** Report to the MCC for transportation to the airstrip two hours before the scheduled departure time.

4. **Inspect Your Gear in the Aircraft prior to departure:** Do not assume that all your cargo and flight details have been taken care of. Inspect your snowmobiles, and make sure you have the keys. You must have survival gear: radios, sleeping bags, tents, stoves, and food. Double-check your cargo manifest against what you can see on the aircraft. If something is missing, don't be intimidated! Tell the loadmaster that the Aircraft Commander must stop the flight. Cargo representatives will need to be advised that equipment is missing.

   All movement around the aircraft is directed by the aircraft loadmaster. Listen and follow his/her directions!

7.3 Planning for Twin Otter Transport to the Field

Sometimes a Twin Otter aircraft is used instead of an LC-130 for remote field party put-ins. The smaller aircraft is traditionally used for small field teams, with moderate cargo, in non-groomed areas. If you know you are being transported by Twin Otter to your field camp, the way you plan for put-in will be quite different than if you were going on an LC-130.

7.3a General Cargo

The type of equipment you need to pack will be the same as with the LC-130 (see Section 7.2c), but the way that you pack it will be different. The smaller size of the Twin Otter means that instead of packing in large triwalls and building pallets, all cargo must be small enough to fit through a door approximately 5’ x 4’ in size. (See Table 7.9.) With that in mind, identify all your cargo and determine actual weights and cubes of all field and scientific equipment, food, fuel, and personal gear. (See “Appendix A” of this manual for weight and cube information.). If you have cargo that has special requirements, (i.e. it needs to be kept frozen), please let the BFC staff know and they will show you where to store it. Remember, all your gear will be hand-loaded by you and the Twin Otter crew.

When you have completed your packing, contact the Fixed-Wing Coordinator with the total weight and cube of your cargo. Unlike cargo shipped on the LC-130, you do not turn your cargo over to USAP cargo. Your general cargo will remain in your cage at the BFC, or with you until the day of the flight.

7.3b Hazardous Cargo

All hazardous equipment must be packaged and flown in accordance with FAA regulations. A listing of common hazardous equipment is in Appendix A of this manual.

Figure 7-2: Twin Otter aircraft (photo by Henry Perk)

Identify any and all hazardous items in your field gear, including science supplies, BFC equipment, and MEC equipment, at least 72 hours before the day of your flight. Put them together in one pile in your cage, and give a list to the BFC. If you're unsure what is hazardous, ask USAP Cargo personnel for assistance. It is the responsibility of USAP Cargo to package all hazardous materials in accordance with regulations. The BFC staff will assist you in submitting and staging hazardous cargo, which will remain in the possession of USAP Cargo personnel until the day of the flight.

7.3c Getting to the Aircraft

The day before your scheduled flight, contact the Fixed Wing Coordinator who will coordinate your rendezvous with the Twin Otter crew. Please allow time to take the airfield shuttle to the airfield. Once you've arrived at the Twin Otter, the crew will determine how the cargo is to be loaded. You will be expected to help load and unload the cargo, as directed by the crew. Please make sure to identify any cargo that needs special handling at this time.

7.4 Radio Communications

Remember to stop at the Field Operations Communication Center (FOCC) to obtain a Frequency Assignment Plan and your radio call sign. Also, every member of your field party should attend the Field Party Shop radio briefing, during which shop personnel will issue your field radios and provide instruction on radio use.

7.5 Weather Briefing

At least two members of your field party should attend the briefing at the McMurdo Weather Office (located on the 2nd floor of Mac Center, Building 165). Weather Office personnel will provide instruction on making weather observations and about how to relay weather observations to McMurdo. You'll also be issued a meteorological kit, which includes a thermometer, an anemometer, an altimeter, and a cloud identification chart. Refer to Chapter 10: Weather for more information on taking and relaying weather observations.

7.6 Ski-Way Marker Equipment

Make sure to pack a few extra bamboo poles, flags, and large black garbage bags to use as ski-way markers for your pull-out flight. The flags also help identify wind speed and direction.

7.7 In-the-Field Procedures

7.7a Camp Put-In Procedures

After the air crew drops you off and before they can leave you in the field, you must make radio contact with a fixed station: McMurdo, South Pole, or any other established field camp (depending on season). You must also erect a shelter (tent). The most efficient way to do this is to split into two groups. One group will set up a tent and light a stove (well away from the aircraft and turning area). The second group will set up the radio and antenna (well away from the aircraft) and establish communications.

7.7b Marking Grid North

One member of your party should consult with the aircraft navigator or pilot in order to set the altimeter (in the meteorological kit) and to determine the location of Grid North. (See Chapter 21: “Antarctic Navigation” for a discussion of Grid North.) Use two bamboo flags to mark Grid North. All heading references given to aircraft and all wind direction information given during scheduled weather reports will be in relation to Grid North. Review the heights and distances of local features (if any) for passing weather information.

7.7c Daily Communication with the FOCC

At a prearranged time everyday, you must have radio communication with McMurdo via the FOCC (call sign “MAC Ops”). Radio communication between some areas of Antarctica and McMurdo is poor. Sometimes it is necessary for field parties to relay between South Pole Station, a major field camp, or another remote field party for daily check-in. See Chapter 9: “Field Radios” for more detailed information on communications.

Figure 7-3: Establishing communications with a fixed station. (photo by Tim Cully)

You may be required to give weather observations in your daily communications. Be prepared with the proper weather information in the correct order. (Refer to Chapter 10: “Weather.”) You might also be asked to relay weather information for another field party. If field party members fail to make their daily check-in, the SAR Coordinator will be notified and appropriate measures will be taken based on the the circumstances. A Search and Rescue may be initiated.

7.7d Communications with the Fixed-Wing Coordinator

In addition to your daily check-in with the FOCC (call sign “Mac Ops”), you have the option of talking with the Fixed-Wing Coordinator from 0900 to 1900 daily. At this time, you can pass along information, make resupply requests, request schedule changes, or request camp pull-out times.

7.8 Preparing for Camp Pull-Out

7.8a Pull-out Schedule and Retrograde Advisory

Coordinate your pull-out schedule with the Fixed-Wing Coordinator. When doing this, you’ll need to pass information regarding the weight, cube, and type of retrograde cargo you have. Of particular importance is the number of fuel drums (full and partial) for retrograde. Field samples will generally replace the weight of food and fuel that have been consumed.

7.8b Waste Retrograde

Remote deep-field groups must retrograde all waste. This does not include human waste. See Chapter 15: “Waste Handling in the Field” for simple methods of waste handling.

7.8c Equipment Staging

Your camp must be entirely broken down; the gear must be staged, palletized, and ready for quick loading when the aircraft arrives. All pallets should be right side up (noted by the red stripe along the edge - this indicates the top of the pallet), broken free of snow and ice, and ready to be towed by snowmobile to the rear of the aircraft.

Nansen sleds should be loaded only with Scott tents. If you overload the sleds with other gear, they may be damaged when they are off-loaded. Everything except tent(s) and radio(s) should be arranged as shown in Figure 7-4 on the next page. **Note:** Snowmobiles and fuel drums (both full and empty) should be staged in this pile.

7.8d Hazardous Equipment Repackaging

All hazardous equipment should be repackaged similarly to how it was shipped (e.g., matches in foil, 12-V batteries in wooden boxes, etc.). Partially full drums should be tightly capped and tipped on their side to confirm a good seal.

Snowmobiles must have between 1/4 and 1/2 tank of fuel in them for aircraft transport. No more and no less!

7.8e Ski-Way Preparation

Before going into the field, discuss required ski-way/ski-landing-area markings with the Fixed-Wing Coordinator. You will be given a Air Force procedure 10-3 to follow for marking the ski-way/ski-landing-area.

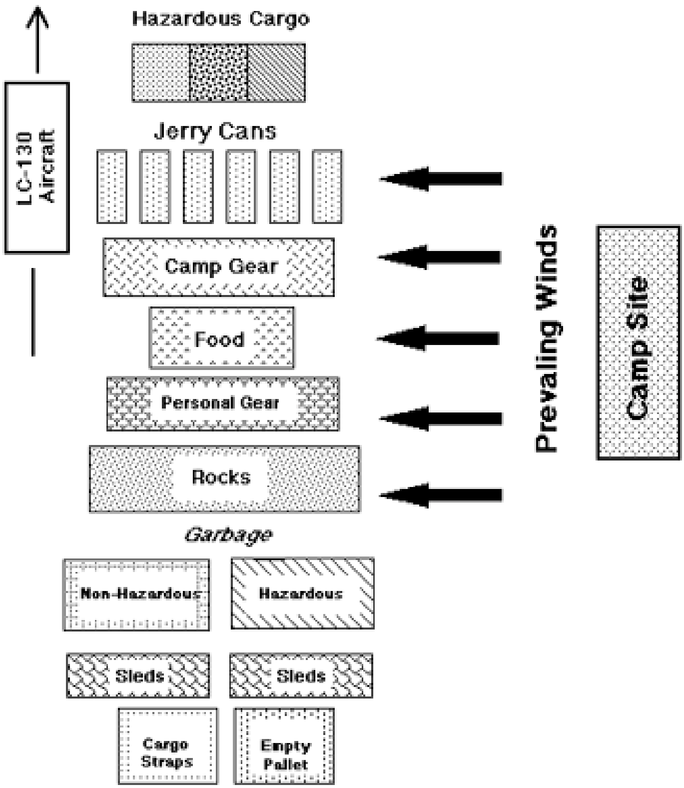

Figure 7-4: Equipment staging.

7.8f Hourly Weather Observations for the Pull-Out Flight

When an aircraft mission to your site is planned, you will be required to begin hourly weather observations six hours prior to the scheduled launch of an aircraft, and continue hourly observations through the landing of the aircraft. See Chapter 10: “Weather” for more detailed instructions on giving weather observations.

7.9 Camp Pull-Out via LC-130 Aircraft

The aircraft will be running during your pickup. If you are not prepared for an expedient loading, you and/or your gear may be left behind due to fuel considerations.

Loading an LC-130 aircraft in the deep field is a slow and smoky process. The engines will be reduced to idle, but will still produce enormous blast, fumes, and noise.

7.9a Communication with Incoming Aircraft

It is the responsibility of the person on the radio to pass along all requested information to the incoming aircraft. Know the condition of the ski-way, the current wind conditions, and the altimeter setting. Using a signal mirror can help the aircraft commander tremendously in making a quick approach to your camp.

While on final approach, the aircraft commander will not want to respond to radio transmissions, but he or she will appreciate short statements regarding changes in weather, particularly wind direction. **Note:** Don't interfere with the aircraft during final approach.

7.9b Loading the Aircraft

The loadmaster is responsible for coordinating the loading of the aircraft. One member of your group should approach the loadmaster (when signaled) for instruction on loading.

Arrange for a visit (via the Fixed Wing Coordinator) to the duty loadmaster at the Ice Runway or Williams Field. Spend about an hour to see how the loading system works in the deep field.

Snowmobiles should be driven nose forward onto the aircraft only by those familiar with their operation.

7.9c Last Minute Camp Pull-Out Details

1. Take down the tent(s) and disassemble the radio(s) and antenna(s).

2. Retrieve the ski-way markers.

3. Before takeoff, take one last look to make sure you have everything and make sure everyone in your group is on the plane!

7.10 Returning to McMurdo Station

After returning to McMurdo:

1. Return all your field equipment to the appropriate work center.

2. Package and mark cargo that will be retrograded to the U.S. Specific instructions for this process are outlined in the Instructions for Packaging and Shipping document which is sent to all researchers prior to the field season.

Chapter 8
Peninsula Area
Boating Operations

Figure 8-1: Zodiac heading out to iceberg.
(photo by Dave Bell)

The Zodiac brand of inflatable boats, which are equipped with outboard motors, are used in the U.S. Antarctic Program for ship-to-shore transport, short range excursions in the marine/coastal environment, as "platforms" for scientific investigations, and for Search and Rescue (SAR) operations. The 16-foot Zodiac MK III as well as the F-470 can carry only six people. The 19-foot Zodiac MK V can carry ten people.

8.1 Zodiac Allocation

The Palmer Station Boating Coordinator is responsible for maintenance, training, and allocation of the Zodiac fleet and will assign a Zodiac for your group to use during the season. All Zodiac use should be requested in the SIP and confirmed in the RSP.

8.2 Preparation Before Leaving Palmer Station

Everyone who travels by Zodiac must complete either the full Boating Safety and Islands Survival Courses or an abbreviated course before they will be allowed to check out. (See Chapter 5 for Field Safety Training requirements.) Each boating party must have a trip leader who assumes responsibility for the boat and for safety of the passengers. At least two people must travel together at all times; solo travel via Zodiac is not allowed.

Check the current weather conditions before you leave station. If conditions are severe, a “no boating” call may be in effect. There are various common patterns that indicate approaching storms. Please refer to Chapter 10 for more details regarding weather.

8.2a Checking Out

The standard station departure regulations apply to all boating operations. Each group must carry at least two radios. Since boating operations do not take place after dark, the hours of operation are adjusted by the Station

Manager throughout the season as the amount of daylight changes. In addition to signing out, each party must provide verbal notice of departure to either the Boating Coordinator or Station Manager. The actual departure from station should be radioed in once all group members are on board the Zodiac.

8.2b Loading the Zodiac

Each person is required to wear a float coat/suit, zipped up with the beaver tail fastened. (See figure 8.3 on page 81.) Make sure that your Zodiac has the following gear onboard before you leave:

- Main engine
- Back-up engine
- Bite cones installed on stern tubes
- Two full cans of gas (one as a spare)
- Two paddles
- Minimum of two radios
- One Boat Emergency Kit, containing:

  - Sleeping bag
  - Spark plugs
  - Flares
  - First Aid kit
  - Tools
  - 1 Air pump with hose
  - 1 Fuel hose
  - Emergency food

(See figure 8-2 on the following page.)

Zodiacs must be loaded evenly. To accomplish this, keep the survival bag and other gear forward in the boat. Be sure to stow gear securely so that in rough conditions it will not bounce around and puncture the boat. Also, make sure that neither the gear or passen-

Figure 8-2: Zodiac loaded with proper gear.
(photo by Mary Lenox)

gers are leaning against the pontoon air valves. Movement of valves may cause the pontoons to leak.

8.2c Checking the Boat

Before launching any boat, you will need to check the condition of the boat and all standard equipment. If equipment is missing or if the boat needs repairs, contact the Boating Coordinator.

8.2d Gear

Floatcoats: Be sure to put on and zip your floatcoat and secure the “beaver tail” before entering the boat. See figure 8-3 on next page).

Personal Gear: Always wear a hat while in the boat. Studies indicate that much body heat is lost from the head. Keeping your head covered may extend your survival time in the water if you fall overboard.

When going out for day trips, take along a day pack or a waterproof dry bag to carry your personal gear. A non-waterproof day pack should be lined with a heavy

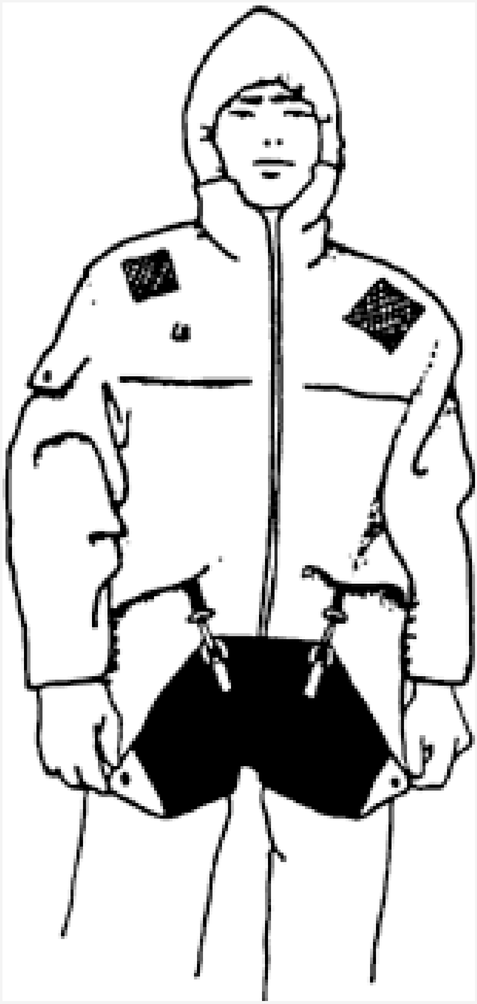

Figure 8-3: Floatcoat

duty plastic bag to keep the contents dry from rain or sea spray. Whatever method you use, it’s a good idea to include to following gear when going out for the day:

- Personal cold weather clothing system with spare socks, mittens, hat, and spare polypropylene underwear
- Food and water—high energy snack food is recommended
- Sunglasses or goggles
- Sunscreen and chapstick
- Waterproof bag for camera, GPS, and gear listed above
- Flashlight or head lamp
- Plastic trash bag and pee bottle for human waste

8.3 VHF Radio

8.3a Radio Check & Communications

Before departing from the mooring area, call Palmer Station on the radio (channel 27) and give the station operator your party name, number in party, boat number, and your destination. You may not leave until you receive confirmation that your radio is operational. If the radio is not water resistant, make sure to shield it from moisture.

Report in as follows:

- Report departure, party name, number in party, boat number, and destination.
- Report arrival at destination.

- Report any changes in destination, Estimated Time En route (ETE) or Estimated Time of Return (ETR).
- Report start of return to Palmer Station.
- Report arrival at Palmer Station.

8.3b Radio Use While Boating

Always keep your radio ON and set to Palmer Station's main boating frequency channel 27 (Motorola Visars, use channel 02) with the marine channel 16 as backup. Don't leave your radio in the boat. Take it with you .

8.3c Returning Radios to the Station

Leave your radio in the return box in the Comms Tech workshop. Inform the Comms Tech if your radio gets wet.

8.4 Boating Hazards and Precautions

8.4a Weather

Weather conditions can change rapidly. In the Palmer area, the worst storms come out of the north. If you are working to the southeast of Bonapart Point, you need to pay special attention to increases in wind from the north. Always watch for wind direction shifts, increases in wind speed, reduction in visibility, and movement of the ice pack. The rapid approach of stratus-type clouds usually precedes an increase in wind and possible precipitation.

All boating parties will be advised by radio if the wind speed reaches 20 knots, and they will be recalled if the wind reaches 25 knots or greater. If wind speeds are such that it is unsafe to return to the station, parties may be asked to make for the nearest island with a survival cache to wait out the weather until conditions improve.

Always reduce your speed in high winds. Zodiacs driven fast into the wind can flip over. If you must travel during moderate windy conditions, the wind direction will determine the best course of action for you to take. If the winds are off-shore, it's best to skirt close to shore where the effects of the wind and waves will be reduced. (Keep in mind that glacier faces may be dangerous.) If the wind direction is on-shore, you should keep the boat away from shore. In both cases, put weight (including passengers) in the front of the boat to avoid the possibility of flipping over.

8.4b Icebergs and Glaciers

Stay at least 300 meters from all glacier faces. Use caution when in close proximity to large icebergs because they can suddenly calve or flip.

8.4c Brash Ice

Always reduce your speed in brash ice. If speed is excessive, Zodiacs can ride up over the ice, tip over, or suffer propeller and hull damage. Make sure engine lock is in the "free" position, not locked down. To free brash ice that has gotten under the boat, it is often necessary to stop, put the engine in reverse, and back-up until the ice is jarred loose.

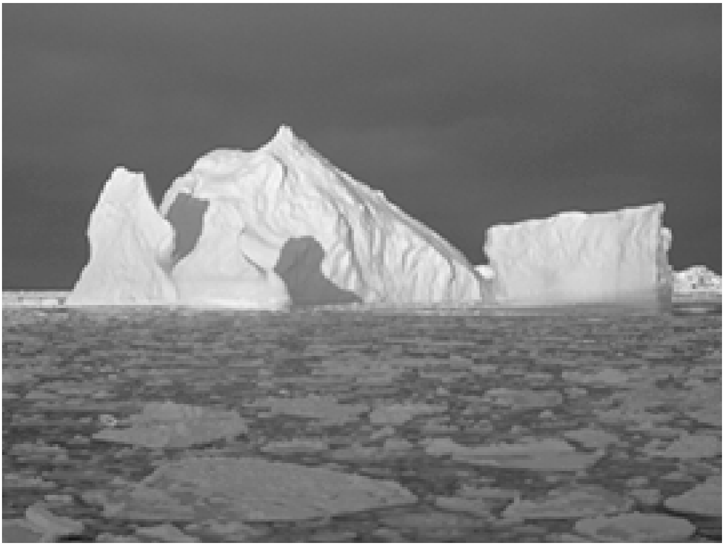

Figure 8-4: Iceberg. (photo by Marian Moyher)

One of the more dangerous situations a boating party can experience is being caught in a stream of thick brash ice that is rapidly drifting out to sea. This can occur when brash ice accumulates in bays and is suddenly blown out by off-shore winds. To avoid being caught in this situation, never attempt to travel through brash ice during windy conditions.

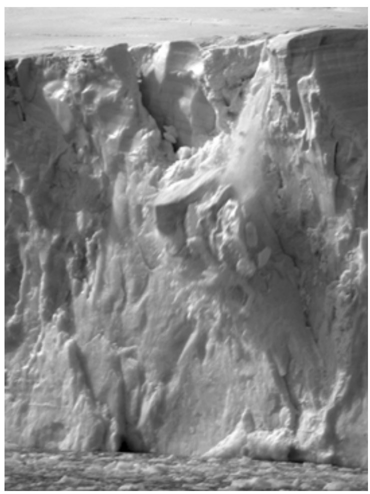

Figure 8-5: Calving glacier. (photo by Marian Moyher)

8.4d Rocks

Traveling over rocks can tear the Zodiac hull fabric. If the front (bow) of the boat is punctured, put most of the weight in the back (stern) of the boat. If deflated, the bow should then be pulled up with the bow line. Radio Palmer of your situation, then make haste to shore.

8.4e Waves

Always approach big waves (1-2 meters or greater) at a 45-degree angle. You may have to use a tacking pattern to reach your destination. In big waves, you may have to shift weight to the weather side of the boat to avoid capsizing. When traveling with waves at your back (a following sea), avoid surfing waves to pick up speed. Surfing can bury the nose of the boat in the next wave.

Figure 8-6: Zodiacs traveling through brash ice.
(photo by Tim Cully)

8.4f Wildlife

Give all animals a wide berth and stay away from Orcas (Killer Whales) and leopard seals. Leopard seals are aggressive and have bitten/punctured the speed tubes and pontoons of Zodiacs.

8.5 Troubleshooting

Several simple things that may cause the outboard engine to not run:

Figure 8-7: Leopard Seal (photo by Tim Cully)

- **Gas tank fuel level is low:** add gasoline.

- **Spark plugs badly fouled:** replace with the spares from the Boat Emergency Kit.

- **Carburetor iced up:** remove ice from the carburetor.

- **Fuel contamination:** use the back-up engine, spare fuel hose, and spare gas tank.

- **Engine runs, but the propeller does not turn:** replace it with the spare engine and proceed to the nearest land or Palmer Station.

- **Mooring line gets wrapped in the propeller:** clear and securely fasten the mooring line to the bow.

If you feel uncomfortable with replacing the main engine or are unable to do so, call in for a tow. It is better to get a tow than risk losing an engine overboard. If all else fails, paddle yourselves to the nearest land. Use emergency signals on the hour if the tow boat is unable to locate you or radio contact is not possible.

8.6 Landings and Moorings

Before landing, carefully select a site so that waves will not overturn the boat or strand it high on the rocks. The boating chart lists recommended landing sites on most of the accessible islands. Always moor the Zodiac with the front of the boat (the bow) toward land, and use a bowline knot to securely tie it. Always tilt the engine up and secure it in place with the lock to prevent shaft and propeller damage in shallow water. Make sure the Zodiac can free float, unless conditions require a tight line so that the boat does not wash up on a nearby shelf.

If you will be at the same site for more than an hour, periodically check the boat and adjust the mooring line so the boat isn't stranded on the shore or washed out as the tide changes.

8.7 Operating Restrictions

The boating limit is a two-nautical-mile radius, as shown on the boating chart (figure 8-9) for Palmer Station and vicinity. Under special conditions, trips are allowed to Biscoe Point to the east and Dream Island to the west. This is the maximum distance that the SAR team can respond within a safe time period. The boating chart is located in each Zodiac.

Figure 8-8: Island mooring point. (photo by Tim Cully)

8.7a Areas of Restricted Access

Antarctic Specially Managed Areas (ASMAs) are areas designated by the Antarctic Treaty Consultative Meeting (ATCM) to assist in planning and coordinating scientific and operational activities to avoid conflicts and minimize environmental impacts. A draft Palmer Area ASMA (formerly called a Multiple-Use Planning Area or MPA) was prepared by the US for submission to the ATCM. Until an official designation is made by this body, the USAP voluntarily abides by the draft Palmer Area management plan. This will ensure that on-going and planned human activities in Antarctica, through their combined or cumulative effects, do not result in mutual interference or in adverse impacts in the Palmer Area. Most of the islands around Palmer Station and within the two-mile boating limit have been included in the draft plan.

The areas listed below must not be visited during the

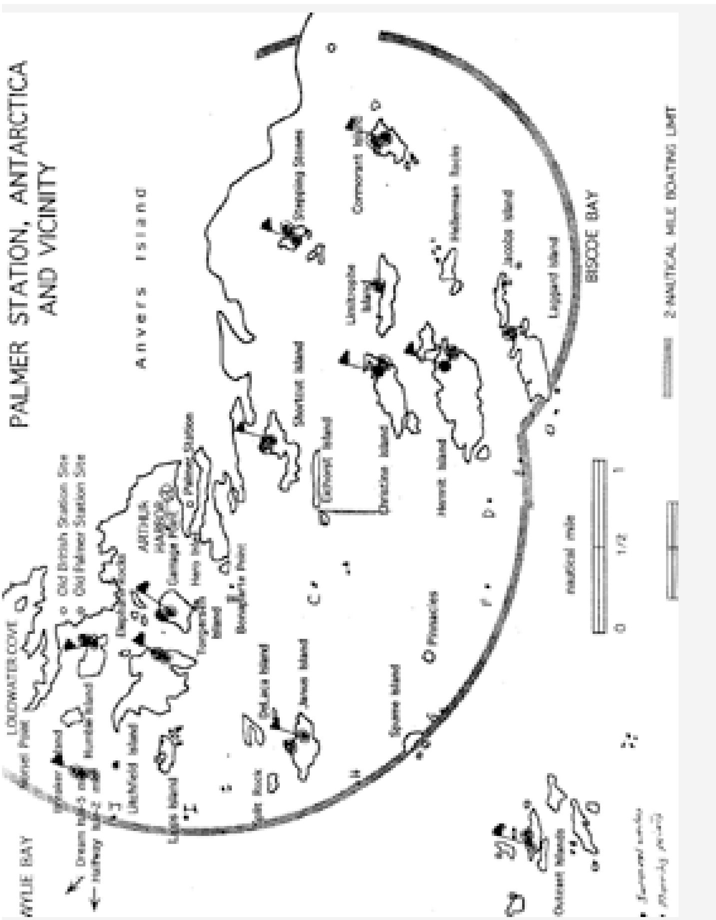

Figure 8-9: Map of Palmer area boating limits and survival cache locations.

critical seabird breeding season from October 1 through March 1, except in connection with scientific activities, survival cache replacement, or emergencies. Principle Investigators (PIs) wishing their field team to enter an area designated in the plan are required to send the NSF/OPP Permit Officer a brief statement of work which includes information regarding which specific islands to be visited and the time frame(s) involved. The NSF/OPP will confirm that there are no conflicts and provide approval for the entry to the PI.

Palmer Area restrictions on entry between October 1 and March1:

Bonaparte Point	Christine Island
Cormorant Island	Diana’s Island
Dream Island	Elephant Rocks
Hermit Island	Humble Island
Joubin Islands	Kristie Cove
Laggard Island	Limitrophe Island
Norsel Point	Shortcut Island
Shortcut Point	Stepping Stones Island

Litchfield Island is a Specially Protected Area and is always off limits. Personnel may not go any closer than 10 meters to shore unless they have an ACA permit.

8.8 Boating Emergencies

The following islands have survival caches and tie-up points, and most are within the two- mile limit around Palmer Station:

Torgersen	Litchfield
Humble	Janus
Shortcut	Hermit
Cormorant	Stepping Stones
Christine	Old Palmer

Outcast- outside of two mile boating limit.
Dream- outside of two mile boating limit.

Landing sites and tie-down locations are marked with painted orange dots. The blue survival cache barrels are marked with flags (see figure 8-11). The survival caches are placed away from wildlife sites. Refer to the boating chart (figure 8-9) for a list of survival cache sites.

8.8a Person Overboard

The cold Antarctic waters make a person overboard the most critical boating emergency, because once submersed, a person has 12 minutes before hypothermia sets in. If someone falls into the water at the shoreline, they

Figure 8-10: Giant Petrel chick sits on nest at Stepping Stones Island. (photo by Tim Cully)

should get out of the water immediately. In contrast, someone who falls into the water from a Zodiac, should limit their movement in the water to the minimum needed to keep afloat (see figure 8-12). Motion increases blood circulation which moves blood away from the body core and cools the body temperature and hastens the onset of hypothermia (see the First Aid section of Chapter 24).

When someone falls overboard, immediately call the station for help. Maneuver the boat for pickup, while ensuring to keep the propeller away from the person. You may need to cut power to the engine to do this. Try to keep everyone, including the person overboard, calm and don't attempt the rescue at the cost of other members of your party.

Figure 8-11: Survival cache on Humble Island. (photo by Tim Cully)

Distribute any gear and passengers to accommodate for the weight of pulling the water-laden person into the boat. The victim may lose use of his/her extremities, and you will have to pull the person into the boat without their help.

If you are alone and the person overboard has lost the use of his or her arms and legs, float the person with their back toward the side of the boat. Distribute your weight across the boat and reach over the side and under the person's arms, locking your hands in front of the chest. Using leverage, roll your entire body so as to pull the person aboard or at least remove as much of the person from the water as possible until the rescue team arrives.

Once the person has been pulled from the water, remove all wet clothing and slip the person into the sleeping bag found in the Boat Emergency Kit. Return immediately to Palmer Station.

Figure 8-12: H.E.L.P positions.

8.8b Search and Rescue (SAR)

If there is a call for help or a field team is overdue with no radio contact, the SAR team will be launched within 30 minutes if the weather conditions permit safe deployment of the team.

Chapter 9
Field Radios

A radio is one of the most important pieces of equipment you will take into the field. Radio contact with McMurdo Station, Palmer Station, other field parties, and aircraft will help make your field season successful and may also save your life.

Groups staying in the field for more than 24 hours are required to check in daily with the station or vessel supporting their field project. If direct communication is difficult, you can relay with another station or field party. If a field party does not check-in as scheduled, a Search and Rescue (SAR) effort may be initiated.

You will receive training on your radios when you pick them up from the Field Party Shop in McMurdo, the Communications Technician at Palmer, or on a research vessel. Please pay special attention to the instructions you are given, as they will be specific to the radios you will be using in the field. Take the time to do a "shakedown" before you go into the field to make sure you know how to operate the radios, and that they are working.

This chapter covers the types of radios you might be receiving and reiterates the instructions that will be given to you with the radios.

9.1 HF Radios

9.1a PRC-1099 Radio Description

The USAP issues two PRC 1099 HF radios to each field party – the second radio is issued as a back-up. The PRC 1099 is a single sideband radio with peak power output of 20 watts. The radio is capable of both Upper Side Band (USB) and Lower Side Band (LSB) operations. However, USB is the only mode of operations available for use by field parties. The complete field kit weighs about 50 pounds. (See Figure 9-1: PRC-1099 radio controls)

9.1b Batteries and Chargers: PRC-1099

The PRC-1099 is issued with two rechargeable, sealed lead-calcium batteries. In the cold the chemical reaction in these batteries will slow down, so keep them as warm as possible. With proper attention, the two batteries provided should last you several months in the field with solar charging alone.

9.1c PRC-1099 Set-up Instructions

These instructions can be found on the laminated card provided with your radios.

1. Erect the Dipole antenna. The Balun Transformer and both ends of the dipole antenna should be mounted on bamboo poles at least chest high. The antenna should be straight out or slightly folded and the apex (the Balun Transformer) should be pointed toward the station you’re contacting to achieve the best communications. (See Figure 9-2: Antenna set up)

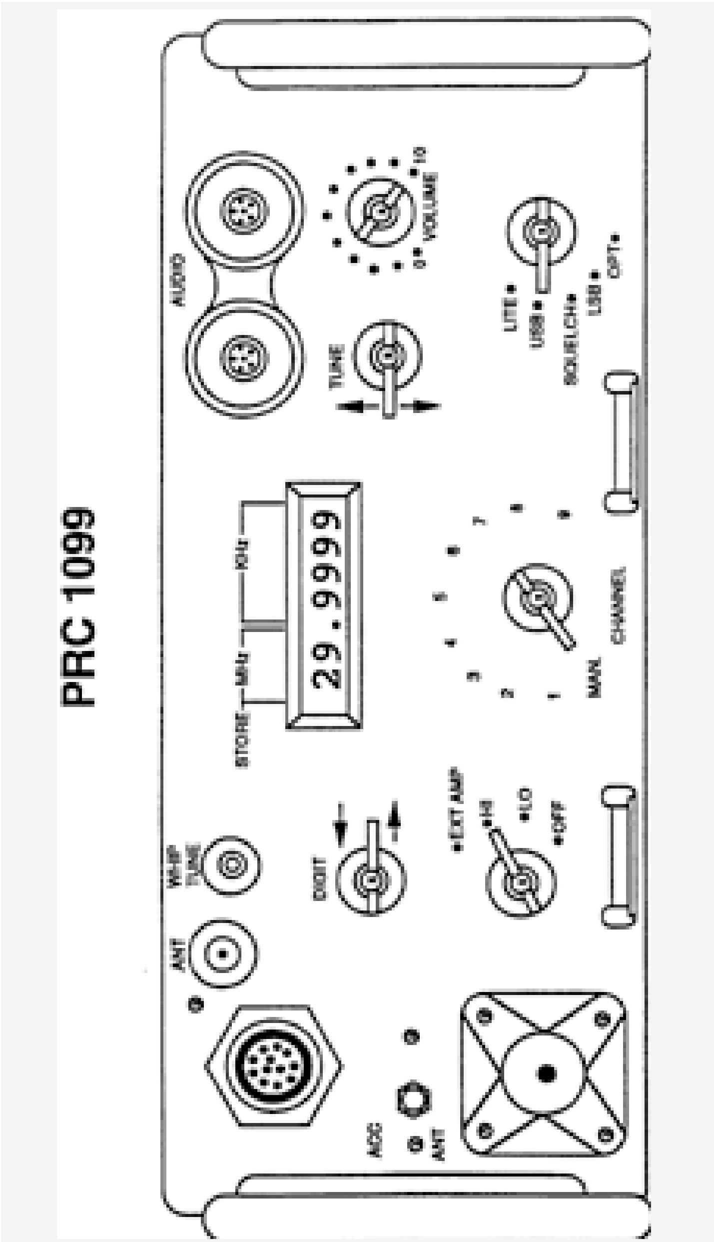

Figure 9-1: PRC-1099 radio controls

Handle the antenna with extreme care to avoid damage to the shorting bar connections. Ensure all shorting bars are connected except the desired frequency. The frequencies are:

McMurdo Station

Frequency	Plug Color	Channel Description
4770 kHz	Blue	Ross Island and Dry Valley Field Parties
5100 kHz	Red	Air-to-Ground
5400 kHz	Green	Scott Base Field Parties
7995 kHz	Orange	Remote/South Pole
9032 kHz	Yellow	Air-to-Ground
11553 kHz	White	Remote Field Parties

Palmer Station

Frequency	Plug Color	Channel Description
4125 kHz	Blue	Secondary USAP Field Parties
11553 kHz	White	Primary USAP Field Parties

2. Place the radio in a warm place (e.g. tent, hut, etc.)
3. Connect one end of the antenna cable provided to the dipole antenna, connect the other end of the cable to the front panel connector labeled “ANT”.
4. Attach the handset to either of the two “Audio” jacks.
5. Ensure the batteries are mounted in the rear of the radio.
6. Connect the solar panel to the accessories connector. The solar panel can remain connected while the radio is in operation. Position the solar panel for maximum exposure to solar rays.

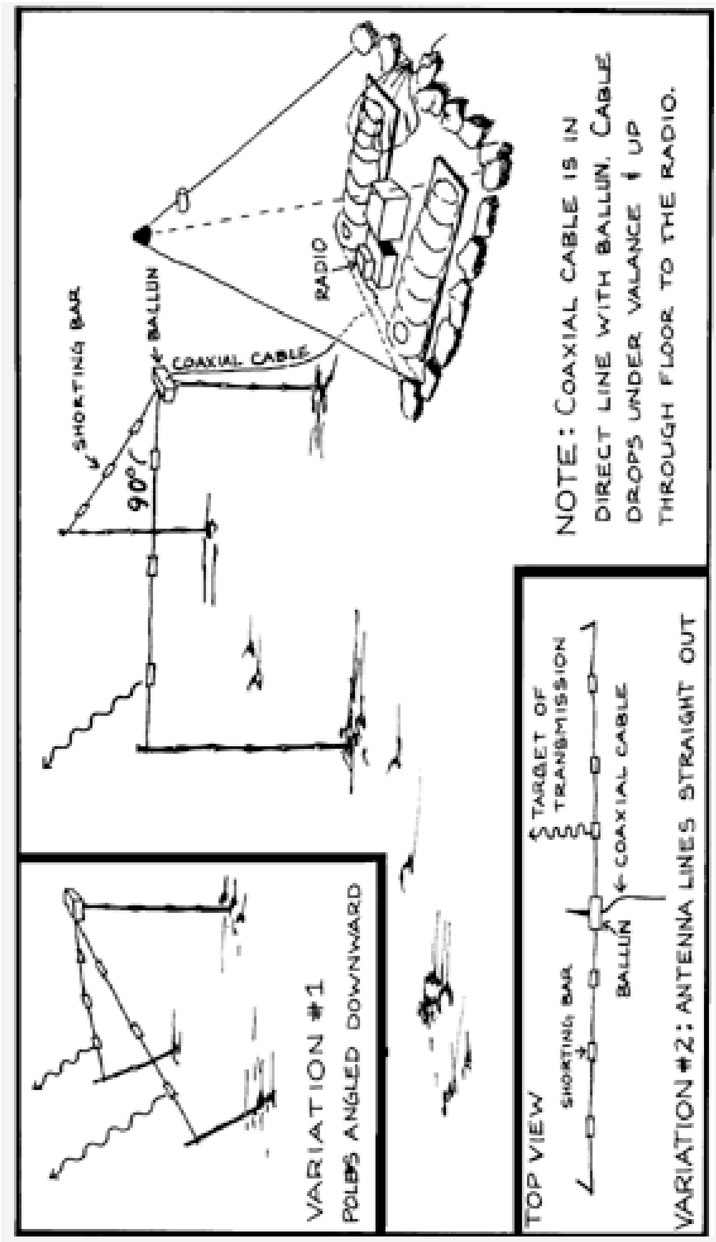

Figure 9-2: Antenna set up

7. Turn the power switch to “HI” (20 Watt) or “LO” (5 Watt) position. The “LO” position should be used if possible to reduce the power drain on the batteries.
8. Select the channel selector to 1 through 6, which correspond respectively to the frequencies, listed above. (McMurdo only).
9. Perform a radio check. For this radio, you need to SPEAK LOUDLY INTO THE MICROPHONE to transmit properly.

9.1d How to Rechannel the Radio

If the memory is inadvertently dumped, rechannel the radio by following the steps below:

1. Set Channel switch to “MAN”.
2. Turn the Digit switch up or down to select the desired digit. The selected digit will flash.
3. Turn the Tune switch up or down to select the correct number.
4. To change frequencies in channel 1-8, set the Channel Control to desired channel number, press/hold the whip tune button and repeat steps 2 through 3.
5. Turn the Function switch to “USB”.
6. Set the power toggle to “HI”.
7. Press the transmit button on the hand-set’s side to transmit.

9.2 VHF Radios

VHF radios are “line-of-sight” radios (i.e., one antenna must be able to “see” the other). They cannot transmit through solid barriers such as land formations. On a flat surface, the horizon and subtle rolls in the terrain limit radio transmissions. VHF communications can also be facilitated between a hand-held radio and an antenna that is channeled on the same frequency at station, or by repeaters. In both of these situations a field-party member must be operating in line-of-sight of the antenna or repeater for successful radio communications.

VHF hand-held radio batteries do not function well in the cold. Keep your batteries warm by having them inside clothing layers and next to your body when not in use.

The USAP issues five different types of VHF Radios. Specific operating instructions for each type is listed below:

9.2a Operating an MX-300R or Saber VHF Radio (McMurdo Area)

1. Ensure that both the battery and antenna are properly attached.
2. Select the proper channel (see the following table for frequencies).
3. Turn the radio on.
4. Turn the squelch on until a “hash” noise is heard. Set the volume control to a comfortable listening volume, then back off the squelch control until the noise ceases. Inability to get the noise often indicates low or no battery charge.
5. Listen to ensure you won’t be transmitting over other transmissions. “Stepping” on other transmissions will cancel both.
6. Hold the radio in a vertical position. Press the transmit button on the side of the hand-held (or the top of the extension mike). Talk slowly and clearly.

9.2b VHF Radio Channelization Plans

On the following lists, asterisks (*) denote Scott Base/ McMurdo Station coordinated frequencies. Repeated channels appear in bold type.

McMurdo Frequency Plan (For vehicle and handheld radios in the McMurdo vicinity):

CH	Net Name	Transmit freq. (MHz)	Receive freq. (MHz)
1*	I-Net (T-Site)	143.000	143.000
2*	Crash Net (T-Site)	139.600	139.600
3*	**NZ Portable**	**142.800**	**138.800**
4*	**NZ Crater Hill**	**139.300**	**143.800**
5	**Public Works (T-Site)**	**139.000**	**142.600**
6	Airfield Ops	139.200	139.200
7	Science Net	139.500	139.500
8	**Field Party Ops (Aurora repeater)**	**138.600**	**143.225**
9	Fuels Net (T-Site)	143.600	143.600
10	**Movement Control Center (U.S. Crater Hill repeater)**	**139.800**	**143.725**
11	Helo Ops	143.400	143.400
12	Penguin Ops/ANG	143.200	143.200

Field Party Frequency Plan (For portable and handheld VHF radios issued to science groups and support personnel deploying to the Dry Valleys, sea ice camps, and Ross Island camps):

CH	Net Name	Transmit freq. (MHz)	Receive freq. (MHz)
1*	I-Net (T-Site)	143.000	143.000
2*	Crash Net (T-Site)	139.600	139.600
3	Science Net	139.500	139.500
4	Helo Ops	143.400	143.400
5*	**NZ Crater Hill**	**139.300**	**143.800**
6	**Helo Flight Following**	**138.500**	**143.975**
7	**Field Party Ops (Taylor repeater)**	**138.600**	**143.225**
8	**Field Party Ops (Wright repeater)**	**138.600**	**143.225**
9	**Field Party Ops (Terror repeater)**	**138.600**	**143.225**
10	**Field Party Ops (Aurora repeater)**	**138.600**	**143.225**
11	**Field Party Ops (Brooke repeater)**	**138.600**	**143.225**
12	Blank		

9.2c Operating a VHF Radio (Peninsula Area)

The Comms Tech will give detailed instruction on communications procedures and radio usage. General operating instructions are as follows (see Figure 9-3 for the location of controls):

1. Turn on the OFF/VOL volume control. Adjust the volume level.

2. Rotate the squelch control clockwise until background noise just disappears. Further

adjustment will cause incoming radio transmissions to be attenuated.

3. To select a channel, make sure the key lock switch is to the off position , then press the up or down key. The selected channel will be illuminated on the digital display. Lock the channel in place by switching the key lock switch to the on position.

4. Press the CH16 key to go from any channel to Channel 16. Press CLR key to revert to the working channel.

5. Transmission is accomplished as follows:

   - Set the H/L power switch to “L” when within the two mile limit of Palmer Station or whenever it provides sufficient output power.

   - Select and monitor channel 27.

   - Depress the Push-to-talk (PTT) switch and deliver the voice message. The transmit (TX) indicator will illuminate. For best transmission, the microphone should be approximately an inch from the speaker’s mouth.

   - Release the PTT to receive incoming messages.

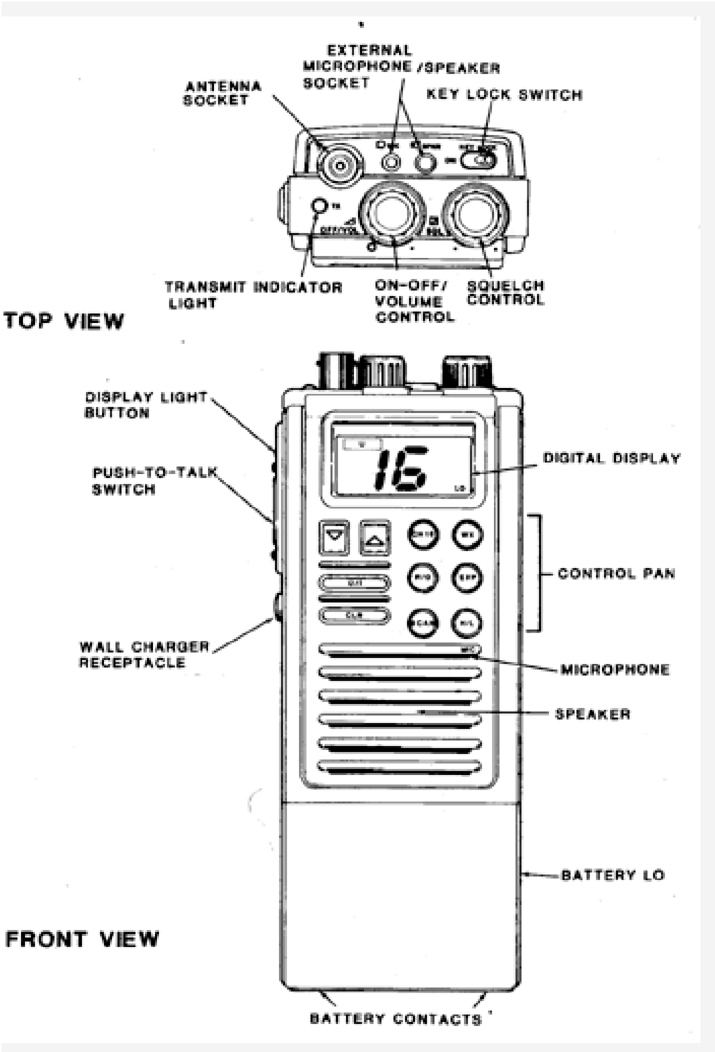

Figure 9-3: Standard VHF radio controls

Palmer Channels for VHF Radios:

Channel 16: Ship Operations (Standard hailing frequency for marine and is used to hail the *R/V Laurence M. Gould* or other vessels when close to the station.)

Channel 27: Boating Operations (This channel transmits and receives with the whip antenna on the tower behind Palmer Station via the repeater near this tower. The hand-held must be in line of sight with the tower to send and receive.) Note: The Motorola Visar hand-held radio uses *channel 02* for this frequency.

9.2d Operating a Visar VHF Radio (Peninsula Area)

(See Figure 9-4 for location of controls)

1. Turn on the radio and make certain it has has passed a self-check.
2. To transmit, first check to make sure the radio is set to channel 02 (this is equivalent to channel 27). Listen for a transmission and adjust the volume control to a comfortable listening level. If no transmission is heard, press the PTT button to unsquelch the radio and adjust the background noise to a comfortable level. When the channel is clear, press and hold the PTT switch on the side of the radio and speak slowly and clearly into the microphone area
3. When receiving, if the transmission is poor, press the monitor button to unsquelch the radio and adjust the background noise.

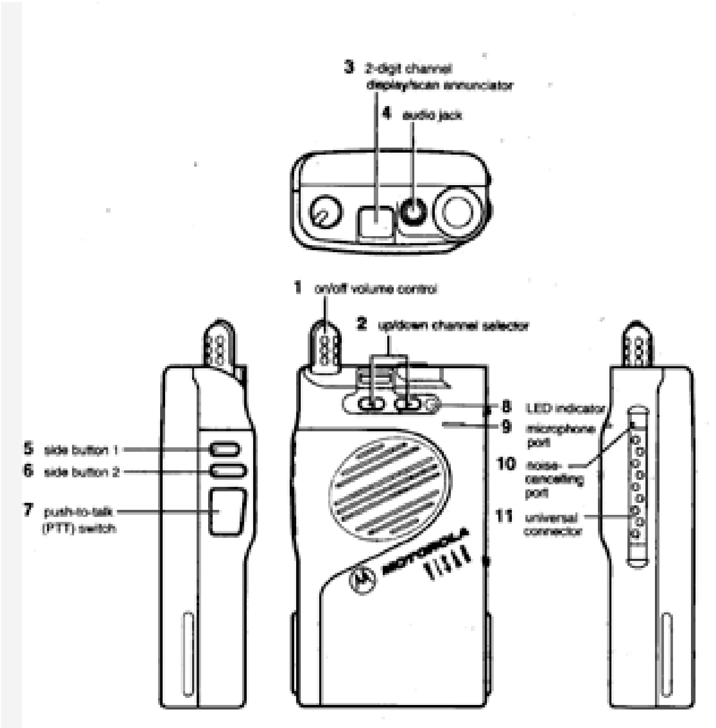

Figure 9-4: Visar VHF radio controls, switches, indicators, and connectors.

4. To change the channel, you must first disable the channel-locking feature. To do this, hold down the channel-selector buttons for two seconds to disable the feature. The two channel-selector buttons can then be used to scroll up or down through the list of available channels programmed into the radio. To enable the channel-lock feature, hold down the channel selector buttons at the same time for two seconds, and the present channel will be locked (preventing accidental channel changes).

9.2e Troubleshooting a VHF Hand-Held Radio

Problem:	Possible Reasons
No power:	Dead battery, or poor battery connection.
No audio:	Low or dead battery, or mode select switch is on the wrong position.
No transmission:	Out of “line of sight” with receiving party or repeater. Try climbing to higher ground - even holding the radio as high as possible with a remote clip-on mike will sometimes help. Moving away from a vehicle may enhance transmission.
	Low battery.Weak light or non light indicates no power. Check battery.
	Repeater may be down. Trigger the mike/ transmit switch and release. If you are operating through a repeater, a noise burst should be heard for approximately one second. If there is no noise, you are either not transmitting or receiving, or the repeater is down. Try another channel.
No reception:	Weak battery. Check both the squelch and mode select switches.
	Party transmitting may have a weak radio or poor vantage point for transmitting. Get to a better site for reception or ask for a relay from another station or party.
	If party transmitting is coming across poorly, try breaking squelch to receive weak incoming signal.

9.3 McMurdo Area Radio Information

After you have attended your science meeting, stop by the Field Operations Communications Center (FOCC) (radio call sign “MAC Ops”) to establish your radio communications plan. This plan will establish your radio call sign, radio-frequency assignments, and your daily health and safety check-in schedule from the field to MAC Ops.

Any time that you will be at a field location at which a helicopter or fixed-wing aircraft leaves your site (for a short period of time), you must have a minimum of two radios, one as a back up unit.

Before going into the field, you must test your radio equipment. This can be accomplished during your Field Safety Training Course.

After arriving at your field site and before the aircraft departs the site, establish communications with MAC Ops (FOCC) at McMurdo. If you are unable to communicate put-in information (at a minimum your call sign, number of field-team members, your location, and that you are being put in at your field site) with McMurdo, attempt communications with the South Pole and ask communications operators there to relay for you to MAC Ops. If you cannot establish communications with either of these two stations, the aircraft will return your field party to McMurdo. Radio relay to MAC Ops via an aircraft does not constitute established put-in communications as this does not provide confidence that your field-radio equipment is sufficiently operable. At the end of your field season return your radios and accessories to the Field Party Communications Shop.

9.3a HF Communications Procedures Between Field Parties and Fixed Wing Aircraft

LC-130 aircraft (Hercs) are capable of communicating on any of the frequencies with which the PRC-1099 radio is programmed. Communications between field parties and fixed-wing aircraft normally occur on 9032 kHz. If a fixed-wing aircraft cannot be reached on that frequency, try 4770 kHz or 11553 kHz to contact MAC Ops at McMurdo.

Air National Guard LC-130 aircraft are identified by the call sign “Skier,” followed by a specific aircraft number. For example, the call sign for a particular aircraft might be “Skier Nine Five.”

Assuming you are Event II-171, proper communications would proceed as follows:

You:	”Skier Nine Five, this is India India One Seven One, over.”
LC-130:	”India India One Seven One, this is Skier Nine Five, copy you loud and clear, over.”
You:	”Skier Nine Five, this is India India One Seven One...(Proceed with your message.)”

9.3b VHF Communications Procedures Between Field Parties and Helicopters

Remember, any time that you will be at a field location at which a helicopter or fixed-wing aircraft leaves your site, even for a short period of time, you must have two radios. Field groups doing day trips in an area serviced by repeaters can use VHF radios. Anyone doing an over-night trip must take a PRC-1099 into the field.

A helicopters primary means of communication with field parties will normally be on Helo Ops (Helo Ops: TX-143.400, RX-143.400). Secondary communications by PRC-1099 (HF) is normally on 9032 kHz. HF communications should be prearranged with the heli-copter pilots prior to departure.

Helicopters are identified by the last three digits on the helicopter tail. The digits are always two numbers and a letter.

Assuming a helicopter is too far away for you to see its call sign, and your call sign is GO-052, proper communications would be as follows:

You: "Helicopter, this is Golf Oscar Zero Five Two."

Helo: "Golf Oscar Zero Five Two, this is Three Four Quebec, copy you loud and clear, over."

You: "Three Four Quebec, this is Golf Oscar Zero Five Two...(proceed with your message)"

9.4 Peninsula Area Radio Information

Hand-held radios are checked out from the Communications Technician (Comms Tech) shop. A base station is located in the Communications Center where channels 27 and 16 are monitored. The base station is set to scan the two main frequencies.

9.4a Traveling Away from Palmer Station

When going away from the station, whether on foot or in a Zodiac, take two hand-held radios from the Communications shop. The radios that are charged and ready for use are hanging on the wall just inside the door to the shop.

Ensure that the backup battery is wrapped in plastic. Batteries will last a few hours if set on high and used for constant communications. They will last all day if set on low (recommended) and only used for check-in and check-out.

All radios taken away from station should be in a harness and worn next to the body, beneath your coat. Keep the radio warm and dry. Another option, if boating is to place the radio in a waterproof plastic pouch for protection against immersion, these are available in the Communications shop.

Keep the radio power switch set to ON all the time. However, if it is necessary to turn your radio off for a short period of time, contact the Comms Tech to inform him how long you plan on being off the air.

Radios are maintained by the Palmer Communications Technician. When done using the radio, return it to the Radio Shop and place it in the used radio box. The Comms Tech will charge the batteries and check the radio before replacing it on the hook for reissue.

9.5 Phonetic Alphabet

HF communications are easily affected by magnetic disturbances and sunspot activity, which will sometimes make communications broken and difficult to understand. On these occasions it helps to spell out words that are not being understood by the station you're contacting. Use the following phonetic Alphabet to ensure that when you say "F" they don't misunderstand you as saying "S":

A	Alpha	N	November
B	Bravo	O	Oscar
C	Charlie	P	Papa
D	Delta	Q	Quebec
E	Echo	R	Romeo
F	Foxtrot	S	Sierra
G	Golf	T	Tango
H	Hotel	U	Uniform
I	India	V	Victor
J	Julia	W	Whiskey
K	Kilo	X	X-ray
L	Lima	Y	Yankee
M	Mike	Z	Zulu

9.6 Ground to Air Emergency Signals

The following two pages (figures 9-5 and 9-6) contain diagrams of ground to air emergency signals. If radio communications with aircraft are not available, you can communicate with the pilots using these signals.

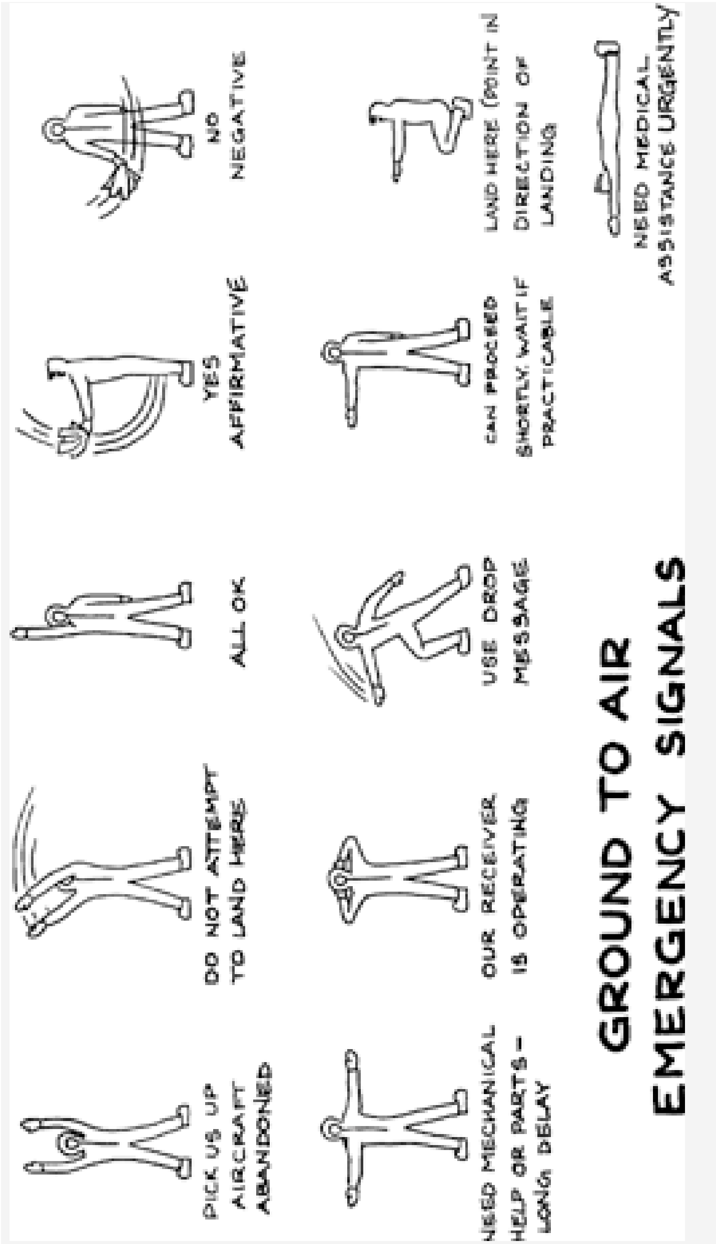

Figure 9-5: Ground to air hand signals

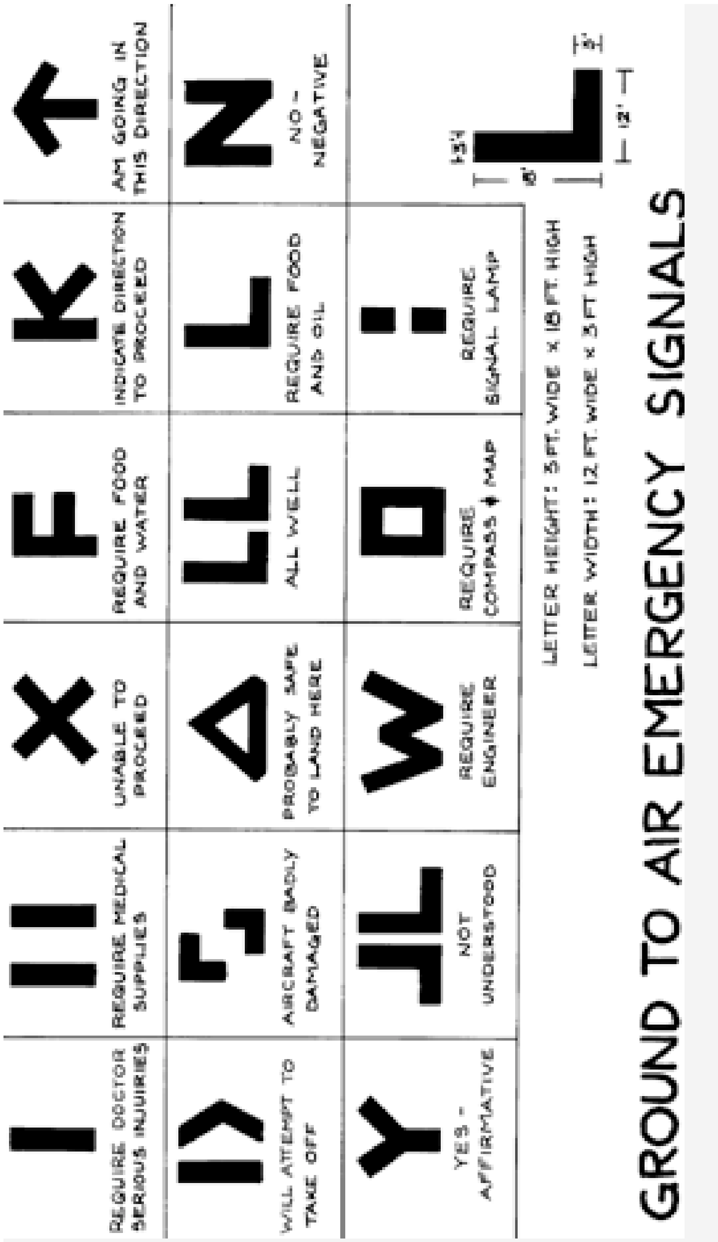

Figure 9-6: Ground to air letter signals

Chapter 10
Weather

Figure 10-1: Storm approaching. (photo by Tim Cully)

Weather in Antarctica is characterized by extremes: extreme temperatures, extreme winds, and extremely variable localized conditions. All of these extremes make Antarctica a difficult place to work and live. The temperatures can vary from below -40 degrees F to above freezing during the course of a season. The polar plateau experiences even colder temperatures because of its higher altitudes and greater distance from the moderating effect of the ocean. Moderate winds are common in Antarctica. It's an unusual day when there is not at least a breeze blowing. The winds take their toll on people, making camp chores such as setting up tents and operating Zodiacs difficult. More importantly, the winds increase the wind chill effect, thus making people more susceptible to hypothermia and frostbite.

The chart on the following page (figure 10-2) details the effects of wind on temperature.

Windchill Chart

Calm / Est. Wind Speed MPH/KPH	Actual Thermometer Reading °F / °C											
Calm	50 / 10	40 / 4	30 / −1	20 / −6	10 / −12	0 / −17	−10 / −23	−20 / −28	−30 / −34	−40 / −40	−50 / −45	−60 / −51
Est. Wind Speed MPH/KPH	Equivalent Temperature in °F / °C											
5 MPH / 8 KPH	48 / 9	37 / 3	27 / −3	16 / −9	6 / −14	−5 / −20	−15 / −26	−26 / −32	−36 / −38	−47 / −44	−57 / −49	−68 / −55
10 MPH / 16 KPH	40 / 4	28 / −2	16 / −9	4 / −15	−9 / −23	−21 / −29	−33 / −36	−46 / −43	−58 / −50	−70 / −57	−83 / −64	−95 / −70
15 MPH / 24 KPH	36 / 2	22 / −5	9 / −13	−5 / −21	−18 / −28	−36 / −38	−45 / −43	−58 / −50	−72 / −58	−85 / −65	−99 / −73	−112 / −80
20 MPH / 32 KPH	32 / 0	18 / −8	4 / −15	−10 / −23	−25 / −32	−39 / −39	−53 / −47	−67 / −55	−82 / −63	−96 / −71	−110 / −79	−124 / −86
25 MPH / 40 KPH	30 / −1	16 / −9	0 / −17	−15 / −26	−29 / −34	−44 / −42	−59 / −51	−74 / −59	−88 / −67	−104 / −76	−118 / −83	−133 / −92
30 MPH / 48 KPH	28 / −2	13 / −10	−2 / −19	−18 / −28	−33 / −36	−48 / −44	−63 / −53	−79 / −62	−94 / −70	−109 / −78	−125 / −87	−140 / −96
35 MPH / 56 KPH	27 / −3	11 / −11	−4 / −20	−20 / −28	−35 / −37	−49 / −45	−67 / −55	−82 / −63	−98 / −72	−113 / −81	−129 / −83	−145 / −98
40 MPH / 64 KPH	26 / −3	10 / −12	−6 / −21	−21 / −29	−37 / −38	−53 / −47	−69 / −56	−85 / −65	−100 / −73	−116 / −82	−132 / −91	−148 / −100
Wind Speeds Greater Than 40 MPH / 64 KPH Have Little Additional Effect	Minor Damage To A Properly Dressed Person				Danger Increased Due To Exposed Flesh Freezing			Extreme Danger of Exposed Flesh Freezing				

Figure 10-2: Windchill chart.

10.1 McMurdo Area Weather

Storms arrive quickly and are sometimes fierce enough to halt all outside activity. Storms can also be very localized. Weather in McMurdo can cause close to zero visibility with blowing snow (halting flight operations), while the Dry Valleys, which are 50 miles away from McMurdo, might be calm and sunny.

Approaching storms are usually preceded by high thin bands of cirrus clouds (mare's tails) followed by thicker layers of cirrus which may cause a halo-like effect around the sun. The clouds grow progressively thicker and lower over the next 6 to 12 hours until the arrival of low cumulus clouds and the main front. Blizzards, or "Herbies," can happen any time of year and and may last as little as several hours to as long as several days.

Storms approaching McMurdo Station usually arrive from the south in the gap between Black Island and White Island, an area known as "Herbie Alley." As the storms approach, they eventually obscure Minna Bluff with blowing snow or low clouds, at which point there's usually less than an hour before the bad weather hits.

Travel will be extremely difficult and dangerous during storms. Blowing snow or whiteouts can be disorienting and can make seeing crevasses or cracks in the sea ice impossible. Even moderate winds can produce a layer of dense, blowing snow that may be as thin as a few feet or as thick as 1000 feet.

A whiteout is an equally dangerous phenomenon. Thick, low clouds reduce surface definition, and the horizon is obscured. It's difficult or impossible to know if you are on a flat or sloping surface. It is likewise difficult to judge distances or the size of objects. Travel should be avoided during whiteouts, unless there is an emergency.

10.1a McMurdo Weather Classifications

The McMurdo Weather Office issues weather forecasts every six hours. These forecasts are available by calling the Weather Office or Mac Ops. The weather office also issues a weather classification for the immediate vicinity of McMurdo that restricts certain activities when the weather deteriorates. These weather conditions are divided into the following three categories:

Condition III: Winds up to 48 knots, wind chill down to -75 degrees F, and visibility over 1/4th mile. Unrestricted travel and activity are allowed.

Condition II: Winds 48 to 55 knots, wind chill -75 to -100 degrees F, or visibility 100 feet to 1/4th mile. Restricted pedestrian traffic only between buildings is allowed. Vehicular travel is allowed in radio equipped, enclosed vehicles only, and check out is required.

Condition I: Winds over 55 knots, wind chill lower than -100 degrees F, or visibility less than 100 feet. Severe weather is in progress. All personnel must remain in buildings or the nearest shelter.

10.1b Weather Observations from the Field

Prior to deep-field put-ins, at least two members of your field team should attend a briefing at the Weather Office. At this office, you will be instructed in weather observations and how to relay this information to McMurdo. You'll also be issued a meteorological kit

Figure 10-3: Storm in McMurdo. (photo by Tim Cully)

that includes a thermometer, an anemometer, an altimeter, and a cloud identification chart. Refer to the booklet in the meteorological kit for in-depth information on field weather observations.

Taking a weather observation entails viewing the meteorological conditions at your camp and reporting those conditions in such a way that they can be visualized by the forecasters at McMurdo. A typical field weather observation in Antarctica relayed by radio includes the following:

Figure 10-4: Storm at Shackleton Glacier Camp.
(photo by Tim Cully)

1. **Wind direction** is expressed in degrees (Grid North) and is rounded off to the nearest whole 10 degrees. Refer to Chapter 21: “Antarctic Navigation” for information on Grid North.

2. **Wind speed** is expressed in knots/hour. A wind gust is a sudden change in wind speed characterized by a variation of 10 knots between peak and lull. Both the prevailing wind speed and wind gust (if applicable) are reported. An anemometer is used to determine wind speed and direction.

3. **Visibility** is given in meters; it is dependent on the geographical features near your camp. Skiway markers, which are set up at known distances can be used to determine surface visibil-

ity. The maximum visibility on a clear day is seven miles, after which a flat ground horizon will fall away to a point that surface conditions cannot be observed.

4. **Cloud height** is expressed in feet. At an open field, cloud height is estimated. If you are in an area with geographical features of known elevations, use those features to determine cloud height. Cloud heights are reported "Above Ground Level (AGL)."

5. **Cloud type and cloud cell appearance** will help determine the height of a cloud layer. The atmosphere over the Antarctic is shallower than it is at the equator; therefore, the heights of cloud layers are lower.

   - **Low clouds (stratus and stratocumulus)** are commonly found at the surface and up to 6500 feet (AGL).
   - **Mid-level clouds (altostratus and altocumulus)** are generally found from 6500 to 13,000 feet (AGL).
   - **High clouds (cirrostratus and cirrus)** are found from 12,000 to 16,000 feet (AGL).

6. **Cloud coverage** is expressed in eighths of the sky. When reporting cloud layers, start at the ground and proceed upward.

Clear and few	Trace to 2/8ths of sky cover
Scattered	3/8ths to 4/8ths sky cover.

Broken	More than 4/8ths, but not total sky cover.
Overcast	Total sky cover.
Partial Obscurity	Sky is partially obscured, typically by snow or blowing snow. Some clouds are discernible.
Total Obscurity	Sky is totally obscured, typically by snow or blowing snow.

7. **Temperature** is given in degrees Celsius. Make sure that the thermometer is not directly exposed to sunlight. Protect the thermometer from the wind.

8. **Altimeter** setting is expressed in inches of mercury to the hundredths. The altimeter setting is the figure that incoming pilots will want the most, because it allows them to determine the altitude (in reference to mean sea level) at which the aircraft will make contact with the landing field.

9. The following **surface definition** terms should be used to report observations:

- **Good:** Snow surface features such as sastrugi, drifts, and gullies are easily identified by shadow.
- **Fair:** Snow surface features can be identified by contrast. No definite shadows exist.
- **Poor:** Snow surface features cannot be readily identified except from close up.

- **Nil:** Snow surface features cannot be identified. No shadows or contrast. Dark objects appear to float in the air.

10. The following **horizon definition** terms should be used to report observations:

- **Good:** Horizon is sharply defined by shadow or contrast.
- **Fair:** Horizon may be identified, but the contrast between sky and snow surface is not sharply defined.
- **Poor:** Horizon is barely discernible.
- **Nil:** Total loss of horizon, the snow surface merges with the whiteness of the sky.

10.1c Radio Transmissions to McMurdo regarding Weather Observations

The primary frequencies for passing weather observations are:

- **11553 kHz** for remote-site field parties.

- **4770 kHz** for Dry Valley and surrounding areas field parties.

10.2 Peninsula-Area Weather

Palmer Station's weather is dominated by its close proximity to the ocean. The nearby water provides the moderating influence that keeps Palmer's temperatures relatively mild (in comparison to other Antarctic locations) and reasonably constant, and it also acts as a ready source of moisture to fuel Palmer's ubiquitous precipitation.

Figure 10-5: Palmer Station in a snow storm. (photo by Dave Bell)

During the summer, the temperature at Palmer tends to stay in a very restricted range, from about 32 degrees F to 42 degrees F, though on rare calm sunny days it can climb to near 50 degrees F. Temperatures during the winter are much more variable than during the summer. The average winter maximum temperature is around 30F, with an average winter minimum of perhaps 15 degrees F to 20 degrees F. During a typical winter, the station might experience several cold spells, lasting from several days to as much as a week, during which the daily minimum temperature will dip below 0 degrees F, with the daily maximum remaining in single digits. Palmer’s extreme temperatures are 53.6 degrees F, recorded on 03 March 1985, and -23.8 degrees F, reached on 12 August 1980.

The dominant characteristic of Palmer Station’s weather is frequent precipitation. While the total yearly precipitation is not extreme, averaging about 28 inches, it is remarkably evenly distributed. Heavy rain or snow is a rarity, but some form of precipitation is observed on about 80% of the days. Average cloud cover is 90-95%, and the most prevalent type of day includes unbroken low clouds with occasional light rain or snow. Snow can fall throughout the year, but the summer temperatures are high enough and rain is frequent enough to prevent accumulation until roughly April. Average yearly snowfall is approximately 12 feet, and the snow cover tends to increase until late October, peaking at an average depth of three to four feet, before it rapidly dwindles to nothing about a month later.

High winds are also common at Palmer, and while they are usually associated with well developed low- pressure systems, it’s not uncommon for squalls to appear “out of nowhere,” accompanied by winds that may increase from essentially calm to 30-40 knots in a matter of a few minutes. The average wind speed at Palmer is about 12 knots, but that average is composed of many calm days and many days with 20-40 knot winds throughout the day. It is rare for a week to go by without experiencing a wind gust in excess of 40 knots, and the vast majority of months include a peak gust above 60 knots.

Newcomers should be aware that the worst storms come out of the north-east. Groups working south of station should always be on guard. When the wind is strong and it starts to switch directions, special consideration should be made in regard to returning to station and/ or emergency landing contingencies. Watch the flags on the survival caches. If the wind starts to pick up and also begins switching directions, pay extra attention and prepare for worse weather. If it suddenly increases and becomes steady out of the north, prepare to head back to station.

All boaters should have “escape” strategies for their particular location. For example, working south of the station and getting hit by a storm out of the north, the team can skirt the glacier along shore to keep out of the wind and waves, and then get to Christy Cove. Getting around Bonaparte Point is usually the worst part. If it’s bad, tie up at Christy and walk home. Hence, anyone working south of station should have a good feel for Christy Cove (i.e. where the tie ups are, where the rocks are that can tear up the prop, etc.) since they may be using this area in an emergency.

Chapter 11
Snow Shelters

This chapter explains how to build different snow shelters in the Antarctic, as well as the relative merits of each type of shelter and the time required to build each type of shelter. The choice of which shelter to build will be dictated by the local snow conditions.

If a camp is occupied for several days, it's a good idea to build a snow shelter for an emergency shelter (just in case). A snow shelter can be used also as a toilet shelter.

11.1 Snow Quarry and Block Cutting

Before you build a snow shelter, identify an area you can use as a quarry to cut snow blocks. The quarry site and the method of cutting blocks are important for the success of most shelters.

In many areas of Antarctica, the snow conditions are perfect for cutting out snow blocks. However, some areas such as the Siple Coast may have sugar snow or powder snow. In these areas, your quarry will have to be stomped out and packed down (ski and boot packing works well), and the snow will have to be allowed to sinter (freeze solid). This can take up to an hour before the snow is solid enough for block cutting. Snow drifts that contain good block-cutting snow can sometimes be found on sea ice or on hard frozen glaciers.

The snow conditions may change in just a few feet in your quarry. You may run into an ice layer or a sugar layer that will affect the quality of your blocks. If this happens, try cutting the blocks at a different orientation (horizontally versus vertically) or try cutting deeper in the quarry or simply moving over a few feet. Probe with your saw or axe for the right consistency. Don't panic if you don't have a snow saw. You can produce good blocks with a shovel - even an ice axe will work.

Keep the quarry close to your shelter; don't double the effort. If cutting blocks for a tent wall, the quarry excavation makes a great spot for your tent site. Blocks can be cut out of the snow shelter site (i.e., the snow trench can be the quarry).

Try to cut your blocks the same size. Put one aside for a model. Rock-box size blocks are preferable for most projects except roofs.

11.2 Snow Walls

Snow walls provide wind-free areas for cooking and for community "lounging." A snow wall should be built around mountaineering tents. This will keep the tent from blowing away in gale force winds, decrease wind chill, and reduce tent flapping noise. (**Note**: Snow walls are not necessary when using Scott tents.)

Snow-wall blocks should all be the same size, and each block should overlap the gaps in the course below it. Rock-box size blocks are preferable.

Figure 11-1: A snow wall. (photo by Tim Cully)

11.3 Snow Trenches (1/2 to 2 Hours)

A snow trench is a good, quick, simple shelter. The snow must be deep and soft enough to shovel to an adequate depth. If an ice layer stops shoveling progress, snow blocks can be stacked to increase the effective depth of the shelter. A trench can be a quick or "hasty" shelter in an emergency, or a cavernous, comfortable abode complete with sleeping benches and snow-block A-frame roof.

11.3a Trench with Snow-Block Roof

1. Choose a site with soft enough snow for digging. Mark an outline in the surface just slightly wider than your shoulders and 6 to 7 feet long.

2. Excavate the trench by cutting out blocks with a snow saw and/or by shoveling. (Blocks for the roof can come out of a separate quarry area.)

   It's critical that the top of the trench "hole" be slightly wider than shoulder width - just wide enough to work in. If you make the trench too wide, you'll have a difficult time roofing it with snow blocks. The trench should be waist deep to armpit deep, depending on snow conditions and the desired comfort for the inhabitants. If hard snow or an ice layer prevents you from digging to an adequate depth, build up the depth by making a wall around the excavation with large, stout snow blocks. (See figure 11-2).

3. When the trench is deep enough, sleeping benches can be carved out of the sides. Be careful not to dig too close to the surface or the

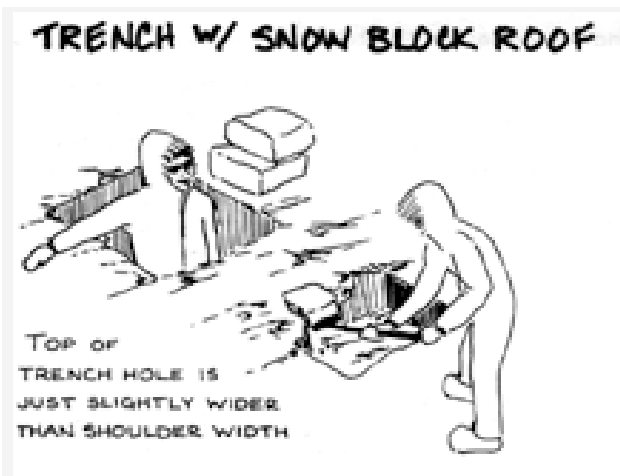

Figure 11-2: Trench excavation

snow will be too weak to support roof blocks.

4. Roof blocks can be either laid flat across the trench or set up as an A-frame, which gives more head room. Roof blocks leaned A-frame style can be staggered to support each successive block. Don't worry about gaps or holes, as these can be filled in later with snow chunks. Good dimensions for roof blocks are approximately 18" x 5" x 30", but let common sense and snow conditions dictate what size blocks to cut. (See figure 11-3).

5. Finish the shelter by "chinking" the gaps with snow chunks and shoveling loose snow over the roof.

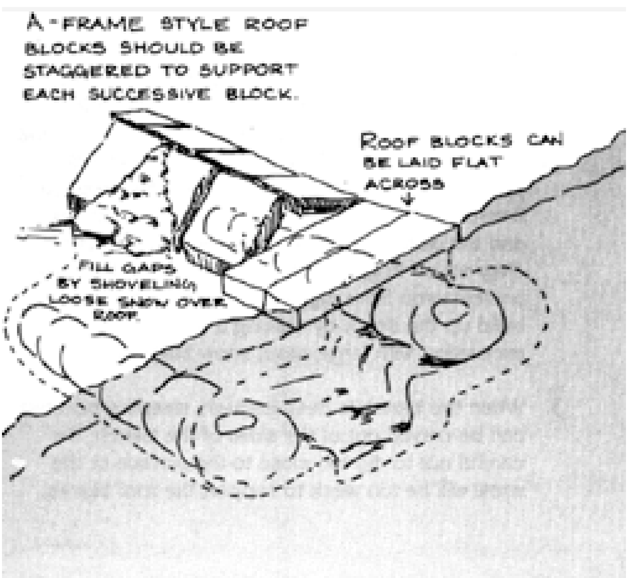

Figure 11-3: Trench roof options.

11.3b Trench with Tarpaulin Roof

A trench with a tarpaulin roof is the quickest shelter you can build. This is very important in an emergency.

1. The size of the trench you dig is dependent on the size of the covering and on the support items used to span the trench. Support items could include skis, ski poles, bamboo flags, rope(s) stretched tight, etc.

2. Span the trench with support items, cover with a tarp, and anchor the edges of the tarp with snow blocks or heavy equipment.

   Improvise with trench coverings. A trench can be covered with a tent fly, skidoo cowlings and covers, Nansen sleds, sled tanks, plywood, pallets, cardboard, plastic, etc. (See figure 11-4).

3. Shovel a light skiff of snow over the tarp to add extra insulation; too much snow will collapse the tarp.

Trenches make good frozen-food coolers. They also make good toilet sites (preferably **not** in the same trench).

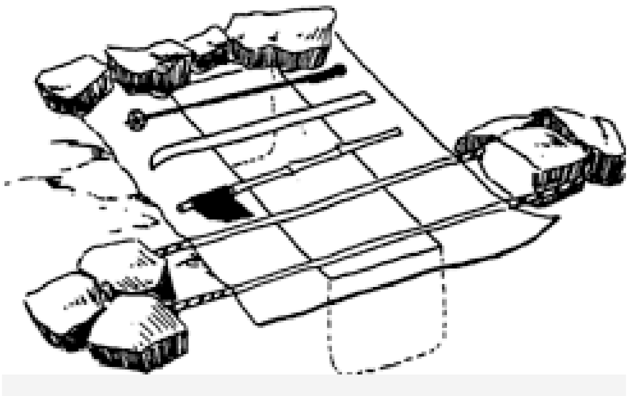

Figure 11-4: Trench with tarpaulin roof.

11.4 Snowmounds/Quinzhees (2 to 4 Hours)

Snowmounds (also known as quinzhees) are among the easiest snow shelters to build. All you need is enough surface snow to shovel into a big pile over packs or equipment. The tunnel entrance is then dug in, the gear removed, and the shelter hollowed out and enlarged.

1. Pile equipment in the deepest patch of snow available. Avoid unnecessarily flattening the site. (See figure 11-5).

2. Standing well away from the equipment pile, shovel snow onto the center, burying the equipment. To increase the mound's strength, pat the snow down as you proceed. The buried equipment must have a minimum of 2 feet of consolidated snow covering it. Probe all around the mound with an ice axe or ski pole and shovel snow on any thin spots. (See figure 11-6).

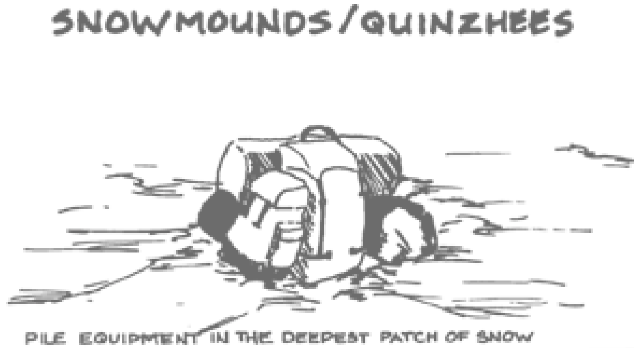

Figure 11-5: Equipment pile.

3. Dig into the mound on the downhill side or away from the wind to form an entrance. Dig down first and then back up into the shelter to create a cold air sump. The entrance should come up right near the wall. Be careful not to

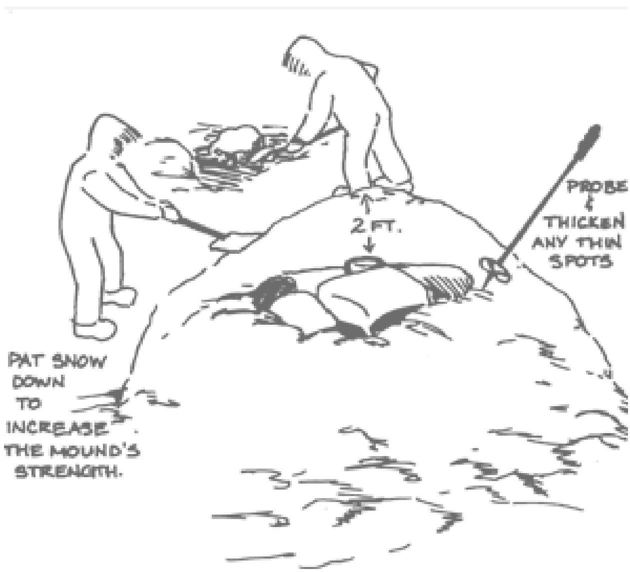

Figure 11-6: Buried equipment pile.

tunnel into the central sleeping area as this will waste space.

4. Another temporary entrance dug opposite the main entrance and dug in at ground level will speed up the hollowing-out process by as much as an hour. This hole should then be blocked up after hollowing out is completed.

5. The equipment in the pile should be pulled out of the entrance(s), the inside of the shelter should be hollowed out carefully, and the floor dropped to increase the inside area. When you begin to see blue light, the walls are the correct thickness (about 12 inches thick.)

6. A vent hole the diameter of a tennis ball should be poked through the ceiling before operating a stove inside the shelter. (See figure 11-7).

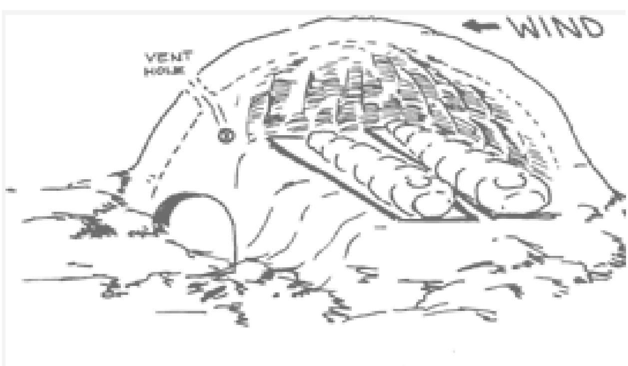

Figure 11-7: Vent hole in snow shelter.

11.5 Snow Caves (3 to 4 Hours)

A snow cave requires a sloping snow surface and snow that is well-compacted but soft enough to shovel. Wet or unconsolidated snow is liable to collapse. Given good conditions, a snow cave will provide roomy and comfortable shelter.

1. Dig an entrance tunnel, about the diameter of a car tire, that extends at least 3 feet into a drift.

2. Scoop out a platform at a level above the entrance tunnel to form a cold-air sump. The platform should be centered on the entrance tunnel and should be long enough and wide enough for all occupants. Remove excavated snow through the entrance. After scooping out the platform, hollow out a ceiling of a reasonable height.

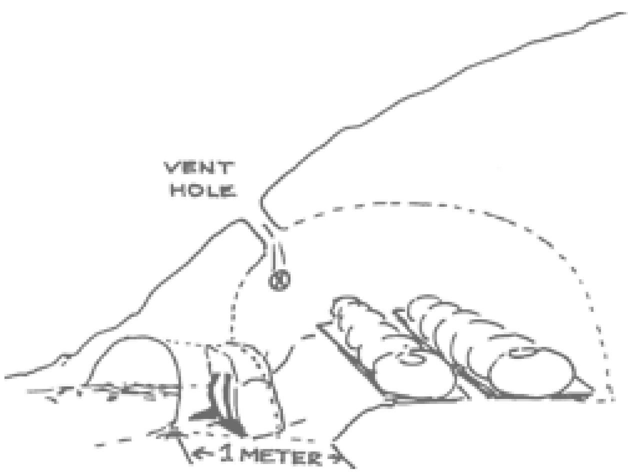

Figure 11-8: Vent hole in snow cave.

3. A vent hole the diameter of a tennis ball should be poked through the ceiling before operating a stove inside the shelter. (See figure 11-8).

11.6 Igloos (3 to 5 Hours)

Although igloos are by far the hardest shelters to build and should not be attempted in an emergency, they are warm, roomy, and aesthetically pleasing.

1. Choose a quarry site for your snow blocks. Snow should cut with an even consistency.
   - Avoid blocks with a “curd-like” texture.
   - Avoid blocks with a shear layer.
   - In loose snow, the quarry area may have to be stomped out and allowed to set up.

2. Scribe a circle in the snow near the quarry site. (See figure 11-9).
   - Maximum diameter: 6 feet (widen it later).
   - Leave a center marker (ice axe or tent peg).

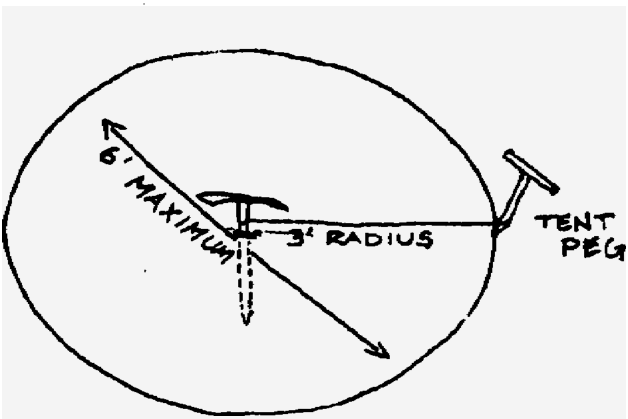

Figure 11-9: Circle mark for quarry site.

3. Cut out the snow blocks.
   - You'll need 50 to 80 blocks.
   - Calculate the ideal block size as shown below in figure 11-10.

Use SMC saw as a ruler:

Total saw (length)
x
1/2 saw (width)
x
blade length (height)

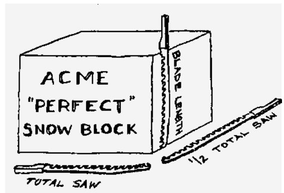

Figure 11-10: Snow block sizing.

4. Lay out the first flight of blocks.
   - Cut the sides of each block so they point to the center as shown in figure 11-11).

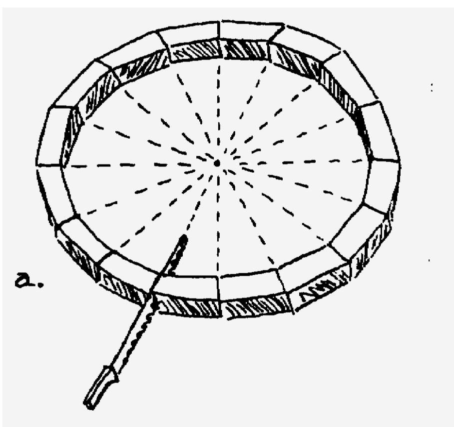

Figure 11-11

   - Cut a spiral from ground level of the first block until the last 4 or 5 blocks are full size as shown in figure 11-12.

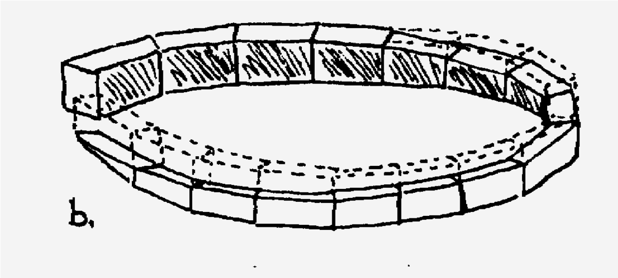

Figure 11-12

- The top spiral cut must point toward the center marker (at ground level). Use your saw as a “sight/straightedge” as shown in figure 11-13.

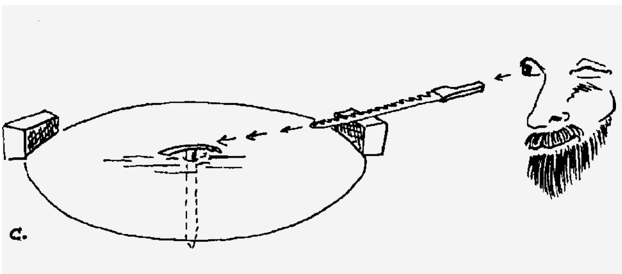

Figure 11-13

5. Continue laying blocks over the first flight. (All the blocks are now full size.)
   - Each flight of blocks is stacked slightly closer to the center as shown in figure 11-14.
   - Remember that side cuts are toward the center as in figure 11-15.
   - Level off the top layer, using your saw as a straight edge to sight toward the center at ground level as in figure 11-16. This brings the igloo progressively toward the center, which eventually closes it.

- The top edge of each flight should be smooth, with no bumps or steps.

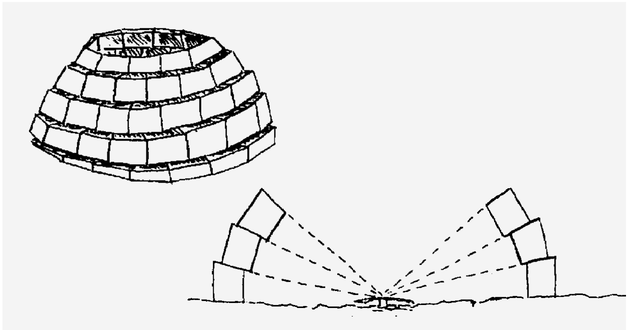

Figure 11-14

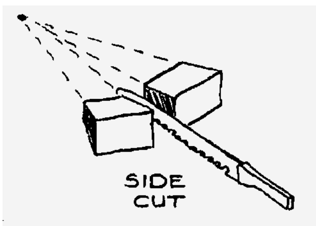

Figure 11-15

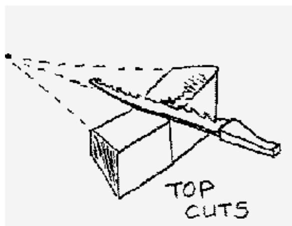

Figure 11-16

6. One person needs to stay inside the igloo with a saw and a small shovel, helping place each block.
    - Don’t chink the blocks to make them fit.
    - Only the block you’re working on needs to be held in place.
    - As you build up, gently tamp the previously laid blocks in toward the center. This locks the blocks together.
    - Never push out on the blocks; this unlocks them.

7. The last block should be cut as a tapered "cork." It is lowered to the person inside the igloo, who can cut the sides until it drops in snugly as shown in figure 11-17.

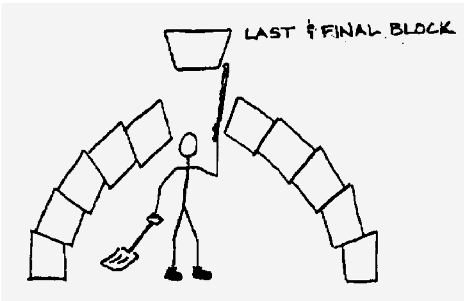

Figure 11-17

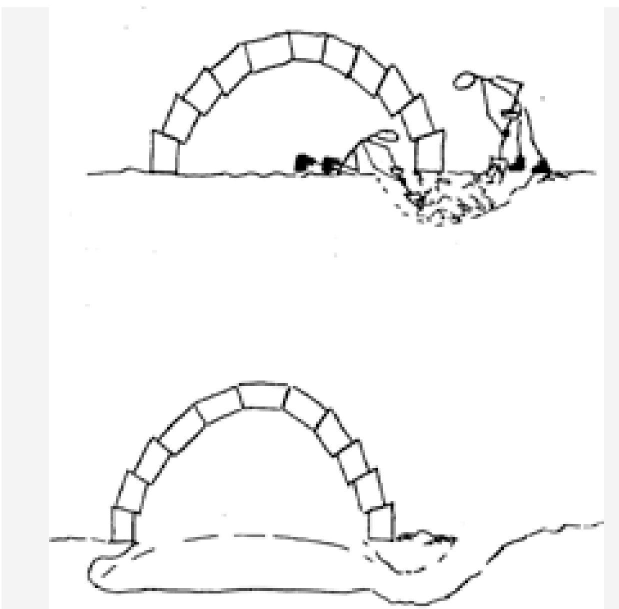

Figure 11-18

8. The inside person should next dig down into the snow at the base of a wall and tunnel over to meet the entrance tunnel being dug by a person outside, as shown in figure 11-18.
   - Keep the entrance close to the wall to avoid using up sleeping area in the igloo.
   - The entrance should be lower than the sleeping area to create a cold sink.

9. Hollow out the floor space in the igloo to increase the sleeping area. Chink and shovel snow over any gaps in the blocks.

11.7 Crevasses and Bergshrunds

Crevasses and bergshrunds, in emergency bivouac situations, can provide shelter which can be augmented by chopping out ledges. **The utmost care must be taken to ensure the safety of you and your companions in such a dangerous bivouac.** Although these shelters are very cold, you will be out of the wind if you choose a suitable site.

Chapter 12
Tents

Figure 12-1: Three Scott Polar tents and one Stretch Dome tent. (photo by Gerry Gales)

This chapter describes the types of tents used in the USAP and offers some tips on using them in the field.

Seven different tents are issued: the Scott Polar tent, the Endurance tent, the North Face™ VE-25 tents, and the Sierra Designs™ Stretch Dome, Super Flash, Tiros 1, and Sphere Expedition tents.

The following pages provide detailed information on the setup and tear down of Scott Polar tents. These tents are unique to polar travel and require some instruction to use properly, especially in strong winds.

The Super Flash or Tiros 1 is packed in survival bags. They are easy to set up, secure in strong winds, and the flysheet provides extra room for cooking or gear storage. The Super Flash is a non-free-standing tent.

The VE-25, Stretch Dome and Sphere Expedition are four-season self-standing tents. The hemispherical shape is extremely efficient in shedding both wind and snow.

The Endurance Tent is a large clamshell shaped tent used by groups as a kitchen or lab tent. There are a limited number of these tents and they require a practice “set-up session” at the BFC.

During your Field Safety Training course, you will receive hands-on instruction on setting up any tent that has been allocated to you. Specific written instructions are packed with all tents.

12.1 Preparation for All Tents

Find a level site free of sharp objects and preferably out of the wind. In strong winds, if it is not an emergency, build a snow wall (See Chapter 11, Section 11.2) before erecting the tent, unless it is a Scott tent.

12.2 The Scott Polar Tent

The Scott Polar tent has been the standard Antarctic exploration shelter for almost 80 years; it has changed little in design since its original concept. This tent is designed for two people, but four or more can be accommodated in an emergency. It travels assembled, sets up quickly, is very secure in strong winds (when set up properly), is safe to cook in, and as tents go, is quite warm.

12.2a Scott Polar Tent Set-up

1. In high winds, raise the tent while belaying with the attached rope, allowing the wind to assist you, pulling the leeward poles into position. (See figures 12-2 and 12-3).

2. In hard snow, ice, or dirt, chop or scoop out small depressions (3-5 inches deep) for the tent poles to rest in.

3. Place heavy items in the valance (flaps), e.g., snow, ice blocks, food boxes, rocks, etc. If you use rocks, make sure the rocks don't rub on the main tent fabric.

4. Secure the stakes, and tighten all the guy lines. Use "slippery" knots that won't require a knife when it's time to take down the tent.

5. Spread the separate floor sheet inside the tent.

6. Insert the vent tube and tie it in so that it doesn't fall out. It's sometimes easiest to insert the vent tube before erecting the tent. Do not operate a stove in the tent without the vent tube in place.

Note: Because of this tent's large surface area, anchors need to be especially "bombproof." In snow, deadman style anchors are the strongest and should be used for

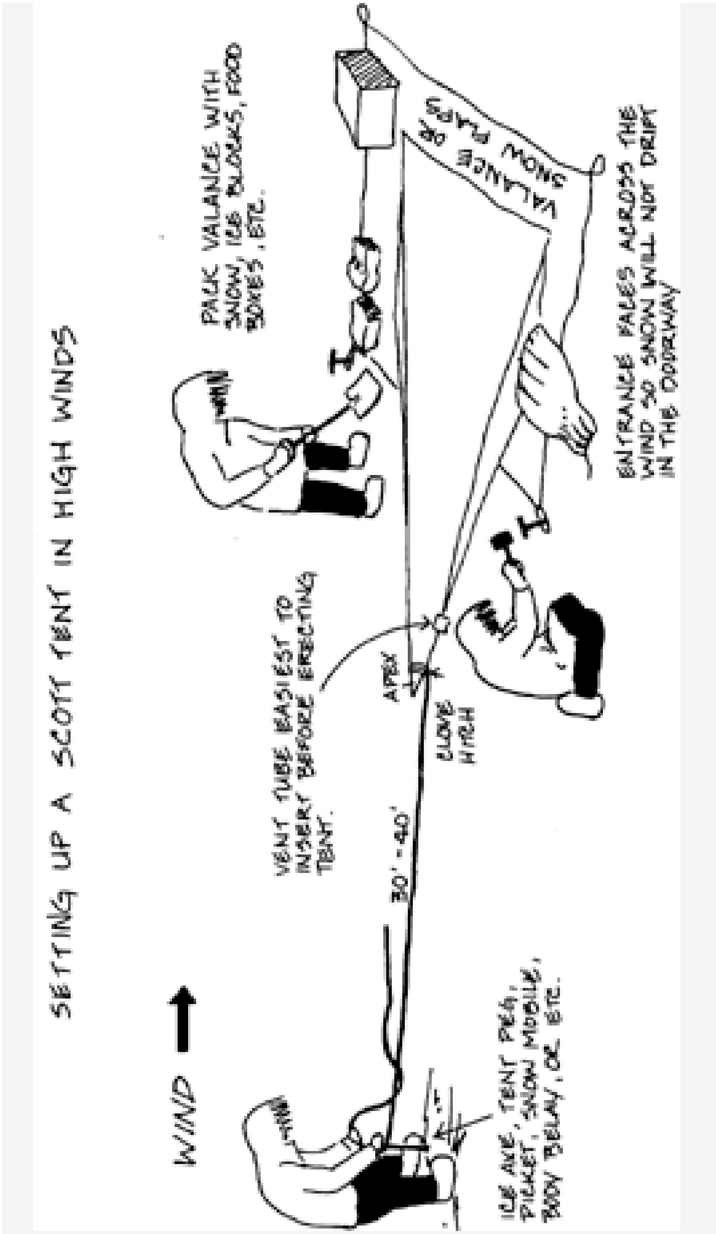

Figure 12-2: Setting up a Scott Tent in high winds.

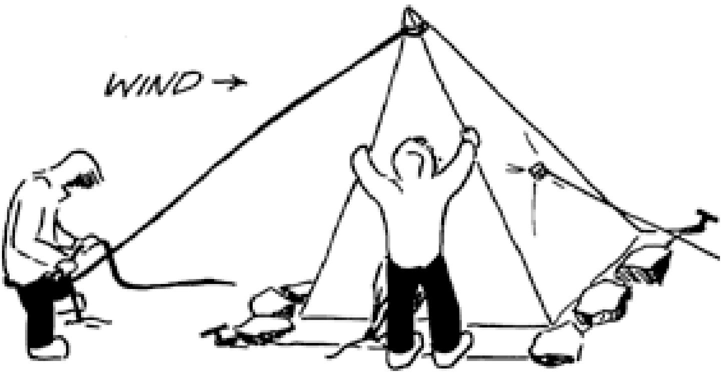

Figure 12-3: Raise the tent while belaying with the attached rope.

guylines. In the Dry Valleys, you may have to spend five minutes on each stake sledgehammering it into frozen dirt and rock.

12.2b Setting a Polar tent up for Extra Wind Protection

The “Braddock Bridle” is recommended for high wind areas, especially where wind direction is variable. See figure 12-4.

1. Place the Bridle over the peak of the tent.
2. Line up the 4 loops over the tent poles.
3. Connect the guy lines to the loops with carabiners.
4. Raise the tent with a belay on the up-wind bridle guy line, if windy.
5. Connect all guy lines to secure anchors and tension lines.

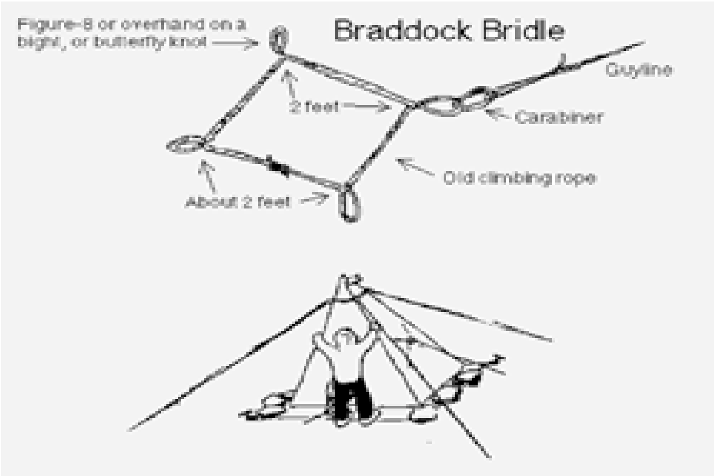

Figure 12-4: The Braddock Bridle.

12.2c Scott Polar Tent Tear-Down

1. Fold up the floor sheet and secure it in a location where it won't blow away.

2. Uncover the valance and disconnect all but the windward guylines.

3. Tip the tent into the wind, collapsing the leeward poles. If the belay rope is still connected to the apex, take in slack to secure the tent. Lay the tent flat on the ground apex into the wind. Disconnect all guylines and neatly wind them up and lay them on the tent. (See figure 12-5).

4. Pull the tent bag over the bundle, insert the floor sheet, and tie off the tent bag as shown below in figure 12-6.

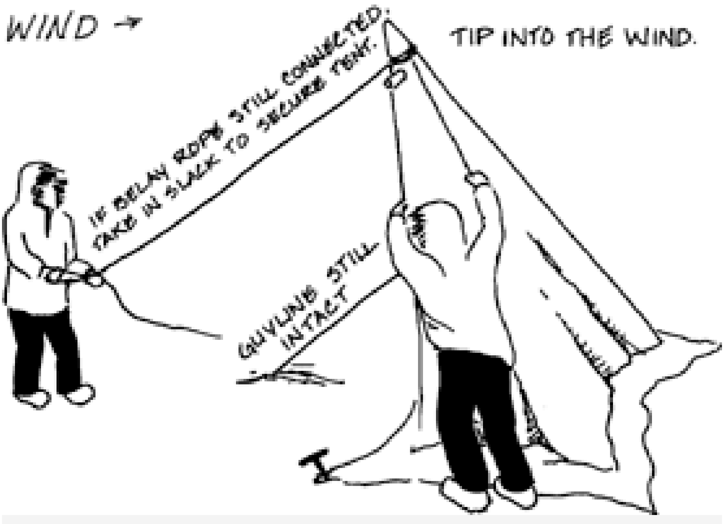

Figure 12-5

If you find any tears or rips on the tent, repair them immediately with repair tape, duct tape, or needle and thread. If you don't repair these tears immediately, high winds could destroy your tent very quickly!

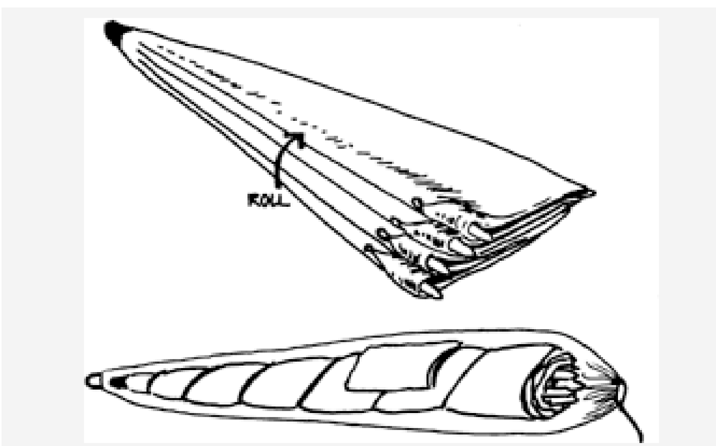

Figure 12-6

At the end of your field season, place tags on the tent indicating tears, rips, pole problems, and/or comments. This will enable the repair staff to quickly locate the problems and fix them.

12.3 Setting up the Stretch Dome, Sphere Expedition Tents

To set up a Stretch Dome or Sphere Expedition tent, stake the floor before inserting the poles. This will allow for greater pitching ease and for greater safety and stability especially in high winds.

Next, stake each of the webbing loops at the back of the tent (points G and H in figure 12-7**)**. Then move to the front of the tent and pull the webbing loops at points A and B until the tent floor is squarely and tautly positioned, and stake them down. Finally, stake the sides (points C and D) , again pulling the tent floor taut. To erect the tent, inset the metal tips of one of the four long poles into the grommets at points A and H, and the tops of a second long pole into the grommets at points B and G. Next, position yourself in the open doorway and locate the double Swift Clips™ at the apex of the roof.

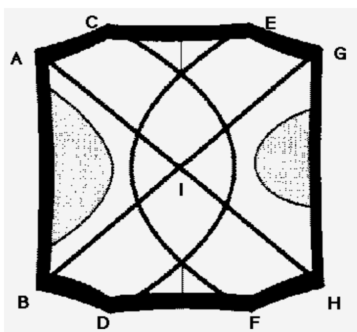

Figure 12-7: Top view of tent body.

Pull the two poles up so that they intersect at point I, and attach both Swift Clips over the intersection of the poles, as shown in figure 12-8. Follow the seams along the paths of the poles and attach the Swift Clips to the poles.

Next, insert a long pole at points C and D, arching the pole around the back of the tent. Following the discontinuous seam along the path of the pole, attach all single Swift Clips, and the double Swift Clips located at the intersection points of the three poles. Insert the remaining long pole at points E and F, arching the pole around the front of the tent and again attaching all Swift Clips along the discontinuous seams as before.

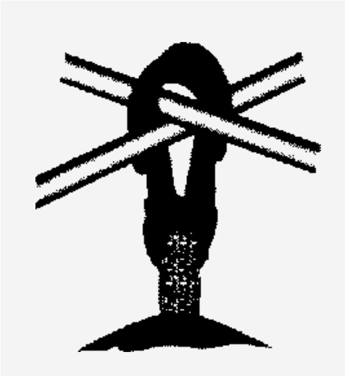

Figure 12-8: Double Swift Clips.

12.4 Setting up a VE-25 Tent

Figure 12-9 on the next page shows how to set up the Northface™ VE-25 tent.

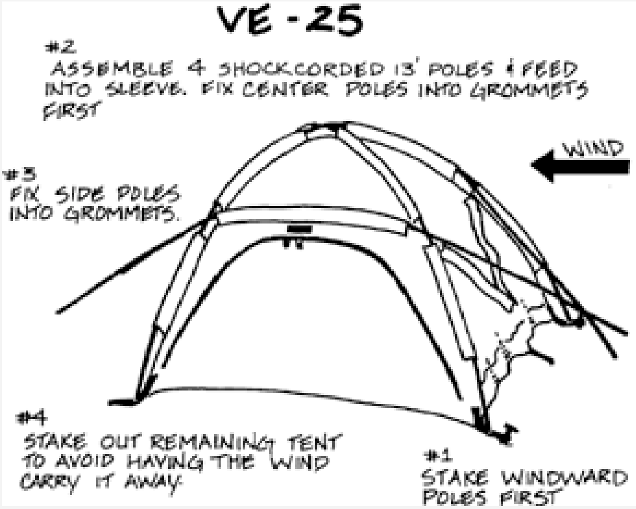

Figure 12-9: Northface™ VE-25 set up.

Chapter 13
Rope Use and Care

13.1 Types of Ropes

There are two basic types of climbing ropes used by the USAP: climbing (dynamic) ropes and static (non-stretch) ropes.

- Climbing ropes are carefully designed and constructed to balance such factors as rope stretch, impact force transmitted to the climber, and abrasion resistance with the goal of producing a rope that minimizes the chance of injury to a falling climber or glacier traveler.

- Static ropes are designed primarily to minimize stretching under working loads. These ropes are useful for rescue and fixed safety line applications, or where rappelling or prussiking are expected, because they eliminate bouncing. Static lines should not be used as safety lines when working in crevassed areas because these ropes transmit large impact loads on a falling victim and the anchor.

Ropes will be identified for you at issue and are easy to tell apart once you know the difference. Use only the correct rope for your intended application or injury may result. In general, all safety ropes will be climbing (dynamic) ropes.

13.2 Rope Care

It's important to treat your ropes as safety devices, as peoples' lives may depend on them.

Ropes are designed to be as durable as possible, but they are nevertheless susceptible to damage from a variety of sources. The biggest causes of damage to ropes are abuse, chemical contamination, and degradation due to ultraviolet light exposure.

Never step on a rope. When dirt or grit is worked into the sheath, it will invisibly abrade the core. Never tow anything behind a vehicle with your climbing (safety) ropes or subject them to repeated high impact loads, such as long practice falls.

When using your ropes around vehicles and people wearing crampons, be careful not to damage the ropes. These ropes have a self-healing sheath which hides damage to the core. As the core accounts for 80% of the strength of the rope, this could be very dangerous.

Chemicals can severely weaken a rope without leaving obvious signs. Battery acid and solvents are a particular problem. Even the vapors from these chemicals can weaken a rope. Damage from ultraviolet light is easier to detect, but no less serious. Ropes should be stored in a stuff sack or pack when not in use.

Both climbing and static ropes should last for several field seasons if they are well cared for and protected from damage. If one of your ropes becomes damaged or suspect, remove it from service and mark it with a tag explaining the problem.

If replacement ropes are not readily available and the damage is localized, you can isolate the damaged section of the rope with a Figure-8 or butterfly knot, with the bad section in the resulting loop. However, this is a stopgap measure and will greatly complicate a crevasse rescue should one become necessary.

When in doubt about a rope's condition, be conservative - the life you save may be your own.

13.3 Knots

Diagrams of some basic knots used for safe crevasse travel are on the following three pages (figures 13-1, 13-2, 13-3). See Chapter 18: "Glacier Travel and Crevasse Rescue" for more details on when to specifically use each of these knots.

Note: Both the Muenter Hitch and the Clove Hitch are usually tied in the middle (of the rope) without accessing either end of the rope. This is not intuitively obvious in the following illustrations.

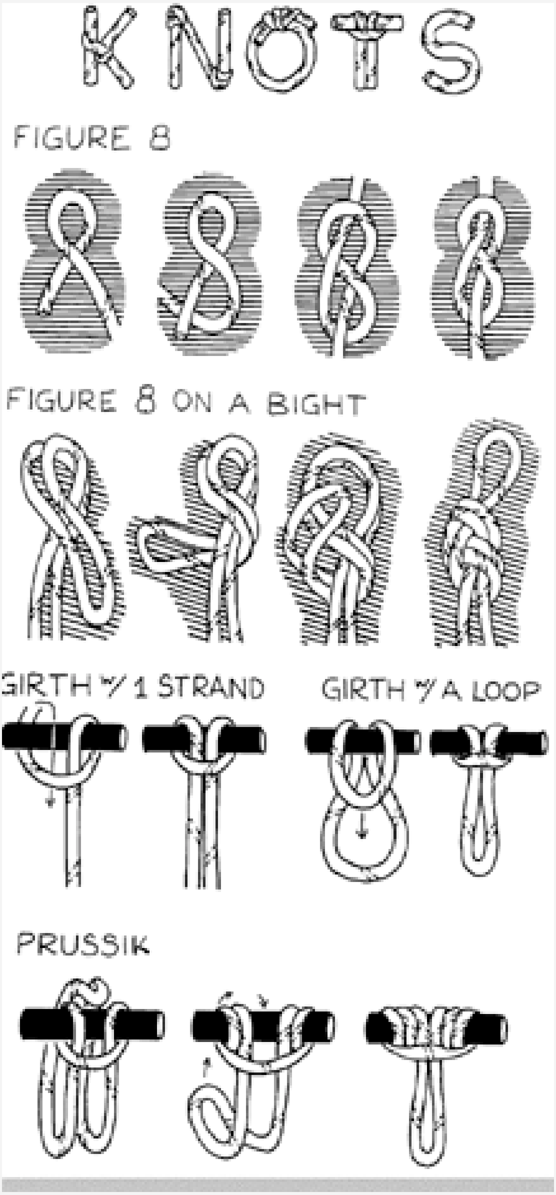

Figure 13-1: Figure 8, Girth and Prussik knots.

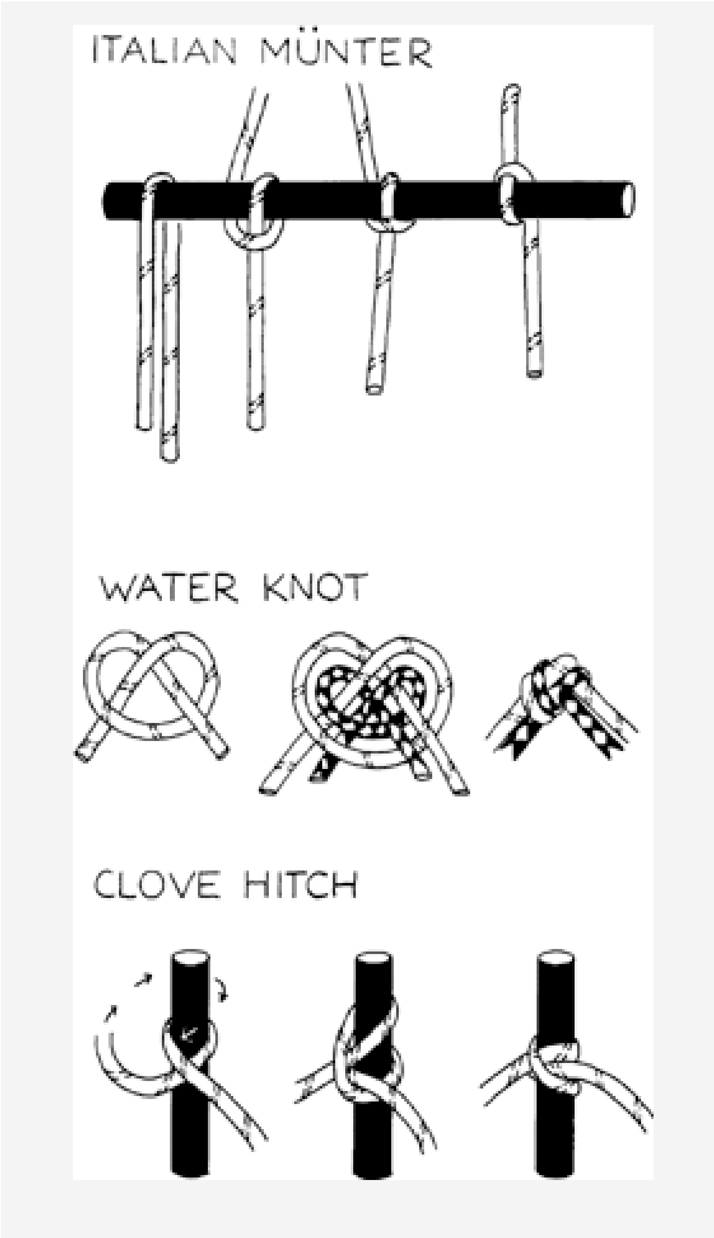

Figure 13-2: Italian Munter, Water and Clove Hitch knots.

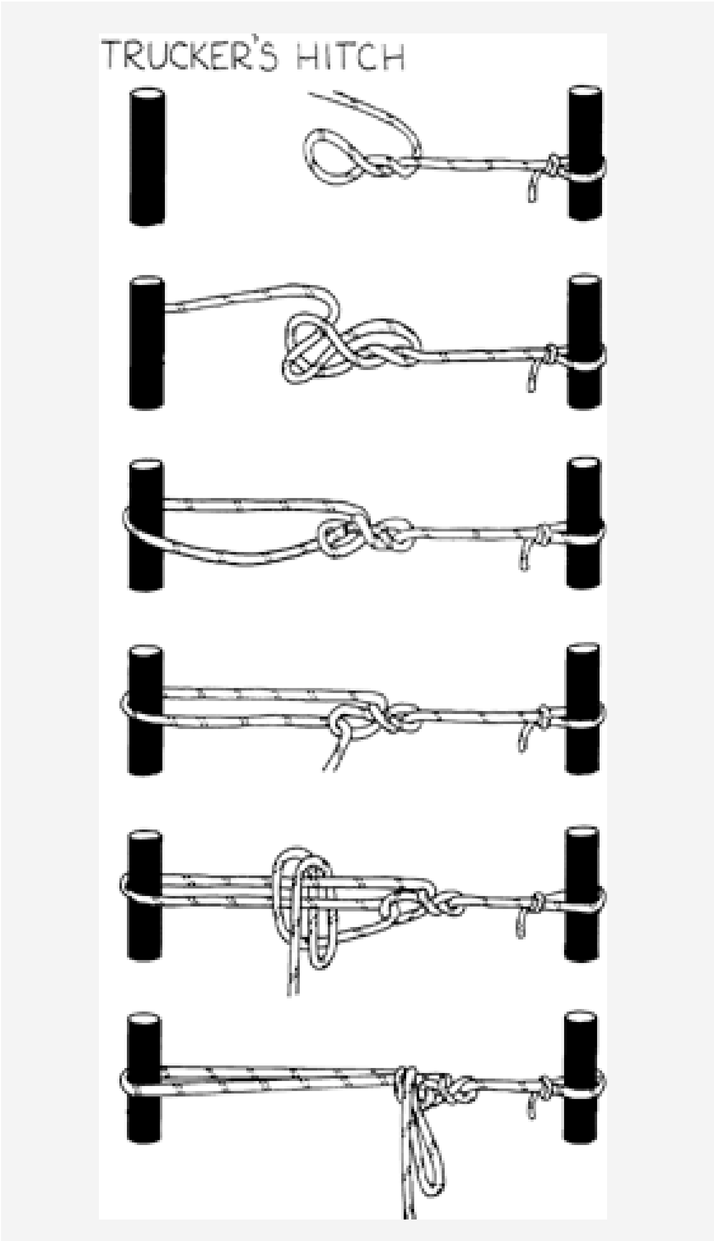

Figure 13-3: Trucker's Hitch.

Chapter 14
Stoves

The USAP issues four types of portable stove to field groups. All four types operate on the principle of pre-heating liquid gasoline or kerosene so the fuel pressurizes, exits the jets as a vapor, and is ignited.

14.1 Types of Stoves

MSR Whisper Lite International ® stove burns white gas (Coleman fuel) or kerosene (with a change of the stove's jets). It's the lightest of the stoves issued (17.8 ounces without fuel). A nearly identical version of the Whisper Lite International is the "shaker jet" model of the same stove with an in-line jet cleaner. The Whisper Lite International, either version, is issued as the emergency stove in all Survival Bags. (See figure 14-1).

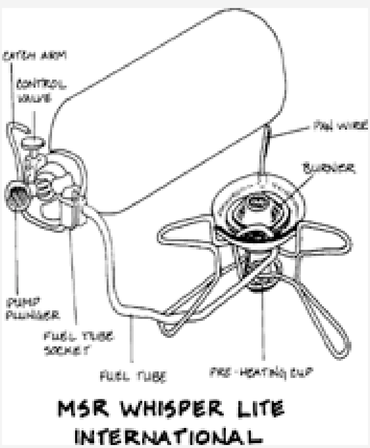

Figure 14-1: MSR Whisper Lite International® stove.

The **Optimus 111®** stove burns white gas (Coleman fuel) or kerosene. This is a compact stove (approximately 7 x 7 x 4 inches) and very reliable. In the field, it's used both as a primary stove and as a back-up or emergency stove. (See figure 14-2).

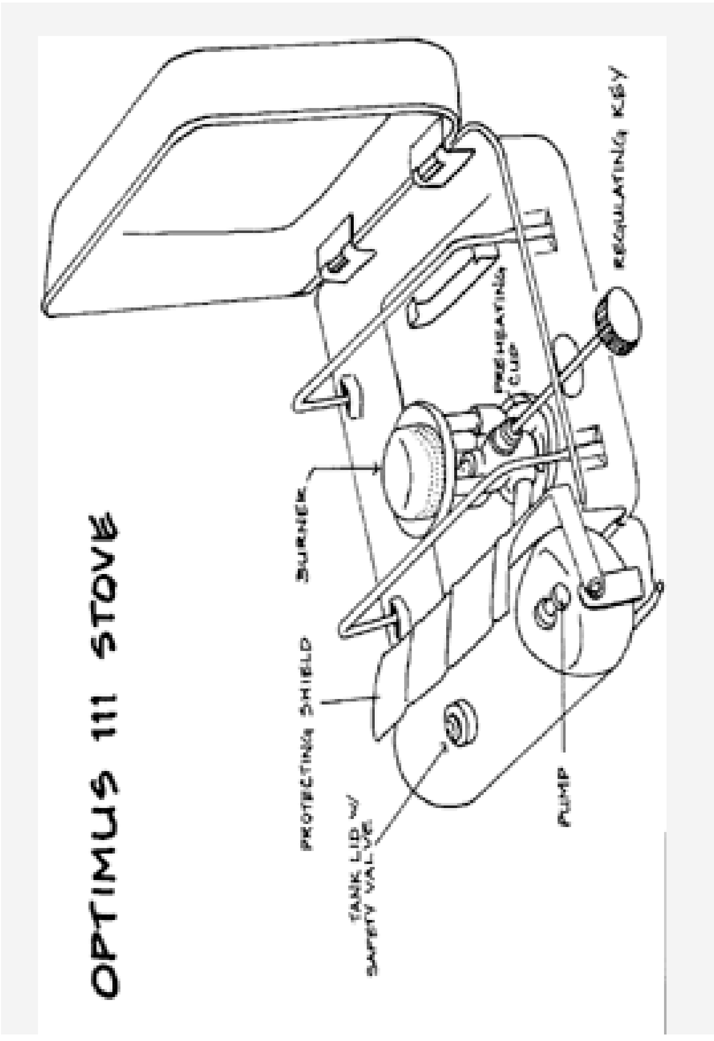

Figure 14-2: Optimus 111® stove.

The **Coleman 2-Burner**® stove burns white gas only (Coleman fuel). It's a large stove that allows two large cookpots to be heated at the same time. This is also the most maintenance-free stove that the USAP issues. (See figure 14-3).

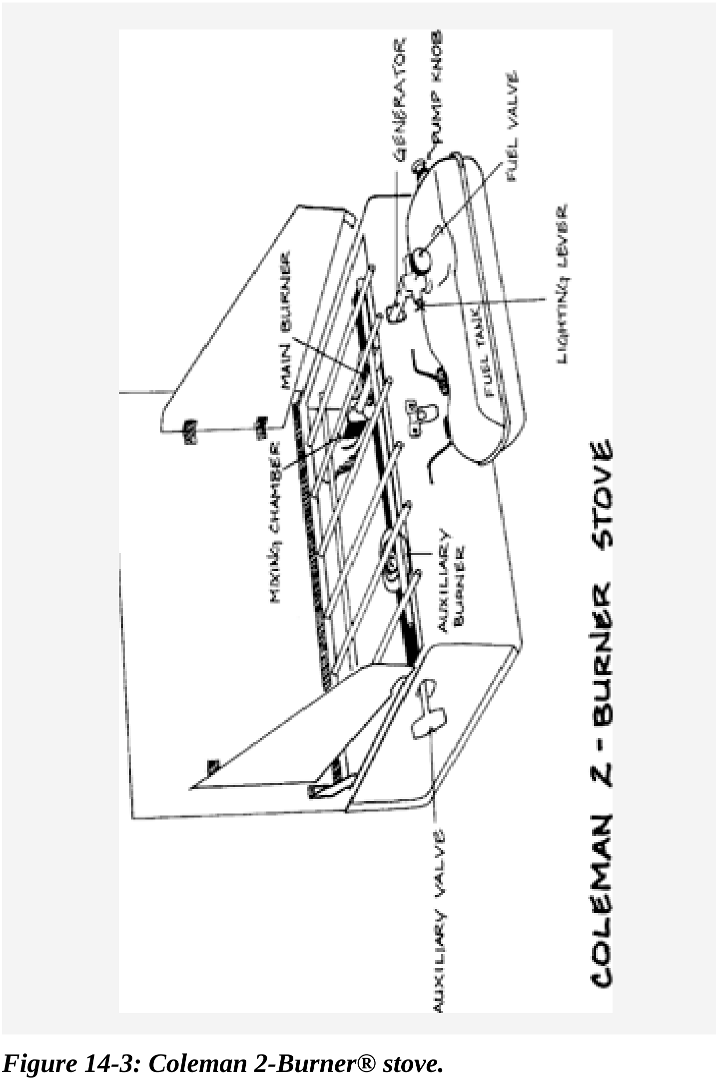

Figure 14-3: Coleman 2-Burner® stove.

The **MSR XGK®** stove burns a variety of fuels: white gas (Coleman fuel), Mogas, kerosene, or JP-8 (with a change of the stove's jets). It's lightweight (18.5 ounces without fuel) and is used primarily as a back-up or emergency stove. (See figure 14-4).

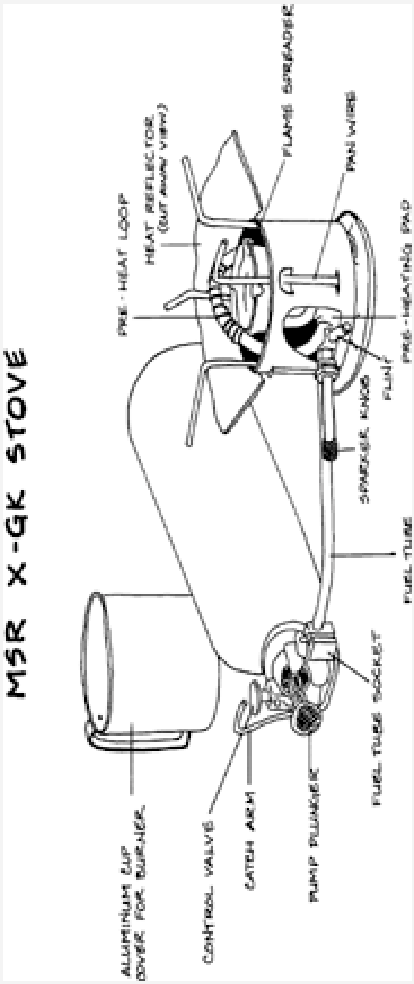

Figure 14-4: MSR XGK® stove.

14.2 Stove Safety

Liquid-fuel stoves are potentially hazardous due to the flammability of the fuels used and the toxicity of the vapors they produce (carbon monoxide). Deaths have occurred in the Antarctic due to improper stove use. When using a stove in the field, make sure to follow the safety measures listed below.

1. Do not use stoves without adequate ventilation.

2. Do not release fuel tank pressure near an open flame.

3. Use extreme caution when refueling. Skin contact with supercooled fuel will cause instant frostbite.

4. Check for leaks before every use.

5. Release pressure in the fuel tank before packing and storing.

6. Pack stoves and fuel away from food.

7. Do not cook in mountain tents except in emergencies. Preheat the stove outside of the tent.

8. Test all stoves before your field deployment.

9. Insulate the base of the stoves so that they won't melt through tent floors.

Should a person’s clothing become ignited, **Stop, Drop,** and **Roll** to extinguish flames. Residues left from evaporated gasoline are combustible.

14.3 Stove Operating Instructions

MSR WhisperLite International and XGK

1. Fill the fuel bottle 3/4ths full with white gas (Coleman fuel), and screw the fuel pump snugly into the fuel bottle. Turn the fuel bottle upside down and check for leaks.

2. Pump 10 to 20 times.

3. Lubricate the end of the fuel tube on the stove with lip salve, sun cream, saliva, etc. to prevent tearing the “O” ring in the fuel-tube socket. Push the fuel tube into the socket on the pump and swing the catch arm around the pump until it snaps behind the pump and over the control valve.

4. Remove the flame spreader (XGK stove only) and poke the jet clean with the jet cleaning wire. Put the flame spreader back in place.

5. Place the reflector ring over the pan support wires and push it down out of the way of the burner assembly. Open the cylinder wind screen and place around the burner assembly, estimating your cook pot size.

6. Prime the stove by opening the control valve slowly. Let up to one teaspoon of fuel come out of the jet. Close the control valve. Light the spilled fuel. (The flame may be quite high - that is why you should never preheat a stove in a mountaineering tent.)

7. When the priming fuel flame is nearly out, slowly open the control valve up to two full turns. If yellow flame shoots forth, rather than blue flame, shut the control valve off and allow the stove to preheat (prime) a little longer. Then slowly reopen the control valve up to two full turns and adjust to desired heat. Remember, there is a time lag between control valve adjustments and the flow of fuel.

8. Adjust the flame with the control valve and by pumping up the fuel bottle.

9. Turn off the stove by closing the control valve until it is just snug. Don’t tighten too much or you’ll strip the nylon threads and ruin the pump assembly. It will take 10 to 15 seconds for the flame to go out. You can blow it out when it turns to yellow.

10. To release stove pressure, allow the stove to cool down several minutes. Turn the burner upside down and open the control valve. The pressure will escape through the jet. Close the valve when air stops escaping from the jet.

11. Burning kerosene or JP-8 in the WhisperLite and XGK stoves requires changing the jet to the “K” (kerosene) jet. You cannot prime/preheat the stove by spilling kerosene or JP-8 into the spirit cup.

Note: You must prime the stove with a flammable fuel such as white gas or Meta-paste. It is recommended to prime the stove aggressively before attempting to open the control valve for stove burning.

Optimus 111

1. Fill the tank 7/8ths full with white gas (Coleman fuel). Check the tank cap seal by holding the stove upside down and looking for leaks.

2. Clean the jet/nipple by turning the regulating key quickly all the way open and back again.

3. Preheat the stove by opening the regulating key and pumping the tank, spilling white gas into the preheating cup. Close the regulating key, and light the fuel in cup. Pump the stove 10 to 20 times. When the flame in the preheating cup burns down, turn on regulating key and ignite the stove.

   A “thimble-full” of Meta-paste can be used to preheat the stove instead of white gas in the preheating cup.

4. Adjust the flame with the regulating key and by pumping the tank. To extinguish the flame, turn the stove off by turning the regulating key clockwise.

Coleman 2-Burner

1. Fill the tank 7/8ths full with white gas (Coleman fuel). Check the tank cap seal by holding the fuel tank upside down and looking for leaks.

2. Pump the tank 10 to 20 times, with the control valve closed. Plug the tank and generator into the stove so that it fits securely in the proper spot. (The generator rod should be plugged into burner body).

3. Make sure that the secondary burner regulating key (on left side of stove) is turned off.

4. Turn the lighter stem on the generator/valve assembly to the Up position.

5. Open the control valve and light the primary (right) burner. After one minute of burning, turn the lighter stem to the down position. Adjust the flame with the control valve and by pumping up the tank.

6. The second (left) burner can now be ignited by turning on the regulating key on the left side of the stove and lighting the burner with a match.

Note: You can effectively preheat this stove by putting white gas or Meta-paste in the primary burner bowl under the generator stem, lighting it, and allowing it to burn down before turning on the stove and lighting the stove.

14.4 Five Major Stove Problems

1. Insufficient preheating.
2. Clogged jet.
3. Air leak in the system (seals and "O" rings).
4. Wrong jet.
5. Contaminated fuel.

14.5 Stove Troubleshooting

Fuel Leakage:

- At fuel bottle: Fuel cap (or pump) not tight.
- At connectors: Seals or "O" rings damaged.
- At pump: Pump valve or seals are damaged.
- At jet: Control valve is stripped.

Limited or No Fuel:

- No pressure: Pump up fuel tank.
- No fuel: Tank is empty, jet is clogged, fuel tube is clogged, and/or fuel is too cold.

Pump won't work:

- Dry cup: Oil the pump cup.
- Dirty pump: Clogged check valve.

Reduced Performance through Jet:

- Lack of fuel: Check fuel level, pump up pressure-tank.
- Obstructions: Clean jet. Improper jet.
- Too cold: Improperly insulated from snow; warm fuel tank in sleeping bag.

Erratic Burning/Surging:

- Pressure too great: Control valve opened too far.
- Improper jet: Kerosene being burned in “G” jet.
- Gas being burned in ”K” jet: Stove is cold. Burner not adequately preheated.

Do not purge gasoline stoves with kerosene or JP-8 as this will ruin them!
Drain and vent only!

Do not leave a venting stove where blowing snow, sand, or dirt could contaminate the fuel tank.

Chapter 15
Waste Handling In The Field

In general, everything taken into the field must be brought out. This includes used food containers, empty fuel drums, toilet paper, urine, human solid waste, used dish water, and everything else that is brought into the field. There are a few specific situations where human waste may be disposed of in the field (see section 15.1).

15.1 Human Waste Management

The NSF's Policy on Management of Human Wastes in Antarctica at Field Locations states the following:

> There will be no discharge of human waste to ice-free areas or freshwater systems either directly onto the land or into any pits, trenches, or similar devices. All human waste will be disposed of in such a way that it is either discharged directly to the sea or containerized for retrograde. Treatment to reduce the volume of waste through the use of composting toilets or similar devices is to be encouraged at fields camps with extended occupancy.

Everything brought into the field must be removed, including human waste. There are two environments where personnel are allowed to dispose of human waste in the field: marine environments and glacial environments.

15.1a Human Waste Disposal in Marine Environments

USAP personnel working in marine environments may dispose of human waste and domestic liquid waste, or gray water, directly into the sea. Waste must be dumped directly into the water, but not at the tidal zone. All other waste must be collected for disposal at McMurdo, Palmer, or on a research vessel.

15.1b Human Waste Disposal in the Accumulation Zone of Glaciers

USAP personnel working in field camps situated in the accumulation zone of glaciers (i.e., in snow covered areas), may dispose of human waste and gray water into the snow. All other waste must be collected for disposal at McMurdo, Palmer, or on a research vessel.

15.1c Human Waste Disposal in All Other Environments

In all other field environments, USAP personnel must collect solid human waste, urine, and gray water and return them to McMurdo, Palmer Station, the research vessel, or Punta Arenas, Chile. Solid human waste collected in ziplock bags may be placed in 20 gallon poly containers. A small number of urine bottles may also be placed in the 20 gallon poly container, provided the total volume of liquid in the container does not exceed approximately one gallon. These containers are incinerated in the U.S. and cannot have large amounts of free liquids.

Unbagged human waste may also be collected in 55 gallon drums, along with urine and gray water. Please do not put plastic bags or other materials into solid waste/urine/gray water drums, as these drums are dumped into wastewater treatment plants in the U.S., and the plants cannot process plastic materials. Groups that are moving field locations frequently may use 5 gallon poly containers in place of 55 gallon drums for urine, gray water and unbagged human waste. All containers must be marked as GRAY WATER, URINE, and/or HUMAN WASTE, as appropriate.

15.1d Human Waste Containers

In McMurdo, the human waste containers are available from the BFC. Personnel working in an area of the Peninsula that does not allow seawater access must use human-waste containers and retrograde the waste at the end of the season. Human waste containers will be provided with your field equipment from Punta Arenas.

All personnel doing day trips in the field must pack-out all human waste. Pee bottles and ziplock bags are used for this purpose and are available at Palmer Station.

15.2 Hazardous Waste Management

Hazardous waste procedures are the same for the entire USAP program. All hazardous waste is returned to the states by vessel. Hazardous wastes encountered in field settings generally fall into the following categories:

Operational Hazardous Waste: Contaminated, used, and excess fuel, oil, glycol, etc. must be retained in or returned to the original container, if possible. If the wastes are in the original container, they may have a drum tag already attached. The tag must be completed, signed, and returned with the waste.

Laboratory Hazardous Waste: All laboratory wastes are considered hazardous and must be segregated and labeled. This category includes reagents, mixtures, laboratory glass, plastic (including gloves, vials, pipettes, and bench liners), debris, biological wastes, and sharps. This category does not include radioactive and highly toxic lab wastes.

Chemical Wastes: Small-volume chemicals are packed in the original containers and labeled as HAZARDOUS WASTE. A Hazardous Waste Identification Sheet (HWIS) must accompany the wastes. Mixtures must have the “recipe” on the container and HWIS.

Radioactive Waste: Special handling and documentation are required for radioactive waste. Generators of radioactive wastes are required to attend a briefing prior to generating any Low-Level Radioactive Waste (LLRW) or using radioisotopes. Guidance on specific procedures for segregation, collection, and documentation of radioactive wastes are provided at the briefing.

Highly Toxic Waste: All wastes contaminated with highly toxic chemicals, carcinogens, mutagens, and poisons (e.g., osmium tetroxide, potassium cyanide, etc.) must be segregated, clearly labeled, and turned over using the HWIS Standard Operating Procedure.

Other Hazardous Wastes: Other hazardous wastes include batteries of any kind, aerosol cans (full or empty), and fluorescent light bulbs.

15.2a Hazardous Waste Containers

Fuel and other hazardous products that are contained in drums are issued to the user with a tag. This tag is a simple form that enables the USAP to track the use of these hazardous products easily from start to finish. Once the drums are issued to the user, he/she must accept responsibility for them and complete the remainder of the tag, before returning the partial or empty drum to McMurdo, Palmer, Punta Arenas, or a research vessel. .

15.2b Using Drum Tags to Mark Hazardous Waste

Tags are used for hazardous waste; however, the tags are not to be pre-attached to hazardous waste accumulation drums. Field personnel are responsible for attaching the tags when the drum begins active accumulation of hazardous wastes.

- CHECK “OTHER” when the drum begins active accumulation of hazardous wastes, in the field.

- COMPLETE the S-EVENT/PROJ CODE, LOCATION, and DATE OUT blocks on the front of the drum tag.

- CHECK the “OTHER” space in the container use information section and indicate the specific hazardous waste being collected. The tag serves as the proper label of the container.

- RADIOACTIVE WASTE also requires documentation on waste profile sheets.

15.2c Notes on Premix

If a drum of mogas is converted to Premix by the addition of 2-cycle oil, the tag must be replaced by the person preparing the premix. The shaded PREMIX block must be checked off with indelible ink marker. S-EVENT/PROJ CODE, LOCATION, and DATE OUT must also be completed by the person preparing the premix.

15.3 Hazardous Waste Spill Response

Any amount of hazardous material spilled on the ground must be cleaned up. All personnel deploying to a field site must be prepared to clean up potential spills. To be prepared, all USAP personnel going into the field must:

- Be equipped with a spill-response kit.
- Know how to clean up a spill.
- Know to whom to report a spill.
- Be prepared to record the GPS coordinates of any spill.

15.3a Spill Response in the McMurdo System

Spill response training is provided to researchers during the Field Safety Training Program. Spill kits are made available to researchers by the BFC; however, it is each science group's responsibility to make sure they have a kit with them in the field. Permanent camps and large deep-field camps are equipped with spill response kits for use in the camp.

All spills, no matter what size, must be reported to the Firehouse in McMurdo. Field personnel may report spills via radio communication to the Field Operations Communication Center (FOCC) ("Mac Ops") and ask them to pass the information to the Firehouse.

Large spills may require outside assistance. McMurdo has a spill- response team in place for these potential situations.

15.3b Spill Response in the Peninsula System

Spill response information will be sent to personnel deploying to field camps in the Peninsula area that are not directly supported by Palmer Station. Researchers working in these types of camps are responsible for ensuring that all personnel in their group fully understand the spill response measures. Spill kits are provided by the contractor and should be requested on the SIP. If communication with Palmer Station is possible, any spill reports must be passed to the Palmer Station

Manager. If communication with Palmer is not possible, retain the information and pass it to the NSF when you have redeployed.

Personnel working at Palmer Station will receive spill-response training from station personnel once on site. Spill kits are available at the station. All spills at Palmer or the surrounding islands must be reported to the Palmer Area Manager.

15.3c How to Remediate a Small Spill

- Contain the spilled material using sorbents, snow, dirt, or some other media capable of holding in liquids.

- If feasible and safe, absorb the spilled material using sorbents from local spill kits or, if the spill is on snow, shovel the snow up and place into 20-gallon polys or plastic bags to be disposed of at station.

- Report the spill, however small, during your next radio check-in.

15.4 The McMurdo Waste System

Since the annual resupply vessel returns to the U.S. after delivery, the USAP is able to retrograde waste via the vessel every year. Recycling and segregation of waste are key to the program, and all field personnel are required to fully cooperate with the system and segregate waste in the field. There is no exception to this rule. Everyone deploying to McMurdo and/or outlying locations must attend a Waste Management Briefing. Researchers will receive information on the briefing times from the NSF Representative upon arrival in McMurdo.

Segregating is a fundamental part of waste handling in McMurdo. Glass, metal, aluminum, plastic, and cardboard are the typical categories that small field groups deal with. In the field, waste must be separated into plastic bags separately, and each bag must be labeled with the science group number.

Personnel working in the Dry Valleys will typically return waste to McMurdo using resupply helicopter flights. Waste that has not been properly cleaned and separated will be staged for personnel to deal with upon their return from the field.

15.4a Segregating and Labeling Waste Bags in the McMurdo System

Collect waste into separate bags according to the categories below, and label each bag with your science or event number and the appropriate waste category.

- **Glass:** All food-contaminated glass jars and cans must be cleaned before they can be disposed. Gray water from doing dishes or snow, and a rubber spatula can be used by tent campers to easily clean cans and jars after each meal.
- **White Paper**
- **Aluminum Cans Only**

- **Light Metal:** includes any metal less than 1/8 inch including banding and tin cans. Tin cans must be clean with both ends cut off and flattened.
- **Heavy Metal**
- **Cardboard**
- **Wood**
- **Burnable Food Waste:** includes food waste, all other burnable items, and food-contaminated waste.
- **Construction Debris:** includes dormitory products (product containers) and construction debris.
- **Vermiculite:** is reused unless contaminated with hazardous waste If it is contaminated, follow the hazardous waste procedures.

15.4b Environmental and Waste Procedures in the Dry Valleys

The Dry Valleys contain geological and biological features that date back thousands to millions of years. Many of these ancient features could be easily damaged by human actions; therefore, visitors must have as little impact as possible. Personnel working in the Dry Valleys will be given a complete copy of the NSF document titled *Environmental Code of Conduct for Field Work in the McMurdo Dry Valleys*. The following is a summary of the document.

Do not:

- Urinate or defecate into the environment.
- Disturb any natural feature.

- Slide down scree or sand dunes.
- Mark on rocks.
- Collect rocks and fossils except for scientific and educational purposes.
- Use explosives on lakes.
- Leave anything frozen into the lake that can ablate and cause contamination.
- Swim or dive in the lakes.
- Walk in or close to stream beds.
- Disturb mummified seals or penguins
- Leave any travel equipment behind (e.g., ice screws, pitons).
- Build cairns.
- Leave markers or equipment for more than one season without labeling.
- Damage delicate rock formations.
- Use chemical-based fluids on glacial ice.

Do:

- Use a urine bottle for urine and ziplock bags for feces
- Pack-in/ pack-out.
- Report all spills.
- Obtain a spill kit and know how to use it.
- Use a spout to pour fuel.
- Use vehicles only on snow and ice surfaces.
- Travel only on established trails whenever possible.
- Camp far away from lake shores and stream beds.
- Reuse old campsites when possible.
- Secure equipment at all times to keep wind from blowing it away.

- Clean all sampling equipment to avoid cross-contamination between lakes.
- Use solar and wind power as much as possible.
- Remove all waste.
- Use fixed helicopter pads.
- Take steps to prevent the accidental release of chemicals and isotopes.
- When permitted to use radioisotopes, precisely follow all instructions.
- Use a drip pan when changing vehicle oil.
- Keep sampling holes clean and secure all equipment.
- Back fill soil pits to prevent wind erosion.
- Collect the minimum sample of endolithic community required for analysis.
- Minimize the use of liquids on glacial ice to avoid contaminating the record.

15.5 The Peninsula Waste System

USAP personnel working in the Antarctic Peninsula area are required to remove all waste from the field. However, because of the difficulties of moving waste between countries, the program disposes non-hazardous waste in Chile. There is no recycling program in place; therefore, waste is simply collected for disposal .

Chapter 16
Snowmobiles

Figure 16-1: Alpine I snowmobile.

The Mechanical Equipment Center (MEC) in McMurdo issues and maintains snowmobiles.You must attend a mandatory snowmobile maintenance course at the MEC before your field deployment.

Palmer Station has two Alpine 2 snowmobiles on station. The Station Mechanic is responsible for maintaining the machines. Refer to the following information for a description of the Alpine 2 and operating and maintenance information.

16.1 Snowmobiles in the McMurdo MEC Inventory

ELAN (275 lbs): A light-duty, 250-cc, Twin-Otter-transportable snowmobile which is not suitable for traverses.

CHEYENNE (350 lbs): A medium-duty, 503-cc snowmobile which is not suitable for traverses.

TUNDRA II (377 lbs): A medium duty, 287-cc snowmobile which is not suitable for traverses. Twin-Otter transportable.

ALPINE 1 (650 lbs): A heavy-duty, Twin-Otter-transportable snowmobile. Available with a 640-cc or 503-cc engine. It is suitable for extensive traverses and preferred for remote camp work. See figure 16-1.

ALPINE 2 (778 lbs): A heavy-duty snowmobile suitable for remote camps and traverses.

SKANDIC (750 lbs): A heavy-duty , single-track snowmobile with wide, long tracks. The Skandic is suitable for remote camps and traverses. It is not cleated and therefore is not recommended for travel on blue ice. Twin-Otter transportable.

All snowmobiles have two-stroke engines that require Mogas fuel pre-mixed with lubricating oil. The mixture is 50:1 (12 ounces of oil to 5 gallons of Mogas). Average fuel consumption when pulling a loaded (1,000 pounds) Nansen sled is approximately 7 miles per gallon.

Park snowmobiles facing into the prevailing wind and always cover them. This helps avoid getting snow in the points and accumulating snow under the snowmobile's cowling.

16.2 Snowmobile Troubleshooting

16.2a Fuel Flow Problems

Symptoms: Engine cranks but won't run, no fuel present in line from pump to carb. Engine may run briefly after priming.

Diagnosis and Cure:

1. Check fuel level in tank.

2. Pry fuel line off carb, pressurize the fuel tank (seal and blow into the vent line) to see if fuel flows out of the end of fuel line. Crank engine and see if fuel pulses out of the end of the fuel line.

3. If fuel flows and then pumps OK, the problem was probably just small ice crystals in the fuel pump valves. Pressurizing the tank dislodged them, thus solving the problem. Replace the line and go.

4. If fuel flows when pressurized but does not pump, the problem is fuel-pump-related. First, disconnect the vacuum pulsation line from the center of the fuel pump to the engine crankcase. Blow through the line. If blocked, clean ice out of the line with a wire. Check the nipples on the pump and crankcase for obstructions. If the vacuum line is clear but fuel still does not pump, replace the pump or remove it and let it thaw.

5. If fuel will neither pump nor flow, then either the fuel line or the fuel filter is clogged. Clean the fuel line or replace the filter.

6. If the tank is under vacuum when you open the filler, check the vent line for obstructions or pinches. Occasionally the line will rub against the exhaust, melting the vent hose. Make sure the tank is venting properly.

7. If all of the above steps have been tried and still no fuel flows, check the fuel line for cracks or holes, and look for any obvious fuel leaks (i.e., discolored snow) in the engine compartment. Repair or replace the fuel line.

8. A mixture of 30 ml of isopropyl alcohol per 5 gallons of pre-mixed Mogas will lessen the chance of water contamination and fuel icing.

9. Pouring fuel through a trail flag or rag placed over a funnel will help eliminate any snow contamination of the tank and will filter the fuel.

16.2b Starter and/or Cranking Problems

Symptoms: Engine cranks slowly or not at all when key is turned.

Diagnosis and Cure:

1. Usually this problem indicates a dead battery, and requires pull-starting the engine. The battery can be charged with an A.C. charger;

however, it should charge on its own with snowmobile usage, unless the battery is shorted or the rectifier is faulty.

2. If the battery is fine, check the in-line fuse (30 amp) in the red wire near the starter, or see if the red-green wire has slipped off the terminal on the starter solenoid. Finally, the starter itself may be faulty.

3. The recoil (pull) starter should be used when the engine is cold, so the electric starter is not overtaxed.

16.2c Spark Problems

Symptoms: Engine cranks but won’t start. Fuel is present in the line between fuel tank and carb.

Diagnosis and Cure:

Unhook both spark plugs, push spare plugs into the wire caps, ground the metal plug bodies to the metal engine housing, and crank the engine. If a spark can be seen at the electrode of the spare plugs, the problem may be that the installed plugs were fouled with excessive fuel, ice, or a piece of carbon. Install new plugs or clean the existing ones. When the engine is cold, the spark may be hard to see in direct sunlight.

Caution: Do not remove the old spark plugs for this test. If you have a spark and the crankcase is full of fuel, an explosion and fire could result.

If a spark is not present, the problem is in the electrical system rather than the spark plugs. Check the kill switches and all electrical connectors. If they look OK, the solution to the problem depends on the engine type.

Elan engine: Problem is probably ice in the points (this usually occurs after exposure to blowing snow). Remove rewind starter and starter pulley, rotate magneto housing until upper point set is visible, spray with alcohol, scrape with file, spray with WD-40, repeat for lower point set, and reassemble.

All other engines: Electronic ignition - problem is probably the igniter box. Replace.

Any engine: Still no spark - may be a bad coil or a shorted wire.

16.2d Power Problems

Symptoms: Runs but lacks power.

Diagnosis and Cure:

If the engine seems to be running fine, but the snowmobile has trouble with uphill starts, the problem may be with the clutch-driven pulley. Remove the cowling and see where the belt is riding on the pulley. The belt should be along the outer edge of the driven pulley when the snowmobile is at rest.

If the belt is slotted down between the driven pulley halves (the driven pulley is the larger diameter of the two pulleys), check belt width against a new one. If it's worn more than 5 mm, replace it. If not, remove belt to see if any foreign debris is lodged in the pulley. If neither of these situations is the case, consult MEC via radio patch; the driven pulley is probably severely damaged.

If the engine has very low power or dies when revved, remove the carb and check for ice. If ice is present, thaw out carb and reinstall. If the engine is weak and running rough but the carb is ice-free, the problem may be a bad spark in one cylinder. Follow the procedures outlined above for cleaning/replacing spark plugs.

Altitude Adjustment: Assess mixture by hill climbing performance and spark plug color. Chocolate brown is correct. A gray or white color indicates a mixture that is too lean, and black spark plug indicates a mixture that is too rich. From sea level to 4,000 feet, decrease the jet size by one increment from standard setting (i.e., 290 to 280):

- At 4,000 feet to 6,000 feet decrease by two increments.
- At 8,000 to 11,000 feet decrease by four increments.

Remember to richen up the mixture when returning to lower altitudes, under penalty of blown-up engines.

16.2e Track/Suspension Problems

Symptoms: Machine pulls to one side.

Diagnosis and Cure:

Check for loose or broken suspension components.

Each operator should be made responsible for checking their machine before use.

Daily: Check suspension, particularly when operating on glacier ice or sea ice. Look for broken suspension components. Check general operations on vehicle. On Alpine I machines, make sure the Bogie bungy is in place.

Weekly: Check for loose mounting bolts on bogies, skis (particularly the two bolts through the spring), rear suspension, and steering. A small suspension problem can rapidly get bigger (slashed tracks, broken bogie mounts, etc.).

Keep the track centered in relation to suspension. Watch the track tension. Check with MEC for specifications, since this varies from model to model. In general, if the track can be heard slapping against the frame tunnel while driving, it is too loose. Adjustments to both tension and alignment are made via long bolts at the rear of suspension.

Beware of loose trailing straps and ropes; they can get entangled in the tracks and around axles.

Be kind to transmissions and shift gently. If gear(s) will not engage, turn off motor, shift gears, and restart. Abusive shifting can cause drive train problems that are not repairable in the field. Never shift the transmission unless the snowmobile is stopped.

Note: LC-130 transport can result in snowmobile damage either from abuse or during loading. Supervise the loading and inspect your machines as much as possible.

Additional information on snowmobiles can be found at: *http://rpsc.raytheon.com/science/prospectus/Transport/snowmo.htm*

Chapter 17
Sea Ice

The sea ice conditions at McMurdo and Palmer Stations are very different from each other. In McMurdo, air planes can land on it and heavy equipment can be operated on it. In contrast, at Palmer only foot travel is allowed on the sea ice. No vehicles, not even snowmobiles, are allowed on the sea ice because typically the ice at Palmer is too thin to safely support their weight.

Although the conditions may vary, the hazards of working on sea ice are the same wherever you are in Antarctica. Because of the different modes of operation on the sea ice, the check-out procedures and equipment used differ at both stations. The following sections describe the hazards of working on the ice and then detail the check-out procedures for each station.

The USAP's past experience with equipment and personnel lost through the ice has dictated the requirement for education, common sense, and the use of caution when traveling over sea ice.

17.1 Sea-Ice Hazards

Although the sea-ice conditions and traveling conditions are different for Palmer and McMurdo, the hazards associated with traveling on the sea ice are similar for both areas.

17.1a Weather

Weather can turn bad while you’re out on the sea ice. It’s important to continually monitor for signs of approaching bad weather. Watch for a lowering ceiling of clouds and fog blowing in from open water. Blowing snow can disorient you. Poor weather conditions will obscure surface definition, making it impossible to detect cracks. Use extra caution if surface definition or visibility is poor.

Check the weather station instruments at Palmer Station prior to going out on the sea ice. Strong winds can be particularly dangerous at any location and even in the stable McMurdo conditions. If the wind is severe enough, the ice edge can drastically change. At Palmer Station, within a few hours the ice can clear out, leaving open water which can possibly strand field parties away from the station or trap them out on the sea ice, adrift on a floe.

17.1b Ice Thickness

Ice thickness is a major concern for everyone who wants to travel on sea ice. The ice sheet can become thin in certain areas due to erosion from strong currents which cause shoals, and at the center of active or newly formed cracks, especially if the thin ice has been covered with snow. Land formations that indicate a potential shoal are long, low-angle ridges or peninsulas that descend into the sea.

Historically at Palmer Station, areas of thin ice have been found in the area around Elephant Rocks, the channel between Torgersen and Litchfield Island, over the shallow reef off the south end of Humble Island, and the narrow channel between Shortcut Island and Shortcut Point. This is by no means a complete list, and conditions do change during the season and from year to year.

At McMurdo Station, local areas with historically thin ice are Cape Armitage at the base of Ob Hill, Hut Point, and the Knob Point/Cinder Cones area. As the air and sea temperature starts to rise, the sea ice becomes progressively weaker and starts to thin, both from the top and bottom. During the austral summer ice temperature monitoring stations are established at various locations and monitored on a regular basis.

The effects of winds, waves and swell are important factors during the early stages of ice formation in terms of how quickly the ice sheet stabilizes. Six inches of ice formed under calm conditions may be stable and safe to ski over, but that same thickness of ice formed under rough conditions may be unstable, thus more hazardous for travel due to cracks.

17.1c Color changes

It's a good habit to pay close attention to the color of the ice as you traverse it. It should be emphasized that if you note changes in color, something about the ice sheet has changed and needs to be investigated. In general, white colored ice is typically the safest, indicating good ice at least 6 to 12 inches thick. Gray colored ice is considered young ice ranging in thickness from 4 to 6 inches. Gray ice will "probably" support an adult on skis but should be avoided if possible. Gray ice can also form as a result of surface flooding and subsequent freezing of the surface water. So it is always important to investigate areas of gray ice. Black ice is newly formed thin ice and should be **avoided at all times.** Otherwise, you're likely to go for an unwelcome swim.

17.1d Cracks

Cracks are fissures or fractures in the sea ice produced by the stresses of wind, wave, tidal action, and thermal forces. Whenever possible, avoid cracks altogether. If it becomes necessary to cross a crack, cross it in a line perpendicular to the crack's direction of travel. Never cross a crack system in a location that will place a vehicle on more than one crack at a time. Avoid sets of cracks which form pie slices. These have a nasty way of breaking off and turning over under the weight of a vehicle. You can generally expect to find cracks anywhere on the sea ice. However, certain sites historically produce a series of cracks year after year. Typically, cracks will form around any coastline, island, grounded iceberg, or glacier jutting out into the sea ice. These cracks tend to radiate out from the land, similar to the spokes of a wheel.

- **Tidal Cracks** occur up to 150 yards offshore in fast ice when the tidal action moves the sea ice above or below the level at which it is shore bound. These cracks are usually parallel to the shore line. When crossing tidal ice zones, walk on the ice instead of snow whenever possible.

Snow masks many of the larger cracks in tidal crack systems. Always carry a probe and use it often when working in these areas.

- **Straight Edge Cracks** (see figure 17-1 below) form as tension is released in the ice sheet. The ice thickness at the edge of this crack will be the same as the surrounding ice thickness. These cracks typically form quickly, and the crack shows either open water or a thin layer of ice covered with snow.

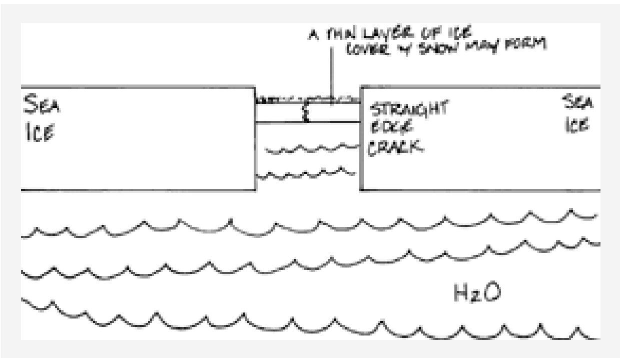

Figure 17-1: Straight edge Crack.

- **Spreading Cracks** form as forces acting on the ice sheet cause the ice to crack and spread apart over time. These cracks tend to form slowly and can stay active for quite some time. The center of actively spreading cracks may be open water or thin ice. The safe edges of these cracks are difficult to judge without getting out of your vehicle and profiling the crack. See figure 17-2.

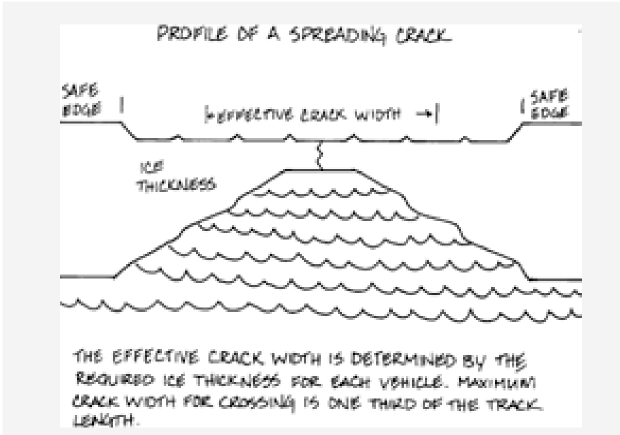

Figure 17-2: Spreading Crack.

- **Pressure Ridges** (see figure 17-3) form when ice is broken by pressure and thrusts up into a chaotic pattern of elevations and depressions. Use caution when crossing pressure ridges, as the uneven chunks of ice can be hazardous to your footing. Occasionally, pressure ridges may pull apart, forming a combination Spreading/

Figure 17-3: Pressure Ridge. (photo by Tim Cully)

Pressure Ridge. Because the ice that forms a pressure ridge is not structural, always drill this type of formation to determine its effective crack width.

17.1e Melt Pools

Melt pools (see figure 17-4) are areas on the sea ice that have subsurface melting. This usually occurs later in the season, typically in late November through December. An ice lens usually forms over the melt water, giving the impression that it's solid. Always drive around melt pools. If it's impossible to drive around a melt pool, get out of your vehicle and drill the underlying ice to determine its thickness.

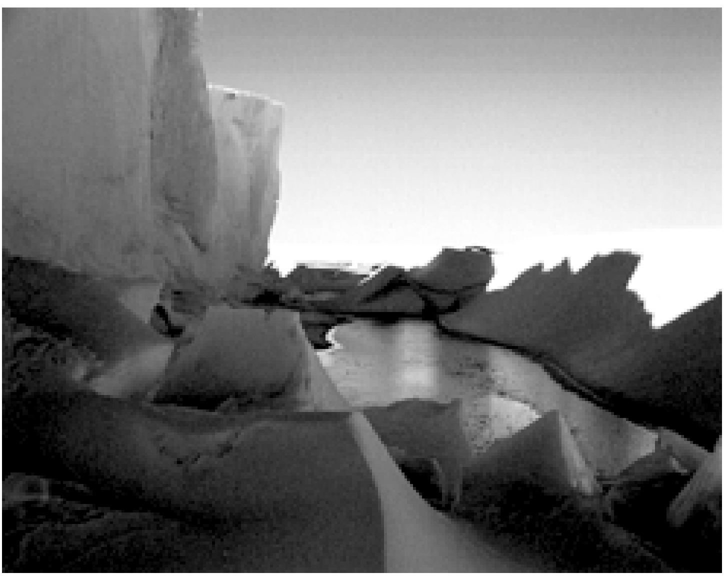

Figure 17-4: Melt Pool. (photo by Tim Cully).

17.1f Seal Holes

Seal holes are a good example of a possible trap. They are usually easy to spot as they develop a “fumarole,” a cone shape projecting upward from the ice. This is caused by the seal constantly pushing ice and water from the hole. However, if there is a new accumulation of fresh snow, it may hide the hole. So, if you see a seal lying far from the ice edge, there will most likely be a seal hole or a crack nearby.

17.1g The Ice Edge

The ice edge can be dangerous because there is always the possibility of breakouts, at any time in the season. Travel to the ice edge should be undertaken during periods of good weather and calm sea conditions. Also, you need to be alert to the possibility of attacks by leopard seals (and possibly Orca whales). It’s a good idea to be roped up and belayed by a team member when working at the ice edge.

What to do if you fall in...

If you fall through the ice, holler for help, clamber out as quickly as possible. One Old Antarctic Explorer (OAE) recommends carrying a sharpened ice pick type tool, protected in an upper pocket to assist in climbing out over slippery ice. Another source recommends that once out, roll in fresh snow on the surface. The idea behind this is that, the fresh snow helps absorb moisture (i.e. it’s quick drying). Be sure someone in the party has radioed the station for help. If able, keep on your feet and in motion. Immediately head back to the station or to the closest survival cache, depending on your situation. Your outer clothing will quickly freeze, giving excellent wind protection, while inner heat of exercise will eventually dry out the cold, wet inner layer. If on the other hand, the victim is unable to walk, that person can be pulled back to the station in a sled.

17.2 Sea Ice of McMurdo Sound

Personnel working on the sea ice around McMurdo will be traveling by either tracked vehicle or by snowmobile. Following is a checklist of the equipment and things you need to do before leaving the station:

1. Check your vehicle and ensure the fluid levels are OK and that there is plenty of fuel.

2. Have the following equipment in your vehicle:
   - ECW Gear
   - Extra Food and Water
   - Survival Bag
   - Kovacs Ice Auger with Extensions
   - Extra Ice Auger Bits, Sharpened
   - Bit File
   - Ice Axes
   - Square Shovel
   - Ice Screws, Assorted
   - Rope (Old Climbing Rope)
   - Carabiners
   - Slings: 1 Short and 1 Long
   - Throw Bags (see the BFC staff on how to assemble)
   - Radio with Spare Battery

3. Call the Weather Office for the current and long-range forecasts for the area in which you'll be traveling and working.

4. Radios: When traveling by snowmobile, EACH snowmobile must carry a VHF hand-held radio and a spare battery. When traveling in a tracked vehicle, two radios must be carried per vehicle, the vehicle radio and one hand-held as a back-up.

5. Check out with the FOCC (call sign "MAC Ops") by passing the following information to the radio operator prior to departing McMurdo:
    - Vehicle call sign (three-digit number and vehicle type)
    - Group number (S, T, W, or A event number)
    - Number of people in your group
    - Estimated time of arrival to destination
    - Estimated time of return to station
    - Name and phone number of a contact person in McMurdo

McMurdo Area Sea Ice Travel Policy:

Solo travel on the sea ice is not allowed unless your group has approval from the NSF Representative in McMurdo. Two or more field-party members may remain overnight at a sea-ice location; solo overnights are never allowed.

In anything other than Weather Condition 3 (good weather) snowmobile travel is not allowed. During

Weather Condition 2, tracked vehicles may be allowed to check-out depending on the forecast.

17.2a How To Profile A Crack for Vehicle Crossing

To profile a crack, start by probing aggressively with an ice axe across the crack. Then determine where the safe edges of the crack are by sliding the pick of the axe over the surface. Drill test holes approximately 15 inches apart starting in the center of the crack to determine its Effective Width. The Effective Width should be no more than 1/3rd of the length of your vehicle's track. A crack's Effective Width is the distance between one 30-inch-thick (or thicker depending on vehicle weight and time of year) safe edge and another 30-inch-thick safe edge as determined by drilling.

Traveling Tips:

- Don't travel off the flagged roads if surface ice conditions are obscured by blowing snow or poor visibility. Remember, cracks in the sea ice can open up at any time.

- Stay well away from the coastline, islands, and landed objects such as grounded icebergs. Working cracks tend to form around these. Stay away from large concentrations of seals.

- Never travel over ice thinner than 30 inches (75 cm). This 30-inch rule is an NSF regulation, which provides a safe margin of error for sea-ice travel in light vehicles, such as pickup trucks

Figure 17-5: Van crossing large melt pool. (photo by Tim Cully)

and Sprytes. Heavier vehicles require more ice. Each operator must know his or her vehicle's requirements for ice thickness. Call the BFC for more information.

Figure 17-6: Don't trust existing vehicle tracks. (photo by Tim Cully)

- The strength of ice decreases as its temperature increases. Consequently, vehicles require a thicker ice for safe travel as the season progresses. Each operator is responsible for knowing the requirements of his or her vehicle. Call the FSTP for more information.

- When traveling, drill and assess any changes in color or texture of the ice sheet. These changes could indicate changes in thickness of the sheet.

Sea Ice Seasonal Period Temperatures:

Seasonal Period	Ice Surface Temp. (°F)	Time of Year (Approximate)
1	-4 to 14	WINFLY to late November
2	14 to 23	Late November to mid-December
3	23 to 27	Mid-December to early January
4	27 to 28.5	Early January to February

17.3 Sea Ice in the Peninsula Area

Personnel working on the sea ice around Palmer Station will be traveling on foot. Following is a checklist of the equipment you need and the things you need to do before leaving the station.

Equipment:

- Skis for lead person in the party
- 2 radios and spare batteries per party
- Ice axe
- Throw rope, ice screws, carabiners, slings
- Local map with routes and hazards
- Compass and/ or GPS
- Food and water (Nalgene water bottles for hot water warming if necessary)

Figure 17-7: Walking on the sea ice in front of Palmer Station. (photo by Marian Moyher)

- Headlamp or flashlight
- Hand warmers
- Plastic trash bag and pee bottle for human waste management
- Spare clothing, which should include:
    - Spare mittens and socks
    - Extra hat
    - Sunglasses, goggles
    - First aid kit

Things to do:

- Check the weather station trends for the past 4 to 6 hours. Pay special attention to wind direction, speed and barometric pressure. See Chapter 10 for more information on weather.

- Obtain approval for the trip from the Station Manager or SAR Leader.

- Check out with the Comms Tech prior to departing Palmer Station and make sure to receive confirmation that your radio is operational before you leave the vicinity. The following information must be provided:
    - Field party name
    - Number of people in your group
    - Destination
    - Estimated time of arrival at your destination
    - Estimated time of return to the station

- When you arrive at your destination:
  - Report arrival at destination.
  - Report any changes in destination.
  - Report start of return to Palmer Station.
  - Report arrival at Palmer Station.

Palmer-Area Sea Ice Travel Policy:

At least two people must travel together while out on the sea ice. In an emergency situation or if unable to return to the station, radio for help and travel to the nearest survival cache. **Under no circumstances should a stranded party attempt to camp on sea ice**.

Sea-Ice Routes and Availability

The Station Manager in coordination with science and station personnel will ultimately determine the routes for sea ice travel. Routes open for travel will be posted on the dining room bulletin board and discussed at station meetings.

The factors that determine whether sea ice travel will be allowed and by which routes, include the following:

Minimum Ice Thickness: Sea ice in the Palmer area often consists of several layers of ice with pockets of slush or water in between. Because of this, it is unsafe to set strict minimum thickness standards. When evaluating the ice sheet for thickness, at least one layer of the sea ice must be a minimum of 6 inches thick. This thickness cannot include slush layers, wet pockets, or air holes. Ice quality in that layer must be such that drilling demonstrates a firm resistant medium. Because of the enormous variability of sea ice from year to year and throughout the season, extreme caution is exercised in evaluating minimum ice thickness.

Figure 17-8: Drilling ice with Kovacs Ice Auger. (photo by Tim Cully)

Contiguous Quality: The sea ice must be "joined in order" and not made up of unconsolidated bits of brash, pancake, or bergy ice. The ice sheet surface must be consistently thick.

Proximity of the Ice Edge and/or Unconsolidated Pack Ice: Depending on the location (exposure to currents, off-shore winds, calving glaciers, survival cache availability, etc.) ,the desired sea-ice route must be at least 200 meters from the ice edge, calving glaciers, or unstable ice.

Proximity to Vessel/Ice Breaking Operations: The sea-ice route must be at least 30 meters from ship operations. Sea ice access is restricted when a vessel is in the vicinity.

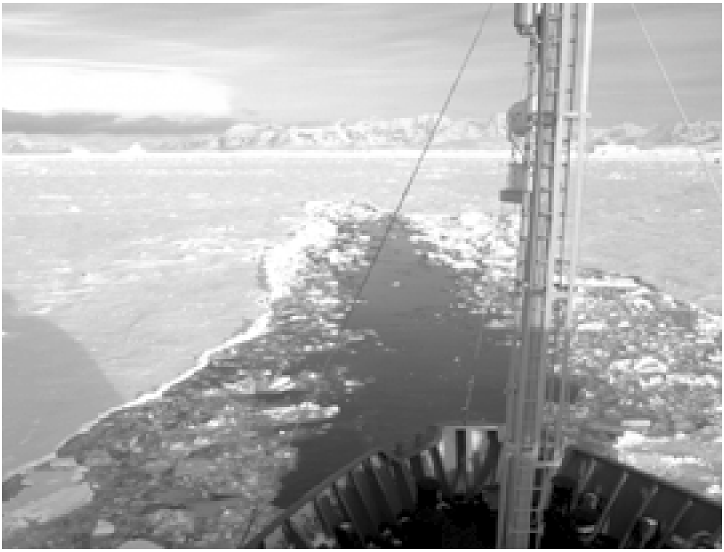

Figure 17-9: Ice breaking operation. (photo by Marian Moyher)

Winds and Weather: Wind direction and speed must be favorable to the route to be traveled, i.e., not from the northeast (off-shore), or not toward the direction of ice edge or unstable ice. Winds must not be in excess of 20 knots if the ice edge is at the tip of Bonaparte Point or closer. Otherwise, winds should not be in excess of 30 knots. (**Note:** The sea ice in Arthur Harbor has completely blown out in as little as 6 hours.)

Proximity to Emergency Caches and Possibility of Rescue: The sea-ice routes will be connected to areas with Survival Caches when possible. When safe sea-ice conditions remain beyond October, first the routes are re-evaluated and additional restrictions may come into effect. Sea-ice routes must have the potential for 'over-ice' rescue or alternative rescue possibilities.

Chapter 18
Glacier Travel and Crevasse Rescue

Crevasses can be difficult to detect and are frequently invisible under thin bridges of blown snow. Many of these bridges may be only a few inches thick and will not support the weight of a person or a vehicle. Roped travel is a necessity in any glaciated area which has not been previously inspected and deemed safe. However, do not assume that a previously traveled and marked route is safe. Glaciers are moving by their very definition and new crevasses can open up at any time. Known routes should be periodically inspected. Steep terrain or the faster-moving glaciers of the coast require more frequent reconnaissance than the relatively slow-moving glaciers of the polar plateau.

Practicing proper rope travel techniques can decrease, but never eliminate, the chances of an injury or loss of equipment in the event of a fall. The best advice for traveling in crevassed areas is to be careful and avoid falls in the first place. It’s easier to stay out of a crevasse than to extract someone out of one.

18.1 Roping Up

Proper roped travel technique achieves the following three goals:

1. Slack rope in the system is kept to an absolute

minimum in order to shorten the length of a potential fall.

2. Only one member of a rope team will be on the same snow bridge at the same time.

3. There will always be enough excess rope available in the system to reach a fallen victim should he or she need assistance while suspended in a crevasse.

The standard method of tying in to the rope uses a 150-foot or 165-foot climbing rope divided up into various lengths depending upon how many people will be on the rope (see the description of rope types and uses in Chapter 13: “Rope Use and Care”). In most circumstances, 40-to 45-feet is the optimum distance between members of a rope team. This distance will be long enough to allow a team to cross most crevasses without having more than one member on a bridge at the same time, but short enough to facilitate communicating within the team in poor weather or when negotiating complicated terrain.

All team members should place their prussiks on the rope or have their mechanical ascenders and slings accessible whenever they rope up. If using prussiks, place the longer leg prussik on the rope closer to you and place the shorter waist prussik further away and clipped into the locking carabiner on your harness. Tuck the extra slack of the leg prussik away in a pocket or wrap it around the coil in such a way as to keep it accessible but also out of the way (to prevent tripping on it or having it get caught up in other equipment).

For all teams operating in areas with consistently larger crevasses, the distance between people on the rope has to be extended. The first person must carry extra rope to allow for the increased distances between people. The last person on the rope must carry a second rope, so that there is enough rope to perform a rescue. In any case, rescuers will always need to have 5- to 10-feet more of rope available for a rescue than the length of the safety rope connecting the rescuer to their partner, as the falling climber's rope will dig into the lip of the crevasse more than the rescuer's rope. (See figure 18-1.)

For rope teams with two members, each person ties a Figure 8-knot 20-feet to either side of the center of the rope, and clips into the loop with two locking carabiners on their harness. (See figure 18-2.) The locking carabiners should be rotated so that their gates oppose each other. Carry the remaining rope in coils around your body or stuffed into your pack. Coils are

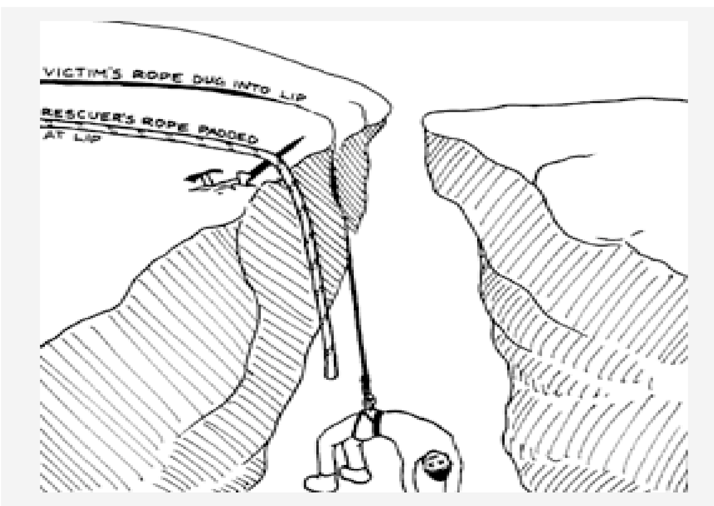

Figure 18-1: Victim's rope digs into lip of crevasse.

preferable because they allow you to take off your pack more easily. In this scenario, the farthest away your partner could be is 40-to 45-feet. Each person has 55-feet of available spare rope to use in a rescue.

For rope teams with three members, use the same 40-to 45-foot distance between people, with the middle person positioned at the middle of the rope. (See figure 18-3.) The people at either end must still carry extra rope to allow for a rescue.

For rope teams of four or five people, the group should be evenly spaced along the full length of the rope. (See

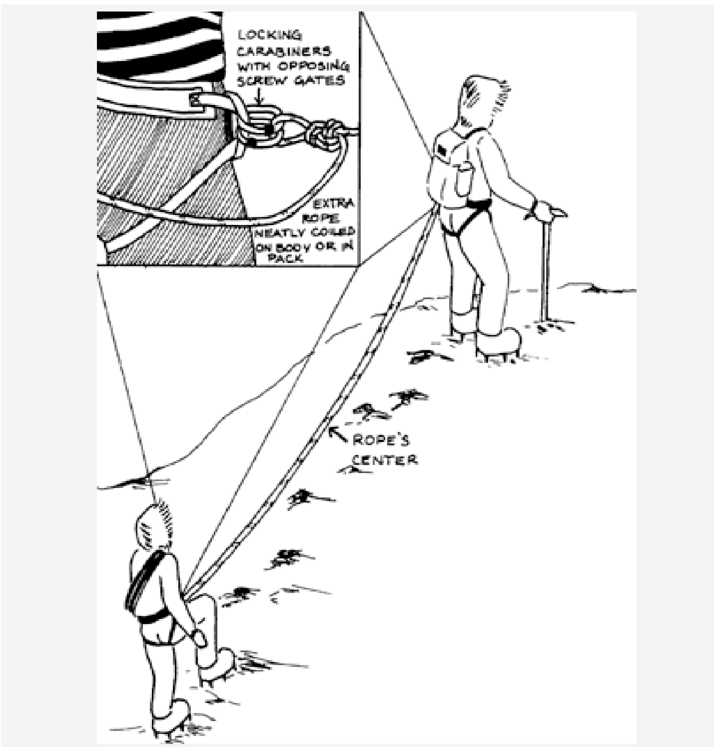

Figure 18-2: Rope configuration for a two member team.

figures 18-4 and 18-5.) Instead of clipping into Figure-8 loops on the rope, the two end people should tie directly into their harnesses using a Figure-8 follow through, thus avoiding having to use carabiners. If only one member falls in a crevasse, the team will always have enough extra rope available between people on the surface to reach the victim in the hole.

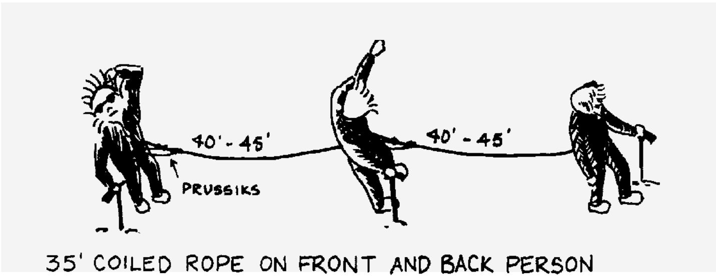

Figure 18-3: Rope configuration for a three member team.

Rope teams of more than five people are not recommended. Large rope teams of four or five people are slow and cumbersome. Unless the team is very inexperienced, it's usually better to break the group into two smaller teams. Besides the added convenience and flexibility, this also provides the benefit of having an extra rope available for a rescue or the ability to send a team for help.

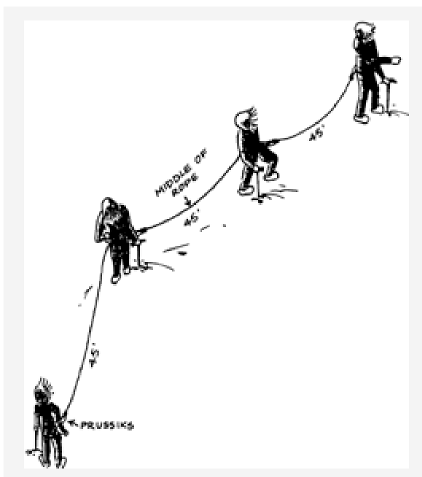

Figure 18-4: Rope configuration for a four member team.

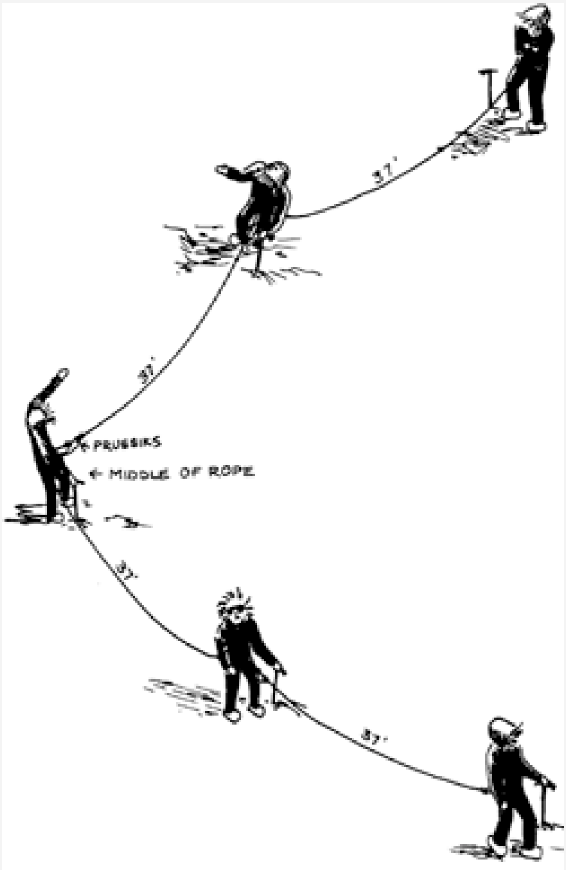

Figure 18-5: Rope configuration for a five member team.

18.2 Crevasse Rescue

In the event of a crevasse fall, you'll need to have the equipment, skills, and knowledge to quickly perform a rescue, while working without outside help or resources. Speed is important to treat any injuries and to avoid the risk of hypothermia to the victim. Self-sufficiency is a requirement because of remote locations and uncertain communications in the Antarctic.

The following is a minimum list of equipment required for crevasse rescue and should be carried on each end of the rope:

- 2 Anchors (flukes, pickets, or ice screws as appropriate)
- 2 Pulleys
- 2 Locking Carabiners
- 3 Non-locking Carabiners
- 1 Four-foot Runner
- 1 Extra Prussik (in addition to the waist and foot prussiks carried for self rescue)

18.2a The Rescue

The first possibility in a crevasse fall is that the victim is conscious and uninjured. The victim can either climb or prussik out of the crevasse under his or her own power. The rescuer can help the victim by doing the following:

1. Lowering a rope and hauling up the victim's pack

2. Padding the lip of the crevasse by sliding an ice axe, pack, skis, etc., under the loaded rope

3. Dropping an extra rope so the victim can prussik up the second line

4. Tying a series of loops at the lip so that the victim can use them as a rope ladder for climbing up and over the last few feet of the crevasse's lip

The second scenario is that the victim is conscious but physically unable to rescue him or herself. The rescuer will have to haul this victim out of the crevasse, but may not have to rappel down, depending on the extent of the injuries. This section provides instructions for one technique to extract a victim from a crevasse.

The third possibility is that the victim is unconscious or has suffered an obviously serious injury, requiring the rescuer to rappel into the crevasse and administer first aid before hauling the victim out.

The worst-case scenario would be a rope team of two with one member unconscious some feet down in a crevasse. In this case, the rescuer would have to:

1. Catch the fall.

2. Build an anchor. (See the anchor types on figures 18-6, 18-7 and 18-8.)

3. Transfer the weight onto the anchor.

4. Approach the lip of the crevasse and assess the site (see the Note below).

5. Rappel to the victim and treat his or her injuries.

6. Improvise a chest harness to keep the victim upright.

7. Prussik back to the surface.

8. Build a 6:1 pulley system.

9. Haul the victim out all the way over the lip of the crevasse.

Your group should practice each of these skills until each of you is confident that you can perform them under the pressure of a real rescue.

Note: The rescuer should always make sure he or she is safely secured before approaching the lip of the crevasse to help the victim.

18.2b Catching a Fall

The difficulty of catching a fall is dependent upon how much slack there is in the rope. When your team is walking roped up, there should be only enough slack to let the rope lie on the surface of the snow (and not pull on the other members of the party). Never carry extra coils of rope in your hands, as they will add to the distance of the fall and increase the impact forces on both the rescuer and the victim. In an area where crevasses are expected and there is enough concern for the leader to start probing, the second person on the rope should keep the rope tight enough to raise it off the ground. This will further reduce the length of a fall by 2- to 3-feet.

In the event of a fall, the victim shouts “falling” if he or she has the time, and the other climbers take a step away from the fall to take up the slack before dropping to a self-arrest position. In a majority of falls, the victim will be caught by the rope before he or she has fallen deeper than the waist, or at worst, the shoulders. From this position, it should be relatively easy for the victim

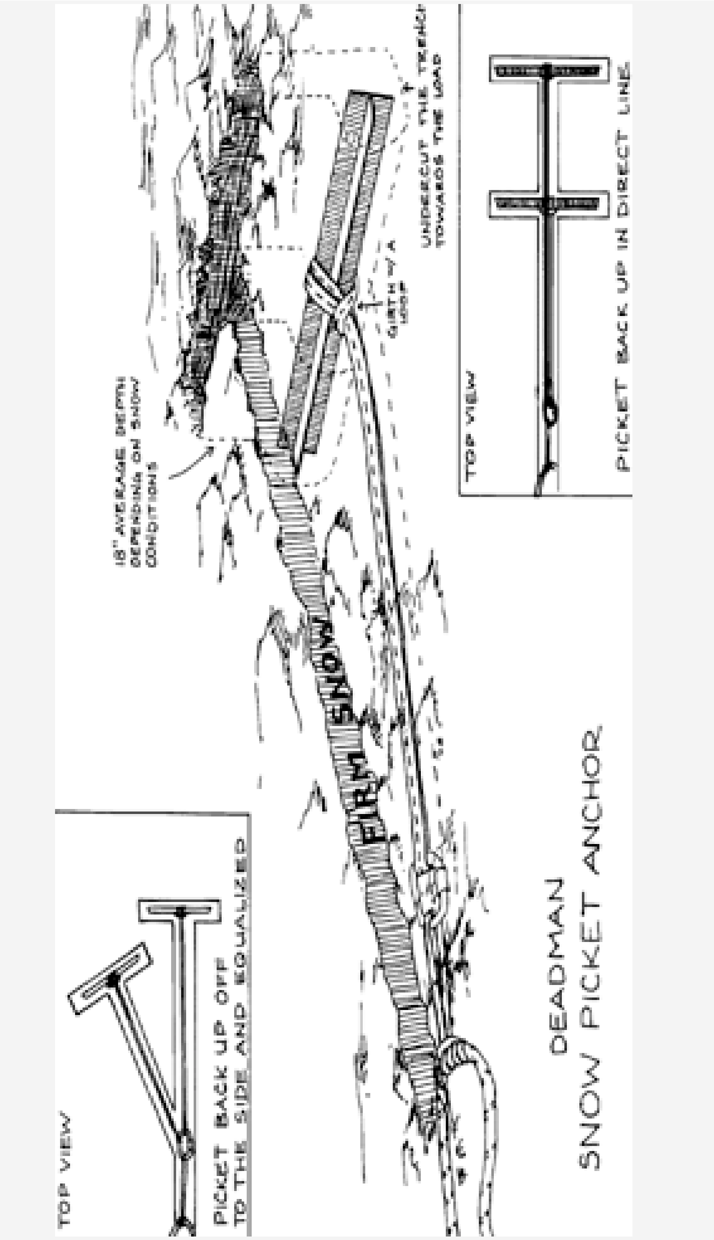

Figure 18-6: Deadman Snow Picket Anchor.

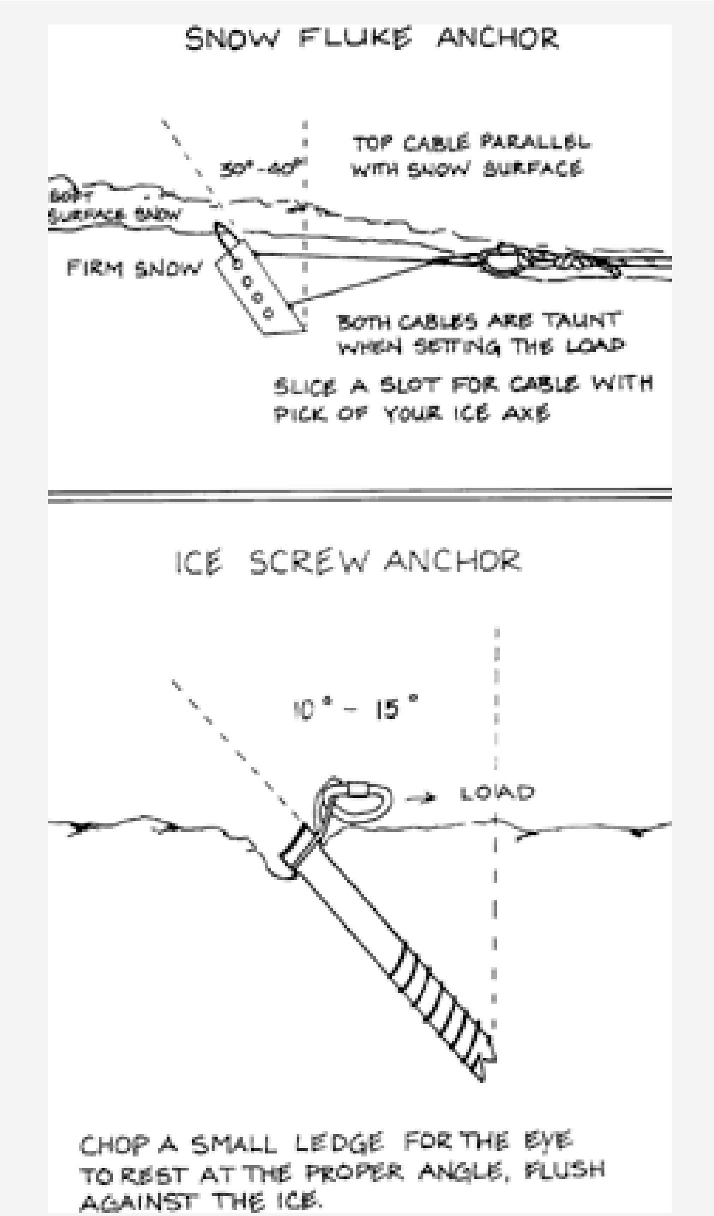

Figure 18-7: Snow Fluke and Ice Screw Anchor.

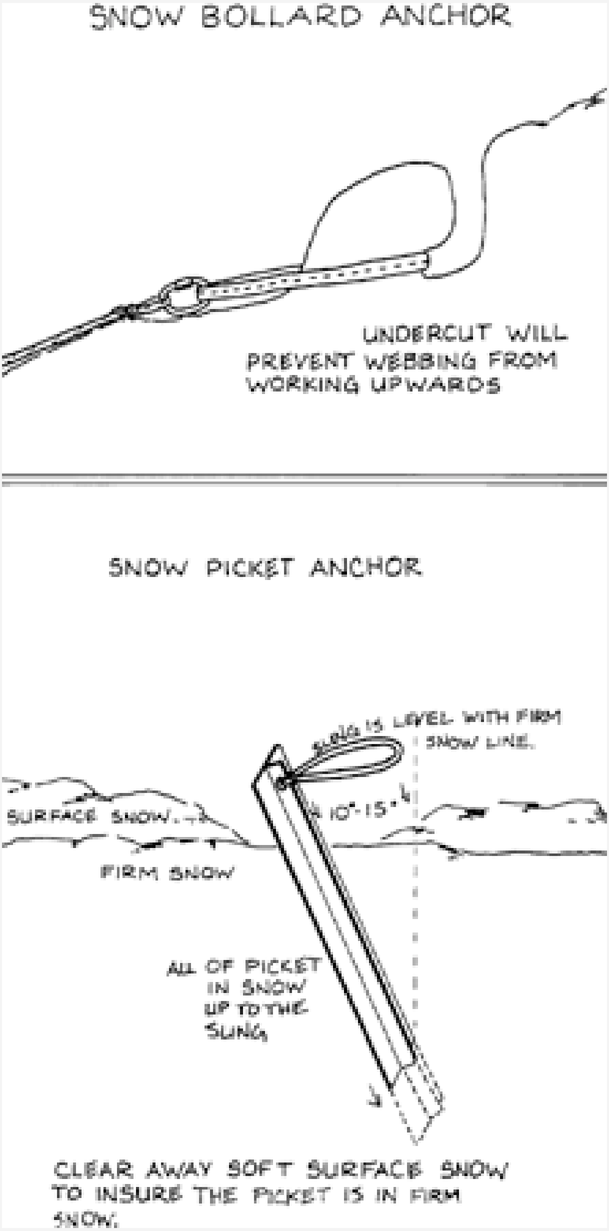

Figure 18-8: Snow Bollard and Snow Picket Anchor.

to climb back onto solid snow, and the rescuer can wait in a self-arrest position. Should a large bridge collapse or other circumstance arise where the victim is deep enough to be out of sight, the rescuer should immediately begin the process of building an anchor.

18.2c Building an Anchor

Once established in a secure self-arrest position, the rescuer needs to escape the system. Kick your feet into the snow or ice as deeply as possible until you feel comfortable working with your hands off the ice axe. From this position, you can safely build an anchor using a picket, fluke, or ice screw as conditions dictate. When satisfied with the anchor, get out your leg prussik (already on the rope), or a mechanical ascender with a long sling attached, and clip it into the anchor with a locking carabiner (shown in figure 18-9).

Slowly transfer the victim's weight onto the anchor by backing up toward the crevasse until all the weight is either on your leg prussik or mechanical ascender. During this process, you should stay in a self-arrest position to catch the victim (and yourself) in the event the anchor fails. Once the anchor has taken the weight, pull on the anchor with your own weight to test it while still remaining in a self-arrest position to catch a fall.

By this time, your confidence in the anchor must be absolute. If the anchor fails after you leave the self-arrest position, the victim (and possibly you) will likely be killed.

If the anchor is solid, you can now leave the self-arrest position to build another anchor behind the primary one. Clip this backup anchor into the locking carabiner already on the primary anchor. **Remember:** The area behind the primary anchor will not have been probed for crevasses, and you're at risk of finding a crevasse of your own. You must stay clipped into the system until you have probed all the working areas and know the extent of crevasses in the area. See figure 18-10.

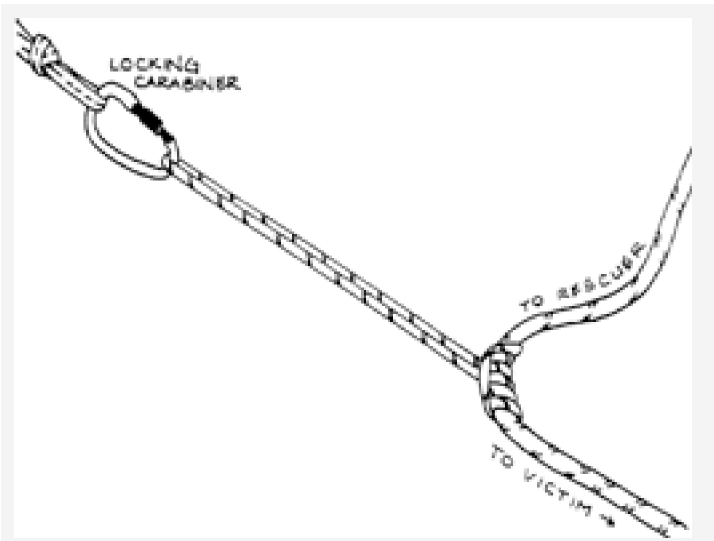

Figure 18-9: Locking Carabiner

18.2d Checking the Victim

The next priority is to check on the condition of the victim. Remove and uncoil the extra rope you are carrying, tie a Figure-8 knot on a bight as close as possible to the anchor, and clip it in. This will back up the prussik or mechanical ascender that the victim is hanging from, and give a solid anchor point for a rappel if that should become necessary. You must then estimate how far it is to the lip of the crevasse where the victim disappeared and measure that off on your rope, allowing a few extra feet of slack. Tie a Figure-8 on a bight and clip it to your harness. Next, a waist prussik or ascender should be switched from the victim's rope to the slack line as close as possible to the anchor, and then clipped back into the harness. Your prussik or ascender will be your belay as you probe for crevasses and approach the lip of the hole, while the Figure-8 on the bight will serve as a backup should the belay fail. See figures 18-11 and 18-12.

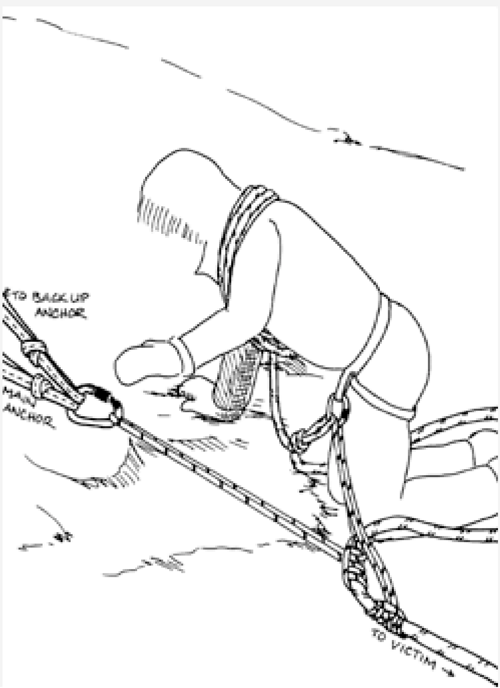

Figure 18-10: Anchor locations

Approach the hole where the victim disappeared by probing an area slightly to the side of the line to the victim. There is less chance of knocking snow or ice onto the victim if the hole/crevasse is not approached from directly above. Carefully probe the entire approach to the crevasse, looking for other crevasses and determining the extent of the lip over the victim. Slide the prussik or ascender as you go. After you've probed the area and deemed it safe, you'll unclip from the rope to perform the rescue **- it is critical that you are sure that the working area is safe**.

When you've reached the lip of the crevasse, check on the victim. In the worst-case scenario of an unconscious or gravely injured victim, you'll need to rappel down to the victim on the spare rope, using a prussik as a backup. Take with you a first-aid kit and any extra warm clothing or a sleeping bag to treat and bundle the victim. Pad the lip of the crevasse under your rappel

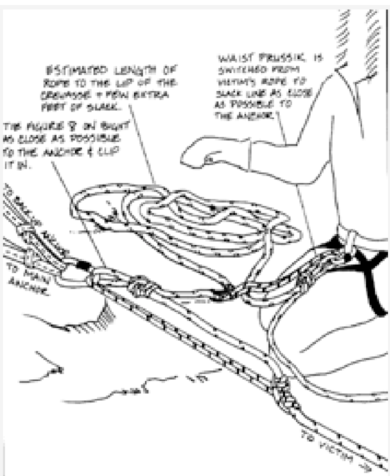

Figure 18-11

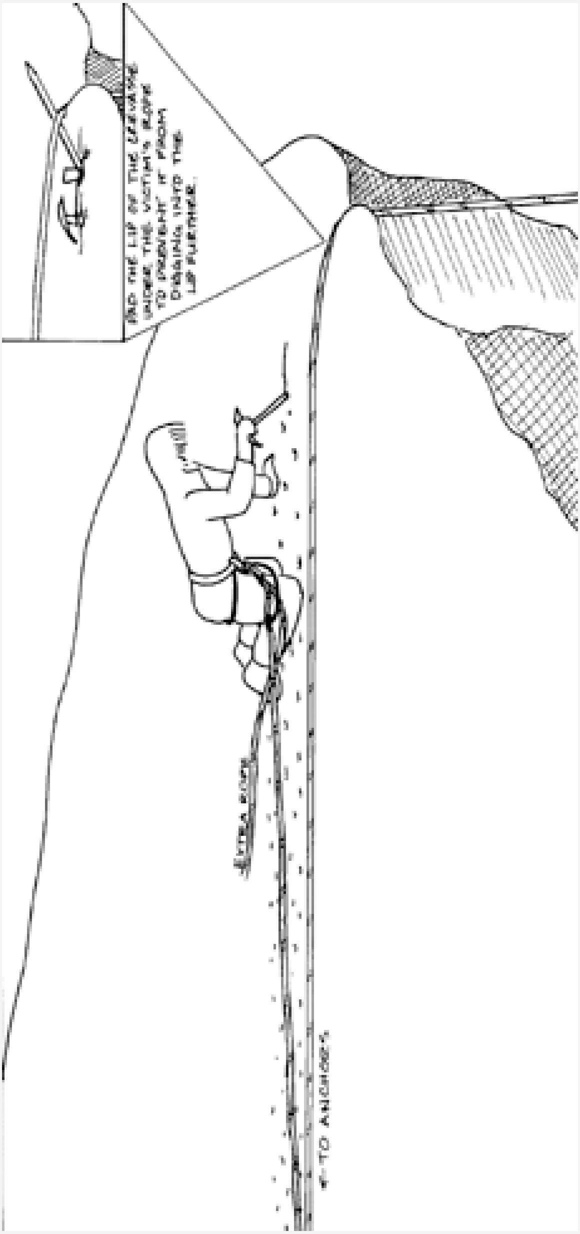
PAD THE LIP OF THE CREVASSE UNDER THE VICTIM'S ROPE TO PREVENT IT FROM DIGGING INTO THE LIP FURTHER.
EXTRA ROPE
TO ANCHORS

Figure 18-12

line to prevent the rope from digging into the snow.

After you've treated the victim, make an improvised chest harness using a long sling and an extra prussik and turn the victim so that his or her back is facing the wall of the crevasse. This prevents the victim from suffocating by being dragged face first through the snow. The process of hauling out an unconscious victim can easily take over an hour. Be sure the victim is well bundled to prevent hypothermia before you begin your climb up to the surface. Retrieve any climbing hardware the victim has with them, particularly the prussiks, before you climb up. See figure 18-13.

18.2e The Hauling System

Once you've reached the surface, the next step is to set up the haul system. First the crevasse lip under the rope to the victim must be padded by sliding an ice axe, pack, skis, etc., under the loaded rope. If possible, anchor the padding to the top surface to prevent it from becoming dislodged and landing on the victim.
Clip another carabiner into the carabiner attaching the foot prussiks to the anchor. At this point, it's safe to unclip the Figure-8 knot attaching the rope to the anchor, and allow the victim to hang from the leg prussik or ascender momentarily (see figure 18-14). Untie the Figure-8 knot, put a pulley on the rope and clip it into the extra carabiner on the anchor (this is the static pulley) See figure 18-15. Remove the self-belay waist prussik from the slack rope and install it on the rope to the victim about 2/3rds of the way to the edge of the crevasse. Place a section of the free rope through a

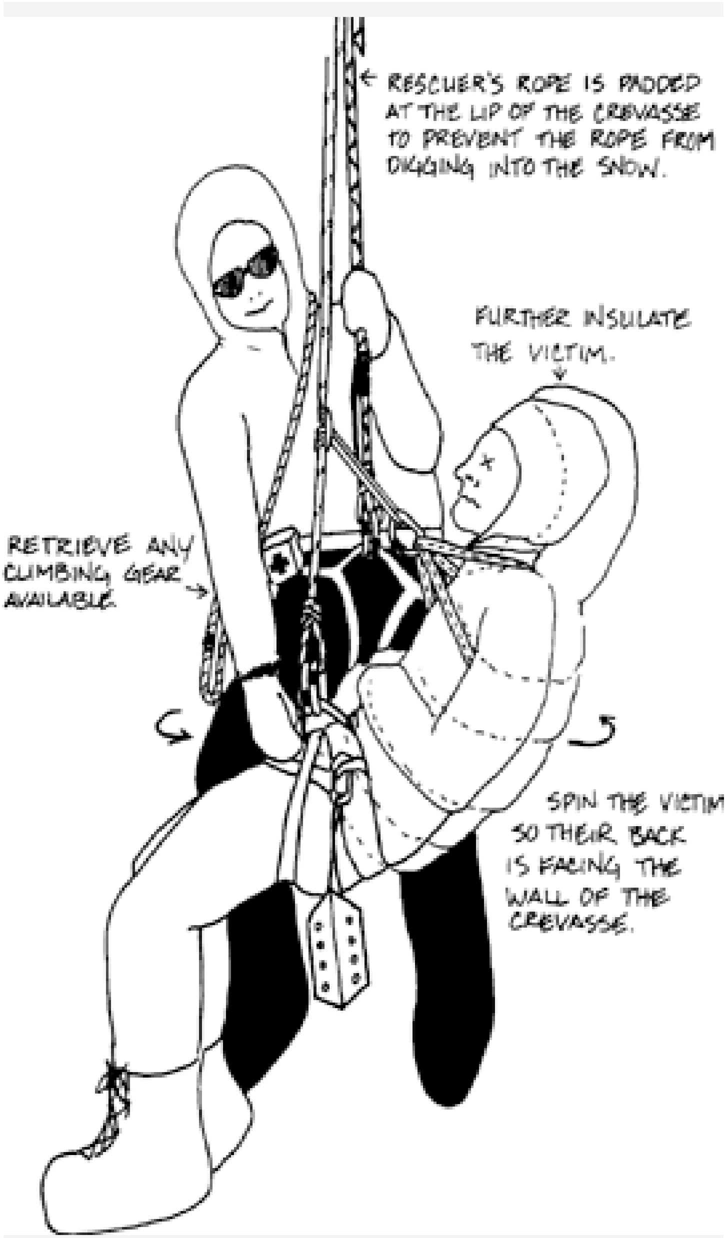
RESCUER'S ROPE IS PADDED AT THE LIP OF THE CREVASSE TO PREVENT THE ROPE FROM DIGGING INTO THE SNOW.
FURTHER INSULATE THE VICTIM.
RETRIEVE ANY CLIMBING GEAR AVAILABLE.
SPIN THE VICTIM SO THEIR BACK IS FACING THE WALL OF THE CREVASSE.

Figure 18-13

pulley, and attach the pulley to the waist prussik with another carabiner.

Attempt to haul the victim up by pulling on the free end of the rope. This will be extremely difficult if working alone, but reasonable if two or more rescuers are pulling. As the victim is pulled up, the foot prussik may jam in the static pulley unless it is loosened so the rope slides freely through it.

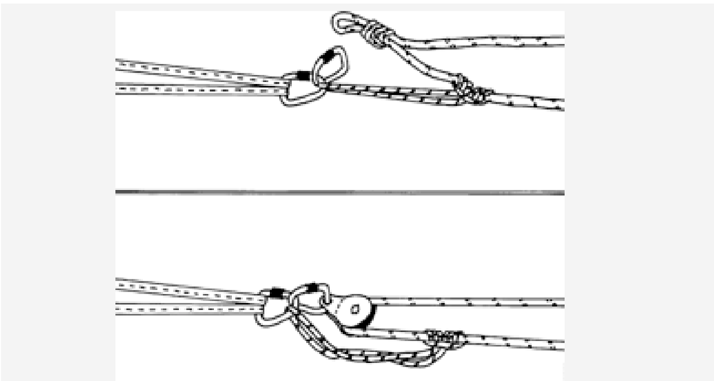

Figure 18-14

Continue hauling until the moving pulley reaches the static pulley. Then, take the slack out of the foot prussik and slowly let the load out until the prussik takes the weight. Slide the waist prussik toward the victim as far as it is safe. Repeat this process until the victim is either stuck at the lip or out of the crevasse.

Note: This system gives the rescuer a 3:1 mechanical advantage, and it is possible to exert large forces on the victim and the anchors inadvertently. Any change in resistance in the haul line should be investigated immediately to avoid injury to the victim or overstressing the anchor.

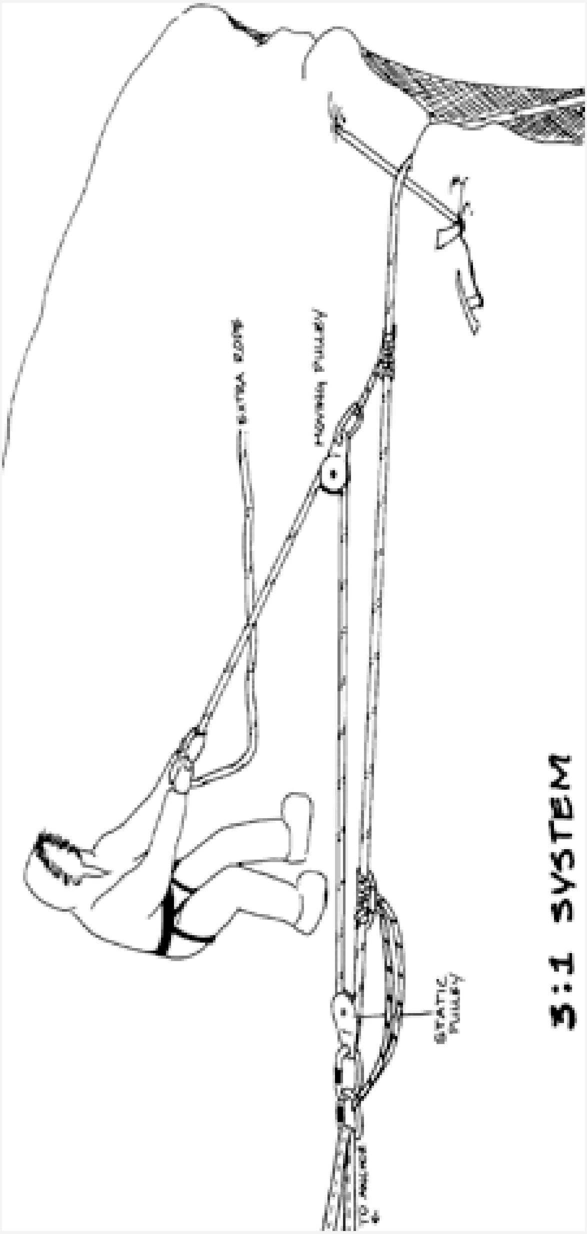

Figure 18-15

If you are working alone, you'll probably need more than a 3:1 mechanical advantage to haul a victim out. You can gain a better advantage by adding a 2:1 system to the 3:1, for an effective advantage of 6:1. Starting

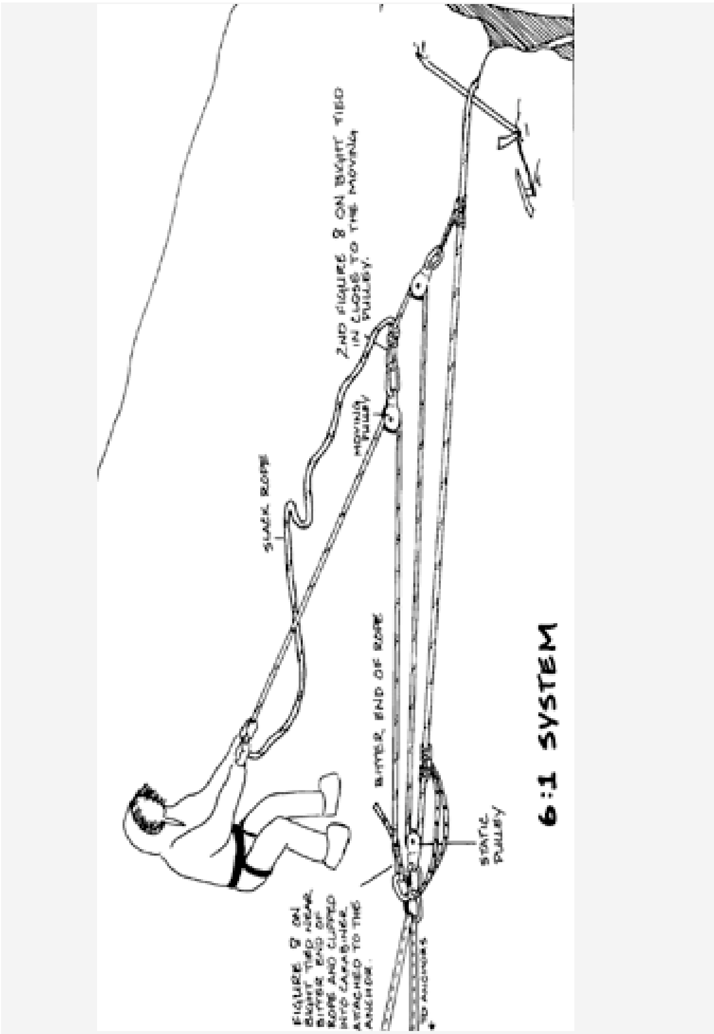

Figure 18-16

with the 3:1 system described before, find the end of the free rope and clip it in to the anchor with a Figure-8 knot (see figure 18-16). Then tie a second Figure-8 on a bight, as close to the moving pulley as possible. Using a carabiner, or another pulley if one is available, attach the free rope to the Figure-8 just mentioned. The rope coming out of the carabiner or pulley that was just installed becomes the haul line, and the victim is raised by pulling it in. Once the Figure-8 knot reaches the anchor, shift the weight to the leg prussik and move the waist prussik back toward the crevasse lip.

After several cycles, retie the Figure-8 loop that the last pulley is attached to, closer to the pulley. (It's not necessary to untie the old knot, and it would be difficult anyway because it's been under a load.) Repeat these steps until the victim is out of the hole.

Rescuers should know also how to construct a 2:1 pulley system (see figure 18-17) independent of the 6:1 system described earlier. It is useful for providing a quick pull to help a conscious victim over the lip, and also to haul victims all the way out if there is a large group of people to do the hauling.

1. Build an anchor and clip the free end of a rope into it.

2. Install a pulley on the rope with a locking carabiner attached.

3. Lower this pulley to the victim on a bight of rope and clip it to his or her harness.

4. Haul on the free end of the rope until the victim is retrieved. Have the free end of the rope belayed by an extra rescuer or attach a prussik between the rope and the anchor, and slide it up the rope to provide a belay as the line is hauled in.

Generally, the hardest part of extracting an unconscious victim from a crevasse is getting him or her over the lip. Once the victim has been raised to the lip, you'll have to attach a prussik to the haul line and go to the edge. Carefully excavate the snow at the lip until there is a gradually sloping ramp to haul the victim onto. If the haul rope is under tension, a vertical tug on the victim will frequently cause him or her to slide up the ramp because of the rope stretch. You may have to repeat this process several times before the victim is all the way up. See figure 18-18.

18.3 Conclusions

Crevasse rescue is a strenuous, complicated process that is difficult under the best of conditions, and cannot be completed without prior practice. The possession of a manual is no substitute for the possession of skills once an accident happens. Rescuers not only need to know how to perform a standard "textbook" rescue, but should have enough understanding of the concepts to improvise solutions to more complicated scenarios.

There have been many crevasse incidents in the past several years in Antarctica - and many more near misses. Many of these crevasse falls happened to

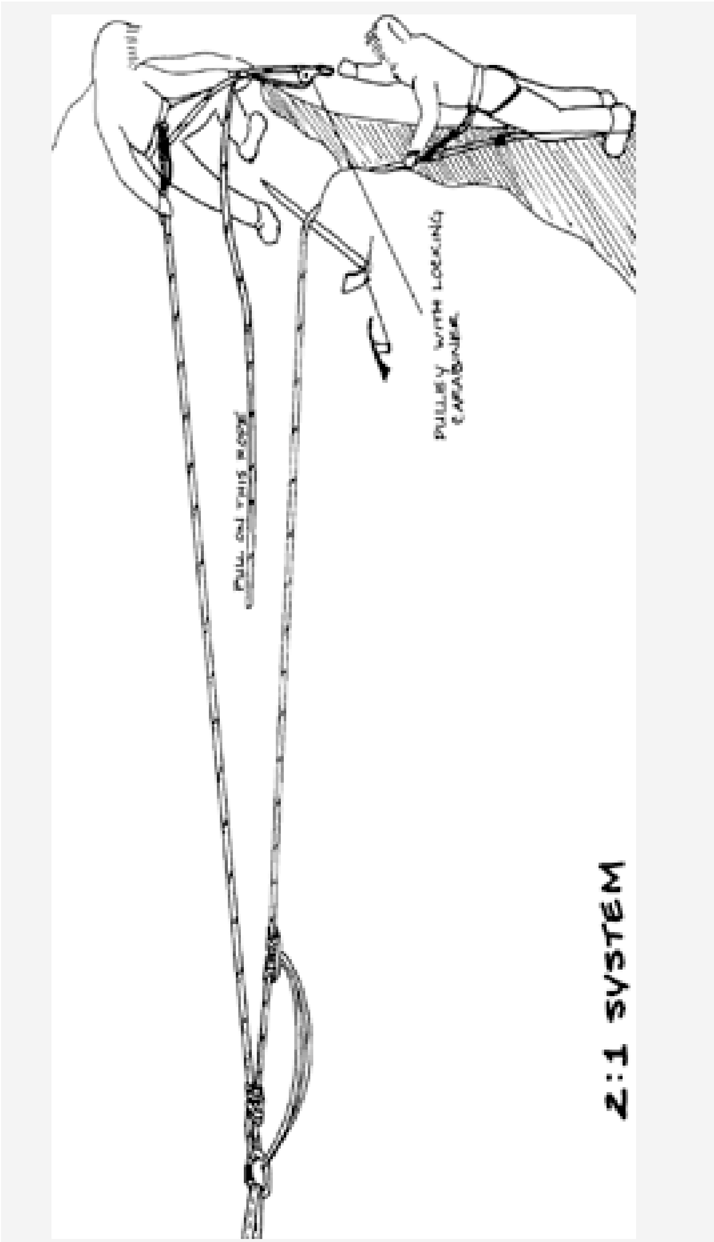

Figure 18-17

parties with years of Antarctic experience in areas where crevasses were not expected. Field parties must be extremely careful to avoid falls - and be prepared to deal with them if falls do occur.

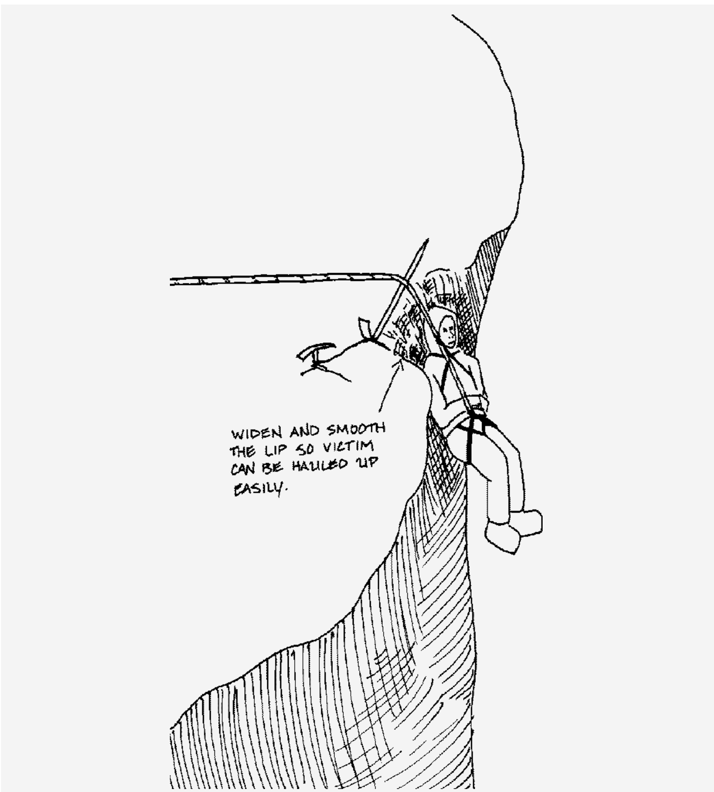

Figure 18-18

Chapter 19
Roped Travel with Snowmobiles and Sleds in Crevassed Areas

Crevasses are dangerous, especially when you are traveling with machinery. Avoid crevassed areas if possible, even if it entails making a considerable detour.

To date, no one in the USAP has been killed as a result of a snowmobile (skidoo) crevasse fall, but there have been numerous close calls. It's only a matter of time before a death occurs unless greater attention is given to safety. People have been killed in a crevasse fall where snowmobiles were not involved.

Limited field testing has been carried out on the actual effectiveness of the methods described in this chapter. The results have been sobering in regard to the difficulty of stopping a fall, especially at speeds higher than 5 mph and/or with slack rope between the snowmobiles. The driver of a machine that falls in a crevasse is virtually assured of severe injury. This means that detection of crevasses and good route-finding to avoid dangerous areas are essential to safe travel.

Always have the capability to rope snowmobiles and drivers when traveling on a glacier. Be aware that glacial conditions vary enormously in Antarctica, from one year to the next. Glacial conditions can change in a few weeks in some areas of Antarctica.

In areas where there is any possibility of crevasses, roped travel should be used. It is often very difficult to detect crevasses. Stop and probe ahead if you're at all suspicious. Act conservatively and operate within a wide margin of safety.

Roped travel with snowmobiles should be practiced with an experienced person in a realistic area before beginning a trip.

There are several systems for traveling through crevassed areas with roped snowmobiles and sleds, and safer options are always being sought. Please feel free to question the systems described in this chapter and provide constructive comments. The information provided here does not substitute for training or experience.

19.1 General Points for Roped Travel with Snowmobiles and Sleds in Crevassed Areas

19.1a Aerial Reconnaissance

Aerial and satellite photographs provide an excellent source of information regarding crevasse locations. Direct aerial reconnaissance from the flight deck should include viewing proposed routes of travel from the air and marking the positions of crevasses on a map. Crevasses are more easily detected when the sun is at a low angle.

19.1b Tow Ropes

Tow ropes are used to connect the lead snowmobile to the sled(s) and/or snowmobile(s) behind it. Tow ropes are separate from, and in addition to, the safety ropes. Tow rope diameters of 3/4" to 1" (22-mm) nylon twisted rope are recommended. Twin 1/2" ropes (or larger) are a good alternative. In Field Safety Training field testing, Figure-8 knots tied every meter in the tow ropes dramatically increased the fall-catching ability of the roped-snowmobile train.

In crevassed areas, all Nansen sleds, including those equipped with rigid hitches, need to be towed with the recommended spacing. The distance between snowmobile and sled should be 15- to –20 meters in suspect areas. In safe terrain, a Nansen sled with rigid hitch can be connected directly to the snowmobile.

The ends of the tow ropes should be tied with Figure-8 knots on a bight, or spliced to 5-ton shackles or locking steel carabiners.

A 1.5-meter-long protective sheath (PVC or rubber tubing) should be placed over the tow rope immediately ahead of where it secures to the sled or snowmobile it’s pulling. Secure the sheath with a piece of cord so that it can’t move forward. This end of the tow rope will then be protected by the sheath should a sled or snowmobile run over it.

Attach the tow ropes to the snowmobiles and sledges with either 5-ton shackles or steel screwgate carabiners. (Don’t use non-locking carabiners.)

Note: Engine vibration can unscrew the locking carabiners. Steel carabiners have failed under very light tow loads when the gate is unscrewed. Two steel carabiners with reversed gates will ensure a safer system. Secure carabiner screw gates and shackle pins with wire, tape, or rubber washers, etc. so that they won't unscrew.

19.1c Nansen Sled Back-up Rope

With Nansen sleds, it's necessary to loosely tie a back-up tow rope on the underside of the bridges. This rope should be 3/4" or 1" nylon twisted rope and should attach onto each end of the Nansen sled towing rope with the same shackle or carabiner that is used for towing. This back-up tow rope needs to be tensioned in such a way that it does not bear the load unless a large impact occurs.

19.1d Snowmobile Cables

All snowmobiles used for travel in crevassed areas should be fitted with a steel cable encircling the snowmobile. The 5-ton shackle on the tow rope must be fitted over this cable when hitching the snowmobile, to ensure that the snowmobile stays belayed to the tow rope in the event a crevasse fall pulls out the snowmobile's hitch plate.

19.1e Tether Switches

The tether switch is a thin line that runs from the snowmobile's kill switch to the driver's harness. This tether ensures that the snowmobile will stop (the engine is killed) if a driver falls from the machine. If the tether switch isn't used, the driver may end up hanging beside a spinning snowmobile track, which could cut the driver's rope or result in serious injury.

19.1f Driver Safety

- When traveling linked, snowmobile drivers should kneel to one side, rather then straddling the seat, so in the event of a crevasse fall there is a better chance to jump or fall clear of the machine.
- Only one person should be on each snowmobile.
- Helmets should be worn in crevassed areas.
- No loose gear should be hanging from the driver's harness. Dangling items can hang up and drag the driver into a crevasse.
- All drivers and sled riders should have either prussiks or mechanical ascenders attached to their safety ropes.

19.1g Communication

A series of prearranged hand signals should be used for communication between linked snowmobiles and sleds. Your field party should have signals for stopping, slower, faster, ok/ready-to-go, crevasse, and any others found to be necessary (i.e., "place flag here," etc.). The hand signals shown in figure 19-1 have been used effectively by past field parties.

Figure 19-1: Hand signals for crevasse travel.

19.1h Travel Speed

Linked travel requires continuous concentration and is not suited for fast speeds. In Field Safety Training field tests, speeds over 5 mph dramatically increased the distance a snowmobile fell, and stopping the fall proved very difficult.

When traveling in linked formation, it is vital that you don’t allow any slack to develop in the tow rope. Invariably this means that the lead snowmobile will at times be slightly pulling the trailing machines. A slack tow rope will continually be run over and will jam. If you drive over the tow ropes and safety ropes, the system will be compromised. The ropes may break under a load if one of the machines falls into a crevasse.

19.1i Crossing Crevasses

Stop and probe all crevasses to determine if they are safe to cross. Probing should be done by the driver of the lead snowmobile. A ski pole, without a basket, will suffice for a probe.

If you must cross a crevasse, always do it perpendicular to the line of the crevasse. If a snowmobile or sled starts to break through a snowbridge, experience and circumstances will dictate whether to brake and attempt to hold the fall, or continue driving forward in hopes of getting across before a catastrophic collapse of the snowbridge. In either case, a change of underwear is recommended.

19.1j Stopping a Fall

When stopping a fall into a crevasse, apply the brakes and, if possible, quickly kill the engine. The engine will be killed automatically if it's your snowmobile that's falling and you fall off the machine, thereby pulling the tether switch line.

In hard snow conditions, rope brakes on the sleds will increase friction and braking ability. If you're a rider on a Nansen sled, and the sled is rigged for it, stand on the footbrake.

19.1k Travel on Foot between Snowmobiles and Sleds

In crevassed terrain, you must remain tied in when walking between your snowmobile and the other machines and sleds. Many a crevasse has been found by a driver stepping off his or her snowmobile (which has a lighter ground pressure than a person on foot), and breaking through a snowbridge that the snowmobile had crossed seconds before without incident. To walk forward or back to another snowmobile or sled, you can self-belay with a prussik or ascender, either on your safety line or a spare rope.

Get into the habit of straddling the tow ropes when walking back and forth between machines and sleds.

19.2 Tying In

The prospect of falling into a crevasse on a snowmobile is extremely frightening. No system presently exists to allow the driver a guaranteed clearance from the snowmobile. There's a high probability of injury occurring to a falling driver. However, the following roping procedures will keep you as safe as possible in the event of a crevasse fall (see figures 19-2 and 19-3).

19.2a Front Driver

Clip the bitter end of an 11-mm climbing rope to your harness with a Figure-8 knot and locking carabiner. Use a prussik or ascender to fine tune the tension.

Walk the rope back to the sled or second snowmobile, tie a Figure-8 on a bight, and clip it into the front towing thimble with a locking carabiner. Coil the unused rope neatly and stow it on the sled.

If there's a rider on the sled, adjust the remaining portion of the rope, clip it to either the front or rear towing thimble of the sled, and then clip it into the rider's harness with a Figure-8 knot. Stow any extra rope out of the way.

Roping up will be much easier and quicker if you cut your safety ropes to the exact lengths needed before you go into the field.

Lead drivers should carry a 45-meter climbing rope in a stuff sack (throw-bag style) neatly stowed on the snowmobile. This can be used for probing out ahead of the machine or to rescue others in the field party. Equip this rope with prussiks or an ascender next to the carabiner (or Figure-8 knot) used to hook onto the driver's harness.

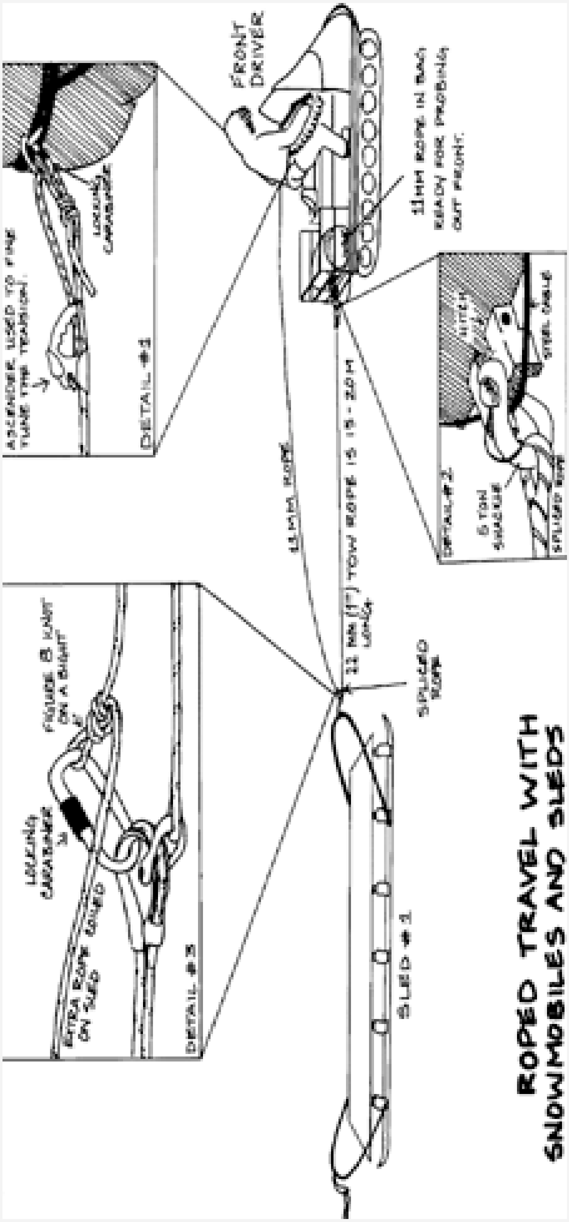

Figure 19-2: Front driver rope configurations.

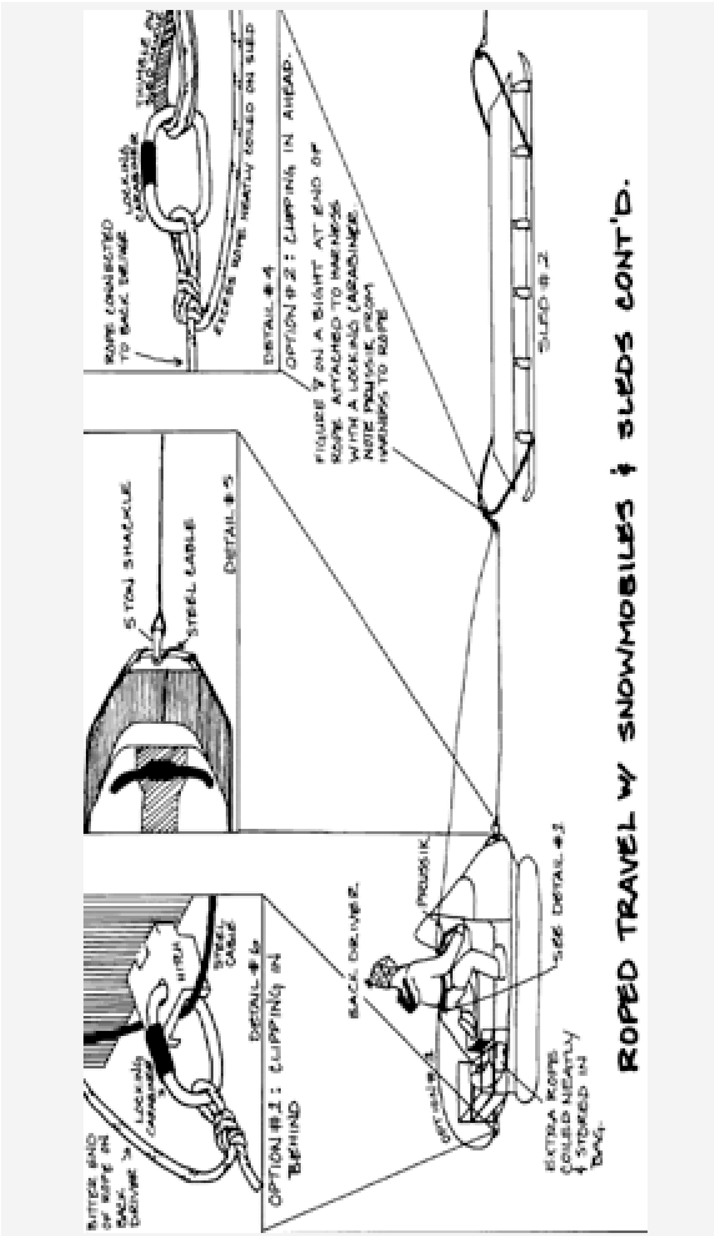

Figure 19-3: Back driver rope configurations.

19.2b Rear Driver

There are two recommended methods for tying in the second snowmobile.

Clipping In Behind: The easiest system to manage is to clip onto the back hitch of the snowmobile you're riding on. Secure the end of a 45-meter rope to your harness with a Figure-8 knot and a locking carabiner. Attach this with a locking carabiner (on a Figure-8 on a bight) to the back hitch of the snowmobile. Make sure the steel cable that encircles the snowmobile runs through the carabiner.

Secure the extra rope in a stuff-sack (throw-bag style) and neatly stow it on the rear of the snowmobile out of the way. The extra rope can be used for self-belaying away from the machine using an ascender and will be handy for rescues. Clipping in behind the snowmobile makes rope management easier, but in a crevasse fall, the driver will be hanging below the machine. Self-rescue will be next to impossible.

Clipping In Ahead: Having the rear driver's safety line run ahead to the Nansen sled is potentially a safer system, but is harder to manage. Attach the end of the safety rope to the driver's harness (Figure-8 and locking carabiner). Take the line forward and attach it to the rear towing thimble on the Nansen sled with a locking carabiner. Use a prussik or ascender on the driver's harness to "fine tune" the distance. Neatly coil excess rope and stow it on the sled.

This system makes it possible for self-rescue by preventing the driver from falling below the snowmobile and by providing an immediate safety line for self-belaying up to the sled in front. However, it's very difficult to keep from running over the rope, especially in rough terrain (sastrugi).

Note: An experienced USAP field mountaineer prefers to run the safety rope from the rear driver to a 9-mm prussik wrapped on the tow rope just ahead of the protective tubing. This helps to not run over the rope and does not allow the driver to fall below the snowmobile.

Remember: It is highly probable that the secondary riders and/or drivers will be the ones that will fall through a weakened snow bridge.

19.3 Travel Configurations

Just as in roped-mountaineering, three snowmobiles roped together are safer than two. In Field Safety Training field testing, a roped-snowmobile train of three dramatically increased the ability to stop a fall quickly (two snowmobiles catching the third). Never travel with less than two snowmobiles and one sledge linked together, when traveling in crevassed areas. Depending on the size of your field party and the amount of cargo you're transporting, there are various travel configurations, which are illustrated in figures 19-4, 19-5 and 19-6.

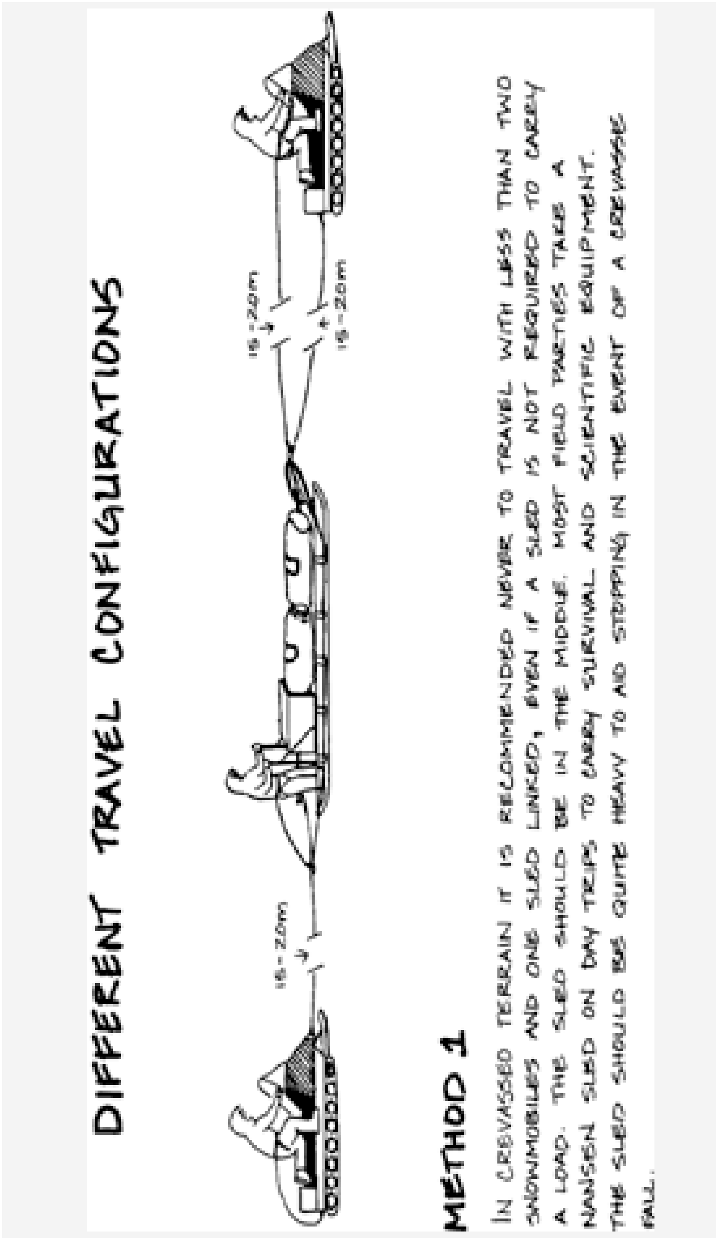

Figure 19-4: Method #1 travel configuration.

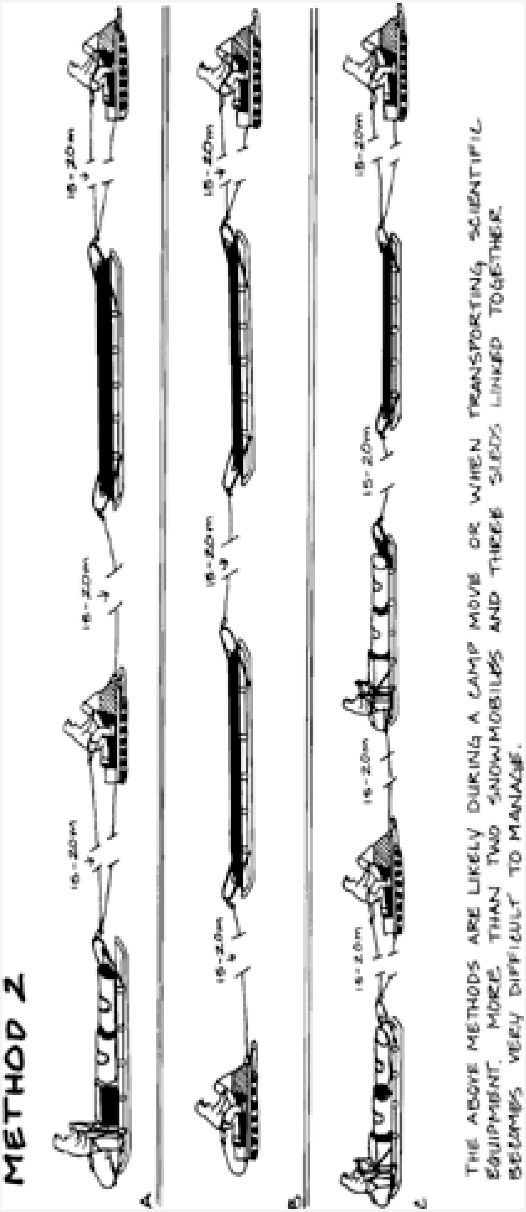

Figure 19-5: Method #2 travel configuration.

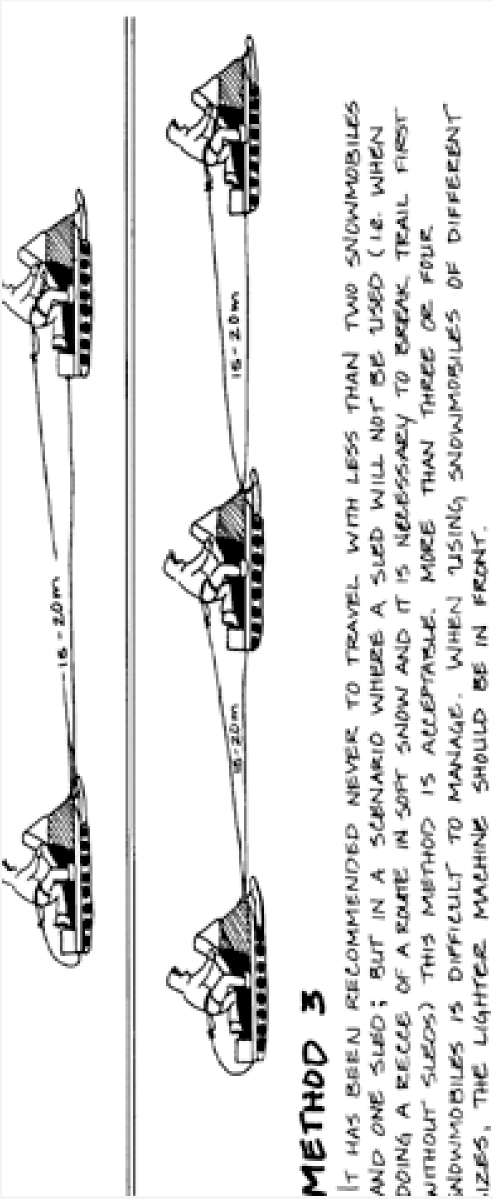

Figure 19-6: Method #3 travel configuration.

19.4 Snowmobile Crevasse Extraction

- Rescue the driver. If necessary, the snowmobile can be tied off and extracted on another day.

- Probe and mark off a safe working perimeter around the crevasse before extracting the snowmobile.

- The crevasse edge must be thoroughly prepared before attempting a snowmobile extraction. Dig a ramp the width of the machine and deep enough to reach very hard snow. Place suitable edge protectors of wood or metal on the lip of the crevasse; tie them off so they don't fall in. These will minimize rope drag during the hauling.

- Your main anchor must be large deadman-style anchors equalized and thoroughly "bombproof."

- A pulley system can be set up on the tow rope, but it is preferable to set the pulley system on an alternate rope (static rope is best) that can be belayed separately as a backup. The snowmobile tow rope can also be secured to a separate anchor for a backup, if necessary. Prussiks should be heavy duty (8-mm is the minimum).

- Before hauling, put the snowmobile in neutral gear, or cut the drive belt so that the tracks can turn. Snow and ice may need to be cleared from the tracks to free them.

- If possible, raise the snowmobile's back end first. Position a person on the crevasse edge for communication and observation. If you have enough people, position another person in the crevasse. This person can ensure that the ski is straight and that the track can spin. Secure this person to a safety rope anchored separately to one side of the main anchor.

- Use three people pulling on a 6:1 pulley system to extract the snowmobile. Or, use snowmobiles to help pull it out. Snowmobile tracks should be pre-packed, and the pull path must be free of anchors and ropes. (See figure 19-7.)

19.5 Rescue Equipment

The following gear should be carried by each member of a field party traveling in crevassed areas. Equipment carried in the crevasse rescue bag is to be used in addition to the personal gear carried by each individual. A listing of the equipment in a crevasse rescue bag appears in Appendix D.

Personal Equipment (Each Person):

4	Prussiks: 2 Long and 2 Short
2	Slings: 1 Long and 1 Short
2	Pulleys
1	Figure-8 Descender
5	Carabiners
2	Locking Carabiners
1	Picket
1	Ice Axe

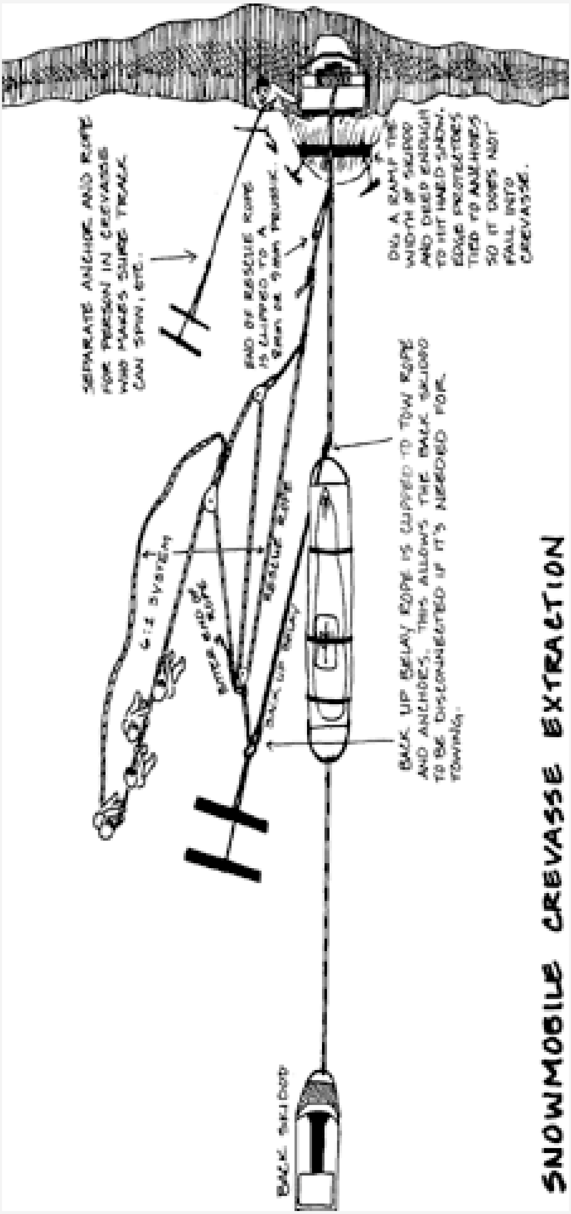

Figure 19-7: Snowmobile extraction from a crevasse.

19.6 How To Travel With A Nansen Sled

19.6a In a Safe, Non-Crevassed Area

If the Nansen sled is equipped with a rigid hitch, attach the sled directly to the snowmobile. (Some of the following comments will still apply.) If the Nansen sled is being pulled with a tow-rope, play close attention to the following:

- When starting with a heavy sled load, have some slack in the tow rope, and have someone rock the sled and push to help break the runners free.

- Stop gradually so that the sled doesn't run into the back of the snowmobile.

- The driver should look back frequently to ensure that the sled is tracking correctly, and those riding the sled are not being dragged by their bootlaces like fools in a cheap spaghetti western.

- When not linked for crevasse travel, keep the tow ropes short to prevent wandering sleds.

- Don't travel too fast. You'll damage equipment if your sled tips over.

- Travel together as a team - don't get spread out too far.

- Use rope brakes on the sled runners when they're needed. A braking snowmobile in the rear is a secure method for steep descents and for traverses. At times, you may need to belay sleds down steep, difficult slopes.

- Sleds with handlebars and footbrakes are recommended on any trip where personnel will be riding on a sled.

19.6b In Crevassed Areas

Even though many Nansen sleds have rigid hitches, do not attach them directly to the snowmobile in crevassed areas. Nansen sleds still need to be positioned 15-20 m from leading or following snowmobiles or other sleds. Attach the tow rope either to the hitch or directly to the front of the sled. Refer back to Figures 19-2, 19-3, 19-4, 19-5 and 19-6.

19.7 How To Load a Nansen Sled

Figures 19-8 and 19-9 show how to distribute the cargo load on a Nansen sled. Following is a list of additional points on loading a Nansen sled:

- Position the heaviest items over a bridge of the sled and slightly toward the rear.

- Use a cargo tank to contain the cargo.

- Support fuel drums with a drum cradle positioned over two bridges. Two 55-gallon drums can be carried on a Nansen sled, secured by cargo straps.

- Rock-box platforms are available for large numbers of boxes.

- Divide equipment among your sleds so that if a sled is lost in a crevasse accident, you'll still have food, water, a stove, fuel, shelter, and a radio on the remaining sleds.

- Place a Scott tent, pointed forward, on top of the loaded cargo tank, along with bundles of flags and a shovel. The crevasse rescue bag goes on top of all of this.

- Lash loads down tightly using rope and cargo straps. Carry spare rope, cargo straps, and bungees on the snowmobile.

- Each person should have a sleeping kit consisting of a sleeping bag, a Thermarest®, and an Ensolite® pad. Carry the sleeping kit in a cargo bag. If you're using mountaineering tents, the tents should go in the cargo bag, along with the stakes.

- Always take a deep-field survival bag and radios on day trips away from the main camp.

- Carry personal items in a pack or duffel:
  - Spare Clothing
  - Goggles

- Camera
- Thermos
- Food
- Sun Cream
- Personal Mountaineering Equipment.

- Use colored webbing or tape to identify each person's gear. The orange "drag" bag issued in Christchurch carries securely on sled handle bars by the bag's shoulder strap. This makes a good personal bag in the field.

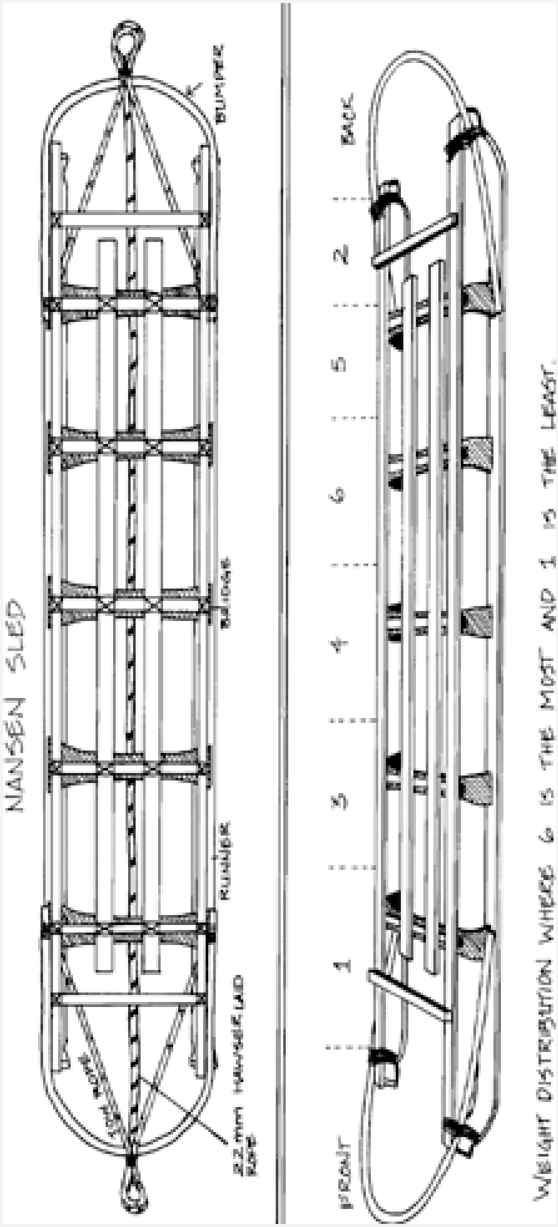

Figure 19-8: Nansen sled weight distribution.

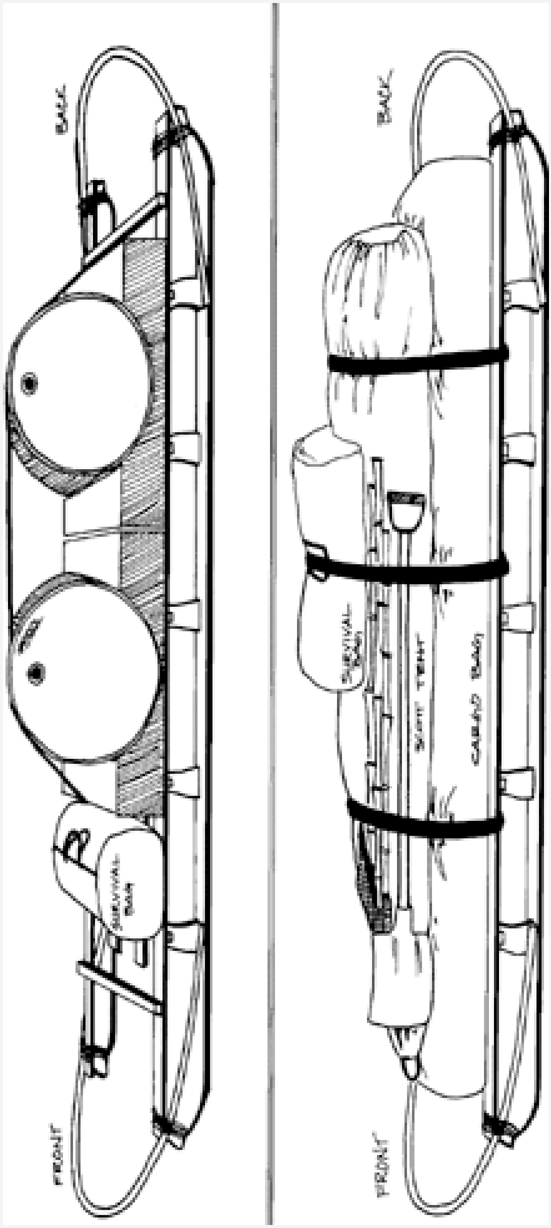

Figure 19-9: Nansen sled load example.

Chapter 20
Glacier Travel with Heavy Machinery

- Never tow a Nansen Sled behind anything other than a snowmobile. Do not tow Nansen sleds behind Sprytes, Pisten Bullys or Tuckers, as serious damage is often done to the sleds when towed by these heavy vehicles.

- Use extreme caution when travelling in a vehicle in glaciated terrain.

- There is no practical system that allows vehicles (other than snowmobiles) to be safeguarded in the event of a crevasse fall.

- Vehicles should only be used on predetermined safe routes. Go around crevassed areas, leaving a wide margin of safety.

- If your field work requires travel through glaciated areas, use rigorous research, interviews, and investigation to determine any previous history of the route. Many “new” routes have an interesting and sometimes disastrous history.

- Before committing heavy equipment to a route in unknown terrain, reconnoiter the route first by aircraft and then by snowmobiles and sledges.

- Always carry survival gear in the cab of the vehicle. It's a good idea to also carry a spare set of clothing in case fuel or other liquids leak onto your clothes. Wear a climbing harness to facilitate a quick rescue.

- If a vehicle breaks through a small crevasse, continue driving forward and the tracks may climb out of the crevasse.

- If you fall into a crevasse with a vehicle, kill the engine immediately to prevent carbon monoxide buildup in the crevasse and subsequent carbon monoxide poisoning.

Chapter 21
Antarctic Navigation

Land navigation in Antarctica has undergone a dramatic change over the past several years due to the increased availability of Global Positioning System (GPS) coverage and equipment.

While GPS is a valuable resource to field parties, it should not be relied upon as the sole method of navigation. There are several methods to plot position and navigate if a GPS is unavailable. Magnetic compasses, sun compasses, sextants, and dead reckoning are all valuable tools to the Antarctic traveler, but they each have their drawbacks.

Prior to your field deployment, you should choose the navigational methods that best suit your location and learn how to use them. You won't have time to figure it out in the field - you can't afford to be wrong while you're learning on the job.

21.1 Global Positioning System

There are still some problems with using GPS in the field. Coverage at the higher latitudes is limited to certain, yet predictable, hours of the day. At time, accuracy is diminished by the low incident angles of the satellites to the horizon. Before planning to use GPS, use the software provided with your system to check availability of coverage at your expected location. If

GPS is a part of your work in the field, you will likely have to plan your work day around the “windows” of satellite coverage.

21.2 Magnetic Compasses

Magnetic compasses must be modified for use in polar latitudes by reweighting the needle. As the compass gets closer to the South Pole, the south-seeking end of the needle is pulled downward toward the earth and will drag on its enclosure unless the proper nonmagnetic counterweight (copper wire) is added to the north-seeking end.

Field parties must be careful of localized magnetic variations. On Ross Island, for example, magnetic compasses are unusable because there is so much iron in the rock. Likewise, compasses are affected by the metal in vehicles. Bearings must be taken well away from such disturbing influences.

Navigation with magnetic compass over long distances is difficult because the magnetic variation (the difference between magnetic and true north) is so high, and changes significantly over short distances. Field parties may elect to travel by using a Grid North system (see the “Grid North” section), versus a magnetic or true-north system.

21.3 Grid North

Grid North is an artificially-convened reference direction which is taken to be parallel to the Greenwich

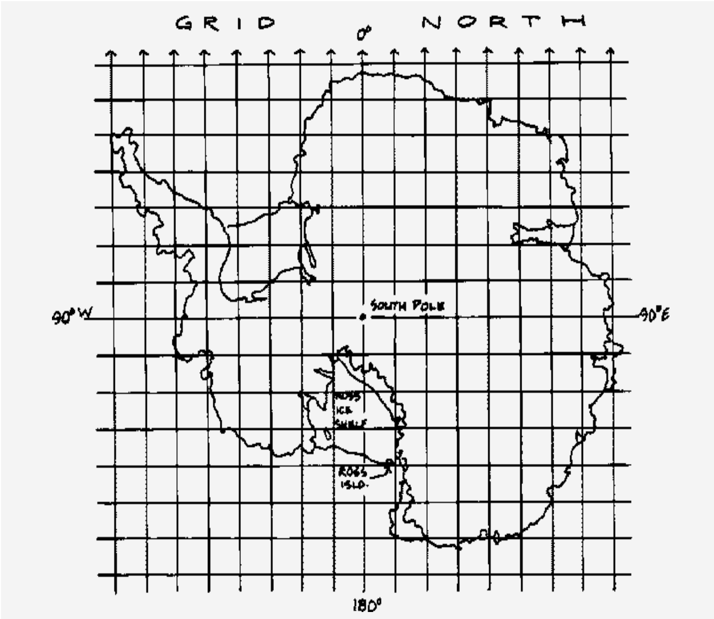

Figure 21-1: Grid North

Meridian. The north/south grid lines run parallel to each other and do not converge at the poles (see figure 21-1).

By contrast, meridians of longitude converge so sharply near the poles that expressing headings with respect to True North becomes impractical.

Aviators circumvent this problem by using Grid North's constant reference direction. This is not only practical for the aviator, but can also greatly simplify matters for the land traveler using a magnetic compass.

For locations south of the equator, the following rules apply:

Easterly Longitudes:

Grid direction =True direction + Longitude of your camp
True direction = Grid direction - Longitude of your camp

Westerly Longitudes:

Grid direction = True direction - Longitude of your camp
True direction = Grid direction +Longitude of your camp

Note: When giving a Field Weather Observation, wind direction must always be given in relation to Grid North.

21.4 Compasses and Sextants

Using compasses is an accurate way to determine bearings. Using sextants (in conjunction with an artificial horizon) is a good way to fix your position. Both methods require an accurate chronometer and extensive knowledge on how to use navigational tables to get good results.

Chapter 22
Search and Rescue

The USAP has Search and Rescue (SAR) programs to respond to emergencies at all USAP Stations.

At all locations the USAP policy is to launch a SAR when a local sea-ice group or a helicopter has not checked-in and is overdue by 30 minutes. Remote rescues will be initiated upon request, or if a field party fails to respond or communicate a check-in with anyone for 72 hours. Since most rescues use fixed-wing aircraft, helicopters or a vessel, weather delays may be significant in the event a rescue is launched. Parties in remote locations should be prepared for a substantial wait before help arrives.

When faced with any emergency, two simple rules apply:

1. Take whatever immediate actions are necessary to preserve life or prevent further injuries.

2. Then stop and think things over.

The first rule ensures that members of the party are not endangered unnecessarily. You cannot afford to have more victims than you already have. The second rule suggests you take an inventory of your situation, including the assets available (check the listing of survival cache and hut locations in Appendix B to see if any are nearby) and the skills of your people - then come up with a plan.

Above all else, you must **Think Before You Act!**

22.1 Medical Evacuations

All medical evacuations (Medevacs) are initiated by the medical personnel on station. Patients will be transported to either Punta Arenas or Christchurch by the quickest means possible. Weather, aircraft, or ship availability all are factors in the amount of time it takes for a medevac to occur.

Figure 22-1: A medevac at Palmer Station.

Chapter 23
Altitude Acclimatization

To minimize the risk of developing altitude sickness, field parties intending to work at altitudes greater 8200 ft (2500 m) must plan acclimatization time into their schedule prior to going above 8200 ft (2500m). In situations where the field team is climbing or using vehicles to move higher, individuals must spend a restful 24 hour period at each 1000-1500 ft (300-450 m) increment above 8200 ft (2500 m) to acclimatize before proceeding higher. Field groups who plan to ascend above 13,125 ft (4000 m) must plan several restful 48 hour acclimatization stops at intermediate altitudes above 8200 ft (2500 m).

Anyone who experiences altitude-related problems must go no higher and should descend to a lower altitude until the symptoms resolve. If symptoms persist or increase in severity, the person should return to a lower altitude and have medical attention.

Field teams that are deploying directly from sea level to an altitude of 9,900 ft (3000 m) or greater by aircraft must plan to acclimate at an intermediate altitude for a minimum of 48 hours prior to the drop-off at a higher altitude. Anyone deploying directly to altitudes in excess of 12,200 ft (3750 m) must acclimatize for a minimum of 72 hours at 8,200-10,900 ft (2500-3300 m).

Because there is medical support available at

Amundsen-Scott South Pole Station (elevation: 9,200 ft /2800 m), no intermediate acclimatization stop is required for personnel traveling there by aircraft from a sea-level location. Short periods at altitude, no more than 8 hours, to high altitudes no greater than 13,125 ft (4000 m) do not require acclimatization.

Individuals who have experienced prior episodes of High Altitude Pulmonary Edema (HAPE) will not be allowed to ascend to altitudes in excess of 9,900 ft (3000 m) without approval by a competent medical authority. Individuals who have experienced a prior episode of High Altitude Cerebral Edema will not be allowed to ascend to altitudes in excess of 9,900 ft (3000 m).

23.1 Treatment and Training

McMurdo Station and Amundsen-Scott South Pole Station have physicians on duty who are familiar with and are equipped to treat altitude-related problems. Chemoprophylaxis (e.g., acetazolamide [Diamox]) for Acute Mountain Sickness is available from either clinic. Chemoprophylaxis (nifedipine) for HAPE may be made available to individuals who have suffered prior HAPE episodes and are seeking approval to ascend to a high-altitude site. South Pole has a portable hyperbaric chamber (a Gamow bag) to increase the effective atmospheric pressure for individuals suffering from altitude-related problems.

All field personnel deploying to field sites that are greater then 8,200 ft (2500 m) must attend a High-

Altitude Lecture from the Field Safety Training Program in McMurdo and be equipped with a Gamow bag. Gamow bags and bottled oxygen are issued by the BFC.

Selected References:

- Cymerman, A. and P.B. Rock. 1994. *Medical Problems in High Mountain Environments.* Technical Note #94-2. U.S. Army Research Institute of Environmental Medicine. Natick, MA

- Houston, C.C.. 1992 Mountain Sickness. *Scientific American,* Oct 1992.

- Hackett, P.H., R.C. Roach, and J.R. Sutton. 1989. *High Altitude Medicine in Management of Wilderness and Environmental Emergencies,* 2nd ed.. Edited by P.S. Auerbach and E.C. Geehr. C.V. Mosby Co., St. Louis, MO.

Chapter 24
Emergency Action Principles and First Aid

Use the Emergency Action Principles to get an accident situation under control quickly. These simple steps will help you take control of an emergency situation and treat immediate life-threatening problems in a safe, methodical manner. The objectives are to avoid injury to you while you are treating a life-threatening situation, to prevent further injury to the victim, and to get help on the way to the accident site if needed.

24.1 Emergency Action Principles

Survey the scene and determine if it is safe for you to work in.

Do a primary survey of the victim called the ABC's, D & E:

- **A**irway: Is it open? Minimize neck movement as much as possible; apply cervical collar if available.
- **B**reathing: Is the victim breathing? Look, listen, feel. Rescue breathing if necessary.
- **C**irculation: Is there a carotid pulse? Is there severe bleeding? CPR if necessary.

- **D**isability: Is there injury to the nervous and musculoskeletal systems? Stabilize “C”-spine.

- **E**xposure: Remove victim from offending environment. If necessary, place tent over victim.

Radio for medical advice: the medical personnel at each station will determine if a medivac is necessary. All serious medical problems in the field must be reported to the station medical personnel.

When you call the station for medical advice, be prepare to give a brief description of the injury or illness and how and when it happened. The doctor will also want the patient’s vital signs and any changes in them. As a reminder the vital signs are as follows:

- **Pulse rate:** In an emergency, the best places to find the pulse are the carotid artery in the neck, or the femoral artery in the groin. In hypothermia cases, you should check for a minimum of one minute. Use the first three fingers to feel the pulse. Never use the thumb, which has a strong pulse of its own that can be mistaken for the patient’s pulse.

  If a patient has a severely injured extremity, record the presence or absence of a pulse beyond (distal to) the injury, and after alignment or splinting.

- **Respiration rate:** (Normal respiration rate is 12-20 per minute.) Look, listen, and feel for weak respirations. A light hand on the chest can detect the rise and fall of breathing, and will keep you “in touch” with the patient.

In cases of High Altitude Pulmonary Edema (HAPE), those who are experienced in listening to lungs may hear “rales” (crackles) when pressing the ear tightly against the chest wall; a stethoscope isn’t necessary. They may be detected first by listening at the level of the right nipple, below the armpit. A cardboard toilet paper tube was used with success by a Field Safety Instructor to listen to and detect rales in a HAPE victim. Cheyne-Stokes respirations may occur during sleep; this is characterized by irregular breathing with pauses and gasps between breaths and are a sign that the body is not acclimated to the altitude, but it can also be a “normal” response to higher altitudes (approaching 10,000 feet pressure altitude).

- **Blood Pressure:** (Normal is pressure is about 120/80, however, 90/50 to 140/90 may be normal for some people.) If you do not have a blood pressure cuff and you can detect a radial pulse (the pulse on the thumb side of the wrist, taken on an uninjured arm), the patient must have a systolic pulse (highest point of the blood pressure curve) of at least 90.

- **Temperature:** (Normal body temperature is around 98.6° F (37.0°C).) Body temperature usually is taken by placing the bulb of an oral thermometer under the tongue and leaving it in place, with the lips closed around it, for three minutes. A reading of 101.5° F or above signifies a fever and a reading below 95° F indicates hypothermia.

Rectal temperatures are preferred for hypothermic or unconscious victims, but are difficult to obtain. Taking a rectal temperature requires a rectal thermometer, which are lower reading thermometers. The bulb of a rectal thermometer is shorter, wider, and rounder, and frequently, the top end of a rectal thermometer is flat.

- **Level of consciousness:** A patient with a normal level of consciousness is alert, oriented, talks coherently to the examiner, and can easily answer questions about identity, location, day, and time of day (although time of day is difficult for any of us working in Antarctica). Report any abnormal findings in mental status, verbal, and motor responses.

Important Note: The doctor may ask you for additional information regarding the victim's condition. Following are five common signs that you may be asked to provide information on:

1) **Skin temperature, moisture, and color:** Examination of the skin furnishes important clues regarding oxygenation, general body stress, and the status of circulation to the skin. However, in dark-skinned people, skin pigment may mask color changes, and examination of the whites of the eyes or the nailbeds may be more reliable. Red skin can be a sign of high altitude problems or advanced carbon monoxide poisoning. Hypothermia may produce pale or bluish, cold, dry skin. Bluish skin (cyanosis) is a sign of inadequate oxygen in the blood. An illness or injury that stimulates a stress response from the sympathetic nervous system leading to increased heart rate and increased sweating is indicated by pale, clammy, cold skin.

2) **Capillary refill:** Using the thumb and forefinger, squeeze a finger or tip of toe until the nail blanches, then release the pressure. The tissue under the nail should return to their normal pink color within two seconds.

3) **Reaction of the pupils:** The pupils are normally round and equal to each other in diameter. Unequal pupils (one pupil normal while the other is dilated) frequently indicates a serious injury involving the brain on the same side as the dilated pupil. However, it is normal for some individuals, so if you see it in a victim ask them if this is normal. The pupils are the “windows to the brain.” Patients who are in cardiac arrest generally have dilated pupils that do not constrict in response to bright light. The pupillary response to light is also lost after death.

4) **Reaction to pain:** Pinching the victim’s skin and asking “can you feel this?’’ should invoke a response of some sort. Inability to feel pain usually means damage to the nerve pathways.

5) **Ability to move:** To test for impaired movement, ask the patient to move his or her fingers and toes and to squeeze your hands. A conscious patient who is unable to comply is said to be "paralyzed." The paralysis can involve a single extremity, one side of the body, or both sides of the body. Record exactly what the patient can or cannot do, and relay that information over the radio. Paralysis can be caused by severe injury without nerve damage if motion is so painful that the patient refuses to try to move.

Do a secondary survey of the victim: Interview the victim and /or companions, and conduct a thorough head-to-toe exam. Record the victim's vital signs at regular intervals, with the date and time of each entry. If the patient is about to be transported, affix a piece of tape on the patient's forehead with the most recent vital signs, date, and time recorded with an indelible marker.

24.2 Frostbite

Frostbite is the freezing of body tissue. Frostnip of your nose, cheeks and ears can be prevented by using the buddy system. Watch your partners and tell them if you see blanched, frozen skin on their faces. When red cheeks and noses become white, cover up! Just by turning one's face out of the wind and covering up the affected skin, you can often cure the problem. If your extremities are cold enough to freeze, you might be getting hypothermic, which is life threatening. Polypropylene glove liners work wonders for protecting fingers from cold metal instruments, cameras, etc.

The hands, feet, ears, cheeks, and nose are all located far from the heart at the periphery of the body and are subject to rapid heat loss because of their large surface-area-to-volume ratio and their exposed positions. Other factors that contribute to frostbite include inadequate insulation, wet clothing, fatigue, poor nutrition, alcohol, tobacco, restricted peripheral circulation (because of tight clothing or equipment), and contact with metal or hydrocarbon liquids such as gasoline.

Frostbite often develops during periods of severe environmental stress when facilities for proper emergency care are nonexistent, and the party's main concern is to escape alive.

Superficial Frostbite: Superficial frostbite, often called frostnip, feels like a mild tingling or pain followed by numbness. Inspection reveals a gray or yellowish patch of skin, usually on the nose, ear, cheek, finger, or toe. The tissues beneath the area remain soft and pliable. This type of frostbite is common with most people that have worked in Antarctica.

Treatment of Superficial Frostbite: Apply direct body heat, e.g., by placing a warm hand on a frozen cheek, nose, earlobe, or holding a frozen finger in an armpit, feet on a warm stomach. The first-aider should consider why frostbite occurred; the patient should add clothing and seek shelter.

Deep Frostbite: Deep frostbite is a full- or partial-thickness freezing of a body part that mainly affects the hands and feet. It should be suspected if a painfully cold part suddenly stops hurting when the part obviously is not getting warmer. The affected part is cold, solid and wooden with pale, waxy skin; it resembles a piece of chicken just removed from the freezer.

Experience has shown that the amount of permanent tissue damage depends on both how low the temperature is and how long the body part is frozen; rapid rewarming causes less damage that slow rewarming.

Treatment of Deep Frostbite: The proper emergency care for deep frostbite is rapid rewarming in a water bath with the water temperature carefully controlled between 102°and 108°F (39° to 42°C). Cooler water rewarms too slowly; warmer water may burn the tissues. Rewarming should be done only in a shelter where the patient's entire body can be kept warm. The rescuer will need a high-registering thermometer and a vessel large enough so that the extremity can be immersed without touching the sides of the vessel. A 20-quart pot is the minimum size needed for rewarming a foot. As a rule, rewarming continues for 20 to 30 minutes or until the frozen areas turn a deep red or bluish color and the color change has progressed distally as far as it will go. As the water bath cools, remove the extremity, add hot water, stir, and retest the water temperature before reimmersing the extremity. Rewarming usually causes severe pain.

While the frozen part is being rewarmed, maintain the patient's morale with hot drinks and apply heat to non-frozen body parts to open up circulation to the frozen area. Be aware that the victim will experience some discomfort during the rewarming process, pain medications may be warranted. Protect a thawed limb against refreezing, infection, and trauma by applying thick layers of sterile dressings held in place by a loosely applied, self-adhering roller bandage. Leave blisters unopened, separate digits with soft cotton or wool pads, and elevate the part to reduce swelling.

Exercise judgment in deciding whether to rewarm a frozen extremity in the field. Do not attempt rewarming if there is any chance that the extremity may refreeze. Field rewarming is indicated if there is a good chance that the part will thaw spontaneously during evacuation. However, if the patient cannot be kept warm or cannot be carried out, it is permissible to let the patient walk or ski out on a frozen foot. Care must be taken to keep the foot frozen until it can be rapidly rewarmed under suitable conditions. This has been shown to cause less permanent damage than allowing the part to slowly thaw during transport.

Patients frequently become aware of a frozen part because of the pain that accompanies thawing. Depending on the size and isolation of the party, there may be no alternative to self-evacuation on the thawed foot. If that is the case, refreezing should be prevented at all costs because it often leads to gangrene.

24.3 Hypothermia

Hypothermia is the lowering of the body core temperature and can occur from a number of different types of situations. On the Peninsula, personnel must be aware that hypothermia can result from exposure to cold rain and high wind, and from falling into cold water. In other field locations where rain is not an issue, hypothermia is still a threat because it is simply a lowering of the core temperature. When it drops and the downward trend is not stopped, the patient will eventually die. Prevention is the key. Proper layering of clothing, adequate food, and sufficient hydration are key elements in avoiding hypothermia.

It is critical to recognize the signs and symptoms of mild hypothermia, so as to stop its progression to profound (severe) hypothermia. If the body-core temperature drops, the body will sacrifice the arms and legs to keep warm blood around the vital organs: brain, heart, lungs, kidneys, and liver. That is called shunting. The warm blood is decreased to the limbs. It is difficult to recognize in oneself. If you are having a hard time working your hands (such as difficulty tying your boot laces), your body core is cooling down. Most hypothermic victims deny that they are having trouble. You must take action.

Signs and Symptoms of Hypothermia

- Difficulty working hands
- Shivering
- Stumbling
- Bumbling
- Withdrawn and grumpy attitude
- Denial

Treatment of Hypothermia: The first priority is to prevent further heat loss by getting the patient out of the wind (and snow, and water) and into a tent or other shelter. The patient should be given dry clothing and put into a sleeping bag, if available. If a sleeping bag is unavailable, put spare clothing under and over the patient and cover the patient's head. Avoid unnecessary handling and do not allow the patient to sit, stand, or walk until he or she is rewarmed. It may be better to cut off wet clothing than to undress the patient; if no dry clothing is available, wrap the patient in a tarp, space blanket, plastic sheeting, or similar material to reduce evaporative cooling. It is more effective to "package" the victim in a "hypothermia wrap" than to lay with the victim in two bags zipped together.

> **Hypothermia wrap:** Remove damp clothing from victim. Dress victim in dry synthetic underwear, balaclava, neck gaiter. Wrap victim in a vapor barrier such as a space blanket, plastic tarp, etc. Place victim in sleeping bag. The more bags the better. Place hot water bottles (wrapped in a sock to avoid burns) on victim's trunk, armpits, groin area. Insulate the head and neck with extra sweaters, jackets, etc. Place another vapor barrier around the outside of the sleeping bags.

Further emergency care depends on the patient's measured or estimated core temperature. If a thermometer is unavailable, the patient can be considered to have a core temperature above 90° F (32° C) if he or she is still shivering and capable of appropriate actions such as zipping an open parka and picking up a dropped mitten. The core temperature is very likely below 90° F if the patient is no longer shivering and especially if he or she has become stuporous or comatose.

Mild Hypothermia: A hypothermic patient whose rectal temperature is 90°F (32°C) or above can be rewarmed by any means available; these means will be limited under field conditions.

Profound Hypothermia: The mortality rate outside a hospital is high for patients who have a rectal temperature below 90° F (32°C). In-hospital survival is better because medical personnel can discover, monitor and rapidly treat metabolic and electrolyte problems, and rewarm the patient under controlled conditions. This is bad news for the remote Antarctic victim, where hospital rewarming is potentially days (or weeks) away.

Patients with profound hypothermia may appear to be dead because their pulses and respirations are so difficult to detect. Spend a minute or longer attempting to detect both vital signs before concluding that they are absent. The motto "No one is dead until warm and dead" emphasizes that all patients with hypothermia deserve an attempt at rewarming.

Summary care for unconscious victim immersion or Submersion Hypothermia:

- If someone falls overboard, immediately call the station for help as you maneuver the boat for the pickup.

- Survey the scene—don't become a victim yourself.

- Horizontally lift victim from the water gently if it can be done without delaying the rescue.

- ABC's:

  Airway: Is it open? head-tilt/chin lift; use jaw thrust if cervical spine injury is indicated.

Breathing? Is the victim breathing? Look, listen, feel. Rescue breathing if necessary.

Circulation? Is there a carotid pulse? Is there severe bleeding? If no circulation then:

- Start CPR if the victim has been in water for less than one hour or the time is unknown, assume the victim is alive.

- Package the victim in a HYPOTHERMIA WRAP as described above for transport.

- Do not give up!

24.4 Carbon Monoxide Poisoning

Carbon monoxide poisoning is fairly common. It can be a significant hazard in the Antarctic environment, particularly when stoves are used in poorly ventilated shelters such as tents, snow caves, and igloos. Many polar explorers have been killed or narrowly escaped death from carbon monoxide poisoning caused by operating stoves in tightly closed areas.

Carbon monoxide is a colorless, odorless gas that is produced by incomplete combustion of carbon-containing substances. Dangerously high levels of carbon monoxide can form whenever fuel is burned in a poorly ventilated space. When inhaled, carbon monoxide combines with the hemoglobin in red blood cells and renders the cells incapable of carrying oxygen. Even a very low concentration of carbon monoxide (0.06%) is enough to block one half of all hemoglobin available to transport oxygen. Carbon monoxide also combines with cellular enzymes and causes tissue damage, particularly in the heart and brain.

The signs and symptoms depend on the amount of carbon monoxide the patient has inhaled. In mild cases, the patient may complain of dizziness, headache, and confusion. Fatigue, numbness, chest pains, heart palpitations, and visual disturbances may also be present. Severe cases may manifest as a deep coma. Many experts feel that some effects attributed to acute mountain sickness may, in fact, be caused by carbon monoxide. Carbon monoxide poisoning is also frequently misdiagnosed as migraine, stroke, alcohol intoxication, heart disease, food poisoning, and psychiatric illness. Recognizing this insidious condition may be difficult when all members of the party are affected.

Carbon monoxide is eliminated from the body very slowly under normal conditions, and it continues to cause tissue damage as long as it is present. Victims of carbon monoxide poisoning may suffer neurological complications a few days to three weeks after exposure, and as late as two years after apparent complete recovery. These complications include memory impairment and personality change, and they may be permanent. Carbon monoxide poisoning should be taken very seriously.

Treatment of Carbon Monoxide Poisoning: Victims should be immediately removed from the contaminated area. To hasten the elimination of carbon monoxide, all victims should be provided with 100% oxygen, no matter how slight or apparently inconsequential their symptoms. The oxygen should be administered via a securely sealing mask and a demand valve. (Other methods of administration, such as nasal cannula, do not deliver 100% oxygen.) Severely affected patients may require rescue breathing (with oxygen) and should be evacuated to an appropriate medical facility.

McMurdo: Patients in the McMurdo area should be taken immediately to the McMurdo Hyperbaric Chamber (at the McMurdo Medical Facility) for evaluation and treatment. Hyperbaric oxygen treatment greatly increases the rate of carbon monoxide elimination and speeds recovery. Further, the late term neurological complications described above have not been reported in people treated with hyperbaric oxygen.

Peninsula: Patients in the Peninsula area (or other areas without hyperbaric chamber availability) should be administered oxygen for a minimum of four hours, or, if oxygen supplies are limited, for as long as possible. Eight hours of 100% oxygen will eliminate almost all carbon monoxide from the body.

24.5 Quick Patient Packaging and Emergency Moves

Because of the extreme cold of the Antarctic environment, injured patients must be assessed and packaged very quickly. A fractured cervical spine, for example, will predispose a victim to a quick case of hypothermia which will complicate what is already a possible life-threatening injury.

If there is no time to immobilize injuries before moving a patient, the spine and other injured areas should be protected as much as possible by using a multi-rescuer lift and transfer, or by pulling the patient in the direction of the long axis of the body, so that the back, neck, or an injured extremity undergo minimal twisting. See figure 24-1.

Note: Participants in Field Safety Training scenario drills are always surprised how difficult it is to transport an “injured actor” a mere 150 feet on solid snow to a shelter without aggravating a spine injury.

Put Shelter Over the Patient: You may choose to provide care and shelter for the patient right at the scene of the accident. A Scott tent can be placed over the patient, or the floor of a mountain tent can be sliced open with a knife, and the tent positioned over the patient. This provides very quick relief from the wind. With the help of others, the patient can be lifted or rolled onto insulation, and packaged with a “hypothermia wrap” (see Section 24.3). Remember, the main danger of moving, lifting, or rolling a patient is aggravating a spine injury.

Improvised backboards and stretchers might include sleds, skis, backpack frames, blankets with poles, climbing rope, pieces of wood or plywood.

Improvised splints might include ice axes, bamboo poles, skis, ski poles, pieces of wood, stiff foam mats or Crazy Creek chairs, uninjured portions of the patient’s own body (e.g. leg tied to leg).

Figure 24-1: Immobilized patient.

C-Collar: Suspected spinal cord injuries require manually stabilizing the patient’s head and neck with slight traction, and then applying a rigid extrication collar (c-collar). If a c-collar is not available, improvise with several layers of ensolite or blue foam, cut to fit and strapped in place around the patient’s neck. A rolled-up blanket wrapped around the head in a “U” shape and secured with tape to a backboard will also work as a make-shift collar that provides support and insulation.

Logrolling a Patient: Logrolling a patient is a technique used to roll a face-down patient into the supine (face-up) position; and it is used to roll a patient onto his/her side so that a backboard, insulation, or hypothermia wrap can be placed underneath the patient. It is performed in a way that avoids producing motion at the site of injury.

- One person must manually stabilize the head/neck with slight traction, while the other rescuers position themselves along side the victim. Apply c-collar.

- Tie the patient's legs together with a cravat (or webbing, cord, etc.). The person at the head should continue to hold slight traction and with the thumbs on the back of the head behind the patient's ears, the index fingers on the jaw angles, and the remaining fingers along the jaw and cheeks. Three other rescuers should kneel in a row on the side to which the patient will be rolled.

- The patient's arms are placed along the side of and next to the patient's body with the palms against the elbows locked to "splint" the spine.

- The second rescuer, who is kneeling beside the patient's shoulders, holds the patient's arms tightly against the body by placing one hand on the patient's opposite shoulder and the other hand on the opposite forearm. The third rescuer kneels besides the patient's buttocks, with one hand on the iliac crest and the other hand on the mid thigh. The fourth rescuer kneels beside the patient's knees, with one hand on the opposite knee and the other hand on the opposite leg just below the calf.

- The first rescuer (at the head) is in charge and gives the signal for the other three rescuers to

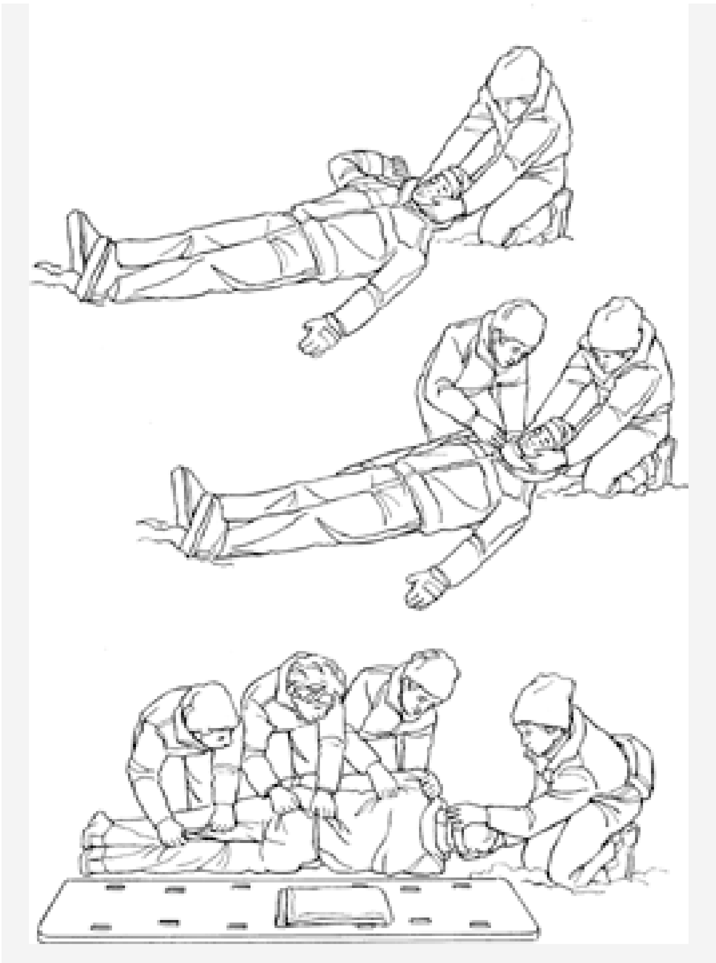

Figure 24-2: Logrolling a patient.

roll the patient slowly towards themselves, avoiding any twisting or bending of the neck. The third rescuer (at the buttocks) can then reach across the patient and pull the backboard, pad, hypothermia wrap, etc. up tight and under the patient.

- Upon the first rescuer's command (at the head), the patient is slowly lowered ("rolled") back down on the backboard, pad, etc. (See figures 24-2 and 24-3.)

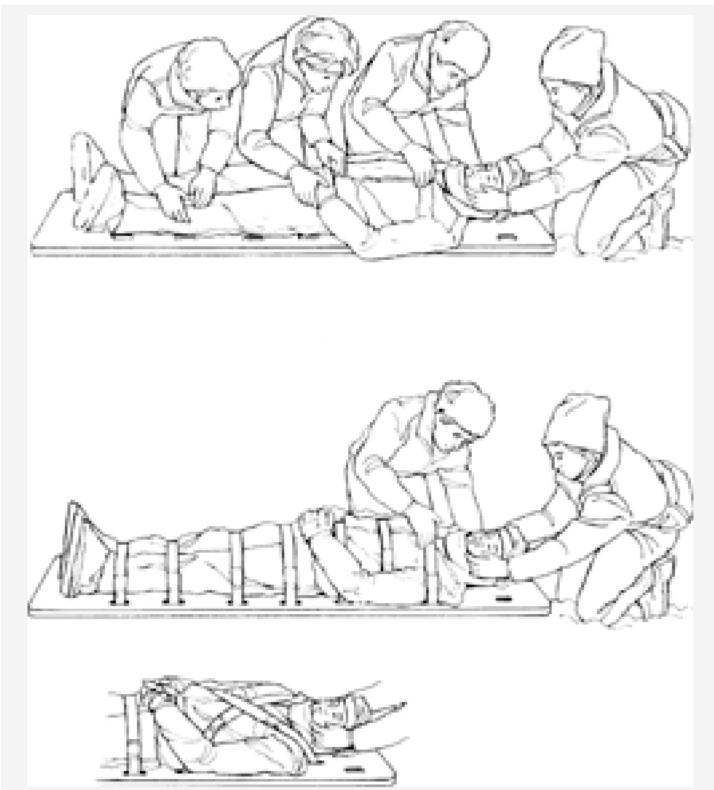

Figure 24-3: Immobilizing a patient.

One Rescuer Moves for Possible Spinal Injury: Roll the patient into the face up position. This is difficult for a single rescuer because the patient must be rolled without twisting the neck or back. The patient can be pulled by the feet and dragged feet first, or pulled by the clothing by gabbing the patient under the armpits or by grabbing handfuls of clothing behind the shoulder blades and cradling the patient's head and neck in your forearms dragging the patient head first.

It is preferable to pull the patient on a tarp or space blanket. The tarp can be place under the patient by first pleating or tightly rolling it lengthwise, leaving one-third flat. Place the rolled side of the tarp alongside the patient and push it under the patient's body; pull the tarp from the opposite side so that it unrolls under the patient.

Appendix A
Field Planning Aid

Equipment Weight and Cubic Feet

Tents:	**Wt/lbs**	**CU**
Endurance tent, 8’x16’	65	20
Endurance tent, 8’x21’	75	25
Polar tent: 2-3 person with lines and poles	80	15
Bag of 18 stakes	20	2
Mountaineering tents: NF VE-25, Sierra Designs-Stretch Dome, and Sphere Expedition 3-person with poles and fly	10	2

Two-Person Kitchen Box: 52 lbs, 2 CU

1	Each	Basin, washtub
1	Each	Bottle/can opener
2	Each	Bowls with handles
1	Each	Can opener, handheld
20	Each	Clothes pin
1	Each	Coffee pot, stainless
1	Each	Cookset; 5 qt & 4 qt, w/lids
1	Each	Corkscrew
1	Each	Cutting board
1	Bottle	Dish soap
8	Each	Dish towels
1	Roll	Foil

4	Each	Forks
1	Each	Frying pan, teflon
2	Each	Hand soap
1	Packet	Handi-wipes
1	Each	Knife, cook’s
2	Each	Knife, steak
1	Each	Knife sharpening stone
1	Each	Ladle
1	Each	Mirror
2	Each	Mixing bowls/Tupperware, w/lid
2	Each	Mug, thermo-insulated, w/lid
1	Each	Pie pan
3	Each	Plate, hard plastic
2	Each	Pot holders
2	Each	Pot scrubbers
1	Each	Pressure cooker, 4 qt, w/instructions
1	Each	Rubber scraper
1	Each	Snow melting pot, 10-quart
1	Each	Spatula
2	Each	Sponge w/scrubber
1	Each	Serving spoon, large
1	Each	Serving spoon, perforated
1	Each	Strainer
3	Each	Tablespoon
1	Each	Toaster, stove top

Four-Person Kitchen Box: 65 lbs, 2 CU

1	Each	Basin, washtub
1	Each	Bottle/can opener
8	Each	Bowls, with handles
1	Each	Can opener, handheld
20	Each	Clothes pin

1	Each	Coffee pot, stainless
1	Each	Cookset: 5 qt, 4 qt, 2 qt, with lids
1	Each	Corkscrew
1	Each	Cutting board
1	Bottle	Dish soap
8	Each	Dish towels
1	Roll	Foil
6	Each	Forks
1	Each	Frying pan, teflon
1	Each	Hand soap
1	Packet	Handi-wipes
1	Each	Knife, cook’s
2	Each	Knife, steak
1	Each	Knife sharpening stone
1	Each	Ladle
1	Each	Mirror
4	Each	Mixing bowl, Tupperware, w/lid
4	Each	Mug, thermo-insulated, w/lid
1	Each	Pie pan
6	Each	Plates, hard plastic
2	Each	Pot holder
2	Each	Pot scrubber
1	Each	Pressure cooker, 4 qt, w/instructions
1	Each	Rubber Ssraper
1	Each	Snow melting pot, 10 qt
1	Each	Spatula
2	Each	Sponge w/scrubber
1	Each	Serving spoon, large
1	Each	Serving spoon, perforated
1	Each	Strainer
6	Each	Tablespoon
8	Each	Teaspoons
1	Each	Toaster, Stove Top

Basic Tool Kit: 18 lbs, 1 CU

1	Set	Allen Key, Standard
1	Each	Channel Lock
1	Each	Crescent Wrench: 4", 8", 12"
4	Each	Emery Paper: 2 Coarse, & 2 Fine
1	Each	File: Flat & Round
1	Each	Hacksaw with 3 Replacement Blades
1	Each	Hammer, Claw
1	Set	Jeweler's Screw Driver Set
4	Each	Pliers: 1 Diagonal Cutter, 1 Needle Nose, Slip Joint and Vice Grips
1	Each	Razor Knife
1	Each	Scissors
5	Each	Screw Driver Sets: 2 Phillips Head, & 3 Slot Heads
1	Each	Tape Measure
1	Roll	Wire: 16 Gauge
1	Each	Wonder Bars

Stoves:	**Wt/lbs**	**CU**
Coleman: White Gas, 2-Burner	7	2
Coleman: Propane, 2-Burner	7	2
Optimus 111	2	.25
MSR WhisperLite	1	.25
MSR XGK	1.5	.25
Petroleum Naptha (White Gas) (1 gallon can)	7	1
Propane: Disposable Cartridge (4.24 lb./gallon)	2	1
25 lb. Cylinder	41	4
100 lb. Cylinder	196	5

200 lb. Cylinder	367	13
Fire Extinguishers, Ansul (2.5 lbs)	5	1

Communications:	**Wt/lbs**	**CU**
Transworld PRC 1099	25	2
Saber and MX300 Motorola, Hand-Held	3	.25

Ice Drilling Tools:	**Wt/lbs**	**CU**
Kovacs Auger, Bit & 1 Extension	3	1
Each Additional Extension	2	1
Sipre Ice Auger Kit: 4-1/2" OD for 3' Core, 5 Ext. for 6-m Drilling Depth	90	4
Sipre Ice Auger Extension Set (21 each - 1-m Ext.)	80	5
Motor for Auger, 3/4" Drill for Sipre Auger (8.5A - 110V)	1	2
Cobra Drill	63	10
PICO Ice Core Kits, 20m	90	5
PICO Ice Core Kits, 50m	208	15
Chisel Bar, 48" Long	7	1

Transportation:	**Wt/lbs**	**CU**
Komatik Sled	350	12
Nansen Sled	100	40
Nansen Sled Cargo Tank	30	10
Maudheim Sled	650	100
Siglin Sled	60	4

Jerry Can (metal), 5 Gal w/Mogas	50	3
Jerry Can (metal), 5 Gal w/JP-8	53	3
Skidoo Oil, Case Lot (12 Qts/Case)	25	1
55-gallon drum (empty)	70	12
55-gallon drum (JP8)	425	12
55-gallon drum (Mogas)	375	12
55-gallon drum (antifreeze)	500	12
Flomax pump	45	4

Field Camp Construction Materials:	**Wt/lbs**	**CU**
Jamesway Boxes:		
• Intermediate section	340	32
• End section	420	32
• Empty box	150	32
Polarhaven shelter 8’ x 12’ with insulated floor	1450	96
Polarhaven shelter 12’ x 16’ with insulated floor	1650	96
Galley Plumbing Kit	350	48
Preway Kit w- flue	200	64
Lumber:		
• 1/2” plywood	50	2
• 5/8” plywood	60	2.5
• 3/4” plywood	70	3
• 2” x 4” x 8’	8	.5
• 2” x 6” x 8’	12	.75
• 4” x 4” x 8’	17	1

Mechanical Equipment Center:	**Wt/lbs**	**CU**
Pickup Truck	8600	600
Van	8600	950

Elan Snowmobile	290	85
Cheyenne Snowmobile	465	114
Alpine I	650	115
Alpine II	770	175
Skandic	570	138
Tundra II	377	138
Tucker Sno-Cat (4 cyl.)	11800	900
Tucker Sno-Cat (6 cyl.)	13300	900
Spryte	6500	780
Loader,CAT 931	19260	750
5-Ton Sled	8560	350
ASV Trailer	2000	350
.65Kw Generator	1100	16
20.0Kw Generator	1400	22
30.0Kw Generator	1764	25
40.0Kw Generator	1810	25
Jiffy (ice auger)	25	1.5
Bit 4”	10	2
Bit 10”	10	2
Extension 4”	10	2
Extension 10”	10	2
Chainsaw	25	3
Herman Nelson	272	20
Hole Melter	450	18
(Hotsy)	305	18
Hand Winch	30	5
Jackhammer	75	7
Dive Compressor	250	20
12v Battery	7	2
Battery, CAT 4-D	19	6
30wt Solar Panel	2	.5
250wt Inverter	1	.5
Battery Charger	5	1
Jumper Cables	5	.5

Snowmobile Tool Kit: 7 lbs, 1 CU

1	Set	Allen Key, Metric
1	Each	Carburetor Repair Kit, Mikuni
1	Each	Electrical Contact File
1	Each	Feeler Gauge
1	Each	Extension Bar For Socket Set: 10.5"
1	Bottle	Locktite
1	Each	Magnetic Screwdriver Set
1	Each	Reversible Rachet
4	Each	Sockets, Metric: 10mm, 12mm, 13mm, 14mm, 15mm, 16mm, 17mm
3	Each	Sockets, Standard: 1/2", 7/16", 9/16", 3/8"
1	Each	Spark Plug Wrench
1	Each	Universal Joint for Socket Set
4	Each	Wrenches, Metric: 10mm, 12mm, 13mm, 14mm, 15mm, 16mm, 17mm
3	Each	Wrenches, Standard: 1/2", 7/16", 9/16"

Hazardous Cargo Examples

Hazardous Goods:

Automotive:
• (Lead/Acid) Batteries
Bleach
Catalytic Heaters
Compressed Gases
Explosives
Fire Extinguishers
Flares, Roadside

Hazardous Chemicals:

Acetone
Benzene
Carbon ice (Dry Ice)
Chloroform
Ethanol
Ether
Formaldehyde, 37%
Formalin, 10%

Gel Cell Batteries
Generators
Herman Nelson Heaters
Jiffy Powerhead
JP-8 Fuel
Matches
Kerosene
Lithium Batteries
Meta-paste
Mogas (Gasoline)
Propane
Propane Torch Kit
Scuba Tanks
Snowmobiles
Stoves:
- Coleman 2-Burner
- Coleman Propane
- MSR WhisperLite & XKG
- Optimus 111

WD-40
White Gas

Glutaraldehyde
Hydrochloric Acid
Isopropyl Alcohol
Methyl Alcohol
Methyl Ethyl Ketone
Nitric Acid
Perchloric Acid, 60-62%
Radioactives
Sulfuric Acid

Appendix B
Emergency Cache and Hut Locations

McMurdo Area
Survival Huts and Caches

Name	Latitude	Longitude
Bratina Island Hut	78.01'S	165.32'E
Cape Bird Hut	77.14'S	166.28'E
Cape Crozier Hut	77.27'S	169.11'E
Cape Evans Hut	77.38'S	166.25'E
Cape Roberts Hut	77.02'S	163.12'E
Cape Royds Hut	77.33'S	166.10'E
F6 Hut	77.36'S	163.14'E
Lake Bonney Cache	77.43'S	162.29'E
Lake Fryxell Hut	77.37'S	163.03'E
Lake Hoare Hut	77.38'S	162.54'E
Lake Vida Cache	77.20'S	162.00'E
Lower Wright Hut	77.26'S	162.37'E
Lake Vanda Hut	77.31'S	161.40'E
Marble Point	77.25'S	163.40'E
Mt. Erebus Hut	77.30'S	167.10'E
New Harbor Hut	77.36'S	163.31'E

Peninsula Area Island Caches

The following islands have survival caches and marked tie up points. The latitude and longitudes listed are GPS waypoints for the primary tie up points.

Name	**Latitude**	**Longitude**
Torgersen	64 46.270’S	064 04.465’W
Litchfield	64 46.273’S	064 05.027’W
Humble	64 45.954’S	064 04.951’W
Janus	64 46.926’S	064 05.995’W
Shortcut	64 46.994’S	064 02.490’W
Hermit	64 47.908’S	064 00.995’W
Stepping Stones	64 47.022’S	063 59.443’W
Outcast	64 48.278’S	064 08.006’W
Halfway	64 44.549’S	064 10.589’W
Dream	64 43.477’S	064 13.982’W

Note: Tie up point locations are marked with painted orange or red dots and the caches are marked with a bamboo flag. The cache barrels are blue.

Appendix C
Conversion Tables

Temperature Conversions

- A Fahrenheit degree is smaller than a Celsius (centigrade) degree.
- One Fahrenheit degree is 5/9ths of a Celsius degree.
- To convert Fahrenheit to Celsius: °F - 32 x 5 ÷ 9
- To convert Celsius to Fahrenheit:°C x 9 ÷ 5 + 32
- The freezing point of water is 32°F or 0°C.
- The boiling point of water is 212°F or 100°C.

Metric Equivalents

Linear Measurements - To Convert, Multiply By:

Centimeters to Inches	0.3937
Inches to Centimeters	2.540
Meters to Feet	3.281
Feet to Meters	0.3048
Meters to Yards	1.094
Yards to Meters	0.9144

Kilometers to Miles	0.6214
Miles to Kilometers	1.609
Meters to Fathoms	3.2808
Fathoms to Meters	1.8288

Square Measurements - To Convert, Multiply By:

1 square centimeter to 1 square inch	0.1550
1 square inch to 1 square centimeter	6.452
1 square meter to 1 square foot	10.76
1 square foot to 1 square meter	0.0929
1 square meter to 1 square yard	1.196
1 square yard to 1 square meter	0.835
1 square kilometer to 1 square mile	0.3861
1 square mile to 1 square kilometer	2.590

Measures of Volume - To Convert, Multiply By:

Grams to Ounces	0.03527
Ounce to Grams	28.35
Grams to Pounds	0.002205
Pounds to Grams	453.6
Kilograms to Pounds	2.205
Pounds to Kilograms	0.4536
Kilograms to Tons	0.0009852
Tons to Kilograms	1016.0
Pints to Liters	0.5682
Liters to Gallons	0.22
Gallons to Liters	4.546

Distances

1 Knot = 1 Nautical Mile per hour
1 Nautical Mile = 1853.2 Meters = 1.15 Statute Miles
1 Statute Mile = 1609.3 Meters = 0.868 Nautical Miles
1 Kilometer (1000 meters) = 0.621 Statute mile = 0.54 Nautical Mile

Liquid Volumes

1 U.S. Gallon = 0.83 Imperial Gallon = 3.785 Liters
1 Imperial Gallon = 1.2 U.S. Gallon = 4.545 Liters
1 Liter = 0.246 U.S. Gallon = 0.219 Imperial Gallon

Appendix D
First Aid and Survival Kits

First Aid Kit: Comprehensive

Medical Information		
1	Each	Book: *A Comprehensive Guide to Wilderness & Travel Medicine*
1	Each	Book: *Illustrated Guide to Life-Threatening Emergencies*
Essential Equipment		
1	Each	SAM splint
1	Each	CPR Barrier Microshield
1	Each	EMT shears
1	Each	Thermometer (96ºF - 107ºF)
1	Each	Thermometer (86ºF - 100ºF)
1	Each	Duct tape
1	Each	Splinter Picker forceps
1	Each	Scalpel #11 blade, sterile
1	Each	Sawyer® Extractor
1	Each	Dental Filling Kit
Wound Management Items		
4	Each	Double Antibiotic ointment
6	Each	Antiseptic towelettes
3	Each	Tincture of Benzoin
1	Each	20cc Irrigation syringe
2	Pair	Latex surgical gloves
2	Bottle	Povidone iodine solution (1 oz.)
10	Each	Wound closure strips
1	Each	Surgical scrub brush

Blister Items

2	Each	Moleskin
2	Each	Spenco 2nd Skin®
1	Each	Non-woven adhesive knit
1	Each	Molefoam

Infectious Control Items

6	Pair	Nitrile examination gloves
3	Each	Antimicrobial hand wipes
1	Each	Infectious control bag

Bandage Materials

16	Each	4x4 or 3x3 or 2x2 sterile dressing
4	Each	Non-adherent sterile dressing
1	Each	Adhesive tape, 10 yards (1/2” or 1”)
20	Each	Strip & knuckle bandages
2	Each	Trauma pads, 8x10 and/or 5x9
2	Each	Conforming gauze bandage (2” or 3")
4	Each	Cotton tipped applicators
1	Each	Elastic bandage with Velcro® (2” or 3")
2	Each	Triangular bandage
2	Each	Stockinette bandage
2	Each	Eye pad

Medications

10	Each	Extra Strength Tylenol®
6	Each	Antihistamine
10	Each	Motrin®
3	Each	Sting relief pads
1	Each	Aloe Vera gel, 100%
2	Each	Oral rehydration salts
6	Each	Diamode (Immodium®)
1	Each	Glutose paste
10	Each	Dristan® Cold & Flu formula
8	Each	Mylanta®
3	Each	Cortisone cream, 1%
3	Each	Tinactin® antifungal cream

Other Items

3	Each	Safety pins
3	Each	Accident report & pencil
4	Each	Pill vials
1	Pack	Waterproof matches

First Aid Kit: Personal

Medical Information		
1	Each	Book: *A Comprehensive Guide to Wilderness & Travel Medicine*
1	Each	Book: *Illustrated Guide to Life-Threatening Emergencies*
Essential Equipment		
1	Each	EMT shears
1	Each	CPR Barrier Lifemask®
1	Each	Splinter Picker forceps
Wound Management Items		
2	Each	Double Antibiotic ointment
3	Each	Antiseptic towelettes
1	Each	Tincture of Benzoin
2	Each	Butterfly closure strips
Blister Items		
1	Each	Moleskin (7x4)
Infectious Control Items		
2	Pair	Nitrile examination gloves
1	Each	Antimicrobial hand wipes
1	Each	Infectious control bag
Bandage Materials		
6	Each	4x4 or 3x3 or 2x2 sterile dressing
2	Each	Non-adherent sterile dressing (3x4)
1	Each	Adhesive tape, 10 yards (1/2” or 1”)
7	Each	Strip & knuckle bandages
2	Each	Cotton tipped applicators

Medications

4	Each	Extra Strength Tylenol®
2	Each	Antihistamine
4	Each	Motrin®

Other Items

3	Each	Safety pins

One Person Survival Bag: Local

(Supports 1 person for 3 days)

1	Each	Down sleeping bag		
1	Each	Bivy bag		
1	Each	Ensolite Pad, 24’x48”		
1	Each	Mountain tent w/instructions & repair kit		
	Tent stake bag contains:			
	10	Each	Tent stakes	
	6	Each	Ice screws	
	2	Each	Snow flukes	
	1	Each	Rock hammer	
1	Each	Collapsible snow shovel		
1	Each	First aid kit		
1	Each	Bottle of white gas (650/975 ml)		
1	Each	MSR stove w/repair kit & matches		
1	Each	Cookset w/2 pots and 2 lids		
1	Each	Plastic mug		
1	Each	Spoon		
1	Each	Pocket knife		
1	Each	Signal mirror		
1	Each	Survival manual		
1	Each	Novelty item, book, or game		
1	Each	Toilet paper roll		

1	Each	Parachute cord (50’)
1	Pair	Wool socks
1	Pair	Wool mits/gloves
1	Each	Balaclava

Food

3	Each	Dehyd. Meals
1	Each	Big chocolate bar
6	Each	Tea bags
6	Each	Hot Chocolate
1	Pack	Mainstay food bars (9)

One Person Survival Bag: Deep Field

This survival bag is intended for use by an individual traveling away from an established camp on a daily basis. The fuel bottle is empty in the survival bag, and will need to be filled in the field; it cannot be flown full into the field by an LC-130. Otherwise all the contents are the same as in the Local One Person Survival Bag.

Two Person Survival Bag: Local

(Supports 2 people for 3 days)

2	Each	Sleeping Bags	
2	Each	Bivy Bags	
2	Each	Ensolite Pads, 24" x 48"	
1	Each	Mountain tent w/instructions & repair kit	
	Tent stake bag contains:		
	10	Each	Tent stakes

	6	Each	Ice screws
	2	Each	Snow flukes
	1	Each	Rock hammer
1	Each	Collapsible Snow Shovel	
1	Each	First aid kit	
2	Each	Bottle of white gas (650/975 ml)	
1	Each	MSR stove w/repair kit & matches	
1	Each	Cookset w/2 pots and 2 lids	
2	Each	Plastic mug	
2	Each	Spoon	
1	Each	Pocket knife	
1	Each	Signal mirror	
1	Each	Survival manual	
1	Each	Novelty item, book, or game	
1	Each	Toilet paper roll	
1	Each	Parachute cord (50’)	
1	Pair	Wool socks	
1	Pair	Wool mitts/gloves	
1	Each	Balaclava	

Food

6	Each	Dehyd. Meals
3	Each	Big chocolate bar
12	Each	Tea bags
12	Each	Hot Chocolate
2	Pack	Mainstay food bars (18)

Two Person Survival Bag: Deep Field

This survival bag is identical to the Local Two Person Survival Bag, except that fuel bottles are empty. Full bottles cannot be flown on a LC-130. You must fill the fuel bottles when you arrive in the field. This Survival bag is intended for teams traversing away from a fixed field camp for the day.

Crevasse Rescue Bag

4	Pickets: 2 long and 2 short
1	Pair Ascenders
4	8-mm Prussiks
1	Belay Plate
4	Carabiners
4	Locking Carabiners
4	Slings: 2 medium and 2 long
1	Ice Axe Spare
1	Hammer
6	Ice Screws
1	Come-a-long
1	Shovel
1	Snowsaw
1	11 mm (or larger) x 50 meter Static Rope
1	11 mm x 50 meter Climbing Rope
1	Crevasse Ladder (Optional)

Appendix E
National Science Foundation Policy on Field Safety in Antarctica

United States Antarctic Program (USAP) scientific and operational teams which are deployed to sites remote from USAP main stations shall conduct their activities in a safe manner. The field party leader shall be responsible for the conduct of all team members in the field, and shall ensure that each member of the team is familiar with the risks involved and proficient in dealing with them.

Background

The USAP has long recognized that operating a scientific research enterprise in Antarctica cannot be risk-free, but rather the activities must be conducted within an acceptable level of risk. Historically, the National Science Foundation's Office of Polar Programs (NSF/OPP) has focused on providing sufficient equipment and logistical support to field parties in remote areas, and has relied on the Principal Investigator (PI) in science field parties and the team supervisor/officer in operations/support field parties to define the levels of acceptable risks for remote field party operations.

OPP will continue to improve field party support logistics and will review operational plans of field party leaders so that both the team leader and OPP are satisfied that significant field safety concerns are appropriately addressed.

Currently, the USAP civilian support contractor provides one-to-three day field safety training and has developed a field manual for guiding field-party operations in Antarctica. These training courses are “shakedown” excursions to familiarize participants with the issued equipment and typical procedures used in the field. They are not intended to develop expert skills in inexperienced field team members. For science field parties, the USAP recommends that PIs select suitable field safety experts for their specific teams when the potential risks to those teams is significant (e.g, deep field deployments, traversing crevasses areas or mountainous terrain). The support contractor also can provide field safety experts to scientific field parties for short periods, when requested, and maintains a list of field safety experts experienced in Antarctic field deployments.

In many cases, deployments to field sites remote from permanent stations do not entail significant risk (e.g., “established” seasonal camps in the Dry Valleys) or the risks are not associated with actual field deployment (e.g., sea ice diving camps), and specific field safety experts would not be necessary. It is strongly recommended that field party members have basic first-aid training, and at least one member have more advanced life support skills (e.g., paramedic, emergency medical technician) if the remote field deployment warrants.

Policy Implementation

In the initial proposal, the PI should determine the safety requirements associated with remote field deployment and include those needs in the proposal's supporting information and budget submission. If the PI chooses to include a field safety expert with experience in polar or remote mountainous regions on the field team, that individual should be included in the staffing submission. The PI can obtain names of candidates with appropriate field safety experience from other investigators or from the USAP support contractor. If a field safety expert is requested from the civilian contractor within the proposal/grant operational support request, it will be evaluated along with other logistics support and will be provided, resources permitting.

If warranted, the USAP may assign an independent field safety expert to teams that are unprepared to address field related safety concerns, or delay deployment until such support staff is available. For construction field parties, the Field Safety and Training Program (FSTP) staff will review field deployment plans and establish field safety requirements for the field party.

NSF/OPP recognizes that the field safety program should continue to be flexible. The hiring of a field safety expert may make little sense for some science groups. Other field parties may require specific skills for only a short time, and will be able to call upon the FSTP for that assistance. Nevertheless, OPP recommends that the PI designate a specific experienced person responsible for the safety of the field team other than him/herself, so that both the scientific goals and the safety of the field party are addressed throughout field deployment.

During the merit review process, NSF/OPP will review the work plan to ensure that field safety concerns are addressed and adequate resources are included in the budget submission. If the proposal is funded, the PI or designated field safety leader may be asked to prepare documentation outlining how the field work will be carried out. That person may be expected to deploy to McMurdo, or Punta Arenas in advance of the rest of the field party, in order to check out field equipment. The balance of the field party still will be required to successfully complete the FSTP's one-to-three day shakedown course prior to field deployment. USAP field safety experts will also advise NSF on the preparedness of field parties prior to field deployment, and may be asked to advise NSF on specific situations that arise in the field.

Each field party's designated field safety leader shall submit an "end-of-season" report, which includes such things as execution of original field plan, technical problems that were encountered and their solutions, performance of issued equipment, and recommendations for improvement of the field safety program. The support contractor's FSTP staff will assimilate this information into their field safety program and into the subsequent revisions of the USAP Field Manual so that field safety and survival skills that are developed and refined throughout the program can be retained and be of use to future field activities. The USAP's support contractor plays a pivotal role in capturing and disseminating practical safety and survival information for field party use. This can best be done through the development of a close, cooperative relationship with field teams and occasional direct involvement with field activities.

Appendix F
Communications Information

Time Signals

Standard radio and audio frequency transmissions are made continuously by the Central Radio Propagation Laboratory, National Bureau of Standards, Washington, D.C., over stations WWV and WWVH. Both stations broadcast on 5, 10, and 15 MHz (15,000 kHz). Signals are sometimes weak in the mornings.

These broadcasts are interrupted at times for maintenance purposes. The standard audio frequencies are interrupted at two minutes before each hour, and every five minutes thereafter (e.g., 1958, 2003, 2008, etc.), resuming after an interval of two minutes. Thus, you can take a series of checks at, say, 2000, 2005, 2010 etc. During the two-minute intervals, Eastern Standard Time (GMT minus 5 hours or NZ time minus 17 hours) is announced by voice, and GMT time is signalled slowly in morse code. A 0.005-second pulse may be heard as a faint click every second, except for the 59th second of each minute; this gives a warning of the return of the audio tone exactly on the hour, 5 minutes past, 10 minutes past, etc.

The BBC's General Overseas Service also broadcasts its "six pips" time signal on the hour throughout the day, and is accurate to one tenth of a second. (The sixth pip marks the minutes, e.g., 2000, 2300 etc.) These can be picked up in the usual shortwave bands between 9.0 and 9.8 MHz, 11.6 and 12.1 MHz, and 15.0 and 15.5 Mhz.

Some Physical Impacts of HF and VHF Radio-Traffic Interference

Daylight:

Time of day impacts HF communications. Change in the zenith angle of the sun (the angle of the sun above the horizon) influences HF. When the zenith angle is greater, HF communications are generally better. Conversely, when the zenith angle of the sun is smaller, HF communications are generally not as good. Experience in the Antarctic has been that HF communications begin to deteriorate mid-to-late evening, local McMurdo time and are at their weakest during early morning hours, local McMurdo time. There is less variance in the angle of the sun over the horizon nearer the Poles.

Solar Flares and Sunspot Activity:

The ionosphere occasionally becomes disturbed as it reacts to certain types of solar activity. Solar flares are an example; these disturbances can affect radio communications in all latitudes. Scattering of radio power by ionospheric irregularities produces fluctuating signals (scintillation), and propagation may take unexpected paths.

At high-frequency (HF), and sometimes at very high-frequency (VHF), a sudden ionospheric disturbance (SID) of radio signals may appear as a short-wave fade (SWF). This disturbance may last from minutes to hours, depending upon the magnitude and duration of the flare.

Solar flares also create a wide spectrum of radio noise; at VHF (and under unusual conditions at HF) this noise may interfere directly with a wanted signal. The frequency (as in times of occurrence) with which a radio operator experiences solar flare effects will vary with the approximately 11-year sunspot cycle; more effects/interference occur during solar maximum (when flare occurrence is high) than during solar minimum (when flare occurrence is very low). A radio operator can experience great difficulty in transmitting or receiving signals during solar flares.

During times of increased sunspot activity, HF radio communications operate best at higher frequencies. During times of decreased sunspot activity, lower frequencies will provide better HF communications.

The peak of the solar max is predicted to occur sometime before 2002. The probability for severe magnetic storms may extend through 2005.

Energetic Particle Effects:

On rare occasions a solar flare will be accompanied by a stream of energetic particles (mostly protons and electrons). The more energetic protons, traveling at speeds approaching that of light, can reach Earth in as little as 30 minutes. These protons reach the upper atmosphere near the magnetic poles. The lower regions of the polar ionosphere then become heavily ionized, and severe HF and VHF signal absorption may occur. This is called a polar cap absorption (PCA) event. PCA events may last from days to weeks, depending upon the size of the flare and how well the flare site is magnetically connected to Earth. Polar HF radio propagation often becomes impossible during these events.

Geomagnetic Storm Effects:

Sufficiently large or long-lived solar flares and disappearing filaments (DSF) are sometimes accompanied by the ejection of large clouds of plasma (ionized gases) into interplanetary space. These plasma clouds are called coronal mass ejections (CME). A CME travels through the solar wind in interplanetary space and sometimes reaches Earth. This results in a world-wide disturbance of Earth's magnetic field, called a geomagnetic storm. Another type of solar activity, known as coronal hole (CH) produces high-speed solar wind streams that buffet Earth's magnetic field; geomagnetic storms that may be accompanied by ionospheric disturbances can result.

These ionospheric disturbances can have adverse affects on radio signals over the entire frequency spectrum, especially in auroral latitudes. In particular, HF radio operators attempting to communicate through the auroral zones during storms can experience rapid and deep-signal fading due to the ionospheric irregularities that scatter the radio signal. Auroral absorption, multipathing, and non-great-circle propagation effects combine to disrupt radio communications during ionospheric storm conditions. During large storms the auroral irregularity zone moves equatorward. These irregularities can produce scintillations that adversely impact phase-sensitive systems on frequencies above 1 GHz (e.g., the Global Positioning System). Geomagnetic storms may last several days, and ionospheric effects may last a day or two longer.

Appendix G
Palmer Station Survival Cache Contents

Each Survival Cache consists of three barrels with these contents:

Barrel 1

Bag 1:

1 roll of toilet paper
1 box of matches
1 pocket knife
2 sets of long underwear
2 pairs of glove liners 1 tent
1 sleeping bag
1 first aid kit
1 medical book
2 Newtro 2400 bars
1 flashlight
6 D-cell batteries
2 pairs of socks
2 balaclavas
2 sets of boot liners

Bag 2:

2 sleeping pads
1 bottle of fuel
6 cans of water

Barrel 2

Bag 1:

1 mess kit: dish, pot, skillet, cups
2 pairs of leather bear paw mittens
1 stove with pump and directions
1 50-foot coil of parachute cord

1 set of oil skins
1 book of knots
1 orange smoke signal
3 meteor flares
1 deck of cards
1 signal flag
1 shovel
3 chocolate bars
4 meals
1 box of matches
1 Antarctic survival book
1 parachute flare
1 red flare
5 candles
2 emergency blankets
1 signal mirror
2 Newtro 2400 bars
1 sleeping bag
2 sets of silverware

Bag 2:
2 sleeping pads
1 bottle of fuel
5 cans of water
1 fuel filter/funnel

Barrel 3

Bag 1:
1 roll of duct tape
2 sets of long underwear
2 pairs of glove liners
1 pair of sunglasses
5 candles
1 whistle
1 parachute flare
1 red flare
2 Newtro 2400 bars
1 sleeping bag
2 pairs of socks
2 balaclavas
1 sleeping bag
1 tube of sunblock
3 emergency blankets
1 box of matches
1 orange smoke signal
3 meteor flares
4 meals
5 cans of water

Appendix H
Glossary Terms and Acronyms

ACL (Allowable Cabin Load)
Payload of aircraft. Calculations based upon take-off (wheels/skis), landing restrictions, range, weather, fuel requirements, etc.

Airdrop
Method of delivering supplies by parachute from an aircraft in flight.

Apple (a.k.a. Tomato or Melon)
Structure or shelter made of red colored fiberglass, helicopter-transportable, segmented, and expandable (longer in length). Manufactured by Igloo Satellite Cabin in Australia.

Bag Drag
In preparation for field deployment, all passengers must weigh in with their baggage to accurately determine aircraft load. Usually held a few hours before the scheduled departure.

Beaker
Vernacular for scientist.

Berg Field Center (BFC)
Building 160 (also known as the Field Party Processing

Center). The central location for issues of field equipment such as tents, sleds, sleeping bags, etc.

Bumped
Referring to cargo or passengers that is/are removed from a flight due to weight restrictions or other considerations.

CDC
Acronym for the “Clothing Distribution Center” in Christchurch, New Zealand.

Chalet
Building 167: the USAP administration and operations center housing the offices of the NSF Representative(s) and ASA Resident Manager, as well as the administrative staff. The central location for referral, information, and assistance to grantees.

CHC
Acronym for “Christchurch,” New Zealand (a.k.a. “Cheech” or “Chi-Chi”).

CONUS
Acronym for the Continental United States.

Crack
A fissure or fracture in the sea ice produced by the stresses of wind, wave, tidal, mechanical, or thermal forces.

Crary Lab
Housed in Building 001, this is the scientific facility

operated by ASA. Also known as CSEC (Crary Science and Engineering Center)

Dive Locker
Located in Building 144. It houses research diving equipment for issue, including an air compressor for filling scuba tanks.

DNF
Acronym for “Do Not Freeze.”

ECW Clothing
Acronym for “Extreme Cold Weather” Clothing.

FAA
Acronym for “First Available Aircraft.”

Field Camps
A fixed location used as a base camp for the pursuit of various scientific endeavors. It often includes such amenities as a toilet, heated shelter, etc.

Field Party
A group of researchers pursuing their scientific interests in the field.

Fish Hut
A temporary movable shelter used on the sea ice.

Fixed-Wing
Describes aircraft such as the LC-130 Hercules or DHC-6/300 Twin-Otter, as opposed to rotary-wing aircraft, which are helicopters.

Flagged Route
A marked route that has been determined safe for vehicle travel by qualified personnel.

FOCC
Acronym for “Field Operation Communications Center” (referred to on the radio as “Mac Ops”).

Freshies
Vernacular for fresh fruit or vegetables.

FSTP (F-Stop)
Acronym for the “Field Safety Training Program,” which is a series of training courses emphasizing survival in the field.

HazMats (Hazardous Materials)
Any and all explosives, flammable liquids and solids, oxidizers, organic peroxides, corrosive materials, compressed gases, poisons, irritating materials, etiologic agents, radioactive materials, and other regulated materials. These items require proper packaging and certification prior to air transport, and may have passenger or other cargo compatibility limitations.

Herbie
Term used to describe a storm with fierce, blowing wind and/or snow, causing outdoor activities to be unpleasant.

Herc or Hercules
Turbo-prop, wheeled cargo aircraft (LC-130), or ski-equipped (LC-130) cargo aircraft.

Hourlies
Pertains to communicating local weather observations every 60 minutes, beginning 6 hours prior to scheduled aircraft departure and recurring “hourly” until after the aircraft lands.

Ice Edge
The boundary between sea ice and open sea at any given time and place.

Jamesway
A portable, rigid-frame, insulated tent similar to a small quonset hut. Can be built to any length, though height and width are fixed.

Jerry Cans
Military 5-gallon containers used to transport liquids such as fuel, oil, or glycol. Jerry cans are not suitable for air transport of flammable liquids.

JP-8
Type of fuel used for aircraft and in diesel applications such as generators, Caterpillar equipment, and Preways. This “single-fuel” replaces JP-4 (for aircraft use only) and DFA (Diesel Fuel, Arctic).

Kilo Air
A method of cargo shipment using surface vessels from Port Hueneme, CA, to New Zealand, then delivered to McMurdo Station by air.

Kovacs Auger
An ice auger used to drill small-diameter holes in the sea ice to determine ice thickness.

Mac Center
Located in Building 165, the air traffic control, flight following, and weather information facility.

Mac Channel
Regularly scheduled trans-Pacific military cargo flights.

Mac Ops
Call sign for the Field Operation Communications Center.

MCC or MCC Central
Acronym for the “Movement Control Center” Terminal Operations cargo facility in McMurdo staffed by ASA and New Zealand Army personnel.

MEC
Acronym for the “Mechanical Equipment Center” in Building 58. The MEC is the issue point for small generators, snowmobiles, batteries, light vehicles, etc. MEC staff prefer to be called MECCA.

Melt Pool
An area on the ice sheet that has sub-surface melting. An ice lens is usually present over the meltwater, giving the impression that it is solid. Many factors, including the amount of wind-borne dust from around McMurdo and ablation of snow cover caused by vehicle traffic, increases the solar absorption on the sea ice in front of McMurdo and immediately north of Hut Point. This area has historically deteriorated first and rapidly. Ice at outlying locations may be substantially better.

Mogas
Acronym for “Motor Automotive Gasoline.”

NSFA
Acronym for “Naval Support Force, Antarctica.”

OAE
Acronym for “Old Antarctic Explorer;” title given to program veterans.

OEA
Acronym for “Oil, Engine, Arctic.” A type of extreme cold weather engine lubricating oil.

Pallet
A portable platform used for handling/moving materials and packages. The pallets used for LC-130’s are made of aluminum and balsa wood, designated by the military as 463L pallets, and lock into place on the cargo deck.

Palletize
To place onto a pallet. Typically, for an LC-130 field operation, all outgoing cargo is palletized. For larger field camps, all camp materials are gathered and staged at a central location, then palletized all at once in a cooperative “palletization party.”

Pax
Vernacular for passengers.

PI
Acronym for the “Principal Investigator.” The senior representative of a science group.

Polarhaven
Tent-type shelter with a framework of aluminum tubing and insulated fabric cover, with either an insulated fabric or wood floor.

Pressure Ridge
Ice broken by pressure and thrust up into a chaotic pattern of elevations and depressions.

Preway
Non-portable type of space heater that uses JP-8 for fuel. Typically used to heat Jamesways and fish huts.

Purging Fuel
Either a diesel or kerosene fuel with a flashpoint above 141° that is used to rinse more flammable fuels out of containers and power equipment.

Recce
Aerial reconnaissance. Performed by LC-130 aircraft when a potential landing site for put-in may be questionable. Some researchers take advantage of the recce flight to view areas of investigation to determine safe traverse routes, and/or to airdrop materials and supplies to reduce the put-in flight's cargo weight.

Recompression Chamber
Housed in Building 85 which adjoins NSFA Medical (Building 142). It houses a chamber for treatment of pressure-related diving accidents and other conditions where hyperbaric oxygen therapy is indicated, such as carbon monoxide poisoning, gas gangrene, etc.

Retrograde
To return cargo from the field to McMurdo Station, or from McMurdo to destinations North. Usually in the reverse order of its initial deployment.

Sastrugi
Hard drifts of wind-carved snow. These drifts can reach 6 feet tall, and accordingly can affect overland travel.

Sea Ice
Ice which forms on the surface of the sea in polar ocean areas.

Shakedown
An overnight trip to test equipment, radios, sleds, snowmobiles, tents, etc. prior to deep-field deployment.

Sipre Auger
An ice-coring auger used to sample sea ice to determine its composition.

Space A
Acronym for “Space Available.” Refers to the program of allowing personnel (equitable between military and civilian) to use available aircraft space for a turn-around flight to South Pole or for a helicopter excursion.

Squirrel
Aerospatiale AS-350B helicopter, this is a sub-contracted helicopter that provides occasional support to the USAP.

Starlifter
Wheeled jet aircraft operated by the U.S. Air Force used for cargo deliveries from Christchurch, N.Z., to McMurdo during early summer operations; usually early October to mid-November, as well as Mac Channel missions. Also known as a C-141.

Tidal Crack
Tidal cracks occur in fast ice when the tidal action lifts the sea ice above or below the level at which it is shorebound.

T-Site
A transmitter facility operated by the Electronics Division. It is located on a hill between McMurdo and Scott Base.

VFR
Acronym for “Visual Flight Rules.” Required for helicopter operations.

WINFLY
Vernacular for the winter fly-in. Early season operations commence in mid-August, primarily to bring in support personnel to the Antarctic in preparation of the coming season.

Winter-Over
Vernacular for the period from late February to early August. It’s characterized by darkness and an absence of flight operations.