
NYLON HIGHWAY
VERTICAL SECTION
NO. 4

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2nd Year NO. 4

NH MAY 1975

COVER Christmas Eve Traverse. For the love of stratospheric passage; high above Plummer's Pit in Hellhole Cave, W. Va., you'll find this hairy, guano covered traverse that was initially assaulted on Christmas Eve by John Dillon and the Editor who in the case is the one who held the ink pen too.

T A B L E   O F   C O N T E N T S

HOW TO SUBMIT MATERIAL

In able to have an authoritarian vertical oriented newsletter we need good material on the subject of vertical travel and related topics. These articles can be reprints from other newsletters or original meterial. Letters to the editor are encouraged but the editor claims the right to censor or alter any article in a way as to fit the publication without changing the intent of the article. We do request that new material be supported with tests and field usage records. Let's please stay away from politics. All pictures are requested to be black and white pen and ink drawings. The editor is able to redraw upon request any pictures of explanation that are unclear. Please submit all material to Bruce W. Smith, 1745 Woodside Drive, Westland, Michigan 48185

The NYLON HIGHWAY is an official publication of the Vertical Section of the National Speleological Society; published at least twice, but not more than four times a year by the annually elected editor. Subscriptions are $3.00 a year while membership dues are $3.00 a year. To enstate oneself as a member of the Vertical Section one will need the endorsement of two charter members or two non-charter members who have been members for two or more years.

SPECIAL THANKS:

A generous donation of $40.00 from Bruce Herr, Saginaw, MI. was gratefully received and the Editor is none too glad to admit that its good to see someone who isn't as tight as he is.

************ATTENTION************************

Your 1975-76 Vertical Section Dues are Due. Send $3.00 (Made out to Bruce W. Smith) to me at 1745 Woodside Drive, Westland, Mich.48185 Please don't make me send you a reminder, it costs more than $10.00 everytime there's a mailing.
I'm still looking for a cheap offset printer to reprint #1. Its 40 pages long. Also please let the editor know of any address correction immediately please.

Editor:

The Vertical Section of the NSS is publishing an interesting newsletter, called the NYLON HIGHWAY, which contains informative articles devoted to the arts and techniques of vertical caving. Unfortunately, the newsletter is only distributed to members of the Vertical Section.

I strongly feel that the Vertical Section should think on a grander scale. Why publish information on the latest innovations in safe and sound vertical techniques to a small audience via a newsletter with limited distribution?? I suggest that at least onece a year the Vertical Section should publish a special issue of the NSS NEWS devoted to vertical caving. This would give maximum distribution of valuable information to all cavers in the NSS.

Sincerely yours,

Bill Deane, NSS 9591F

LETTER FROM THE EDITOR

The NYLON HIGHWAY has come through its second year with out much difficulty. Our membership has grown to 120 while we lost 25 members. I am encouraged with this years participation by other writers. We've been able to give a good cross section of ideas and I hope a newsletter that was worth $3.00. I see no reason to raise prices next year so relax. All the present members can help by talking up the NYLON HIGHWAY. The more members we have the more professional we can make it look.

I like Bill Deane's idea, but I would hate to be the one who had to select which articles would go to make up the issue. The NSS NEWS, I feel, definitely lacks in Technical articles.

Vertically yours,

Bruce W. Smith

IN SEARCH OF A BETTER SEAT SLING

by Wil Howie

Has it happened to you? You start to walk over to the rope to rig in and you trip over your seat sling or you're climbing out and your seat sling insists on riding somewhere around your knees? Or you're wearing more clothes because it's going to be a long, cold trip and your regular seat sling doesn't want to get up around your waist? Some of us thought that custom slings might be the answer but while these probably come closest to giving the best fit several problems come up. Most cavers don't have access to the good sewing machines necessary to do the job. Also to build a properly fitted sling can be incredibly time-consuming. One well-known vertical freak, who owns his own machines, said that he spent 11 hours putting his custom deluxe sling together.

Where does this leave the caver who wants and needs a good sling? One that will fit him, give him a confortable fit, won't drop to his ankles every time he stands up and moves and one that does not require a heavy duty sewing machine close by and large amount of time?

I have used the following design for the last 5 years in a wide variety of pits, under many different conditions, to my complete satisfaction. As near as I can determine, the basic idea for the sling was Jesse Guzman's. One evening he walked into the meeting in San Antomio and threw a 10 foot piece of 2" webbing on the table and challenged anyone to make his seat sling out of the material. Since then, I have added to or modified most of the features of his design though the basic idea remains unchanged.

All you need to construct the seat sling is 1 Paragear No. 339 buckle (available from Bluewater) 1 large oval locking carabiner, 10' of 2" webbing (this is enough for the average size caver, larger bodies require more) and a sewing awl. Somebody in your grotto probably has an awl, if not, Sears sells them. Other sources are shoe repair shops or tent or awning makers who have heavy duty machines. Sweet talk them into helping you out but make doubly sure that they use nylon thread, both on the spool and the bobbin (nylon won't burn but will melt). Don't be afraid to ask and to supervise the stitching; after all, it's your life, not theirs, hanging on the sling. Sew the buckle on one end (see "Nylon Highway" #3 for a discussion on stitching patterns) a 4" overlap should be quite adequate.

To get rigged in, first run the end with the buckle thru the carabiner allowing enough slack so that the end can go around your thigh. (To determine more closely what length is correct for you, measure the diameter of your thigh at your crotch and add 6".) Hold the carabiner and webbing in front of your crotch, see Fig. 1, then with your right or left hand reach from behind and thru your legs and grasp the buckle. Bring it around the back of your right or left thigh (not the buttocks) and thru the carabiner from behind, See Figure 2. With your other hand, reach around the other thigh,

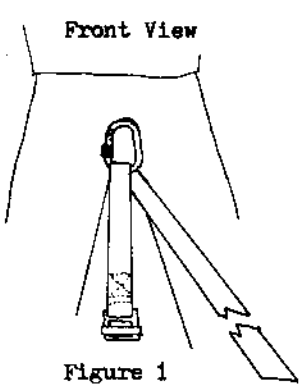


Figure 1

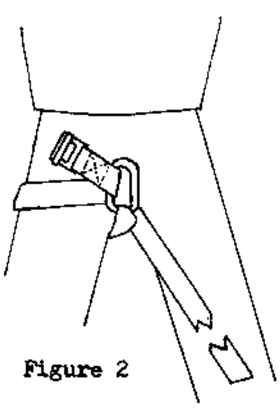


Figure 2

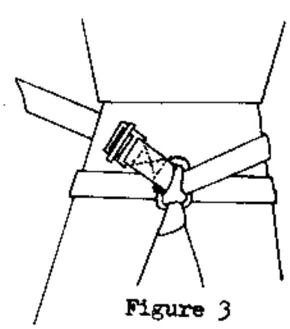


Figure 3

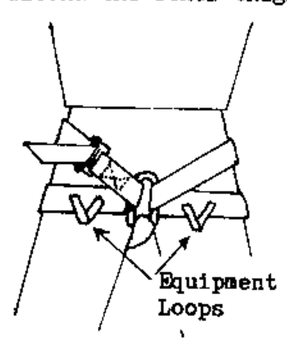


Figure 4
Half-hitch
not shown

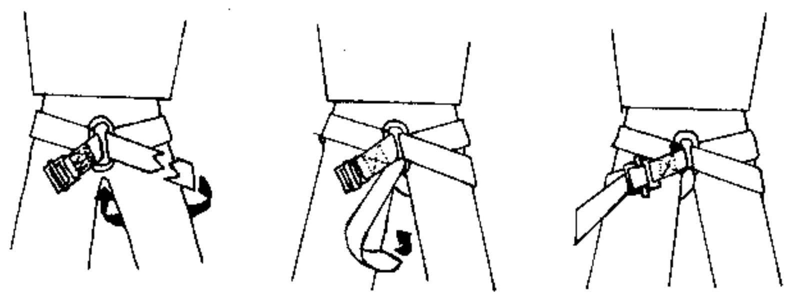
thru your legs and grasp the other end and bring it around and thru the carabiner from behind, i.e., from close to the body outward, see Figure 3. Take this end and carry it around your back and just above the buttocks and then fasten in to the buckle and secure it with a single half-hitch, Fig. 4 and that's it.

Advantages:

1. It's cheap to make and easy to put together.
2. It provides a tight but comfortable seat sling that you can walk in and one that won't fall out of place, on or off the rope.
3. It is custom fitted to you but can fit just about every other caver, an extremely useful feature in rescue and training situations.
4. I have used it extensively with many types of ascending systems and it fits into each readily, either as the nucleus of the system or for the resting stage.

Pointers:

1. The sling might be a bit awkward to rig in at first until you become familiar with it. As with any new rig, play around with it until if feels right. Men must be conscious of their anatomy when first putting on the harness.
2. One inch webbing and "D" rings for buckles can be substituted as can a steel ring in place of the carabiner.
3. Be sure and use nylon thread to sew with a cotton thread will rot.
4. Always finish off with a half-hitch above the buckle, no sense in having to look down and see the end snaking out thru the buckle and freaking out.
5. After you've gotten it adjusted, you can sew on equipment loops, see Figure 4, clip in a couple minibiners and instead of derigging between multiple pits, just clip in your equipment into your seat sling.



Editor's Note:

As a caver, as well as an editor, it is always good to hear from someone who agrees with your own personal practices or methods. I have been using the seat sling Wil has explained for more than 7 years with no problems. I've thrown a little different twist into it though by wrapping the 2" webbing around my waist first, then proceeding as shown above. It's fast, fits as good or better than any custon built job, it's compact, light, comfortable and can be used in a multitude of other simple riggings like strapping your gear to the top of your car.

WHIPPING

by Bruce Smith

If I may, let me propose a whipping which I've used for several years when tieing up prusik cords. Nylon is an excellent material to use, but too often, I find it slippery with a tendency to slide and work itself out of a knot. So I looked for a good whipping, one which I felt confident with.

The first thing and of paramount importance is the cord which is to be used. A heavy Nylon thread that tests up to 50# a strand is great. Allied Electronics sells a 50# test nylon lacing tape which is waxed. The waxing is the key. A waxed thread or string locks on itself when you tie a knot. If your thread is not waxed, use beeswax. In fact waxed thread should always be used whenever

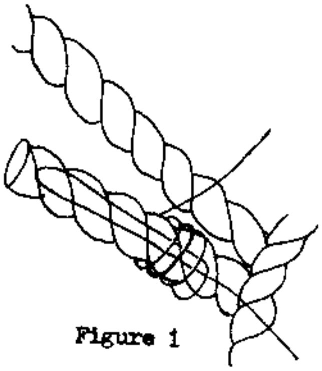
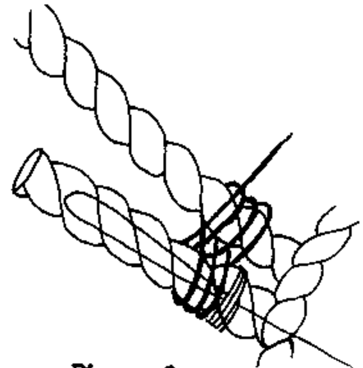


Figure 1



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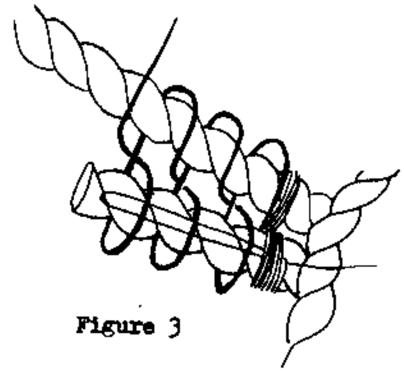


Figure 3

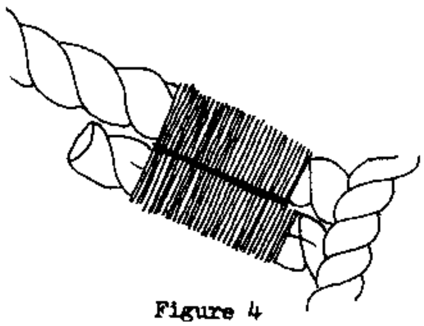


Figure 4

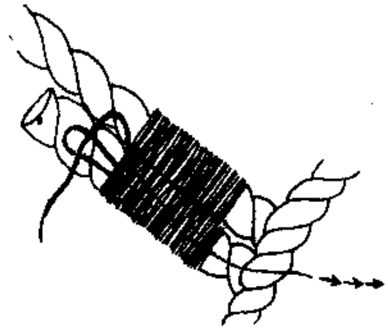


Figure 5

End View

possible, when stitching webbing, seat slings and climbing gear.

The whipping takes about five minutes. Begin with a standard whip and progress to a figure 8 stitch to hold the two cords together. (Fig. 2) Then begin (Fig. 3) binding up a long series of lock stitches. Finish it off after many lock stitches like you would a standard whip.

The advantages are numerous. The whip is so strong it could easily hold your weight without a knot to back it up. With each stitch locked, it's like having many little whippings all combined in one. If any part of your knot jets out or snags on sharp rocks, the rest of the whipping is actually unaffected.

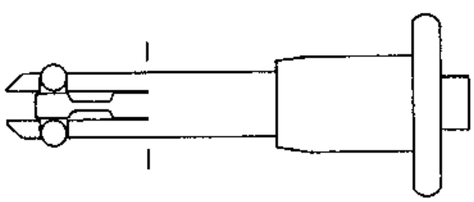
In 1968 I whipped about ten cords this way. Today in June 1975 they are still my most trusted prusik cords. I've never had to replace any one of them over the last seven years. To top it off the whipping looks good and gives your equipment a sense of pride.

MUD-PROOFING QUICK RELEASE PINS

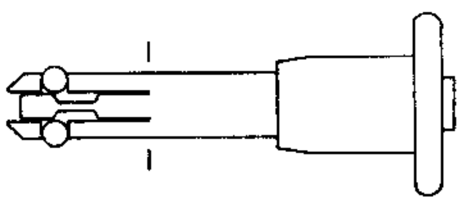
by Kirk MacGregor

Shortly after the quick-release pin version of the Gibbs Ascender went on sale, everybody was surprised to discover that the pins were not reliable when muddy. After some experience with them I found the cause of this problem and told Charlie Gibbs how it could be minimized. Gibbs Products then got Avdel Limited (which manufactures the pins) to modify them slightly, and mud problems are now uncommon. However, for the benefit of anyone who does encounter a mud problem, here are the causes, the symptons, and some cures.

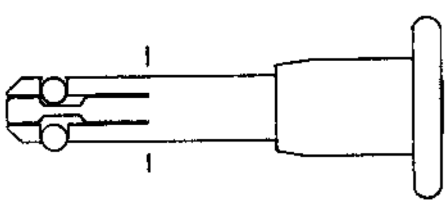
While mud could clog a quick-release pin in a number of different ways, all the problems I have heard of involve only the two small steel balls and the parts touching them. Normally these balls are either free to move in and out (the released condition of the pin, as in Figure 3), or are immovably held out (the locked condition of the pin, as in Figure 1). The position of the balls is controlled by the position of a small diameter part of the rod in the center of the pin. When the releasing button is pushed, the attached central rod slides towards the ball end of the pin, placing its thin part between the balls, and allowing them to move. When the button is released, the spring in the pin handle pulls the central rod back towards the handle end of the pin, placing the full diameter section near the end of this rod between the balls, and forcing them out into the locked position. The quick-release pin mud problem occurs when a film of mud around the two balls prevents them from moving quite all the way out when the releasing button is released. If the clearance around the balls is too small to accommodate the thickness of the mud film, the spring in the handle cannot pull the central rod all the way back towards the handle, and the pin only partially locks, as in Figure 2. Note that the balls are on the taper to the thin part of the central rod in Fig.2, not safely on the uniformly thick end of the rod as in Fig. 1. A pin in this condition can be removed from its Gibbs without the releasing button being touched at all. As force is applied to such a pin, the hole in the Gibbs wedges the balls inwards, the balls wedge the central rod along so its thin part is between them, and the pin is out. Of course, the force required varies greatly with the pin and the circumstances, so a lot of partial lockings can go unnoticed, except for one symptom.



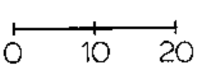
1. Properly locked.



2. Partially locked due to mud.



3. Released.



Approximate Scale (mm).

Figures 1, 2, & 3: The quick-release pin in three conditions. Note that the left end of each drawing is a cross-section, while the right end is an outline.

The symptom of a partially locked quick-release pin is a half-out releasing button as in Figure 2. Any pin in this condition may come out of its Gibbs. It's a good idea to get such a pin properly locked

Two temporary in-cave cures exist. The first is to fiddle around with the pin, and, if possible, rinse it in water. While this often works, the easiest "first-aid" is to put the Gibbs on the rope and then jam a sufficiently thin and strong object into the hole in the ball end of the pin to force the central rod into its properly locked position. Sometimes such "cures" last all the way out of the cave, but it is common to have to repeat the cure again each time the pin is locked (i.e. for each pitch), especially if the pin was a bad case that did not respond to treatment number one. Forcing the central rod over is easy if you have a pocket knife with a marlin spike. (The marlin spike is excellent for pushing central rods digging carbide out of lamps, untying jammed knots, and other odd jobs, making such a knife well worth getting for caving. Most yachting and some "Surplus" stores carry them.) If you don't have a marlin spike, a "central rod pusher" can be made in advance from coat hanger wire. Make it short with a reasonably comfortable handle, as considerable force may be required.

Having escaped from the cave, you may want a permanent cure for this problem. Simply increase the clearance around the two little balls to make room for a layer of mud as well as the balls when the pin is locked. When they are clean, the balls of a pin with adequate clearances can "rattlearound: in their holes a bit when the pin is locked. However, the adequacy of the clearances cannot be determined completely reliably just by looking, and only mud gives a certain test. Note that increasing the ball clearances may reduce the life of the pin, as that much less wear is then required before the outer ends of the holes holding the balls becomes too wide and the balls fall out. Thus the clearances should be no larger than necessary. On the other hand, none of the pins I have treated has lost any balls after several years, and there is no point in prolonging the life of a pin that doesn't work.

One approach to increasing ball clearances is to take your "rod pusher" or marlin spike on all your vertical trips and keep forcing the central rod over as needed. Inside of 30 pitches, the metal around the balls will deform to give adequate clearances, and all will be well! However, the quickest and probably best, way to increase the clearances is to grind them out. There are a number of ways to do this, but what follows is probably easiest for most people.

Put a ½" steel washer on a ¼" arbor, mount the arbor in an electric drill, and mount the drill so it doesn't need to be held. (Feel free to use plain steel rod, the flange of the arbor, a drill press, a lathe, and/or any variations on this that you like. The details are not critical, and almost any rpm will do.) While holding the releasing button of the pin in, push 180 to 280 mesh grinding compound in around the two little balls. (A small screwdriver is good for this job. Somewhat coarser or finer compound can be used, but too coarse a grit will shorten the pin's life - perhaps to zero for 100 mesh! - and too fine a grit will give only partial mud-proofing.) If the pin functions normally despite ample amounts of grinding compound in with its balls, it should be mud-proof, and you can skip the grinding and clean the pin. Mud sensitive pins only partially lock when gritty, and need grinding.

To grind the pin, turn on the drill and press one ball against the edge of the rotating washer so the ball spins. Rapidly move the central rod back and forth a little around the position in Figure 2 by moving the releasing button (do not go as far as the positions in Figure 1 and 3), meanwhile moving the whole pin a bit relative to the washer and frequently rotating the releasing button (and thus the central rod). This usually needs both hands, and ensures that the grinding is spread around evenly, avoiding future trouble with flat spots on the ball,extra dents in the central rod, etc. Every several seconds, change to the other ball, and, as the grit wears down and allows the pin to lock normally, add more grinding compound. Be careful to apply the moving washer <u>only</u> to the balls, not to nearby metal. Removing metal from the outside of the pin does no good and may shorten pin life. It may also be worth holding the ball end of the pin a bit lower than the handle end to discourage migration of grit into the handle.

In a few minutes, no amount of new grinding compound will prevent the pin from locking normally. Grind the pin a bit longer to get your money's worth out of the new grit, and then clean the pin. The cleaning is easily done by snapping the releasing button in and out while alternately dipping the ball end of the pin vertically down into a solvent that dissolves your grinding compound (some don't, so check! Also ventilate adequately and avoid igniting inflamable solvents,) and wiping the ball end of the pin on a rag. When no more grit comes out, the pin is finished. Quick release pins work best if they are kept lubricated with powdered graphite (not oil, which collects dirt), and the first lube job can be given as soon as the solvent has evaporated. Put the graphite in beside the releasing button as well as around the balls and down the central hole, and repeat occasionally as desired.

LADDER CONSTRUCTION AT McMASTER

by Peter Thompson & Julian Coward

The following article describes the method of flexible metal ladder construction used at McMaster. A thorough discussion of the various methods of ladder construction can be found in "Manual of Caving Techniques" (1969. Ed. C. Cullingford, Routledge, Kegan and Paul, London).

1. Materials

1.1 Rungs - ½ inch outside diameter tube, 16 gauge aluminum, preferably 2024 T6 (aircraft grade alloy), or 6061 T6 alloy.

1.2 Wire - 1/8 inch diameter, 7/19 construction galvanized aircraft wire rope (minimum 2000 lb. breaking strain).

1.2.1. Belays - 5/32 inch diameter wire, same construction. (minimum 2000 lb. breaking strain).

1.3 Epoxy Resin - Hysol 4362 resin and 3404 hardener.

1.3.1. Filler - Alundum (100 - 200 mesh Al_2O_3).

1.4 Ferrules - Nicopress oval sleeves - 18-3-M for 1/8 inch wire, 18-4-P for 5/32 inch wire.

1.5 C - links - Welded, 5/16 inch mild steel chain.

1.6 Thimbles - Preferably 5/32 inch (or 1/8 inch) galvanized or stainless steel for the 1/8 inch wire, and 3/16 inch galvanized for the 5/32 inch wire.

1.7 Corks - Size 1

1.8 Pins - One inch by 16 gauge panel pins.

2. Method of Construction

The 1/8 inch wire is cut to the desired lengths. To calculate the length of wire needed the number of rungs to be used should be multiplied by spacing (usually 10 inches) and about 1 foot added. An oxygen/gas torch is a useful cutting tool because the wire can be twisted when hot and drawn to a point; this makes threading of the rungs a simple process. If a torch is not available the (clean) cut end can be dipped in solder and then filed down to produce a tapered end.

The aluminum tubing is cut into six inch rungs with a tubing cutter, which is fitted with a guide to allow equal length rungs to be cut. The rungs are then corked at both ends and the corks pushed 7/16 inches below the end of rungs with a simple flanged tool. Two 0.136 inch (drill No. 29) holes are drilled through the rungs 5½ inches apart. The jig shown in Figure 1 ensures rapid,

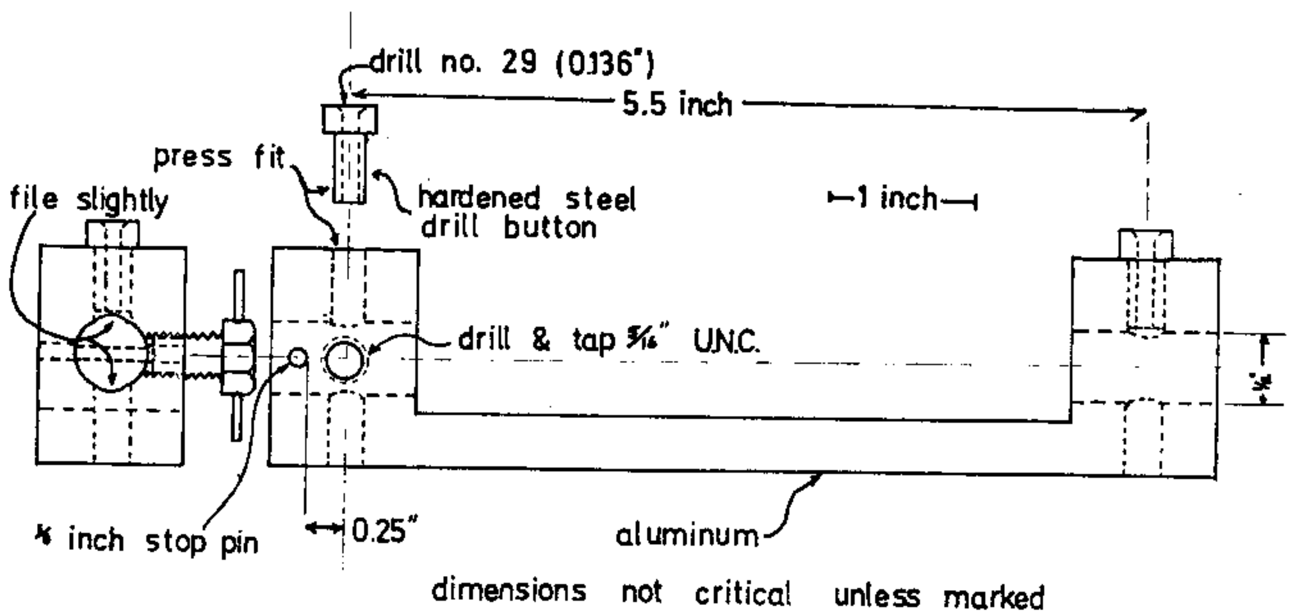


Figure 1

RUNG DRILLING JIG

uniform positioning of the holes. The required number of rungs are threaded onto the two lengths of wire. Optimum rung spacing is 10 inches a bit of a drag. Rung spacing is made easier if a jig such as shown in Figure 2 is used.

To allow resin to permeate between the strands of the wire (to prevent rung slippage) a 1 inch panel pin is pushed into the wire (between strands 3 and 4) inside each rung. The head of the pin is cut off if it protrudes beyond the end of the rung. After each set of rungs is pinned the ladder is turned over before the next set of rungs are pinned to reduce accumulated errors in one side of the ladder. The pin also effectively holds the rung in position so the ladder can be removed from the spacing-jig then loosely rolled ready for the next operation.

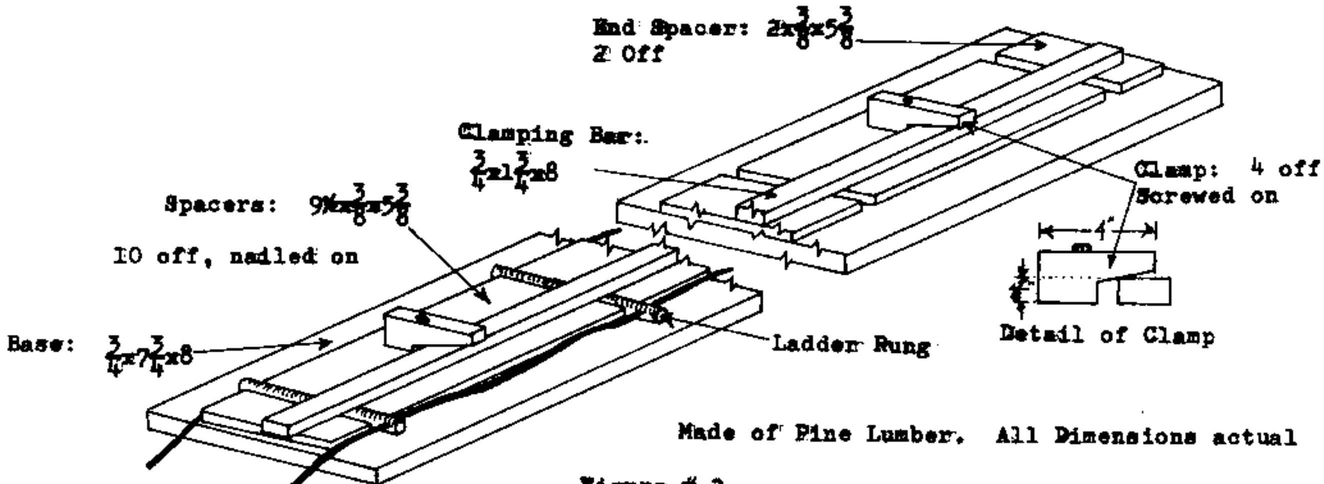


Figure # 2
RUNG SPACING JIG

Before the rungs are permanently fixed in position the wire and inside rung must be degreased. The best degreasing agent, also relatively cheap, is hot trichloroethylene but the vapours are quite noxious. The degreasing step should only be carried out in a well bentilated area. Other organic solvents such as carbon tetrachloride can be used. If possible an industrial degreasing plant should be used.

When all of the degreasing agent has evaporated the resin may be mixed. A filler is added to reduce the amount of resin used and to increase the strength of the bond. The proportions of resin: hardener: filler are 100:7:70 by weight. The correct proportion of resin to hardener is critical. The resin has a pot life of only 30 minutes at 25°C so the next operation has to be performed quickly. When the mixture is thoroughly homogenised the resin is drawn into a 25 ml plastic syringe, with the needle and drilled out to ¼" and inserted into the end of each rung. When all the rungs on one side of the ladder are filled the resin is left to harden. The resin can be cured at 60°C for 2 hours or it can be left for 24 hours at room temperature. When the resin has set the ladder can be turned over and the operation repeated. It is usually necessary to later add more resin to each side of the ladder to fill up loss by leakage and air entrapment. The wire at the end of the ladder is then cut off leaving 6 inches beyond the end rung. This wire length gives correct rung spacing over the join, but between ladders a check should be made if thimbles, C-links or sleeves are changed.

To enable sections of ladder to be joined, the ends of the wire are spliced around "C" - links Two saw cuts at right angles are sufficient to produce these links. Figure 3 illustrates the position of these cuts. (N.B. The cuts must be made through the welded part of each link). A Thimble is slotted onto the C-link, then the four ends of the ladder are spliced using the

Nicopress sleeves. A hand tool is used to crimp the sleeves onto the wire. This tool costs about $50.00 but is usually kept by suppliers of boat equipment and accessories and can usually be rented at a moderate cost. Talurit sleeves are generally used by wire and rope manufacturers. These splices are slightly stronger but usually cost $1.50 each. A self explanatory diagram of the finished ladder is shown in Figure 4.

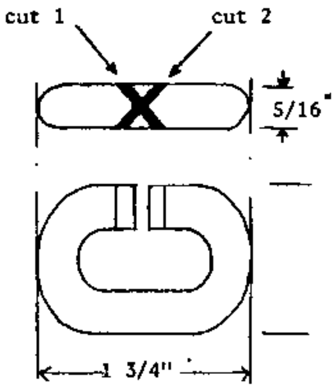


Figure 3 Position of cuts to make "C"-link

Belays, or tethers, are made from 5/32 inch wire. The ends are finished in exactly the same way as the ladder but the sleeves and thimbles are of different size. Belay lengths ranging from 5 feet to 20 feet are sufficient for most situations. A slightly modified type of belay is the spreader which can be attached to pitons or expansion bolts. A spreader is shown in Fig.5.

3. Testing

Some comparative tests on two unused, freshly-constructed ladders and a ladder used extensively for 3 years were conducted to check for deterioration. A gradual force was applied between two test rungs until one rung slipped on the wire. It was found that slight slippage occurred when the applied force was about 200 lbs. below that at which complete slippage occurred. The results of these tests are shown in Table 1.

It is gratifying that the used ladder appears to be stronger than the new ladders. This is probably due to the fact that the resin in ladders 1 and 2 was not properly cured when tested. The ladder cured at high temperature (No. 2) was weaker than the ladder cured at room temperature (No. 1). The result for the used ladder is entirely satisfactory. In addition to the above tests both new and used splices were tested. The Nicopress fittings are copper with a zinc coating on the inner surface. There was some concern that a corrosion cell may develop between the wire and sleeve when the ladder is wet. The same 3 year old ladder, which has been used down many wet caves, was used for this test. A new splice failed at 2850 lbs. and the older splice failed at 1900 lbs. when the wire broke. Consequently it appears that the wire deteriorates more quickly than the splice, but after 3 years of use, the wire failed only just below the specified minimum breaking strain. It is not known whether a linear extrapolation can be made to predict when the wire would fail under normal caving use. More tests at a later date

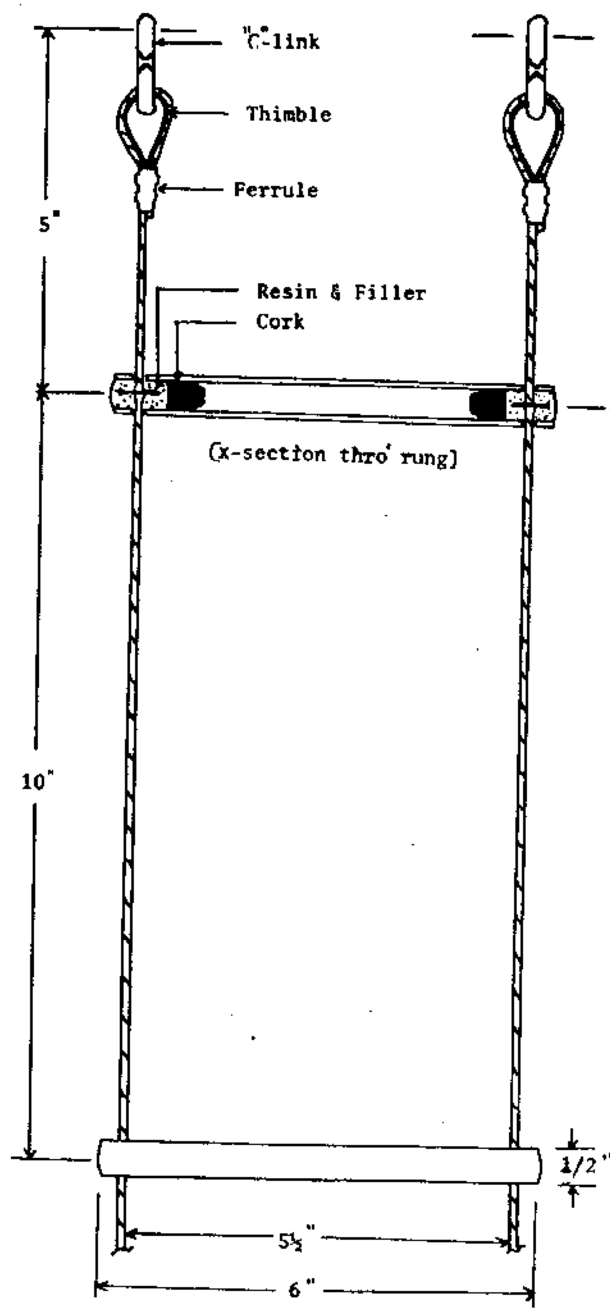


Figure 4 End section of finished ladder (Approximately to scale)

should help to resolve this. Considering the results of the rung testing there is a good possibility that in an older ladder the wire will break before the rungs slip.

Table 1

Force Required to Slip Rungs on the Wire

	NEW				USED	
	Ladder 1		Ladder 2		Ladder 3	
	1*	2**	3	4	5	6
applied force (lbs) at failure	1050	1100	950	900	1950	2100

* neat resin used - no filler
** resin and filler used

ladder 1 cured at room temperature for greater than 3 days.

Ladder 2 cured at 100°C for 1 hour. Left at room temperature for 2 days before testing.

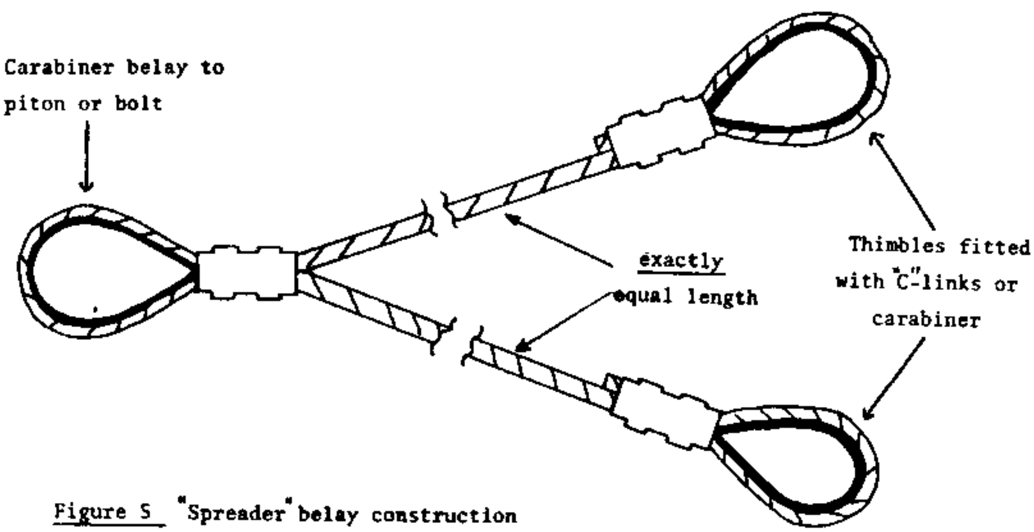


Figure 5 "Spreader" belay construction

The C-links were also tested and these started to open between 650 and 800 lbs. When the applied load was between 1000 and 1050 lbs the links started to open rapidly. None of the three links tested broke, but opened up sufficiently to release the other C-link. These links therefore constitute the weakest part of the ladder but under normal cave conditions they should be adequately safe. Stronger, but more expensive, links could undoubtedly be obtained.

In summary, there appears to be no possibility of rungs slipping under normal caving use, on ladder up to 3 years old. There appears to be some deterioration of the wire rope but even after 3 years the breaking strain is still comparable tothe manufacturer's specifications. There is no appreciable deterioration of the Nicopress splice after 3 years of use.

4. Repairs

In over 600 feet of ladder, used on many caving trips for three years, not a single rung has slipped and no wire or C-link has broken. However a few ladders have been damaged by falling rocks, and repairs are made by cutting out the offending rung or piece of wire, and either making two short ladders or re-joining the shortened ladder with two nicopress sleeves. A small space should be left between the two sleeves to allow for expansion when the sleeves are pressed.

5. Costs

It is difficult to estimate the cost of making a single ladder because the exact amounts of material required cannot usually be purchased. If a number of ladders are to be made the average cost can be calculated. Based on the prices shown below the average cost of a 30 foot ladder is approximately $21.00. (This assumes the ends are spliced professionally at a cost of $1.50 per splice. Clearly, it is not worth buying the tool if only a few ladders are to be made). This does not include the cost of building the rigs shown in Figures 1 and 2.

5.1. Cost of Raw Material

½ inch (outside diam.) 16 gauge aluminum alloy		$31.00 per 100 ft.
1/8 inch galvanized aircraft wire		11.90 per 100 ft.
5/32 inch		13.00 per 100 ft.
Hysol 4362 resin		19.50 per gallon (13 lbs)
Hysol 3404 hardener		2.75 per pint (1lb.)
Alundum filler		10.75 per 25 lbs
Nicopress sleeves 18-3-M (for 1/8 inch wire)		8.35 per 100 (minimum order)
Nicopress sleeves 18-4-P (For 5/32 inch wire)		10.85
Nicopress tool, 64 CGMP		49.50 each
Thimbles		.11 each
Corks	approx.	.50 per 100
Pins	approx.	.40 per 1000
5/16 chain for C-links		.04 a link

Note 1. Many companies that sell tubing and wire require a minimum order of $25.00

2. These costs are as of September 1972.

Completed ladders can be purchased from McMaster Caving and Climbing Club at a cost of $1.50 per foot (subject to change). A limited number of ladders can be supplied to clubs or individuals who do not want to invest entirely in ropes and prusik gear. Enquiries should be made to The Canadian Caver, Department of Geology, McMaster University, Hamilton, Ontario.

BEYOND THE 7th TOOTH

Into the Twilight Zone with Gibbs Ascenders
by Don Davison Jr.

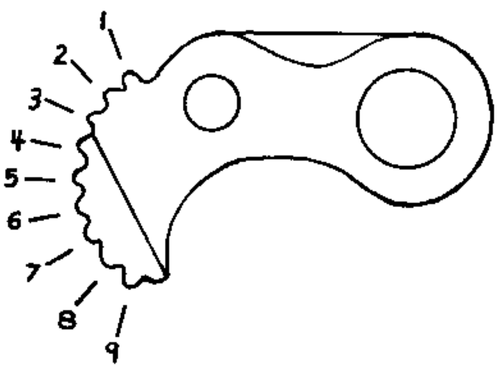
The amount of wear which a Gibbs Ascender cam jaw can sustain and still hold multiple body weights in a critical factor in the ascent of long drops and the assembly of rescue hauling systems. It is important that all vertical cavers be familiar with this wear-point since Gibbs Ascenders are becoming increasingly popular.

In developing and testing the Davison System, individual components are taken to destruction under actual caving situations. In this manner, the effects upon safety and mobility can be fully analyzed. The average caver should never experience component failure with the system because its approach is very obvious, and the component will have been replaced long before the actual failure point is achieved.

The following incidents will serve to illustrate the critical importance of the cam jaw wear point on 7/16" rope: We were demonstrating the rescue-lift method of the Davison System on a rope rigged from a fire tower. I (180) pounds started up the rope with the Davison System and approximately 6 feet from the ground paused to allow a second man (175) pounds to clip into the shorter of the two slings which were hanging, one from each leg loop. I then cammed up (total 355 pounds) an additional 6 feet with no problem. At this point, a third man (160) pounds clipped into the longer sling and I attempted to cam up the rope (total 515 pounds). My foot cam held well, but the knee cam slipped continuously under the 515 pound load. I could only raise the three of us about 4 feet before the load tired my right leg excessively. At this point, the third man unclipped and lowered himself to the ground. With the load now reduced to 355 pounds, I continued easily up the final 20 feet of the rope with NO slippage of the knee cam. All this took place on marine lay Goldline in free fall conditions.

Both the foot and knee cam jaws appeared badly worn, after the incident. But the knee cam had held under 1 and 2 body weights, so it went back caving, with the rest of the system. About 80' after the initial slippage (under 515 pounds) during a high speed climb, out of Ellison's Warmup Pit (125'), under one body weight, the knee cam began to slip continuously on the mountain lay Goldline. Several other drops were done on that trip and just over 800' after the initial knee cam failure, on the fire tower, the foot cam also began to slip continuously under one body weight on mountain lay Goldline. My other two points got me up.

Tooth Designations of the Gibbs Ascender cam jaw. Originally drafted full scale.



Note that if either of the cam jaws had been used as a stop cam in a rescue hauling capacity, or as a belay cam, that day in Ellison's, the results could have been extremely undesirable, especially under shock loading. Yet, each cam was satisfactory for ascending under one body weight, when the cave was entered!

OBSERVATIONS:

After failure at one body weight, the knee cam jaw showed a sharp channel in the 7th tooth (See illustration) from wear. The 8th and 9th cam jaw teeth showed many faint linerations, with the mold line ridge barely in evidence on the crest of either tooth. The foot cam jaw, after failure at one body weight showed a sharp channel into the 5th tooth and a broad channel into the 6th tooth obvious loss in tooth height and many parallel scratches. On the 7th tooth, the mold line ridge was almost completely suppressed; tooth height was somewhat reduced with many parallel scratches in evidences. The 8th tooth was polished with some wear of the mold line ridge being obvious and the 9th tooth was slightly polished on the mold line ridge only.

CONCLUSIONS:

Gibbs Ascender cam jaws are readily inspected - an excellent safety feature. It is advisable that all cam jaws be retired from use on 7/16" rope when polishing of the 7th tooth mold line ridge occurs. Wear beyond this point will result in obvious wear of the mold line ridge of the 7th tooth, followed by the development of a sheen on the top of the tooth, and finally, the occurrence of very fine, faint, parallel scratches on the tooth with suppression of the mold line ridge. On Gibbs Ascender cam jaws with no mold line ridge on the crest of the teeth, development of a sheen on the 7th tooth will be the first indication of the need to retire the jaw followed by scratch development. Cam jaws should be inspected before used in a hauling system to make sure that the mold line ridge of the 7th tooth is not polished and be inspected closely during clean up after each trip, especially after polishing of the 6th tooth is noticed. The fact that a cam holds your body weight does not automatically mean it can hold a much greater load. Check it!!

A laboratory study might prove beneficial if anyone would like to send in their retired Gibbs Ascender jaws.

KNOTS USED FOR CAVING

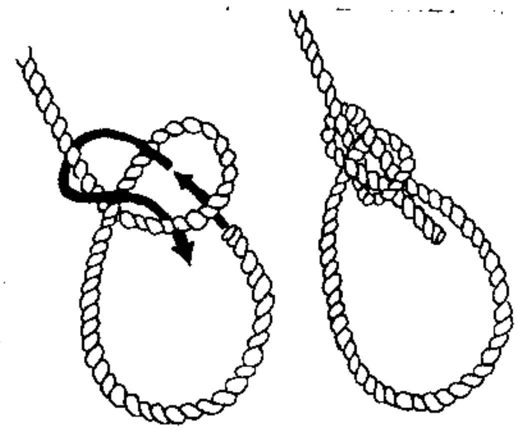
by Bruce Smith

There seems little use in going into great detail about all the knots that could be used with regard to caving. But my purpose here is not to write volumes but present a useful set of knots that hopefully can get you out of most any problem. I'm not going to attempt any actual ascending or friction knots because each one of those should be given special attention as was the Bachmann knot in Nylon Highway # 3. We can classify all other knots used in caving into 3 major categories: (1) End-line Riggings (2) Midline Riggings (3) End-to-end tie offs.

END-LINE RIGGINGS

It seems the more I'm around cavers the fewer and fewer I see who will willing to take the responsibility of rigging the rope. If a caver in your party hasn't got the confidence or knowledge to rig the rope, chances are he/she should not be there. If we're going to be safe and use good judgement, it only makes sense to sit down and teach the other members in your party the necessary knots for caving. Why not do it in the car on the way to the cave.

End-line riggings are those knots we tie at the end of the rope. Loops and various other end-line riggings can be affixed to trees, rocks, snap-links or even other cavers.



Bowline...Rabbit comes out of the hole, around the tree and back in the hole again.

Bowline

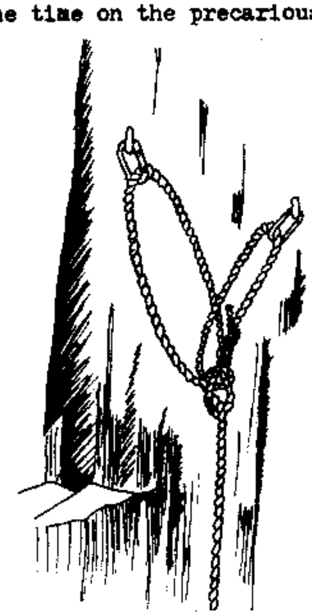
The bowline takes the shape of many knots. In fact, if you reorient a sheet bend, it's a bowline. The basic bowline has an efficiency rating of 65% and is as easily tied as untied. If the bend around the standing line is backward approximately 50% of the strength is lost. It is a pretty good knot but one must always remember that nylon is slippery so when we tie bowlines and several other knots, it is always wise to back these knots up with overhand knots.

One should be able to tie a bowline blind folded and fast, for that one time on the precarious ledge with no light.

French Bowline or Self Equilizing Bowline

This bowline has proven more useful than I ever dreamed. It has a double loop that can snap into two rigging points. Because of the way the knot is tied the tension on each loop remains equal no matter where

French Bowline or self equilizing bowline. Sometimes referred to as a double bowline, but I don't believe that is a correct nomenclature.

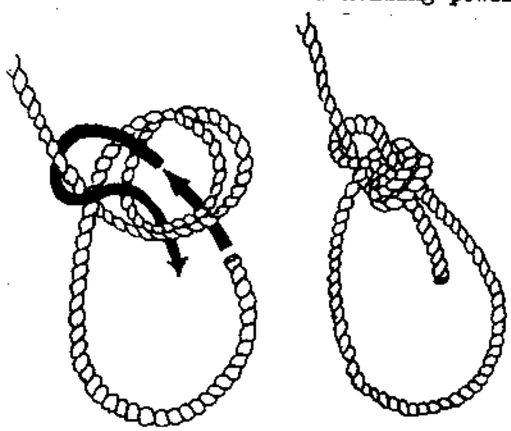


French bowline is used with two offsetting rig points. The knot will equilize tension on both points. Notice overhand backup shown.

your two rig points are. I've also used two separate stalagmites to throw the two loops over. Two rig points are better than one. If you made more than two loops such as 4 or 5 you'd have a bowline on the coil used by some mountaineers. This knot has somewhat of a greater efficiency than that of the bowline because the coils within the knot are not as tightly bent.

Mountaineering Bowline

Another bowline that is becoming popular, I know of no other name but that of Mountaineering bowline. It's internal holding power is superior to that of the bowline. Develop it's use and I think you'll like it.



Mountaineering bowline, notice the extended hole that the rabbit must work his way out of and then back into again.

Midshipman's Knot

This is not a bowline, but could very easily use a bowline in it. The Midshipman's knot is by far the best tie off you could possibly use. It's so easy that little kids tie it while playing and never realize it. Just wrap the rope around as many times as needed so that no tension on the end of the rope is required to hold the climbers weight on the rope. Always secure the end either to another tree or even around the main line.

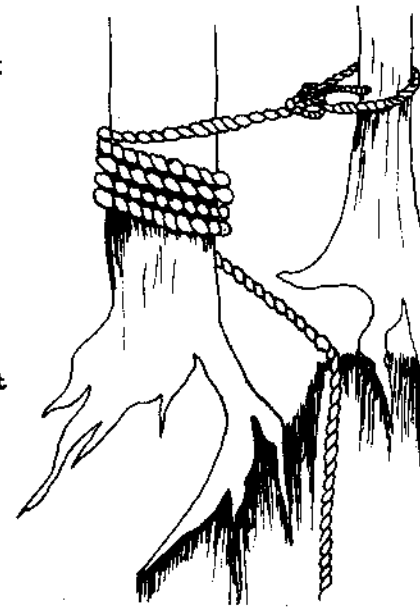
Figure 8 Knot

As a safety precaution tie a big secure figure 8 knot on the bottom end of your rope so you won't rappel off the end by accident. Don't laugh, it happens too often.

All of these knots I think you'll find useful for end line riggings. They are as easy to tie as untie, they are compact and have a high efficiency rating.

Midline Rigging

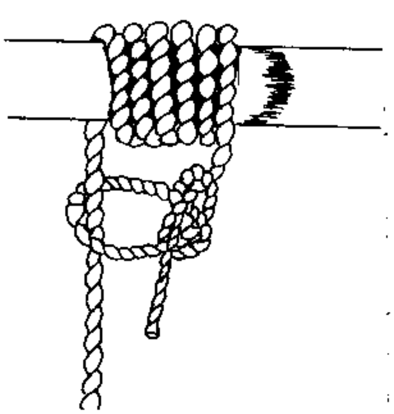
Often times you need to tie a knot from the middle of the rope such as a carabiner clip point or a 100' drop with 600' of rope. It would be senseless to throw 600' into a 100' shaft so obviously it would be best to rig in the middle of the line somewhere.



Midshipman's knot, rigging shown is one used at Elkhorn Mt. Cave, West Virginia

Bowline on the Bight

Another bowline, with a high efficiency rating and remains impossible to untie while around anything. These coils will not adjust as in the French bowline.



Midshipman's knot Rigging shown is one used in Hosterman's Pit, Pennsylvania.

Butterfly

The Butterfly is an elaborate midline rigging and in a way has proven to be some sort of a status symbol in knowing how to flip this knot into shape. It has a 63% efficiency and is as easy to tie as untie. Here are two methods of tying to get the same end result. It is not as popular as it use to be but still is a good knot to know and use.

Figure 8 on the Bight

Use this instead of an overhand on the bight, more efficient and easier to untie. Again, an excellent knot for carabiner clip-in's, trolley line hook-ups and primary riggings from the middle of the line.

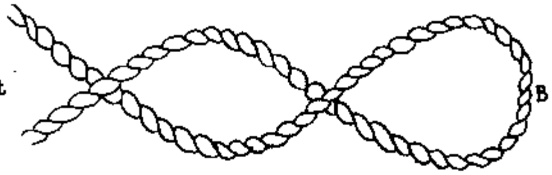
Editors Note:

Since publication it has come to my attention that the knot that I've known for 6 years as a midshipman's knot is in actuality another knot having the characteristics of a slip knot.

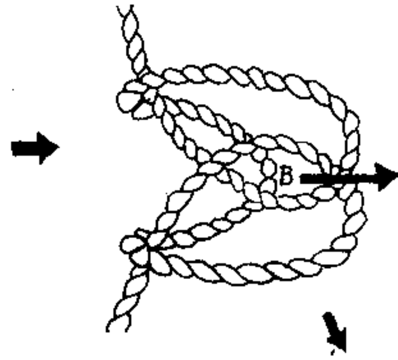
I've depicted it the way I was shown by those who taught me how to vertically cave. At present we've been unable to find a nomenclature that directly refers to the knot shown in any literature thus far examined.

It is commonly referred to as far as I can ascertain as a Multiple wrap with a back up. Can anyone help us out?

Start

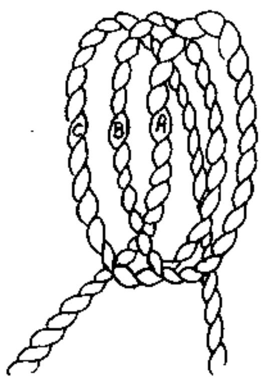


Form an eight in the rope.

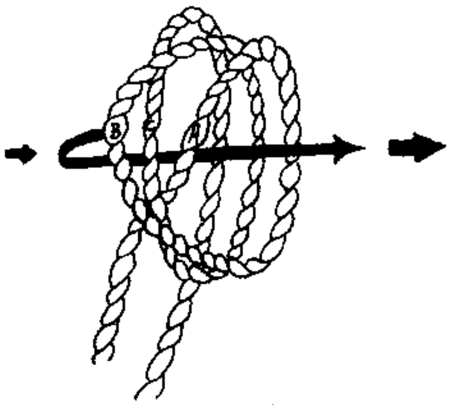


Pull "B" around and back through the center loop.

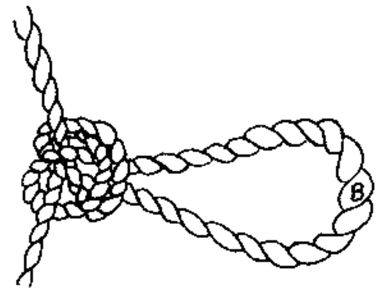
Start



Wind rope on your hand back towards your thumb.

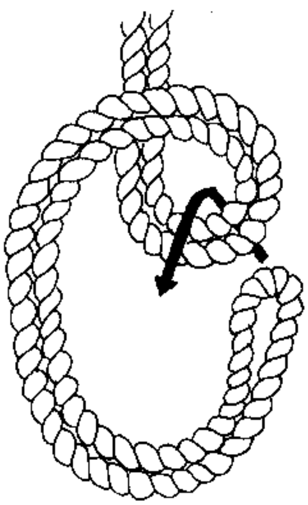


Pull the middle cord "B" out and pull it through the center of the coils.

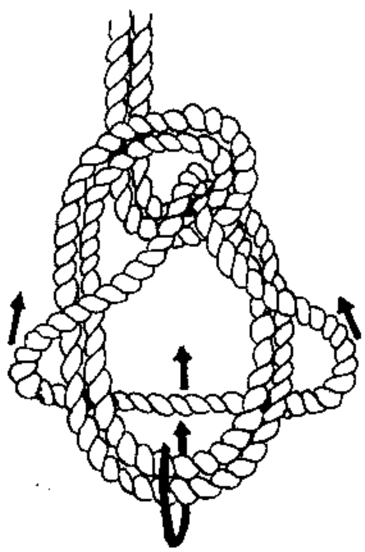


Finished Butterfly knot

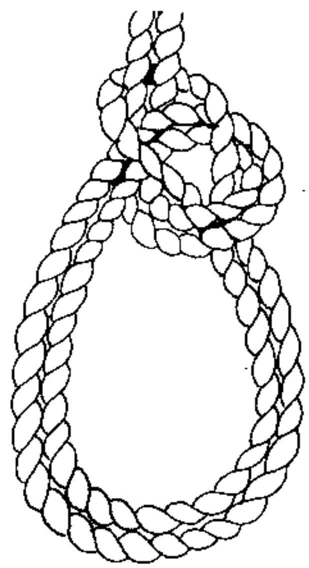
Two ways to form the Butterfly knot.



Bight the rope, form a loop and pull the end through the loop.



Pull end through hole and around the entire orginial loop and slide the loop up.



Bowline on the bight. tighten to finish the knot

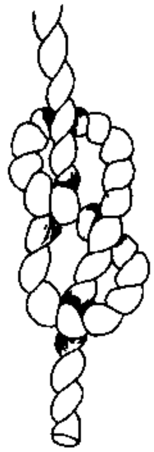


Figure 8 knot to be put at the end of a rope to avoid rappelling off the end.

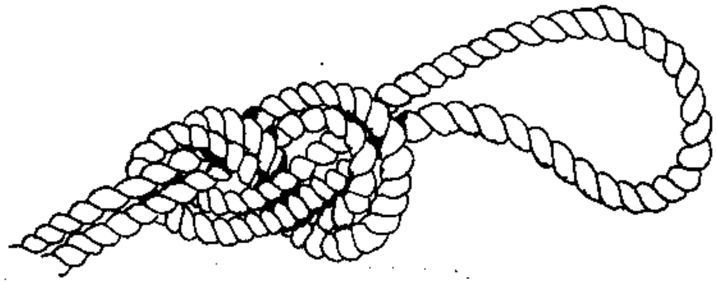


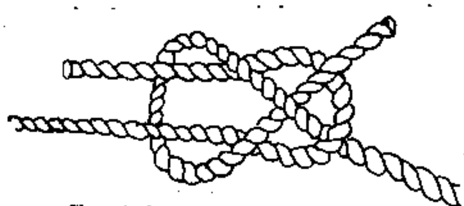
Figure 8 on the bight. Use this instead of an overhand on the bight.

End-to-End Tie Offs

These knots are primarily used for slings and other endless loops required for climbing on various occasions. Once in a while a climber may need to hook two lines together to get a rope long enough to reach where he needs it, such as in the recent rigging requirements of the 440' tyrolean traverse of Roy Gap between the North and South butress'of Seneca Rock.

Sheet Bend

The most common connecting knot if the Sheet bend, or weaver's knot. Its primary use is the connection of two different diameter ropes. It is generally not recommended for most climbing use unless it is either backed up with a good whipping, half-hitch or overhand knots. You should consider using a double sheet bend for rope work if you want to use some form of the sheet bend.



Sheet bend. A different orientation of a Bowline.

Fisherman's Knot

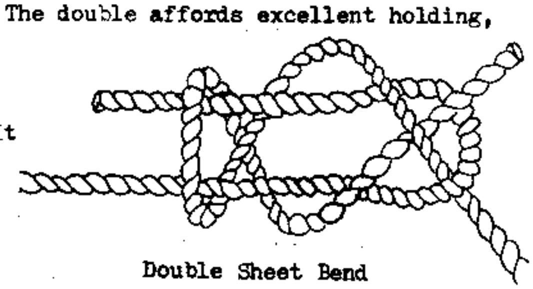
A very good connecting knot needs to be secured with a second set of overhand knots. This knot also falls under the name of the Englishman's knot and the lesser known name of the True Lovers knot.

Overhand Bend, Water Knot, Blood Knot, Follow Through, Ring Bend

All common names for the same knot and are of the most useful knots cavers or mountaineers use to join slings. Often times a climber will tie two side by side to form an endless loop. The double affords excellent holding, security, compactness and a high degree of efficiency.

Figure 8 Bend or Flemish Bend

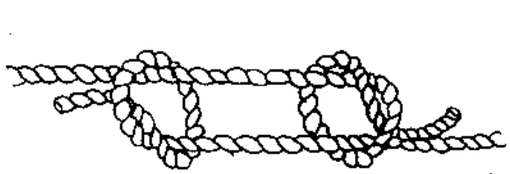
This knot is a good substitute for the overhand bend. It is more effecient and easier to untie.



Double Sheet Bend

The Barrel Knot or Triple Fisherman's

The Barrel knot or triple Fisherman's is probably the newest end-to-end tie thats been developed recently. It's holding power is not only superior but, the testing machine claims it stronger than the rope itself as reported by Kyle Isenhart. It is so good that if loads in excess of 500 pounds are hung on the rope the knot tightens to the point of impossible release. As reported by Kyle Isenhart, it is impossible to untie if 500 pounds or more are loaded on one end.

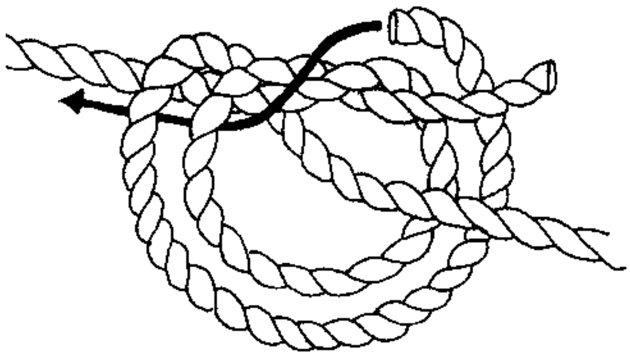


Fisherman's knot, tie two overhand knots around the other standing lines.

Pull the two overhand knots together to complete your Fisherman's knot.

These knots should enable you to rig any situation Practice, judgement and good common sense are your keys to successful rigging.

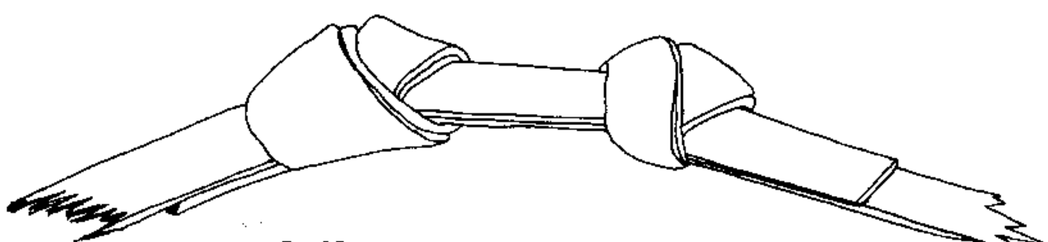
Too often climbers worry of knot weaknesses but it's a proven fact that very few ropes even break at a knot. Usually an old cut or a point of strain, like over a sharp rock, will cause a rope to break. Internal weakness caused from a fall or grip inside the fibers can also cause a rope to fail. Knots are not the beginning or the end of safe caving and climbing, but are definitely as necessary and integral as the entrance and exit ramps to the nylon highway.



Form an overhand knot in one end of the rope and follow the knot backwards with the other end of the other rope, pull tight.

Overhand bend, Water knot, Blood knot, Ring bend, Follow through knot......All the same knot.

DOUBLE WATER KNOT



Double Water knot tied with webbing, a good knot to tie endless loops.

FIGURE 8 BEND

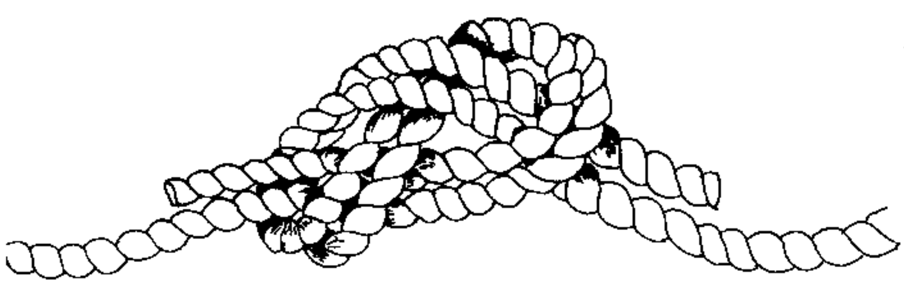
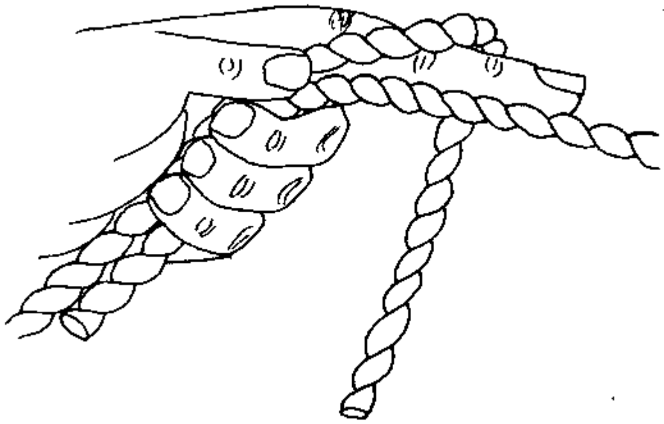
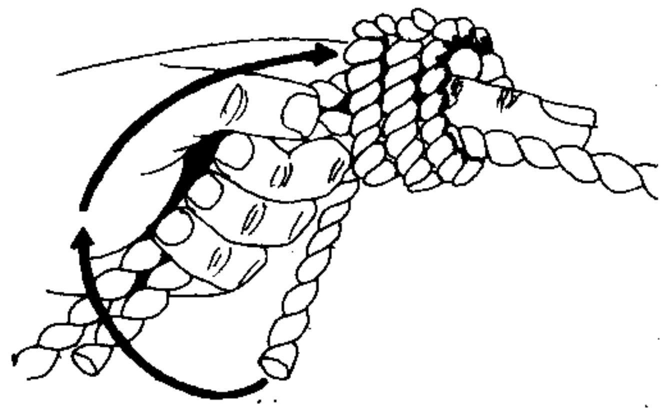


Figure 8 bend or Flemish bend. It is similar to a Water knot only follows the path of a Figure 8 knot.

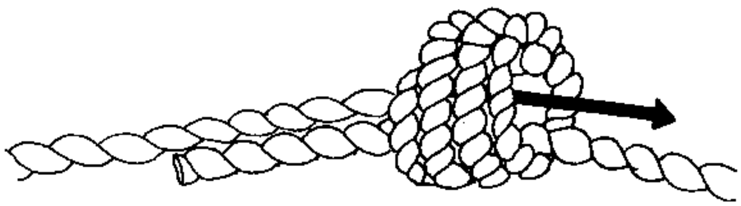


Lay the two ends side by side and start by wrapping one end around your finger and the rope toward your thumb.



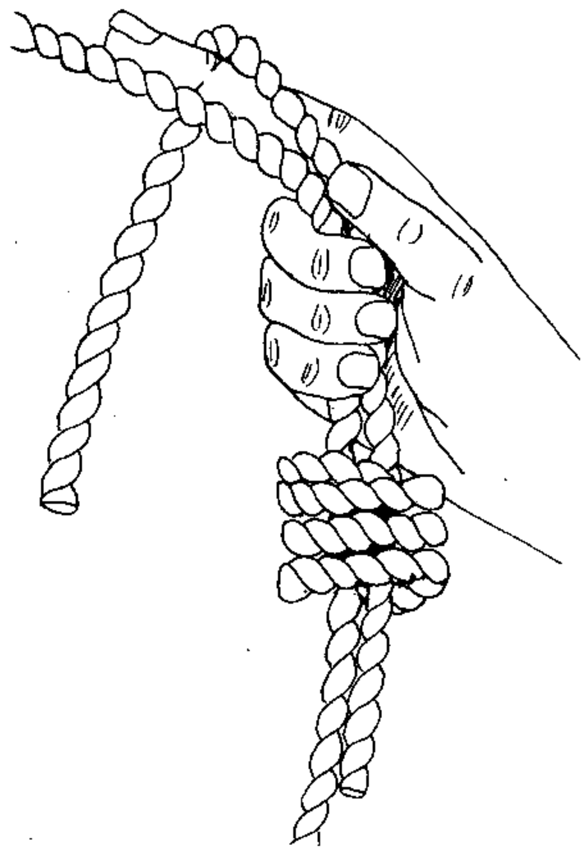
After wrapping put the rope end into the hole where your finger is.

TRIPLE FISHERMAN'S KNOT
or
BARREL KNOT

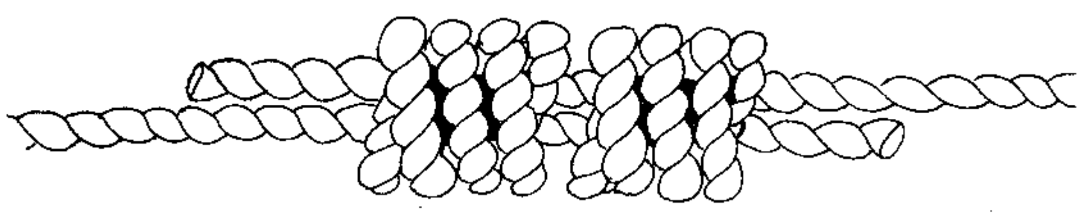


Put the rope through the hole and tighten.

Some of the numbers that appear in this article are from the excellent publication, ROPES, KNOTS, AND SLINGS FOR THE CLIMBER, BY Walt Weelock.



Repeat the whole process over again with the other end.



Triple Fisherman's or Barrel knot. Pull the two small barrels together.

BAG IT

by Don Davison Jr.

Have you ever been forced into inactivity within a cave and felt helpless as you chill (e.g. as the bottom or top of a deep or wet drop, while belaying a technical aid climb, in a rescue situation)? Have you been in this condition because the change of clothes or extra chest clothing was left behind as too bulky and inconvenient? Or was it because you had worn too many layers of garments and too late noticed that they had become damp with the perspiration of active caving and lost much of their insulating power? An inexpensive, compact, disposable, multi-use solution to the problem may be found in the plastic garbage bag.

Each "Glad" brand plastic garbage bag weighs only two ounces, costs about 12 cents, and may be carried flat or rolled into a cylinder, 4 inches long and 1.25 inches in diameter, with a volume of only 5.0 cubic inches (22% of the volume occupied by an 8 ounce baby bottle). It is strong and although some care is desirable if moving through tight places, the tears from snagging usually result in relatively minor holes.

Many a caver has waited for those before him to finish ascending from a deep pit, while the inactivity, waterfall spray, and breeze contributed to his overall chilling. Several of these factors may be reduced through the use of the garbage bag, in one of several configurations. The caver could, (1) Cut a tight neck hole and wear the bag over his upper torso, with no arm holes; (2) Place the bag over his head and upper body in a tent like fashion (with a small hole in the top of the bag to allow slow air circulation through chimneying); (3) If some activity is required, but arm and neck holes and weat the bag like a sweater or shirt. Holes should be made carefully and as small as possible. If situations are anticipated, the modifications may be made before entering the cave, and the edges of the holes reinforced with ducting tape. Using these arrangements, mist and spray is kept off the caver's clothing, the chill factor associated with a breeze is all but eliminated from the covered areas, and an insulating layer of, in essense, non-moving air is formed, reducing heat lost through convection and evaporation.

A carbide caver, when producing his own tent, as in method 2, might;(2a) place a second garbage bag on a rock; and sitting on it, face his carbide lamp towards himself and place it on the ground between his thighs. Thus he has produced a space heater for his tent. The amount of heat may be controlled by adjusting the flame and the size of the chimney hole. The chimneying of the hot air, up the front of the caver's body, will dry clothing on the chest, thighs, and arms--- with the heat of evaporation supplied by the carbide lamp not the caver's body. By opening the shirt and trousers front, the drying of undergarments may be enhanced and some of their insulating power regained.

Garbage bags may also be used in a more preventative mode. Several more cavers might be alive today, if they had worn garbage bags while in wet drops---instead they are hypothermia statistics.[1] When moving through or near waterfalls or in areas of heavy drip; (4) The bag is placed over the head and upper torso and then the helmet is positioned on top. The chin strap is positioned and a breathing hole is immediately pinched open. A mouth hole and two eye holes may be formed or a single full face opening. Arm holes are then added. In this manner, the neck and back are protected from water running off the rear of the helmet and from heavy spray or splatter, which would chill the sensitive rear neck area and run into the chest garments. This arrangement has worked very satisfactorily, with "Glad" brand garbage bags, while in Ellison's Cave, Ga., while entering through waterfalls and descending in and near them, when the cave was in full flood.

Although the aspects of comfort are dealt with almost exclusively in the preceeding information, it should be clear that the wise use of plastic garbage bags can enhance the probablity of survival in exposure cases by stablilizing a victims condition while awaiting rescue. The early signs of

[1] Keider, Marlin B. (1967), Physical and Physiological Factors in Fatal Exposures to Cold, in Nat. Speleol. Soc. Bulletin Vol. 29, No. 1, p. 1-10

exposure can be treated and possibly reversed while the victim conserves his energy and waits for assistance. This as opposed to a panicy headlong effort to reach the entrance and leave the cave---while often compounding the problem. But of greatest importance is the prevention of even the initial phases of hypothermia, a task made easier by the plastic garbage bag.

TEMPERATURE STUDIES OF RAPPELLING DEVICES

by Kyle Isenhart

The increasing number of people doing longer rappels has caused the temperature of the rappelling device in contact with the rope to become a point of concern. Temperatures above 300°F should be avoided not only because of the possibility of rope damage, but also because the device may come in contact with the body causing severe burns.

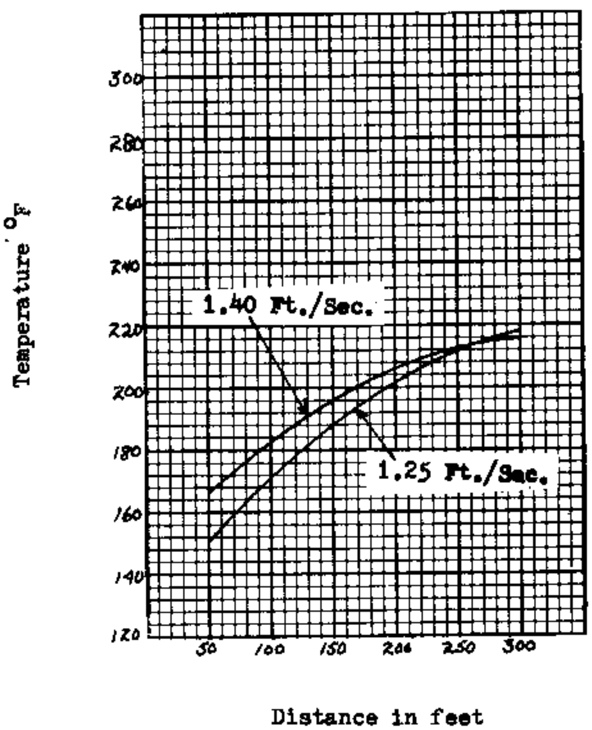
This paper deals with a study of heat generated in various rappelling devices as a function of distance. Several previous papers have been presented dealing with the theoretical amount of heat introduced into the braking device while rappelling. Papers have also been presented which attempted to explain their efficiency as a function of heat dissipated to the air, a specific alloy's heat capacity, etc. Although their subjects were dealt with thoroughly, the papers produced little practical data of use to the explorer in the field. Because actual field experience occasionally conflicted with the theoretical behavior and some commonly accepted theories the data gathered in this study is being presented here.

The rappel devices tested were as follows: A standard rack using five commercial round brake bars; a set of double carabiners and brake bars using aluminum oval carabiners and round commercial brake bars with a steel chain link connecting them. This latter rappelling device was included because many of them are in use. Due to their low strength and extremely limited friction range this device is not recommended. Also tested were both a "Super Rack" with 1 inch square aluminum bars radiused where the rope travels and another "Super Rack" with brake bars made of 3/4 inch schedule 40 18-8 stainless steel pipe. Two small racks were tested, the "Mini-Super Rack" and a similar rack manufactured by Ken Klaman. They were included due to their obvious convenience in transportating and to determine if their small size had any major effect upon their heat producing and dissapiting ability. As can be seen from the graphs they are acceptable in this area but the author and some others who have used the small racks have had serious control problems with them. Their braking effect seems to be unpredictable and the amount of overall friction change obtainable is very limited. I therefore discourage their use.

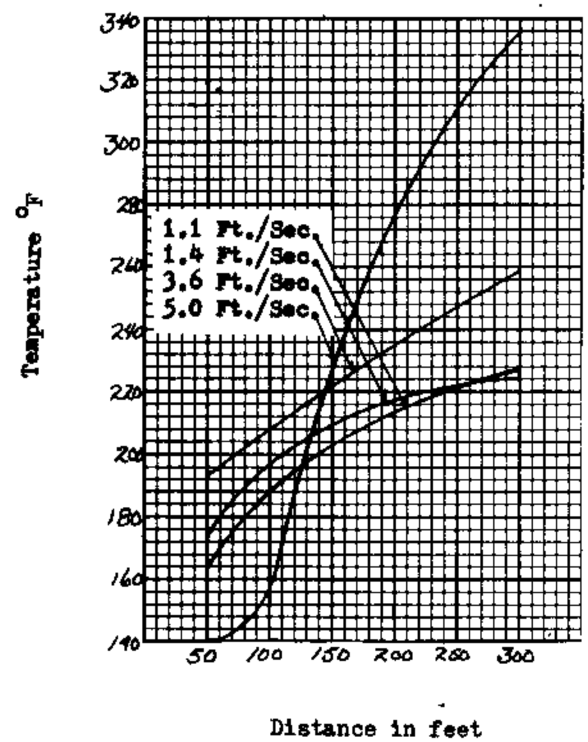
Several other rappel devices such as the bobbin, whaletail, spiral brake, spool, and descending hook were not included in this study due to either their bulk, lack of security in holding the rope, very limited friction range, or combinations of these and other factors which render the devices undesirable.

The temperatures listed in this study were detected by using iron-constan thermocouples. In the earliest tests conducted a few years ago the thermocouples were actually imbedded in the brake bars but this method was discontinued due to breakage and inconvenience in using the devices with the wires attached. The bar temperatures were determined with a surface probe placed approximately one quarter inch away from where the rope contacted the bar. On the rappel racks the temperature of the top four bars was measured. On the double carabiner brake bar device the top of the upper

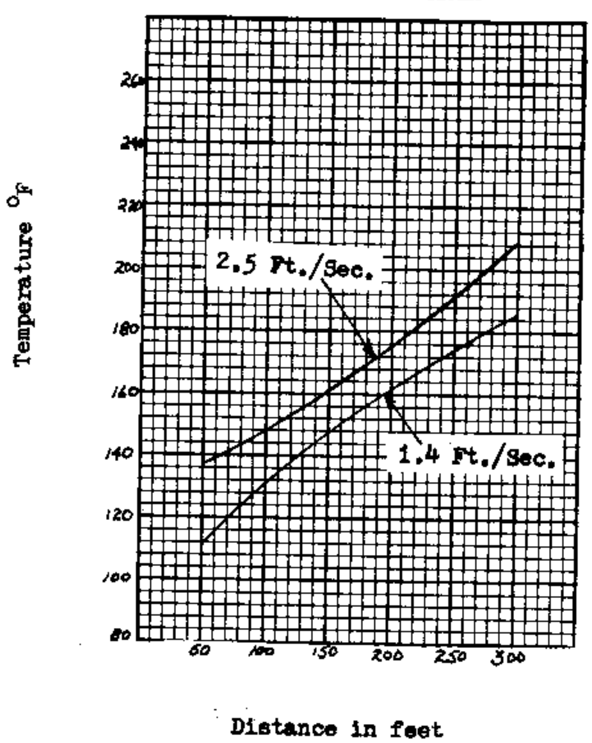
DOUBLE CARABINERS WITH
ROUND COMMERCIAL BARS



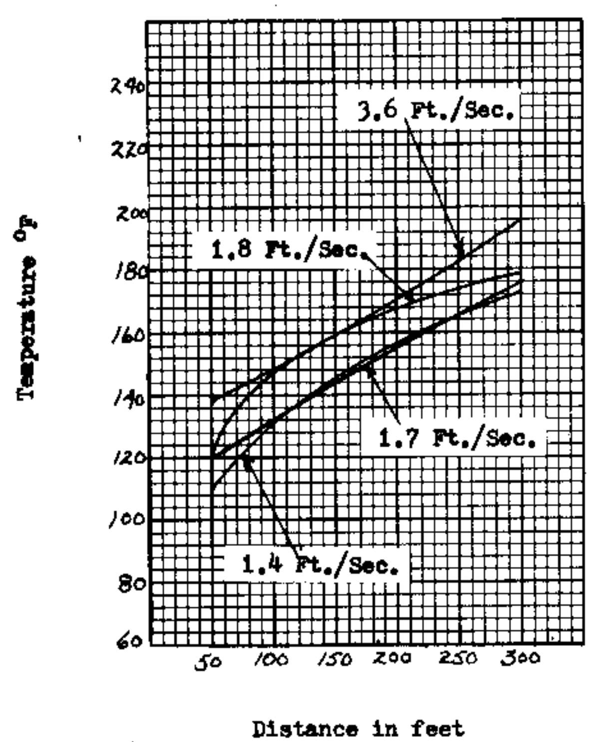
STANDARD RACK WITH
ROUND COMMERCIAL BARS



MINI—SUPER RACK

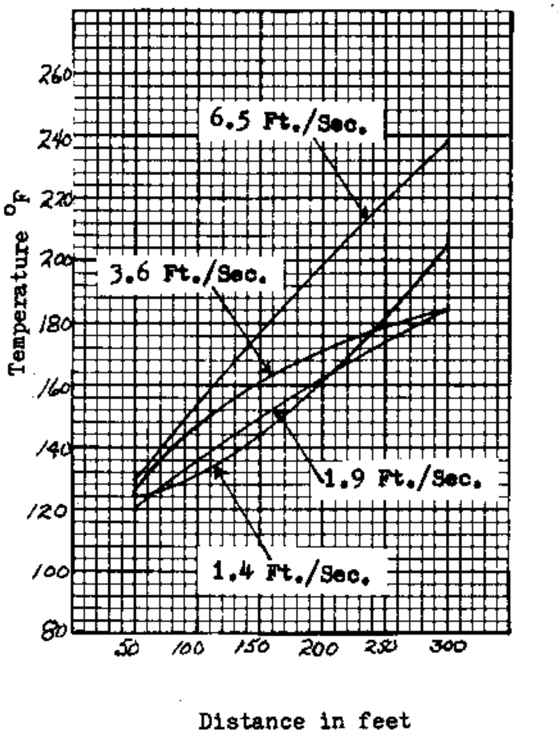


SUPER RACK WITH 1" SQUARE
ALUMINUM BARS

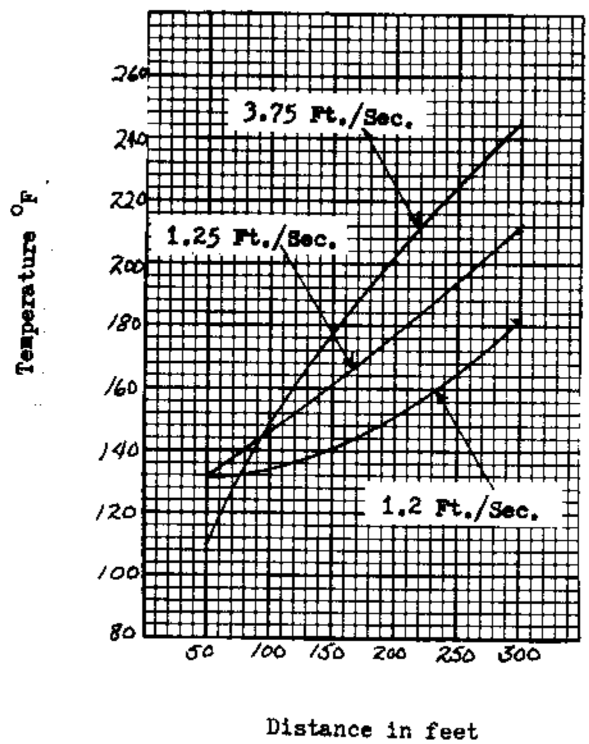


Temperature Studies

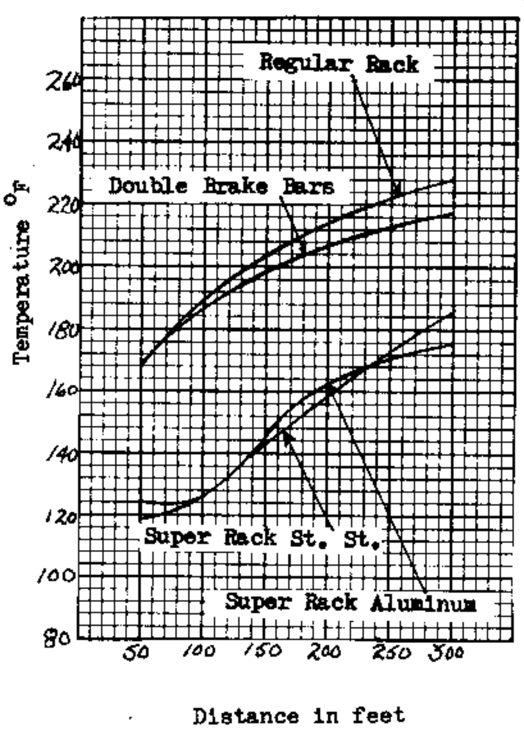
SUPER RACK WITH 3/4 INCH SCH. 40 STAINLESS STEEL PIPE BARS



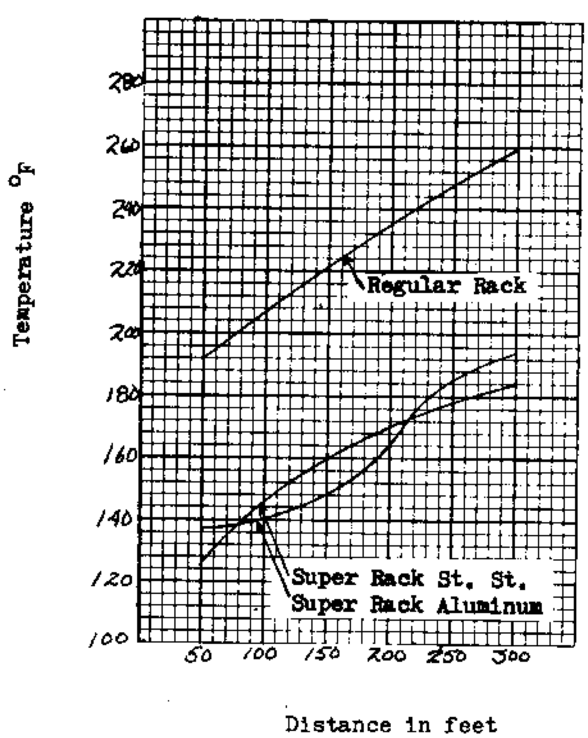
KEN KLAMAN'S RACK



COMPARISON 1.4 FEET PER SECOND



COMPARISON 3.6 FEET PER SECOND



carabiner where the rope exited, the upper brake bar, the bottom of the upper carabiner, the top of the lower carabiner and the lower brake bar temperatures were measured. On the rappel racks extreme care was taken to insure that the top two bars did not come too closely together and overheat thus causing erroneous results. The temperatures shown in the accompanying graphs are the average temperature of the two hottest parts of the rappelling devices. In the case of the racks this was always the two top bars. The double carabiner and brake bar device was the hottest on the top of the upper carabiner where the rope exited, and the second hottest area was the upper brake bar.

Initially in this study the surface temperature of the rope approximately one inch away from the rappel device as it exited was taken. No temperatures in excess of 95°F were obtained so the procedure was discontinued and the results are not reported. The ambient conditions at the time of the temperature studies presented in the accompanying graphs were: Temperature 75 to 90°F, Wind velocity 5 to 10 miles per hour, Relative humidity 65 to 70%.

A comparison of laid ropes e.g. Goldline vs. braided ropes e.g. Bluewater was not made. The ropes utilized in this study were used Bluewater II & III which were freshly laundered and very clean. No noticable temperature differences were found between the Bluewater II & III although the Bluewater III was considerably more flexible.

The actual testing procedure used was as follows: A 500 pound capacity spring balance was fastened to an anchor point and the rappel device being tested was attached to the balance. The rope was loosely coiled on the ground beside the device and a person was assigned to keep the rope feeding freely to the brakeman. The brakeman operated the device in a manner so as to obtain a constant 200 pound load. Another person operated the stopwatch and calculated the rate at which the rope was being pulled through the device by the vehicle. Two more people checked and recorded the temperatures. The ropes were marked every fifty feet and temperature measurements at the points described on the rappelling devices were taken at those intervals. The testing procedure varies from actual rappel conditions in the following two major ways: during a long rappel the weight of the rope below the rappelling device contributes somewhat to the braking effect, and enough braking effect was not applied to cause a 200 pound load to stop, as at the bottom of a rappel but simply enough to maintain a constant 200 pound load at a certain rate of descent. Results of other testing done by the author et. al. during actual rappelling verify that only slightly higher temperatures are obtained by coming to a complete stop after two hundred feet.

It was found during this study and previous ones that ambient temperatures in the 50 to 100°F range had very little effect on the obtained temperature curves of the rappelling devices. Relative humidity, however, has a very pronounced effect. Below 30% the devices get considerably hotter, while above 80% they are slightly cooler. Wind velocity in the area of the rappelling device has little effect at velocities below 15 miles per hour. The effect of velocities above that has not been studied but such velocities are rarely encountered in caves. The condition of the rope is by far the most important factor in determining how hot a rappel device will get while being used in the field. A rope impregnated with foreign particles, or coated with mud will cause large amounts of heat to be generated very rapidly. A clean, damp rope, on the other hand, will cause the device to heat very little in comparison. Another important factor that the previous tests have shown is that brake bars with deep grooves (over ¼ inch deep) heat much quicker than bars with no grooves. The accompanying graphs show the results of those tests ran in this study.

Acknowledgments:

The author wishes to thank the following whose help proved indispensable during the field work while preparing this report: Delbert C. Province, William C. Bauman, and his 4 wheel drive truck, Howard N. Smith, Randy Bauman and Phil Collins.

THE MECHANICAL PRUSIK RACES

by Kirk MacGregor

Since 1967 Bill Cuddington has organized prusik races at every NSS Convention except the 1968 one. Originally these races have been over a distance of 100 feet and were split into 3 classes (3-knot, 2-knot, and mechanical) for each sex. In 1970 Bill added long races (400 feet for men and 300 feet for women), and in the early 1970's he phased-in a splitting of the contestants into age groups as well as sexes.

A great deal could be written about these races (someday I will!!), but this note is being kept short by restricting it to the mechanical class of the races and ignoring age groups. Those not familiar with the races can read John M Patten's article "Prusik Contest" on pages 187-188 of the NSS NEWS, Vol. 24, No. 8 (August 1966), which describes the rules and equipment that are still used (except that the rope is now 7/16" Bluewater, not Goldline.) That article also gives winning times in a prusik race run by Bill Cuddington at the Southeastern Regional Association (SERA) Cave Carnival in 1965, and is the source of my 1965 information (unfortunately no women entered the 100' mechanical race then).

The currect (as of the end of the 1974 Convention) record-holders for the races that this note cover are:

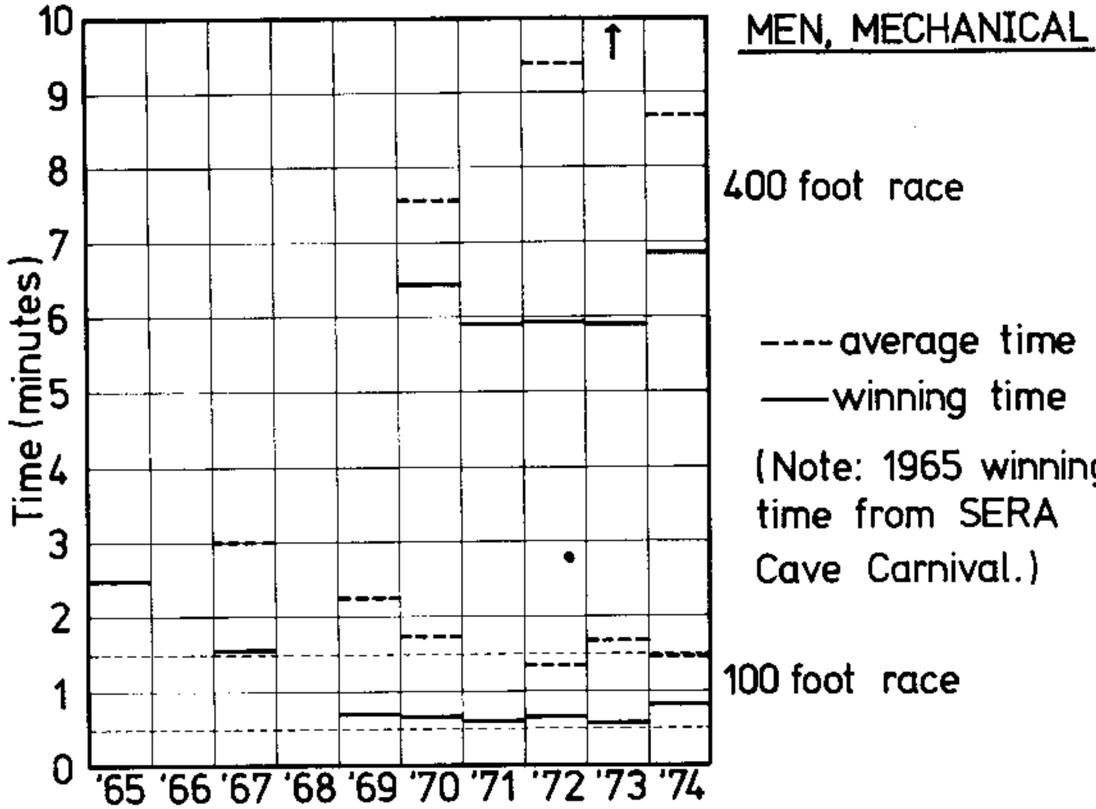
Record Holder	Time	Race
Peter Sprouse	33.8	100 Ft. Men
Nora White	50.6	100 Ft. Women
Kirk MacGregor	5:54.3	400 Ft. Men
Miriam Cuddington	5:43.3	300 Ft. Women

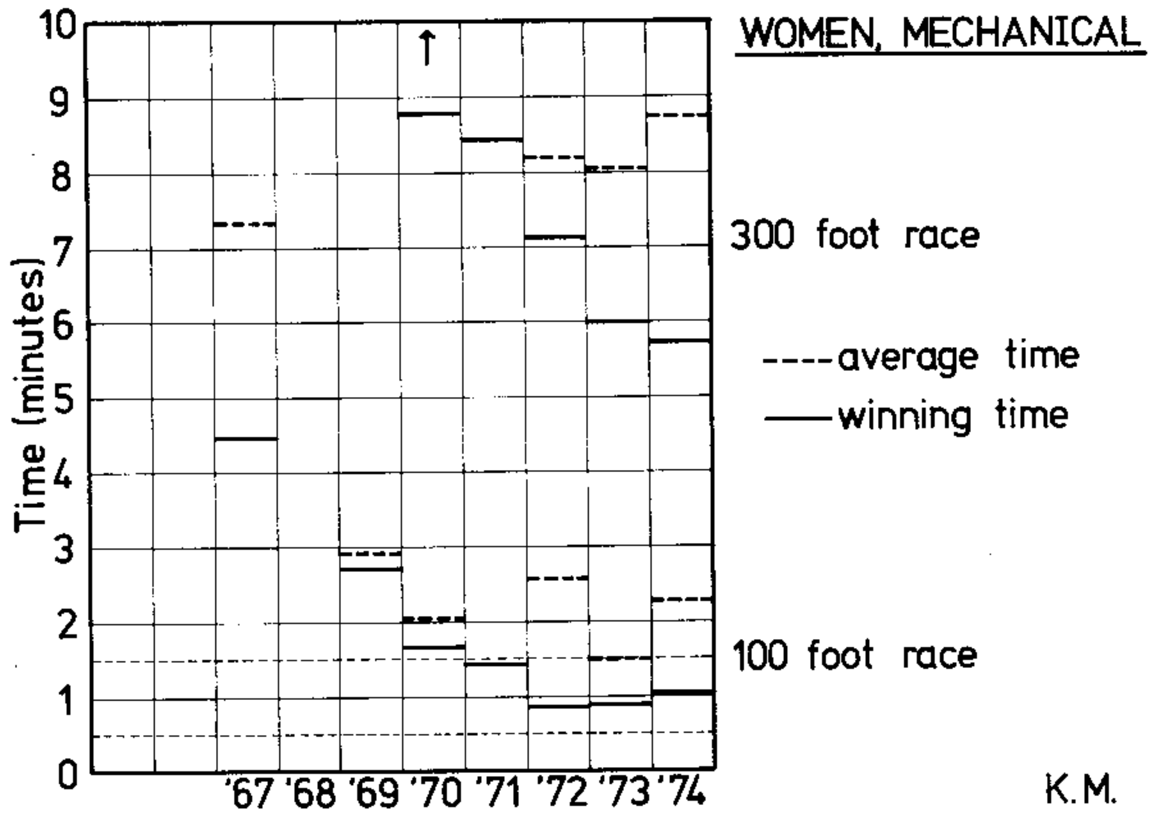
And to fill out the other end of things, the slow records are:

	6:41.4	100 Ft. Men
	11:00.0	100 Ft. Women
	22:12.0	400 Ft. Men
	14:46.6	300 Ft. Women

The two graphs on the next page show the results of these races in more detail. Both the average time for all people who completed the race and the winning time are given for each race and year. (Unfortunately, all the 1971 data except for the winning times seem to have been lost, so average times could not be calculated for that year. Also, one average time in the 400 ft., race and one in the 300 ft., race are indicated only by upward-pointing arrows on the graphs, as they were over ten minutes.)

Obviously speeds have increased greatly since 1965, but it also seems that the races started late enough to catch only the tail-end of this increase. Even so, average times in the 1970's are often less than winning times in the 1960's. Furthermore, it seems that the primary cause of this is probably an actual general improvement in techniques and equipment, rather than just the slower people stopping racing, as Bill's age-grouping seems to have kept everyone from grandmothers to grandchildren in the race. On the other hand, most records are now set by people using refinements such as lightweight shoes (instead of heavier boots) and ball-bearing boxes, that may be usable in most caves. Women have dramatically increased their speeds since the races began, but it looks like the women were about 3 years behind the men, and thus a larger part of their transistion to speed has occurred since the races started. All contestants climbed a total of 83,000 feet or 15.7 miles, that's enough to make 62 ascents of El Sotano!!


MEN, MECHANICAL
400 foot race
----average time
——winning time
(Note: 1965 winning time from SERA Cave Carnival.)
100 foot race
Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
'65 '66 '67 '68 '69 '70 '71 '72 '73 '74


WOMEN, MECHANICAL
300 foot race
----average time
——winning time
100 foot race
Time (minutes)
0
1
2
3
4
5
6
7
8
9
10
'67 '68 '69 '70 '71 '72 '73 '74

K.M.