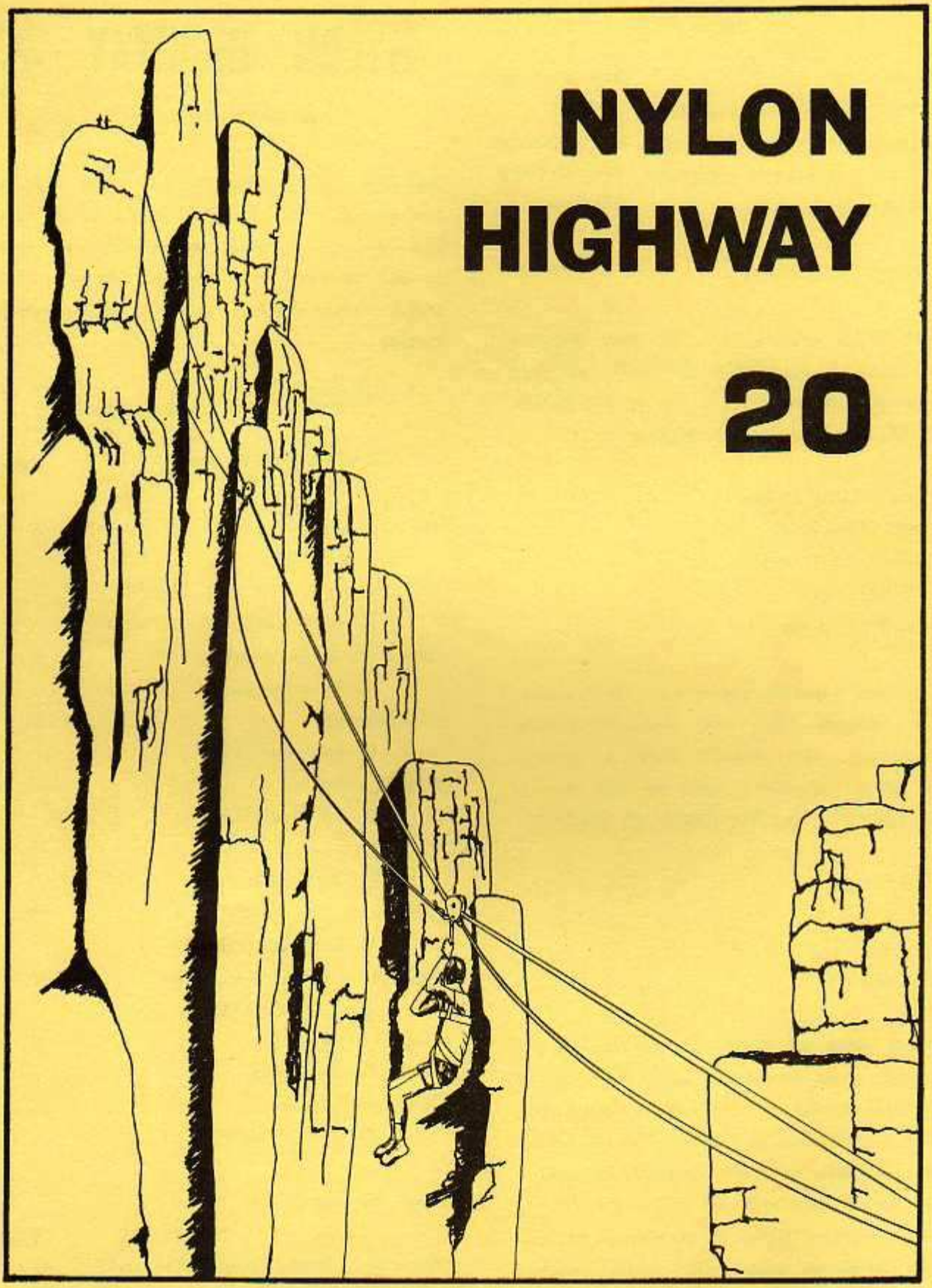

. . . ESPECIALLY FOR THE VERTICAL CAVER

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NYLON HIGHWAY 20

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VERTICAL CAVE SURVEYING

By Bob Thrun

Vertical cavers often map the caves they visit. Who else would? If you define a vertical caver as anyone who uses vertical caving techniques to visit a vertical cave, then it follows that no one else can! Bruce Smith knows of my interest in mapping, and has asked me to describe some techniques to use for mapping vertical caves. I will include in my definition of vertical surveying any surveying done down a drop or very steep sloop. For the purposes of surveying it does not matter whether or not a drop is climbable.

I will confine my discussion to what I consider normal cave surveying equipment: Suunto compass and clinometer, or a Brunton type compass, and a tape or long wire. I do not know anyone who has used helium balloons or laser rangerfinders in a cave.

I will cover several situations; in order of increasing complexity:

-Direct vertical drop.
-Single steeply slanted shot.
-"Stairstepping", multiple vertical shots.
-Multiple slanted shots.
  a. Two slanted shots.
  b. Three or more slanted shots.

There are also possible combinations of vertical and slanted shots, but these differ little from the situations I will describe.

DIRECT DROP

A single vertical drop is the easiest to survey. It is also, probably, the most accurate way to survey a drop. There are no high angle compass or clinometer errors to contend with. You simply lower the tape straight down and read off the distance. If the drop is longer than the available tape, a long wire can be used. Cavers often just mark the rope at the top and bottom and measure the rope after they have left the cave. The rope may have quite a bit of stretch. Surprise Pit in Fern Cave was 426 feet deep until it was remeasured with wire and found to be 437 feet. Bill Steele ("Thoughts on Surveying Pits", Texas Caver, April 1982) mentions using copper wire. I would use steel or iron wire because copper wire can stretch and has less tensile strength.

To make a vertical shot, you must find a place where the tape will hang free. The survey does not have to go exactly where the rope goes. If the drop is not too long and there is no noisy waterfall nearby, you can drop rocks to find a free drop. The top survey station may be on some protrusion that you could not keep the rope on. Depending on the geometry of the pit, you might put the top station on the opposite wall or on the ceiling above the pit. Normally, it will not be possible to sight from the station at the top of the drop because it would require the instrument reader to hang in mid-air over the drop, but if he

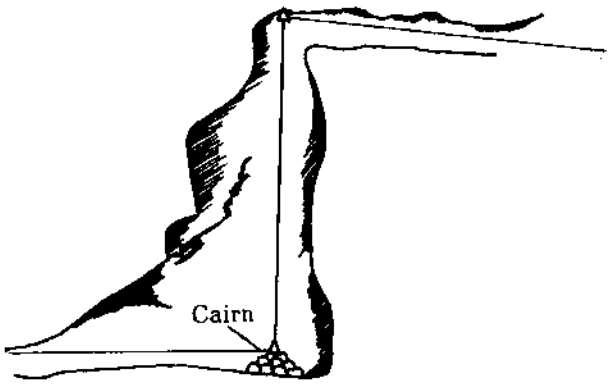


Figure # 1 A Straight Vertical Shot.

can chimney in place to do it, that's great. I often find that the lip at the top of a drop is slightly rounded and that it is necessary to hold the rope out from the lip and have the station in mid-air. That's O.K. as long as you can locate the station in the same place for both the horizontal shot to the top station and the vertical shot (taping only) down the pit.

The end of the tape will swing around. The swinging can be reduced by repeatedly stopping the end in mid swing. It helps if there is a heavy weight at the end of the tape or wire. On a long drop, the air currents (or water currents) may make it impossible to completely stop the tape. Just guess the bottom as best you can. Cave surveying does not have to be super-accurate.

The bottom station on a vertical shot is wherever the tape lands. Some sort of marker should be placed where the end of the tape lands. It is sufficient to be able to sight to the bottom station. Some cavers will build a large cairn so that they can sight from the bottom station. If a tripod mounted Brunton is being used, the tripod may be placed at the bottom and the measurement will be made to the tripod head. Sometimes the bottom station is in a hole at the bottom of a pit and the shot to it will have to made down at a steep angle. The techniques for slanted shots may be used, or a horizontal compass shot may be made on the tape while it is hanging down.

SLANTED SHOT

If you can not make a vertical shot, then you must resort to a slanted shot, or perhaps some combination of vertical and slanted shots. The techniques for making a slanted shot are different with Brunton-type compasses and Suuntos.

There is one good way of sighting up with a Brunton, one good way of sighting down, and a couple of usually poorer ways of sighting down. I am giving drawings of all of them. None of them involve the 'shadow method', which I consider overrated anyway. In all of the Brunton sighting methods, The compass should be leveled with the circular level that is built into the compass. The steeper the shot, the more important is the leveling. The level is the Brunton's big advantage over the Suunto in any surveying that involves a lot of ups and downs.

To make a steep upward shot with a Brunton, raise the long sight and look over it into the mirror. Fold the mirror so that it reflects upward and away from you. Then rotate the Brunton in a horizontal plane so that you see the top station in the mirror. The tip of the long sight, the hairline on the mirror, and the target station should be lined up while the compass is kept level. I usually first fold the sight and mirror approximately right, locate the top station, and then corrrect the leveling in small stages while making adjustments in the sight and mirror to keep the station in sight. The whole procedure is most easily done from a tripod, but it can be done handheld. On this or any other kind of handheld shot with a Brunton, I almost always have the hand with the Brunton resting solidly on a rock.

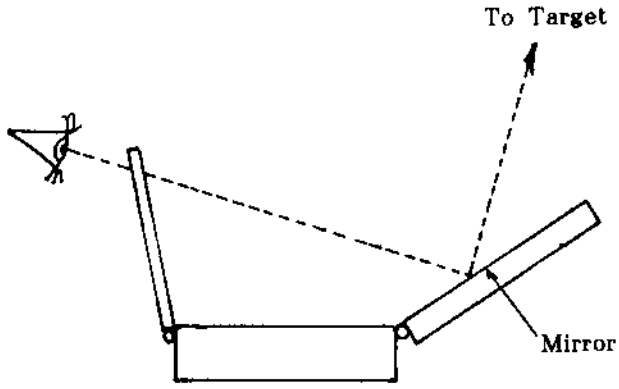


Figure # 2 Steep Upward(good)

To sight downward at an angle of not more than 45 degrees, I use roughly the same arrangement of long sight and mirror, but look thru the hole in the mirror. For steeper downward shots, I still look thru the hole in the mirror, but I fold the long sight flat and adjust the angle of the mirror so I see the long sight reflected in the mirror. This method is easier to coordinate in awkward situations than the method of sighting upward because you are looking straight at the target while sighting downward.

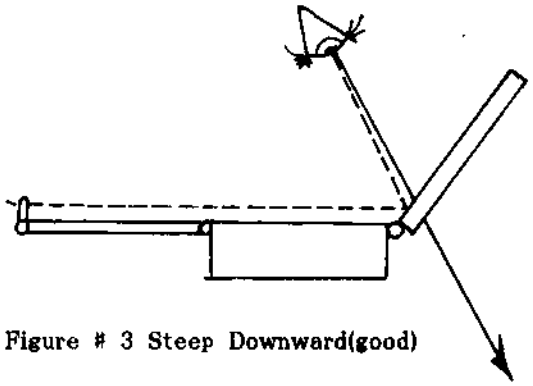


Figure # 3 Steep Downward(good)

To Target

Brunton compasses usually have the north end of the needle painted white. With both of the methods described above, the long sight is pointed away from the target and other end(south end) of the needle should be read.

Some other methods of reading a Brunton on a steep downward shot are shown for completeness. On one of them, the long sight and the reflecting surface of the mirror are not used at all.

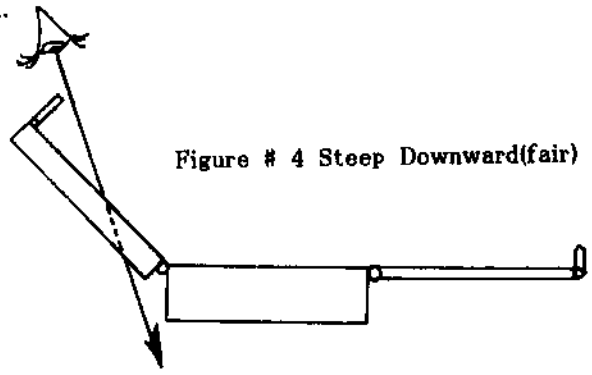


Figure # 4 Steep Downward(fair)

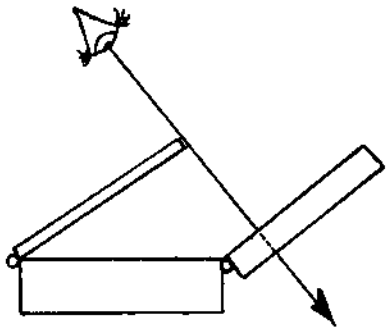


Figure # 5 Moderately Steep Downward (fair)

Suunto compasses are less suitable for making steep shots than Bruntons. The design of a Suunto requires that you be looking horizontally while using it. There are no sights on a Suunto. The person using a Suunto has to imagine an extension of the hairline or guess when the target is directly above or below the hairline. Because the upper part of the hairline is easier to illuminate than the part of the hairline below the compass scale, an upward shot is often easier to make than a downward shot. Taping the compass and clinometer together, as some surveyors like to do, also makes downward shots harder. The accuracy of a Suunto compass reading depends on how good the compass reader is at estimating when the target is directly above or below the hairline. Caves have few vertical lines to assist the compass reader in his judgement. The usual procedure is to tilt the compass from side to side until the hairline is parallel to the markings on the dial and then mentally extend the hairline.

There are two troubles with relying on the compass dial markings as a vertical reference. First is the fact that the marks are seldom truly vertical. The earth's magnetic field is not horizontal. In the northern hemisphere it is tilted down to the north. Compass needles or dials must be counterweighted to make them level. Brunton compasses have wire counterweights that can be slid along the needle by the user. Suuntos must

be counterweighted at the factory for where they are expected to be used. The tilt of the dial due to magnetic dip and the resulting compass error is greatest on a east-west shot and disappears on a north-south shot. The errors due to magnetic dip are in the same direction on a foresight and backsight, so taking foresights and backsights will not detect the error. Bubbles in the compass cell can cause an independent tilt of the dial.

The other problem with using the dial markings as a vertical reference is that there seems to be a systematic bias in extending the lines. I was recently on a survey trip where the foresight and backsight on a steep shot disagreed by 8 degrees. I tried reading the same Suunto compass and got readings that agreed with the first set of readings, but still disagreed in opposite reading in opposite directions.

Despite having been pictured on the front cover of the January, 1976 NSS News, cementing a hemicylindrical glass or plastic rod or tube to the body of a Suunto is not a good idea. If the rod is accurately mounted, it might eliminate errors in estimating an extension of the hairline, but it will not eliminate errors in side-to-side leveling of the compass. Try tilting a glass rod from side to side and watch what happens to the image of a ceiling light. The image moves from side to side as the rod is tilted. The author of the News article was inspired by Lang Brod, who was the first person I saw who mounted a glass rod on a Suunto compass. Brod, however, realized the importance of side-to-side leveling because he milled a groove in the bottom of his Suunto and installed a bubble level so that it could be seen thru the eyepiece of the compass.

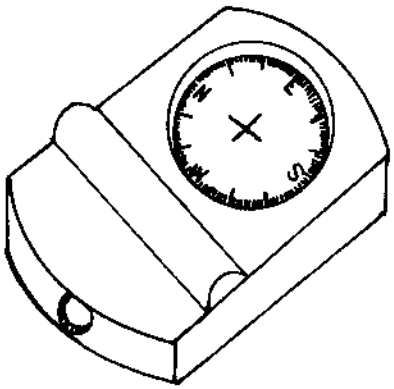


Figure # 6 Semicylindrical glass rod on a Suunto (Poor)

I have used the practice of "sagging" the tape to get a sighting point in the same vertical plane as the target station. Sagging is best explained by a picture. If sagging can be done, the main source of error will be air currents. Watch out for steel rings at the end of some tapes.

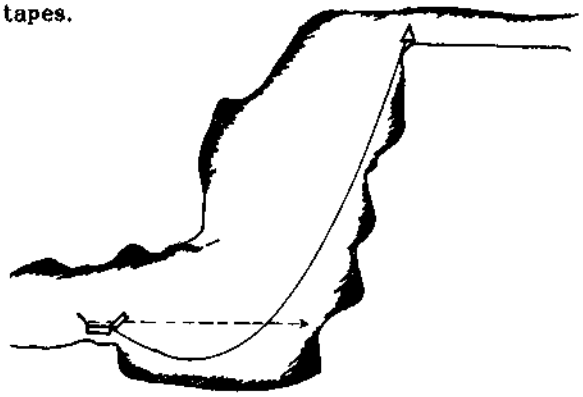


Figure # 7 Sagging the tap.

I have seen a description, by Lang Brod, of a technique that involoves hanging a plumb bob or other weight in the middle of a shot. It is best explained by the picture. I have never used this technique. It should be less susceptible to air currents than sagging the tape. It requires coming prepared with cord and may take a while to set up.

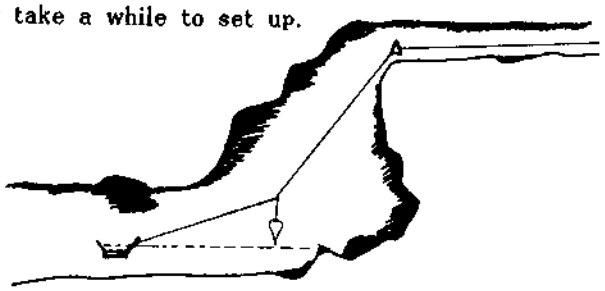


Figure # 8 Using a Plumb Bob in the middle of the shot.

It is possible to hold a weighted cord in front of a Suunto and use it as a vertical reference line. This requires that the compass reader hold the compass, a light for reading the compass, and the cord in his hands at the same time. Fortunately, it is possible to hold the cord and light in the same hand in front of the Suunto. To quickly make the cord stop swinging, gently lower the cord until it touches the floor, and then gently raise it straight up. I have not used this method in a cave, but I have verified that it is feasible.

STAIRSTEPPING

Because steep shots are more difficult and less accurate then straignt vertical shots connected by short horizontal shots. This technique is, most often, used for working down (or up) thru breakdown, but it can be used in narrow fissures too. The biggest problem with stairstepping is that it requires a well coordinated crew, where everyone knows how to find a good station, or a lot of time will be spent finding stations.

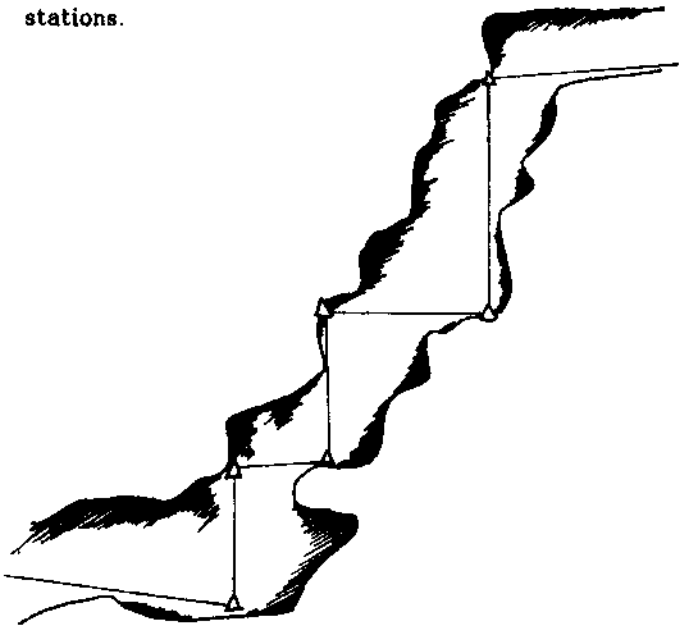


Figure # 9 Stairstepping. Vertical shots are connected by short shots that are nearly horizontal.

MULTIPLE SLANTED SHOTS --
Drops Requiring Two Shots

On many drops it is not possible to see directly from the top to the bottom and the dimensions make stairstepping impossible. Often there is some point in the middle of the drop where it is possible to see both the top and bottom. It is usually easier and more accurate to sight the instruments from a solid position at the top or bottom than it is to sight while swinging on rope. The ideal way to survey a two shot drop is to have two sets of survey instruments. Someone can station himself in the middle of the drop while readings are made from top and bottom. If there is only one set of instruments, the instrument person should go down or up the rope in the middle of the crew. Some drops are not too awkward. Because of the high incidence of error on steep shots, you should consider making shots from on the rope as a check on the other shots if nothing else, even if you do not normally do foresights and backsights. There is really little difference in surveying on the way up or on the way down on a two-shot drop.

MULTIPLE SLANTED SHOTS--
Drops Requiring More Than Two Shots

On some drops, all else fails and there is nothing else to do than to make a series of steep angle shots while hanging on the rope. There is danger from loose rock because a survey requires that the surveyors be a good distance apart. If there is only one rope, the survey will have to be done on the way up, because you can not have two people rappelling on the same rope. If the readings are being made with a Brunton, it will be better to have the compass reader on top, because it is easier to make a handheld reading in a downward direction.

THE CLINOMETER

Up to now I have concentrated on the troubles of making compass readings. The clinometer reading presents no special problems, but there are some precautions that have to be observed.

With either a Suunto or Brunton, it is important that the body of the clinometer be in a vertical plane. If it is not, the sideways tilt of the instrument body will contribute to the angle of the survey shot.

With a Brunton clinometer there are a couple more mistakes that the reader can make. Both of these involve aligning the sights and mirror so that the line of sight is not parallel to the body of the compass. Just to make clear what I am talking about, I am including a couple of drawings of how not to use a Brunton's clinometer. If the line of sight is not parallel to the compass body, you will be sighting in one

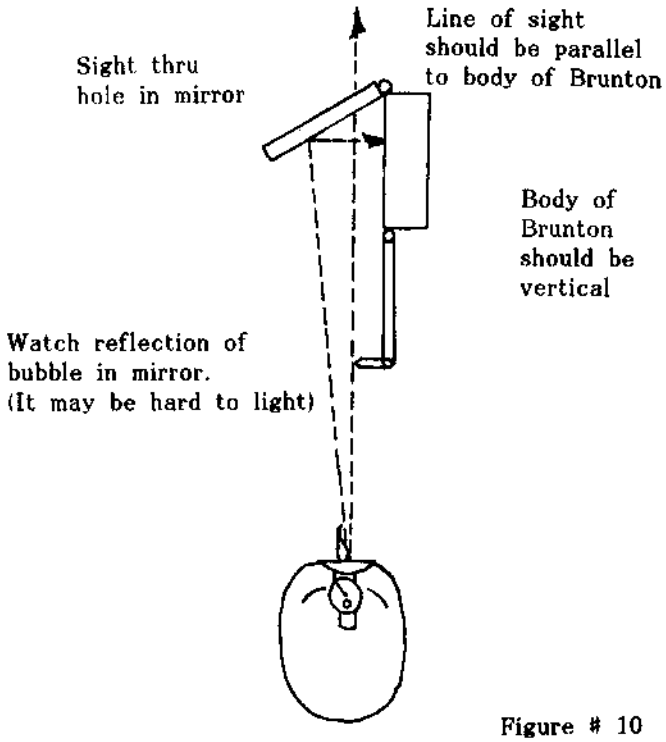


Figure # 10

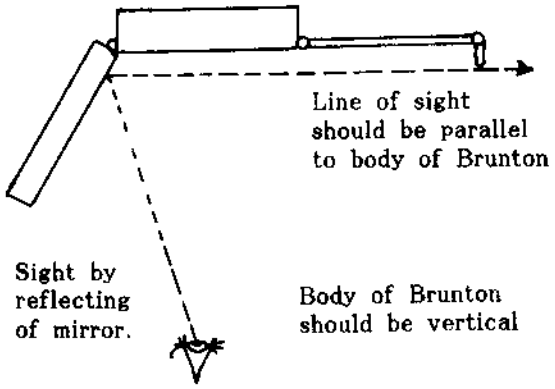


Figure # 11

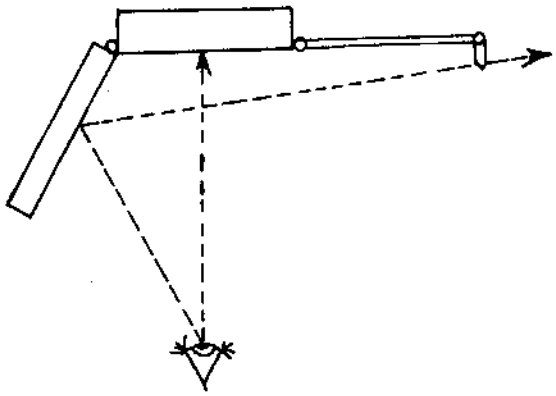


Figure # 12 BAD! Line of sight is not in the same direction as the angle measurement.

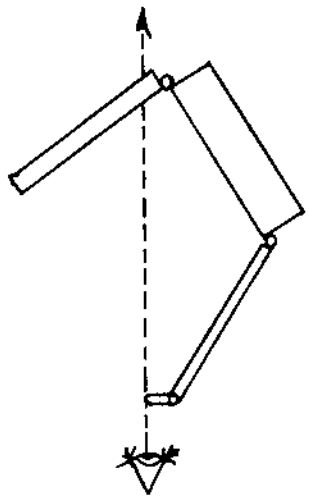


Figure # 13 BAD! Line of sight is not in the same direction as the angle measurement. I have seen some users read this way so they can light the clinometer bubble.

direction. If you are looking at the face of the Brunton and seeing the reflection of the target in the mirror, the point on the mirror where the reflection appears should be as high from the body of the Brunton as the front sight. The other method of sighting a Brunton involves looking over the long sight and thru the hole in the mirror. The mirror is folded so that the bubble of the clinometer can be seen. The trouble with this method is that it is hard to get light on the bubble. A light mounted somewhere other than on top of a caver's head is needed to illuminate the bubble. I do not know any good way of placing the light because the compass should be manipulated with two hands. To light up the bubble, I have seen some instrument readers open up the compass. Again, the line of sight is not in the same direction as the clinometer. □

BEING CAREFUL ON THE "SHORT ONES"

By Bill Cuddington

Yesterday, we went to Pipeside Well. It is a very nice pit with a 63 foot entrance drop. The weekend before, we had been in North Carolina doing a 350 foot drop and then a 200 footer.

The point is that we found ourselves being just as careful rigging the 63 footer as we had done the weekend before rigging the 350 and 200 footers.

At the 63 footer we rigged our main line, plus a parallel rope for the two rope pads needed to protect our rope. In fact, we rigged two ropes and needed two pads for each drop.

Making the descent and ascent we had to be just as careful as if we were back on the "350".

A 63 foot drop is considered short to most vertical cavers and that's the problem. There is the temptation to relax too much, particularly if you have been doing long drops (100 ft. or more) prior to doing a "short drop". Be extra careful on the shorter drops. Fight the temptation to relax too much. A common error when making the ascent, is to try to "short cut" climbing rig, using only part of it. An example is using two ascenders instead of three with no real back-up. When you do this, you usually cut your safety margin in half. Also, you may end up taking longer to climb the drop than if you had used your full rig.

I once had to use a full sophisticated Gibbs rig to climb a 20 foot drop. There was no "short cutting" for me that day.

The modern climbing rigs are very quick to get on rope and you should be as proficient as possible in getting on and off rope. I am speaking of fast efficient 3 point systems and of course, also have your <u>extra</u> quick attachment safety with you.

Don't take a chance by **short cutting**. Be just as careful on a 20 footer as a 100 footer and be just as careful on your 1000th rappel as you were on your first. □

JUMARS vs. GIBBS REVISITED

By David McClurg

It doesn't seem so many years ago that a lively debate was raging over which vertical system was the best: Jumars or Gibbs. At that time, (late-1960's) I was a die-hard Gibbs man and used to argue long and loud about how my rope walker system was way better than any Jumar Jerry rig.

In all fairness to the Jumar users (who out numbered us cam lovers by about ten to one back in those days), the Mitchell system was just getting invented about then. That means that most Jumar systems were sit-stand or Texas type, great for short drops (50 feet or less), but (at least for me), a killer on medium or long drops.

But a funny thing happened on the way to those pits I call Vertical: Medium (50 to 150 feet). I found that for a whole lot of caves with multiple drops, especially those with some crawling or climbing between pits (California's Lost Soldier's Cave comes immediately to mind), I prefer to load my vertical pack with my Mitchell System.

My version of the Mitchell is pretty much like everybody else's. I use two Jumars with an REI seat harness and a Gossett Box. For a third ascender I use either a short (20 inch) safety loop of 7mm Perlon or my Spelean Shunt clipped into the carabiner on my seat harness... In either case, this third point on the line just rides there above the Gossett Box. It's so smooth, you never know it's there. This third ascender gives me that extra margin of safety and provides a good resting position in case I get tired or need to make an adjustment to my rig.

My Gibbs rig floats both ascenders on a single bungie cord looped up through a pulley on my Gossett box chest harness. Again, I either use a Prusik knot or a Spelean Shunt for the required third point on the line tied into the carabiner on my REI seat harness. When I do the really deep ones, 150 to 1000 plus feet, this system is hard to beat.

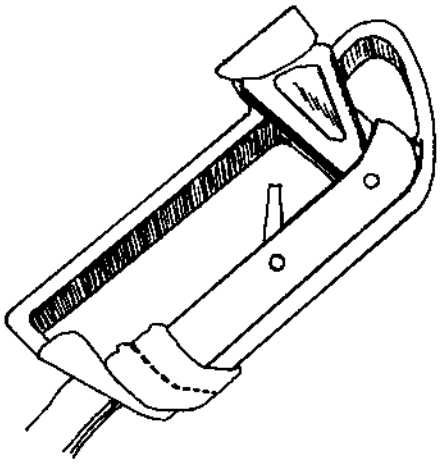
Summarizing the pros and cons of the two ascenders, here are some things to consider.

Jumars

Jumars were the first mechanical ascenders and remain very popular with climbers and cavers. They consist of cast-aluminum frames with steel spring-loaded cams. Their big advantage over Gibbs is they are much easier to put on and take off the line. With only a little practice, you can do it one-handed. This is a real plus when you need to come up over a lip, cross a knot, or negotiate an overhang. Because they're so easy to put on, many Gibbs-system cavers carry a Jumar (often called a safety Jumar) clipped into the seat sling for just such emergencies.

The main advantage of Jumars is their ease of handling and versatility. They are much easier to put on and take off the line. A Jumar system (ascenders and slings) is easier and faster to put on and take off yourself.

JUMARS VS. GIBBS REVISITED



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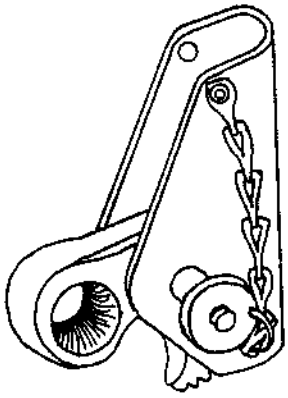
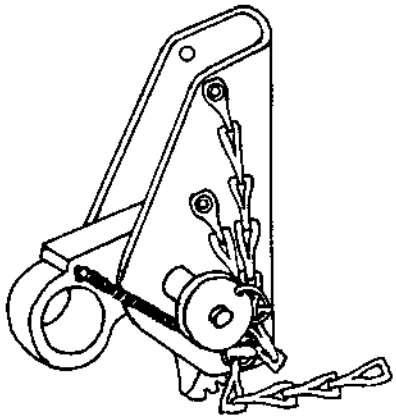




Thus, Jumars are preferred where you have a series of ascents separated by crawling passages or climbing that require taking off your ascending rig. One word of caution, however. Jumars will sometimes slip off the rope particularly on slopes where the rope is on an angle instead of hanging free.

Jumar versatility allows you to descend almost as easily as to ascend. That is, the Jumar catch can be released and the Jumar can easily be moved downward. Now, this doesn't mean that cavers have taken to rappelling with Jumar ascenders. But you could go all the way back if you had to.

Furthermore, there are situations at overhangs and outcroppings where it is sometimes better or more convenient to go back down a few feet and either readjust your rigging or choose another route. Getting up over the lip and crossing rope knots is also easier, because the Jumar can easily be unclipped (assuming the other ascenders are still secure) and put back on the rope above the lip or knot.

Finally, if you have to do any climbing to get over the lip or to fight your way up through a tight fissure or shaft, it's nice to have your feet free of the rope to find foot holds. With Mitchell system slings, both feet are much freer than with the Gibbs arrangement. This may seem like a minor point, but it's really something to consider in multiple drop caves or when doing a through trip in a Mexican cave.

Gibbs

Gibbs ascenders are harder to put on the rope but most people can climb faster with a Gibbs system than with Jumars. Gibbs also usually work better on muddy or icy ropes than Jumars... They are cheaper and stronger than standard Jumars. Gibbs test up to 2200 pounds and are all individually tested to 1000 pounds. When you need to go back down the rope a few feet, it is possible with Gibbs, but not as easy as it is with Jumars.

The main disadvantage of Gibbs is that since they have to be partially taken apart, they are more awkward to put on the rope. You really have to use two hands. It is also quite hard to cross a knot with the foot Gibbs if there's more than 20 pounds or so (300 feet of rope) below you or if you're climbing in tandom on the same rope with another person. An exception would be if the lower person can reach your bottom ascender, release it for you, and reassemble it about the knot.

The Bottom Line

The consensus seems to be that the Gibbs are superior for deep pits and for pitches where both hands are needed to push away from the wall. However, Jumars are probably more versatile for complex multi-drop caves and are more easily clipped on and off the line.

As for the old-fashioned Prusik knots, they are still in use today particularly for shorter drops where the added complexity of rigging into the line with ascenders is too much trouble. Also when equipment weight and bulk looms large or where backpacking trips call for minimum equipment, prusik slings may be taken along in preference to the heavier Jumars or Gibbs. □

1. Matching Cave Gear to Cave Hazards, D. McClurg, Proc. 8th Int. Cong, Speleo., 1981, pp 252-3.

1983 MINUTES

By Kirk MacGregor

The 1983 Vertical Section meeting was held in Elkins, West Virginia, starting about 4:45 p.m. on Thursday, June 30th. Approximately forty section members attended. Executive Committee members present were Bill Cuddington, Kirk MacGregor, Gary Storrick and David McClurg, who chaired the meeting.

Kirk MacGregor read the 1983 Treasurer's and Secretary's reports which are reproduced on page 21 of Nylon Highway #17.

The question of whether one member of the Executive Committee should continue to be elected specifically as Convention Coordinator was discussed. This was done on a one-only basis in 1981, and was informally repeated in 1982. (See Nylon Highway #16, page 17.) After no volunteer for 1983-84 could be found, this procedure was allowed to lapse. In the future, the Executive Committee will appoint the Convention Coordinator who can be any suitable section member.

Bru Randall, one of the two people who organized the caving short course at the 1983 Convention, suggested that the course would be better if the vertical work were done separately, given more time, and run by the Vertical Section. In a number of minutes of discussion, several people agreed with this, but no one volunteered to run such a basic vertical techniques course.

The meeting concluded with the elections. Those elected were:

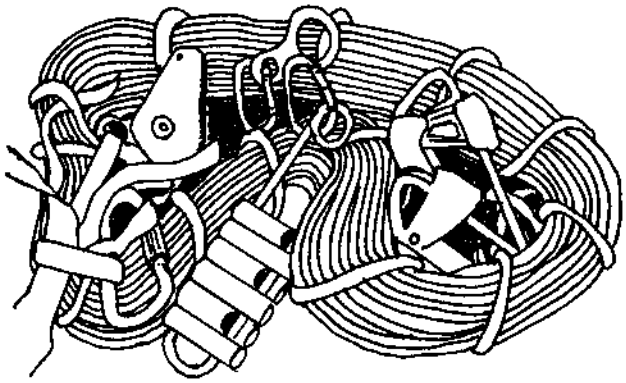
Bruce Smith	Nylon Highway Editor
Kirk MacGregor	Secretary-Treasurer
Bill Cuddington	Committee Member
David McClurg	Committee Member
Gary Storrick	Committee Member
Darrel Tomer	Committee Member

When the meeting ended at 5:30 p.m., the five Executive Committee members met and selected David McClurg as Chairperson. □

VERTICAL SENSE

By CJ Rushin Bell

The following tips are pretty much common knowledge among experienced vertical cavers. However a few DO'S and DON'TS bear repeating:



DO

--Inspect your rope after each use: check for surface damage such as broken fibers, glazed spots, cuts, etc. A light surface fuzz on the sheath is okay...until over 50% of the sheath fibers are broken. Core damage may be indicated by a change in diameter, lumps, soft or hard spots. Also feel for any unusual stiffness which could be the result of age. frequent use, or being wet and dry many times. Cut the rope in two at any badly worn areas rather than have a potentially weak spot in a load bearing portion.

--Retire your rope after it has caught a hard fall or been under a severe strain (such as a heavy load) for a sustained period of time; whenever it is aged, worn or brittle; or if you have any reason to suspect it may be damaged. A new rope is certainly cheaper than a funeral.

--Reverse ends of the rope if one end is receiving more wear. For instance, using a 165' rope repeatedly on 80 to 100' drops will wear one end more if the rope is always deployed in the same manner.

--Always check a rope immediately after it has been hit by a rock or any other heavy object. Cavers have knocked rocks loose while on rappel, resulting in a cut or damaged rope below.

--Always pad a rope at rub points, particularly sharp edges. Proper padding will extend the rope's life...and yours. Pads may be fashioned from a piece of canvas with holes or grommets and parachute or accessory cord to tie it in place. Other impromptu pads may be items such as a jackaet, blanket, pack, rope or duffel bag, blue jeans leg, a piece of leather or garden hose. Carpet scraps are often used as pads...but beware of using any nylon, rubber or plastic scraps against a synthetic rope such as nylon or you may find pad fibers fused to the rope.

--Carry your rope in a rope bag or tackle sack whenever possible to protect it from mud and grit, sunlight, chemicals, etc. Especially put it in a sack when dragging it through a cave. This will help prevent rock and dirt particles from getting on the sheath and working their way into the rope and cutting core fibers. Remember, the core comprises approximately 70%-80% of the strength in a static kernmantle rope...so we certainly don't want anything cutting core fibers, do we?

--Store your ropes in a cool, dry, well-ventilated location out of sunlight and preferably in a rope bag. Remove any knots or kinks before coiling or storing it.

--If you receive new rope on a spool, or need to uncoil any rope from a spool, be sure to unroll it by having someone insert a rod or broomhandle in the center hole and hold it for you while you pull out the rope. Otherwise, you will have a kinked, snarled mess.

--Use a 15 to 1 safety factor if you intend to use your rope for rescue work. If 450 lbs. is the most you expect to load the rope (say a victim and rescuer). Multiply the weight (450 lbs.) times the safety factor (15). In this case, you would need to use a rope with a tensile strength of a least 7500 lbs. If you expect a load of 600 lbs., (a victim, litter, and one or two attendants) you would multiply 600 X 15 to get 9000 lb. minimum test rope. (ED. Consider 2 7/16th inch ropes if this was the case).

--Remember that knots, sharp bends (such as over a carabiner), abrasion and over-loading can reduce a rope's strength by up to 50%.

--Remember that nylon can lose up to 15% of its strength when wet. Keep this in mind when rigging in the rain or in a waterfall. Since it is weaker, a wet rope will abraid easier when rubbed against a rock face...Keep in mind it's difficult to pad in a waterfall.

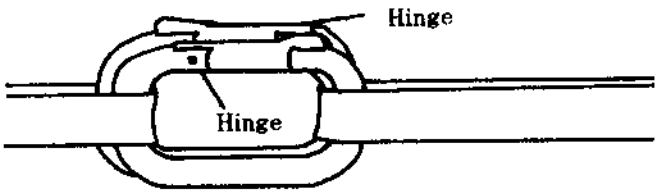
--Use caution when using a knife around a loaded rope.(See Nylon Highway # 18, Pg. 3.) Better yet, don't use a knife if at all avoidable when the rope is under tension.

--Keep your rope clean. This may be accomplished by one of several methods: by rinsing in a stream and scrubbing with a soft brush, by hosing it off, by use of a commercial rope washing device that screws on to a faucet, by soaking it in a bathtub with a commercial cleaner such as Lifeline; or by washing it in a washing machine with a mild detergent such as Ivory Flakes.

--Chain your rope if you wash it in a washing machine to prevent tangles. Select the gentle action or nylon cycle and use only cold or lukewarm water. Fabric softener may be used if desired, but make sure it is labeled "safe for nylon". Fabric softener will not only make the rope slightly more flexible, but also slicker for rappelling, so beware. Expect 2%-5% shrinkage the first time the rope is washed. Allow for this when initially choosing your desired rope length.

--Dry the rope in the shade. It may be unchained and hung over a ladder, for example. Pulling it through a descender will squeeze out some of the excess water and speed the drying process.

--Use locking carabiners and **LOCK THEM**. You'd be surprised how many cavers forget to lock their 'biners. If non-locking carabiners are used, make sure two are used and that the gates are opposite and opposed.



Opposite and Opposed non-locking carabiners

--Keep angles between anchors and the tie off point less than 120 degrees or safer still, less than 90 degrees. The greater the angle, the higher the load on each anchor.

--Try to select an anchor point that allows a safe area to rig and derig. A good anchor spot will also avoid sharp lips, loose rock areas, and waterfalls.

--Think about the direction of pull on your anchor when the rope is loaded. What would happen if it failed. Rig functional backups.

--Make sure any trees you rig to aren't dead or shallow-rooted.

--Wear safety goggles when using a bolting hammer. (If you must) Learn about proper bolt installation and use only high tensile bolts and hangers. Never rely on only one bolt and don't use bolts that you do not know the history of. Make sure the carabiner gate is down and away when clipped into the hanger.

--Use caution when placing a carabiner anywhere in your vertical set-up. Make sure it is loaded along the long axis only. No carabiner was designed to be loaded on the small axis or on the gate. The gate, and especially the hinge pin, are the weakest part of a carabiner. Triangular screw links (version of a Quick Link) work well in cases of multi-directional loading. such as in a seat harness. When locked, they are equally strong on all sides. Be sure to face the opening sleeve of a triangular screw link down if you use it to attach your seat harness to a rappel device, less serious results would ensue should the locking sleeve accidently work open.

--Leave a few inches of rope off the ground (with a figure eight knot tied in the end so you don't run the risk of rappelling off the end). This will help alleviate some of the twisting and kinking in the rope that occurs if one happens to be using a Figure Eight descending ring to rappel. Rig in this fashion only when you can see the bottom of the drop (and the bottom of the rope) or someone is already at the bottom) so you know you will be able to touch the ground.

--Smooth out any sharp chipped areas in a Figure Eight descending ring with an emery cloth.

--Switch the top bars in a rappel rack with the bottom ones when the top ones begin to show wear.(ED. Wear on a solid aluminum bar is about half way through in the center of the bar. If the groove is to one side retire much earlier) The capstans on Petzl Stops and Claccics may also be reversed.

--Rappel with the short leg down and the rope coming off the bottom of the lowest bar into the braking hand when using a standard rack. Rig the eyes of the brake bars, in alternating fashion, on the long leg. (See Nylon Highway # 18)

--Face downwards towards your braking hand when using a body (Classic, Dufur) rappel.... otherwise you run the risk of falling out of the rope. Always use a top belay with this method of rappel.

--Remember that when tying slings for your ascenders, high strength accessory cord is more resistant to abrasion do to its shape than 1" nylon webbing.

--Remember to clip a carabiner from the bottom safety sling of ascenders such as jumars to the rope when the rope is not vertical, such as on a traverse. This will help prevent accidental twisting or torquing of the ascender off the rope.

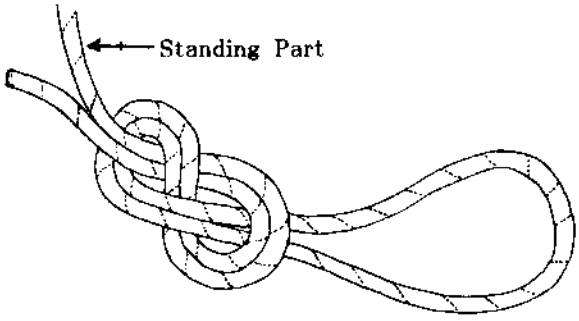
--Take care of your harness as you do your rope: keep it clean, away from chemicals and abrasive surfaces, and retire it at the first signs of brittleness or age. Frequently check the stitching and edge wear.

--Make sure you can flip upside down and not fall out of your harness. Only use a harness that will still keep you attached to the rappel device should one piece break. Think about it: what would happen if the rope accidently burned through a diaper harness that was not backed up by a separate waist loop?

--Remember that a correctly sewn harness is stronger than one tied together by knots.

--Use the best helmet you can afford, and always use a chinstrap. Joe Brown, Climb High, MSR, and Petzl make excellent helmets if you can afford them. Keep your helmet out of ultra violet rays as much as possible; don't store it in the back window of your car.

--Tie a figure eight knot such that the standing part of the rope(the end that will be loaded, for instance) is on the outside of the bends of the knot.



--Consider temporarily covering knots in use with tape(make sure it is safe for nylon) to prevent abrasion.

--Remember that any knot in the rope will weaken the rope at that point. The tighter the loss of strength. Be sure to check all knots before loading them.

--Use only a tightly woven continuous spiral weave when using 1" tubular nylon webbing. It is less subject to snagging and abrasion than other designs, and is very strong (approx. 4000 lbs. test). 9/16" tubular webbing generally tests at 1500 lbs. This varies according to manufacturer.

--Frequently check webbing for age, abrasion and melted spots. Throw it out at the first hint of chemical or other damage. Use care not to snag it on carabiner gates and don't scrape it over sharp edges, especially when loaded.

--Use a water knot (a.k.a. ring bend, tape knot, overhand bend, sling knot or webbing knot) when tieing a knot in webbing and check it frequently. It could come loose when not under tension. Back this, and all knots, with an overhand knot on each side.

--Select lighter colored slings if it must be left out in the sun for a long period of time (we're talking about weeks and months here, not for a short open air pit trip). Lights colors tend not be as sensitive to the damaging effects of ultra violet rays.

--Try to select a pulley that is approximately 8 times the diameter of the rope to be run over when hauling heavy loads or for rescue work. Example: If you are using 7/16" rope, multiply 7/16" times 8 = 3.5". Meaning, you would want to use a 3 1/2" or 4" pulley. A 2" pulley would be sufficient for light duty work, however, eight times the diameter of the rope is the magic number at which a rope loses little strength when running over a bend. Smaller pulleys, of course, may be used, but will result in a decrease in rope strength at the pulley. Cavers commonly use 2" pulleys in haul systems and for rescue purposes with no problems...just use good judgement and know the limitations of your rope. Remember that the better the bearing and larger the pulley, the more efficient it will be.

--Be sure to tie a knot in the end of the rope before rappelling. Especially in a pit of unknown depth or one you can't see the bottom of.

--Save the spectacular leaps and bouncy descents for the movie stars. Not only is it unsafe, but also hard on your rope, the descender, and the anchor. A smooth, slow rappel prevents heat build up in your descender, avoids possible heat damage and

abrasion to the rope, and allows you to stop at will. Plus, you will have time to react should something go wrong.

--Always carry ascending gear with you in case you need it before completing the rappel (the rope doesn't reach bottom; you get stuck; the rope is damaged below; or there is a rattlesnake at the bottom of the pit). Always recheck your rigging if you stop and unweight midway on rappel, say getting off on a ledge to look around.

DON'T

--Use a statiac kernmantle rope as a climbing rope or to catch falls. It wasn't designed for this. Use your Goldline or climbing rope for belays, not Bluewater II, PMI, or SSP.

--Use any rope smaller than 7/16" for rappelling unless it is doubled. The rope fibers in the smaller diameter ropes are under more stress when loaded, and therefore more susceptible to abrasion.

--Stand, walk, drag, jump on, or sit on a rope...it could grind dirt particles into the sheath and eventually to the core.

--Leave your rope or webbing dangling in the sun or out in the weather for weeks on end.

--Store your rope near a battery, battery fumes (such as a charging wheat light battery), on rusty or sharp nails, on a concrete floor such as in a garage, near strong acids or strong alkalis, near phenols, bleaches, gasoline, rust, solvents such as lacquer thinner, paints or cresols. Never store rope in the back window of your car or anywhere it would be sitting in the sun. Avoid storing it where vehicle exhaust is present, or in areas of excessive heat (such as near a radiator or furnace or excessive cold.

--Store rope wet and tightly coiled, with knots or kinks, or leave it under tension for a long time.

--Throw the rope in the back of a pickup or in a car trunk where chemicals and sharp objects could damage it.

DON'T

--Tow a car with your rappel rope. It is literally your lifeline. Treat it as such. Never borrow a rope you don't know the history of and likewise don't loan your rope to someone you wouldn't trust with your life.

--Use a rope when you can see core strands through the sheath. (Called a "puff")

--Ever let nylon run over nylon, be it rope, a harness, or a rope pad. The non-moving piece could easily become weld-abraided.

--Toss a large amount of rope over the edge of a drop when rigging. The weight of the sudden mid-air stop could strain the rope fibers...not to mention possible snarls.

--Load a kinked rope, serious damage to the rope fibers could result.

--Leave excess rope at the bottom of a pit in a tangled mess. Coil it out ot the way or store it in a rope bag. This will hopefully get it out of the way of falling rocks and prevent cavers from stepping on it when they derig from rappel and rig in for ascent.

--Run the rope around a tree, pulley or other object less than 8 times the diameter of the rope, when you can avoid it. Anything less will result in loss of rope strength. Of course, it is sometimes impractical to haul a 4" pulley around underground when saving weight and space important.

--Use any bleach or any detergent wich contains bleach when washing a nylon rope. Don't use hot water or a washing machine with a

plexiglass window...it could fuse the rope during the spin cycle.

--Use a clothes dryer to dry rope if you can avoid it. If you do, then use the "cool" or nylon cycle. And never dry your rope near a campfire. Not only might it get too hot, but you run the risk of sparks hitting it.

--Use a chain of carabiners to connect anchors or anything else your life depends on. The weak axis may be accidently loaded or the gates twisted open.

--Test an anchor by pulling on it while leaning towards the drop!

--Suddenly jerk a rope already under a heavy load.

--Tension a tyrolean until it is taut: Obey the "10% Rule" -- 10% X # of people to be on the rope at one time X length of the rope = the amount of slack to be left in the Tyrolean line.

--Stand near a rope that is under extreme tension--should it fail, it can recoil with tremendous force and seriously injure bystanders.

--Use any carabiner, descender or ascender that has been dropped a significant distance or hit hard on a rock. I could have unseen hairline cracks. It is cheaper to replace the item than to have it X-rayed, and certrainly not worth the risk to keep using it.

--Use any carabiner that has a "sticking problem" or bent gate, misaligned pin, or is rusty, pitted, worn, or clogged with mud.

--Lock a carabiner while under load ...you may not be able to unlock it once the load is removed. If this does occur, try using a strap wrench made out of webbing. Lock carabiners only to finger tightness with the load off. (ED. I've found reloading the overtightened 'biner will allow it to be unscrewed easily)

--Use locking carabiners with sharply crested threads -- they can tear webbing. Look for flat crested threads instead.

Deeply Cut Threads

Rounded troughs, but razor crests.

--Use Figure Eight descenders on longer drops. They do not contain enough metal to properly disipate the amount of heat generated on a long drop. (Over 150') Not only do they get real hot, but could cause heat damage to the rope.

--Sew your own harness, unless you are well informed on the subject. Leave it to a professional or buy a good quality commercially available brand. Check the NSS News for advertisements or harness makers. Most cavers are not familiar enough with the proper stitching patterns or the correct thread to sew their own harness. An alternative is to contact a parachute harness maker. Try to use a contrasting color of thread in the harness: wear and tear on the thread will be easier to spot.

--Use a harness that falls down to your knees when you are off the rope.

--Use a helment which has received a heavy blow or one that is uncomfortable to use for any reason. Don't use a helmet that blocks your hearing. Never use paint, glue, tape, or markers on plastic helmets unless the manufacturer states they are safe for use.

--ever belay with a rope that has been joined with knots.

--Load directly on a knot...move it off to one side.

--load a bowline sideways: it could be pulled into a slip knot.

--Unjam a jammed knot by beating it with a rock, etc. This will only damage the rope fibers.

--Pull rope through a webbing anchor on a pull down trip...It's the old nylon-on-nylon story again.

--Use a plastic or nylon pulley wheels where a life is at stake - an accidently non-spinning wheel could be melted through by a running rope.

--Let a hot rappel device remain in contact with the rope at the end of your rappel - remove it immediately.

--And last, but not least, the old standby we all learned: Don't leave any danglies unsecured such as long hair, a beard, loose shirt tails, or an electirc light wire, that could get caught in your rappel device. □

A LETTER

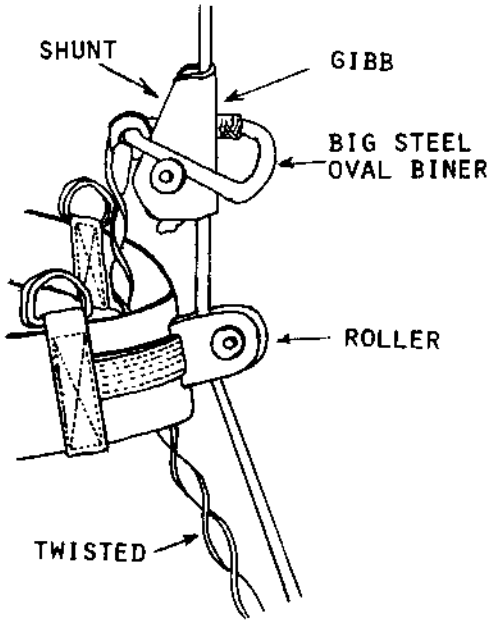
Comments on the **Spelean Shunt** article, Nylon Highway # 19.

Twisting the webbing of the shunt makes it shorter and it tends to grab better, which is what you want it to do. This is sort of a "fine tuning process."

Just twist it, if the webbing is too long before you attach it to the rope. After a little practice you will get the feel of about how many twists you need.

Another point: There may be a slope leading down to the top of the drop, so you may think you have too many twists because the shunt may constantly try to grab. Try to put up with this, because once you "hit" the free fall section you will probably find that the amount of twists are just right.

Remember, the shunt should be fine-tuned to where it is just to the point of engaging. Try to rappel with your upper hand held under the shunt, sort of barely holding it with two fingers under the bottom, coaxing it along.



SPELEAN SHUNT

Holding it too tight or holding a hand above it, could keep it from engaging and saving you in an emergency. Be sure to run the shunt up from your swiss seat and under or behind your chest harness. This makes your shunt engage much quicker in the event of an emergency.

As stated in the original article, you should rappel slowly when using the shunt. Don't just go whizzing down the rope! □

Bill Cuddington

1984 MINUTES

By Kirk MacGregor

The 1984 Vertical Section meeting was held in Sheridan, Wyoming on Thursday, June 28th at 12:30 p.m. Approximately twenty-five Section members attended. Executive Committee members present were Bill Cuddington, Kirk MacGregor, Gary Storrick and David McClurg, who chaired the meeting.

Kirk MacGregor announced that he was resigning as Secretary-Treasurer and presented the Secretary's and Treasurer's reports (see page in this issue of Nylon Highway).

Bruce Smith stated that Nylon Highway #18 had not been published before the convention due to lack of material. Bill Cuddington thanked the people who helped run the 1984 Prusik Contest, and asked for more volunteers in 1985. A discussion developed on unsupervised children playing near the Contest, creating a safety hazard. These were especially numerous this year because of the location of the gymnasium. David McClurg suggested putting up a warning sign saying that the Contest is not a baby sitting service and not to leave children there unattended.

David then asked whether Section members would be willing to contribute money to create a fund to pay for equipment testing. About ten people joined the discussion on this. Among other things, it was noted that the testing grants the Section offered in the past were not used, and that the major limiting factor seemed to be lack of access to test facilities (e.g. tensile testers), not lack of money to buy vertical equipment. The discussion ended without any action. However, the Executive Committee has always been empowered to spend Section money on anything it feels is worthwhile so anyone who needs money for testing can submit a proposal to the Committee for approval.

Bruce Smith moved and Allen Padgett seconded that:

> Each Executive Committee member with the exception of the Secretary-Treasurer shall be responsible for researching and producing one major contribution to the vertical Section's publication each year.

This was debated vigorously with some strongly for it and some strongly against it. It was agreed that Committee members could meet this requirement either by producing a contribution themselves or by persuading someone else to produce it for them. This motion passed with a fifteen (15) to seven (7) vote.

Then Bruce Smith moved and Bill Bussey seconded that:

> The Chairperson shall prepare proposed Executive-Committee-member job descriptions to be submitted to the Section members present at the 1985 NSS Convention.

The vote in favor of this was unanimous.

The meeting then considered an NSS request for someone to produce a revised version of the

out-of-print book Prusiking by Bob Thrun. (Bob himself was not interested.) Bruce Smith and Allen Padgett volunteered. After some discussion, it was decided to write a new book covering rappelling and rigging as well as prusiking with the book to be reviewed by the Section Executive Committee before publication. The Committee unanimously appointed Bruce and Allen as the book-writing committee. It was noted that the 1985-86 NSS budget contains the money for publishing this book, and the book committee agreed that the book would be finished in that fiscal year.

Following discussion of the need for a "Convention Coordinator", Gary Storrick moved and Bill Bussey seconded that:

> Each year, the Vertical Committee shall elect a Convention Vertical Coordinator whose duties shall include inspecting the site of the next NSS convention and communicating with both the NSS Convention Committee and the various Vertical Section event chairpersons to ensure that proper facilities and equipment are available for all section activities and that the event chairpersons are adequately informed about facilities, etc.
>
> If the choice of convention site has not been made at the time of the Vertical Section meetings, or a suitable person is not available, the Convention Vertical Coordinator position may be left vacant temporarily, to be filled by the Executive Committee when the convention site is selected, or as soon as a suitable person can be found.

The vote in favor of this was unanimous. (Note: The above motion originally contained a statement that the Vertical Coordinator would become a member of the Section Executive Committee. However, this was deleted by a seventeen (17) to four (4) vote immediately before the vote on what appears above.)

The meeting concluded with the elections. Those elected were:

Bruce Smith	Nylon Highway Editor
Bill Bussey	Secretary-Treasurer
Bill Cuddington	Executive Committee
Jim Hall	Executive Committee
Kirk MacGregor	Executive Committee
David McClurg	Executive Committee
Bill Cuddington	Convention Vertical Coordinator

When the meeting ended at 1:55 p.m., the Executive Committee met briefly and selected Kirk MacGregor as Chairperson. □

ROB LANDAU has agreed to manufacture several of his chest rollers and is soliciting orders so that quantity production (10-20) can keep the cost down. The rollers, as described in Nylon Highway # 18 use a contoured plastic roller rolling on a steel dowel pin with the roller assembly attached to an aluminum chest harness block by a standard quick release pin. They will be made at cost. Prices should be $10-$20 depending on quantity. Contact Rob at 201 E 27th St. Minneapolis, MN. 55408; (602)-871-9026.

Treasurer's Report

NSS VERTICAL SECTION

1984 JUNE 21

INCOME:

Memberships	$704.05
Subscriptions	47.00
Back Issue Sales	701.50
Bank Interest	7.57
Other	3.60
Total	$1463.72

EXPENSES:

EDITOR:

Mailing Nylon Highway # 17	29.10
Reprinting N.H. Covers (1-8&15)	165.00
Other Postage	41.92
Printing Nylon Highway # 17	265.00
Printing Nylon Highway # 14	195.00
Mailing Envelopes	52.17
Other	34.23

SECRETARY-TREASURER:

Postage	$61.64
Supplies	.10.15
Other	.35
Total	.$854.56
NET INCOME	.$609.16
BALANCE AS OF 1983 JUNE 22	$758.11
BALANCE AS OF 1984 JUNE 21	$1367.27

SECRETARY'S REPORT

NSS VERTICAL SECTION

1984 JUNE 21

Number of Single Members	219
Number of Family Members (# people)	12
Number of Nylon Highway Subscribers	20
Number of Paid Grotto Subscriptions	1
Number of NH's Exchanged	10
Total Number of Section Members	231
Total Number of NH's Mailed	264

~ DUES ARE DUE ~

NYLON HIGHWAY: is published by the NSS Vertical Section, and available to Subscribers and Vertical Section members for $3.00 per year. For Delivery outside North America add the following extra postage charges:

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Air Mail.....$4.00

For Spouse memberships add an additional dollar. Please insure that these payments are in U.S. dollars. Frequency of the publication is based on the availability of material. All material that is submitted must be readable. The Editor is able to arrange, upon request, professional quality drawings explaining your topic.Checks made payable to the NSS Vertical Section.

SPECIAL THANKS Take careful notice of the names listed under each Feature Article in the Table of Contents on the inside of the cover. These are the movers and the shakers of the vertical world...these are the people that feel being current about vertical stuff is important. Their concern keeps this publication alive and I truly appreciate their contributions. Words can not express my gratitude. Thank you...

ALWAYS LOOKING FOR GOOD ARTICLES

SUBSCRIBERS VS. MEMBERS

What's the difference? Members have NSS #'s... Subscribers don't. Members vote during elections and key issues, Subscribers shouldn't. Otherwise the cost is the same.

ILLUSTRATIONS By the Editor

COVER: The Great Tyrolean over Roy Gap from a photograph of John Markwell, of Gendarme fame, crossing.

MARGIN OF SAFETY

By C.B. "Cheyenne" Sweatman

I would like to relate a problem that I had recently that could quite possibly become a safety hazard to those who are unaware. It is for this reason, maintaining a margin of safety, that prompted me to write.

I use a Three-Knot Prusik system, of which, the top knot I replaced with a new spring-loaded Gibbs Ascender. This system works well for me and is safe, lightweight, as well as efficient. It is not the system that is the problem, but rather with the Gibbs Ascender itself that is the cause of this particular problem.

I had just replaced my seat harness and made a new sling using 6mm perlon rope to which I attached to the cam of the Gibbs Ascender by means of a hitch knot. I was in preparation for an upcoming pitting trip to 3 of the larger and deeper pits in TAG country...making sure my gear was in top shape. After the rip. I was in the process of cleaning and inspecting my gear when I noticed that the seat sling had, what appeared to be, excessive wear at the hitch knot connection on the cam. Upon disconnecting the sling rope from the cam. I found that not only had the rope's protective braiding been worn through, but also the kernmantle itself had been cut almost 1/3 of the way through as well. The sling being new rope and having only done three pits for a total of 576 vertical feet, I felt that the problem must be with the Ascender's cam. In the ensuing inspection of the cam, I found that the inside edges of the "eye" could be filed and polished to eliminate the problem completely, thereby removing any potential safety hazard. At present, I am using a locking steel oval carabiner through the cam to which I have tied my sling.

In talking with a member of another nearby Grotto, about a rope walker system using Gibbs Ascenders, the same problem was related to me about the cam's "eye" cutting into both rope an webbing used in the systems he'd built.

My intention of this article is not to find fault in Gibbs Ascenders, I will continue to use them, but rather, to bring to the attention of my fellow cavers the need to be aware of potential hazards that could quite easily be overlooked. Further, to bring it to their attention early enough so that we might prevent one of us from becoming another statistic in what would have been a preventable accident report. □

Kyle Isenhart writes "Incidentally the "New Knot" referred to by Brian Judge for the adjustable sling is a "Magnus Hitch", First shown by "Steel" in 1794. The version is listed by Ashley for use when tightening circus tent guys.

1985-1986 DUES ARE DUE...If you are not attending the 1985 NSS Convention, please remit $3.00 with the enclosed sheet(no increase again) to Bill Bussey, P. O. Box 311 Stanley, N.C. 28164. Make checks payable to **NSS Vertical Section**

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GREAT VERTICAL EVENTS is a NYLON HIGHWAY feature. From time to time great vertical achievements take place utilizing rope techniques commonly used in a cave. Often times these events require special talent, equipment, money and sacrifice. It is our intent to bring you those stories as they happen with all the significant details. Got any you want to share...?

THE SENECA ROCKS TYROLEAN TRAVERSE

By Kyle Isenhart

On May 29, 1982, a group of 4 riggers, and additional 20 or so invited guests, and the usual assortment of hangers on went to Seneca Rocks, West Virgina to rig a tyrolean traverse across Roy Gap.

The author had led another successful rigging of this traverse in March 1975. That rigging trip took a technical rock climbing team and over eight hours of very hard work to get the rope across. In the two days the traverse was rigged only six people crossed it.

The 1982 rigging was significantly improved over the 1975 effort. After the initial orientation, the personnel present were divided into two groups, one going up the main rock to an area near "East Broadway", and the other group going up the hill by the Southern Pillar to an area near the top of the "Great Chimney". No climbing above Grade 5.0 was required for either group. The Southern Pillar rig point was about 80 vertical feet above the main rock rigging point.(Seneca Side)

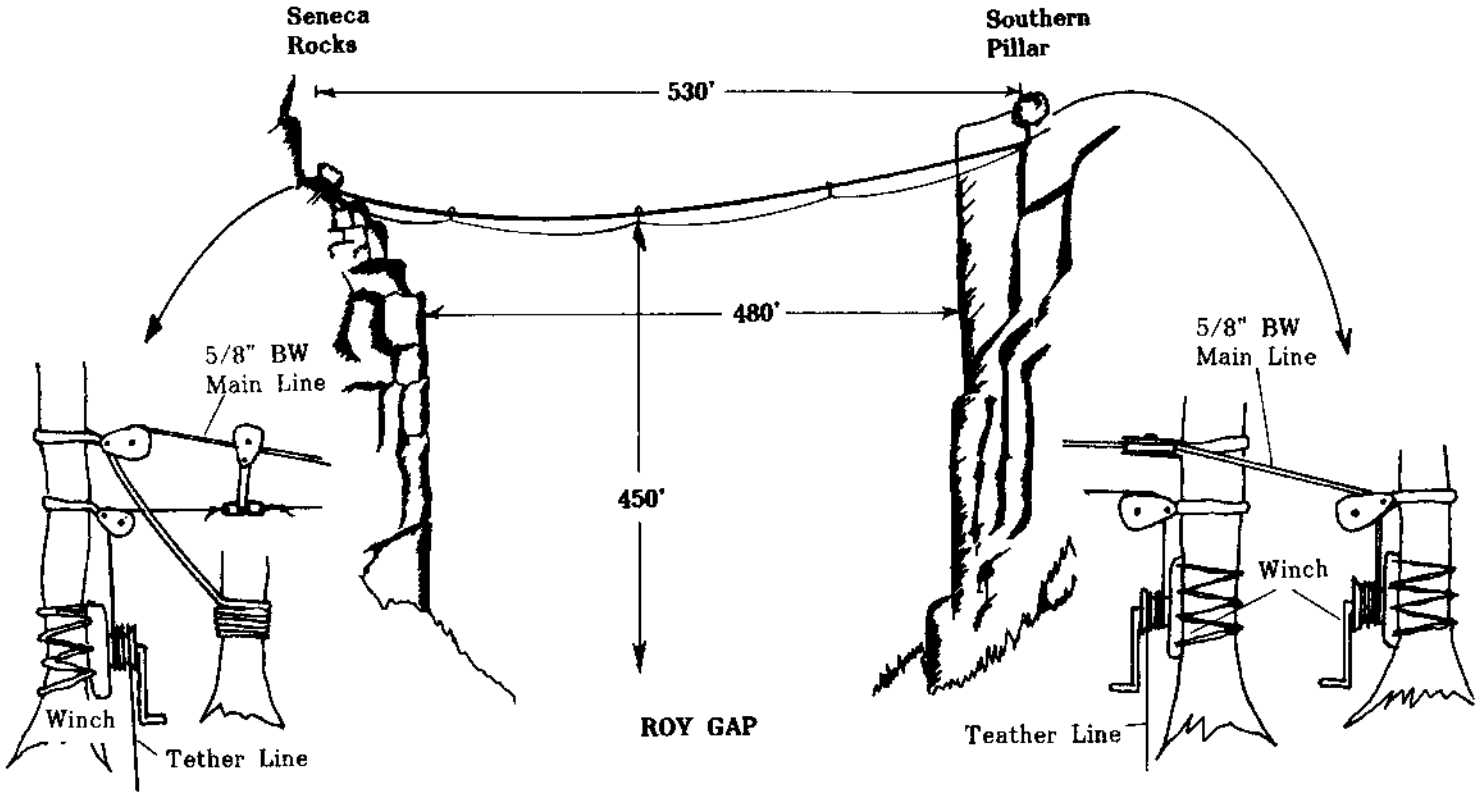
The rigging on the recent traverse was greatly simplified by the use of a custom built line cannon. This 1" bore black powder cannon belongs to the author. It shoots a 3 foot long rod to which a cord or rope is attached. It will shoot 1/2" rope over 600 feet and 1/8" cord for maximum accuracy. The window at which the shot was aimed was only 8 feet wide and 15 feet high. The projectile landed exactly in the center.

The rigging points on both sides were trees. On the Seneca Side some large chocks were used as back-ups. The main highline was 5/8" Bluewater "Superline" Orange rescue rope. The control lines were mixed 7/16" and 1/2" Bluewater Superline Orange and Bluewater Gold rescue ropes. This color coding allowed easy identification of ropes during operation. At the 1975 traverse the main line was two 600 foot Bluewater II ropes. The control lines were also BW II, and this made it confusing as to which rope was for what.

Due to the tremendous loads involved in tensioning the large highline and moving personnel across the traverse in both directions three winches were used. These small and highly efficient hand operated winches made the nearly impossible job reasonably easy. One of the winches was used to tension the highline. By using a highly accurate torque winch for a handle in this winch, the tension in the highline could be easily monitored. The other two winches were used to move personnel and equipment across the traverse via the color coded control lines.

Because of the long spans involved the control lines were tethered to the highline every 150 feet. This is necessary to keep tension in these lines to a managable level. This was done by tying knots in the control lines every 150 feet and suspending them via carabiners and short slings from a pulley which ran freely on the highline. Special knot passing pulleys were used at the capstan style winch drums and the procedure for knot passing during operation of the system worked very well.

THE GREAT TYROLEAN



The use of the line cannon shortened the time of getting the ropes across the traverse from the eight plus hours of 1975 to less than two hours in 1982. The winches made the mechanics of the operation quite straightforward. This brought to the forefront the problem that all organizers of major events have to content with, Logistics. The problem of getting all the right equipment in the right place with the right people at the right time. Along with this is also the problem of money. For this traverse there was over $5000 worth of ropes, winches, carabiners, pulleys, etc. There was also over $6000 worth of UHF radios on the mountain. This financial requirement has removed most major events from the realm of non-manufacturer supported groups.

As a service to those who are interested, a complete list of equipment used and which side it was taken up on is listed below:

SENECA ROCKS SIDE

1-Winch
3-UHF Radios
1-Line Cannon and 800 ft. of 1/8" cord
4-150 ft. 7/16" or 1/2" Orange ropes
2-30 ft. 7/16" or 1/2" ropes
3-15 ft. 7/16" or 1/2" ropes
1-Rappel Rack
7-Wide pulleys
2-4" Pulleys
2-2" Pulleys
4-Spring Loaded Gibbs
24-Locking carabiners
10-Non-Locking carabiners
6-1 ft. Jumper slings
2-2 ft. Anchor slings
2-4 ft. Anchor slings
1-Adjustable seat harness
1-Wire basket litter bridle
1-Wire basket litter
3-Rope Pads

SOUTHERN PILLAR SIDE

2-Winches
2-UHF radios
1-600 ft. 5/8" rope
4-150 ft 7/16" or 1/2" gold ropes
3-50 ft. 7/16" or 1/2" ropes
1-Rappel rack
4-Wide pulleys
2-4" Pulleys
17-Locking carabiners
18-Non-Locking carabiners
1-Torque Wrench
2-6 ft. Anchor slings
2-4 ft. Anchor slings
2-2 ft. Anchor slings
4-1 ft. Jumper slings
3-Spring Loaded Gibbs
1-Roll Duct Tape
2-Rope Pads

When the exercise was completed everything except one wide pulley and two locking carabiners was used on the Seneca Side. There was one extra rope pad on the Southern Pillar. NO EXTRA equipment was needed. Personnel crossing were requested to furnish their own seat harness and attachment carabiner.

The time required for crossing the traverse was between 20 and 30 minutes. Most of the crossings were with one person, but two people did cross together once. At one time the wire basket litter with a live victim, a litter bearer, and a photographer were all on the traverse at once. The tension in the main traverse line never exceeded 1400 pounds. Well within the safe working load of the 5/8" rope.

The Traverse was rigged for approximately the same number of hours as the 1975 traverse. In that same time 21 people crossed as compared to 6 in 1975. The purpose of the exercise was to evaluate the practicality of wide traverses in rescue operations. While it was hard work and required some time to put into operation, the system operated flawlessly. The necessity of prior planning and good communications cannot be overstressed in any field operation that is to be successful. It is with some pride that we can say that the plan worked and not one injury requiring so much as a band-aid occurred during the evolution and the ensuing clean-up.

The author would like to stress to those interested in doing tyroleans of this type that they can be very dangerous. You must stay within the safe working load of your ropes (usually about 11% of ultimate tensile strength) and if all possible have some method of monitoring the tension in the main line during the evolution. The use of tape to secure the ends of rope exiting knots is a necessity when passing them through pulleys and other equipment. If you are going to have more than one person on the traverse at once or a heavy load you should use either 5/8" rope or self equalizing doubled 7/16" or 1/2" ropes. It is important to remember that the tension in the main line of a traverse decreases dramatically as the angle deviates from horizontal. If you have the option, a sloping traverse is much safer if you have sufficient brakes for the load.

EDITOR'S COMMENTS I can't help but add my two sense for I had the privilage to be invited. There were many "magic" moments for the multitudes that shared in this high altitude activity. Among the most memorable were two. The line shot...Kyle maticulously measured the angle of trajectory. Was the wind right?...A remeasure...A warning call to all the climbers

on the face...the silence ...the black powder explosion that shattered that silence and the whistling of the line cord as it followed the missile in a perfect arc to the Southern Pillar. The gallery of onlookers hanging from every hand hold cheered and clapped as the catcher walked out from behind his tree of safety on the Southern Pillar...took one step forward and lifted the missile into the air. The adrenalin just ran.

That second "magic" moment happened for all of us who crossed. Clipping in...verifying that your relief straps were the right length...the high sign and the winches began to tick off the excitement. The wind whistled...all the faces turning serious as they grapple with each assignment...and then it happened as you pass over the edge and the floor of Roy Gap just falls away 450 feet below...The adrenalin flushes through every pour...What a rush. A big difference from the long vertical rope because below the rider is absolutely nothing... sort of like hanging from the bottom of a helicopter by your seat harness.

I feel there is one more significant note; that being the part of the Amusement Ride Manager Kyle Isenhart ...His time, his talent, his money and an unselfish dedication to further our knowledge of Great Vertical Possibilities . Kyle never rode his own ride. We ran out of time. □