

NYLON HIGHWAY NO. 39



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NYLON HIGHWAY

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THE NYLON HIGHWAY

The *Nylon Highway* is published by the Vertical Section of the National Speleological Society on a semi-annual basis pending sufficient material. Vertical Section dues are \$5.00 annually. It is the intent of this publication to provide a vehicle for papers on all aspects of vertical caving. All submitted articles containing unsafe practices will be returned to the author. With this issue, the Vertical Section has over 1100 members with a mail out of over 1200 copies of each issue.

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Front Cover: Dick Lawson in Juniper Gulf, United Kingdom. By Linda Heslop from photo by Dave Elliot.

Na One Pit, Deepest in the United States

by William R. Halliday

Impressive pit craters on Hualalai volcano on the Big Island of Hawaii traditionally have been known as the Bottomless Pits. Estimates of their depths have ranged up to more than a thousand feet. Such estimates, however, have been greeted with considerable skepticism. In 1915, Lorrin A. Thurston checked out one estimated to be 1400 feet deep and found its depth to be 194 feet. And so matters rested. The area is one of very rugged volcanic terrain, with only a few 4WD tracks used for ranch management. Staff persons of the U.S. Geological Survey were permitted entry to the ranch and estimated the depth of one pit as 700 feet, but kept the information largely to themselves for a long time. That one is still virgin.

In the course of studies with planetary geologists in a different part of the ranch, I came to know its new manager. He loves the high elevation countryside, and invited Spike Werner and me to accompany him on a Sunday jeep outing. The climax of an amazing day was a vast pit far down the southeast rift of Hualalai, looking amazingly like a Mexican cenote, even to an inner pit visible on a ledge well above the floor of the pit crater itself. We were impressed.

I estimated the depth of the main pit as 150 to 250 feet, but I am no vertical caver. When I tried to get the NSS Vertical Section to organize an expedition of vertical cavers to check it and others nearby, I was met with considerable skepticism. A few months later, however, Steve Smith was along on another summit jeep tour, and said that I had underestimated it. Also, along was planetary geologist Ron Greeley. He too was impressed and express hope that we could get some geologic samples from the depths of the inner pit. But when vertical cavers came to Hawaii, they were interested in beaches. Everybody knew that deep pits are in limestone, not volcanic rock.

In January 1994, however, Doug Medville brought a team to Hawaii that included several excellent vertical cavers. They came to map lava tube caves, but with some difficulty, I persuaded them to bring gear and ropes. Kevin Allred already was on the Big Island, for the same purpose, and with the same attitude. He and Carlene reluctantly brought along 1300 feet of static rope. 14 years earlier, I had persuaded them to bring 200 feet of goldline to descend Devil's Throat in Hawaii Volcanoes National Park. But after we all walked around its friable

edge, we shuddered collectively and walked away -- a mistake, as it has been used for rescue practice by Park staff in recent years. And I had promised Nashville's Dave Doyle some interesting caving if he stopped by, en route from Guam to the mainland, and brought his ropes. He did, but only one of them.

On January 21, 1994, the pits of Hualalai volcano got Kevin's attention, on a mere scouting hike on the northwest rift of the volcano. After a few ordinary craters (one a mini-Golondrinas, complete with swirling green parrots which escaped from some aviary far below), he and I looked into Kaupulehu Crater. Seemingly, Kaupulehu Crater is an ordinary bowl-shaped crater. But from its rim, we could see an inner pit, somewhat S-shaped, with vertical walls. It is only about 30 feet deep, but at its jungle type far end, Kevin found an open vertical volcanic conduit continuing down, requiring vertical gear to even get a good look. We expected to return to this and nearby pits later in the week, but Na One Pit intervened.

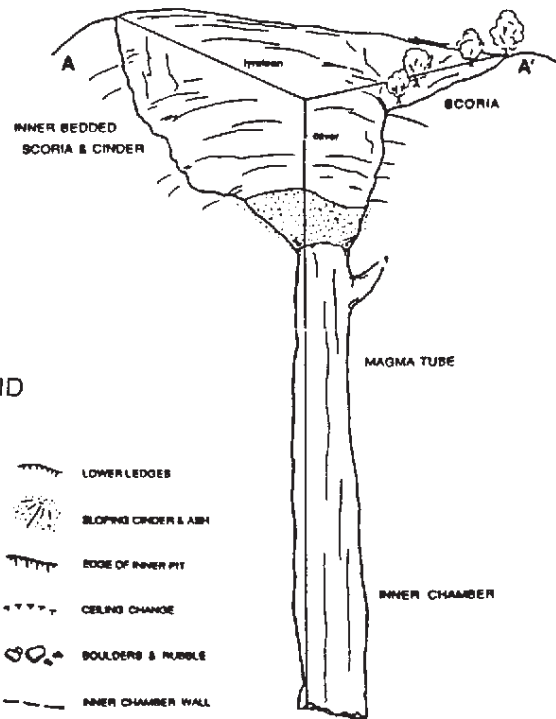
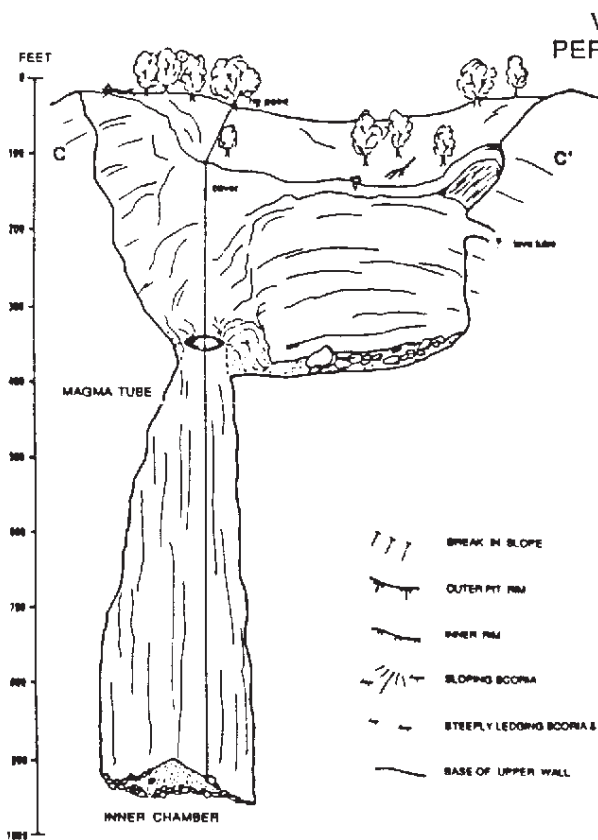
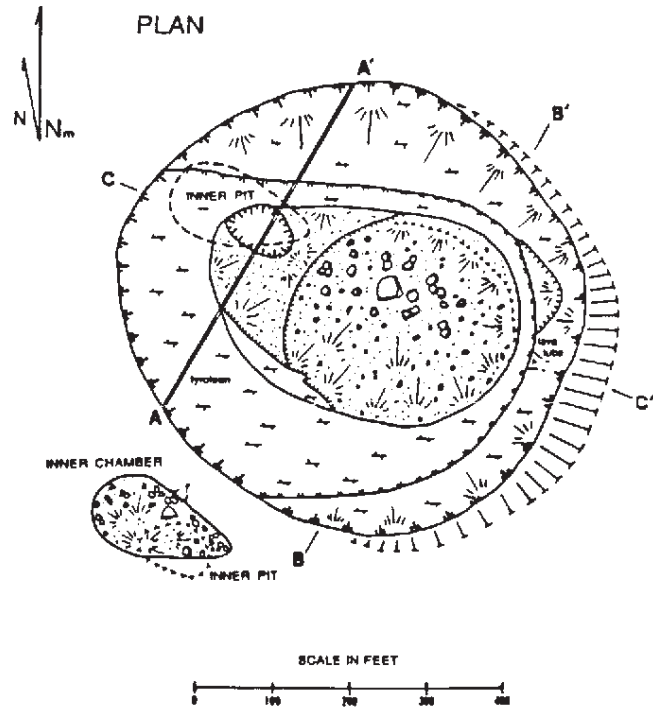
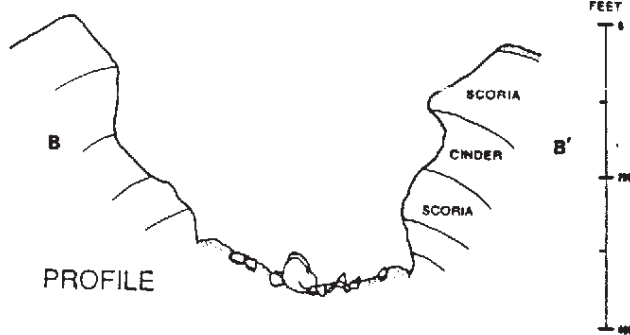
On January 24, I managed to get us lost and unlost several times in summit fog en route to Na One Pit -- it's almost 14 miles from a paved road, in distinctly hostile terrain. Skepticism was almost as thick as the fog, so I chose the parking spot very carefully, where everyone had to walk to the very rim before they could see into it. It paid off, with real gasps of surprise, and a unanimous, WOW!

This was a Hawaii Spelcological Survey project, with Kevin Allred in charge. The crucial decisions, however, were team decisions. After everyone walked around the rim of the pit, about 500 feet in diameter, everyone agreed that Kevin and Don Coons should drop the outer pit, look into the inner pit if they could and map whatever they could, while the rest of us mapped the surface and froze our tails in a sleet storm.

Don and Kevin rigged the side of the outer pit opposite the inner pit, mostly in routine fashion for a steep hundred-foot initial slope on crumbly volcanics, followed by a nearly free fall of almost 300 feet. The fall line was only a few feet away from the opening of a rift tube about 200 feet down, and it was hoped that at least one of them would be able to pendulum into it. But caterpillars began to develop despite padding; it seems lava ledges are sharper than chert. It remains virgin.

NA ONE
PIT 6082

Sound and tape survey January, 1994 by
Kevin Alfred David Doyle
Dave Bunnett William Hallock
Don Coons Carol Vesely
Hawaii Speleological Survey



LEGEND

- | | | | |
|--|---------------------------------|--|----------------------|
| | BREAK IN SLOPE | | LOWER LEDGES |
| | OUTER PIT RIM | | SLOPING CINDER & ASH |
| | INNER RIM | | EDGE OF INNER PIT |
| | SLOPING SCORIA | | CEILING CHANGE |
| | STEEPLY LEDGING SCORIA & CINDER | | BOULDERS & RUBBLE |
| | BASE OF UPPER WALL | | INNER CHAMBER WALL |

Don rigged a re-directional point partway down, off of some scrubby bushes and also placed a rope pad. Aside from the caterpillars, he and Kevin descended uneventfully, while the others watched and took photos or sought shelter in the vehicles after the surface mapping.

We had been worried about the ascent from the bottom of the main crater to the ledge leading to the inner pit, but it proved to be no problem. Except that there was no place to tie off to descend the inner pit. Don rigged to the end of a 90-foot rope and lowered himself over the 40-foot drop above the main crater floor as Kevin rappelled as far as he dared go without pulling don in behind him. All he could see was that the inner pit belled out into impressive blackness. After a 6-second free fall to a debris slope far below, the rocks ricocheted out of sight.

Don and Kevin mapped their way back across the outer pit, then up the rope. Though a bit dismayed to encounter the wind chill at the top (the elevation is over 6000 feet). Kevin showed (and admitted to) tremendous exhilaration. Especially after inspecting the three largest caterpillars, nobody wanted to rappel the wall of the outer pit again. But there was less than 100 feet of unused rope on hand, and the H.S.S. permit expired within 5 days. So did the non-refundable airline tickets most of the vertical group had. Dave Doyle got on the phone to his parents in Kentucky and the other chipped in for air express of his extra 600-foot rope. It reached the Kona airport on January 27, with a 4x4 waiting. In mid-day sun, the team began to rig a Tyrolean traverse over 500 feet with Dave Doyle's rope. Fortunately, the weather had cleared (after leaving three feet of snow on nearby Mauna Kea).

The Tyrolean traverse was believed necessary to avoid crumbly walls above the inner pit. One or two safety lines had to be rigged to thread the main line around some straggly trees growing on the crumbly rim. The plan was to use a lateral "Tag" line hooked to the traverse line at the point where the vertical descent would be made. This "Tag" line could then be pulled or released to adjust the descent point. For this, two "miscellaneous" ropes had been borrowed from local caver.

Fortunately, the Allreds had tossed a couple of small rescue pulleys into their gear before flying from Alaska to Hawaii. These were used on the traverse line. First, Kevin tested the system and adjusted the tag line; unsurprisingly, they had guessed wrong on its attachment point along the traverse rope. A 200-foot rope of mine, plus a length of Dave Bunnell's rope, were used as a belay line to lower the cavers along the traverse line.

Chief cartographer Carol Vesley reported the slope of the traverse line as about 12 degrees on one side and 17 degrees on the other. In the process, a very annoying problem developed; the pulley (backed up with a carabiner on the traverse line) quickly overheated. Frequently, Kevin had to stop, to blow it cool enough to touch. Except near the rim where the belay line was used to lower Kevin, then Don, it was necessary to use a Jumar ascender off the long side of a Mitchell System to creep along the traverse line -- in both directions. The ascender line was passed through a carabiner at the pulley and then to a foot.

Finally, everything was ready. In the last rays of sunshine, Kevin crept back along the traverse rope with more than 100 pounds of rope to be positioned for the descent -- a very small spidery figure in a very big cavity. "I was literally scared to death," Kevin smiled later. "But I knew what had to be done, so I did it." After a number of failed attempts at changing over with the heavy rope bag he finally tied into the descent rope and made a free-fall descent straight to the bottom, feeding out the rope as he went. One knot had to be crossed, between a 500-foot 7/16" PMI rope and a 600-foot 1/2" Bluewater II. At least he didn't have to worry about the anchors of the traverse line; 4WDs served as backups for tree anchors. But he still recalls inspecting every endless inch of rope for fancied flaws.

The inner pit indeed belled out to a shadowy shaft as much as 100 by 200 feet. Little bedrock was exposed; the wall consisted mostly of a thin, granular red-brown lava coating. At the bottom, 863 feet below the spillover point of the outer pit, was a debris cone, but its rock was unremarkable. Don Coons later found a small, detachable piece of bedrock for geological study, but it too, was unremarkable. After making sure he hadn't missed anything, Kevin began the long, tedious ascent, half in underground darkness, half in starlight. He had become the first person to make first descents of the deepest pit in the United States on two occasions. (Alaska's El Capitan also was the deepest known when Kevin dropped it).

When the haul crew had retrieved Kevin, Don Coons followed, solo surveying around the bottom chamber and ascending after midnight, all alone in the blackness, just himself and the rope, ascending straight toward Alpha Centauri. For both cavers, it was an incredibly powerful illusion of ascending into the very stars; the traverse rope was invisible for most of the climb, and the higher they got, the more amazing was the spectacle.

Dawn was not far off and, in the subfreezing wind, no one else felt like making the descent. The team derigged, slept fitfully for a couple of hours, loaded up and headed for pavement, a telephone and the airport, in that order. Don Coons and Carol Vesely produced a notable map for the 1994 NSS Convention and every looked forward to the next trip to this and other pits in this amazing site. But permission for that next trip has not been forthcoming. The Hawaii Speleological Survey has good landowner relations with the ranch manager. But it seems that the very idea of someone descending more than 800 feet on a single rope -- and maybe more in another pit -- scared the collective wits out of the ranch's liability management team. Ever since that first descent, the H.S.S. has been trying to negotiate a legal release transferring all possible liability from the landowner to participants in vertical caving. But it is a matter of small importance to the ranch's legal staff, and has a low priority. At this time, it is not possible to even guess when -- if ever -- more vertical caving will be possible on this huge ranch. This chapter in the book of American vertical caving opened and closed in a single week.

The name of the pit? Initially, no one had bothered naming it. Some of the vertical team wanted to call it Pele's Abyss, but a different Hawaiian goddess is associated with Hualalai volcano, not Pele. And besides, it the landowner has the right to name features on its

property. It turned to the local Kupuna (Native Hawaiian elders). After due deliberation, they chose the name Na One (pronounced nah oh-nay), meaning "The Sands" in reference to the extensive volcanic ash around the outer pit. In the interim, it was called Pit 6083, because of a USGS benchmark on its rim, indicating an elevation of 6083 feet. But now all culturally sensitive cavers will call it Na One. The depth was determined by measurement and ordinary trigonometry. A deeper pit exists on the nearby island of Molokai, but most of it is under water.

In addition to Kevin Allred and Don Coons, participants in the project were Dave Bunnell, Dave Doyle, Carol Vesely and myself. If you have doubts about pits in volcanic rock, ask someone who's been to Na One.

Acknowledgment

As chairman of the Hawaii Speleological Survey, I am deeply grateful to Rick Robinson, manager of the ranch, for permission for us to investigate Na One, and to all the members of the team for all that they did to make its descent possible. Especially, I am grateful to Don and Carol for the notable map of the pit, and to Kevin and Don for descriptions of the pit and of their feelings. It was quite a team, folks.

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Tuning Your Double Bungie

by Peter Grant

Quite a few people are having problems with climbing smoothly with the double bungie rope waling system that was developed by Maureen Handler around 1986. It was developed as a way to use rope waling with rebelay and used Petzl ascenders instead of Gibbs, since Petzls are easier to change while on rope. The Petzls needed to be pulled up by elastic cords (bungies), while the lower Gibbs was raised directly by the lower foot. The problems seen mostly are the attachment side of the Petzls are twisted so they try to slide against the body where they bind up. Tuning something up means making adjustments to improve performance. Here are some suggestions

The lower Petzl could be placed on the left foot with a Petzl Basic, B08 (the purple spotted one). It should be connected to the foot loop by a delta maillon, which orients the Petzl 90 degrees from where it would be if sewn directly on the foot loop. The Petzl should then have the attachment to the left and the rope channel to the right, not front to back. The Basic is considered to be right handed and used on the left foot. The Croll (the yellow one) is left handed and is used on the knee on the right leg. Properly tuned, the upper Petzl attachment points to the right and the rope channel to the left. You may have to twist the strap from the foot to the Croll, when preparing to climb, to get it to be left to right.

When going up, bent a little at the waist, so the bungie doesn't rub between the rope and the body. Leave some room. Most important, for any rope walking system is to have the chest box as high and as tight to the body as possible. An inch of slack makes twice the work. Two inches makes as much work as the French system. See *Nylon Highways* #28 & #35 for more details. Editor's Note: I use Petzl Basics for both ascender. It is extremely important that the foot ascender be oriented parallel to the plane of the body when rigged onto the foot sling. The rope channel should be to the oriented on the instep side of your foot. Also, the bungie cord must be fairly tight when standing to prevent 'slop' in the system.■

Letter from the Editor

by Maureen Handler

As I finish what appears to be my last issue, I keep thinking back about all the wonderful things that have happened to me since I became the editor six years ago. I was able to participate in the NSS/Vertical Section exchange trip for 2 ½ weeks of caving in the Ukraine. I receive exchange publications from organizations all over the world and the *Nylon Highway* is sent to about 30 countries overseas. I have been kept abreast of the happenings around the country through all of the domestic publications I receive.

The Vertical Section membership swelled to well over a thousand members and 1400 issues of the *Nylon Highway* were printed with each of the last four issues. Now, unfortunately, the membership has dropped to an all time low of the last decade. The main reason for this has been the lack of timely publication of the *Nylon Highway* for the last couple of years. For this, I sincerely apologize to the entire Section membership. Changes in my personal life have left me with little time for caving or editing. A year and a half ago, I started a new job and bought a small farm. Then last summer I started dating a part time farmer. This landowner business is long, hard work and since I anticipate buying another small farm to build a house on, I see no recourse but to resign as the *Nylon Highway* editor.

With this mailing, you should be nearly caught up on issues. This is the January 1995 issue. Geary Schindel is guest editing issue #40, which will be the June 1995 issue. Our new editor is producing issues #41 and #42. Members whose membership expired in June 1995 will also receive issue #41 in hopes that you will renew your membership. The Section needs your support to continue to distribute information on single rope techniques to as large an audience as possible.

I will still do my best to contribute to the publication. After 15 years of vertical caving, I still have plenty of stories to tell. I have certainly come to learn that this publication is only as good as the material received to publish. The Vertical Section has always had a top quality publication and I want this to continue into the next century. I thank you for all of your support and eagerly look forward to future issues of the *Nylon Highway*

MYTH BUSTING

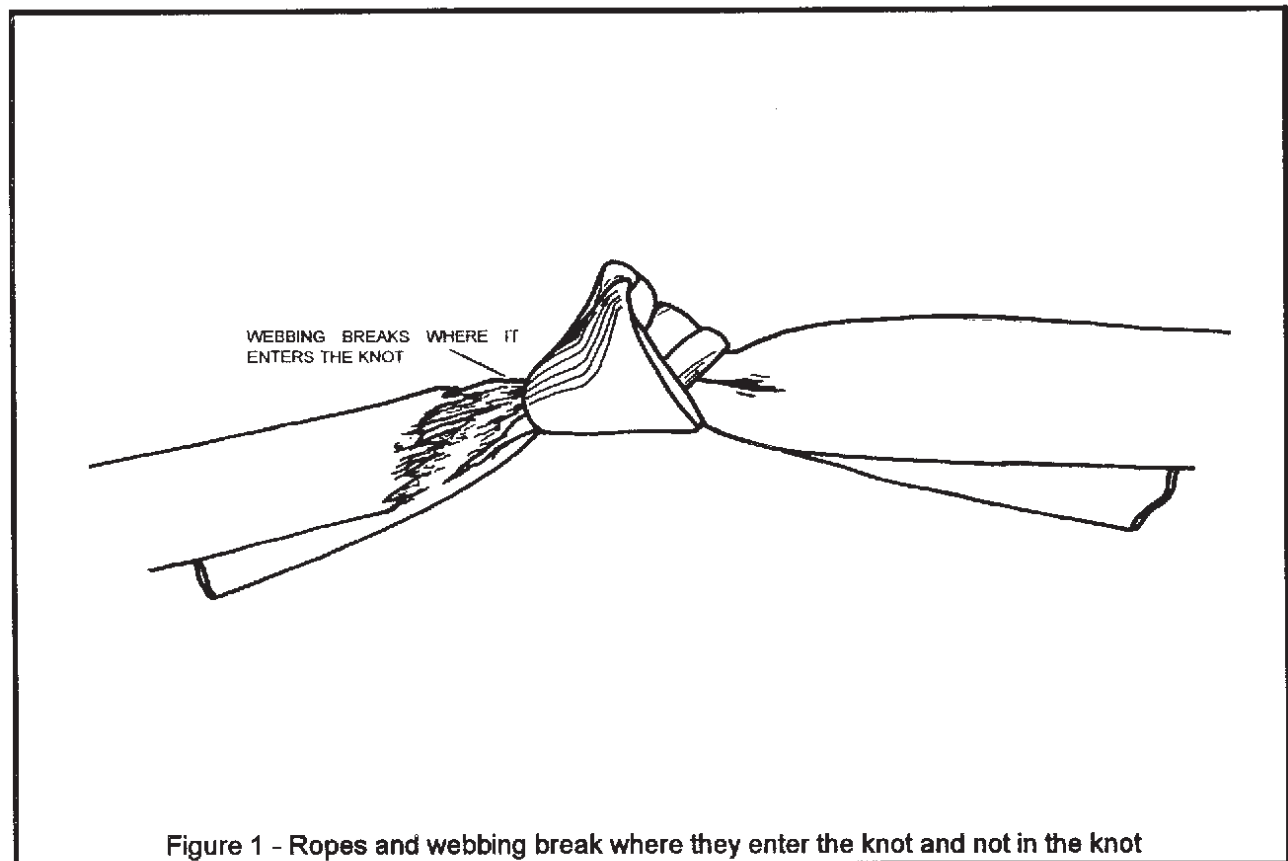
By Bruce W. Smith

I Love this. So many wives tales. So many traditions that perpetuate themselves, that when you're lucky enough to actually stick your head into some research books or better yet a testing lab, and blow the doors off some old myths..., Well, I just can't wait tell you what I've found.

MYTH # 1

It is important to make sure the load bearing line going into a *Figure Eight on a Bight* take the outside turn in the knot. This will give you 8% more strength. Not!

What the research and testing have shown is that in all recorded history, a rope has never separated in the middle of the knot. The rope, when pulled to destruction will break at the point the rope enters the knot (Fig. #1). The turns of the knot pinch the rope so severely that it breaks at that point. This goes for webbing too. So all this concern about lay orientation in a *Figure Eight on a Bight* sounds good but in reality, it really doesn't matter.



MYTH # 2

A *Water Knot* is the best knot to tie webbing together to form a sling. It maybe the simplest knot to tie, however tests performed at PMI's testing facility on February 4, 1995 have shown it to be the weakest. Most knot efficiency charts show the Overhand Knot causing rope failure between 49% and 55% of the rope's original strength. And again, in a series of tests, a loop of webbing stretched between two 4½" steel barrels, broke, on the average, at 4480 lbs. or 56% of the advertised 4000 lb. tensile strength of 1" tubular webbing. Being looped the potential tensile is basically doubled (Fig 2).

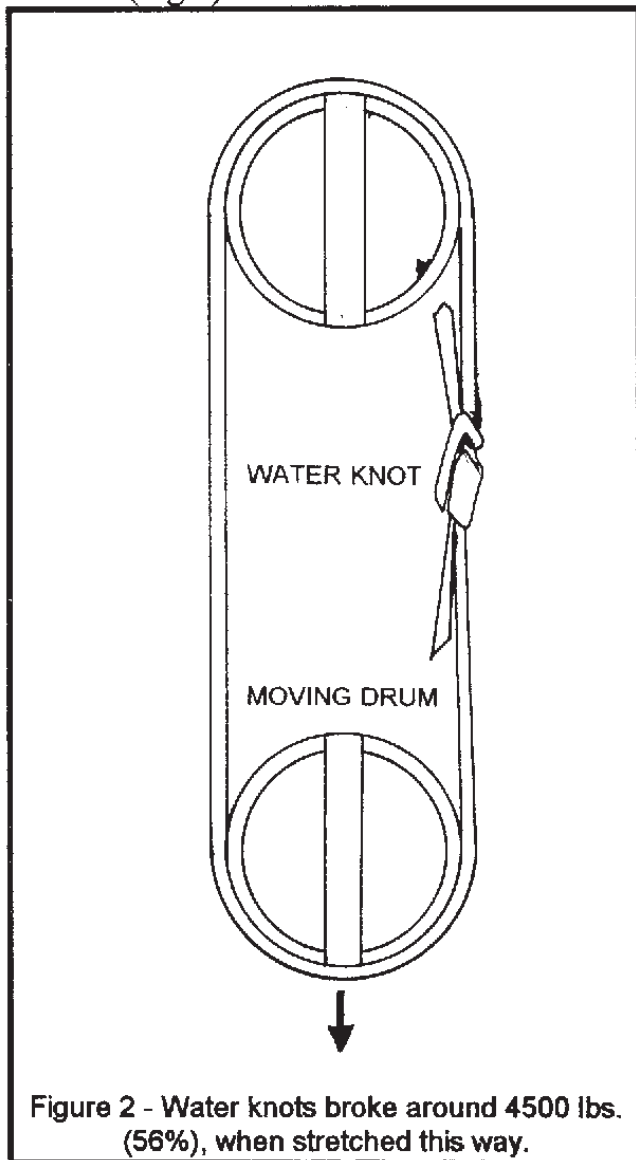


Figure 2 - Water knots broke around 4500 lbs. (56%), when stretched this way.

So what knot tied in webbing fared better? Interestingly, a *Figure Eight Follow Through* proved substantially better. This series of tests broke, on the average, at over 80% of the webbing's potential tensile. It may be an ugly knot when tied, but it sure proved stronger.

That's not all! Peter Ludwig, at an NSS convention about 6 years ago shared a knot at the Vertical Session called the *Beer Knot* (Something about beer being stronger than water). The *Beer Knot* is half knot, half splice. Peter told us that he thought it was stronger. The Ludwig understatement. The *Beer Knot* in a series of tests averaged over 75% of the webbing's potential tensile (Fig. #3). What is especially nice about the *Beer Knot* is the beauty of this knot. It has no tails. When completed, the knot completes a cleanly formed loop. Its only drawback is that it does take a few minutes to tie one. Practice makes the competent rope technician proficient at tying this knot.

MYTH #3

This isn't exactly a myth. For years there has existed a controversy over the establishment of two separate anchors around the same bomb proof anchor (say a large tree). The party line has stated that each anchor must be established with two separated pieces of webbing tied with separate *Water Knots*. I have often felt that one piece of webbing doubled tied with one *Water Knot* would surely do just as well and take **HALF** the time. Establishing anchors at a rescue is the most time consuming activity there is and if small time saving advantages could be employed, it could streamline the whole rigging process. After the series of test comparing the two rigging methods, pulling each rigging method to destruction, the test showed there was **ABSOLUTELY NO DIFFERENCE** (Fig. #4).

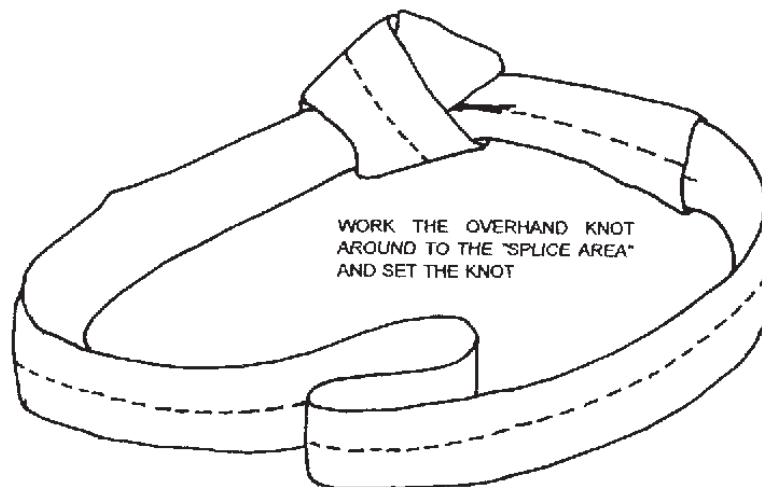
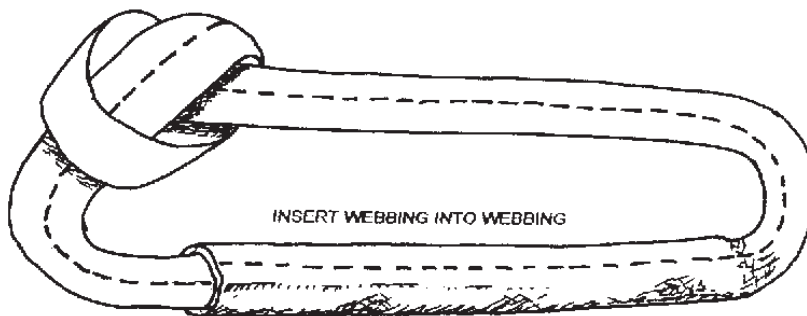
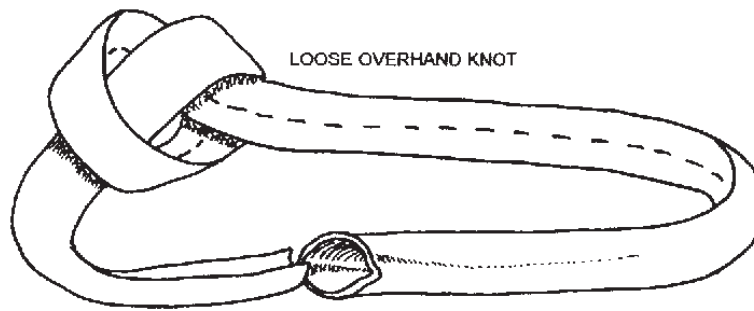
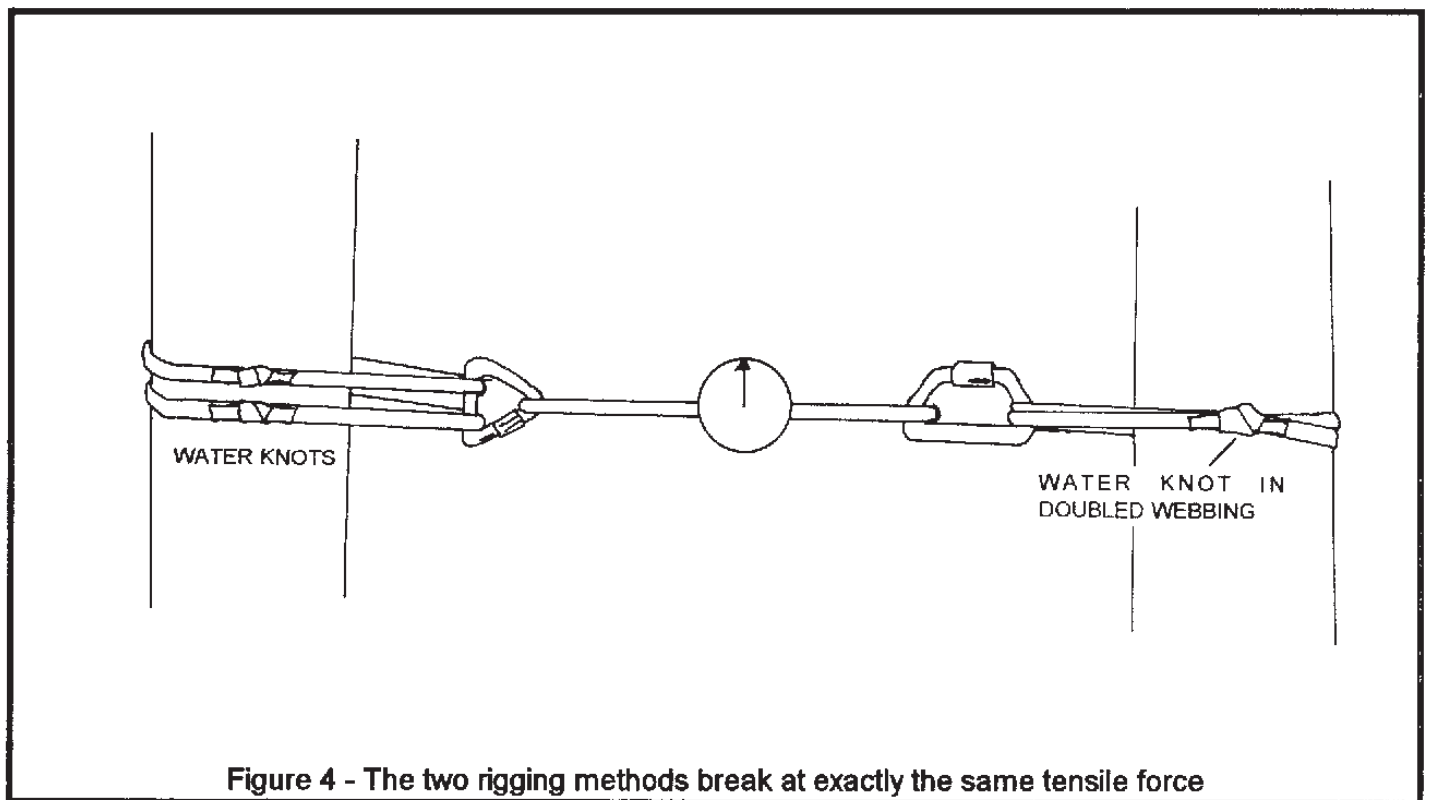


Figure 3 - The *Beer Knot* maintains a 75% efficiency during tensile testing



MYTH # 4

A sling of webbing clipped into a carabiner is double strength through the entire length of the rigging until it enters and circles the carabiner. At this point the webbing or rope is only a single strand. Therefore it is only single strength. NOT!

According to tests either done or witnessed by Larry Caldwell, retired owner of PMI, repeatedly showed that rope broke about 1.5 times the rope's tensile (Fig. #5). Webbing fared much better. Depending on whether it was draped or sewn, webbing tested in this way achieved results between 1.5 and 2 times the webbing's tensile.

MYTH # 5

Stitching patterns make a difference when sewing webbing, straps, harnesses etc. If there is a shortage of thread, this is true, not to mention that your sewn gear always looks better if there is a planned stitch pattern.

However, in some exhaustive tests done by Geary Schindel from Nashville, he determined that if you have unlimited thread, stitch patterns don't make a difference. Over stitching hides a multitude of problems created by stitch pattern scrimping. So, in the big picture if you stitch the hell out of a connection point, it really doesn't make a difference where you put the stitches.

Interesting Trivia # 1.

Prior to the writing of Ashley's definitive study on knots that was published in 1944, there did not exist a knot that he knew about that was ever named after a person. Here is a partial list of knots I have come to know and occasionally use.

Prusik Hitch Münter Hitch
Sponge Knot Hedden Knot
Frost Knot

I am sure you can think of a few of your own.

WHEN PULLED TO DESTRUCTION
THE WEBBING OR ROPE BREAKS
HERE

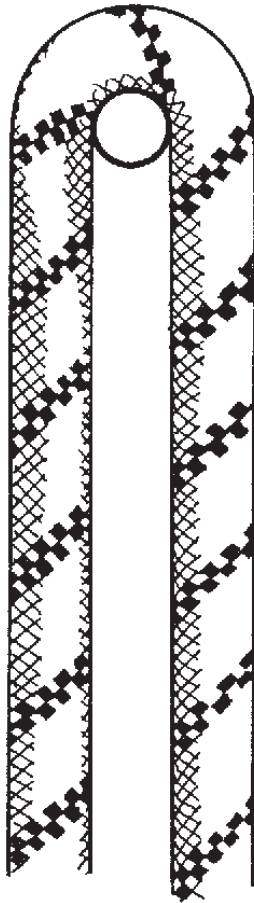


Figure 5 - Rope and webbing breaks at about 1.5 x the tensile strength of a carabiner. Example - If a rope's tensile strength is 7000 lbs., it will break at about at about 10,500 lbs

KNOT COMPACTNESS

If there is a concern I have about riggings, it falls into the category of efficiency. Many riggings, I have observed seem to believe there

is endless rope available for the knots and back-ups within them. In fact, there is a philosophy out there that states, "If you use enough rope to complete your rigging it will hold," or "The more rope the better."

I come from a different school that professes technique first. I like to see the job expertly done with as little rope as possible. "Waste not, want not!" So I did a study to look at many of the commonly used knots to rig. I took a 4" pipe to form all the loops around and used an 11 mm dynamic rope to tie all the knots with. This then would give the purest readings as a stiff rope would require more rope to make the knots and exaggerate the results.

| Knot | Inches needed to form the knot |
|-------------------------|-----------------------------------|
| Bowline | 23.5" |
| Mountaineering Bowline | 28" |
| Butterfly | 30" |
| Girth hitch | 31" |
| Overhand on a Bight | 32.5" |
| Figure Eight on a Bight | 40.5" |
| Bowline on a Bight | 45" |

These results support the fact that the *Bowline* is the most frugal knot of all. An *Overhand Knot* back-up takes 8" of rope and would be consistent to most all of these if a keeper knot were required. Using stiff caving rope could double the lengths required to form them. There is another newer knot guideline that is becoming more and more popular and that is:

The loop formed in a knot should be only large enough to receive whatever is going to be clipped in or inserted into it.

What happens if we take out the rope required to make the loop and just compare the rope needed to make the knot. The loop, in my

test, required 14" of rope to form. This effects only one knot drastically. The *Bowline on a Bight* moves from 6th on the chart to 4th.

| Knot | Inches needed to form the knot |
|-------------------------|--------------------------------|
| Bowline | 9.5" |
| Mountaineering Bowline | 14" |
| Butterfly | 16" |
| Bowline on a Bight | 17" |
| Overhand on a Bight | 18.5" |
| Figure Eight on a Bight | 26.5" |

What is interesting about this relationship is that it takes 180% more rope to form a *Figure Eight on a Bight* than a *Bowline*. There has been a lot of *Bowline* bashing lately and the pros and cons need to be weighed. It takes almost 3 times as much rope to make the knot-part of a *Figure Eight on the Bight* than a *Bowline*. In fact, when you look at all the knots commonly used for rigging, the *Figure Eight on a Bight* is bulkiest knot of them all. It's Twice as Long!

Bulk is not the only issue. How much room does each knot actually take. When clipping, hauling, rigging, etc. every component (carabiners, keeper knots, bridles, pulleys, swivels, load releasing hitches and stretch), in the rigging, takes up room and it comes down to every inch being important. After keeper knots, the *Figure Eight on a Bight* is twice as long as a *Bowline* (at least 5 inches long). Big Deal!

You say, big deal! Well, it could be. Many people think that the *Figure Eight on a Bight* is the only knot you need to know and I repeatedly see people with climbing rigs formed entirely with *Figure Eights*: All three loops in Cows tails, QAS's placed in the seat harness carabiner, Knee ascender tether hooked in the seat harness, ascenders attached to the foot stirrups, shoulder cam attachments into the seat harness, etc. etc. Then it is the rescue scene and you're passed the haul line and the belay line, both with *Figure Eights on a Bight* and asked to put them into your seat harness. You could be a litter tender and asked to tie in short. Before you are done there are 4,5,6 or more bulky *Figure Eights* all vying for room hanging all over a climber/rappeller.

The *Figure Eight on a Bight* is a nice knot with a multitude of great uses, but I think it sometimes gets over rated. The competent vertical technician weighs all the attributes of all the knots she has in her bag of anchors, and chooses the best one for the job.

Special Thanks: I want to thank Chuck Webber for his gracious donation of time and the use of the PMI testing facility that allowed these tests to take place.■

Responsibility

By Mike Payne, NSS 36371

Being a vertical enthusiast for several years, I have had the opportunity to observe a number of people on rope. One thing has become increasingly apparent, and that is the lack of responsibility people are exhibiting, both on and off rope. To the environment, themselves, their partners, land owners, and equipment and property of all involved. I believe this trend is growing and needs to stop and be reversed, if we are going to be able to continue to participate in our sport. The evidence is there for all to see, and unfortunately, is ignored by many. It's no wonder caves, pits, cliffs and canyons are being closed or placed off limits almost weekly. Especially in the TAG area.

Property is being littered. Trees are being cut. Entrances excavated or bolted without the owners permission. Trespassing without permission. Rudeness and graffiti to name a few.

What about our ropes being walked on? Cigarettes being thrown next to them. Edges not padded. Bolts not backed up. Rocks dropped in pits with people inside. Ropes tossed over the edge without warning. Bystanders and children standing too close to edges. People with inadequate training, practice or experience, thus causing them to exceed their abilities in vertical work or caving. Let's also don't forget a lack of proper or adequate equipment. All these things do is keep cave rescue teams busy. I think we would be much better off by putting rescue teams out of business due to lack of work.

Caves and surrounding property are not trash cans. Ropes are not carpets. Private property is not public without permission, and 500 foot pits are no place to teach someone how to rappel or ascend for the first time.

Etiquette, safety, practice and training are the responsibilities that we should observe, pursue, teach and participate in.

Seek out experienced, responsible people for advice and training. Avoid self proclaimed experts and regard them as dangerous. Practice and learn knots. Practice anchoring and backing up anchors. Learn how to operate haul systems and use mechanical advantage. Be aware of critical angles. Get to know your climbing system and become familiar with others. Use belays and good quality equipment. Treat people's caves, property and equipment as well as, if not better than your own. Then maybe, just maybe we'll be able to enjoy our sport a little while longer.

Remember that so called recon runs into a cave without permission of the owner makes you a criminal. Leaping Australian rappels into pits constitutes insanity, and these flea market bargains for vertical gear has the potential of making you dead.■

Tying the Muentner Hitch

by Lee Trowbridge

The Muentner hitch is a useful know which can serve as a simple, effective belay device. In a pinch, accompanied by a leg wrap, it can be used for short rappels in preference to the "biner wrap". The only hardware required is a carabiner, preferably a steel one for reasons of abrasion resistance. According to Padgett and Smith's On Rope, as a belay device the Muentner hitch can provide more frictional force than either a figure * or a sticht plate.

In On Rope, a relative simple technique is described to tie the Muentner hitch, and with the book open in front of you, it is no trouble at all to tie this knot. In a dark, muddy cave, however, even the simplest task can be more difficult than is easily appreciated in the comfort of one's living room. Having one needed three try's to tie this knot (no, I can't explain the mental lapse), it occurred to me that a more easily remembered means of tying it would have helped. The accompanying diagram shows such a method. It is essentially a variation of the On Rope method, but with the rope distorted so that it appears more symmetric. This method consists of four parts:

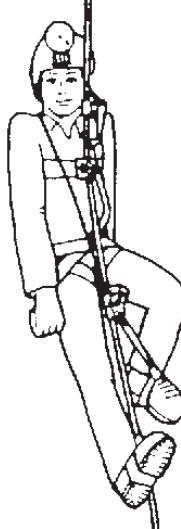
1. Form a bight on the main rope,
2. Twist the bight a full 360 degrees,
3. Clip the carabiner above and below the twist,
4. Anchor the carabiner and pull on the load end of the rope.

The carabiner of course needs to be anchored appropriately (to what, depends on the intended use). The Muentner hitch is self-reversing. That is, either end can support the load, the other being the belayer's end.

Should the load reverse, the knot will flip to the other end of the carabiner and reverse.


This technique has made it easier for me to remember (even under duress) how to tie this useful knot, and hopefully it will prove useful to others.

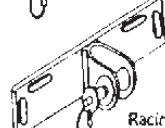
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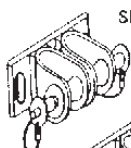


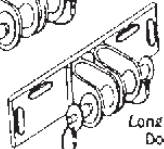
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Caving Ropes

Types, Properties, Care, Storage and Cleaning

by Dave Shurtz (Utah Grottos)

Cavers all over the world venture into darkness and never have to use vertical techniques. However, if one stays around for more than a few trips, it becomes readily apparent that the real frontier in caving involves vertical work. The first thing necessary on any vertical trip is a rope.

For the novice caver, the world of rope can be a bewildering look into mass confusion. Depending on who you talk to, any of numerous types of ropes may be mentioned. The purpose of this article is to discuss the various types of rope available and possibly make some recommendations, and then discuss ways of taking care of this life sustaining thread connecting vertical cavers to the sunny overworld we all sooner or later long to return to.

On page fifteen of On Rope, we discover that rope has been being made and used for over 5,000 years. Some of the first ropes were made from hair and plants. There are two major divisions of modern ropes. The first are ropes made from natural fibers and the second are ropes made from man made fibers. Natural fiber ropes include manila, sisal, hemp and cotton. These natural and rather short plant fibers are twisted into bundles which are then "laid" or twisted into larger bundles, which, through opposing twists, remain tightly together in the form of rope we call laid rope. These appear as a twisted vine which upon untwisting and releasing, snap back into their original form. These fibers may also be woven or braided into rope or cordage.

The main problems with this type of rope include the following:

- low resistance to abrasion
- limited ability to absorb shock loading
- degrades rapidly in strength even with the best care
- can rot without obvious outward signs
- have much lower breaking strength than synthetic fibers of the same diameter
- do not have continuous strands but use short fibers.

Man-made or synthetic fibers have the advantage of being much longer and include nylon, polyester, polyolefins (polypropylene and polyethylene), and high tech fibers such as aramid fibers like nomex and kevlar. Other fibers include spectra, carbon and fluorocarbon (teflon and gortex), to name a few. These are often woven into the above mentioned forms of rope, as well as many new and unique forms including single braids, hollow braids and braid on braid (double braids), kernmantle and various other forms.

Each of these fibers have been developed through chemistry and have various properties which make each one unique and valuable. In order to determine which fiber or combination of fibers is best for what we need, we must first determine what qualities we want in a rope. The following is a list of properties to consider, (reprinted from an article by the Wellington Puritan rope manufacturer).

1. Tensile strength
2. Abrasion resistance
3. Shock load ability
4. Controlled elongation
5. Heat resistance
6. Flexibility
7. Light weight
8. Resistance to chemicals
9. Resistance to ultraviolet light
10. Low creep
11. Low cost

After much testing, trial and error, the majority of the caving world has (at least for now) settled on Nylon as the fiber of choice. It is impossible, however, to build a rope that is ideal for every situation.

Nylon has the following good properties:

- Very strong
- Good abrasion resistance
- High melting temperature (type 6 - 480 °F; type 6/6 - 430 °F)
- Excellent shock load absorption
- Good resistance to alkalis and UV

Nylon also has the following problems:

- High elongation
- Poor resistance to acids
- Absorbs moisture
- Becomes considerably less strong when wet (on drying, the full strength is regained)

There are two ways to determine if you have a nylon rope as opposed to other types.

1. The rope will not float on water
2. The rope burns with a blue flame

Technically, Nylon is a generic term for a family of polyamides and is defined as any long chain polymeric amide which has recurring amide groups as an integral part of the main

polymer chain. It comes in many types. Some of these include type 6, 6/6, 6/10, 12, etc. In Europe, nylon ropes are called perlon. There is basically no difference between perlon and nylon. A perlon rope is a nylon rope type 6.

Now let's spend some time on construction of ropes. We have already considered laid rope basic construction of which there are two main types. First there is marine lay and second there is mountain lay. These two differ in that mountain lay is more tightly twisted as an attempt to increase its abrasion resistance and to decrease the chance of fibers being snagged and damaged. We will now discuss some of its properties. Laid rope is somewhat resistant to shock loading problems because of the large amount of inherent stretch it has. This protects the fibers from a shock load by transferring much of the stress evenly throughout the rope. However, there are a number of problems with this type of construction which include, but are not limited to, the following:

- When loaded, the fibers tend to untwist causing spin
- Each fiber is likely to appear at the surface numerous times in the length of the rope. This creates a situation where all fibers are more susceptible to damage.
- These ropes have high stretch, which can cause a host of dangerous situations in caving and rescue.
- Upon loading a stretchy and twisted rope, it is likely there will be some kinking which will take place. This property can be exacerbated by incorrectly coiling a laid rope.
- Many a person has dropped a coiled rope of any construction down a pit and proceeded to rappel into a snarl.

This likelihood of this is magnified with laid rope.

Plaited ropes use eight bundles of fibers braided together. These tend to be soft and pliable ropes, but are prone to picking of the fibers, have low abrasion resistance and are too stretchy. Braided ropes (single, hollow and double) are soft, pliable ropes which are seldom used for high angle rope because they are easily contaminated throughout by grit and dirt, they pick easily and have low abrasion resistance.

Kernmantle ropes are ropes made of two distinct parts. The kern or core and the mantle or sheath. The kern is a central core of fibers which support the majority of the load, covered by a woven mantle which protects the core from abrasion, dirt and environmental effects, such as sunlight (UV). There are two major classes of kernmantle rope, dynamic and static. A dynamic rope has 15% stretch and as much as 60% stretch before failure. A good static rope has less than 15% stretch and commonly as low as 3% to 6%. The advantage of dynamic kernmantle ropes over laid type ropes (also dynamic) is the reduction in spin. The ropes are commonly used for lead climbing and mountain climbing, where a long fall is possible and even likely. This allows for a more gentle stop at the end of the fall due to the shock absorption qualities of the rope. This effect is mechanically engineering into the rope by a number of methods, which include a thin mantle and a twisted or braided core. The problems with this type of rope for caving or rescue include the following:

- The thin sheath allows dirt and grit more easily into the core of the rope.
- The elasticity can create situations which are dangerous during rescue and enclosed pit operations.

Static kernmantle rope is the choice of rope for both rescue and caving. This is nice as it is possible for any vertical caving trip, regardless of how minor, to turn into a rescue situation.

The good characteristics of static kernmantle rope are as follows:

- Low stretch
- good resistance to dirt and grit penetration through the sheath
- good abrasion resistance
- high tensile strength

Some of the disadvantages to this type of rope are:

- The ropes tend to be very stiff because of the thickness and tightness of the weave of the mantle, making them difficult to tie knots in and to store.
- These ropes are not designed to receive a severe shock load and decrease the stop shock on the load itself like dynamic rope can do by absorbing some of the force in the stretch.

The size of the rope affects the strength of the rope. The material in the rope affects the strength of the rope. The amount of yarn used per foot of length in the rope affects the strength of the rope. A 5/16 inch (9mm) rope generally has less than 5000 pounds breaking strength. A 7/16 inch (11mm) rope has an average breaking strength of 6000 pounds and the breaking strength of a full half inch (13mm) rope is approximately 9000 pounds.

These are generalities for nylon, kernmantle, static caving ropes of good manufacture. The 7/16 inch ropes are the most popular caving ropes in the U.S. Larger diameter ropes are preferred for rescue, as the working load and

breaking strength becomes critical. If smaller diameter ropes are used, as is popular in Europe, great care should be taken to avoid the rope abrading on any rock surfaces.

Abrasion resistance mainly has to do with the tightness of the mantle weave. For example, a rope manufacturer may offer a regular and a flex model caving rope. Many are tempted to buy the flex because it is soft and easy to coil and tie knots in. But you lose abrasion resistance and the rope absorbs water more rapidly and hold it in greater quantities. Thus, the rope is less strong, heavier when wet and more prone to permanent and non-visible damage than the stiffer ropes.

Now you should understand how to figure a good safety margin or factor for your rope. In other words, how much weight is too much for your rope. There are many varying ways of doing this, but I will teach you the one I live by. The factor is 15 to 1 (15:1). This means that if you plan to put two persons weight on a rope, such as in a tandem climb, you need to first add the combined weight of both climber (400 pound for this demo) and multiply that by 15, which in this case equals 6000 pounds. This would mean that you should not use anything less than a 6000 pound test rope for this load factor. It will also give you 14 safety margins to help avoid a collision with the Murphy Principle.

In order to stay alive and healthy in the world of vertical caving, one must not only buy the proper rope, but must carefully use and properly care for and store the rope to keep it in good condition for as long as possible. I will address use first. There have been many caving accidents in recent years as a direct result of misuse of ropes. The number one problem being proper padding of the rope

when rigged over sharp bends or rough projections.

Rappelling, if done properly, is much easier on a rope than climbing, because climbing tends to bounce the rope up and down. This bouncing of a tensioned rope can cause high abrasion over sharp or rough areas pressing against the rope. We can either accept this abrasion (which will greatly decrease the life of our rope) or we can pad that area and protect or thread to the sunlight.

Rope pads are cheap and easy to make. There are many different types of pads, but one of the easiest to make and most versatile pads is to simply hem up some heavy canvas and either tie cords to the upper corners or put in some grommets in the upper corners for the cords. These are then tied to rocks, trees or other anchors (the rope itself as a last resort) in such a manner as to support the pad over the rough spot and under the rope. If this can be done without tying directly to the rope, then the pad is no problem for the rappeller or climber. Heavy pads can be made by doubling or tripling the materials before hemming. These take up very little room in a pack and can be laid flat or rolled up. As carefully buying a good rope is an investment in the life of any vertical caver. So a rope pad becomes an investment in your life line.

It is also important to properly anchor your rope. The worst thing you could do is tie your rope so tightly to the tree or rock that there is too sharp an angle. This can put an undo stress on the rope and the anchor which may be many times the actual weight on the end of the rope. It is wise to make sure the knot is a ways away from the anchor. This assures a proper angle. It is wise to know that any knot tied in the rope weakens the rope at that point.

If a loaded knot can be avoided by rigging a tensionless anchor, this is very desirable and leaves your rope at its maximum strength potential.

Care should also be used to avoid ascending and rappel devices which may damage the rope or not function properly on the rope. Some of these may include improperly sized ascenders, badly worn ascenders, and worn, hard anodized figure eights. Care should be taken to rappel slowly and evenly. Avoid bouncing as this shock loads the rope and anchor to well beyond your weight. Ascend as smoothly and evenly as possible. Avoid jerky movements and bounce motions.

Ropes should not be left hanging in caves over off seasons when possible. Even leaving ropes hanging in caves over a caving season can be hard on them, especially if the cave is wet or if there is any possibility of falling rocks to damage your rope. Keep too long coils out of the fall zone. Always carefully examine your rope before and after each use for possible problems. Look for abraded areas, soft spots, area where the diameter of the rope changes (large or small), stiff spots, glazed areas, partially cut areas, picked areas, etc.

If, upon examining your rope with a magnifying glass, you note that over 50% of the fibers in most of the pics (each area where the rope fibers cross each other) are broken, then it is definitely time to get rid of the rope. If a bad place is found in the rope, you should immediately evaluate the damage. If it is serious, take a hot knife and cut the rope at that place. This is a hard thing to do based on the cost of our ropes and the attachment we have to them, but it may save your life. If in doubt, then have someone more experienced than you examine the problem area. Avoid

getting the rope anywhere near batteries containing acid (such as wheat lamps and car batteries), or anything which may contain formic acid or liquid phenol (carbolic acid) such as some wood preservatives. Gasoline, antifreeze, beer, urine, bat guano, whiskey, brake fluids and oil do not attack nylon, however, they are difficult to remove and cause dirt and grit to stick to the rope and thus should be avoided.

Next, I will discuss care, cleaning and storage of ropes. Caving, being what it is, your rope will almost always be some shade of brown, grey, red or black after finishing the cave. Often the rope is also wet or at least dusty. This means that microscopic cutting edges have been introduced to the fibers of your rope. A rope should never be stored dirty. It should also never be used dirty any more than is possible. When ascending or descending a dirty rope, these cutting edges (grit and sand, etc.) are worked into rope through the sheath. These then stay in the rope, even after being washed and work their destruction on the main load bearing part of the rope, the core. This should be avoided as much as possible.

Knots should be untied as soon as possible and a rope should never be stored with any tight bends in it. A tight bend in a rope is defined as any bend which is tighter in radius than four times the diameter of the rope. For half inch rope, this is two inches. Any bend in the rope tighter than this two inches also decreases the strength of the rope (such as a knot). This is all figured into the 15:1 safety margin, but should still be avoided whenever possible. After a rope gets dirty, it should be cleaned as soon as possible. Proper cleaning is one of those heavily argued things, but based on my own experience and after being involved in cleaning and using many ropes, I recommend

the following: Ropes can be minimally cleaned by washing with a hose and nozzle or by running the rope through a commercial rope washer. If your ropes never get really dirty (only cavers understand this) then this should suffice.

For seriously dirty ropes, this should be followed by a good hand or machine scrubbing in hot soapy water. This can be accomplished by using scrub brushes and cleaning the rope foot by foot or by using a front loading washing machine. Warm or hot water should be used. (Note, household water heaters and laundromats are generally set at about 140° F. This is sufficient to clean well, but is well below the 180° F temperature when nylon is still safe from even long term immersion degradation). Use a good detergent. Many have said to use a mild soap like Ivory but these don't keep the dirt suspended from the rope like a good detergent will. One person recommends Tide if a powdered detergent is used and Wisk or Liquid All, if a liquid detergent is used. Any good detergent should be OK. Pre-soaks are not recommended. Bleaches can be used as long as they are not chlorine bleaches. I will repeat, DO NOT USE a chlorine type bleach on nylon. After hearing all the controversy over the use of fabric softeners, I believe it is probably advantageous to use a small amount in the rinse water. I believe this helps replace the lubricant which is removed by the washing process and can help keep your rope more flexible and protect the fibers at the same time.

Ropes should always be completely dry before storing. A dryer works well as long as the temperature remains low enough (be careful) but air drying is the best and safest. Avoid drying in sunlight, as it may be possible for the UV in sunlight to damage the nylon.

After the rope has been properly cleaned and dried, it should be properly stored. All ropes should be stored in a dry, cool and dark place. Again, avoid tight bends and stresses on the rope. Rope should never be placed on cement as cement is worked with acids, which stay around for a long time and are activated by moisture. If stored in a dusty area, the rope may need to be cleaned again before use. Never store any rope near chemicals of any kind or in any area where the rope has any chance of being contaminated by chemicals or even fumes from chemicals.

Now, I will discuss when and how to retire a rope. It has been shown that nylon degrades with time, even when properly stored. This has calculated into approximately 1.5% per year. This is if the rope is properly cared for, cleaned and stored and not abused during use (properly padded, not used for a tow rope, not left in a cave over a season, not used for heavy expedition use, etc.)

It should be noted that wet nylon loses up to 15% of its total strength. Although this is completely regained after drying, it is a factor in wet caves where the rope gets wet during use. Ropes should be duffed when hauling through caves to avoid damage from abrasion and banging against the rough walls of the cave and picking of the fibers.

All of these things lead us to ask, when is it time to retire our rope. This is a very difficult thing. The following is a disclaimer for the formula that is about to be discussed. You must know that this formula and the models presented, though they represent many hours of thought, work and calculations, are only a product of my mind. They are not necessarily backed up by any research other than they seem to fit most of the parameters in most of

the books and articles I am familiar with. They are presented in the spirit of beginning and of assistance.

With that in mind, I propose the following formula to be considered for use with 7/16 inch, nylon, kernmantle, static caving ropes. The following represent factors which are all to be subtracted from the initial rated breaking strength of the rope on a cumulative yearly basis.

It may also be noted that these numbers represent percentages of breaking strength.

Age subtract 90 pounds per year (count partial years as whole years)

Improper Cleaning subtract 120 pounds (subtract yearly if the rope was used when not properly cleaned after each trip)

Improper storage subtract 120 pounds (subtract yearly if rope was not properly stored, even for a short period)

Usage:

Light use subtract 180 pounds per year

Moderate use subtract 240 pounds per year

Heavy use subtract 300 pounds per year

Abuse subtract 600 pounds per year for minor abuses such as not padding the rope properly where no visible damage is noted and up to 6000 pounds for major abuses such as using the rope to tow your car, the rope receives a serious shock load, using the rope for heavy expedition use, storing the rope on concrete or next to chemicals of any time, driving home on a hot day with the rope in the back window of the car, driving to the cave with the

rope and wheat lamp next to each other, etc. Abuses may also be rated somewhere in between. This is the subjective area and it would be wise to rate harder on your rope if there is any question. Better to be safe than sorry, or even worse, dead.

Conclusions from the models: As you can see, these models allow one to systematically "write off" your rope on a yearly basis and to adjust the safe working margin (or load) of the rope yearly. The first model shows that by the time the rope is 4 to 5 years old, under average use, it is probably not a good idea to use it for tandem climbs. It further becomes apparent that by the tenth year of use, the rope is approaching its usable limit for even a light weight caver when you consider weight plus bounce and other shock-loading factors into your thinking.

The second model was produced to show a typical pattern I imagine may be common in the caving community. Once may care for a new rope better than when the rope gets older. Also, use fluctuates. The caver let care slip a little one year and then had a very bad year. The resulting drop in usable safe strength that year caused the caver to improve. The rope required retirement early due to the improper care and down right abuse of the rope.

As you can see, this is something that could be beneficial to the average caver. I have put my neck on the line and produced a beginning place. If you know of factors I have ignored or of design, then please let me know and I will either fix it or retract it. For now, try it and see if it works. Use the formula with your old ropes, be honest and even critical with your evaluations. The critical area may be the abuse category.

Rope Use Retirement Models

Example:

The following is the cumulative history using the above rating system for a rope with moderate yearly use for ten years. This rope has been properly cleaned, used and stored for all ten years. At the end of each year I have applied the 15:1 safety margin rule so it is readily apparent what limits the rope is good for. The initial breaking strength rating is 6000 pounds.

MODEL ONE:

Year 1: $6000 - 90 \text{ (age)} = 5910 - 240 \text{ (moderate use)} = \text{divided by } 15 = 378 \text{ (safe working margin)}$

Year 2: $5670 - 90 = 5580 - 240 = 5340 / 15 = 356$

Year 3: $5340 - 90 = 5240 - 240 = 5010 / 15 = 334$

Year 4: $5010 - 90 = 4920 - 240 = 4680 / 15 = 312$

Year 5: $4680 - 90 = 4590 - 240 = 4350 / 15 = 290$

Year 6: $4350 - 90 = 4260 - 240 = 4020 / 15 = 268$

Year 7: $4020 - 90 = 3930 - 240 = 3690 / 15 = 246$

Year 8: $3690 - 90 = 3600 - 240 = 3360 / 15 = 224$

Year 9: $3360 - 90 = 3270 - 240 = 3030 / 15 = 202$

Year 10: $3030 - 90 = 2940 - 240 = 2700 / 15 = 180$

MODEL TWO:

Year 1: $6000 - 90 \text{ (age)} = 5910 - 300 \text{ (heavy use)} = 5610 \text{ divided by } 15 = 374$

Year 2: $5610 - 90 = 5520 - 300 = 5220 / 15 = 348$

Year 3: $5220 - 90 = 5130 - 240 = 4890 - 120 \text{ (improper cleaning)} = 4770 / 15 = 318$

Year 4: $4470 - 90 = 4680 - 180 = 4500 - 600 \text{ (rope improperly padded resulting in some abrasion to sheath at 90 foot point)} = 3900 - 120 \text{ (improper cleaning)} = 3780 - 120 \text{ (improper storage)} = 3360 / 15 = 244$

Year 5: $3360 - 90 = 3570 - 240 = 3330 / 15 = 222$

Year 6: $3330 - 90 = 3240 - 240 = 3000 / 15 = 200$

Year 7: $3000 - 90 = 2910 - 180 = 2730 - 120 \text{ (improper cleaning)} = 2610 / 15 = 174$

****rope retired****

Remember that it is your life and the lives of your closest friends that hang in the balance.

Now, how do you retire that old rope? The best way is to cut it up and destroy it so no one is tempted to use it for a life safety line. Remember, just because the rope is unsafe for caving doesn't mean it doesn't still look good.

We are all tempted to keep it around for a tow rope or for tying things in the truck.

This is OK, but permanently mark the rope (black on both ends and in the middle is the most common and widely recognized way) it would also be wise to cut the rope into shorter (usable around the house) lengths (who needs a 300 foot tow rope?)

Now, the final thing I will mention before I close this mammoth article, is the rope log. Any caver who thinks ver highly of his or her life and that of their friends, should keep a rope log. Some of the things I think should be on your rope log, include:

- Date of manufacture of the rope
- Date you purchased the rope
- New length
- Washed length
- Diameter
- Manufacturer
- Rope type and color
- Identification marks placed on the rope
- Who owns the rope

You then need to have multiple areas to record the following information:

- Dates used
- Location used
- Type of use (rappel, ascent, haul, lower, etc.)
- Number of people using it, inc. tandem climbs
- Shock loads should be noted inc. circumstances

Other items to note is the result of any rope inspections, cleanliness of the rope following the exercise or trip as well as the nature of the dirt and whether and how it was washed and how the rope came out after cleaning.

This is a fairly detailed log and for general use could be fairly simple.

In conclusion, if you have actually muddle through this whole article, it shows that you are either truly interested in your life and your caving rope or you are just plain bored. I hope it was worth your time.

This is the fourth in a series of safety articles written for the Utah Caver newsletter and adapted to the *Nylon Highway*. The purpose is to disseminate information to all cavers and to hopefully increase knowledge and thus safety. In writing these articles, I in no way claim expertise, but only hope to promote the exchange of ideas and the increase of knowledge.

All cavers are encouraged to respond (bot positively and otherwise). I have drawn from many sources in the preparation of this article. They include On Rope by Smith & Padgett, High Angle Techniques by Vines and Hudson, articles from the *Nylon Highway* (NSS Vertical Section newsletter), NFPA 1983 Life Safety Rope, Fabric Softener and Rescue Rope by Frank, and The Care and Feeding of Nylon Rope by Isenhardt.■

Tape Knot (Water Knot) Problem Solved

by Heinz Prohaska

When nylon came into use, climbers believed the old, traditional knots developed for natural fibers like hemp would work in the same way with the smoother more elastic modern material. The first one who reacted to the new situation seems to have been Franz Bachmann of Austria, with his knot of 1948 [1]. But the whole extent of the problem was not yet realized at that time.

Some years later, 1953, after a rappel accident caused by failure of a nylon braided sling tied with a square knot, climbers woke up. Since nautical rope specialists, confronted with the matter, took the view that any knot in nylon would give way below the tensile strength, it was recommended in a mountaineering magazine that nylon slings should be joined with a special splice only [2]. Another author tried to avoid splicing and tested slings of nylon webbing joined with two bowlines [3]. Knowing the story so far, it's easy to understand that the introduction of the tape knot for nylon in the late fifties was regarded as great progress (Figure 1).

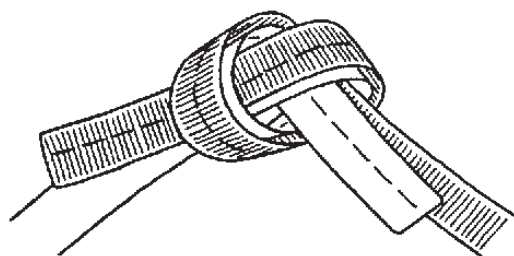


Fig.1 Tape knot in its main application for joining tape slings

The knot itself wasn't new. It was a well-known angler's knot [4], recommended for joining ropes by the Alpine Club in 1891 [5], and shown as a knot for hammer slings with strapping about thirty years later [6].

Useful in both webbing and rope, simple and easy to tie, the tape knot became popular among mountaineers throughout the world. But accidents showed that the knot, though it worked well in the tensile testing machine, was one of the most dangerous of all in practical use. Numerous slings came untied.

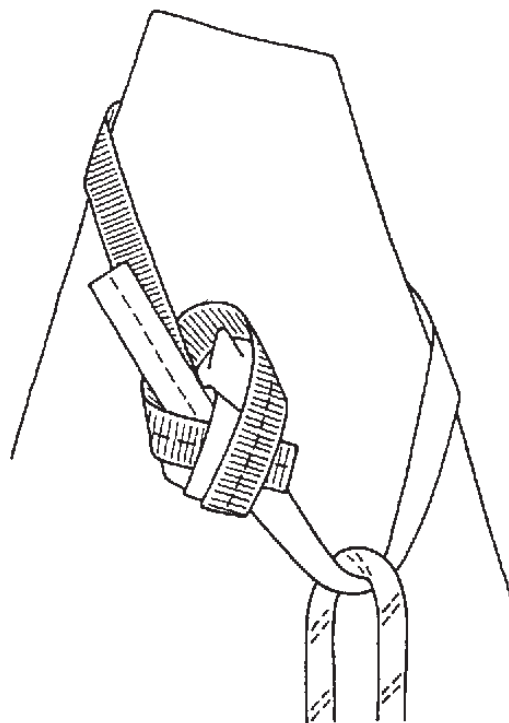
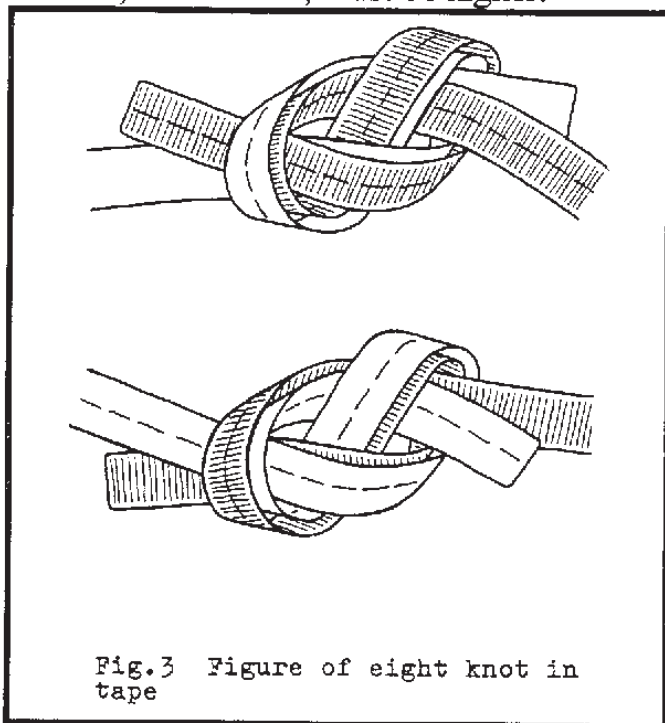


Fig.2 Failure of the tape knot through getting caught on a rock spike

A team of three decided to do some rappelling. Using a sling around a rock spike as an anchor, the woman started first. In the first seconds, the anchor held, but when the directions of the pull changed and the sling moved on the rock. The knot caught on a little spike, came untied and she fell to her death. Details are shown in Figure 2. The important part of this observation wasn't realized during instruction. The knot was recommended as before.

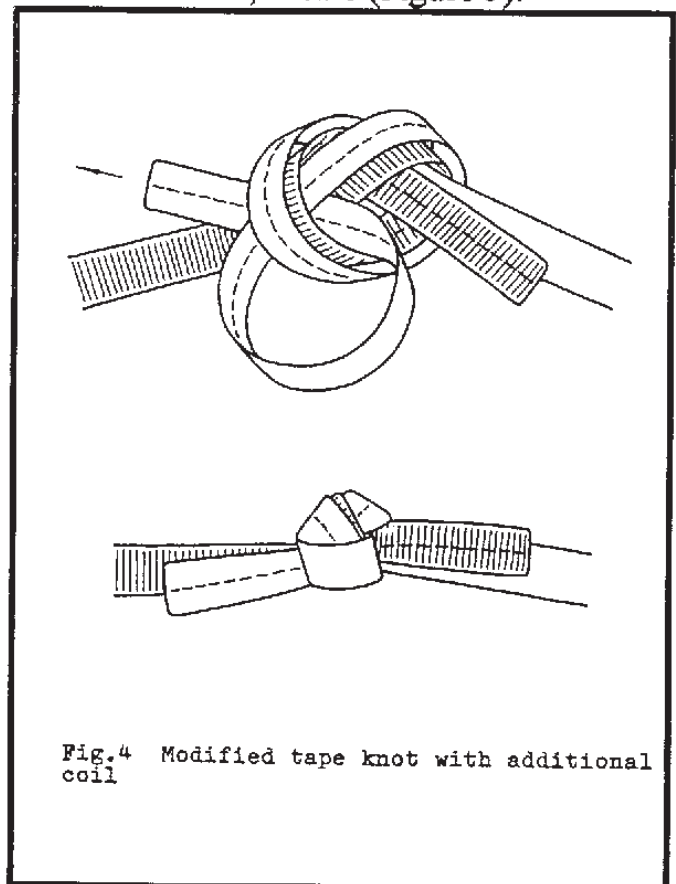
Now, ten years later, a least a half dozen of such events are known among German mountaineers. In three cases, people at the top saw what happened. In three other cases, the sling was used several times in the same way before it failed. Four persons were seriously hurt, one was dead [8,9]. The total number, world wide, must be higher.



As tests of the German Alpine Club showed, adhesive tape can not solve the problem. To fasten the ends by sewing would be troublesome and impractical. Two tape knots in a series or similar solutions shorten short

slings too much. The use of sewn slings instead of knotted ones would be a step back to the spliced slings of the fifties. To avoid rock contacts is no solution.

The author left behind the tape knot in the seventies because he didn't feel safe with it and turned to alternatives. The most obvious one was the figure eight knot. In comparison to the tape knot, whose ends are in opposite positions (one end inside, the other one outside) the ends of the figure eight are both inside or both outside, and the first version, both ends inside, is safe (Figure 3).



Unfortunately, this knot is too complicated and troublesome for practical use on a larger scale. It turned out to be simpler to secure the outer end of the tape knot with an additional coil thread before the tape knot is tightened and tightened after that (Figure 4). This knot could also be used with Spectra, but the

simplest solution resulted from a combination of both systems, namely from securing the tape knot by twisting the outer end inside (Figure 5). The tape must be twisted in the shown direction, otherwise the knot would be less compact.

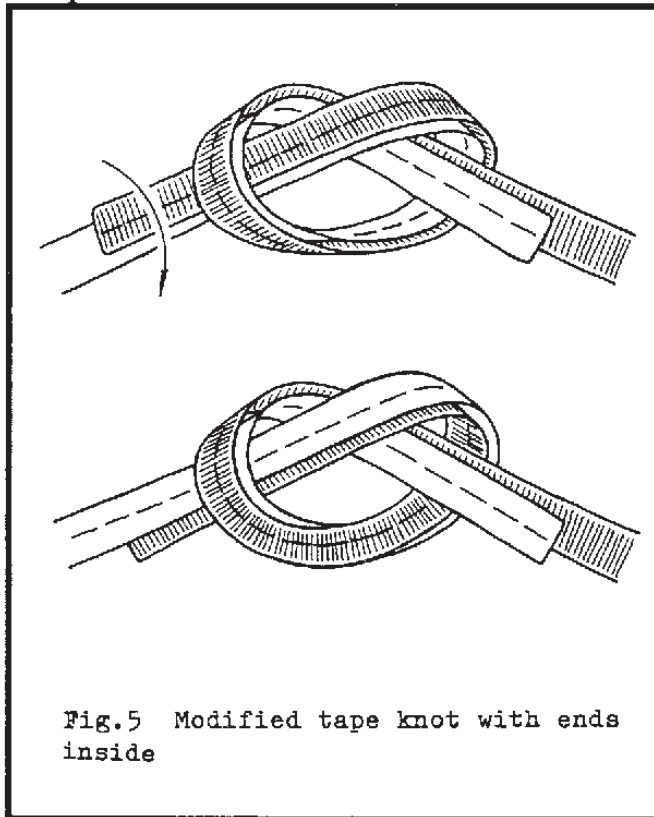


Fig.5 Modified tape knot with ends inside

The strength wasn't the problem, but when the ends are inside, the standing parts are outside, where the radius is longer. This should be an advantage, and in fact the test of the author show the strength is increased.

References

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- [3] Stirton, R.J. and Lembeck, A.C.; Knots in Nylon Slings, Part II, Up Rope, Vol XII, No 14, 3 June 1956, pp 1-4
- [4] Ashley, Clifford W.; The Ashley Book of Knots, New York 1944, p 50
- [5] Alpine Club; Provisional Report of the Special Committee on Equipment for Mountaineers. London 1891, pp 5-6
- [6] Alpenvereins Sektion Bayerland: Anwendung des Seiles. München 1922, p 7
- [7] Deutscher Alpenverein: DAV-Unfallstatistik 1985
- [8] Schubert, Pit: Vorsicht mit Band (schlingen) knoten. DAV-Mitteilungen, Vol. 46, No 4, Aug 1994, pp 293 - 294
- [9] Schubert, Pit: Noch einmal Band (schlingen) knoten. DAV-Mitteilungen, Vol. 47, No 1, Feb 1995, pp 73 - 74



New Tricks in Old Ellison's

by Mike Fischesser, NSS 18140

In March 1994, I trained and led a group of sixteen Outward Bound instructors to Ellison's Cave, Georgia as part of their cave leadership training. We focused on single rope techniques specific to Ellison's drops for several days on the cliffs near the North Carolina Outward Bound School.

All staff used Butt Strap Harnesses rebuilt from the original models sewn for the 1978 Outward Bound Staff Expedition to Ellison's which attempted to climb the Snowball Dome. That trip only reached a height of 200' in the dome, but was very successful in terms of conducting a camp in the Gypsum Room for 16 people for 4 days. All waste (except urine) was hauled up the 510' drop in Fantastic Pit and out of the cave. Bob Jeffreys and crew eventually completed our climb some years later only to find that the dome dead-ended.

Prior to the March 1994 trip, the southeast received a large amount of rainfall (6" over 2 days). I called Allen Padgett to assess the local water levels. We both knew that Ellison's can be a very serious undertaking in high water, but the system does drain itself fairly quickly ever after huge rains. I told the instructors that we might arrive at the cave only to discover that the conditions were unsafe. We decided to keep training anyway. So we trained in the rain. (Sounds like a song.) Rappels, spelean shunts, heel hangs, haul systems, partner rescues, ascending, changeovers and longer rappels were made quite miserable due to the cold, nasty rain that fell for several days straight in March. But I must say that it sure did prepare everyone well for Ellison's.

We decided to drive down to Pigeon Mountain and assess the conditions. A large part of northern Georgia was flooded. It was a weird sight to look out of the cave at night and see vast expanses of water alongside the highways. This wasn't looking at all good for an Ellison's trip.

I went down a day early to see PMI friends and install the Richard Schreiber Memorial Plaque. It was interesting to see at the water resurgence had been up about four to six feet, hours before my arrival. All said it had flooded parts of the road. When I reached the New Entrance, the rain had stopped, but all the hollows and drainages were roaring down Pigeon Mountain. What a great time to ridge walk and follow water into holes. Even though Pigeon Mountain has been heavily walked - you never know what you might find. I had a great time following streams down gullies.

The New Entrance was taking a large volume of water. There was no way to enter without becoming totally immersed in the waterfall-like entrance. I decided to purchase some plastic tarps and divert the water with the group's help.

The next morning found us arranging the tarps to divert the water into the Dug Entrance. This was very effective in reducing the New Entrance to a trickle, but of course the water was still going into Ellison's. Our plan was to simply take the trip a step at a time and assess conditions as we moved along. The stream was roaring in the Ecstasy passage to the Warm-Up Pit, but it was manageable.

Everyone had a layer of pile or heavy capilene on under rugged rain suits. Plus backup layers for long waits. We had stoves, food, soups, radios, balaclavas and group heat tents (LRUES tents) for the tops of the long drops. We were prepared with good equipment and folks who were in good shape. But best of all we possessed a healthy attitude of willingness to abort the trip if things seemed too dangerous.

We tried to dampen the power of the waterfall at the Warm-Up Pit by hanging long plastic sheets at the break-over point, but the water hits a ledge lower down and kicks out anyway, so our tarps probably didn't help much here.

I went down first with a tiny, VHF marine band radio. I told the group if thing were bad I would come back up and we would head out. Everyone seemed fine with that plan. There was more water in the cave than I had ever seen before, but the bottom of the Warm-Up Pit wasn't that bad. I radioed back up to come on down with hoods on. With two separate ropes rigged, the group was down in short order. Everyone used their floating knee cam for their spelean shunt.

An advance rigging team kept ahead of the larger group which helped keep folks continuously moving along. We rigged a tarp on the waterfall near the Balcony rig point (510'), but all it did was settle down the spray just before the tight crawl. There's no way to settle down a 510' waterfall. We rigged two separate ropes to do the 510' drop from the Balcony. Then I went down first with the radio. I wasn't positive, but it looked like the high water mark in the bottom of Fantastic had been at least six feet up the wall. The register was soaked. The rappel wasn't that bad, so I radioed for the group to come down. We

erected a group heat tent with stoves and hot drinks at the top and bottom of the big drop. Folks stayed warm, dry and comfortable in reflective mylar tents. The VHF radios worked well from deep within TAG Hall, up and over the lip at the Balcony. The radios did not require a direct line of sight.

We explored down to the stream intersection, but I had no intention of tiring the group out with a tourist trip to the North Pole, since conditions were still fairly serious. I wanted them fresh for the trip out. The stream was still too swollen to proceed upstream anyway. When it was my turn to climb up the 510', I had to wait 30 minutes at about the 100' level while my tandem partner operated on her harness back at the heat tent. I was being pummeled by the waterfall, but with my hood on and arms down, I stayed warm, dry and comfortable. I was wearing Wild country waterproof pants and anorak over light pile with capilene finger gloves.

One of the tricks I had taught the group was to carry half a hacksaw blade as a substitute for a knife. Several of the members almost had to use their hacksaw blade when their spelean shunts leaped out of reach, but stepping up in a Prussik worked better.

The hacksaw blade is a great tool for cutting things when near a loaded rope. It requires a premeditated sawing action that won't accidentally cut a nearby loaded rope with a single swipe. Any good quality hardware store blade will work. Simply take the broken end and two it away in the battery pack, helmet or cave suit.

Everyone used the Roosa electric headlamp with four D cell alkaline batteries and a #502 screw base bulb with provides 50 hours of

light. This headlamp is manufactured by the Hartford Easter Seal Rehabilitation Center, but is sold by a number of distributors with their own name. It is the red, heavy plastic headlamp that comes with the large black perforated rubber head band. We always sew up small, tight cordura stuff sacks to protect the battery pack.

I use two Roosa lights permanently mounted to my Petzl Ecrin Roc helmet. Both cords are taped together with Scotch Brand 33+ black electrical tape. Both battery packs fit tightly into the chest pocket of my cave suit. The cord leaves the rear of the helmet and goes inside the neck of the cave suit and enters the battery pack from an inside pocket slit. I used #425 bulbs, which gave me 24 hours of wheat lamp candlepower (with 8 alkaline D cell batteries).

The new Petzl Ecrin Roc helmet is fantastic for winter mountaineering, rock climbing, paddling and caving. Especially on a cold, wet cave trip it is great for quickly adjusting the size with the thumb dials to accommodate hats. This new design is one of the best innovations to hit the climbing and caving world in a long time.

I tried sewing up a smaller butt strap harness system (3 Gibbs ropewalker) by using Rock Exotica's Microscenders with a curved interface on the shell. Microscenders are similar to a tiny Gibb's ascender at first glance. Due to my excitement to assemble this new rig I forgot that the curved interface causes the rope to bend around the cam arm and into that cavity, which causes horrendous friction during an ascent. A free running Gibb's works much better for that application. The spring loaded quick release pins would get clogged with mud and grit, so after a while they didn't

work as well as they do when clean. Rock Exotica makes extremely well designed and manufactured equipment. I've been very impressed with their products like the microscender and soloist. I tried using my microscender floating knee cam as a safety rappel cam. This worked great by using a small piece of shock cord to hold the cam in an open position. By simply striking the tether, the shock cord releases the cam and it stops the rappel in progress. Everyone climbed tandem out of Fantastic Pit. The heat tent was a welcome refuge from the windy, wet storm raging at the bottom of the pit. Eventually we began the long process of heading out. Folks napped at the top of the Warm-Up Pit until all ropes were pulled and the entire group was re-gathered. It was a tired group that crawled into their sleeping bags around 2:00 am that night down at the Blue Hole.

Allen Padgett came by the next morning to check on us and gave the group a presentation of the history and exploration of Ellison's. After the trip, I began thinking about using an 8 mm, PMI static rope in Fantastic Pit. Hauling two, wet 11 mm by 600' ropes out of the cave is an arduous event, especially climbing out the Warm-Up Pit (125') with approximately 44 lbs. Of soaked rope underneath you.

I was using 8 mm rope a lot for above ground climbing and fixed line work, but hadn't used it for caving. I called Buddy Lane and Smokey Caldwell to discuss the idea. Buddy and his friends had been using it a lot on smaller drops with rebelayes. He said it was very stretchy with tandem climbers on the same section. He didn't know of anyone who had used 8 mm x 600' in Fantastic Pit and was eager to hear about it.

Allen Padgett and I returned to Ellison's in April 1994, to try the 8 mm from the new rig point in the Attic (586' drop). We self-equalized it to the new double bolts in the ceiling and I started down with the radio. Water levels were still high in the cave in April. I again wore a rain suit on the descent. Adequate friction in the 6 bar rack was provided by taking a complete round turn around the top bar before threading the rack normally. The descent was very smooth and controllable.

The ascent was with the microscender rope walker rig. It worked better on 8 mm than 11 mm. I can't speak how well other ascenders work on 8 mm, especially in a tandem situation. (IMPORTANT: I do not want to start a stampede of 8 mm long drop descents.)

I would only do it under controlled situations when I was sure the rope would not abrade against the rock. There is less margin for abrasion error with 8 mm than some of our beefier 11 mm American-made static ropes.)

I had a small rope rack made for 8 mm x 600' rope. Allen and I coiled it tightly onto the rack and slipped it into the pack. It was a joy to carry it out compared to the heavy 11 mm x 600' ropes. The 8 mm was small, compact and weighed only 20 lbs. (dry).

Hopefully folks will learn some new tricks from this article. Feel free to contact me if I can further elaborate on any of these techniques.■

Letter to the Editor

I was upset to hear that someone needed rescue because of an old method that was proven bad years ago. Someone had to be rescued from a 400+ foot drop because he used a Prussik safety. I won't discuss rescuing an uninjured person, but there is something wrong with communications when such a bad method is still used.

I had close friends injured in the early 1060's from using Prussik safeties. There are three problems with them. The user is to pull the knot with him during normal use and let go in emergencies. People in a panic hold tighter, so the concept is horribly flawed. One friend ended up with two broken legs from holding too tight. She hit the wall and got hands knocked loose and the knot tired to grab and fused to the rope when she hit bottom.

The second problem is that the knots grab at the wrong time, making the user take steps to get the knot loose. The third problem is that the user may be going so fast that the loop is pulled overhead when it grabs, pulling hands away from rappel control. Good thing another friend bounced off the wall of Natural Well and away from the landing ledge and onto a knot at the end of the rope.

Another old bone breaker that cavers should be warned against, again, is the single brake bar. I haven't seen this used in years, but another friend used one in the '60's and ended up with a broken back. Jennifer realized the primitive cave rescue situation and climbed out on Prussik knots with a bad back and bones showing in her hand from trying to stop on the single brake bar.

Is there something the NSS and the Vertical Section can do to warn cavers about accident prone caving methods like the ones above.■

By Peter Grant

Minutes of the 1994 NSS Vertical Section Meeting

June 22, 1994

by Bill Bussey

The 1994 NSS Vertical Section meeting and papers session was held Wednesday, June 22, 1994 at the Brackettville Civic Center in Brackettville, Texas. Executive Committee (EC) members present were Chairman Bruce Smith, *Nylon Highway* Editor Maureen, contest Coordinator Bill Cuddington, Vertical Techniques Workshop Coordinator David McClurg, Secretary/Treasurer Bill Bussey, Ed Sira, Miriam Cuddington and Allen Padgett. Approximately 70 Vertical Section members were in attendance.

Chairman Bruce Smith called the meeting to order at 9:13 AM by introducing the Executive Committee

Secretary's Report: We have 1129 members. We mailed 1285 *Nylon Highway* #37's in July. We had 107 members desiring representation in the NSS Congress of Grottos. Total membership in the section continues to be approximately 10% of total NSS membership.

Treasurer's Report: Total Income \$8,504.78. Total Expenses: \$6,381.66. Net Income \$2,123.12. We've not yet published *Nylon Highway* #38 so figures are inflated. Balance of \$8,976.77. We have \$1,011.77 for use for other purposes.

Editor's Report: *Nylon Highway* #37 is out. *Nylon Highway* #38 will be out by end of summer. Always need articles.

Rebelay Workshop Report: Matt Oliphant organized and ran an excellent Rebelay Workshop in place of Gary Bush who couldn't make it to convention.

Contest Chair Report: Bill Cuddington thanked everyone for helping with the Climbing Contest. From now on, contest awards will be presented at 6:30 or later immediately before the auction. We need to try and have an EMT on site at the contest in the future.

Vertical Techniques Workshop: Dave McClurg said we are running two Workshops this year, a Basic and Intermediate. We have 36 students signed up for Basic and 24 for Intermediate Workshops. Need held and racks for both Workshops. Bruce added that a workshop review committee will meet Friday to talk about how to proceed with future Workshops.

Symbolic Devices: Tray reported that sales have been steady, but slower than the year before. He is reducing prices on 20th Anniversary shirts to move them out. Also, will sell off crew neck sweatshirts and not reorder them as hooded sweats sell much better.

Contest Display Timer: Bill Bussey told about how contest attendees, staff and contestants really enjoyed having the rented display timer at last year's Convention. We've discussed purchasing one

for several years in order to add some “professionalism” to the contest. They cost \$1,395. Though expensive, we can do it now. There is also the possibility of someone in the Section being able to build one for less. There is a %500 anonymous donation toward a timer if/when we choose to purchase. Tom Faulkner questioned the return on such a purchase. Tray Murphy said it is not that large of an investment for the contest in which we have already invested a lot of time and money. After discussion, it was moved and seconded that: “The Vertical Section will allocate up to \$1,395 purchase a display timer in time for the 1995 NSS Convention. An effort will be made to have a Section member build a display timer if possible at a lower cost.” The majority of those members present voted to purchase a timer. Bill Bohle moved that: “Bill Bussey will be the contact person and organize fund raising activities to pay for the display timer.” The motion was passed unanimously.

On Rope II Update: Allen Padgett reported that due to legal problems with the previous illustrator, we can’t use any of the illustration in On Rope. Another illustrator, who had been lined up to do illustrations in the new book, was not able to do it. So, Allen and Bruce are looking for an artist. Anyone interested should contact the authors directly. DO NOT copy drawings from On Rope for your grotto newsletter as the artist owns the legal right to them and will want compensation for their outside use.

Vertical Training at Spring ‘94 Vertical Camps: Bruce Smith distributed the outline of the Basic and Intermediate training guidelines to members in attendance. David McClurg ran an “exposure to multiple climbing systems camp” for 28 students in California this spring. This helped students determine what vertical rig they wanted to set up for themselves. David related how difficult and expensive it was to get the camp’s Special Event insurance. The insurance alone cost over \$750 for the weekend.

Later in Chattanooga, Bruce led a “total immersion in one system camp” for those who knew what rig they wanted to use. Students here got to know their chosen system very well in an intensive 48 hour weekend, with ten hours of this being on rope. They repeatedly practiced change-overs, hair entrapment, knot crossing, rack usage and more. Training is repetition. Bruce showed some slides from the Chattanooga camp.

Current plans are for us to provide a Vertical Section sanctioned teacher’s lesson plan to a grotto or whatever group chooses to locally run this training program. The Section will use the first few groups doing this to beta test the lesson plan, with one of the writers of the plan monitoring in order to fine tune it. The lesson plan is specific enough, with objectives and goals sufficiently spelled out on both the instructor lesson plans and student check sheets, that most should have no problem following it.

This is being done on the grotto level in order to reach caves on a local rather than regional levels because more can be trained locally than regionally or nationally. As the lesson plan is broken up into many units, it can be separated into two or more weekends.

Articles of Incorporation: Bill Bussey explained that last year we were incorporated as a Non-Profit Corporation in the state of North Carolina. During the year, the state requested Articles of Incorporation in “legalese”. Gary Bush had earlier provided articles which Bill gave to the State. This is a different document than our Constitution and Bylaws, and thus we need to approve them.

They are printed elsewhere in this issue. Allen Padgett moved and Maureen Handler seconded that: "We adopt these Articles of Incorporation". The vote was unanimously in favor.

Guidelines for Vertical Section Testing Grants: Ed Sira moved and Tom Faulkner seconded that: the Guidelines for Vertical Section Testing Grants be accepted as Section policy". These guidelines are published elsewhere in this issue. The vote was a majority in favor.

New Business: Maureen Handler and Bill Bussey seconded that: "Any Vertical Section Executive Committee Member who does not fulfill the Bylaws required responsibility of writing or have an article produced for *Nylon Highway*, be ineligible for office the following year". After discussion, the motion failed.

Maureen Handler moved and Ed Sira seconded that: "The Bylaws requirement for Executive Committee members must write or produce an article for *Nylon Highway* yearly, be revoked". After little discussion, the motion passed with a majority in favor.

Papers Section: At this point, the meeting was turned over to Miriam Cuddington who hosted the Papers portion of the meeting. Papers included: Ed Sira showed a rack he designed and is selling featuring an emergency stop feature. Gustav Stibranyi from Czechoslovakia showed some Czech vertical gear and demonstrated rope pick-off techniques. Bruce Smith showed slides which graphically presented how the various climbing systems fail when one or more ascenders blow.

Elections: In elections, Gary Taylor was elected Secretary/Treasurer and Maureen Handler was elected Editor, both by acclamation. Bruce Smith, Bill Bohle, Allen Padgett and Miriam Cuddington were elected to the Executive Committee. Later that week, the Executive Committee met and selected Bruce Smith, Chair of the Vertical Section.■

Guidelines for Vertical Section Testing Grants

Up to \$500.00 annually is available to individuals or groups for projects or testing on the subject of single rope techniques. Money amounts can not be accumulated from year to year. For money to be approved the following criteria must be met.

1. A request with a budget needs to be submitted before testing begins.
2. The person or group requesting the money should be a Vertical Section member or an NSS member.
3. The testing money can not be used to achieve personal financial gain.
4. An article discussing the results of the test must be submitted to the *Nylon Highway* before being submitted to any other publication.
5. A majority vote from the Executive Board of the Vertical Section of the NSS is necessary for fund approval.■

Treasurer's Report, NSS Vertical Section

July 15, 1993 to May 31, 1994

Income:

| | |
|---|----------------|
| Memberships | \$5813.00 |
| Subscriptions | 320.00 |
| Back Issue Sales | 769.00 |
| Symbolic Item Sales | 861.81 |
| Vertical Techniques Workshop (93) | 353.00 |
| Advertisements in <i>Nylon Highway</i> 37 | 90.00 |
| Bank Interest | 289.97 |
| Overpaid Postage from Dues Renewal | 18.00 |
| Total Income | 8504.78 |

Expenses

Editor:

| | |
|--|----------------|
| Mailing <i>Nylon Highway</i> #36 | 319.00 |
| Mailbacks on <i>Nylon Highway</i> #36 | 13.55 |
| Dues Renewal Mailing | 75.00 |
| Printing <i>Nylon Highway</i> #37 | 2245.95 |
| Total mailing <i>Nylon Highway</i> #37 | 332.38 |
| Halftones | 65.00 |
| Other Postage | 43.69 |
| Supplies | 53.35 |
| P.O. Box Rental | 24.50 |
| Bulk Permit & Permit Fee | 150.00 |
| Mailing Envelopes | 83.95 |
| Total Editors Expenses | 3406.37 |

Secretary-Treasurer

| | |
|---|------------------|
| Postage | 401.56 |
| Supplies | 264.37 |
| Vertical Techniques 93 Workshop Expenses | 192.02 |
| Rope Pads for Contest & Vertical Techniques Workshop (16 @ \$18.00) | 288.00 |
| Contest Prizes at 1993 Convention (Budget \$400) | 255.00 |
| Binding <i>Nylon Highway's</i> 1-30 for Sale | 43.85 |
| Symbolic Items Cost | 787.04 |
| Symbolic Items Shipping | 167.26 |
| Symbolic Items Account Bank Charges | 25.25 |
| Ads (1993-94 <i>NSS News</i> and Member's Manual) | 91.50 |
| Reprint <i>NH</i> #2, 3, 6, 7, 8, 18, 23, & 32 | 224.00 |
| Timer Rental & Shipping | 122.56 |
| Check Charge | 15.13 |
| Bank Charge | 45.75 |
| Incorporation Fee | 40.00 |
| Day Pass & Russian NSS Membership | 38.00 |
| Other | 4.00 |
| Total Secretary-Treasurer Expenses | \$2975.29 |
| TOTAL EXPENSES | \$6381.66 |
| NET INCOME | \$2123.12 |
| BALANCE AS OF JULY 14, 1993 | \$6853.65 |
| NET INCOME | \$2123.12 |
| BALANCE AS OF MAY 31, 1994 | \$8976.77 |

Articles of Incorporation of the Vertical Section of the National Speleological Society

- FIRST:** The name of the corporation shall be VERTICAL SECTION OF THE NATIONAL SPELEOLOGICAL SOCIETY.
- SECOND:** The place in North Carolina where the principal office of the corporation is to be located is Cary, Wake County, North Carolina.
- THIRD:** The purposes for which this organization is organized are principally to educate its members and the public in, and to advance the study and science of, speleology and, to that end, generally to receive and maintain real or personal property, or both, and, subject to the restrictions and limitations hereinafter set forth, to use and apply the whole or any part of the income therefrom and the principal thereof exclusively for charitable, religious, scientific, literary, or educational purposes either directly or by contributions to organizations that qualify as exempt organizations under Section 501(c)(3) of the Internal Revenue Code and its regulations as they now exist or as they may hereafter be amended.
- FOURTH:** No part of the net earnings of the corporation shall inure to the benefit of, or be distributable to, any trustee, officer, or member of the corporation or any other private individual (except that reasonable compensation may be paid for services rendered to or for the corporation affecting one or more of its purposes), and no trustee or officer of the corporation or any private individual shall be entitled to share in the distribution of any corporate assets on dissolution of the corporation. No substantial part of the activities of the corporation shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the corporation shall not participate in, or intervene in (including the publication or any distribution of statements) any political campaign on behalf of any candidate for public office.
- FIFTH:** The corporation shall distribute its income for each taxable year at such time and in such manner as not to become subject to tax on undistributed income imposed by Section 4942 of the Internal Revenue Code of 1954 or corresponding provisions of any subsequent federal tax laws.
- SIXTH:** The corporation shall not engage in any act of self-dealing as defined in Section 4941(d) of the Internal Revenue Service Code of 1954, or any corresponding provision of any subsequent federal tax laws.
- SEVENTH:** The corporation shall not retain any excess business holdings as defined in Section 4943© of the Internal Revenue Code of 1954, or corresponding provisions of any subsequent tax laws.
- EIGHTH:** The corporation shall not make any investments in such manner as to subject it to tax under Section 4944 of the Internal Revenue Code of 1954 or corresponding provisions of any subsequent federal tax laws.
- NINTH:** The corporation shall not make any taxable expenditures as defined in Section 4945(d) of the Internal Revenue Code of 1954 or corresponding provisions of any subsequent federal tax laws.
- TENTH:** Notwithstanding any other provisions of these Articles of Incorporation, the corporation shall not conduct or carry on any activities not permitted to be conducted or carried on by an organization exempt from taxation under Section 501(c)(3) of the Internal Revenue Code and its regulations as they now exist or as they may hereafter be amended, or by an organization contributions to which are deductible under Section 170(c)(2) of the Internal Revenue Code and regulations as they now exist or as they may hereafter be amended.
- ELEVENTH:** Upon a dissolution of the corporation, the board of Trustees shall, after paying or making provisions for the payment of all of the liabilities of the corporation, present all of the assets of the corporation to the National Speleological Society unless at that time, the National Speleological Society does not qualify as an exempt organization under Section 501(c)(3) of the Internal Revenue Code (or the corresponding provision of any future United States Internal Revenue law). If the National Speleological Society does not so qualify, then all of the assets of this corporation will be disposed of exclusively for the purposes of this corporation in such manner, or to such organization or organizations organized or operated exclusively for charitable, educational, religious, or scientific purposes as shall at the time qualify as an exempt organization or organizations under Section 501(c)(3) of the Internal Revenue Code of 1954 (or the corresponding provision of any future United States Internal Revenue law), as the Board of Trustees shall determine. Any of such assets not so disposed of shall be disposed of by the Court of Common Pleas of Wake County, North Carolina exclusively for such purposes or to such organization or organizations as that court shall determine, which are organized and operated exclusively for such purposes.
- TWELFTH:** These Articles of Incorporation take the place of and supersede any existing Articles of Incorporation.■

Ded-Mao-Pompe

by Mark Jancin

SpeleoCAI is an Italian caving newsletter that we receive in our grotto exchange. Even though I do not know Italian, I was thumbing through the April 1994 issue and found some interesting diagrams having to do with variations on the Frog climbing system. The article is entitled, "Confronto fra tecniche di risalita: Ded-Mao-Pompe" (no author is named). Although I cannot read the article, it seems clear that it is a comparative force and efficiency analysis of the Frog (or Ded) system, the Italian (or Mao) variation, and a variation new to my eyes, the Pompe (might mean "pump"? -- regardless, that's what I'll call it here). Although I feel to be dangling a bit in relating to you anything about an article I cannot read, I think the essence of the Pump is simple and of general interest.

The Frog system now is well-known and popular in the United States. It has many nice points, but on longer drops it is not necessarily for every body type. The Frog works very well for body types with good power-to-weight ratios and lower centers of gravity. However, if you are top-heavy or just plain big and heavy, the Frog is a pretty tiring way to go -- the need and effort of pulling your upper body into the rope as you stand-up is relentless and tiring. I suspect that the Mao and Pump variations were developed to make climbing less strenuous for big folks and the carrying of heavy gear.

Figure 1 (all three figures are from p. 31 of the aforementioned issue of SpeleoCAI) shows the essence of the Frog system. Once your top (foot) ascender is raised and set, you gain distance l with your Croll as you stand up.

During the stand-up the elevation of your foot stirrup does not change. Now, I can't really follow the article's force analysis, but I will guess that the term F refers to the downward force on the foot stirrup during the stand-up, and the term P refers to the upward force on the Croll during the stand-up -- however, I may be wrong on these definitions (you've been warned for the last time). For the Frog, these two forces are considered equivalent in magnitude in this analysis.

Figure 2 shows the Mao variation on the Frog. The normal foot sling is replaced by a piece of rope that goes from the top of the Croll, through a small pulley on the bottom of the top ascender, and down to the foot stirrup. During the stand-up the foot stirrup loses elevation exactly equal to the gain in elevation attained by the Croll. $F = \frac{1}{2} P$ in this analysis, which I interpret to mean that a 2-to-1 mechanical advantage has been gained by the Croll, such that it has on it an upward force P that is twice as great as in the standard Frog stand-up. This means the climber should not have to work as hard during the stand-up in order to take the Croll to its top position to be set.

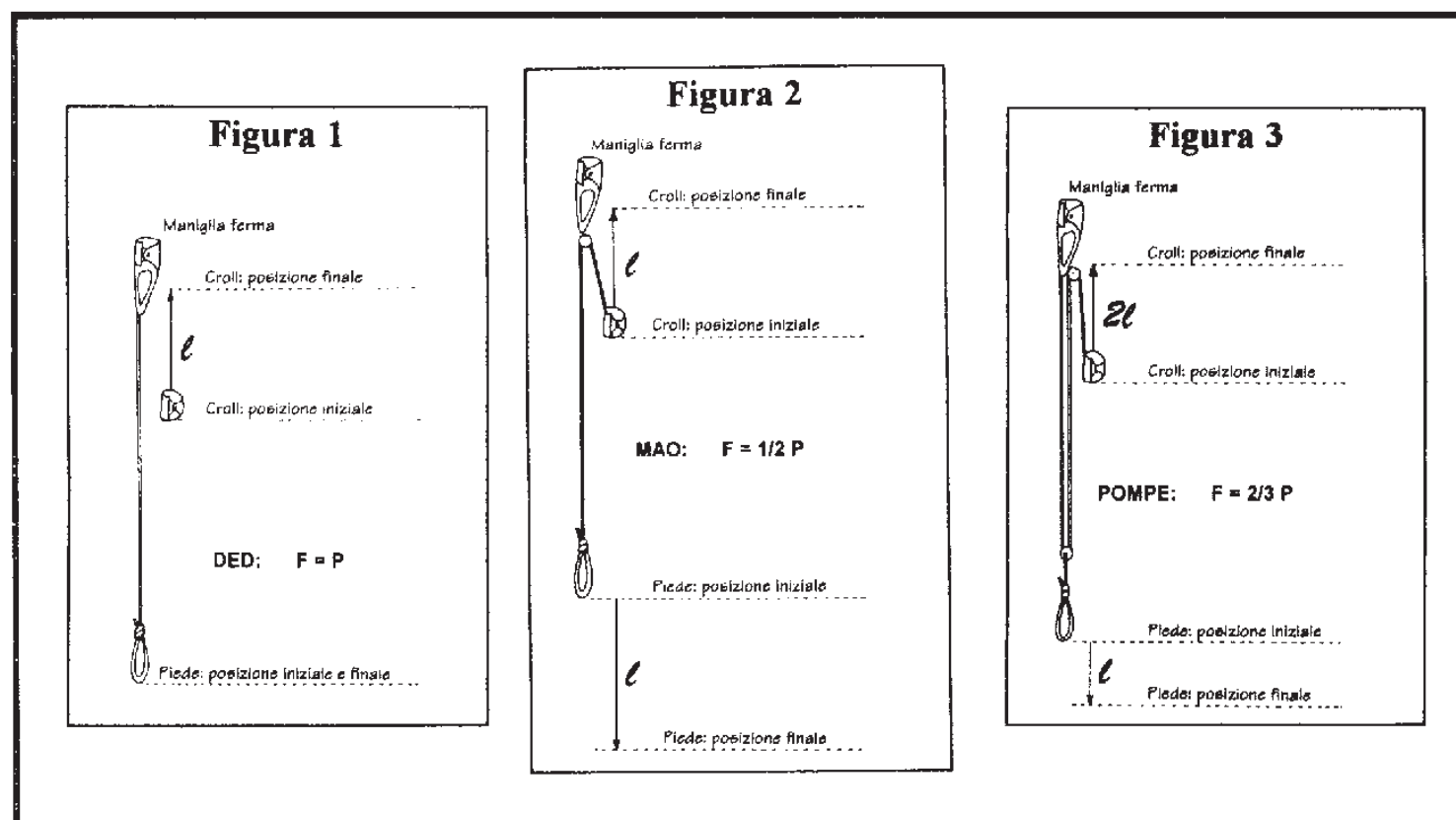
To the uninitiated the Mao can seem like an infernal contraption -- if you don't keep your feet and legs tucked under your butt, the pulley provides a wacky, unproductive directional. However, with practice the Mao definitely lessens the effort required for each stand-up step -- thus it is rather well-suited for heavier cavers and load hauling. However, this mechanical advantage has a drawback. Each foot of distance the top ascender is raised

requires that your foot stirrup be raised by two feet. Yet, when you stand-up, your foot stirrup loses half of its originally gained elevation. What this boils down to is an efficiency loss wherein your feet move through potentially very long distances for each sit-stand cycle, while your Croll takes proportionally small upward bites. For a fixed distance of raising your feet, you will require more sit-stand cycles to cover a fixed length using the Mao, in comparison to the number of cycles required with the straight Frog. You more-or-less trade-off the mechanical advantage against the total number of steps needed.

Figure 3 shows the Pump variation on the Frog. The new twist is the second small pulley on top of the foot stirrup. One end of the foot-sling rope is attached to the bottom of the top ascender, the other to the Croll -- this rope passes through the two pulleys as shown. Although this system is pretty darn Rube Goldbergesque, it is interesting.

This pulley configuration allows mechanical advantage along with proportionally decent upward Croll gains. During the stand-up, the foot stirrup loses only one-half the elevation distance (1) that the Croll gains upward (2l). Although I have not yet tried the Pump, it looks to me like the inclination to get your feet awkwardly high (a la Mao) just before the stand-up is mitigated. In this article's analysis, $F = 2/3 P$, which I interpret to mean that a 1.5-to-1 mechanical advantage has been gained by the Croll, such that it has on it an upward force P that is 1.5 times that in the standard Frog stand-up. Therefore, in consideration of the effort required for the climber to raise the Croll to the top of the stroke, it falls in between the Frog and the Mao.

Well, between not reading Italian and never having tried the Pump variation, I suppose I have said enough. If you are into Frogging and have a couple of small pulleys (such as Petzl 1"), and especially if you are a heavy caver, why not give it a try? ■



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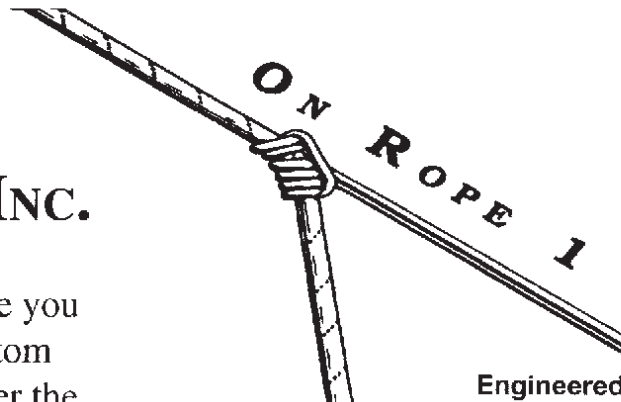
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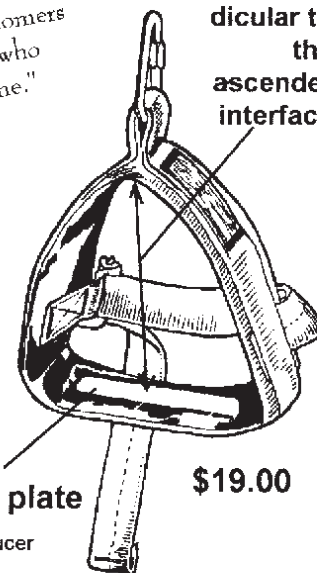
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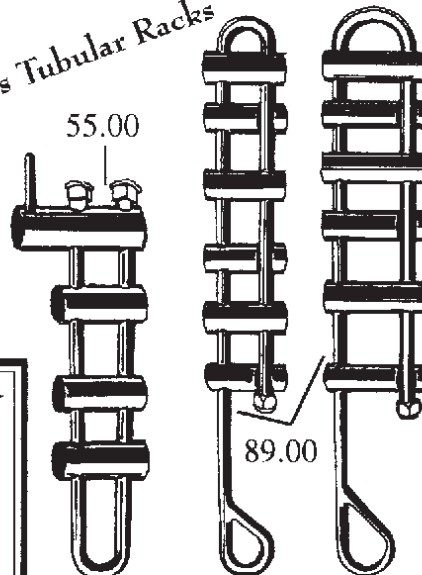
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