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

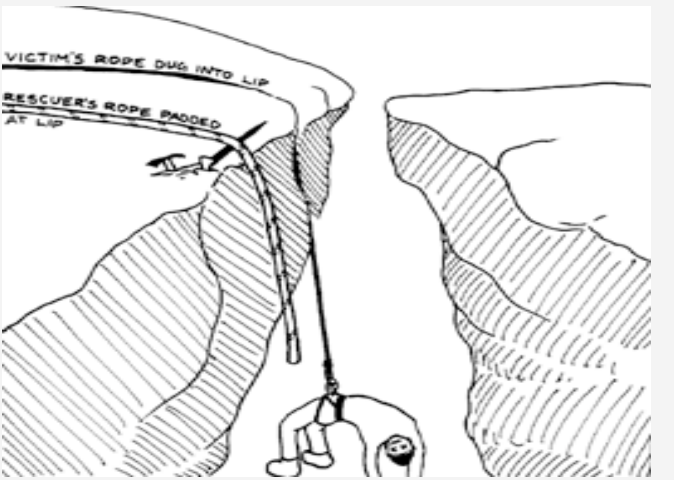

Figure 18-1: Victim's rope digs into lip of crevasse.

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

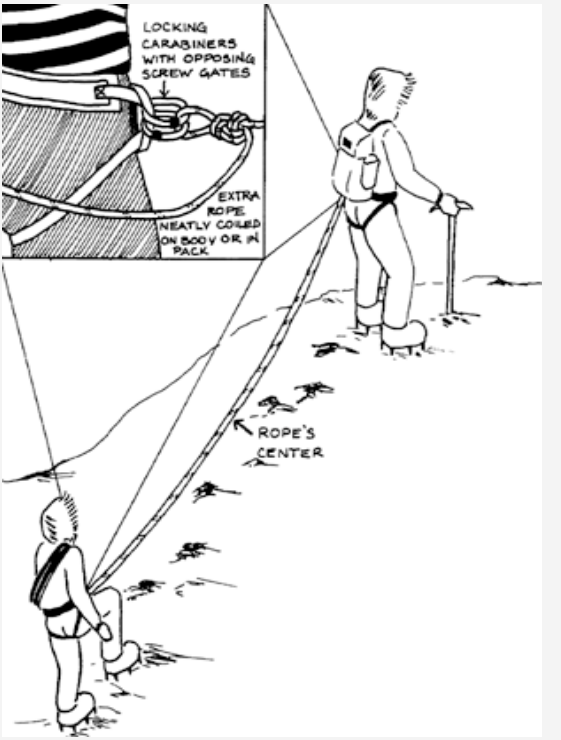

Figure 18-2: Rope configuration for a two member team.

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.

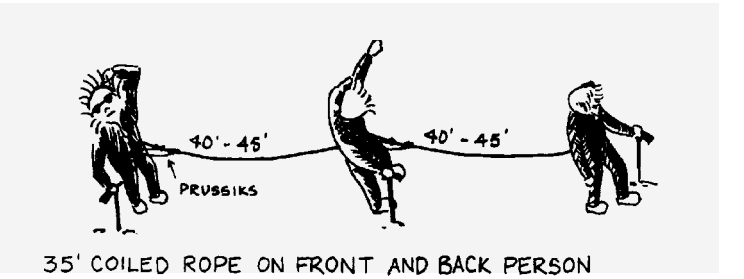

Figure 18-3: Rope configuration for a three member team.

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.

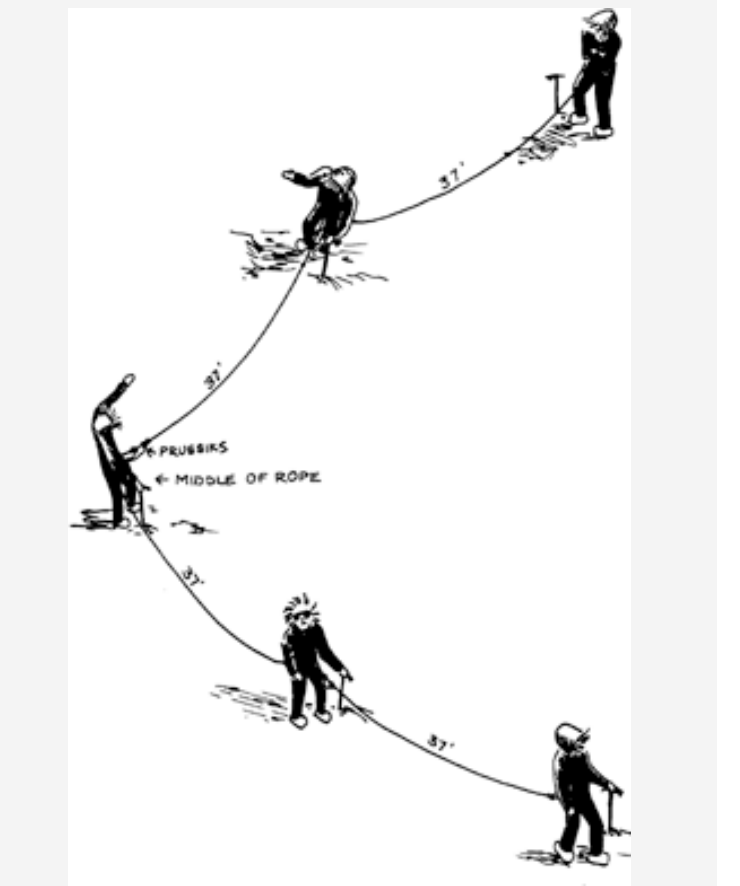

Figure 18-5: Rope configuration for a five member team.

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

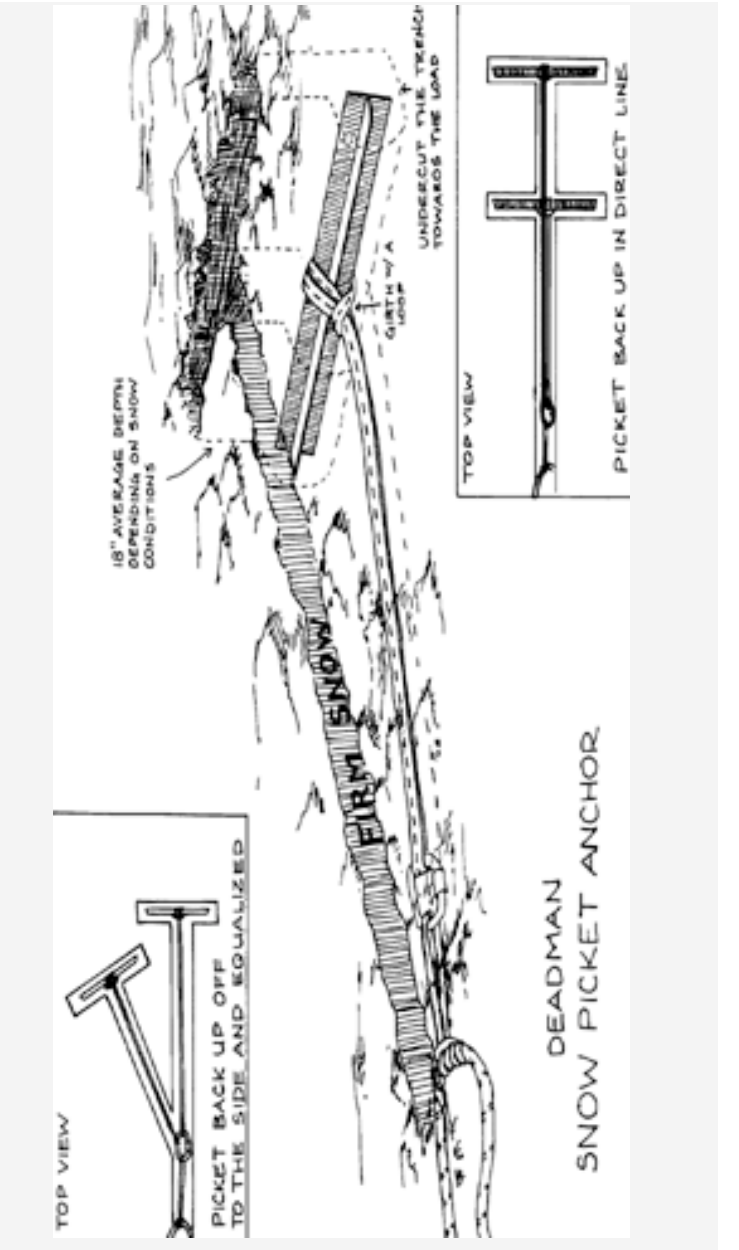

Figure 18-6: Deadman Snow Picket Anchor.

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

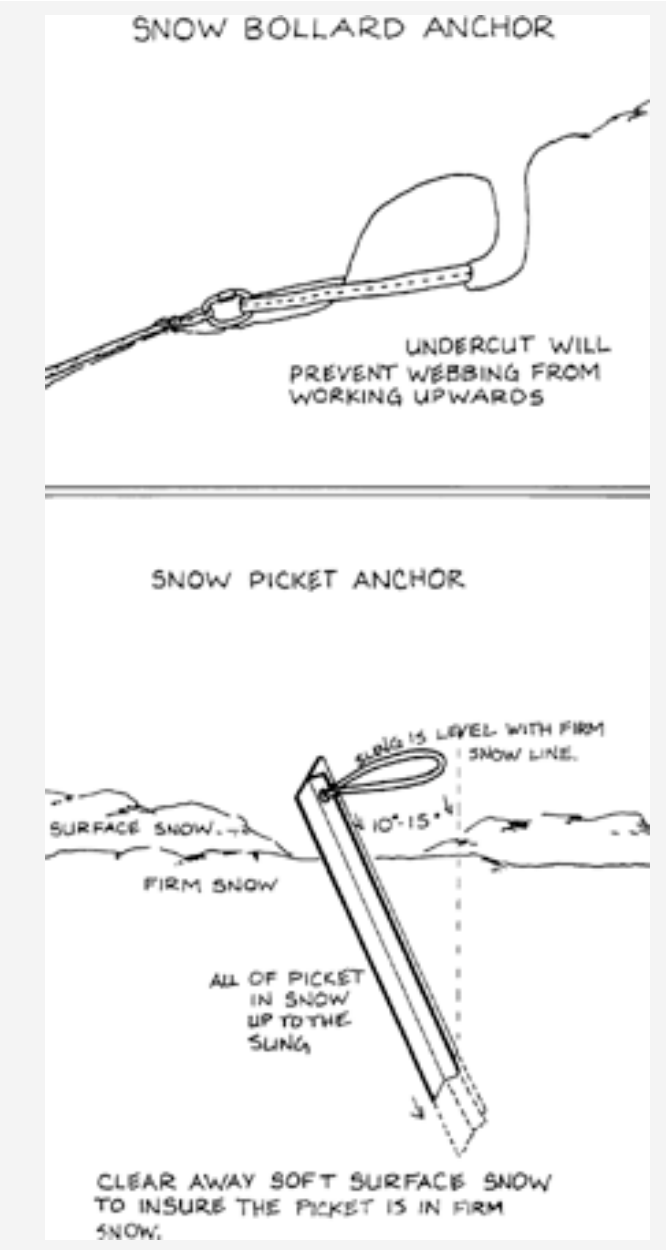

Figure 18-8: Snow Bollard and Snow Picket Anchor.

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.

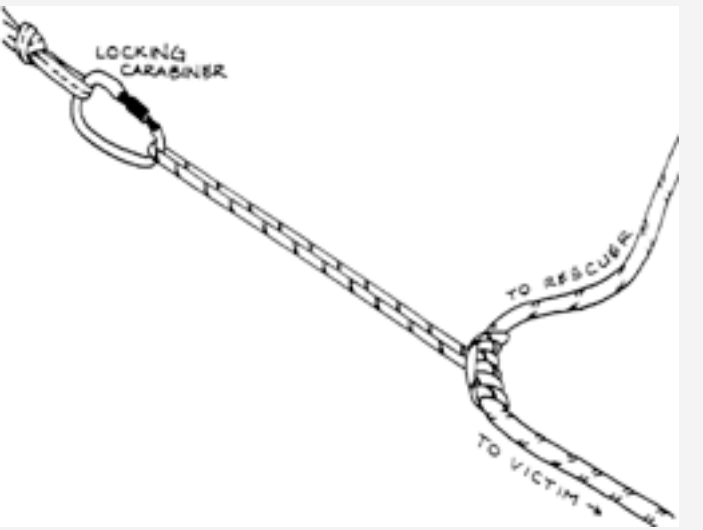

Figure 18-9: Locking Carabiner

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.

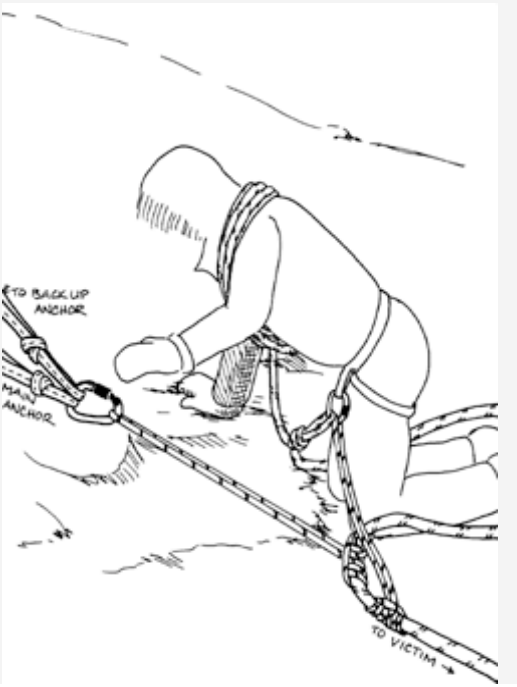

Figure 18-10: Anchor locations

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

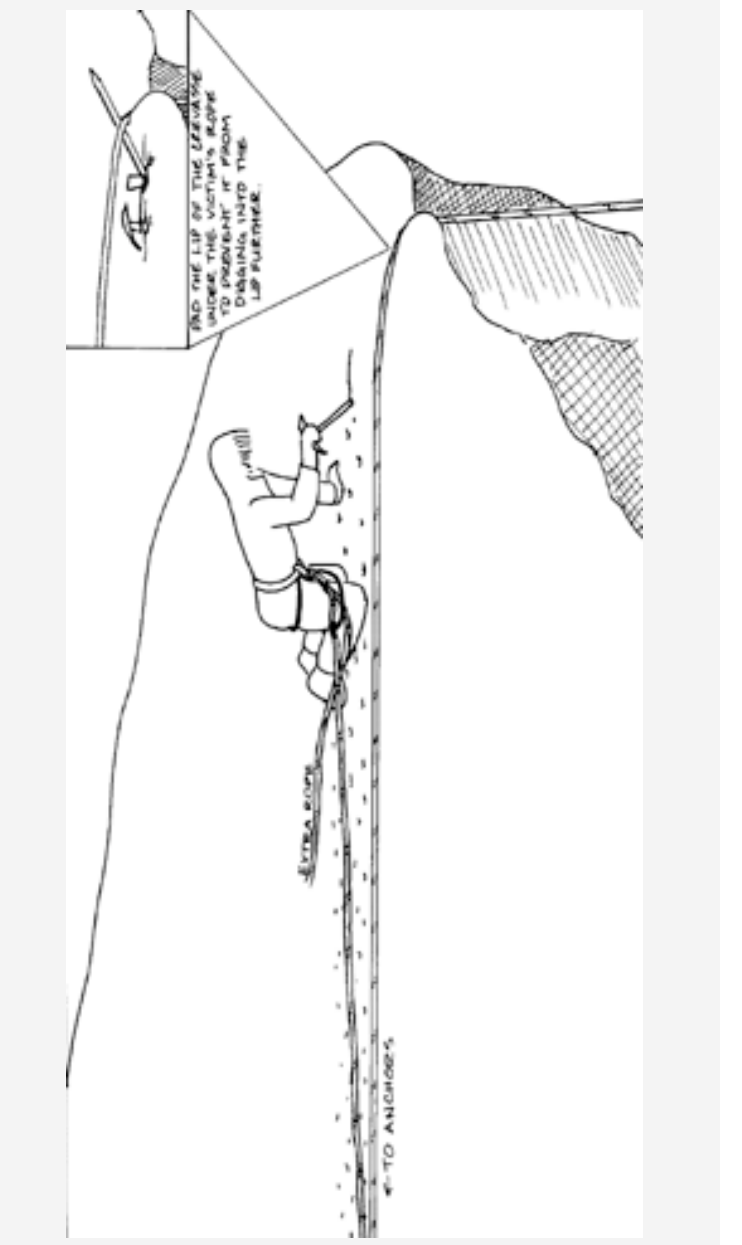
END THE LIP OF THE CREVASSE
UNDER THE VICTIM'S SLOPE
TO PREVENT IT FROM
DIGGING INTO THE
LIP FURTHER.
EXTRA ROPE
TO ANCHORS

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

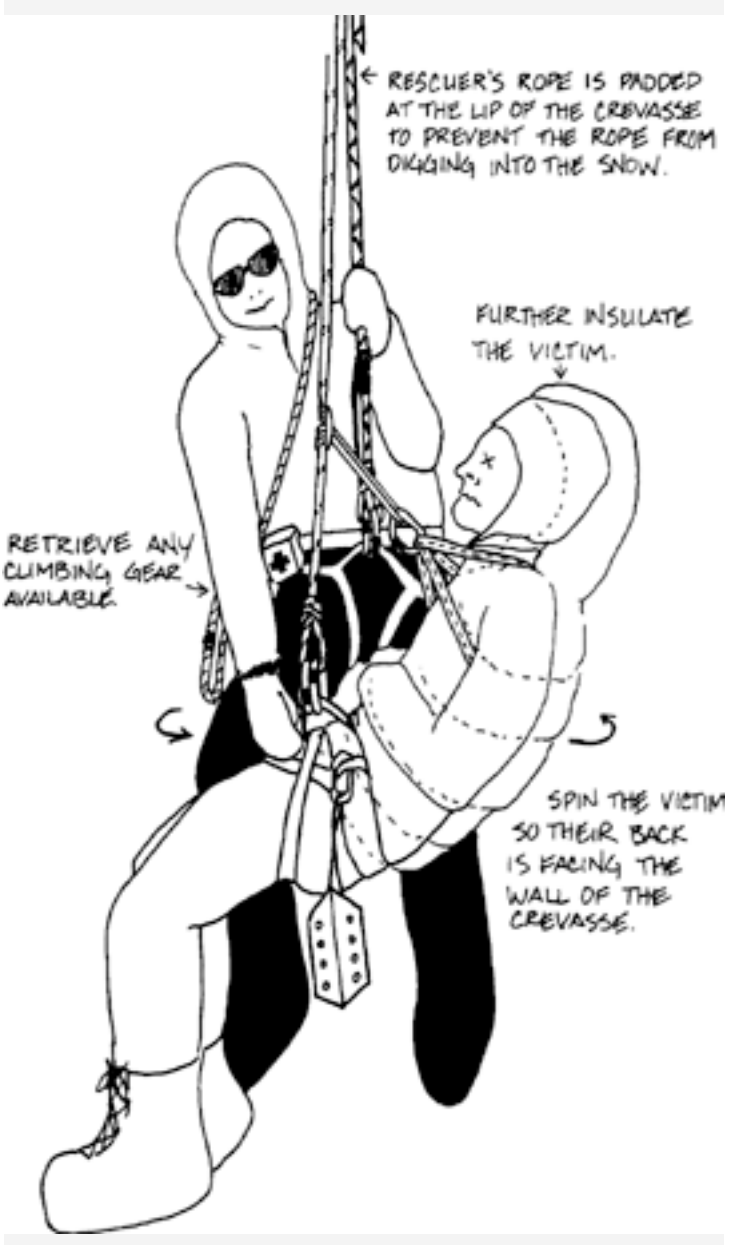
RESCUER'S ROPE IS PADDED AT THE LIP OF THE CREVASSE TO PREVENT THE ROPE FROM DIGGING INTO THE SNOW.
FURTHER INSULATE THE VICTIM.
RETRIEVE ANY CLIMBING GEAR AVAILABLE.
SPIN THE VICTIM SO THEIR BACK IS FACING THE WALL OF THE CREVASSE.

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.

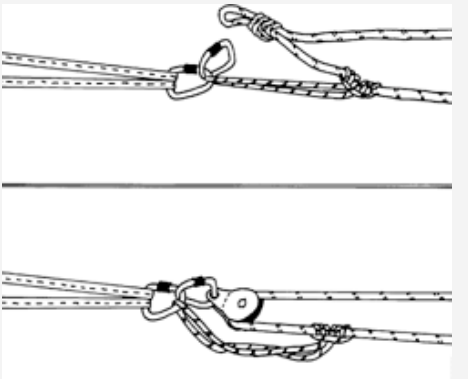

Figure 18-14

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.

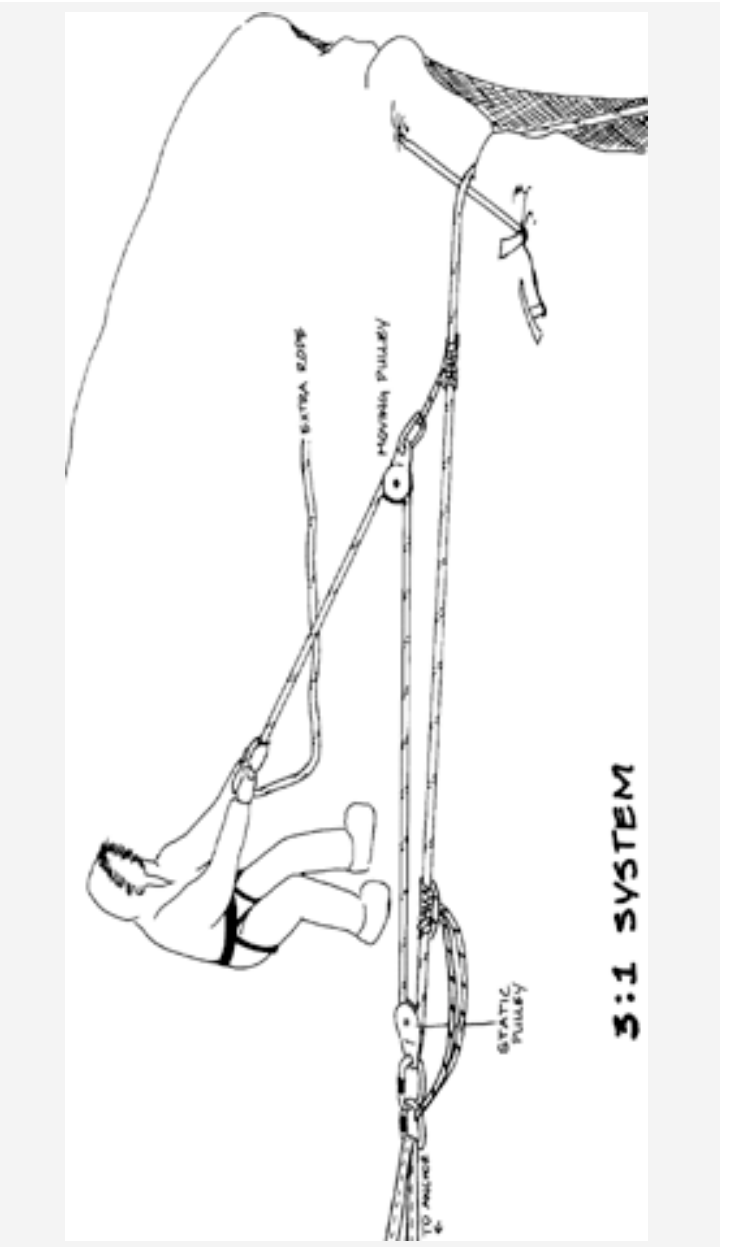

Figure 18-15

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

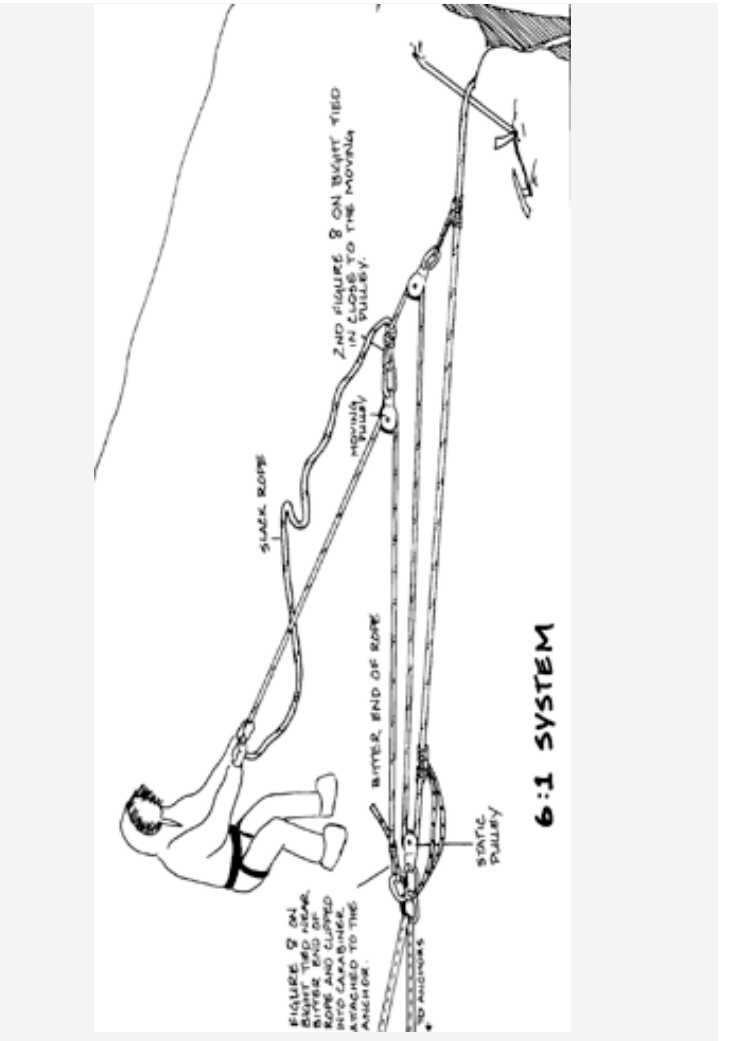

Figure 18-16

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

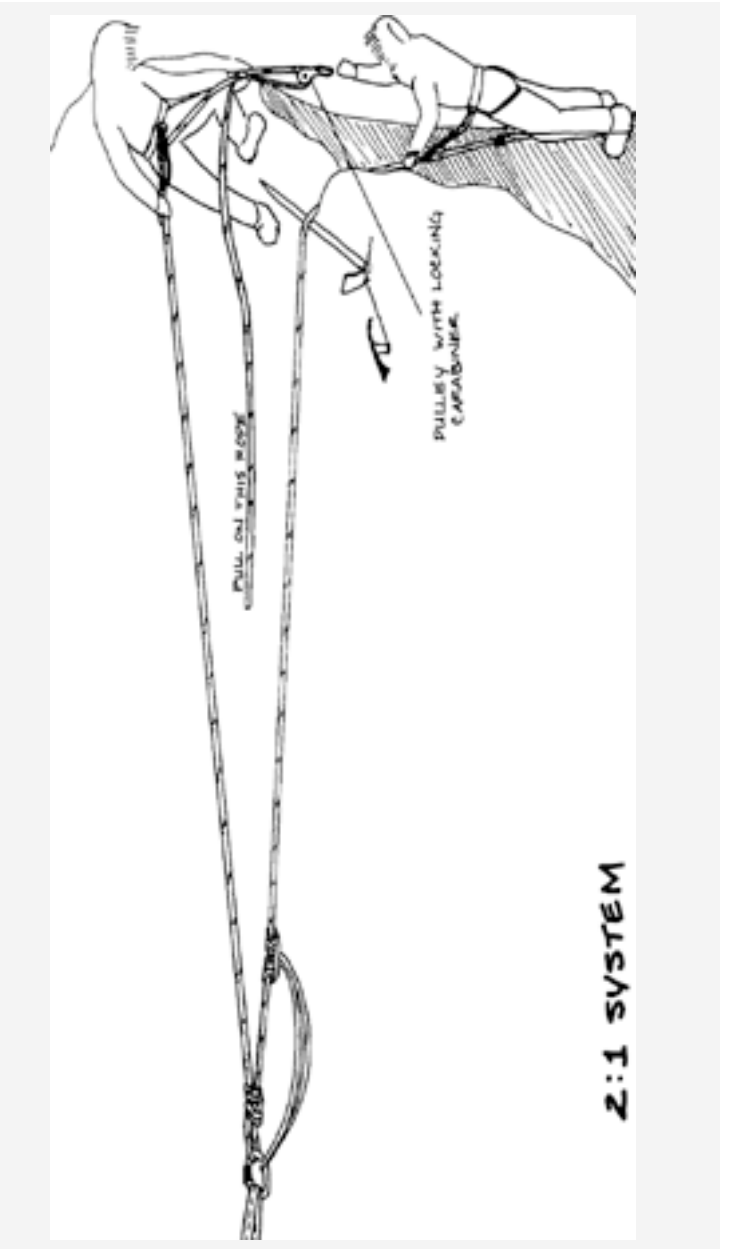
PULLEY WITH LOCKING CARABINER
PULL OUT THIS SLACK
2:1 SYSTEM

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.

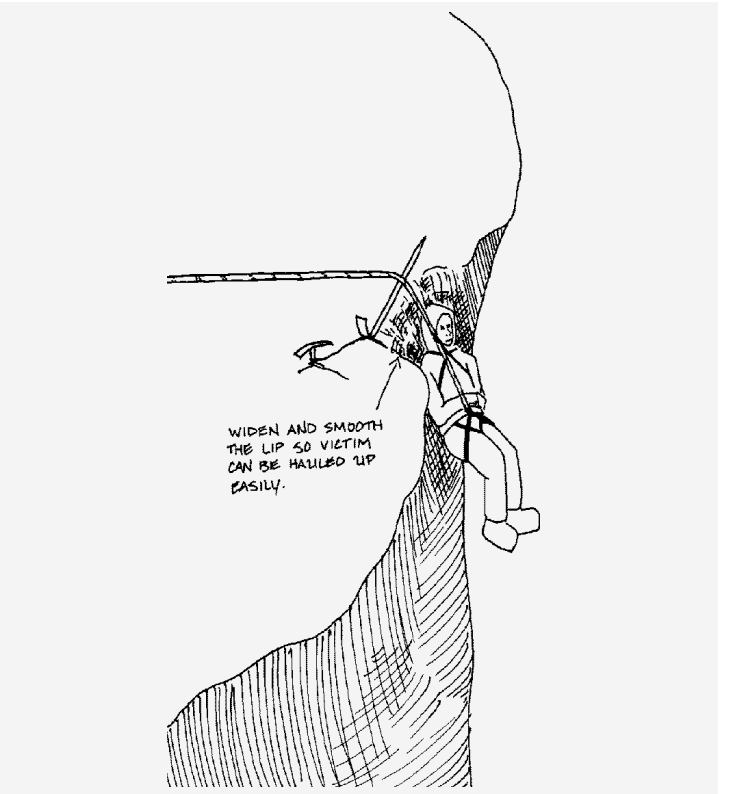

Figure 18-18