NYLON HIGHWAY 9

Nylon Highway 9

NSS
Vertical
Section
May, 1978

CONTENTS

Officers

319 Kilbourne Ave.
Appalachia, VA 24216
703-565-1718

Cover

The cover photo is another creation by Bob Alderson of Blacksburg, VA

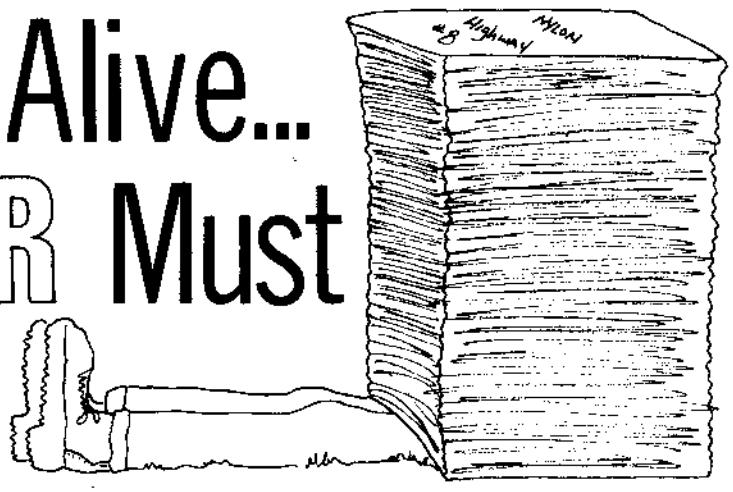
Details

DEADLINE for NYLON HIGHWAY #10 is October 1, 1978. Articles need to be typed double spaced if at all possible, and illustrations, graphs, etc., inked, ready for final copy. One need not be a Vertical Section member to contribute. Letters to the Editor are welcome.

NYLON HIGHWAY is published by the NSS Vertical Section, and available to non-members at a rate of $3.00 per year. Overseas rates are $1.00 higher for surface, and $4.00 higher for air mail. Grottos may receive issues for the cost of postage. $1.00 deposit required. Receipt of copies of articles appearing in the organization's publication concerning vertical techniques, equipment, etc., which may be considered for reprinting in the N.H. will be considered an exchange for one issue. Frequency of publication is based on the availability of material.

"Hey man, I sent my 3 bucks in . . .
Don't I at least get an explanation?!"

The Editor IS Alive... The PRINTER Must Be Dead !!



Yes, yes, I know...I'd also begun to wonder what'd happened to N.H. #8!! (Should you not have received it by this time, well all I can say is that it's been promised...) And I don't blame you for writing me nasty letters (I wrote some myself). #8 really did go to the printer (a caver...) Feb. 17. It seems he lost interest and the issue sat sat in the shop half done. There wasn't much I could do that was within the limits of the law!!

However, #8 could have come out before Christmas, had I received the articles promised at convention! V.S. members, please make an effort to contribute to the HIGHWAY, and encourage others to do so! Subscriptions are growing, but we'll only be able to obtain a wide circulation if we have a HIGHWAY worth reading, issued fairly regularly. And, yes, we will reprint articles from grotto publications! Just send them on down.

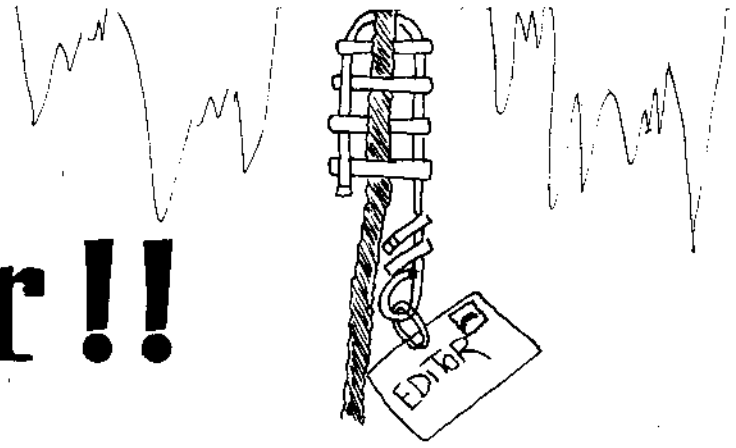
CHANGING SUBJECTS: Take note of the article dealing with the proposal on the COG agenda concerning the Vertical Section. If the COG takes a stand on this topic, a precedent could be set for other Internal Organizations and other issues. The COG's purpose is to recommend proposals for action by the BOG, and to let the BOG know where the NSS membership stands on various issues. Should a person or group be able to take this route if they wish to influence the operation and policies of an I/O? Especially without having contacted the I/O to first try to resolve the issue?! Think of where this approach could lead! Grottos and sections should be left to run their OWN affairs, within the limits set up by the I/O committee.

Consider the proposal, and be present at the COG meeting to make your views known.

Cheryl

Why the Executive Committee? What function is served? What functions could be served? Should there be a limit on the number of re-elections? Should a time be allotted during the meeting for discussion of the candidates? Should a short Section meeting be held during the first of the week simply to nominate members for the executive Committee? Thus allowing a couple of days for discussion of and with the candidates before voting. Should the Section be able to vote on Chairman and Secretary? If any of these ideas appeal to you, or you have others, prepare a motion for the Section meeting.

A Letter!!



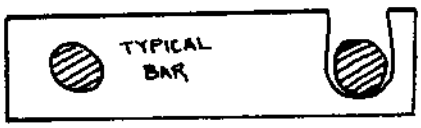
Dear Cheryl,

....I have a few comments on the Whaletail Descender article by Neil Montgomery in issue #7. I have used a conventional rack for several years, and have been involved with a Whailtail descender based on G. Woods original design at several vertical training sessions of the Central Connecticut Grotto. The problem with the Whailtail is that it can be threaded backwards (as in figure III in the article) and still function as a descending device, only to come completely off the rope halfway down the drop. This actually happened to a girl at one training session and only the separate safety belay saved her. The modified version with the safety gate is better of course, but a novice could still get into trouble.

The rack can also be threaded backwards, of course, by a novice or any tired caver but there is an important difference. If the bars are fitted carefully to the rack, so that each one swings into place without "snapping" tightly into place, then a backwards threaded rack will simply fall off the rope due to its own weight, while the nervous owner is still standing safely at the top of the pitch. A rack of this type also allows fingertip addition of bars during the descent. Of course the loose bars are a pain while carrying the rack between pitches, but nothing is perfect.

On the same subject, most caribiner-brake bar sets I have seen have very snug fitting bars. I stopped a friend of mine just in time some years ago about to descend a 120 foot overhanging outdoor drop. He had the rope threaded backwards and had at least half his body weight on it at the time. There is no substitute for double-checking, but loose bars would probably have prevented any accident.

Sincerely,
/s/Brian Pease
NSS 7476

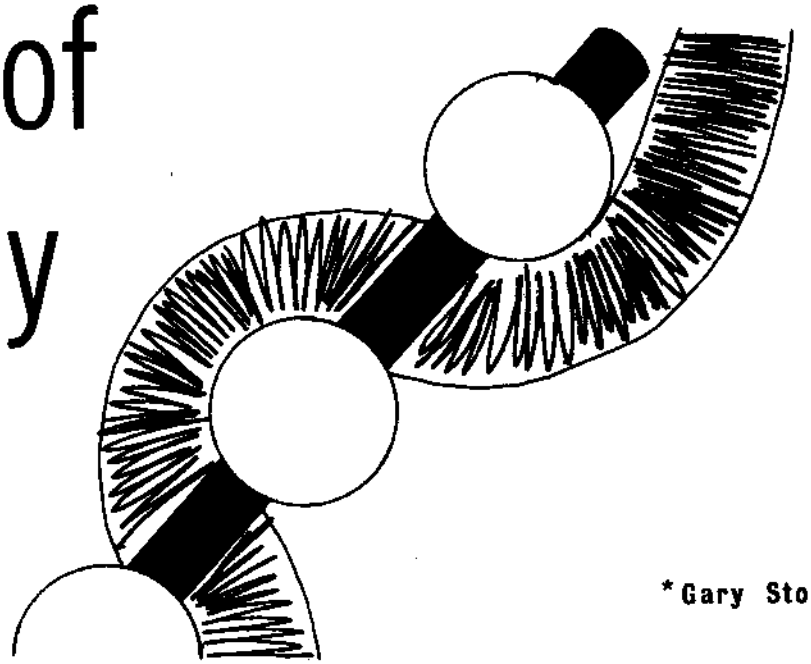


**Perhaps a nylon draw-string bag slipped over the rack while moving between pitches would solve the problem of flapping bars?--Ed.

V.S. Business .....

A proposal will be made at the Section meeting that the membership requirements as they exist presently be changed. Several people see no need in the required endorsement by two regular members. Also to be included is the elimination of the Associate membership class (bet some of you newer members didn't even know about it, huh?). Prepare to discuss and vote on this issue, or send a proxy to convention with a friend.

Design of Specialty Racks



*Gary Storrick

In recent years more attention has been given to the problem of heating of rappel racks during long rappels. Although the standard rack provided adequate heat dissipation on drops of a few hundred feet, they lack the required mass and surface area for longer drops. SupeRacks were developed to help reduce the temperature rise in the bars, which can reach 350°F. on standard racks. However, the design involved four equally sized bars which seemed wasteful. Therefore, I undertook the task of analyzing the rappel rack in hopes of obtaining a design which, in theory at least, would involve bars sized in proportion to the respective heat inputs.

Two major equations were necessary for the computer model. The first, relating the tensions above and below a bar under constant velocity rappel, is given by(see figure 1)

$$(1) \qquad T_2 = T_1 e^{-\mu\phi} \quad (\phi \text{ in Radians})$$

Where μ is the coefficient of friction between rope and the brake bars. The second equation involves computing the angle of rope travel at each bar. From figure 2 we see that

$$(2) \qquad \text{Tan}\,\theta = \frac{\sigma + R\cos\theta}{S - R\sin\theta - \frac{D}{\sin\theta}} \qquad ; R = r_1 + r_2 \qquad \sigma = \sigma_1 + \sigma_2$$

which reduces, upon substituting $\sin\theta = \sqrt{1 - \cos^2\theta}$, squaring and solving the quadratic in $\cos\theta$, to

$$(3) \qquad \theta = \cos^{-1} \frac{-\sigma(R+D) + S\sqrt{S^2 + \sigma^2 - (R+D)^2}}{S^2 + \sigma^2}$$

or

$$(4) \qquad \theta = \cos^{-1} \frac{-\sigma\eta + S\sqrt{\xi - \eta^2}}{\xi} \qquad \text{where} \quad \eta = r_1 + r_2 + D \,, \quad \xi = S^2 + (\sigma_1 + \sigma_2)^2$$

The bar parameters can then be varied and the rack analyzed, indeed, a whole rappel (involving rope weights, bar control and "everything") can be simulated.

However satisfying this digression may be, it is still necessary to calculate the required bar sizes. Several design decisions must first be made. I chose to make my bars out of 1" plate aluminum for the top four bars and 3/4" x 3/4" bar stock for the bottom two. The bottom two bars will be oversize in order to provide an adequately large radius of curvature. The rack frame will be made out of 7/16" stainless steel rod (for strength) according to standard design, since U frames prevent using an odd number of bars and hence lack the adjustability of standard design frames.

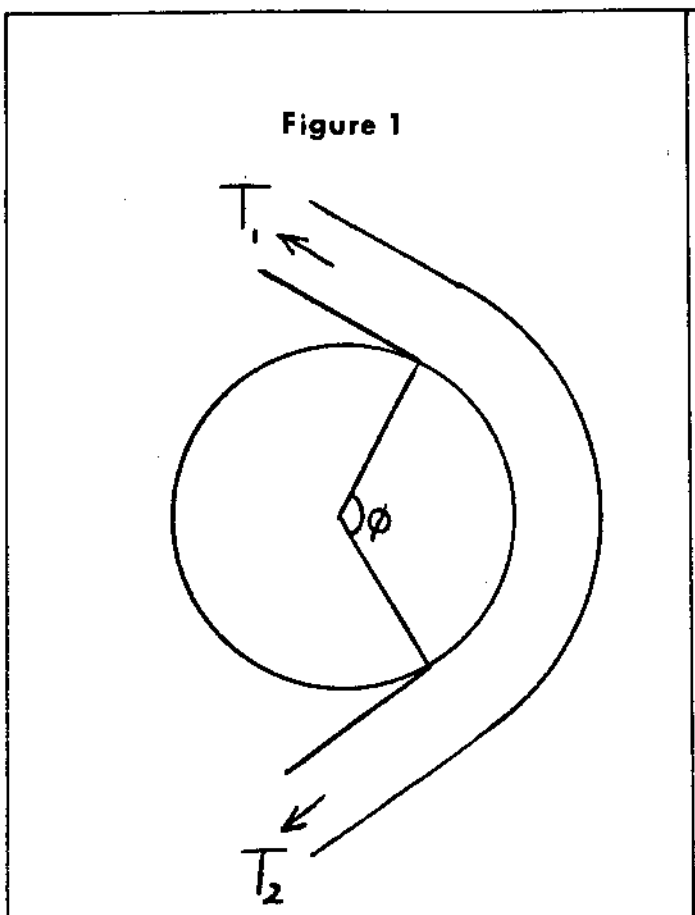


Figure 1

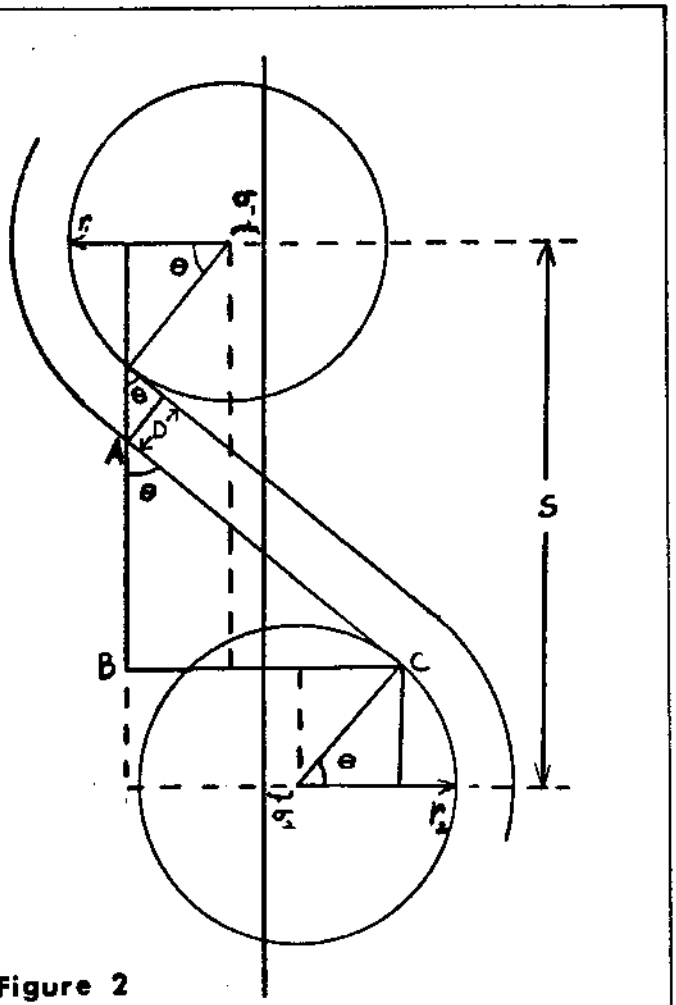


Figure 2

Table 1 shows a sample hand calculation of bar loadings. Since the heating of each bar is essentially proportional to the tension difference at the bar, the power into each bar need not be calculated numerically. In the sample calculation, μ was chosen as 0.25 (typical). As a further convenience in hand calculation, θ was set equal to 1 radian for all bars (therefore ϕ = 1 or 2 rad, depending on the bar). A 200 lb. caver weight was chosen.

Several assumptions were made to simplify the analysis. First, rope stiffness, temperature and effects of rapid flexing were neglected. Stiffness and flexing should be of less importance as effective bar radius increases, and for the final design this proves to be the case. Rope temperature is neglected due to the low mass of the rope in contact with the bars, and the short time of contact. Ropes don't tend to get extremely hot unless the rappel is extremely fast, or the caver stops while on rappel. Secondly, the rope is assumed to run perpendicular to the bars. Bar spacing and wear grooves can be accounted for by varying the geometric inputs (s for spacing, r_1, r_2, σ_1, σ_2 for wear grooves). Thirdly, the coefficient of friction is assumed constant for a any given bar, although variable could be modeled.

From calculations similar to those in Table 1, and several computer runs, the bar sizes shown in Table 2 were chosen.

The result is a rack which provides much better heating characteristics than presently available racks, without sacrificing control. The rack was field tested and as far as control was concerned, was found to behave much like a standard rack; however, heating did not seem to be as much of a problem. For example, in one case a 200' free rappel was done in approximately 30 seconds. The bars remained cool enough to be comfortable to touch with the bare hand. Further testing continues.

Table 1

Calculation of Bar Sizes $\mu = 0.25$
$\theta = 1$ rad

Bar	Tension (eq 1) (lb)	Tension Difference (lb)	Relative Bar Size (#3 - 1.00)
	200		
1*		44	1.19
	156		
2**		62	1.68
	94		
3**		37	1.00
	57		
4**		22	0.59
	35		
5**		14	0.38
	21		
6*		5	0.14
	16		

* $\phi = \theta = 1$ rad
** $\phi = 2\theta = 2$ rad

Table 2

Bar Sizes Eventually Chosen[1]

Bar	Thickness (in)[3]	Height (in)[3]
1	1	1-1/4
2	1	1-5/8
3	1	1
4	1	3/4
5	3/4	3/4 (oversize)[2]
6	3/4	3/4 (oversize)[2]

[1]Optimum choice varies with μ; these values are from a "middle of the road" approach for the various calculations performed.

[2]Oversized to provide adequate bending radius.

[3]The decision was made to use rectangular bars with milled grooves to guide the rope. In this way the rope bends through a much larger radius than is convenient with round bars and has more area of contact with the bars.

One last point, slightly off the main track. Note that on a standard rack, the second bar tends to heat up the most with the top bar close behind. Two minor modifications can improve the heat characteristics of the standard rack. First, install spacers between the top two bars to lessen ϕ on the top bar. Secondly, use two bars facing the same way for the second bar. The heat will then be distributed over twice the mass and surface area as before, and the bars will run cooler. The handling of the rack remains nearly unchanged.

Brake Bar Design

*Ed Seaman

Several years ago, I did some experimenting with various sizes and shapes of brake bars for the Blue Water stainless steel rack and found that I like bars as described below. They appear to be stronger than 3/4" round bars and are made of high strength aircraft aluminum - 6061T6.

Since the rope tends to feed right down the center, it seems to produce a smoother ride than the 3/4" bars even if the 3/4" bars have a groove filed in them. They also seem to have a greater heat-absorbing and dissipating qualities than standard bars because of increased mass and surface area.

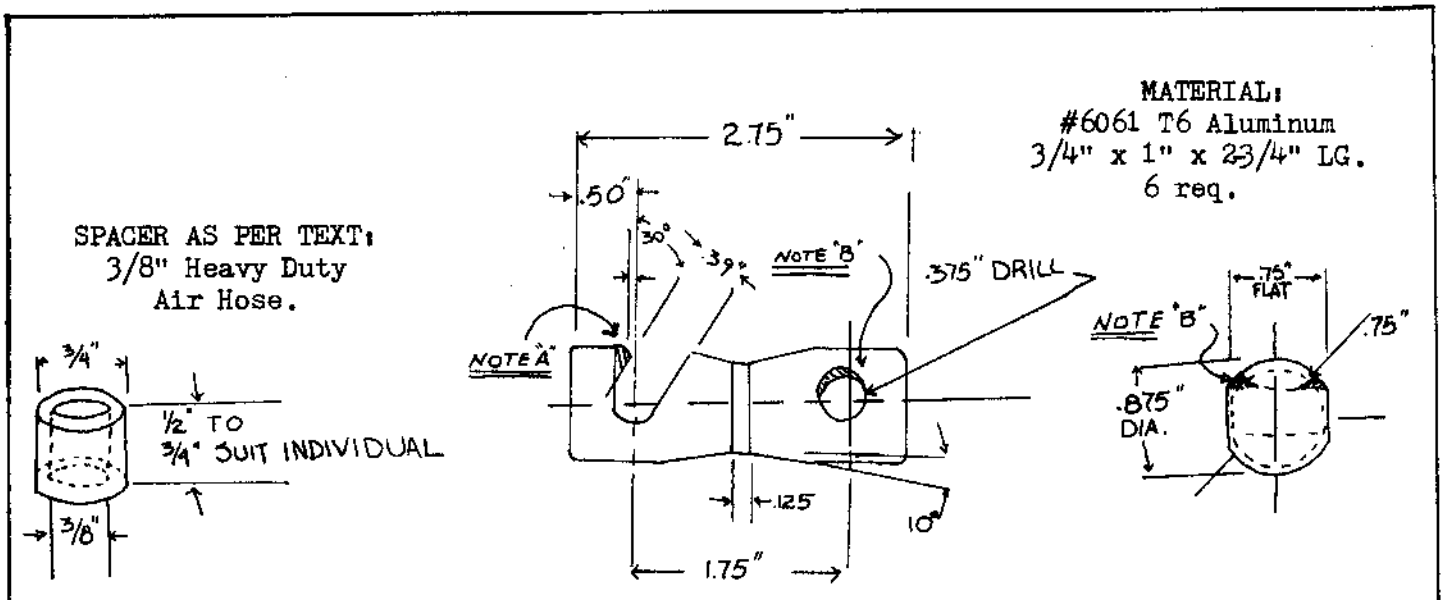
These bars have never been tested scientifically, so these claims are based only on observation and personal experience.

A drill press and metal working lathe are necessary for making them, along with some rather careful work with hand tools such as hack saws and files.

You will notice that a small "V" is removed from the outside of the slot end of the third bar. This is to prevent the springing effect of the rack from holding the bar on a rack if the rope is rigged onto the rack backwards. This can also be done on regular 3/4" round bars.

Some other modifications I have made on my own rack are as follows: Put a spacer of 3/8" I.D. (3/4" O.D.) heavy-duty air hose about 1/2" to 3/4" long between the first and second brake bar on each side of the rack frame. This prevents the top two bars from pinching up so tight and jamming, and allows the caver to control speed by manipulating the lower bars.

Also, file just enough off the non-load-bearing side of the holes in the bars at the extreme ends of the holes (see drawing), to permit the bars to slide over the top curve of the rack frame. This makes it easier to add and take off bars on rappel, and to spread bars farther at the beginning at the beginning of a very long drop.



NOTE "A": Mtrl. removed from 3rd bar down as in text.
NOTE "B": Mtrl. removed to pass bar over top curve of "rack".

The Spelean Shunt Technique

W. B. Toomer & Bruce R. Welch

Abstract

A new method of rigging a trailing ascender as an abseil safety device. The device described is readily released after its activation.

Introduction

A simple, safe abseiling safety device has long been needed, and several different types of trailing ascenders have been designed by cavers throughout the world (Montgomery, 1977). Unfortunately all of these are either unnecessarily complicated or require another prussik device to enable them to be released after activation.

The Spelean Shunt Technique uses only equipment which is currently available from caving equipment shops. All that is required is a Gibbs ascender (with quick release pin), one "D" carabiner, and a length of 5mm kernmantle rope. (Tape* may be used instead.)

The Spelean Shunt is designed to ensure that as soon as the abseiler changes his balance the cam will lock onto the rope. Thus if the caver was to become unconcious, or loose control from some other cause, he would naturally move to a stable position (which means he will lean back) and the device will lock on. The Spelean Shunt is arranged so that the caver will not be pestered by the cam locking on during normal abseiling.

The technique is also designed so that the cam may be released with a not unreasonable amount of force on the release mechanism of the device.

Description of Rigging

A Gibbs is rigged on the abseil rope above the descending device in the normal way. However before attaching the Gibbs to the rope a short length of 5mm kernmantle rope (about 1 metre) is passed through the eye of the Gibbs cam, then a "D" carabiner is passed through the eye of the cam, and finally around the rope. The U-shaped part of the Gibbs is then passed up through the inside of the carabiner (figure 1), and the quick release pin inserted. The carabiner is attached in such a way that the long (ungated) side is on the same side of the Gibbs as the head of the quick release pin around the outside of the carabiner.

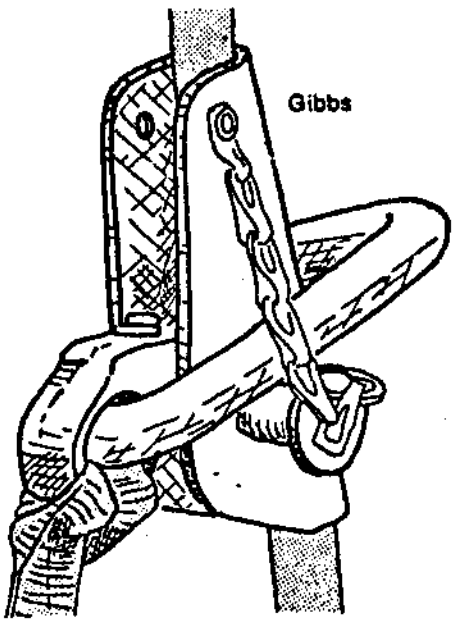


Figure 1

Take hold of the two ends of the 5mm rope and tie a double figure of eight knot in it close to the cam eye. Pass one end of the 5mm rope through the carabiner in your sit-harness and join the two ends. The correct length for this loop will be found by ensuring that when the Shunt is locked onto the rope under load, there is 30-50mm between the shunt and the top of your descending device. The chest activating link is then attached. Pass a carabiner through the loop at the eye of the

cam, then attach the carabiner to your chest harness (n.b. Your chest harness must be tight for this device to be effective.)

You are now fully rigged into the Spelean Shunt (figure 2). To activate the Shunt, simply lean back a little and the Gibbs will lock onto the abseil rope. To release it, pull down on the back of the carabiner attached to the Gibbs with your left hand - don't forget to hold the abseil rope with your right hand (on the lower side of the abseil device).

As long as the body is kept upright, the Gibbs will slide sown the rope without assistance, however if preferred you may rest your left hand around the back of the Gibbs and hold the carabiner down thus ensuring that there is absolutely no chance of the Shunt locking on during normal abseiling. The presence of the hand on the carabiner does not prevent the Shunt from working. If you have trouble releasing the cam, a short length of tape may be attached to the back of the carabiner to aid in its release. As with all SRT** devices, some experimentation will be required to ensure that your Shunt works efficiently.

The Spelean Shunt is so simple that it could be used to make routine stops on any abseil, rather than being reserved only for emergencies. This would be most useful when using an abseil device such as a brake bar rig, which does not have a ready stop position.

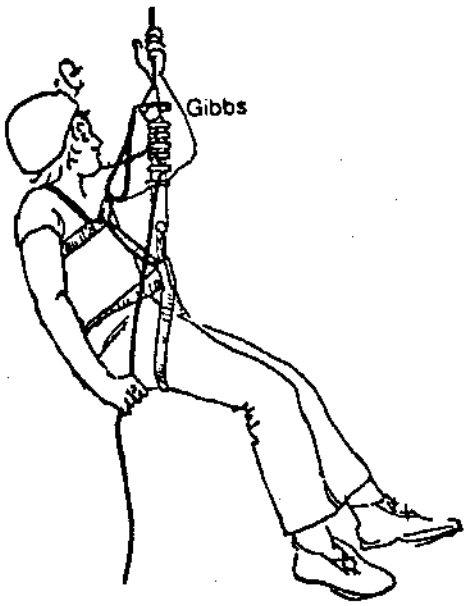


Figure 2

Reference

Montgomery, N.R., 1977, SINGLE ROPE TECHNIQUES (Sydney Speleological Society) pp 68-69.

* The author is referring to nylon webbing.
** Single Rope Technique

When rappelling or ascending with awkward, heavy loads or ropes, clip the load into the leg loops of your seat, so that the gear hangs below you and out of the way. Since the load rides directly below you, the problem of being pulled off balance with weight on your back is eliminated. Also, the situation where a coiled rope slips off your shoulder, pinning your arms to your sides is no longer a concern.

* * * *

Evelyn Bradshaw wrote in the DC SPELEOGRAPH that she'd like to have a nickel for every time she's seen vertical cavers write about their "verticle" work. To add to that, I'd also take a nickel for each "break" bar and foot "Gibb"!

construction & use of

an etrier [ā' - trē - ā]

*Ed Seaman

A useful piece of gear for both horizontal and vertical caving is an etrier (webbing ladder). This can be rigged to the main rope, at the lip of a pit, with a Jumar, prusik knot, or tied-off with a separate length of rope so as to permit a climber to stand in the ladder and get his weight off the main rope. This eliminates the hassle of getting Gibbs or knots over the lip, and is especially helpful if you are carrying a heavy pack, are tired, or if the main line is heavy due to its length or being wet.

Used as a handline, it is much easier to hold onto than a rope and, of course, is much lighter and easier to carry than a rope.

Thirty feet of 3/4" or 1" nylon webbing will make an etrier about 11' - 12' in length and can be made as follows: Lay the webbing out flat and fold over in the center so as to double it. Tie an overhand knot in the loose ends. About 10" - 12" from the end knot, gather about 5" - 6" of stock on one of the halves of webbing and make another overhand knot. This creates a loop effect similar to a stirrup on one side of the ladder. Continue this procedure alternating right and left sides. Keep the webbing and knots laid out neatly so as not to develop any twists in the webbing. Leave a reasonable loop of webbing at the end.

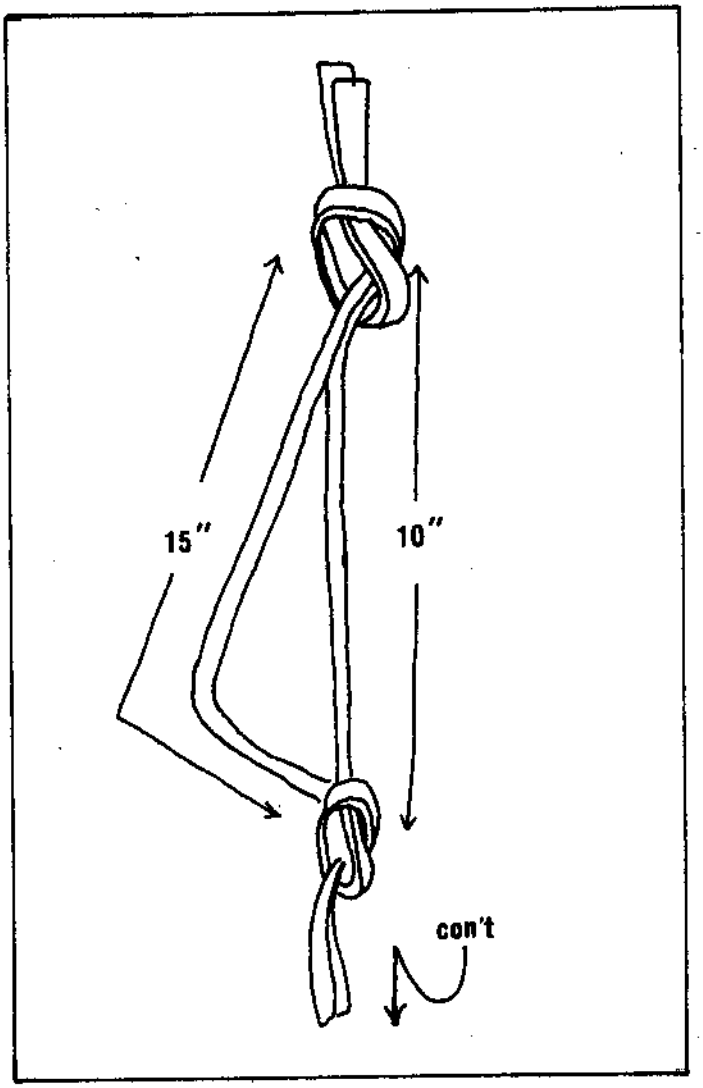
These ladders can be joined at the ends. This permits several people in a caving party to carry short ladders which can later be joined at the cave or pit as necessary.

This device is only a passive aid, and since you are not attached to it, a belay is necessary if there is any exposure to falling. When used at the lip of a pit, all climbing devices - Gibbs, knots, Jumars, etc. - are left on the main line while the climber stands in the ladder.

I suggest that, as with any piece of caving gear, you practice its use on the surface first. It should be inspected for frays and abrasive damage before each use; and, as with ropes, a pad should be used if it comes in contact with sharp and abrasive objects.

Store in a cool, dry place and wash in warm water.

DO NOT LEAVE an etrier rigged in a cave for strangers to use.



Tensile Tests on LIBERTY 'biners

These tests were performed on March 15, 1977, by Kyle Isenhart and Howard N. Smith. The specimens were loaded at a rate of 0.02"/minute on 0.500" diameter steel pins.

Aluminum "D" Locking:

Sample #	Load at which gate would not open (lbs.)	Load at failure (lbs.)
1	262	5175
2	258	5625
3	316	5450
4	275	5400
5	248	5500
6	285	5800
7	296	5650
8	273	5050
9	335	5300
10	313	5600
Mean	286	5455
Standard Deviation	28.3	230.6

Aluminum Oval:

Sample #	Load at which gate would not open (lbs.)	Load at failure (lbs.)
1	387	3040
2	350	2820
3	346	2880
4	289	3100
5	381	3000
6	406	2850
7	342	2980
8	368	3120
9	400	3130
10	401	3030
Mean	367	2995
Standard Deviation	36.2	112.2

Assuming that the data are normally distributed and that the carabiners tested were a random sample, it can be calculated that 99.99% of new Liberty aluminum "D" locking carabiners have breaking strength above 4590 pounds, and that 99.99% of new Liberty aluminum oval carabiners have breaking strengths above 2580 pounds.

The test carabiners were furnished by The Speleoshoppe.

Contributed by Kirk MacGregor

V.S. $$$

Testing Grants Proposal

A proposal will be brought before the Vertical Section in New Braunfels concerning equipment testing grants to be provided by the section. A draft of that proposal as written by Kirk MacGregor, Chairman, follows. Anyone interested in obtaining an equipment testing grant should follow these guidelines in preparing a report to be presented at the NSS Convention, since the grants may be handed out on a first-come-first-served basis. We hope this program will help to encourage responsible testing of vertical equipment.

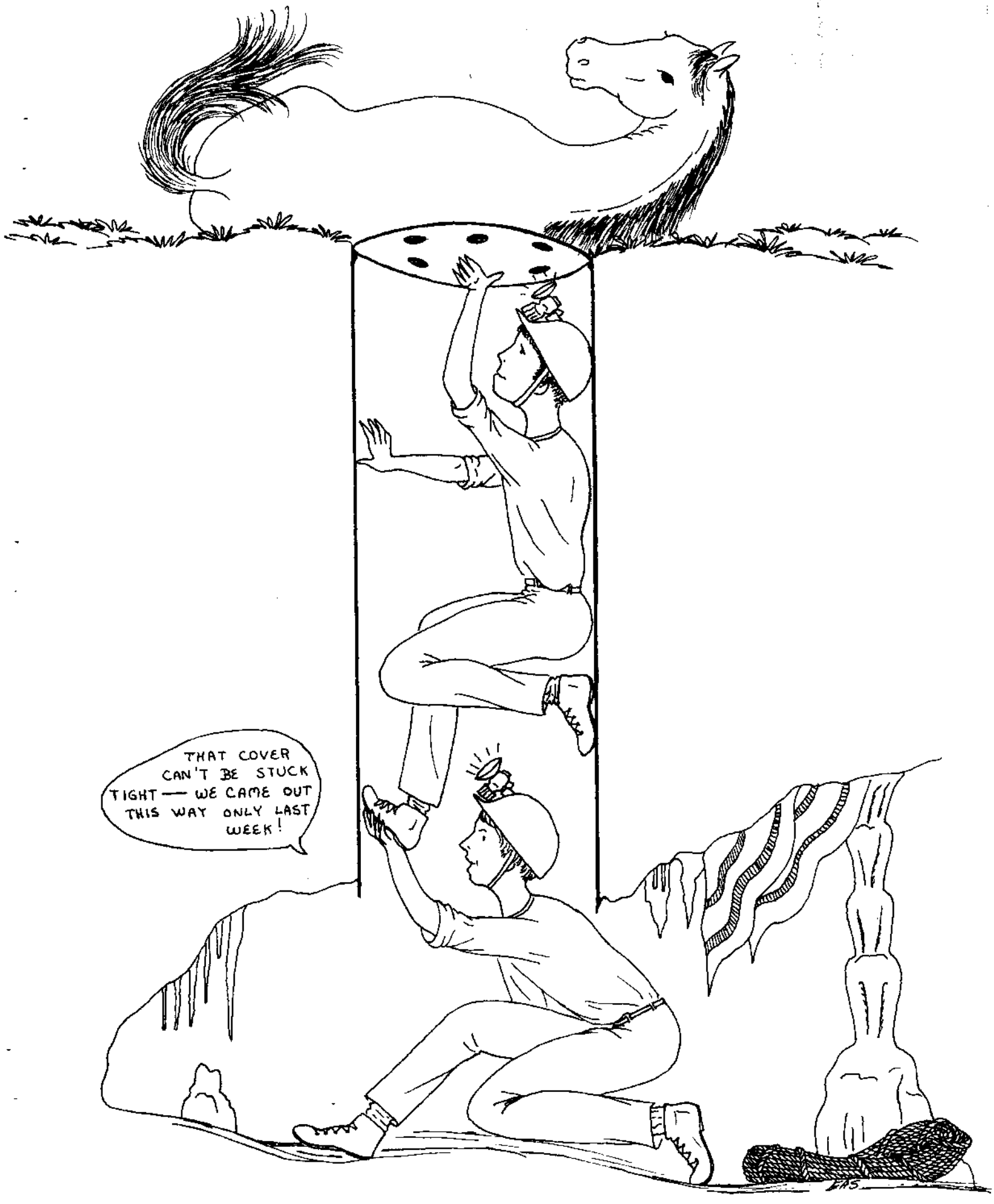
"To apply:
1) Arrange to get free access to the facilities and equipment that you will need at a university, etc. (The grant money should be used primarily for buying items to be destroyed in testing or other materials that cannot reasonable be obtained free.)

"To apply:
1) Arrange to get free access to the facilities and equipment that you will need at a university, etc. (the grant money should be used primarily for buying items to be destroyed in testing or other materials that cannot reasonably be obtained free.)
2) Be prepared to submit a report on the test and the results for publication in the NYLON HIGHWAY. The report should be sent to NYLON HIGHWAY a reasonable amount of time after you receive the money.
3) Send a description of the proposed test and an indication of how the grant money will be sent to: Kirk MacGregor
78 King High Ave.
Downsview, Ontario
Canada M3H 3B1

Grant applications will be reviewed by the executive committee of the Vertical Section. Within two months, each person applying for a grant will receive either the grant, or a brief explanation of why the grant was rejected.

We are especially interested in innovative tests (e.g. of techniques to stop cave rats from damaging ropes, on the effect of side-to-side abrasion on ropes), but we will also support routine tests (e.g. how strong are brand X carabiners?). Our budget being limited, we cannot consider requests for over $100, and prefer requests for significantly less."

When putting a rig together with new Gibbs, take the time to remove rough places which may abrade webbing. The most important place perhaps is the inside the eye of the cam jaw. Using a sharp knife, carve away the ridge left by manufacturing, then finish off with emory paper and steel wool. The eye should be smooth and polished before being used with webbing to cut down on abrasion.


THAT COVER CAN'T BE STUCK TIGHT — WE CAME OUT THIS WAY ONLY LAST WEEK!

READ THIS

COG Agenda, 1978...

III. NSS Policies....

C. Question: Should the NSS Vertical Section be urged to include an emphases on safety techniques in connection with the contests they sponsor? YES or NO

1. If yes, should one or all of the following skills be demonstrated?
   a. During descent, the caver should be able to switch from rappel to prusik without touching the gound.
   b. During ascent and descent the caver should be able to pass a knot.
   c. During ascent and descent the caver should be able to switch ropes.
2. How should this be demonstrated? (VOTE FOR ONE OR MORE)
   a. Establish a content so that the above skills could be judged on a point basis?
   b. Require that the cavers entering the vertical contests demonstrate the ability to accomplish the vertical skills.
   c. Arrange for a demonstration of the above-mentioned skills during the vertical contests.

(Sumitted by D.C. Grotto)

Reacting with some alarm and disbelief, I wrote to Paul Stevens, Chairman of D.C. Grotto. Paul in turn had Dennis Seekins contact me, since the proposal was his idea. I spoke with Dennis on the phone, questioning his purpose and methods as well as trying to explain why parts of his proposal were not feasable. He agreed to reconsider, and perhaps remove it from the agenda. However, he has decided to let the proposal remain, but with the removal of the first sentence (which gives a rather misleading conception of the Vertical Section).

Dennis told me that there is not enough emphases on getting out of trouble once the caver gets into it. "Problems arise that need to be overcome while on the rope", and thus the rationale behind the articles in his proposal. He felt that these problems "aren't well enough addressed" by the Section. The contests emphasize speed, but should also emphasize safety; side by side. The items proposed should somehow be worked into the contests.

I explained how we'd probably loose most of our racers if they had to go through a screening process prior to racing. The place for demonstrations is the vertical session, and ropes are always available during the contests simply for practicing, experimentation, instruction, etc. We would need more room and more manpower to operate several contests involving the skills mentioned. An article in the HIGHWAY would reach more people and would serve as a reference. Also, there are many problems which can arise while vertical caving, and many skills would be valuable -- rigging in and climbing in the dark, righting oneself from hanging by an ankle and proceeding to climb, etc., etc. Where should the line be drawn??

Dennis figgures the COG would know where to draw the line. If enough people think an idea is worthwhile, then it should be implemented. "But why not approach the Vertical Section first?" This would be the most direct route, and the most effecient. Also, why leave the COG to pass judgement on a subject and Internal Organization about which they know very little? Dennis stated that he had no quarrel with the Vertical Section, and he wasn't critisizing. He wasn't attempting to go around the Section or go over its he head. The COG was simply another route. He wanted the topic out for discussion. Why not inform the Section's officers of his intentions beforehand to perhaps receive some recommendations and feedback? Dennis didn't want to hassle with all the letter writing.

Comments? Opinions? Attend the COG to express your ideas. Or speak to an Executive committee member so that he will know how the section feels. We have one vote in the COG, and should make good use of it!!