4:1 HAULING SYSTEM

The 2:1 Yosemite system (Figure 157) can be modified to give a mechanical advantage of 4:1. This is called the Crowther Lift (Figure 160) (Cosbey 1968).

For a horizontal pull, two 2:1 systems can be stacked together to give a 4:1 system called the piggy back system (Figure 161) (Smith 1976c).

LOWERING

Lowering is, of course, easier than hauling, but will only be infrequently used in cave rescue because the way out of most vertical caves is an upward one.

The lowering technique is simple. Just as for lowering equipment (page 102), an abseil device is anchored at the pitch top and the victim's rope is threaded through it. The victim is helped over the edge and someone wearing gloves can then pay the rope out slowly. If possible a person should abseil beside the victim and the victim should be lifelined as well.

PITCH ACCIDENTS

It is now appropriate to consider the case of a pitch accident where a hauling or lowering system will need to be quickly set in operation without any advance preparation and possibly without cavers in favourable positions. The general action taken by the caving party will depend on whether they are all on the bottom of the pitch below the victim, all on the top above him, or scattered between both places.

CAVING TEAM ABOVE THE VICTIM

This is the most likely case. Typically the first member of a team will have descended a pitch, experienced difficulties, and been unable to return to his companions. A case example occurred in 1965 when a caver had trouble returning up a very cold waterfall pitch in Schroeders Pants Cave, New York State, USA. Only about 4m from the top of the pitch and both his companions, he became too weakened to prusik (presumably from hypothermia), lost consciousness, and died. His two companions were unable to pull him to safety (Boston Grotto 1975, Hartline 1965).

While this accident seems to have been caused primarily by the jamming of wet prusik knots,

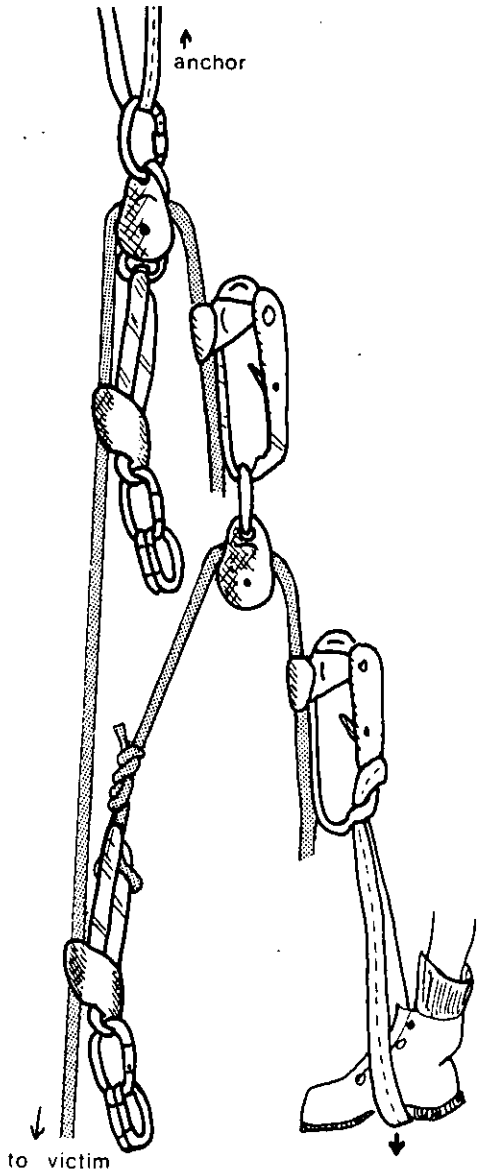


FIGURE 160: The Crowther Lift.

other circumstances such as injury or the presence of foul air could result in exactly the same situation.

Fast action will usually be required. Probably it will be unsafe for anyone to abseil down to the victim on a separate rope and render assistance, because this person could easily become a second victim. Usually, assistance will better be given from the pitch top. It will be necessary to either lower or haul the victim. Where practical, hauling is better because it starts the victim on his

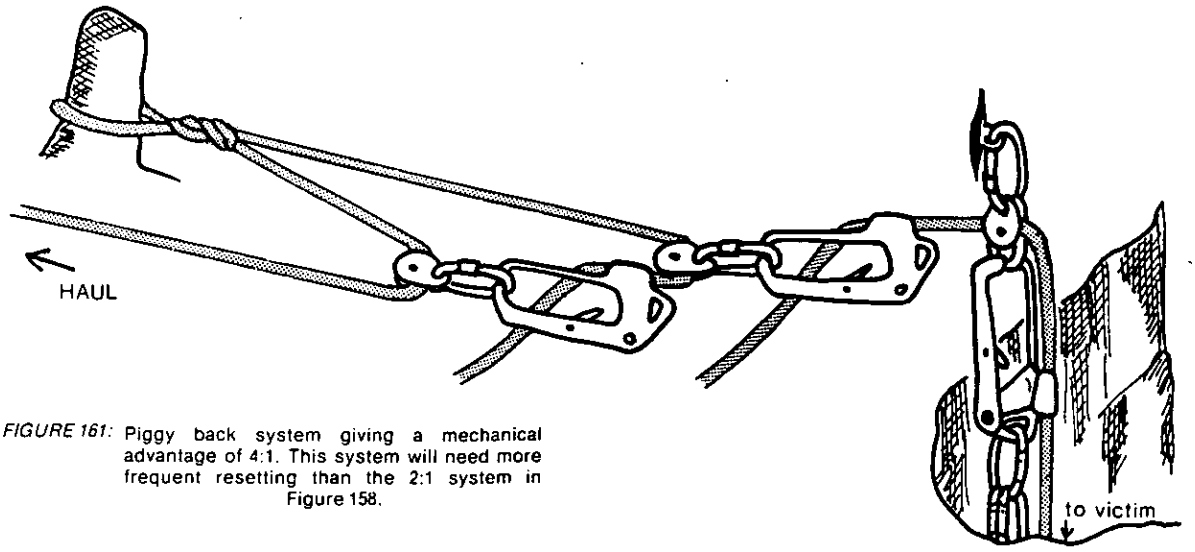


FIGURE 161: Piggy back system giving a mechanical advantage of 4:1. This system will need more frequent resetting than the 2:1 system in Figure 158.

way out of the cave. However, if his condition is very serious, lowering may be faster and more comfortable. It will help if the victim is conscious and able to advise on the relative merits of hauling or lowering. If he is unconscious, there will probably be little choice but to haul as lowering could cause the victim to drop into a pool and drown or otherwise land in a very awkward position. The hauling method will depend on the available manpower and equipment, and the urgency of the situation. For accidents requiring immediate assistance, a "brute force pull" will probably be best if there is sufficient manpower. A holding ascender will be all that is needed. Otherwise, a hauling system will need to be rigged. Figure 162 shows a method of coupling any system to a taut line in a way which eliminates friction at the pit edge. In addition, if no spare rope is available to rig a mechanical advantage system, the method can be used with a Yosemite Lift to haul up sufficient rope.

If the victim is to be lowered, a spare rope will need to be threaded through an abseil device and tied to the victim's rope. The victim's rope will then need to be released from its anchor. This is simple if it has been secured by winding it around the anchor (page 15), but otherwise it will need to be cut, or briefly hauled to take the weight off the knot.

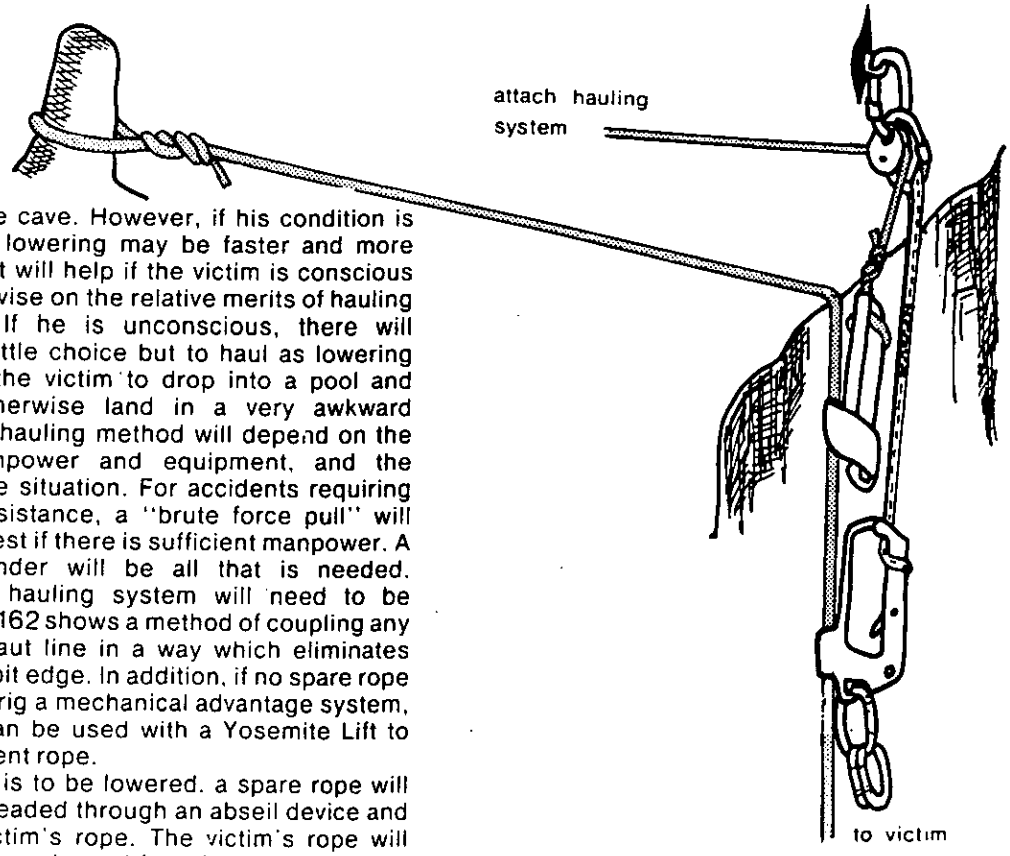


FIGURE 162: A method of coupling a hauling system to a taut rope.

CAVING PARTY BELOW THE VICTIM

The other main category of pitch accidents is that where the accident victim has been the last to descend a pitch or the first to ascend it. The whole party is then beneath him, faced with a difficult rescue problem. The case of a caver injured while ascending will be considered first.

The first step is again for a rescuer to reach the victim, this time by prusiking up on the victim's rope. A decision can then be made to haul or lower. Hauling will require at least one person to prusik past the victim and rig a hauling system at the pitch top. However, this is a relatively lengthy procedure, and there may be insufficient time. Lowering will often be safer. The general procedure is for the rescuer who has prusiked to the victim to detach the victim from the rope and abseil back down with him. This may sound impossible but, with the right technique, it can be done. The rescuer need only carry a spare ascender, a pulley, a cord about 2m long, and a few spare carabiners. Figure 163 illustrates the method, which is based on a similar method by Dobrilla and Marbach (1973). It definitely requires practice if an unbelievable tangle is to be avoided.

The method may be simplified if a spare rope is available. The spare rope could then be threaded through the pulley and operated by cavers on the ground to first support the victim while his ascenders are released and then to lower him with an abseil device anchored at the bottom of the pitch.

Simpler versions of the same techniques can be applied to rescue a caver who has been the last to abseil down a pitch and has had an accident. Normally, he will slide all the way down to the ground but, if using excessive friction in his abseil device or, if using a trailing ascender belay, he may be left hanging on the rope.

DIVIDED CAVING PARTY

The simplest situation in a pitch accident is generally that where the caving team is divided between the pitch top and bottom. The two groups can then communicate and decide on the best procedure, which may make use of any of the methods described above.

The important point with all rescue techniques is to practise them thoroughly in simulated rescue situations. Then in an actual emergency, the rescue effort can be mobilised with a sense of confidence and efficiency that will save invaluable time and calm the victim and the rescuers alike.

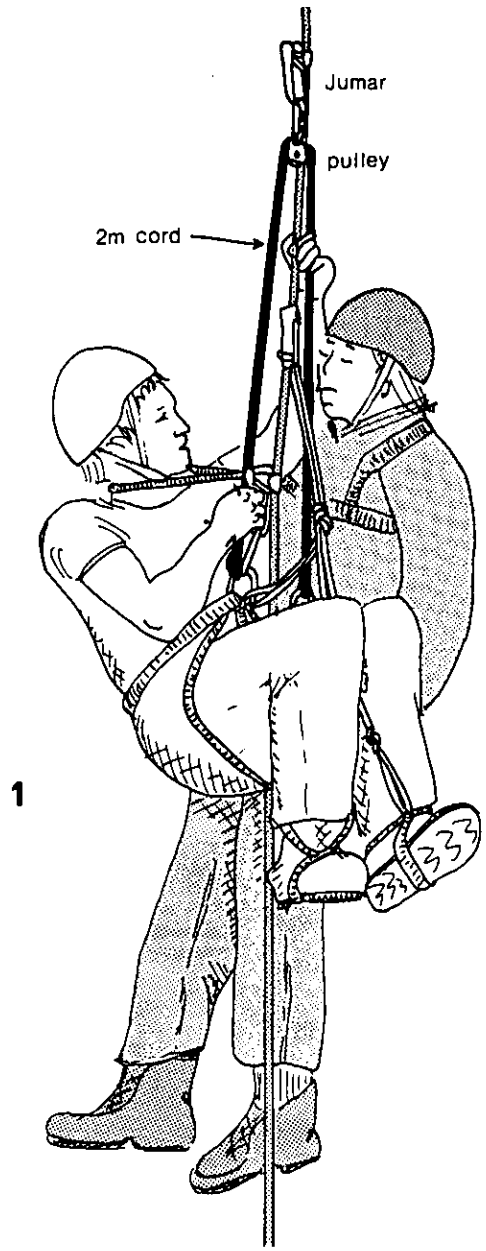


FIGURE 163: Removing an accident victim from a rope. The first step is to prusik up beside the victim, remove as many of his ascenders as possible, and attach the Jumar, pulley and cord arrangement as shown. The rescuer can then act as a counterweight and lift the victim slightly so that the victim's remaining ascenders can be removed. The victim will then be supported solely by the weight of the rescuer. (Figure continued over page.)

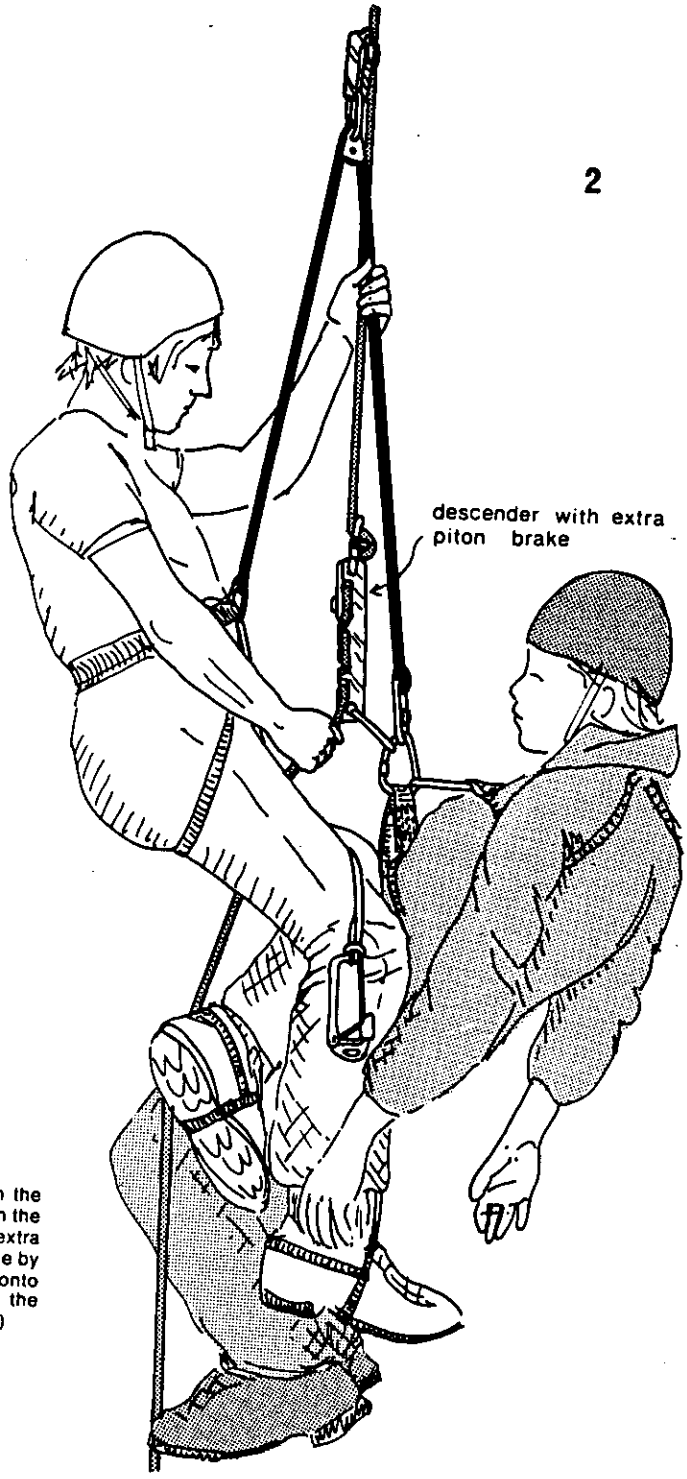


FIGURE 163 (continued).

The rescuer must then remove his own ascenders from the rope, thread a descender and clip the victim to it. Since both the rescuer and victim will abseil on this one descender, some extra friction will probably be required, as provided in this example by a single piton brake. The victim's weight should be lowered onto the descender and the descender locked off to prevent the victim from sliding downwards. (Figure continued over page.)

PRUSIKING

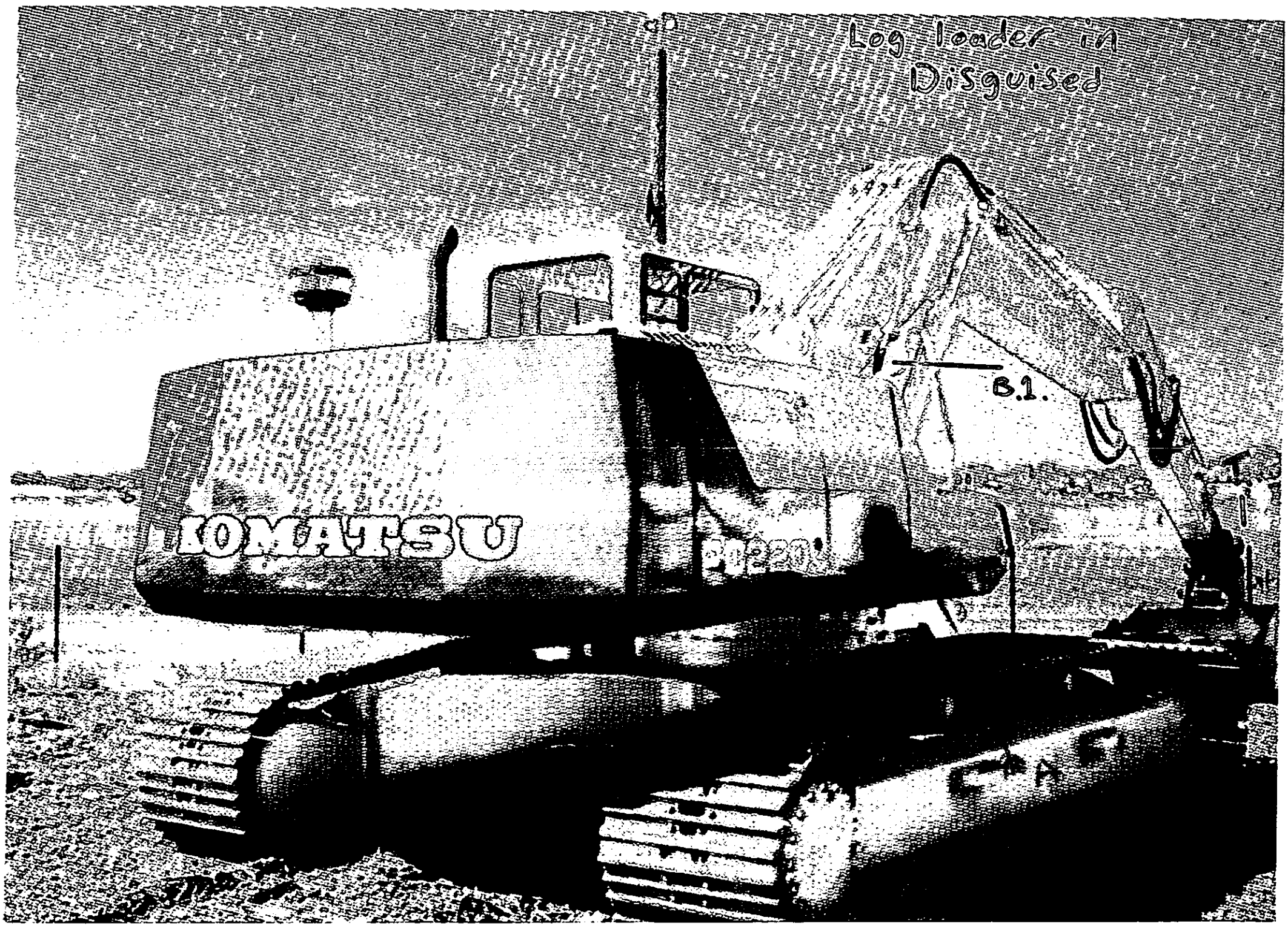
Prusiking is an old single rope climbing technique still in use today.Divices called 'jumars', or 'ascenders' can be used. They are safe and efficient, but heavy and expensive. As an alternative, our favoured 'prusic', or 'helical' knots can be used.

In principle, prusiking is like climbing a rope hand over hand, but much less tiring and much safer.
Each knot is alternately loosened, slid up the rope, then tightened by the application of the climber's weight. For best results the prusik line should be of 3mm. smaller diameter than the rope being climbed. Thinner line tends to jam. Thicker rope tends to slip.
If a layered,(3 strand), rope is being climbed, then the bottom half of the prusik knot should spiral in the same direction as the lay.

PRUSIKING.

PRUSIKING IS AN OLD SINGLE ROPE CLIMBING TECHNIQUE STILL IN USE TODAY. ~~IN PRI.~~ IN PRINCIPLE IT IS LIKE CLIMBING A ROPE HAND OVER ~~HAND~~ BUT MUCH LESS TIRING AND MUCH SAFER. MECHANICAL DEVICES, CALLED JUMARS OR ASCENDERS, ~~OTHER~~ OR ROPE KNOTS, CALLED ~~PRUSSICS~~ PRUSIKS OR HELICALS, ARE USED TO GRIP THE ~~ROPE~~ CLIMBING ROPE. THERE ARE VARIOUS ~~ARRANGING~~ ARRANGEMENTS FOR CONNECTING THE PRUSIKS TO THE HARNESS DEPENDING ON PERSONAL TASTE & PHYSICAL STRENGTH.

MECHANICAL DEVICES CALLED JUMARS OR ASCENDERS CAN BE USED. THEY ARE SAFE + EFFICIENT BUT HEAVY + EXPENSIVE. ALTERNATELY, OLD FASHIONED PRUSIK OR HELICAL KNOTS CAN BE USED. → 2 LINES ARE NEEDED IN PRINCIPLE, BUT ONE SHARE FOR EMERGENCIES. PRUSIKING IS LIKE CLIMBING A ROPE HAND OVER HAND BUT MUCH LESS TIRING + MUCH SAFER. EACH KNOT IS ALTERNATELY LOOSENED, SLID UP THE ROPE + THEN TIGHTENED BY THE APPLICATION OF THE CLIMBERS WEIGHT. TWO FOR BEST RESULTS THE PRUSIK LINE SHOULD BE OF 3mm SMALLER DIAMETER THAN THE ROPE BEING CLIMBED. THINNER LINE TENDS TO JAM + THICKER ROPE TENDS TO SLIP. IF A LAYED (3 STRAND) ROPE IS BEING CLIMBED THEN THE BOTTOM HALF OF THE PRUSIK KNOT SHOULD SPIRAL IN THE SAME DIRECTION OF THE LAY.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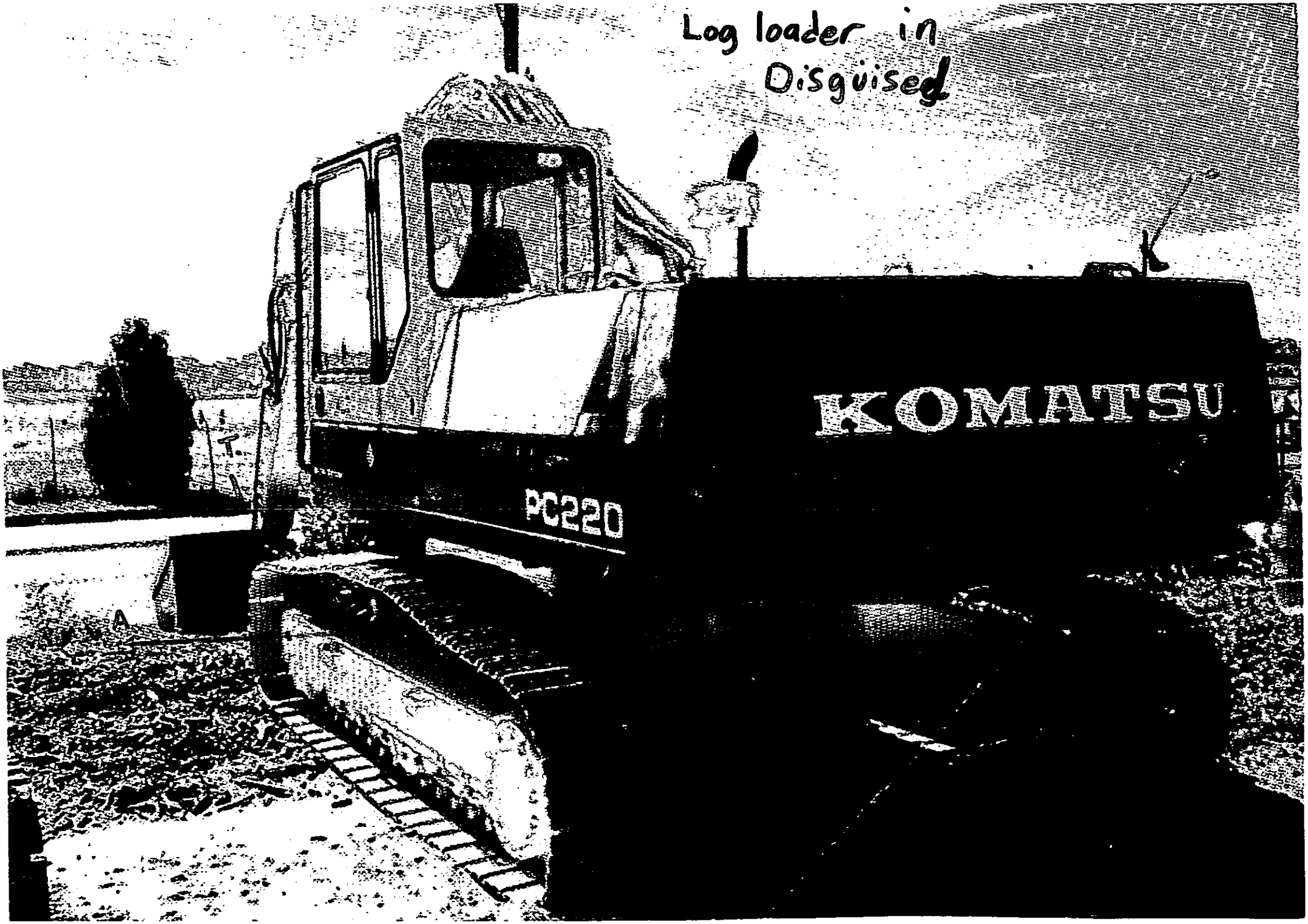
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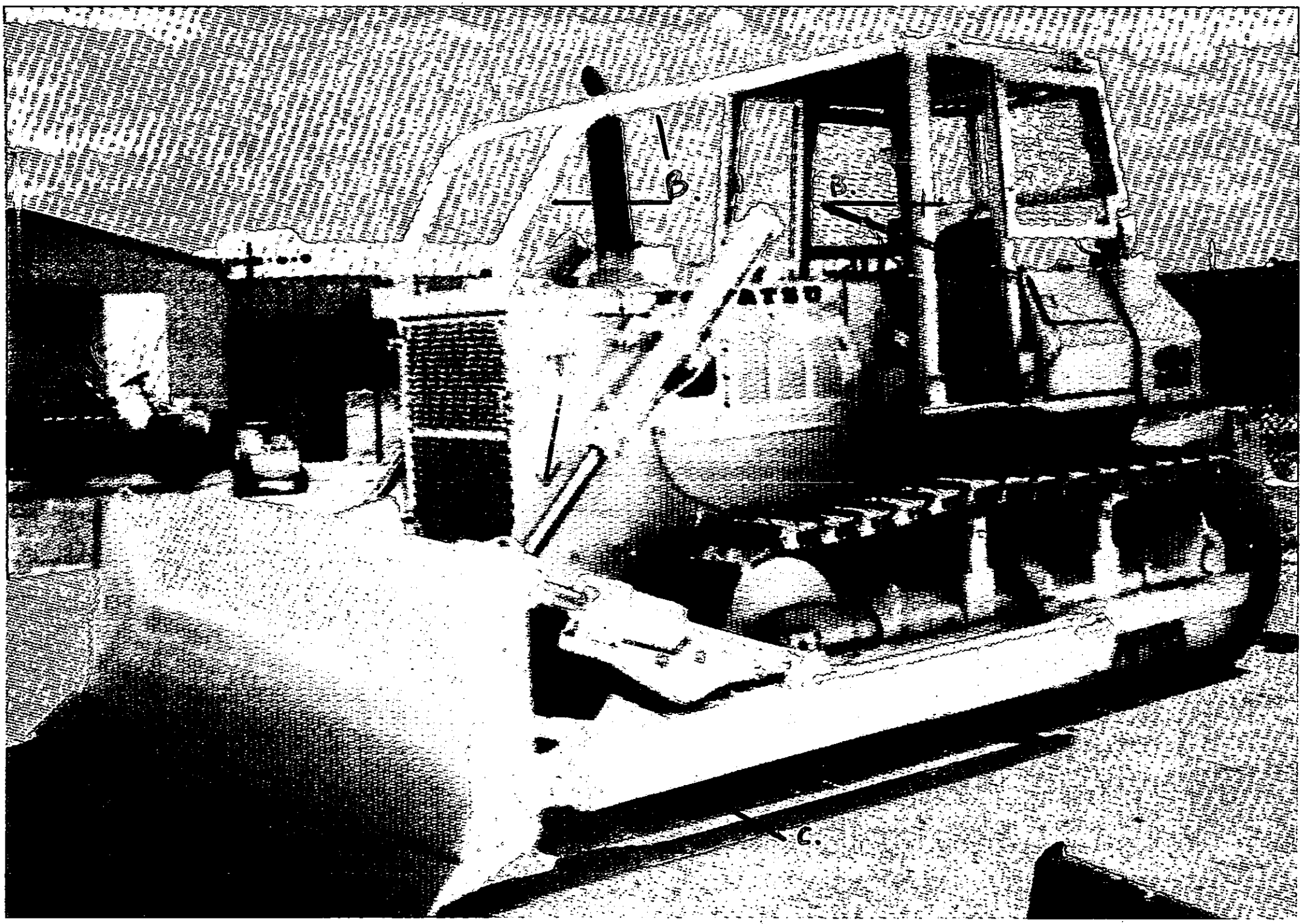
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DARTBOARD FOR LOCK ON BOXES AND TRIPOD'S

A. TWO PEOPLE CAN KEEP EACH OTHER COMPANY WITH TWO LOCK ON BOXES.
B. SINGLE PERSON LOCK ON.
B.1. SINGLE PERSON CAN LOCK ON SITTING IN A BOSUN S CHAIR. (Swing)
C. PERSON LAYING ON THE GROUND LOCKED ON.
T. A GOOD PLACE FOR A TRIPOD LEG.

PRUSIKING

prusiking a rope is an old style single rope climbing technique and it is still being used today. Most climbers would recommend this technique to be the safe rather then using jumars which damage easy and a lot heaver to carry and it is not easy to self test the unit. To ascend an rope with this technique is similar to climbing a rope hand over hand but it is safer and less tiring, using the prusik knots as an advantage to get grip on the rope as person slip the other prusik knot up to gain grip and slid the other prusik knot up and so on too perform this manoeuvre you would need two loops
of line plus anther one in case of emergency (for best result, you use 3mm diameter under the size of the rope you are climbing, for example you are climbing 10mm diameter rope you would be using 7mm diameter prusik line if it is too fine the prusik knot tends to jam on the rope, if it is thicker the prusik knot tends to slip down the rope.

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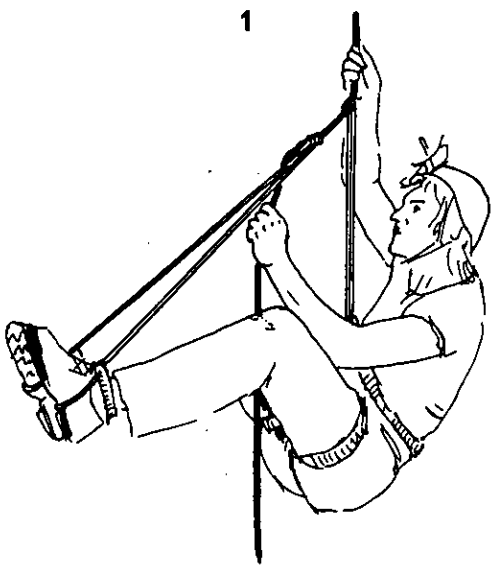

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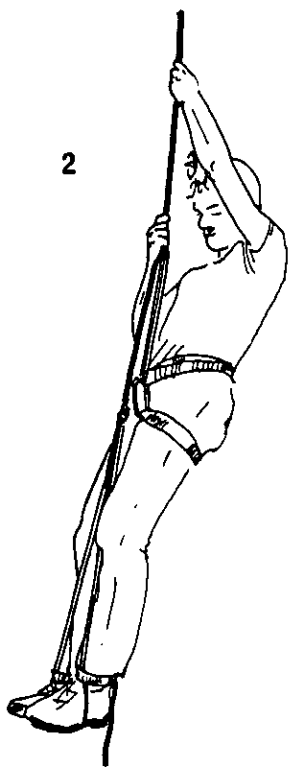

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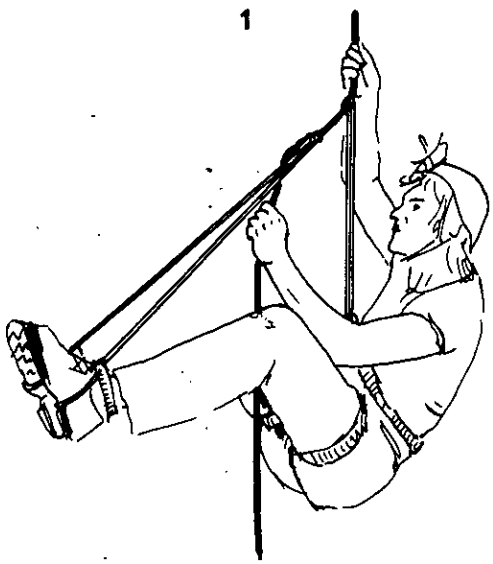

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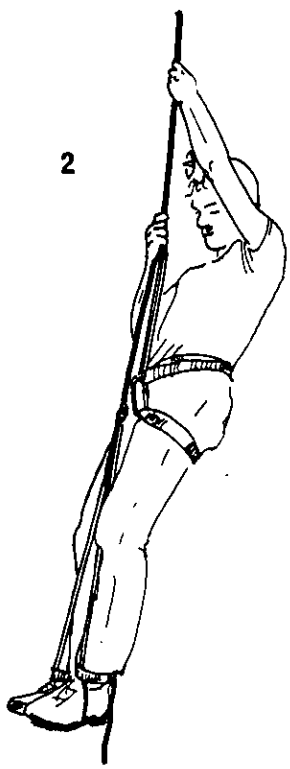

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ROPE JOINS

At certain times you need to join ropes, slings, prusik line, safety lines and even the rope you are climbing on. To join equal diameter ropes, double/ triple fisherman's knot or the figure eight bend are excellent and similar in usage The fisherman's knot can hold a lot more load without slipping out.

DOUBLE FISHERMAN'S KNOT

Double fisherman's take's a little to get right (solution, practice make's perfect) it has an unmistakable. aesthetic appearance when formed correct (fig 1.) each side of the knot is tied separately and the halves are drawn together.(For triple fisherman's, before you feed the tails through the loops, you'd form another loop on each half).

FIGURE EIGHT BEND

An analogue of the overhand knot You start the knot on one of the end's of the rope with an knot looking similar to a number eight (fig 3.) then the other end is woven though it. the standing part of each should be on the out side of the first bend.

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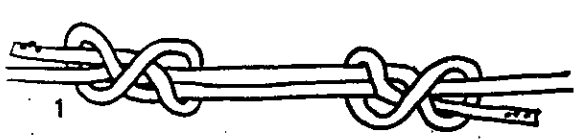

THE BOWLINE

The Bowline is an simple knot, very quick to tie, also with practice you can tie the Bowline one handed, in the dark, wet and cold .In the past the Bowline has been used for shipping and rigging. Today it is used for rock climbing, tree surgeon and rescue work it is perfect for tree sit, crane sit or banner drop (note with banner drop it pays to have more then one anchor, the air conditioning might not hold you, martyrs can not die by air conditioning related death).

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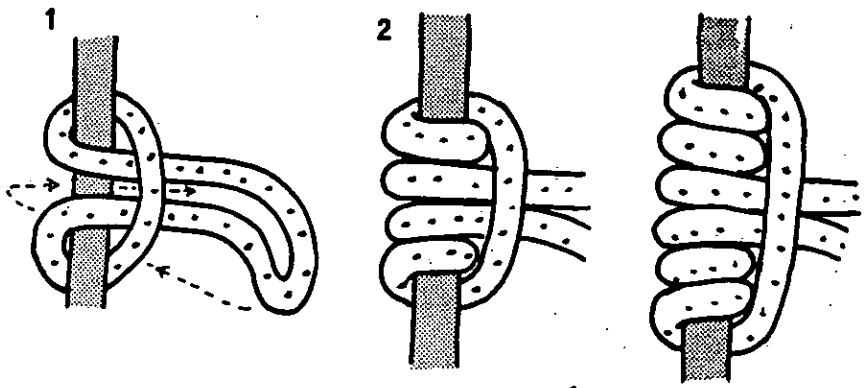

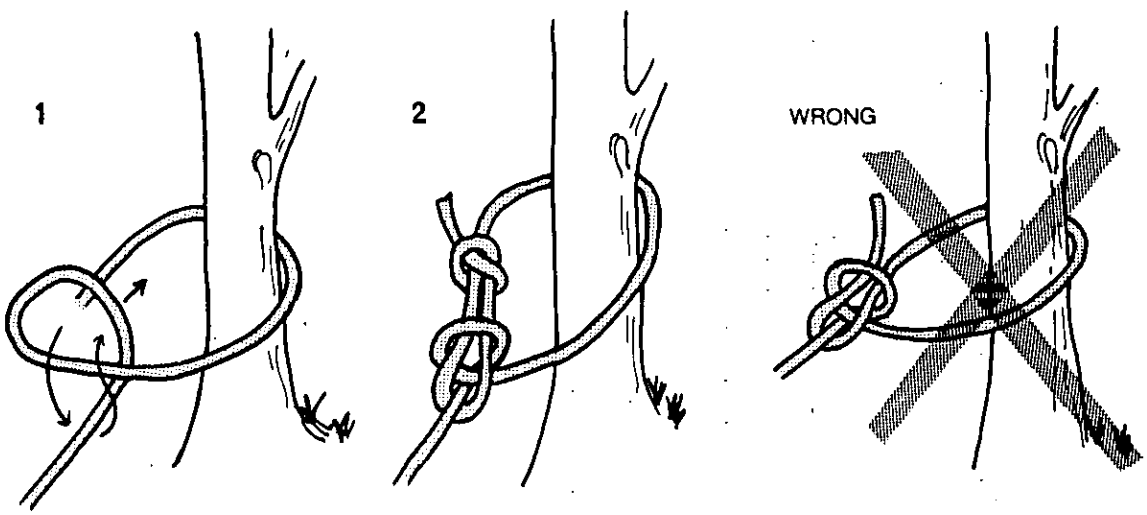

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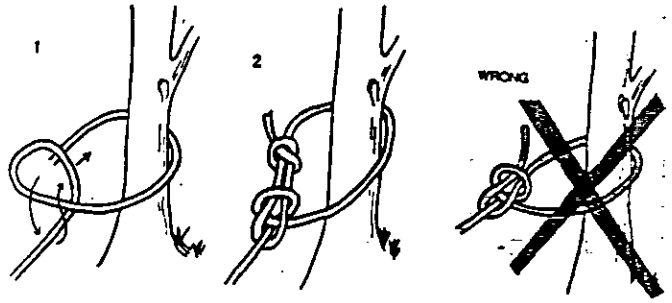
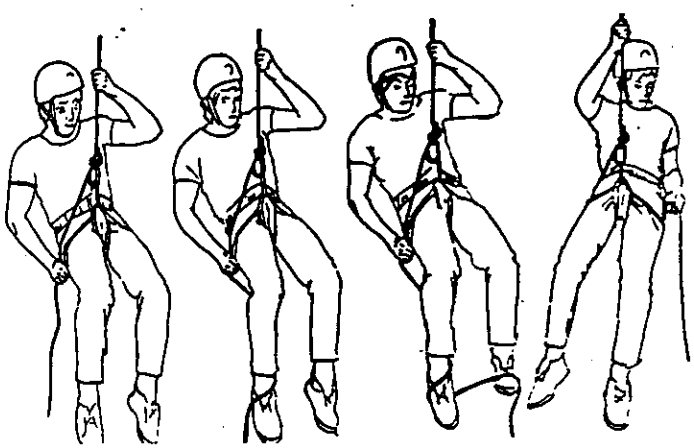


It is good style to move at a slow, steady speed without straining the arms, and with enough control to be able to stop easily at any time should the need arise. Where possible, you should avoid using an abseil device with so much friction that constant feeding of rope is necessary, since this causes arm tiring and a jerky motion which provokes rope abrasion.

Equally well, you should not use so little friction that excessive body friction is required. Some control of friction must be achieved with the body. As far as possible, friction should be taken with parts of the body other than the arm, because the arm tires easily. Good methods are to run the rope across the thigh, behind the back, or wrap it around one or both feet (see Fig 110)

These procedures also have value in emergencies. When using thigh friction, care must be taken not to run the rope heavily across the seat harness since it may melt.

Once the rope is attached to the figure eight descender; (making sure the rope you will be pulling away from is tense so you don't fall on the rope)lean back, let the rope take your weight in your hand. Slowly release the rope and let your whole body descend At the same time, keep your head well away from the rope, or you will lose your hair.
HINT. Tie back your hair before you climb.



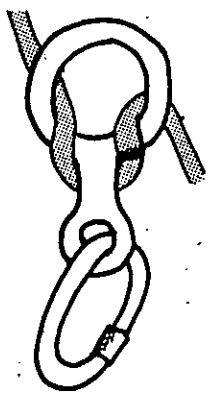


FIGURE EIGHT DESCENDER.

The figure eight descender offers exceptional strength and security. It is light, compact and ideal for extreme situations.

Alter your speed by the amount of friction you place on the rope.

To stop; grip the rope tightly. Once away from overhangs, use your other hand to take the rope below where you are holding the brake. Pull it around your bottom to reduce the weight on your brake hand. Use your feet to kick past obstacles. To avoid friction burns it is best to wear leather gloves.

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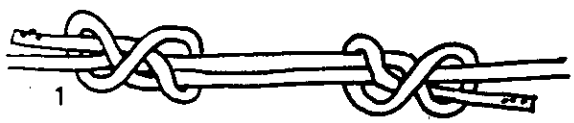

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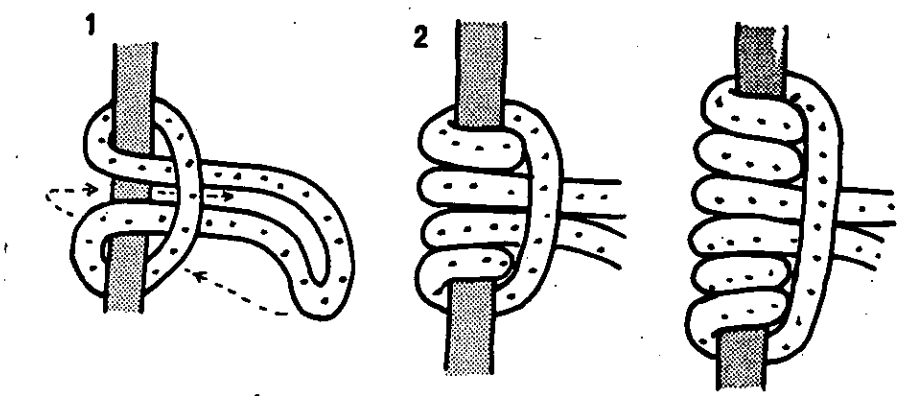

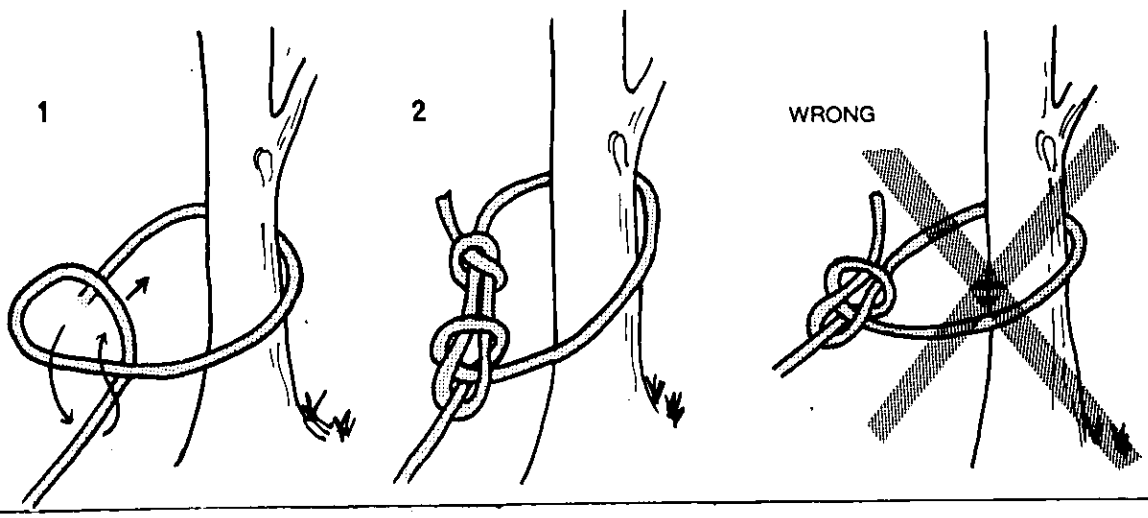

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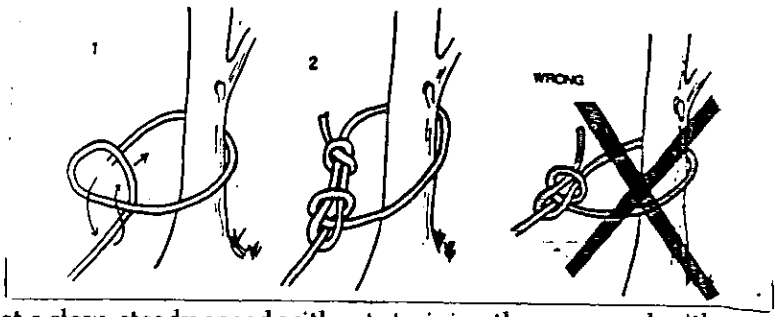

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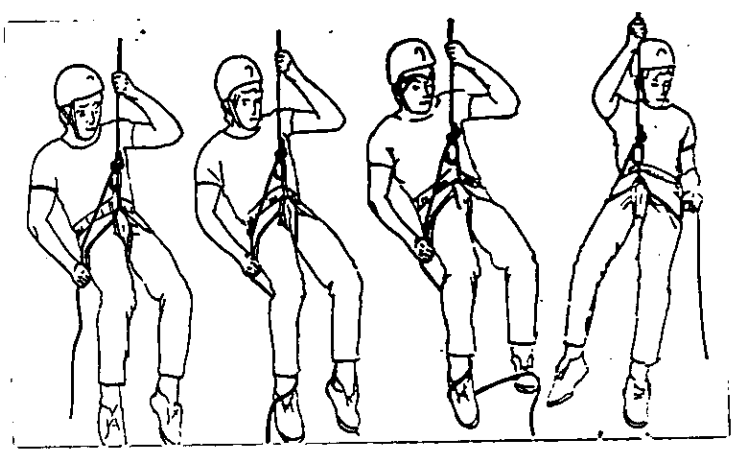
HINT. Tie back your hair before you climb.



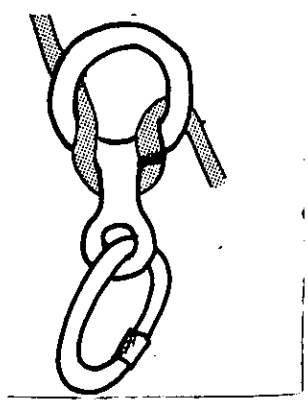


FIGURE EIGHT DESCENDER.

The figure eight descender offers exceptional strength and security. It is light, compact and ideal for extreme situations.

Alter your speed by the amount of friction you place on the rope.

To stop; grip the rope tightly. Once away from overhangs, use your other hand to take the rope below where you are holding the brake. Pull it around your bottom to reduce the weight on your brake hand. Use your feet to kick past obstacles. To avoid friction burns it is best to wear leather gloves.