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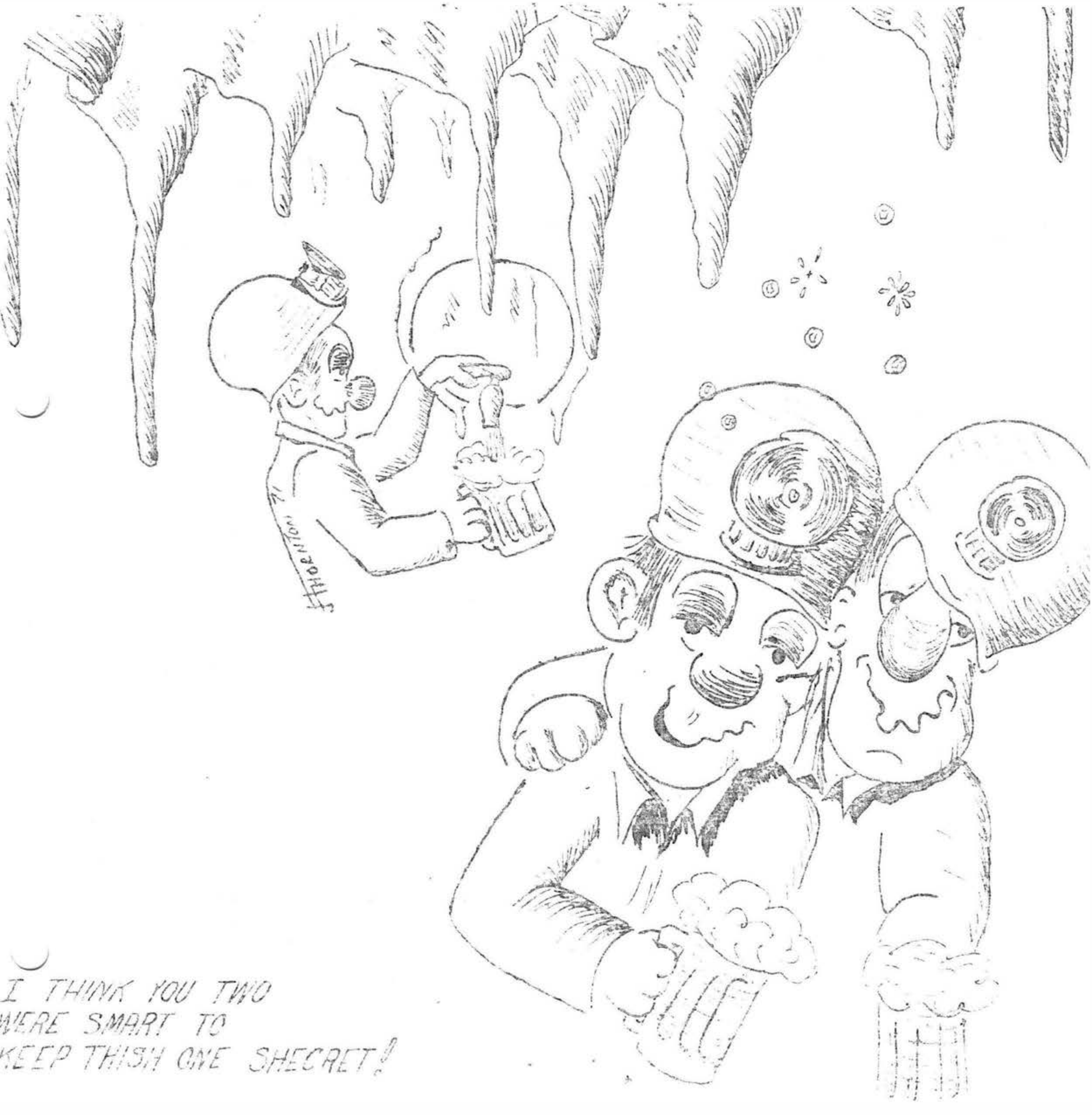


GROTTO EVENTS

OCT. 16	Grotto Meeting 8:00, 1117 36th Ave. East, Seattle.
OCT. 20	Windy Creek Cave, call Mark Sherman (524-8780).
NOV. 20	Grotto Meeting 8:00, 1117 36th Ave. East, Seattle.
NOV. 23-25	McLaughlin Canyon Cave, call Ben Tompkins (524-9526).
NOV. 23-25	Papoose Cave, for more information call Bob Brown at 569-2724.
DEC. 18	Grotto Meeting 8:00, 1117 36th Ave. East, Seattle.
JAN.15	Grotto Meeting 8:00, 1117 36th Ave. East, Seattle.
FEB. 15-17	Symposium on Cave Management, Science and Technology hosted by the Salt Lake Grotto, in Salt Lake City. For more information call Kirsten Stork (801) 583-1143.
MAY 18-27	Survey trip to Bighorn Cave in Wyoming. Contact Bob Brown.

GROTTO ELECTION

The nominations for next year's Grotto officers will be made at the meeting on October 16. If anyone is interested in running please contact Jim Harp at 745-1010. The positions are: Chairman, Vice Chairman, Secretary/Treasurer, and Regional Represenative.

TRIP REPORT CONTEST

The voting for the Best Trip Report of the Year will take place at the meeting on October 16, with a first prize of $50.00. The three reports were selected by the Chairman, the Vice Chairman and the Editor. They are:

Arch Cave by Tom Miller (Sept-Dec 83)

Jamaica Again by William Halliday (April 84)

The Six Entrance Hokeb Ha System
by Tom Miller (July 84)

If you are going to be at the October meeting you might want to re-read these articles.

This month's cover cartoon was done by Jerry Thornton.

Ed. Note: The following article is the second in a series of handouts from the 1984 Regional.

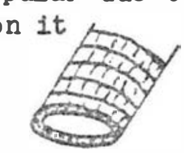
ANCHORS AND ANCHOR SYSTEMS

By Bill Clem

In one of my more interesting nightmares I find myself strung out on an incredibly gripping lead -- I come to a blank section of wall without a crack or a horn in sight -- my life flashes in technicolor as I glance between my feet and in a moment of genius I whip out my tube of Superglue ('five seconds - holds a rampaging rhino with one drop') and attempt to glue a sling to the rock only to glue my hands to the limestone for all eternity.

Proper anchors require good planning skillful usage and the right equipment. Equipment is perhaps the least important but it is the proper place to start.

The omipotent sling. Made from one inch tubular or flat nylon webbing or from a piece of kernmantle or laid rope. Tubular webbing is the most popular due to its high strength and easy handling. End-on it looks like the figure on the right. It is important to get webbing that is designed for caving or climbing.



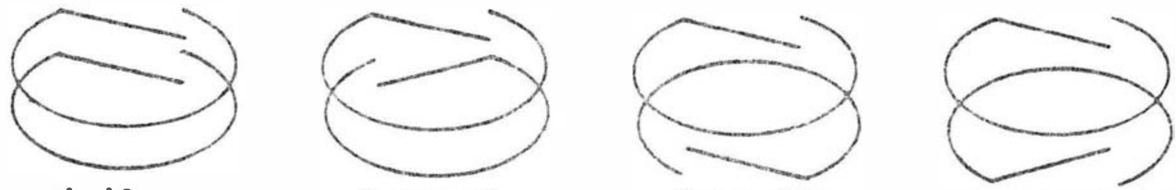
On close examination the sling should have a spiral pattern to its construction.

Some surplus webbing that may be hazardous to your health looks like:

which seems to be two smaller pieces sewn together.

One generally uses a ring bend (water knot, follow-through) to tie the webbing into a sling: for kernmantle slings a double fisherman's (barrel knot) is preferred. Examine your slings frequently for abrasion or melts. The rated strength for new one inch tubular webbing is about 4000 pounds, but this material is exquisitely sensitive to abrasion and melting and should be discarded at the slightest provocation. I use 500 pounds as a maximum working load limit.

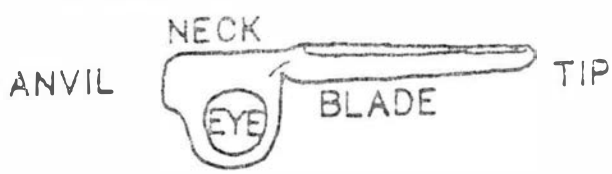
Carabiners are well described elsewhere. At points in the system depending on carabiners you should use locking carabiners or double-up with two carabiners placed with gates opposite and opposed to each other so that it is practically impossible for both gates to be opened simultaneously.



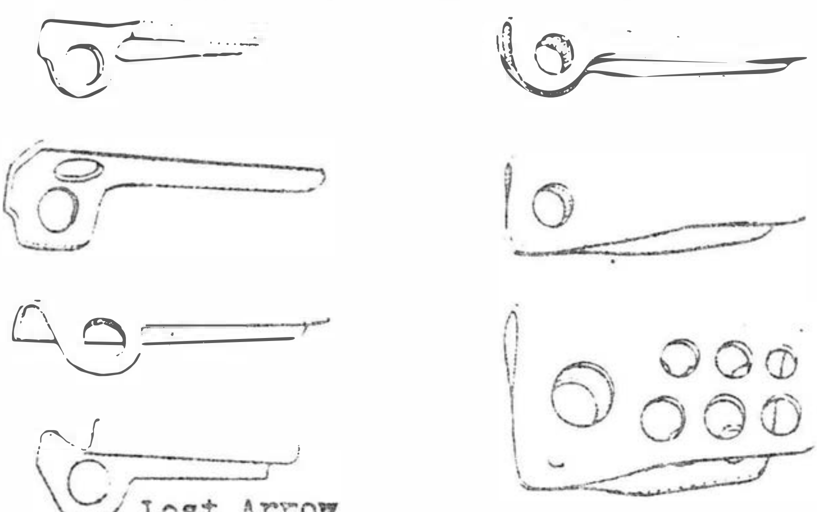
Similar Opposed Opposite **Opposite & Opposed**

Know the load limits of your carabiners and use as a working load limit 1/4 to 1/3 of the maximum. In cave rescue it is essential to clean carabiners regularly - I know of no more abrasive compound than cave mud. As with all the equipment retirement at the slightest hint of damage or significant wear is prudent - bent gates, rust, misaligned pins all would indicate a questionable carabiner.

Pitons or pins were the mainstay of the climbing world not too long ago and their demise for routine climbing is appropriate. For rescue work I tend to be a trifle less considerate. You must remember that you are working under pressure with a great deal more at stake than a climb, cave trip or a troublesome leader fall. Most of the time you are working in a place you don't want to be, taking risks you don't want to take in order to get someone else out of a jam. If it means destroying some rock to protect your life or someone else's or you can do the job more quickly and efficiently then use a pin (or a bolt) and set like there is no tomorrow.



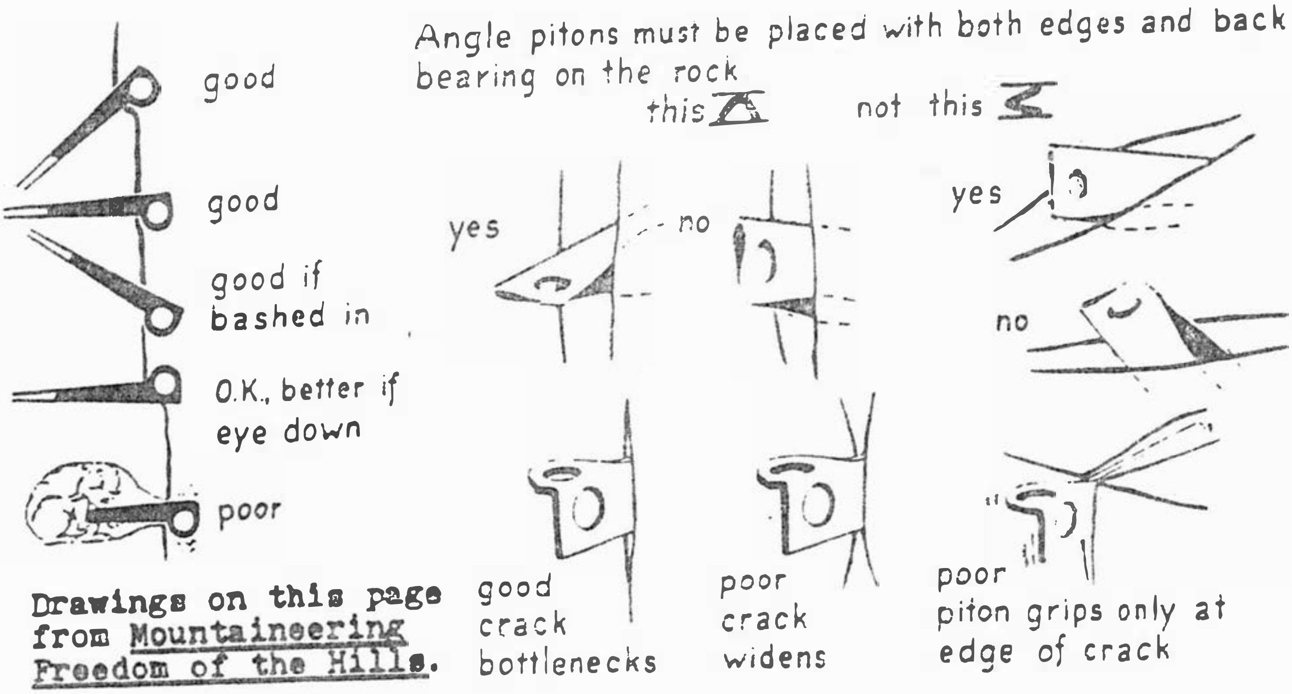
Various types of pitons include:



Lost Arrow
Bugaboo
Shallow angle
Leeper Z

Regular angle
Wide angle
Bong

The strength of a piton is dependent on the quality of the rock and the selection and placement of the proper piton. Proper pincraft only comes with practice but some useful guides are listed below.

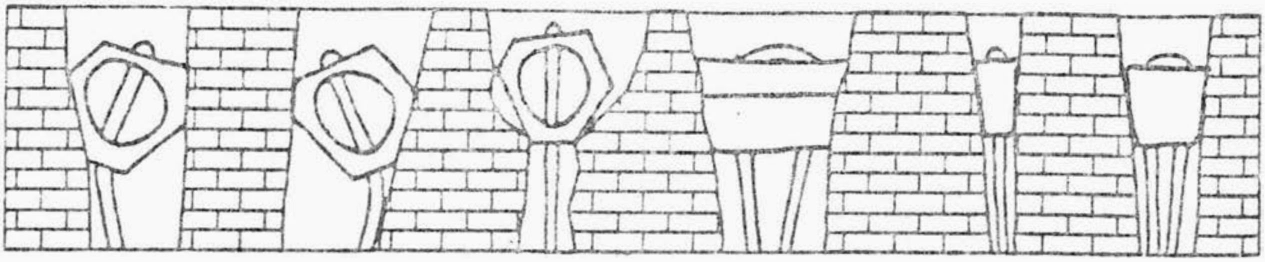


Drawings on this page from Mountaineering Freedom of the Hills.

Piton placement is most secure when using a crack which is perpendicular to the load. Chouinard and Frost in an early catalog described the basic technique of pounding a pin:

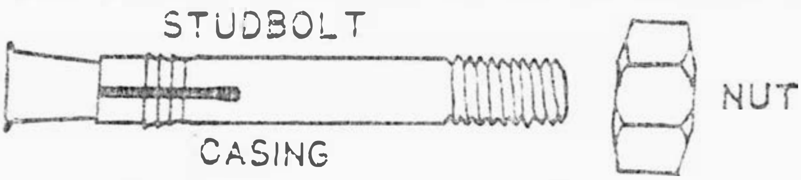
> "First, select the piton size for the crack and then locate the section of crack that best fits the piton. (Depending upon its length and taper, the piton should normally allow 1/2 to 3/4 of the blade to be inserted into the crack before driving.) Pound the piton in only part way, then give one or two light downward taps (vertical crack assumed) on the head to see how well it is in, and how well it resists shifting. Then drive more according to the results of the test, and retest with another downward blow until the piton appears adequately solid in its resistance to shifting. ...If, however, a perfect placement is not possible , then the best security can of course be obtained from a really hard-driven piton..."

As a rock climber the use of chocks has become second nature to me. On a climb, the selection and development of the `protection system' is a practiced art. But as a cave rescuer I have found that while chocks can be useful, it is necessary to carry a wide assortment. This can be cumbersome and I have found that chock placement in wet, muddy limestone is quite different than its surface counterpart. My own reluctance/inexperience with using chocks underground and my desire to maximize usefulness while minimizing weight has resulted in my dependence on pitons, bolts and natural formations. This is not to say that I believe chocks inadequate underground but to say that in cave rescue they are less efficient.

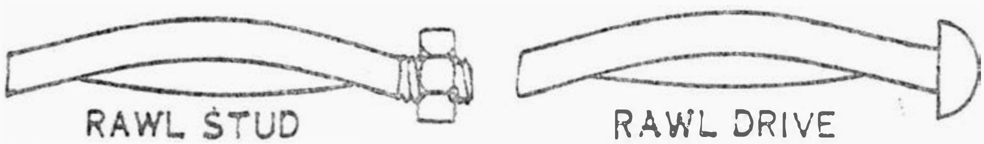


Expansion bolts are absolutely essential in cave rescue and rock rescue. You often do not have a choice where an anchor must be and bolts are the only alternative. The major types are:

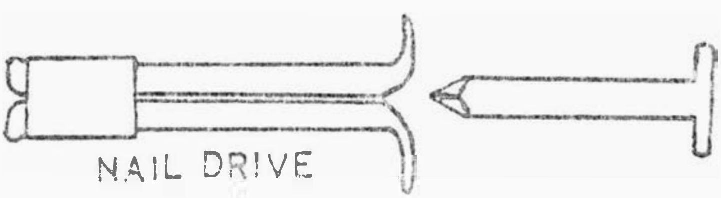
Star studbolts - The major advantage of this bolt is that you only have to drill a hole the same size as the bolt rather than a larger hole as with some others. It does require a separate drill and bit. I use only 3/8 and 1/2 inch sizes.



Split-nail (Rawl stud, Rawl drive) - As tested by Leeper in the early 1960's these are good bolts as long as the hole is precisely the correct size. If the hole is too wide or too shallow then the bolt tends to loosen. There has been some question of metal fatigue when these bolts are used as permanent anchors.



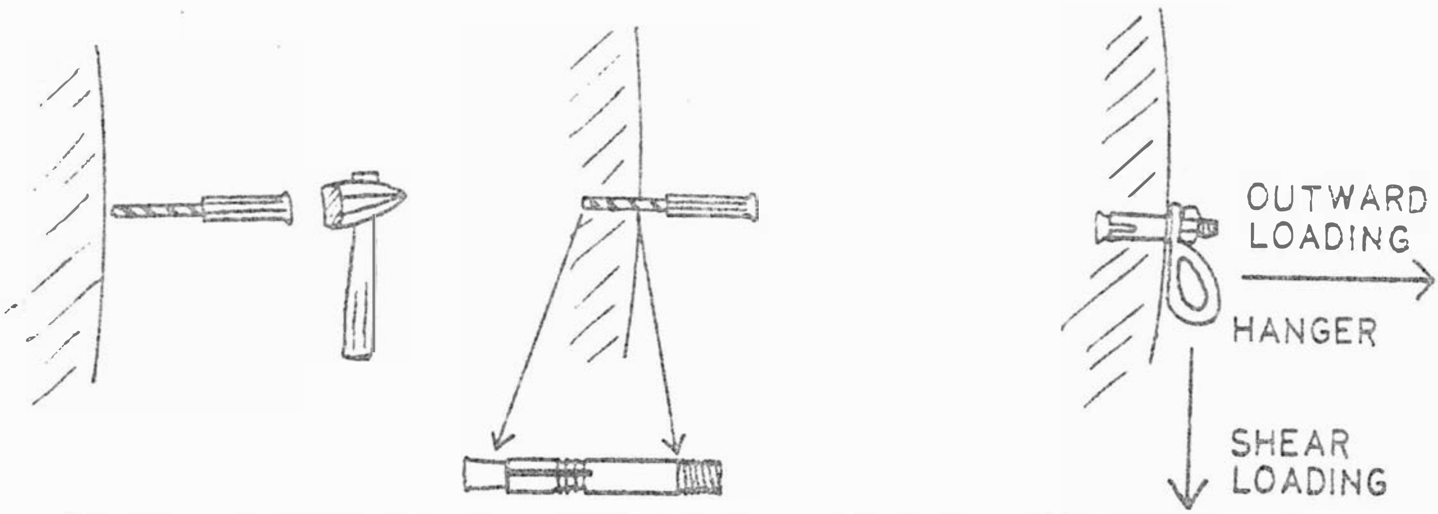
Nail-drive (Star driven) - Good for hanging pictures and little else. They are hard to place well, loosen easily and have very poor resistance to outward loading.



Self-drive - I have heard self-drive bolts lauded for many years and in theory the idea is nice. These do not require a separate drill bit but rely on the teeth at the end of the bolt casing. Unfortunately in most of the limestone I've placed these into, it has required at least two bolts to drill a sufficiently deep hole because the teeth dull rapidly. In addition to place a 3/8 inch bolt you must drill a hole that is 3/4 inch in diameter - a time and energy consuming task. Some cavers prefer self-drives stating that the hole is more precise, a better fit, which in limestone helps to prevent water from squeezing between the casing and the rock and loosening the bolt. This is a factor of longevity and in cave rescue the life of the bolt is not a crucial issue as long as the bolt is tested properly prior to subsequent use or is destroyed after use.

My own preference is to Star studbolts. I carry extra bits and a small file in case things get really grim and this seems to work well. Twist drills seem to work better than Star bits and make dust removal easier.

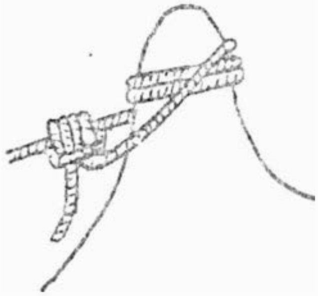
EVOLUTION OF A BOLT

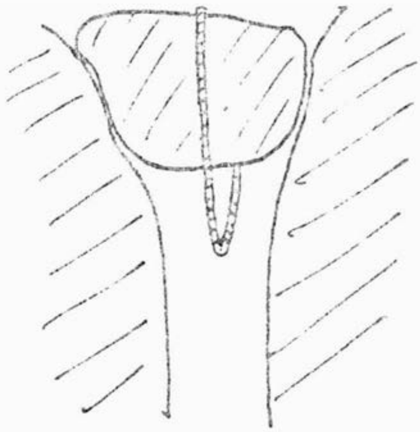


For rescue purposes use only 3/8 and 1/2 inch size bolts. Recent studies have indicated that the thread depth in 1/4 inch bolts is not sufficient to prevent failure at very low (under 200 lbs) loads.

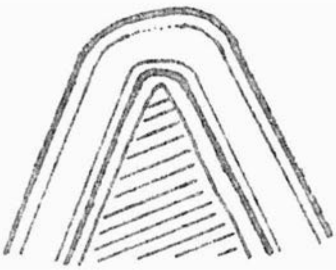
Bolts are not magical. They are subject to failure as is any other anchor and provision for backups is as essential as with any other anchor. If a second bolt is used make certain that at least 12 inches separates the two to decrease the likelihood of shattering the rock.

Natural anchors provide anchor points that may be totally bombproof or completely inadequate and it is usually difficult to tell the difference. In general trust only a formation which is part of bedrock, not a speleothem. Flakes are difficult to judge since they may feel secure and then break at the slightest effort. If shear loading, loading along the plane of the supporting rock, is applied you are much safer than with outward loading. But the key to remember is that these anchors should be evaluated with a keen eye to the type of rock, cracks and fissures surrounding the structure and the direction the load is applied.





Most systems that you design will require knots to hold things together. While in most situations the amount of rope strength over and above the usual working load on a rope makes consideration of knot efficiency immaterial, in rescue you often load ropes to several times the usual working limit and a knot in the system may become the weak link. Anytime you take a rope over a sharp bend you decrease the strength of the rope at that point. This is mainly due to the distribution of forces through the rope. The fibers that run along the outside of the bend are stretched and therefore stressed harder than the fibers in the inside. A kernmantle rope is particularly vulnerable since its fibers are more or less running parallel to each other. Laid ropes tend to unravel a bit and distribute the load a little better.



There is a limit to this problem and we usually say that the decrease in strength is negligible at 8 times the diameter of the rope. So a 1/2 inch rope running over a 4 inch bend loses little strength.

In short the tighter the bends in a knot, the greater the loss of strength. Compare the relatively tight bends in a sheet bend to the flowing bends of the double fisherman's. Compare the strength.

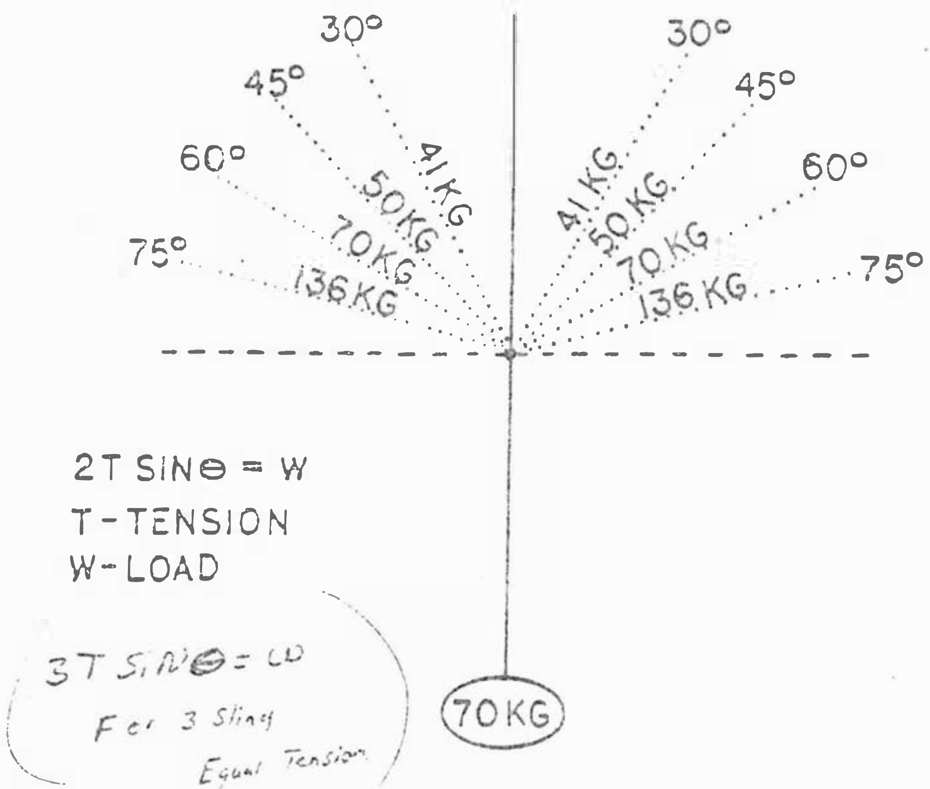
Knot Efficiency

Double Fishermans	70%
Double Bowline	69%
Bowline	65%
Ring Bend	64%
Double Sheet Bend	63%
Fisherman's	59%
Sheet Bend	49%

(adapted from Mountain Search and Rescue Techniques)

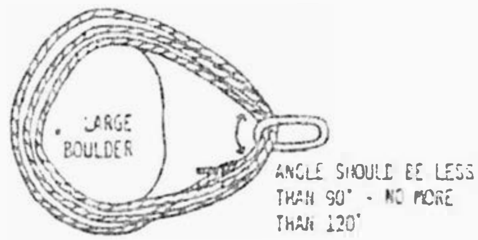
In rescue systems I usually insist on three separate anchors to make a single system to trust lives to. In some instances for a single rappel two separate anchors are sufficient. But anytime more than one person or the stress of a lowering or hauling system is added then three bombproof anchors are required. There is safety in numbers and three seems to be a good choice. I don't always follow my own rule - sometimes it is not necessary and other times it is not possible but it is a goal to try for.

One point that is not commonly understood is that angles effect the individual loading of anchors and portions of anchors. ideally there would be no angles in an anchor system - the load would be directly applied along one direction. As the angle increases, as illustrated below, the load increases on the anchors in multiple anchor systems or on the components of a single anchor system.



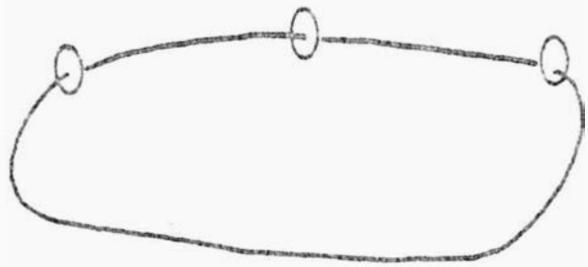
The stress on the pair of components is greater than the load itself. For the two anchors such that the angle between them is 160 degrees each anchor is stressed to 136 kg or 272 kg total. This is impressive since there is only a 70 kg load being supported.

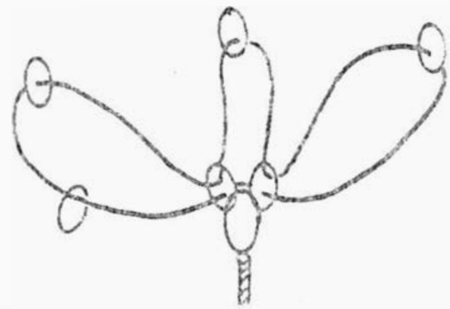
A more practical example below shows an anchor which is set up to minimize this effect.



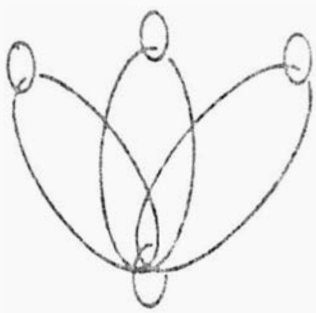
(from Mountain Search & Rescue Techniques)

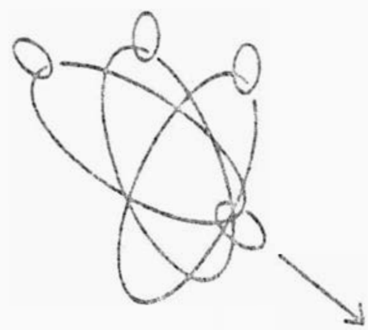
Multiple anchors can be constructed in a variety of ways. Most often they are simply independent anchors joined at a single point to provide an anchor system. Self-equalizing anchors have the additional attribute of distributing the load evenly to all the anchors regardless of shifts in the direction of pull. Some examples follow.





A simple three anchor system. It is not self-equalizing because changes in the direction of pull will unevenly stress the anchors.





Anchor systems are just that - systems. You must carefully consider your requirements, what you have available, the demands of the moment, and build something that works. I have misjudged in the past; several times I have trusted systems that did not quite warrant trust simply because to spend more time would have endangered someone's life even more - a calculated risk, but the entire game is one of calculated risks. Try to build the best, safest systems you can given the time and materials available. The key factors in anchor systems are proper planning, backups, and practice.

MT. ST. HELENS CAVE INVENTORY RECOMMENDATIONS FOR MANAGEMENT
PART TWO: VULNERABLE HABITATS AND VISITOR IMPACTS

by Rod Crawford and Clyde Senger

Types Of Vulnerable Habitats

Twilight Vegetation.

Since basalt is an unusually permeable rock, lava flows in general usually have little surface water and the surface vegetation may have a desert-like character even in a moist climate. The flora of collapse sinks and cave twilight presents a great contrast, since it is both more sheltered and physically closer to groundwater (their climate is also influenced by moist cave air and colder air trapped in the sink); thus, this flora is often very interesting (Crawford in press). Several entrance and twilight areas of the Cave Basalt caves have unusually diverse, aesthetic, and interesting plant communities. Ten bryophyte species were found only in cave twilight during this study: five liverworts and five mosses (for list of species see the original report). Unusual fauna may be present there also, as with the salamander population in the third entrance of Ole's Cave. Casual trampling by visitors unaware of the values present is likely to severely impact such plant communities, and should be prevented by not encouraging visitation of the caves invloved. Other potential impacts include disturbance by biologists or persons collecting plants for "rock gardens", and particularly by any artificial modification of the entrance.

Aquatic Habitats.

The great importance of preserving the habitat of the unique aquatic community in Little Red River Cave and its source aquifer is pointed out in the "Rare and Vulnerable Species" section [to be published later]. It does not appear from our results that any of the seasonal streams in other caves in the area have any importance for aquatic life, but nevertheless, pollution of any cave waters should be avoided. It is very probable that the same, and perhaps other, unique aquatic animals are present in presently inaccessible underground waters in the lower part of the Cave Basalt also. Thus it would be desirable to take reasonable precautions to avoid pollution, flooding, or excessive withdrawal of groundwater throughout the Cave Basalt.

Slime.

Lava tube slime consists largely of very slow growing actinomycetes (see "Energy Sources", to be published later) and takes a very long time to replace lost growth. This is demonstrated by the continued visibility of old grafitti written in the slime. Thin slime probably takes even longer to replace than thick slime, since it grows under less favorable conditions. As slime is the sole support of Speolepta gnat larvae, which are among the most important primary consumers at the base of the cave food chain, any large-scale disturbance of it should be avoided. The writing of grafitti in slime should be discouraged, but any attempt to erase such marks may cause even more damage. Obviously, spray paint is locally fatal to slime. The removal of such should be done without volatile solvents which may have more far-reaching ill effects. The Gem State Grotto has employed a propane torch to burn off paint with considerble success; if this is done in a slimy area, however, the area above should be shielded from the heat. Slime may also suffer from the introduction of extraneous bacteria here and there on the slime; it is difficult to say what the long-term result of this might be. Certainly any discharge or leakage of sewage where it might contaminate the seepage into a cave should be avoided at all costs. Actinomycetes are intolerant of acid conditions, and use of acids in cleaning, etc., should be avoided where slime is present. Since slime is dependent for nutrition on the organic matter in seepage water, any changes in surface conditions which might greatly change the amount or type of this material passing into the cave could seriously affect slime growth. This could involve road building, mudflows, or other serious soil disturbances; or, conversely, deposition of any sort of rich organic compost. We noted that slime is rather sparse in the area of Ape Cave overlain by recent alluvial deposits. Unfortunately, there are no previous observations for comparison to see if this has been detrimental to the slime.

Roots.

Roots are an important energy source in lava tubes and, where numerous, may be of paramount importance. They are also susceptible to a variety of impacts. Obviously, death of the source plants of cave roots should be prevented if at all possible. Repeated brushing against the roots by cavers may also severely damage or kill them (Howarth 1983a, b). Such had occurred in Deadhorse Cave, killing several former root curtains along main travel routes (L. Nieland, personal communication). Brushing or shaking of roots can also knock off animals feeding on them, possibly leading to their death (Howarth and Stone in press). Because of these problems, it may become necessary to limit caver traffic in caves and passages with substantial root growth.

Wood And Other Organic Deposits.

Any deposit of organic matter, such as wood, that has been in the dark zone or deep twilight of a cave for some time, probably supports life even if such is not immediately visible. Such should not be removed in the name of "litter cleanup" unless it is particularly unsightly or dangerous, nor should these deposits be needlessly trampled or disturbed. Biologists and others checking such sites for cave life should be aware that associated habitat conditions may take some time to evolve, and are best preserved by replacing objects exactly where they were found.

Loose Rocks.

Apparently the surface portions of breakdown piles are not important habitats in these caves, and can withstand moderate disturbance. It is not known what life the deep interiors of breakdown piles may harbor, but such are not immediately accessible to disturbance in any case. Naturally, any life that may be present there would not be helped by dumping of trash, spent carbide, etc. between breakdown to get it "out of sight". Rocks in contact with solid or clinkery substrates are a different matter. The spaces under such rocks very often harbor cave life, as well as supporting a growth of slime even where there may be little or none on the walls. Microclimate conditions under rocks are often dependent on the exact relative positions of rock and substrate. Such rocks should therefore not be moved unless necessary, and, if moved, replaced in the exact original positions.

Rough Floors.

There is some evidence that the spaces within rough, clinkery, broken, or fractured floors are important habitat for troglobitic campodeids, and very likely for other small cave life. Cavers should be aware of this and tread softly in such areas (this also helps save boots). In sections where the floor is fragile enough for the effect of trampling to be obvious (seldom the case in the Cave Basalt caves), it is a good policy for all visitors to keep to the same trail.

Small Passages.

Crawlways typically suffer much greater damage from caving traffic than larger passages. If enough cavers pass through a small crawlway, its values are going to be eliminated by sheer abrasion. All of the above mentioned habitat types are likely to suffer more in smaller passages. Fortunately, crawl caves tend to attract fewer visitors and so the problem tends to solve itself. Crawlways on route to or from larger passages and those with unusual, or interesting features, should be considered at risk. Examples: crawlways at several points in Gremlin Cave; the Red and Stream passages in Lake Cave. The crawlways on the main routes of Ole's and Spider caves probably have already suffered about all they are going to.

Bat Roosts.

As noted in the "Rare and Vulnerable Species" section [to appear in a later issue], bats in hibernation and nursery roosts, and possibly also in late summer night roosts, are extremely sensitive to disturbance of any kind, and desirable roost sites are limited in number; strict regulation of entry into the caves involved during "critical seasons" may be the only practical approach to this problem. A less obvious, but equally serious, problem is that any change in environmental conditions (temperature, humidity, drip, etc.) of a bat cave may lead to its abandonment. Changes in surface drainage or a kill-off of surface vegetation over bat-inhabited passages may make them too "drippy" for bats; any enlargement or restriction of the cave's entrance, Likewise changes in its exposure or "shading", will likely affect cave temperature and humidity, with potentially serious consequences. If bat caves are gated, several parameters are crucial to gate design; this is discussed more fully below under "Visitor Management" (next installment).

Woodrat Nests.

Nests, scats, and food deposits of woodrats can be important energy sources for caves. Although woodrats, <u>Neotoma</u> spp., very commonly nest in caves in other areas, this has been noted only a few times in the Cave Basalt. Consequently, where nests do occur, they and their occupants should not be disturbed unnecessarily. The previous collection of nests by CMS in Beaver Bay and Spider caves, while necessary to sample fleas, apparently led to abandonment of the caves by woodrats. That has also occurred in talus caves near Bellingham (CMS). The rats may have made an important contribution to the ecology of Beaver Bay Cave when they were present. Pikas, also, might well abandon caves if unnecessarily disturbed.

Impacts From Cave Visitors.

It has long been known that even moderate numbers of people passing through a cave with delicate geologic features will damage those features, through carelessness, ignorance, and deliberate vandalism. This problem is especially acute in lava tube caves because their geologic features are non-renewable (Nieland et al. 1980). Ape Cave is a good example of this problem; one has only to compare the barrenness of all reachable surfaces there now with the numerous fragile features described by Halliday (1963). It is now generally recognized that visitors have a variety of significant, usually detrimental, impacts on a cave's biota as well. Howarth's (1983) data on Hawaiian lava tubes showed that "other factors being equal, species diversity and population levels of invertebrates in caves is inversely proportional to the level of visitation and human disturbance." Some of the documented impacts of visitors on cave biota are as follows:

Trampling of floors and abrasion of crawlways is a problem with even the most considerate of cavers. To quote Howarth (1983) again: "The cave environment shares with other discrete habitats, such as montane bogs and sand dunes, a vulnerability to trampling and physical disturbance. However, the surface biologist often needs only to go 100-200 m away from a well worn trail... Since the cave is a discrete void in rock, the cave biologist is restricted to the same passages as every other visitor... he can count on his study areas being crawled through, trampled, or even vandalized." In the previous section, we discussed visitor impacts on special habitats like roots and slime. Body heat, and heat from lamps and lanterns, affects a cave more than one might think. Denbo (1981, 1982) found measurable temperature increases in smaller walking height rooms and passages from the presence of just one or two people, and substantial increases after passage of tour groups. This may well affect invertebrates (body heat and light certainly affect hibernating harvestmen), and passage of even a few cavers is very likely to cause arousal of some hibernating bats (Mohr 1976). Bat disturbance problems are discussed more fully in the "Rare and Vulnerable Species" section. Some cave visitors disturb habitats greatly by such activities s illegal archeological excavation (Benedict 1973), and a few people seem attracted to well known caves for unusual or even bizarre activities, such as fire dancing (Benedict 1975).

Few visitors other than organized cavers some to a cave prepared to dispose of their own litter. Even at developed sites, there is often little or no provision for litter disposal (Benedict 1973). Most cave litter can be divided into three categories: inert (glass, plastic; the largest category), organic, and poisonous. Most inert litter probably has little effect on cave life unless it is so abundant as to consitute a habitat disturbance. That is often the case, however, in well known caves. Nieland and Woods (1975) reported removal of 146 pounds of trash from Ape Cave and 39 pounds from Ole's Cave on a single weekend. Even in minor quantities, inert litter is aesthetically unappealing.

Organic litter affects the cave community directly. Nutrient-rich forms (a "high risk, high gain" food source) tend to favor a few opportunistic troglophiles that may not even be native to the cave, at the expense of more efficient, slower reproducing trolobites (Poulson 1976). Wilson (1976) notes that in British caves with even small amounts of rich organic litter, abundance of fauna was greater but the troglobitic species became rare. That is exactly what we found in Ape Cave. Some fly species are vastly more abundant there than in other caves, but only one troglobite was present (Hap locampa sp.), and it was far less common than in any other cave where it occurs. Less rich organic litter, particularly wood, is a "low risk, low gain" food source in that it contains little food value, but lasts a long time. It may actually be beneficial to the cave biota, supporting a diverse community of species, including troglobites.

Almost certainly, poisonous litter is actively detremental to cave life. Probably the commonest type is acetylene headlamp waste ("spent carbide"), mainly calcium hydroxide with some unreacted calcium carbide. Eventually, this substance reacts with water and carbon dioxide to form harmless, but unsightly, calcium carbonate. Until then, it is acutely toxic to cave animals that encounter it directly (Peck 1969); if it reaches an aquatic habitat, it could become an environmental toxin. Carbide also affects cave fauna indirectly by killing microorganisms on which it depends (Poulson and Kane 1977, Lavoie 1980). Other common types of poisonous litter include dead batteries, tobacco, and lantern mantles which could cause heavy metal poisoning (Stitt 1977) and contain radioactive thorium (Senger 1965). We found cigarette ends and a lantern mantle in the Little Red River Cave lake; these might have been factors in the low populations found of amphipods and flatworms. Poisonous gases often introduced into caves include spray paint propellants/solvents (particularly in Ape and Lake caves; fresh paint noted at the lower end of Lake Cave in 1983) and flare smoke. Tobacco smoke contains a powerful insecticide which, in the enclosed cave atmosphere, challenges, if not kills, many invertebrates (Howarth 1983). Nicotine from cigarette smoke also settles and persists on nearby surfaces (D. Williams, personal communication). Howarth also notes that any kind of smoke lowers relative humidity in the affected area, something most troglobites cannot tolerate.

The introduction of species into caves and passages where they do not normally occur could have severe effects. It is well known in surface ecology that an introduced non-native species will often outcompete and replace several native species, and may in some cases upset the entire ecosystem. Howarth (1973) noted that many introduced household pest and soil animals have colonized Hawaiian lava tubes, including insects, arachnids, and isopods, and have vastly altered the ecology of affected caves. Wilson (1976) documents introduction of a Phorid fly species into passages where it did not previously occur by transport on cavers' garments. Introduction is not yet a problem in the Cave Basalt because it it in an unpopulated area. Population centers, even very small clusters of inhabited buildings, provide sites where introduced species can gain a toehold and spread into the surrounding area. However, sooner or later visitors are sure to introduce non-native troglophiles into Ape Cave, and if cavers are not careful, they will transport such species to other caves. Construction of any permanent work facility in the area would accelerate this problem, and we recommend against it. For further discussion, see below under "Surface Management" (to appear in a later issue).

Ideally, all persons who enter caves should first be educated about impacts they might have, and in how to avoid these as far as possible. This need applies to scientists as much as, or more than, to laymen. An ill-considered scientific study is likely to have much more impact on cave biota than casual visitation, because it involves extensive deliberate manipulation of habitat and populations. Affects of banding, census, weighing, etc., on bat populations can be tragic, as discussed above. Peck (1975,1976) documents serious reductions of troglobitic invertebrate populations from intensive pitfall trapping in small caves or passages, but generally collection seems to have little effect in comparison with the accompanying habitat disturbance. Even environmentally conscious scientists tend to be insensitive to cave values outside their own fields; Howarth (1983) documents several such cases. Education is a paramount need for all cave visitors; some ways and means are discussed in the following section [see the next installment].

Ed. Note: References for this article will gladly be provided, just contact Rod Crawford or myself.

NEW FORMAT FOR THE CAVER

Starting with the next issue, the Caver will be changing somewhat. If anyone has anything different you would like to see, please let me know and I'll see if it can be added. Send your ideas to:

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Grotto Meeting: OCTOBER 16 at 8:00

Please see Trip Report Contest on page 50 before the Grotto Meeting.