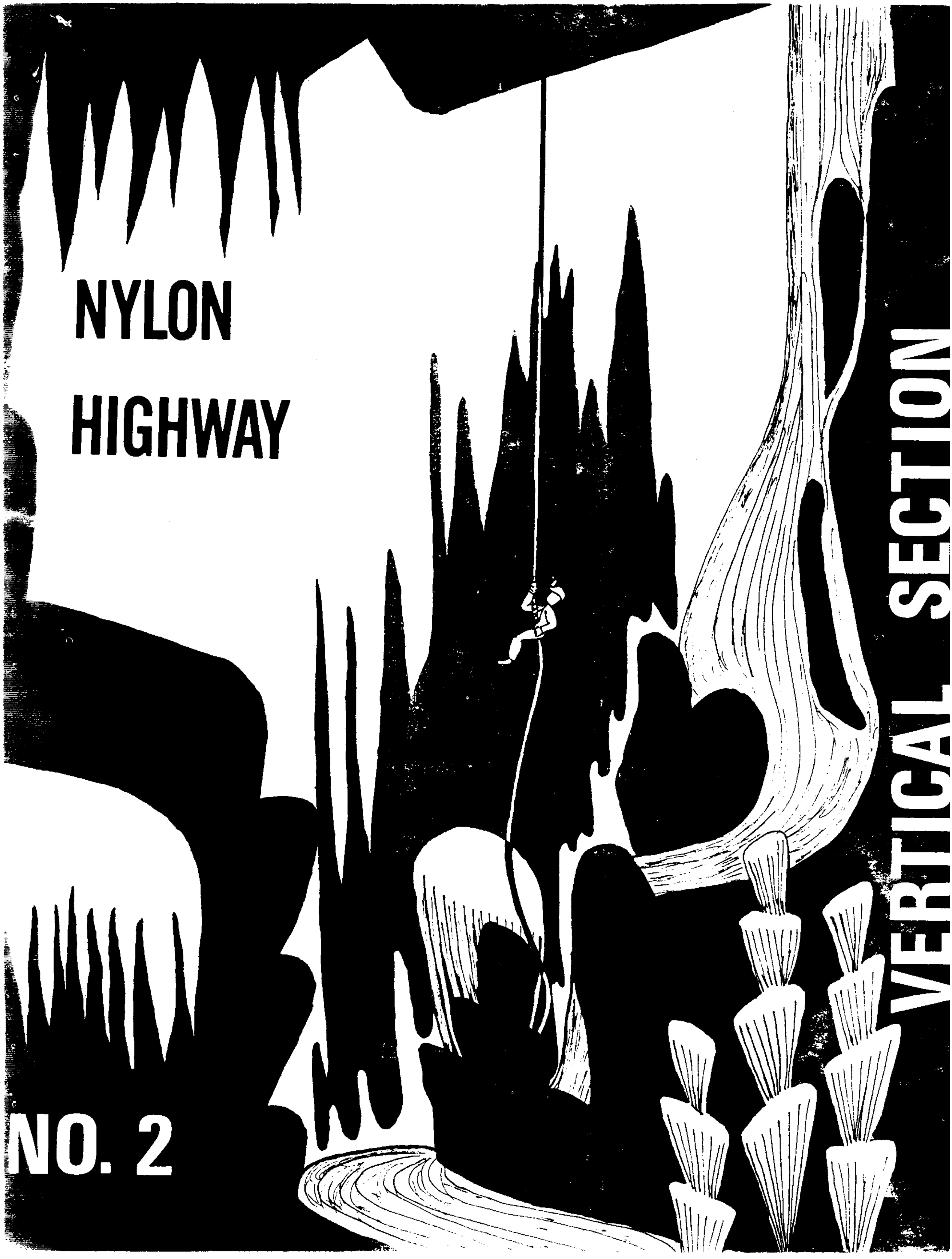
NYLON HIGHWAY



NO. 2

VERTICAL SECTION

NYLON HIGHWAY

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ILLUSTRATIONS
All the illustrations found in this newsletter are orginal productions by the editor except those found in the Davison article and Vernon Smith's article

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

Vol. 1

NO. 2

NH July 1974

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HOW TO SUBMIT MATERIAL

In able to have an authoritarian vertical oriented newslwtter we need good material on the subject of vertical travel and related topics. These articles can be reprints from other newsletters or original material. Letters to the editor are encouraged but the editor claims the right to censor or alter any article in a way as to fit the publication without changing the intent of the article. We do request that new material be supported with tests and field usage records. Let's please stay away from politics. All pictures are requested to be black and white pen and ink drawings. The editor is able to redraw upon request any pictures of explanation that are unclear. Please submit all material to Bruce W. Smith, 1197 Spaulding Street, Staunton, Va. 24401 or the newly elected editor.

The Nylon Highway is an official publication of the Vertical Section of the National Speleological Society; published at least twice, but not more than four times a year by the annually elected editor. Subscriptions are $2.50 a year while membership dues are $2.00 a year. To enstate oneself as a member of the Vertical Section one will need the endorsement of two charter members or two non-charter members who have been members for two or more years.

COVER The Cover for the second issue is a pen and ink drawing by the editor of a vertical drop that he himself would like to rappel into someday.

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THE NASTY BREAKOVER

by Sam Pitthan

Did you ever climb out of a pit in 2 minutes and then take 5 more in getting over the sharp lip at the top where your rope does a 90° turn on you? My two suggestions are these. In an in-cave drop place a bolt so that it is higher than the lip, as much as the space will allow. (fig. 1) For an outdoor pit use a piece of webbing tied in a prusik knot or whatever and attach a carabiner, all of this around a tree. (fig.#2) This will allow for an easy rappel and prusik without confronting problems associated with sharp break-overs. Physical effort is reduced and risk is reduced. Some people disconnect from the rope to cross a lip then reconnect above the lip. Depending on the system in use this isn't always the smartest thing to do. These suggestions won't work in every situation but then what does? They can only help I hope.

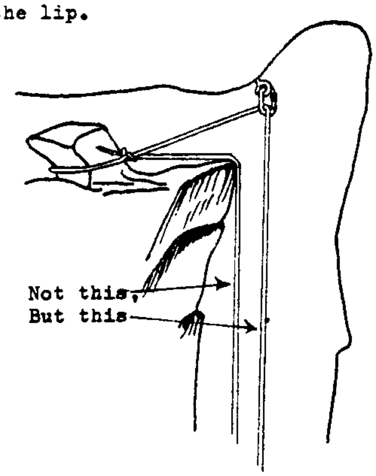


Figure # 1
In-Cave Drop

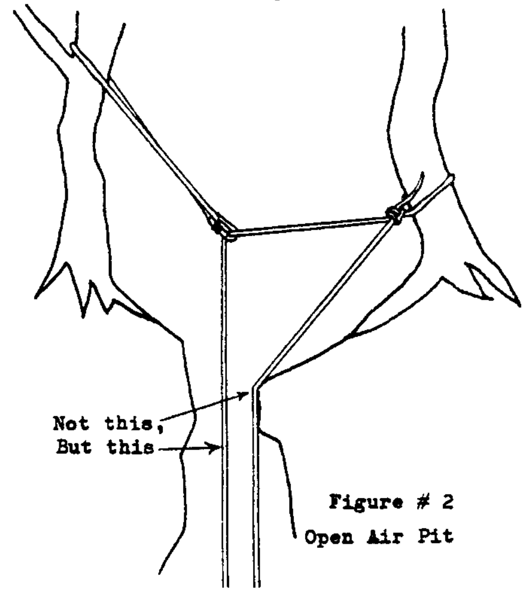


Figure # 2
Open Air Pit

Editor's Note:
As long as bolts have been brought up for rig points: May I strongly suggest that if you prefer bolts, and place bolts, please use a strong, reliable, 3/8" eye screw type. Rawl 1/4" studs rust and become loose in their hole and should not be used if found in a cave at a rig point. Also if you are going to set yourself up as a pit rigger with bolts, know what you are doing, practice, be able to place a good solid bolt. Don't ever leave a poorly placed bolt at a rig point. And by the way it is unwise to ever rely on pitons in a limestone cave.

PIT RESCUE

by Bruce W. Smith

There has been a great deal of information written about and taught about first aid. The British Manual of Caving Techniques, by Cullingford does an excellent job of explaining how to transport victims through caves and a couple of very elaborate methods of raising a victim from a pit, but it is here that only a spattering of knowledge is known. All good cavers, should tote along with them either in their trunk or back seat, pulleys, webbing and extra rope, for that one time when he least expects it, a rescue becomes necessary. No method is easy and all require a maximum effort from all rescuers. On several of these raising techniques non stretch manila rope or Bluewater II or III is advised. The victims injuries should be carefully considered to determine the degree with which he can help remove himself from the depths.

The following are raising techniques that have been developed and passed on by many people and publications through the years. This should be the most complete collection to date.

Direct Pull Method

This method is self-explanatory. Unfortunately it take at least four strong rescuers topside to lift a caver from the inner depths. As mentioned by Sam Pitthan, try to eliminate frictional forces that counteract progress by installing pulleys where the rope must make sharp bends. All pullers must be securely situated at the top to curtail the possibilities that one man or several may be pulled into the pit. Always employ belays and be sure that all progress is captured by a stationary prusik knot or some other device. This method can really exhaust rescuers. There is an old formula that was presented at the NSS Convention in Blacksburg by Wilmer McCavit, Cleveland, Ohio, that tells how to calculate the number of pullers that are needed for any direct pull rescue.

$$\text{Number of Men Needed to pull a victim out} = \frac{\text{Pit depth in feet} + \text{victims weight in pounds}}{50}$$

For example a 150 pound man being raised from a 150' pit would require six men to do an adequate job. Each puller should use a Gibb or a Jumar to help him keep a strong hold upon the rope.

Car Lift

If the cave has a long flat run way leading from its mouth, rescuers may consider using a car as the main lift apparatus. Again eliminate as many frictional phantoms as possible. A signaling system must be arranged between the driver of the car and the pitman who controls the speed of ascent at the pit edge. The rope should be fastened to the frame of the car and around smoth edges. Never run the rope next to an exhaust pipe. Don't drag the rope across the ground. Use guy lines from below and again capture progress from the pit edge and use belays. This is a dangerous method because the rope may become wedged in a sharp crack and the cars strength would snap the rope, causing the victim to fall. The method should be one of the last considered and always use extreme caution.

Confidence Method

Too often a caver just hasn't got the stamina to finish the climb. The legs seem to be the first to falter. A method that has been proven successful on several occasions I call the Confidence Method.

A strong experienced caver joins the frightened exhausted novice from below on the same rope. Immediately the novice has renewed confidence because of the warm body near-by. If the rescuer is prusiking using a Texas method, he should face the climber above him and let the novice use his, the rescuers, lap as his foot prusik. If Jumars are being used let the novice use the climbers shoulders for his foot prusik advance. It is amazing how strong someone can get if they have experienced company close by. This method is also a good rescue for frightened girls who have given up and decided to spend the rest of their life hanging around.

Bilgeri

This method is harder on the victim than on the rescuers. The person that needs to be pulled out should have no more than a broken arm. Two lines run over a frictional force at the pit edge and extend to the feet of the victim. His feet should be placed in tight loops that have been tied at the ends of the running lines. The two lines should also pass through a chest carabiner to secure the victims balance. Only one man is required to hold each rope. The victim should call out, "left" and since he would be facing the wall, the rescuer on the right would pull up his line. The victim would then raise his right foot and call out, "right". The rescuer on the left would then pull his line taut and secure it. After a while a coordination will be established and no verbal signals should be required. Non stretch rope should be used with drops in excess of 40' because of nylon's stretch factors. If you haven't used this system during some sort of practice session it would be unwise to attempt it during an actual rescue situation. See figure #1.

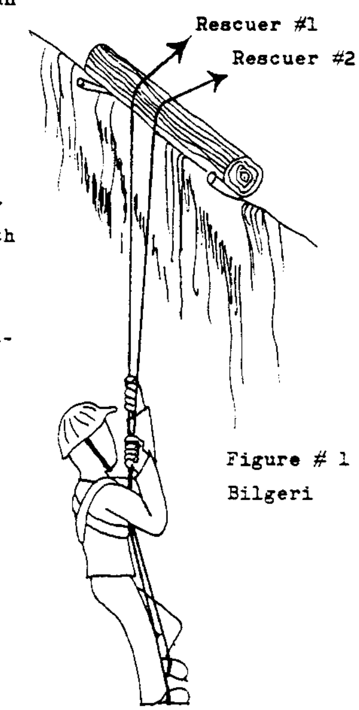


Figure # 1
Bilgeri

Pulley Systems

There are several pulley systems that can be arranged to afford a mechanical advantage. It must be remembered that there will be at least a 10% efficiency loss with each pulley due to friction. Carabiners are even less efficient than pulleys. Take a hypothetical situation in which 200 pounds needs to be lifted and three pulleys are incorporated into a system with a mechanical advantage of four. Theoretically the purchase line now needs only 50 pounds of pull for advancement. But the three pulleys add enough frictional forces to total 35 pounds or more. Now there needs to be 85 pounds of pull on the purchase line to raise the load. The mechanical advantage is now approximately $2\frac{1}{3}$. If there is not enough rope to reach the victim, twice as diagramed in figure #2, incorporate prusik knots as shown in figure #3. Capture progress with prusik cord A and then readjust prusik cord B, along with the entire pulley system. It becomes necessary for one person to tend to prusik cord A at all times.

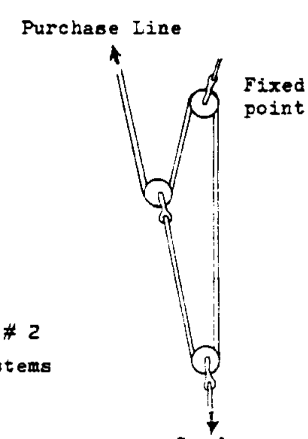


Figure # 2
Pulley Systems

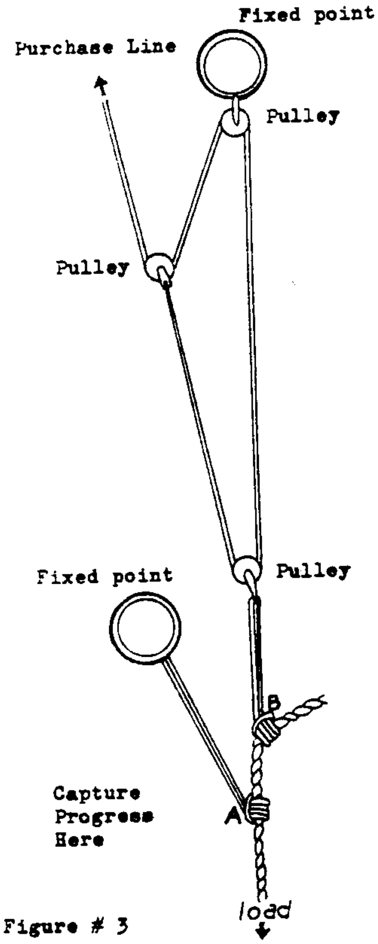


Figure # 3
Pulley Systems

Winches

Winches are dangerous. They injure more people than they help. Often times they are of the "homemade" variety and are crudely put together. A well designed winch with variable speed controls and sensing devices could be of value. A wrecker winch or jeep winch would be practical, but one must remember that it's human beings on the endof the cable, not dead weight. (Let's hope not; If a motorized ascender is available, use it from above. Fasten it to a tree and apply about 10 pounds of pressure. (As you know MAD works on the principle of a windlass) Always use safety lines whenever machinery is involved. It's a good practice to keep rescue operations as simple as possible in frantic situations where thinking isn't clear as it should be and time is a major importance factor.

Prestovert

The prestovert method, for lack of a better name, if set up correctly can be highly efficient. Secure a pulley at the edge of the drop. Run the main rope through it and secure a prusik cord to the rope about 30' away and tie the cord around a tree. Make the distance between the prusik knot and the tree as small as possible. Fasten a similar set up between the pulley and the edge of the drop. Manila or a low stretch rope must be used. To lift the victim, just push sideways on the rope between the pulley and the first prusik knot. Another person will have to tend to the prusik knot at the edge to capture the progress. Each hoist under ideal conditions can advance the victim 30% of the distance between the two trees.

Counter Weight

The Counter Weight method is one of the easiest and most efficient ways of raising a person from the depths. The method essentially involves the weight of one climber lifting the weight of a second. The only draw back is that one person

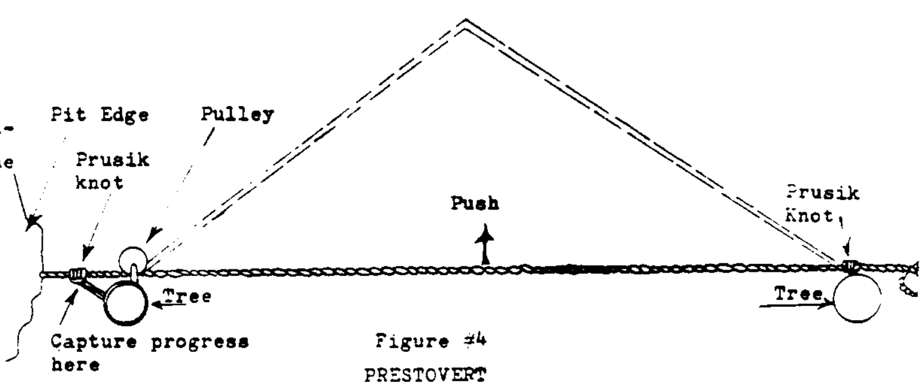


Figure #4
PRESTOVERT

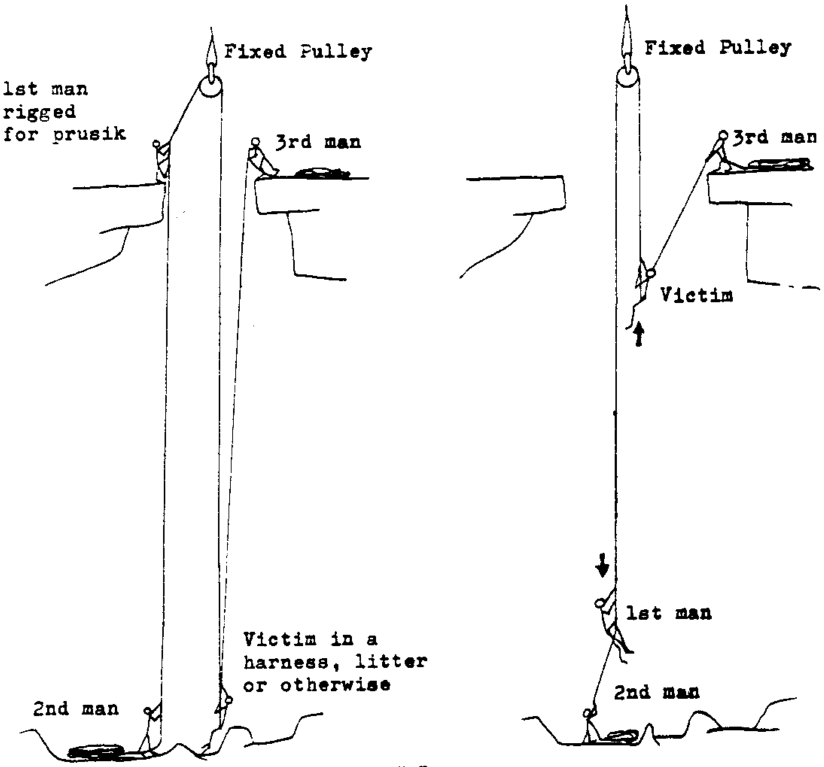


Figure # 5
COUNTER WEIGHT

must prusik the drop twice. For a physically fit caver this should be no problem. It takes at least three people to perform this operation. There should be available at least 3 lengths of rope equal the height of the drop. One of the rescuers acts as a counter weight. The second rescuer controls a guy line from the first rescuer and the bottom and the third man controls a belay line from the victim to the top. If the victim's weight differs from the first rescuers weight by less than 40 pounds there will be no movement up or down by either person. This is where the other rescuers come into play. It takes only a small pull to offset this balance and start the two weights moving. The first rescuer should be attached to the rope by prusik cords so that he can ascend the rope a few feet to overcome the stretch of the rope. Because of rope stretch the rescuer will land on the bottom before the victim arrives at the top. If he prusiks the correct distance then both men will arrive at their destinations at the same time. Be sure that the main line between the two weights is anchored at the top somehow before the victim's weight is removed from the rope. The whole process can take place in only a few minutes for a 200 foot drop. If the first rescuer desires and speed is not important, he can drop just below the pulley and prusik. If all goes well, he will remain stationary and the victim will rise. Braided rope should be used with this type of rescue to avoid any tangling of double or triple lines.

References: Pit Rescue

Adamson, Stan. Cave Rescue Technique. 1965 Speleo Digest, which was reprinted from the Guacharo.

Cullingford, Cecil (Editor). Manual of Caving Techniques. Garden City Press: London. 1969.

EXPOSURE

by Bruce W. Smith

One of the primary dangers of pit caving is the threat of exposure. If a person's body temperature drops due to cave water saturation or prolonged periods of inactivity in cold humid surroundings, he is probably suffering from a primary condition called exposure. Exposure becomes hypothermia in its advanced conditions. Death occurs when the body temperature drops between 80° and 75°F. Exposure or hypothermia aggravated by cold water, wind and exhaustion is the #1 killer of outdoor recreationists.

The body gives off several signals during times of heat loss. Among these are: Unreasonable behavior, tiredness, foaming at the mouth, complaints of cold, numbness, a slow pulse, tripping, muscular rigidity, unclear thinking, abnormal vision, unclear speech, shivering, irregular heart beat, cramps, pale skin color, irregular bursts of energy and colorful language.

There are several simple ways of avoiding the exposure phantom.

1. Always avoid getting wet.
2. Never. prusik or rappel in or through a water fall unless properly clothed.
3. Try to wear waterproof clothing when it is known water is unavoidable.
4. Every caver should be highly experienced in a wet vertical cave.
5. A fast prusik rate is necessary for wet vertical caves.
6. Always have the fastest prusikers ascend first. This will afford minimum exposure time for the inactive cavers below. Contrary to the Hell theory caves are colder the farther down an explorer goes. Cold air is heavier and sinks to the lower portions of caves.
7. While one man is prusiking on the rope, have the next man all ready hooked up--ready for ascent. This is a good practice and a good timesaver. It should be mentioned though that the man below should never stand below the climber while rigging.
8. Explore wet protions of a cave last if possible.
9. A set of dry clothes in plastic bags could be the key to warmth.
10. Wear gloves only when necessary, avoid wearing wet gloves. A tremendous amount of the bodies warmth escapes through a persons hands, head and feet. If any of the three are kept unprotected or get wet the body will loose heat much faster.
11. Try to do a thorough job of exploration in a short period of time.
12. Keep a good pace during traverse.
13. Don't sit in cold, wet places to rest.
14. Use multiple rope riggings whenever possible.
15. If there is a large number of cavers and several pits, stagger ascending groups on the way out. Pairs of caers should surmount each pit without waiting for the cavers behind. This will minimize waiting time and the possibility of exposure.
16. Eat a good meal before the trip and eat while inside the cave.
17. If any symptoms of exposure are noticeable on any member of the group, ask what he thinks about his condition, if he feels that exposure may be present, get out! One exposure death resulted only one hour after the situation had given call for alarm.

References: Exposure

By Nature's Rules : From the Association Sterling Film Libraries, Printed and pulished for the National Park Systems by Safeco Insurance Co., 1974

Knight, Jace: Exposure, A Serious Caving Hazard. Speleo Digest. 1965

THE RELIEF STRAP

by Bruce W. Smith

The relief strap was developed by Delbert Province, tried and tested by Kyle Isenhart and passed on to me the editor to write about.

Too often a caver has had to sit in a seat harness for an extended period of time--over 5 minutes. If the seat harness is on as tight as it should be 10 times out of 10 your cir-

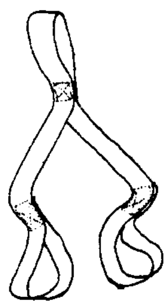


Figure # 1
The Relief Strap

culation will be cut off, your legs will ache, cramp and eventually go to sleep. This simple little device will prevent all of this. It is made of a light material such as ½" webbing. Six to eight feet is plenty, three stitchings or knots are necessary. (Fig. #1) Place the top loop in the seat harness and when the time comes when you must get relief from the cutting of your harness, just stick your feet in the two loops and raise yourself a few inches--instant relief. Don't wait for your legs to go to sleep or you won't be able to raise yourself. See Figure #2. The lengths of the straps are critical. They must be tight when your knees are bent as shown in the drawing.

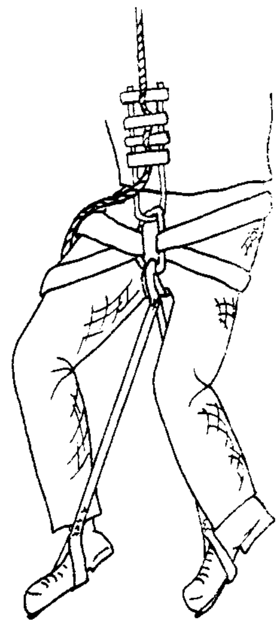


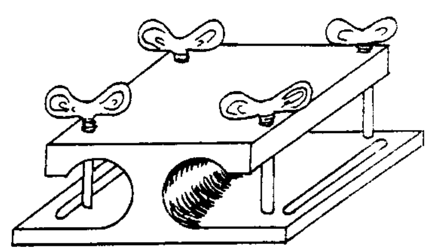
Figure # 2
Relief Just by Standing up.

EVOLUTION OF A CHEST BLOCK

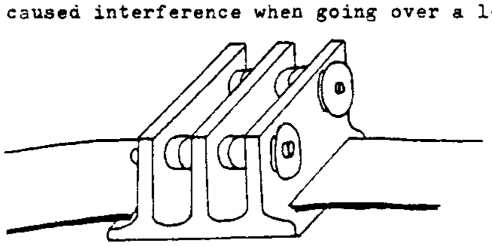
By Jim Gossett

The first time I saw or used a mechanical device to hold the upper portions of the body in close proximity to a rope was during my early years with the NSS. A carabiner attached to the chest with a rope sling was sometimes used on prusik climbs and with guide lines on long drops. This was a satisfactory solution in those days when the prusik techniques did not permit climbs fast enough to generate significant heat of friction.

With the advent of mechanical ascenders such as Jumars, the carabiner became less desirable due to friction. Several types of chest blocks containing bearings were developed to overcome the friction. My first look at these devices was at the 1967 NSS Convention in Alabama. The idea was excellent but I was appalled at the poor safety/convenience aspects of the devices. With most climbing rigs, the chest block is a vital link for safety.



I went home determined to make a safety first chest block. The first attempt was a machined aluminum device that looked like the figure on the right. It seemed safe enough but the friction was terrific and the wing nuts caused interference when going over a ledge.

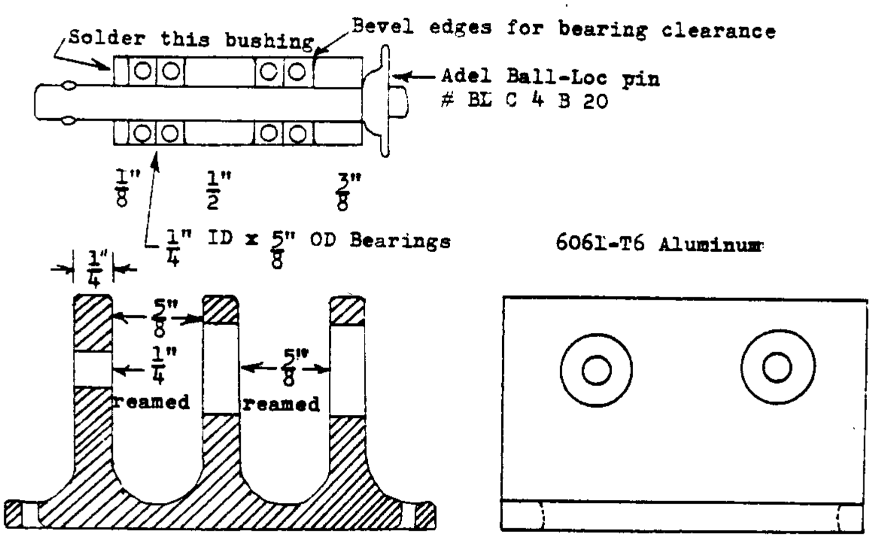


The second attempt was better and looked like the figure on the left.

Safety, friction and convenience was excellent but the nylon deformed. This was replaced with ¼" I.D. x ½" O.D. ball bearing. This worked will but the bearings were instrument grade and expensive. Later models used $\frac{5}{8}$" bearings which can be found in profusion in surplus government equipment.

Using sealed bearings I have not had any problems with dirt in the bearings; but I live in California and don't get in the mud caves very often. A good compromise would be to make a steel ring with a nylon insert.

Gossett Box



My climbing technique is peculiar to most. I run each Jumar line through a separate compartment on the chest block with both Jumars above the block. It is not necessary or desirable to run the climbing rope through the block. It is perfectly safe. Either Jumar rig can break and body is held securely to the rope by the remaining rig.

I have just recently discovered that my balance is just as good if I position the chest block about four inches above the waist line as it is higher on the chest. This is a great advantage with my climbing technique because I can get a longer bite or operate with less arm fatigue.

I purposely published this design in the Limestone Ledger soon after conception so that a patent would not be valid. Anyone is invited to manufacture or improve on the device.

I would also like to see other cavers take a closer look at the technique of using both Jumars above the block. It offers more advantages in transferring to different ropes, speed of tying onto a line, going over knots or over ledges.

Editor's Note: The system of climbing that you describe I have long, known as the Jumar Method. It is described in instructions that come with the Jumars and I have seen it published and talked about in many cavers publications. The Jumar method has been around a lot longer than the Mitchell System.

SWING OPEN CAM

by Bruce W. Smith

Your carbide lamp is flickering and the icy spray of the waterfall next to you is aggravating your obvious case of exposure. This will be the final pitch if you could only get rigged up. You are so cold that your hands are shivering wildly. You would have been climbing already if you could only get the cotton pickin' pin in the cam ascender hole....[1]

You've finally finished the 180' climb and begin unrigging your cams from the rope. Tired and fatigued you pull the pin--"the shell...... Someone grab the ...." Clang....... Ching.......[2]

You're at least 300' up the lower face of Stone Mountain and you are still in the free. You've worked you camspretty hard, but unbeknown to you, you had failed earlier to push your quick release pin all the way in on one ascender and the wire has come loose from another and two out of your three pins have worked themselves loose. Almost as if they were directed with a muscians baton, the pins drop and the shells seem to float through the tree tops while you hang from your shoulder cam....[3]

Swing Open Cam

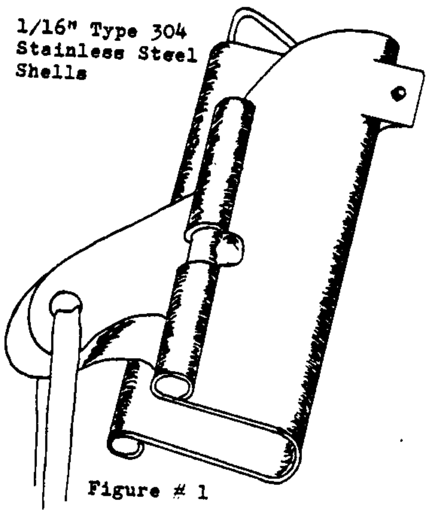


Figure # 1

Swing Open Cam with Spring Loaded locking Pin and Roller. Hinged side

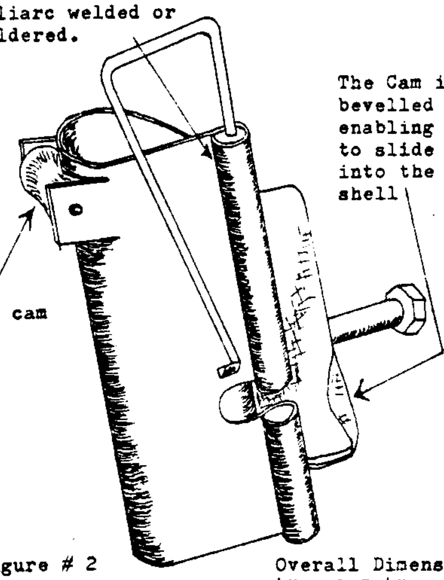


Figure # 2

Overall Dimensions 4" x 1 3/4"

Swing Open Cam With Spring Loaded Locking Pin and Roller. Locking side--open position

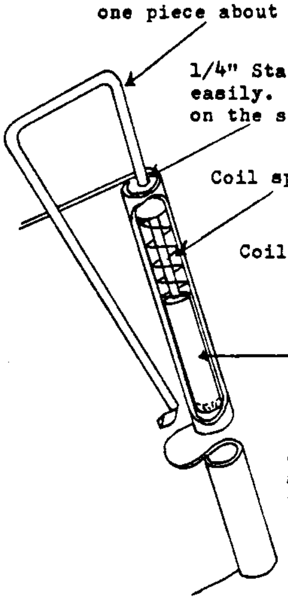


Figure # 3

The Lock in Open Position

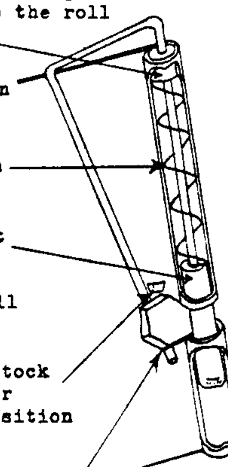


Figure # 4

The Lock in closed Position

I'm sure most cavers have there own special incident that they can relate to the previous mishaps. All could have potentially killed someone if they occurred under different conditions. An improvement was inevitable.

Delbert Province went to work in 1972 and the first Swing Open Cams were manufactured. The obvious advantage of the Swing Open Cam is that there are no pieces to lose no strings to cut or break, no pins to line up on holes, and there's no way anything can work loose.

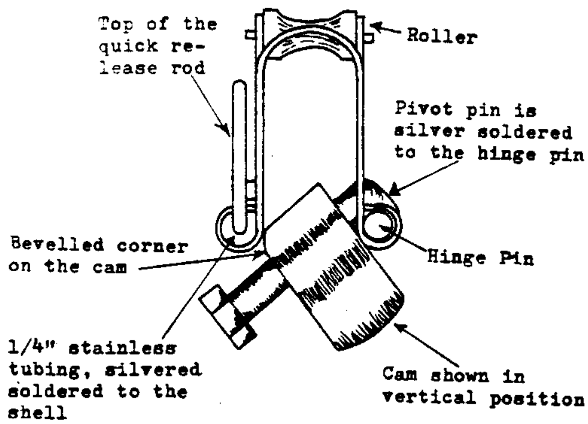


Figure # 5

Top View: Actual Size

All the models made so far have been of stainless steel (type 304) construction and are extremely sturdy. Please see figures #1 and #2 for views of the two sides. Figure #5 gives a top view while figure #3 and #4 show the quick release locking rod.

Although the manufacturing of these units would be somewhat costly (about 10 manhours each) they have proven their worth over and over again. They have been tested and used extensively at Ellison's, Fern, Whiteside, Mystery Hole and many others. As it seems to go with the Province-Isenhart tradition--flawless operation everytime. The unit weighs about 1½ times as much as a commercial Gibb's ascender and is extremely sturdy. Even if the cam is left unlocked by accident the cam must be positioned until it is almost parallel with the shell before it will open. This is an added safety factor (another Province-Isenhart tradition, safety). Bravo and congratulations from the editor. The only problem that lies before us now is the development of the method of inexpensive mass production. It does appear to be the cam of the future.

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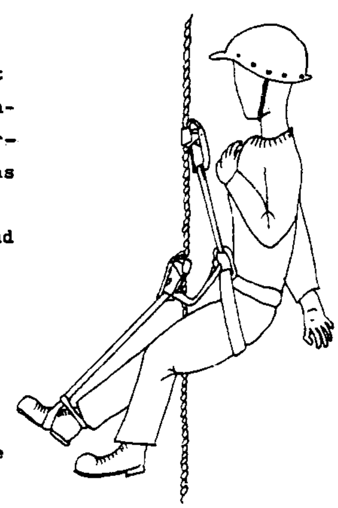
[1] Swago Pit, W. Va. Jan. 1972 during high water. A caver had to rappel the drop to put the ascenders on for the exposed caver.

[2] Hellhole Cave, W. Va. Cass Cave, W.Va. and many others.

[3] Stone Mt. Georgia. June 1971, The climber pulled the only piece of equipment he had out of his pocket, a heibler and prusiked down 300 feet.

We Stand Corrected

In the first issue of the Nylon Highway, it has been pointed out to me by Paul Duncan of Corpus Christi, Texas, that the illustrations referring to the Texas prusik System were not depicted correctly and in the future I shall try to illustrate all systems as accurately as possible. The Texas System drawn on page 26 of NH No. 1 failed to show the chicken loop, the climbers helmet and the connecting safety strap between the foot Jumar and the seat harness. See the figure to the right.



Fact of Special Interest: According to Governmental Statistics among the causes of accidental death in our country only motor vehicle accidents rank higher than falls. As vertical cavers we should take careful note of this vital statistic.

THE DAVISON SYSTEM

by Don Davison Jr.

The following designs comprise the Davison System. It was developed to provide a cam harness and a cam foot rig which would be sewn and yet adjustable to fit the majority of cavers in a precise fashion. (A desirable feature in certain rescue and training situations.) In addition, the system is constructed so that all the cams ride in their proper orientation on the rig, with no design induced torques being developed when the cams are placed on the rope. There is no slop in any cam attachment; thus each upward motion is totally recovered. There are no small parts which may be lost; for, as used on a drop, the System consists of only two pieces, the harness and the foot rig. Yet, the components of the harness are easily disassembled for use as stop cams or handholds for hauling (especially useful in rescue and mud conditions). The harness can be worn in comfort for long periods of time and while climbing, crawling, chimneying, or walking.

Construction

The System is constructed as 6 separate parts: 1. foot rig, 2. right harness, 3. front strap, 4. left harness (and back strap). 5. shoulder strap, 6. knee assembly. The materials used are: 2" nylon webbing, 1" tubular nylon webbing, $\frac{9}{16}$" tubular nylon webbing, Paragear No. 339 buckles, Paragear No. 219 baby D-rings, 2" harness rings, 1" harness rings, 700 pound test braided nylon cord, ¼" shock cord, Gibbs Ascenders, Bonatti steel locking carabiner, Paragear No. 1029, 50 lb. test, white No. 6 nylon cord No. 415. This heavy duty nylon should be impregnated with beeswax before sewing.

Foot Rig

The design of the foot rig is presented in figure 1. The 2 pieces of $\frac{9}{16}$" webbing are each 3½" long. Also note that 2 rings are placed in the loop where a single 1" harness ring is pictured.

Right Harness, Front Strap, Left Harness and Back Strap

The plans for the right harness and front strap are detailed in figure 2, while those for the left harness and back strap are shown in figure 3. Note the two baby D-rings on the back strap.

An 18" piece of 2" webbing should be sewn loosely (so as not to reduce the size of the leg loop) on the outside of each leg loop, to stiffen it and prevent bunching. The webbing should be placed around the inside leg, beginning at the front stitching junction and continuing until the webbing is exhausted. Stitching is done in separate rows, about 2" apart, running across the webbing.

Shoulder Strap

The plans for the shoulder strap are given in figure 4. The piece of $\frac{9}{16}$" webbing is 5.7" long and the piece of 1" webbing is 6½" in length. A baby D-ring should be placed on the $\frac{9}{16}$" webbing loop along with the cam jaw. The ring should be to the right of the cam jaw when the jaw points away from you, or behind the cam jaw as pictured in the lower illustration

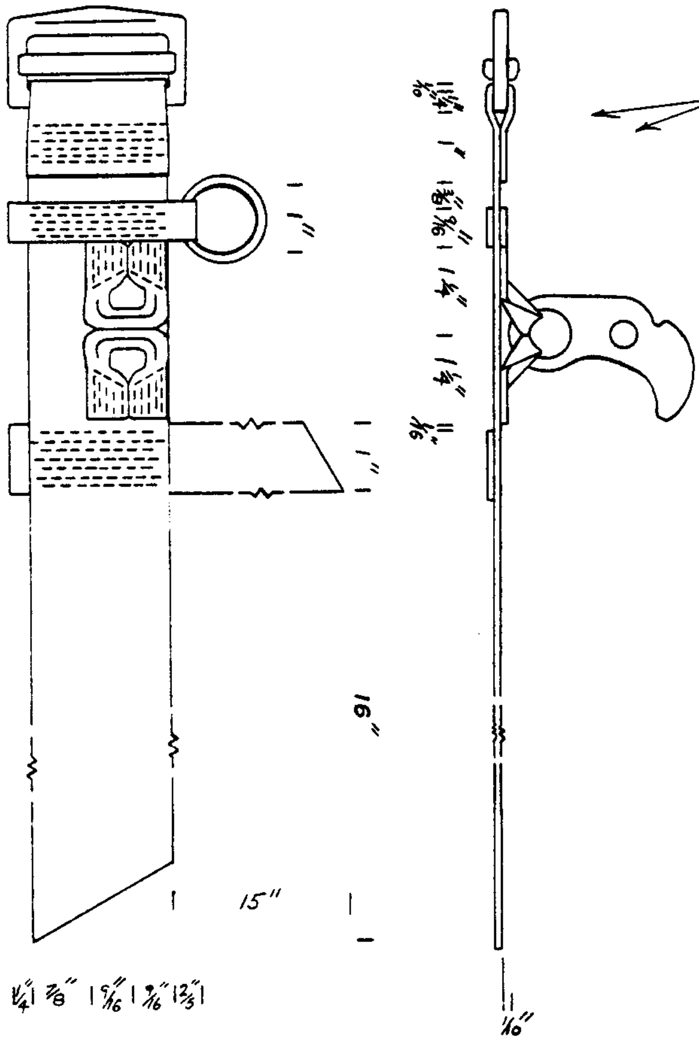


Figure #1. Foot rig of the Davison System. Note that the cam jaw has been removed in the illustration to the left. Also, two rings should be placed in the loop of $\frac{9}{16}$ webbing where a single 1" harness ring is indicated. Drafted to scale.

in figure 4. The shock cord of the knee assembly will pass through the D-ring when the harness is fully assembled.

Knee Assembly

The foot portion of the knee assembly is illustrated in figure 5. The $\frac{9"}{16}$ webbing passes across the front of the left foot and through the D-ring on the other side of the foot, around the Achilles tendon, and is fastened into the double D-rings. The double overhand knot

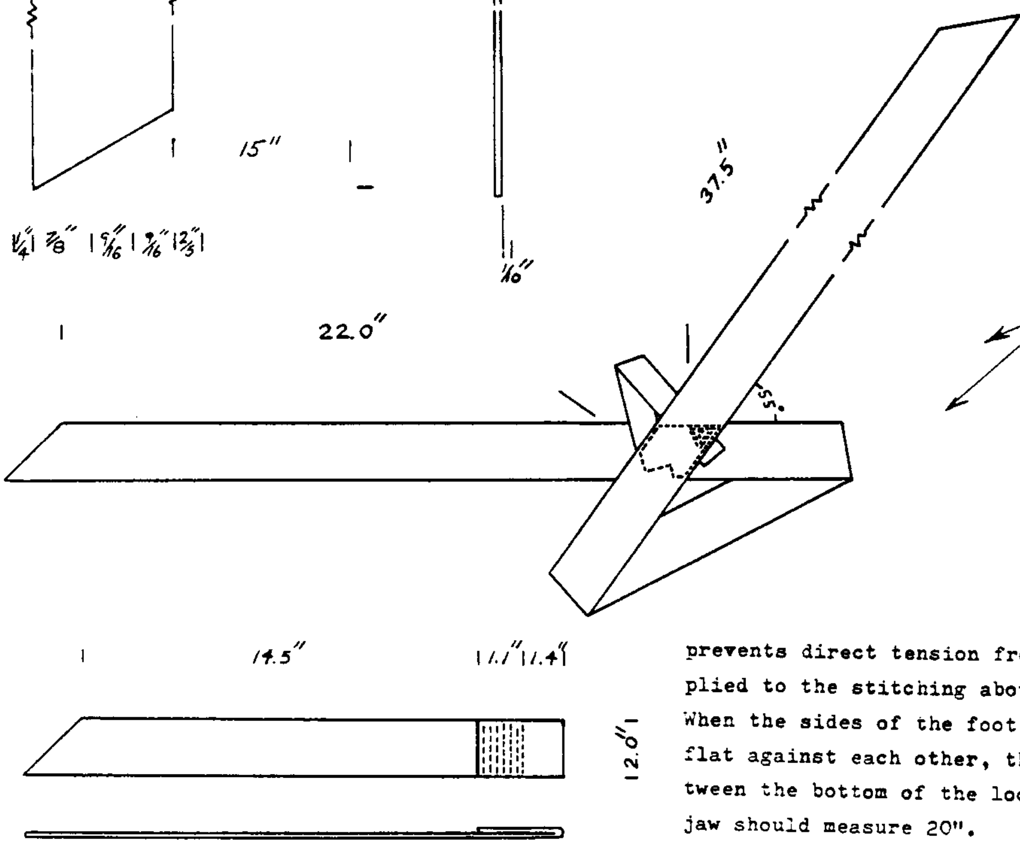


Figure 2. Right harness and front strap of the Davison System. Drafted to scale.

prevents direct tension from being applied to the stitching above the knot. When the sides of the foot loop are laid flat against each other, the distance between the bottom of the loop and the cam jaw should measure 20".

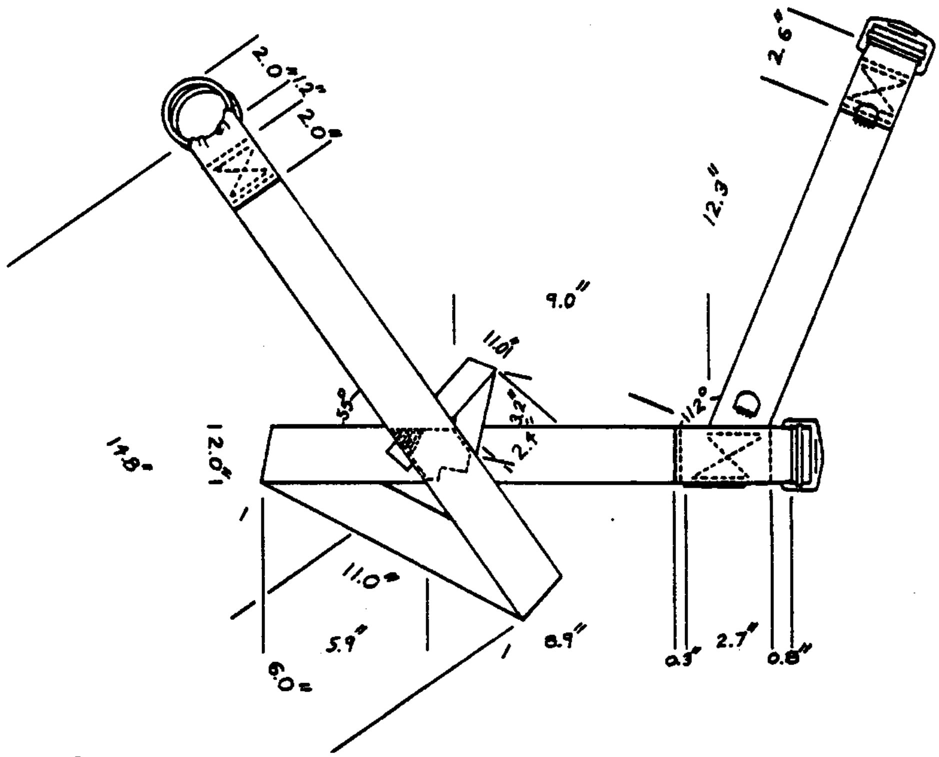


Figure 3. Left harness and back strap of the Davison System. Note the two baby D-rings on the back strap. Drafted to scale.

To attack the shock cord to the cam shell, first tie a double overhand knot in the shock cord, leaving a small loop (overhand knot on a bight). Drill a 1/4" hole, 3/8" below and slightly forward of the hole in the cam shell directly opposite the rivet holding the quick release pin. After rounding the edge of the hole off with steel wool, pass 700 pound test nylon cord through the holes so that both ends are outside the cam shell. One end of the cord is passed through the loop in the shock cord, twice, and after the slack is taken out, the two ends of the nylon cord are tied together with a surgeon's knot. After the excess cord is removed, the loose ends are melted into the knot. This knot and the knot in the shock cord are finally covered with ducting tape to protect them from abrasion. After

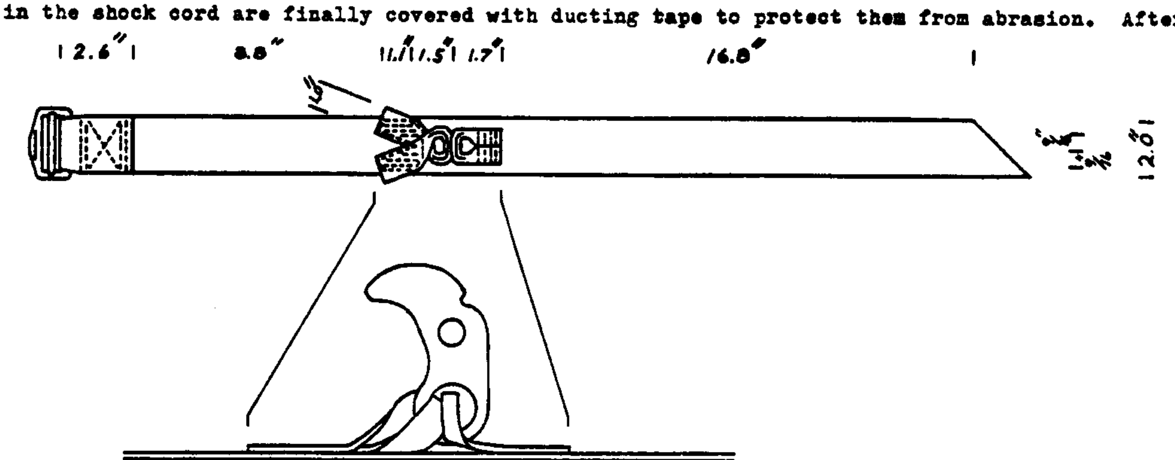


Figure 4. Shoulder strap of the Davison System. The cam jaw and baby D-ring (see text) have been removed from the upper illustration. Upper illustration drafted to scale. Low at full scale.

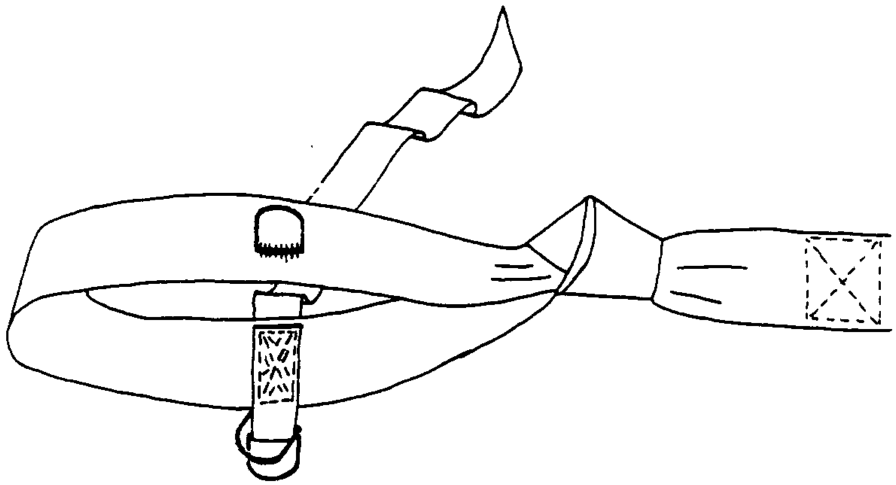


Figure 5. Foot portion of the knee assembly in the Davison System. Not drafted to scale.

the connection has been made, there should be 4½ feet between the cam shell and the end of the unstretched shock cord.

In certain mud conditions (e.g. Spence Cave, Virginia) the knee cam is difficult tc break. In these situations, the shock cord attachment illustrated in figure 6B should be made. Some individuals rig the shock cord as in Figure 6A, which method should never be used. In 6A the shock cord eaily breaks the knee cam loose but since it has an equal lever arm with the webbing, the cam will not grab easily. In 6B though, the shock cord will still break the cam jaw but the webbing maintains a superior mechanical advantage because it has a longer lever arm. This enhances the ability of the cam to grab.

Stitching - All stitching in the System is done with Paragear 50 lb. test Nylon Cord. This is heavy duty parachute tacking nylon. Sew the harness well; it is designed to hold very large loads. The double webbing, passing through the eyes of the shoulder cam and foot cam jaws, was placed so that at no times would the stitching itself come under direct tension. Stitching is only meant to hold two pieces of cloth in contact, with the friction of the cloth maintaining the configuration. Stitching is designed to undergo shear not direct tension

Stitching should be tied into itself so that only loops are left in the finished System. The knot which is employed is a surgeon's knot with the loose ends melted into it. The knot should be tied between the two pieces of webbing so that it is protected from abrasion. Always have at least 2 or 3 loops of stitching at each sewn point. Thus, if one loop is broken by wear, rock cut, etc., the other loops

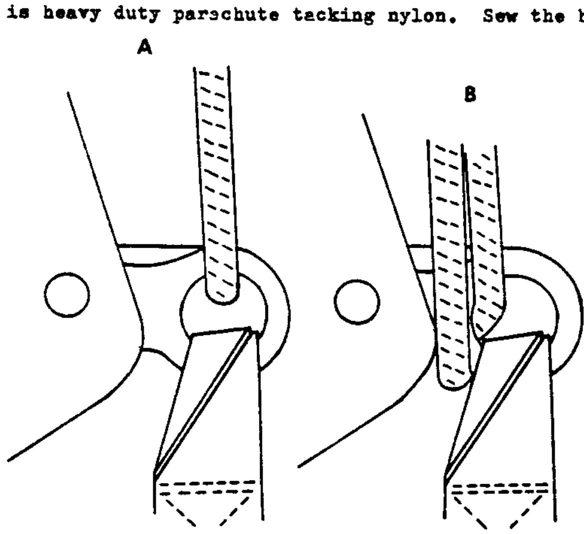


Figure 6. Knee cam - shock cord attachment in knee assembly of the Davison System for use in heavy, adhesive mud (6B) and example of an incorrect method (6A)

may still remain continuous and competent. The stitching should be done with a sewing awl or a sewing machine, because this type of stitch will not pull out traumatically if the loop is broken.

Gibbs Ascender Modification

There are several modifications to the Ascenders which are desirable. The inside of the eye of each cam jaw should be smoothed with fine steel wool. This reduces the wear on the webbing which passes through the eye. (As the jaws are used, they will become very highly polished and be more valuable than new cam jaws.) The quick release pins should be affixed to the cam jaws on specific sides. If the Ascender shell opening is pointing away from the reader, these are: shoulder cam--left side; knee cam--right side; foot cam--left side. The hole in the cam jaw, through which the pin passes, should be reamed with a large diameter drill, but only on the side from which the pin will be inserted. The reaming facilitates the assembly of the cam, expecially in mud or darkness. The same reaming may also be carried out on the cam shells to a very shallow depth.

All cam shells are attached to their respective cam jaws with 700 # test nylon cord. The cord is passed through the hole in the cam shell opposite the attachment rivet of the quick release pin.(requires that a second hole be drilled in the shell of the knee cam 3/8" below the first). An overhand knot is tied on the outside of the cam shell. The portion of the cord inside the shell is passed through the eye of the cam jaw and tied with a double overhand knot.

The teeth of the foot cam jaw are ground out from the thick portion of the jaw to the first tooth which is into the rope under full load. The teeth are removed, using a rat tail file and steel wool, to produce a smooth polished channel whose cross section mimics the curvature of 7/16" rope (or the teeth may be totally removed with a flat file). This allows the foot cam to break easily, permitting the rope to be dropped very soon after starting to ascend. Channelling the cam jaw also enables one to back down easily without having to use hands on the foot cam. The channel produced will resemble that produced in the knee cam jaw by long periods of wear.

PRINCIPLES

Channelling Theory

As the rope is compressed by the cam jaw, it becomes ellipsoidal in cross section, with pressure being applied by a few cam jaw teeth. As the pressure is released, the rope rebounds to a less eccentric ellipsoidal cross section and applies force to the tooth immediately above the uppermost tooth which is engaged under full load. This causes difficulty in breaking. By channelling the cam jaw, a grab or break situation is created. The rebounding rope contacts no part of the cam jaw except smooth metal. When starting to climb or backing down, the foot should be held close to the rope and the lower leg should ride parallel to the rope to further enhance the breaking action by minimizing shell-rope friction.

Shock Cord

Shock cord is used in the knee assembly for safety. The following test has been conducted many times on 3/16" and 1/4" shock cord. A 22 pound weight is hung from a short piece of shock cord, thus putting it at extreme elongation. A razor-sharp knife is then drawn across the shock cord until something happens. The first cut will cause the weight to drop several inches and cause the rubber core to fail completely. The second random cut will cause the weight to drop a small amount. The third random cut will cause the weight to crash to the floor as the sheath fails. Thus even under excessive tension, no single cut, likely to occur in a cave, will cause the cord to fail. This is reassuring to know with the shock cord aimed towards the vicinity of your right eye! The durability of the shock cord allows flaws, caused by wear, to be easily and safely detected.

Many individuals preach the use of surgical rubber tubing. Try the 22 pound test with rubber tubing and you won't use it on your caving rig. These individuals generally say that shock cord has insufficient stretch to be effective. A 12" piece of 3/16" shock cord will stretch to 22½" but a 12" piece of 1/4" cord will stretch to 29½", an elongation of almost 150%. Using the Davison System (not a racing rig) I have run 100 feet in 48 seconds using 3/16" shock cord, so I can't see what advantage there is in using surgical tubing. Your eye!

Quick Release Pins

Quick release pins are used on all cams. They cannot pull out because the simultaneous application of two forces in vectorially opposite directions is required to disengage the pin. They are absolutely safe. Also, the quick release pins are easier to use than standard pins, especially in mud and while switching over on a rope. There is no cotter pin wire to break off and lose, with quick release pins. If a pin jams open in gritty mud, just press the plunger a few times or in rare cases smash it against the cam shell. When a pin is inserted into the jaw and shell, always check it by attempting to remove it without pushing on the plunger. The pins should be cleaned and worked after drying, following each muddy cave.

USING THE DAVISON SYSTEM

Foot Rig

The foot rig is designed to be worn on the right foot. The foot is oriented with the toe to the right in the left illustration of figure #1, when putting the foot rig on. The buckle is on the outside of the foot with the 2" webbing being passed under the arch, fastened to the buckle, and tightened very snuggly. Stepping on a rock with the instep of the foot facilitates the tightening of the 2" webbing, in mud conditions. The 1" webbing passes around the Achilles tendon and is secured on the double harness rings. The rig may be worn on the left foot, but the 1" webbing cannot be employed. It should be tucked under the 2" webbing. The cam rides above the foot, thus the load is directly down with no uncomfortable torque being applied to the foot. Note that there is no slop in the movement of the cam jaw.

Harness, Knee Assembly

The harness is worn as shown in figure 7. The harness is placed on the body snuggly and adjusted for comfort and fit. The shock cord of the knee assembly is passed through the baby D-ring on the shoulder and those on the back strap. It is then tied to the lowermost ring with a half hitch with the end fed back to form a bow. This allows the tension in the shock cord to be varied easily.

Because the harness fits snuggly and cleanly, it may be worn while doing nonvertical caving, except extremely tight crawls. Thus it is especially useful in long multiple drop caves. Crawls such as the Misery in Ellison's Cave, Georgia are easily negotiated while wearing the harness. The harness has been worn continuously for over 9 hours with no discomfort in spite of belly crawls, chimneys, and over 600 feet of vertical work. For nonvertical caving, the knee assembly is removed or passed across the chest around the back, and secured to the 1" webbing loop at the right harness stitching junction.

To rappel, clip a locking carabiner into you rappel device and clip it into the Bonatti carabiner. To carry equipment when descending, clip the equipment into a leg loop with a

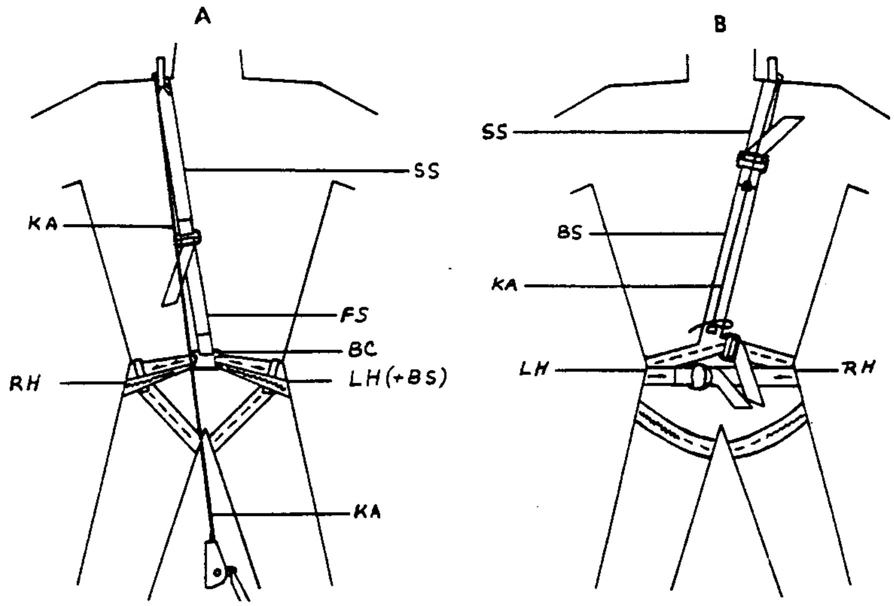


Figure 7. How to wear the harness and knee assembly in the Davison System, front view (7A) and back view (7B). SS=Shoulder Strap. KA=Knee assembly. FS=front strap. BC Bonatti carabiner. RH=Right harness. LH=Left Harness. BS=Back Strap. Note patterns on the harness straps, added for clarity. Not drafted to scale.

carabiner. The load will ride directly below the rappelling device and not unbalance the person rappelling or block his vision. I have rappelled in comfort with over 55 pounds hanging from the harness. To ascend with light loads, clip them into the lower portion of the 2" harness rings with a carabiner. For heavy loads, clip in as if rappelling. I have brought 60 lbs. up an 85 foot drop in comfort, this way. On another occassion, I ascended 125 feet with 125 pounds hanging from the harness. It was uncomfortable and slow but the load arrived at the top of the drop!

The knee assembly is easily removed from the harness for use as a stop cam with automatic return. Just clip the foot loop into a carabiner and clip into an anchor. Then tie the shock cord under tension to a rock or pack towards the drop from the anchor. The shock cord will allow the cam to drop into the line of pull when hauling and jump into an anchoring configuration when the tension of hauling is released. The knee assembly may also be used as a hauling cam with automatic return, in an analogous manner. The shoulder strap and foot rig are also easily used as stop or hauling cams but without the automatic return feature. Thus three highly adaptable cams are available for use in any hauling situation.

General Use and Advantages

The Gibbs Ascender is the strongest most positive way to ascend over all types of 7/16" or slightly smaller rope without damaging it. The Ascender works on manila, nylon, or steel rope under any condition: ice, mud, water, grease, etc. It never slips or has to be thumbed open or closed in mud conditions. You can't accidently take a Gibbs off of the rope.

With the Davison System and similar rigs, one always has 3 SOLID points of contact with the rope, even when crossing a lip. (You are not in danger of falling, because you came out of your box.) You can pass out at any time with the System and hang by your seat, not by your chest. At breakovers, you can easily get away from the rope by slipping the shoulder strap off. The harness is going to stay on your body, even while leaning out, until you undo the buckles or rings. One doesn't need to worry about freezing his hands off at a cold entrance or about freezing his hands to the metal because he isn't wearing gloves. Although hands are usually used above the top ascender, you can have your hands free at all times to do what you will and still ascend steadily. You can always used your hands to push away from a wall or away from a breakover. Using the System, we can cross breakovers in tandem as the top man (something that cams are not supposed to be able to accomplish, according to popular folk legend). When in tandem, one man moves while the other rests.

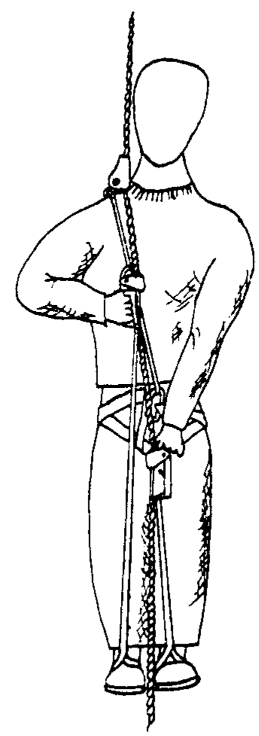
On a free ascent, the shoulder cam should ride tight at the shoulder. For ascent against the wall, loosen the shoulder strap at the back strap buckle. Do not tighten the front strap excessively, as this will cause discomfort at the shoulder and is not needed. To ascend a slope, slip the shoulder strap off, grab the shoulder strap immediately behind the ascender, and draw the shock cord taut. Then, move the shoulder Ascender and knee Ascender up as one unit, as you walk up the slope.

There are several rest positions with the System. One can rest: in a sitting position with bent legs forming a solid table on which to recarbide, take notes, eat lunch, etc.; sitting with legs extended, or standing vertically with some of the weight being held by the shoulder cam. In addition to its other uses, the harness may be used as a rock climbing harness, and when used with the shoulder strap and front strap, may be attached to a rope to give an easily adjusted belay at the edge of a drop or a convenient self belay while ladder climbing. When using the System, wear will first be noted at the lower edge of the shoulder cam, which is the first portion of the System to wear out.

In conclusion, the Davison System grew up in the tight drops and mud of Spence Cave and Virginia vertical caving. It has seen total immersion in waterfalls and deep free fall drops. It has withstood extra ordinary loads and the punishment of crawls and chimneys. It is adjustable, safe, and easily disaggregated into components useful for hauling or rescue. What more can you ask of a vertical caving rig?

THE PYGMY PRUSIK SYSTEM

by Bruce W. Smith



The Pygmy system is basically an augmentation of the Mitchell system and utilizes some of the fine points of both Jumar ascenders as well as Gibbs ascenders. The Pygmy system can be rigged with Mitchell system equipment only needing an additional shoulder cam and harness.

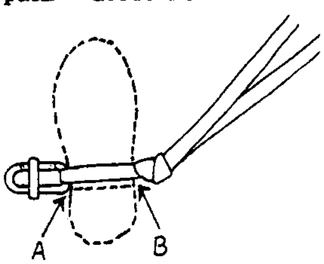
Looking objectively, there seems to be two basic drawbacks to the Mitchell system. The upper Jumar arm tends to get tired on long drops. Bill Cuddington developed the "Cuddington Switch" whereby the climber's hands merely exchange Jumars without hesitation during a cycle and thus relieving the strain on the upper arm. The other point, centers around the ascender box. The box does not position the climber at the maximum vertical stance. Therefore the box could be replaced with a shoulder Gibbs, thus allowing the climber to hang as vertically as possible. Using a shoulder Gibb allows enough room below the Gibbs for both ascending Jumars. This brings the upper hand down to a more comfortable position. The system is not a swift system as with the Floating Cam system, but is basically designed for long tiresome drops where energy must be conserved. The author has found that to adjust his own Mitchell system Jumar straps to Pygmy lengths he need only wrap the short Jumar cord three times within a carabiner and the long cord eight times in another. This may vary conciderably depending on the climber's height. In fact very tall climbers may have to use two carabiners on the long cord to shorten it enough. My tests with this system are limited. A little more than 1000 feet to be exact. But throughout its entire trial period it did what it was designed to do, did it safely and quickly.

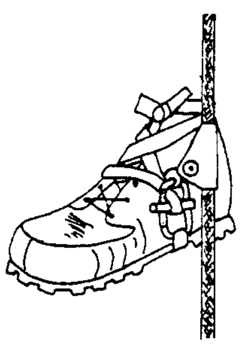
Be sure to include the strap from the lower Jumar to the seat Harness and chicken loops. Neither are shown in the drawing on the previous page.

RIGGING THE FOOT CAM

by Vern Smith

Upon finding the usual way of rigging the Gibbs ascender to the foot with a length of webbing unsatisfactory, I began looking for another method of rigging it. The way it is mostly rigged is by tying the ascender to a piece of webbing and then wrapping and tying it to the foot. The result is to find, when on the rope, the rigging has loosened considerably and is riding somewhere around the center of the top part of the arch of the foot. This loses about five inches per step and feels just plain sloppy. The method described below will provide a way of rigging the ascender solidly to the boot in a position it will stay in no matter how much you climb on it. The materials needed for this system can be found in any vertical cavers pack - about six feet of 1 inch tubular webbing, 1 standard oval carabiner, and 1 brake bar.





1. Tie an overhand knot in the center of the sling material to form a loop.
2. Place a carabiner in the loop of webbing. The distance between the knot and the carabiner (points A & B) is important. It should be long enough to just fit under the sole on the instep of your boot.
3. Now add the ascender and brake bar as shown. Be sure the brake bar opens away from the boot.
4. Place this assembly under the instep of your boot with the knot on the outside. Take one end of the webbing and bring it over the top of the foot and around the brake bar.
5. Bring that end back around the side of your foot and cross the other end over the opposite side of the foot. Draw this up as tight as you can get it.
6. To finish the rigging off, I tie a knot in the back then one in the front.

You may have to retie the loop in the webbing (step #1) if the length under the instep becomes to long when the knot tightens for the first time. It is important that the knot be right on the side of the sole of your boot. I have been using this for quite some time and found it to work very well with no problems. It may be used with any Gibbs ropewalker or floating cam system.

HOW TO RIG A VERTICAL PITCH

by Kyle Isenhart

The purpose of this article is to assist you in determining the best way to rig a rope when doing a vertical drop. The utmost consideration must always be safety. It doesn't matter what kind of drop you make if you don't live to tell about it.

When faced with a pitch, too often people tie the rope around the closest object and, without real thought, throw the rope over the edge and start rappeling. They give no consideration to the careful selection of the tie-off point, proper rope padding, or numerous other variables that can mean the difference between an enjoyable trip and tragedy. The proper rigging of a vertical drop requires time and careful attention to small detail. While many factors will vary from place to place some items that should always be considered are listed below.

Types of Rigging Points

These fall into two general classifications, natural and man-made. In most cases natural anchors are more secure than pitons, chocks, pins or bolts. One should always make it a practice to use at least two man-made anchors to carry the load and never rappel or climb on a rope secured by only one bolt or piton. The use of bolts smaller than 3/8" x 2" should be avoided as well as the indiscriminate placing of hardware in caves.

Selecting the Rigging Point

Having determined the types of rig points available it is time to start selecting the one to be used. First you should eliminate the unsatisfactory ones. When using natural anchors above ground, try not to use small trees growing at the edge of the pitch. Also avoid old wooden fence posts, dead trees (it is sometimes hard to tell in winter), and loose rocks. Always be careful not to stretch a rope across natural animal paths that usually exist around pit edges. There have been several recorded incidents of rodents or other furry little animals that take offense at there natural thourough fare being blocked by somes nylon intrudor and chew it out of the way. When using natural anchors below ground try to avoid small formations, loose rocks, and wooden objects whether washed in or placed earlier. When using man-made anchors be sure they are not seriously rusted and that they are absolutely solid. After this elimination process you should decide which of the remaining points to use. Now you must consider such things as the amount of loose debris in the area of the rope, (especially when rigging a virgin interior drop), the presence of water, the difficulty of getting over the lip at the top, and numerous other variables such as mud and whether the drop is free or against the wall. You usually cannot have all the desirable qualities in a drop and must sacrifice the less important ones for safety's sake.

Tieing off the Rope

When tieing off the rope it is always best not to load the knot directly. The ideal situation is to have two large trees or round rocks near the drop: tie the rope around the object farther from the pitch, then take at least two turns around the close one and place the rope over the edge. We have done this hundreds of times and the rope has never tightened at the knot. This greatly increases the strength of the rope because of the decrease in strain around the large object as compared to the tight bends in a knot. This is also advantageous if you need to loosen the rope so it can be rigged to pull someone out. Not only do you have several feet of rope available to work with, but you can easily untie the knot and proceed quickly. While this ideal condition is not always available you should try to wrap the rope around another anchor, if possible, between the drop and the knot to lessen the strain. The next step is to actually tie the knot: the generally accepted knot is the bowline. It is easy to learn, can be tied with one hand, and is quite secure if properly "backed-up". A bowline will not hold in synthetic rope subjected to repeated loading and unloading without being "backed-up" with another knot. The common practice is to use several half-hitches but two overhand knots are much better. If you must use the rope as it exits directly from the knot you might consider one of the more difficult to tie but stronger knot such as the modified midshipman's hitch. These knots must also be properly "backed-up" and checked periodically for tightness. Always make it a habit to check the knot yourself before starting down a rope.

Padding the Rope

The importance of this cannot be over-emphasized. Regardless of how well a rope is tied or placed, if it is cut by abrasion on the rock walls, lives could be lost. Even if properly padded, after extended use the point of contact between the rope and pad will wear through and the rope will no longer be protected. Thus is particularly prevalent on drops over 200'. Not only must the rope be padded for protection against abrasion by rocks but it should also be padded to protect it from mud and dirt. Rope pads should be made from heavy canvas or carpet and should not burn readily. Do not use nylon carpet for rope pads.

In conclusion I can only say that rigging a rope properly is not difficult, but takes time and the exercise of good judgment. Everytime you do a drop you put your life on the rope. Give yourself every possible advantage. A good rope, correctly placed, well tied, and properly padded is your best chance of living to cave another day.

Letter From The Editor:

Our first issue from all reports was received favorable and I thank all those who have sent contributions and those who have put up with mailing delays and have understood the trials of editorship. Our present membership and subscription list is listed on page one of this issue. We have 95 fully paid subscribers at the present which covers 26 states and 6 countries. I especially want to mention David Neff for extending the services of his press after so many members had said they would be unable to help. David Neff is presently the publisher of The Underground Leader in Point Lookout, Mo. This will be the last issue under my editorship this year.

Bruce W. Smith