# PHOLEOS

JOURNAL OF THE WITTENBERG UNIVERSITY
SPELEOLOGICAL SOCIETY

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June, 1991

### The Wittenberg University Speleological Society

The Wittenberg University Speleological Society is a chartered internal organization of the National Speleological Society, Inc. The Grotto received its charter May 1980 and is dedicated to the advancement of speleology, to cave conservation and preservation, and to the safety of all persons entering the spelean domain.

## The National Speleological Society

This is to certify that

*Wittenberg University Speleological Society*

*having fully complied with all the requirements established by the Board of Governors, and having accepted the responsibility which such status entails, is hereby chartered in the National Speleological Society, and is entitled to all due rights and privileges: in testimony whereof the President and the Chairman of the Internal Organizations Committee have hereunto set their hands and the Seal of the Society, this* 14th *day of* May *, 19*80.

The National Speleological Society — Corporate Seal — 1941

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Wittenberg University Speleological Society — Springfield, Ohio

Cover: Trash-filled sinkhole in Adams County, Ohio.
Photo by H. Hobbs III.

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**MEETINGS:** Wednesday evening, 7:00 p.m., Room 206, Science Building, Wittenberg University, Springfield, Ohio.

Editor's Note:

Call to all former W.U.S.S. members!! What have you been up to lately? Have you done any interesting caving? Have you done ***any*** caving? We would love to hear about it! Why don't you write an article for *Pholeos*? *Pholeos* has just completed its tenth year of publication. In the next issue, we would love to include what the past ten years of W.U.S.S.'s are doing now. We would welcome any type of submissions. It was nice hearing from those of you who responded last time.

It has come to our attention that a correction needs to be made from the June 1990 *Pholeos*. A mistake occurred in the article about Lechuguilla. The entrance to the cave was explored and excavated over a period of several years by a group lead by John Patterson and Dave Allured, who noticed blowing rocks in the entrance on a CRF ridgewalk. When the exploration had reached Boulder Falls, several hundred feet and two ropes drops into the cave, Rick Bridges joined it. Sorry for any inconvenience this caused.

We've enclosed a map of Well Cave, Menifee County, Kentucky by Bill Stitzel. This is one of many fine caves in the Red River Gorge area of the Boone National Forest.

J. T.

# Mammoth Cave 330 Miles Long

*from*
*Cave Research Foundation Report*
*May, 1991*

Chief cartographer Scott House reports that the updated length for Mammoth Cave is 330.0 miles. This is close to a complete figure, but about 50 field survey books out of a total of approximately 2600 still await analysis.

The breakdown by area is:

| | |
|---|---|
| Crystal Cave | 14.1 miles |
| Colossal Cave | 29.2 miles |
| Salts Cave | 19.4 miles |
| Unknown Cave | 45.2 miles |
| **Flint Ridge total** | 104.9 miles |
| River System | 32.9 miles |
| Roppel Cave | 59.2 miles |
| Mammoth Cave | 130.0 miles |

The "River System" includes Proctor and Morrison's Caves and the Hawkins/Logsdon River passages. The Roppel Cave data is from the Central Kentucky Karst Coalition.

Historic Mammoth Cave is the longest part of the system, and is not far short of the mythical 150-mile figure that advertising hyperbole claimed through much of the 19th and early 20th century (a period when only 40 miles, at most, were actually documented).

# Human Impact on the Cave Ecosystems

*by*
*Kevin Simon*

Blind albino crayfishes...Colonies of thousands of bats...Beautiful and delicate speleothems... These are only a few components of the cave ecosystems that are threatened by humans. Even seemingly harmless activities can damage these fragile and unique environments; more direct interference in caves can result in the destruction of the ecosystem.

Caves are often filled or destroyed during quarrying and construction. For example, in the process of digging a cess pit, the Bermuda telephone company discovered a cave and incorporated it into the cesspit since the cave expanded the cess pit volume (Hobbs, 1985). The excessive pumping of water from the aquifers in karst regions has led to accelerated ground subsidence and the collapse of caverns. This is a common sight in Florida where the ground suddenly collapses (often beneath valuable buildings and homes) destroying the caverns below. The construction and presence of roads and highways also have numerous impacts on cave ecosystems. Pits and caves are uncovered during the construction, allowing silt and clay to wash in, causing fish kills (Hobbs, 1991). Road salts and accidental spills on highways contaminate the groundwater flowing into caves damaging the ecosystems (Anon.,1987). Pless Cave, Lawrence County, Indiana, had 4700 gallons of gasoline wash through it in 1985, wiping out the crustacean population in the cave. The source of the spill was a gas station located on a nearby highway (Hobbs, 1987).

There are numerous other sources of groundwater contamination that can damage cave ecosystems. Agricultural runoff, heavy metals, and other toxic materials from industries are only a few examples. Organic pollution is another problem in cave ecosystems. Increased decomposition accompanies the excess organic material. This results in the depletion of oxygen in the water, without which the cave organisms die. This is complicated by the often long residence time of cave water. Since the oxygen poor water is not exchanged quickly for more suitable water, poor conditions exist for long periods of time compounding the problem. Hidden River Cave in Kentucky is an unfortunate example of a cave with severely contaminated water. Creamery waste, sewage, and heavy metals have transformed the cave water into a thick sludge unsuitable for cave fauna (Hobbs, 1991).

Cans, bottles, and other trash are common sights in many caves. Sinkholes are often used as trash pits by those with the "out of sight, out of mind" mentality. Unfortunately, potentially damaging materials dumped into these sinkholes flow into the caves, damaging the cave population as well as ending up in well water. Graffiti and broken speleothems (some of which take centuries to form and are irreplaceable) are not unusual sites in caves. Vandals have even been know to enter caves in Kentucky and kill thousands of bats as they hibernate.

Bats are also threatened by poisoning, flooding, and commercializing of caves (Mohr, 1972). The removal of bats from caves can severely affect the entire cave ecosystem. Bat guano is a major energy input in caves. It has been found that populations of all cave fauna decline with the loss of bats (Hobbs, 1991). Perhaps one of the greatest threats to the bat are cavers themselves (Mohr, 1972). The bat populations can be so disturbed by cavers that they leave the cave permanently, removing a large and significant energy source from the cave. These bat colonies often end up in a less suitable habitat, reducing or destroying the population. The perturbance of bats during hiberation can also be detrimental to them. When the bats are disturbed, they must expend energy that they need during their hiberation and usually die (Mohr, 1972).

Cavers threaten other cave fauna as well. The collection of organisms by "spelunkers" (this includes cave biologists as well as sport cavers) can damage fragile cave populations. Road Cave, Kentucky has experienced a significant decline of cave fish as a result of such collections (Hobbs, 1991). The calcium hydroxide from carbide lamps can also cause problems when left in caves by spelunkers. This basic materials can change the pH of the cave soil and water, threatening aquatic cave organisms.

The construction of gates and permanent closures of caves can protect or damage cave ecosystems. In many cases gate construction works well in protecting caves such as Bat Cave in Carter County, Kentucky. However, if the gate is not constructed properly, such as in Shelta Cave, Alabama, the loss of bat populations can occur (Hobbs and Bagley, 1989).

Dams can have tremendous impacts on cave systems. A good example is the proposed series of dams in the Lost River Karst area in southern Indiana (Hobbs and Wells, 1972). Had this plan not been stopped, the construction of the dams would have led to the inundation of the caves by the backwater from the dams and the filling of caves with sediment. The stocking techniques used in the reservoirs would also have led to the destruction of aquatic cave organisms. These techniques called for the use of poisons to kill all non-game species in the watershed. Had this been done, the poisoned water would have entered the caves and destroyed the fauna found there.

Any influence on the cave dwelling species is magnified for a number of reasons (Hobbs, 1991). First, caves are limited in number and area; thus, once a cave ecosystem is destroyed, a unique system is gone and it is difficult, if not impossible, to restore. Cave ecosystems are also vulnerable to local disturbances. An isolated problem (such as the gas leak near Pless Cave) can result in the loss of an entire cave community. Most cave organisms are K-strategists, meaning they have a low reproductive capacity and it takes years for an individual to attain sexual maturity. It is therefore very difficult for a cave community to recover. Many cave organisms have long life-spans. Toxic materials, even in small quantities, build up in the organisms over time and lead to their death. Therefore, it is not necessary for one large dose of toxic material to upset an ecosystem. Finally, caves depend on outside sources of energy. No photosynthesis takes place in caves, thus even a disturbance outside the cave can have tremendous impacts on the cave ecosystems.

Steps are being taken to protect cave ecosystem. Recently, a number of organizations have been instrumental in pushing through several state and federal laws, while working actively to clean up and protect caves (e.g. the National Speleological Society, Wittenberg University Speleological Society, and bat conservation societies). A number of cave organism have also been placed on endangered species lists as well.

Humans, both inside and outside the caves, have a tremendous impact on cave ecosystems. These ecosystems are especially vulnerable to disturbances for a number of reasons. Some steps to clean up and protect caves have been taken, but the problem of human disturbance of cave ecosystems has not been solved.

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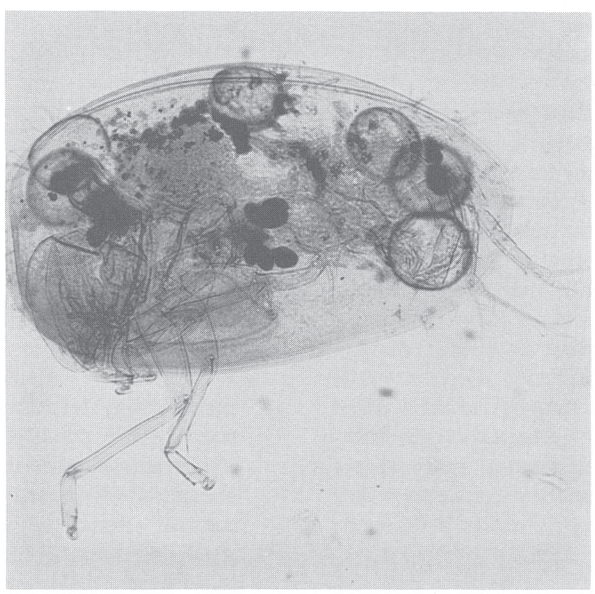


*Sagittocythere barri* an ostracod commensal on the troglobitic crayfish, *Orconectes i. inermis* in Pless Cave, Indiana. Photo by H. Hobbs III.

# Article Review

*by*
*Warren Phillips Luther*

Reid, Frank S., "The Science of Exploring Caves," in *Science PROBE!*, 1(2), April 1991, pp.63-68, 199.

Reviewing an article always gives this reviewer a good excuse to add circumstantial material and—with his readers' indulgence—some opinions. Frank Reid's article appears in the second issue of a new popular magazine aimed at "amateurs" in science who, like some of their illustrious predecessors, have much to contribute in all branches of science. The magazine's purpose is explained well enough, for its charter on page 4 reminds us that "a broad and enthusiastic knowledge of science, whether self-taught or acquired in a classroom, is an essential element of a balanced education," and that "many fundamental scientific discoveries and inventions have been made by amateur scientists." It is an interesting coincidence that the National Speleological Society celebrates its fiftieth anniversary this year; our Society was founded on similar principles, continually attracting men and women from many professions and occupations who share a passion for caves—"amateurs" in speleology, perhaps, but who did much to define the science and to gain international respect for their efforts. Geology, hydrology, oceanography, biology, archaeology—all these disciplines and many more constitute speleology, except for astronomy, philately, and neurosurgery—and more about the latter, anon!

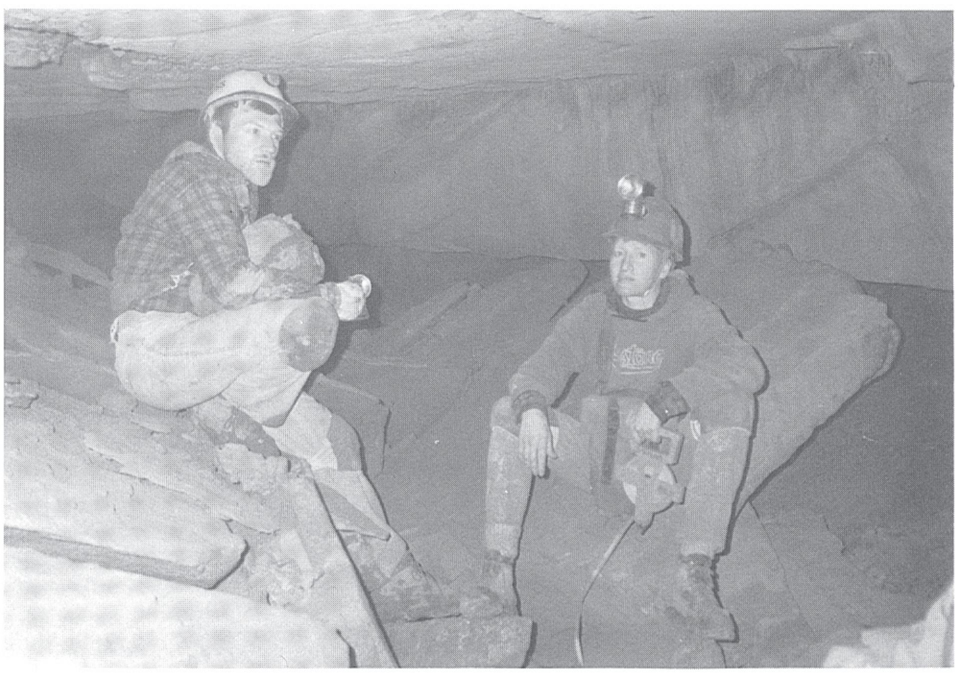
But let us, in the interest of Science, define our terms. *The Oxford English Dictionary* (second edition, 1989) explains that an amateur is "one who loves or is fond of [something]; one who has a taste for anything," and further, "one who cultivates anything as a pastime as distinguished from one who pursues it professionally, hence, sometimes used disparagingly, as [a] dabbler...." This standard definition of "amateur" seems inadequate without qualifying it, for an amateur may be as well trained as a professional, and might be inclined to pursue a certain line of study or research with greater passion (and with no need to fear censure) than a professional. Let us end this lexicographical diversion by stating blatantly that some pioneering American speleologists were fully "professional" in their methods and took their speleology very serious indeed. In 1882, respected theologian and cleric Horace Carter Hovey published the first general book on American caves, inspiring a whole series of similar volumes sponsored by N.S.S. many decades later. Among the early cave-enthusiasts drawn into the young N.S.S. was author Clair Willard ("Clay") Perry; he was no geologist, but a regional historian and adventure writer whose passion for caves (and sense of humor) comes through in his always entertaining books. Perhaps the greatest American amateur was Mammoth Cave guide Stephen Bishop, a slave who transcended his plight by learning all he could about his cave, so much so that great and learned men from several continents sought him out for the value of his first-hand observations.

The purpose of Frank Reid's article is not to popularize cave exploration, but to explain to a younger or less informed readership the many sides of speleology, and how sciences or activities as disparate as mineralogy and rock-climbing, or scuba-diving and archaeology (in fact, everything from Amphibiology to Zoömorphy) all become complementary in speleology, as the men and women who pursue them for pleasure—for a salary. It is a carefully written article, simple yet intelligent, the very kind of article that stirred the imagination of this reviewer 40 years ago, turning his interest in geology into a passion for caves. It is also the kind of article you might show your parents, if you are a youngster returning wide-eyed from your first cave adventure, clad in muddy tatters, and desperately in need of an encouraging authority—that is, an adult who dares to say that caves are worthy of exploration and study, and that YOU, dear Impressionable Reader, may strike it big down there for Science—and it may be necessary to get muddy and soaked first!

Reid, a member of the Bloomington Indiana Grotto of the N.S.S., has covered his subject well, packing much information into a well-organized series of paragraphs, each on a different aspect of speleology. First, from a narrative of a cave exploration during which virgin cave was discovered, he leads his readers into brief yet salient discussions of caves in fiction (the popular notions), the origins of various cave types, the contents of caves, prospecting for caves (by using clues from topographical maps and the local geology), archaeology, conservation, the pollution of groundwater resources, cave biology, and the importance of mapping. The latter includes the author's own application of a "magnetic-induction cave radion," useful in locating from the surface a point within a cave and ascertaining its depth as well, obviously important for underground rescues, accurate well-drilling, and the digging of new entrances. Finally, Reid admits that speleology, now in its "golden age" of discovery and exploration, remains a fertile pursuit because large (and often remote) areas of the globe have just begun to reveal their potentials; enormous and deep cave systems full of yet unseen wonders are still to be found, even in familiar regions where well-traveled caves abound.

Several photographs guaranteed to whet one's appetite for underground splendors accompany Reid's article—nothing, however, that might indicate the dangers of cave exploration because this magazine is about science, not sport. These dangers are enumerated in the largest of several boxed inserts (textbook style), because after all no science is without its hazards either in the laboratory or in the field (and always in transit between the two—"Safer in a cave than in a car," promised an old N.S.S. motto!). Other inserts direct the reader towards the N.S.S. and its affiliated organizations, or to a handful of reliable (and readable) books and articles on caves.

Of course, not all sciences welcome the amateur, so it will be interesting to see in future issues of *Science PROBE!* just where they draw the line, if anywhere. Amateurs have much to contribute at all levels—from discovery, exploration, and invention, to more sophisticated research and development—to the most arcane disciplines, except perhaps or neurosurgery which does require a rigorous course of preparation and testing, to assure us that the candidate knows the difference between ganglia and grey matter— that is, to established credentials— before his or her passion (if it may be called that) be put into practice. In this respect Reid's article begs for parody, as does the whole magazine. Imagine, Reader, if you dare, a boxed insert delineating the maxims of Neurosurgery for Beginners, to wit—"Never operate on a brain alone," or worse, "Take nothing but vivisections, leave nothing but sutures, kill nothing but galloping carcinomas." But before we disgrace THIS respected journal any further by continuing in this (uh) vein, let us not forget that among physicians and physicists are to be found the best of amateur musicians, capable of holding their own against (or with) the giants of the concert hall; it seems to be a matter of taking something serious enough to excel in it— to cultivate the "professional attitude," one might say, without restrictions. Let us also never underestimate either amateur or professional, or they may be of equal intellectual stature; one may have the advantage over the other—for it is in that case only a matter of degrees...



*Canyon Cave, Kentucky. Surveyors hard at WORK!! Photo by H. Hobbs III.*

# An Overview of Land Management Problems and Hazards in Karst Regions

*by Scott Engel*
*NSS# 32520*

**ABSTRACT**
As much as twenty percent of the earth's land surface is classified as karstic. The development and urbanization of these regions has created unique land management problems and hazards. This paper briefly outlines the origin and consequences of some of these problems and hazards. Solutions proposed include: improved public awareness and research, higher zoning and building standards, and stronger legislative measures.

**INTRODUCTION**
Karst is a term used to describe distinctive land forms and drainage patterns above and below the ground that are the result of the chemical solution of bedrock. This topography occurs almost exclusively where the bedrock consists of carbonates or evaporates and is controlled by the hydrologic cycle. It is easily recognizable by such features as caves, sinkholes, uvulas, blind valleys, dry valleys, and poljes.

The world wide distribution of karst regions is dependent upon the presence of the specific rock types and is not limited by major geographical divisions. It has been estimated by Gvozdetskii that as much as twenty percent of the earth's land surface qualifies as karst (qtd. in White, 1988: 4). Perhaps a more significant statistic is the estimation that twenty-five percent of the global population is partially or entirely dependent upon karst waters (Ford, 1989: 6).

With such a large worldwide distribution of karstic land, it is inevitable that many people have settled and exploited these regions. As with any populated land environment, there are certain problems and hazards that consequently affect the humans residents. And when humans alter and disrupt the natural topography for their purposes, these hazards are often increased both in frequency and in magnitude. This paper will briefly outline some of the common land use and management problems associated with karst regions and how they can be reduced or avoided.

**OVERVIEW**
For the purposes of this paper, the problems and hazards associated with land use management in karst regions will be divided into four groups consisting of natural, engineering, agricultural, and water related problems. Water is the underlying cause of all karstic hazards but only the primary concerns of flooding and pollution will be addressed here.

The most characteristic and easily recognized feature of a karst region is the sinkhole, also known by the scientific term doline. These depressions in the landscape are the result of the collapse of material into subsurface cavities. The rates of these collapses can range from a slow sinking over several weeks to a sudden ground failure within a few minutes or hours.

Based on the human time scale, the natural frequency of this type of downwasting is extremely slow; therefore, the catastrophic event would be rare. However, as humans continue to alter the landscape and subsequent drainage networks, there have been increased occurrences of catastrophic sinkhole collapses. Increased urbanization and industrialization in karst regions has resulted in millions of dollars in property damage. Large sums of money in the form of court costs are spent every year in an attempt to determine who is legally and financially responsible for these collapses. Nevertheless, Florida is the only state to have a specific law requiring insurance companies to cover damages from sinkhole formation (White, 1988: 368).

Many of these events have been linked to problems such as increased dissolution of bedrock due to leaking pipelines, sewers, or septic tanks, and increased runoff from parking lots and roadways. Another major cause for these collapses stems from the raising or lowering of the water table within the region. Increased ground water withdrawal in Florida over recent years has resulted in six to eighteen collapses a month. The most famous example of this occurred in Winter Park in May of 1981. Over a seventy-two hour period, a sinkhole measuring 106 meters in diameter and 30 meters deep formed in a heavily populated area destroying roads, buildings, and automobiles. The cause of the collapse is believed to be the result of a six meter lowering of the water table in the area during the preceding months. The water table has since been returned to its original level, but as with all dolines, the land can not be reclaimed (Ford, 1989: 526).

Because of the dissolution associated with carbonates, the bedrock is seldom flat, but very uneven and pock marked. This feature is sometimes referred to as cutter-and-pinnacle (White, 1988). Therefore, when building in karst regions, special precautions must be made to prevent occurrences of uneven settling. If care is not taken to anchor building foundations into the bedrock, the added weight of the structure will cause compaction of the underlying material. The compaction will tend to follow the contours of the bedrock's upper surface and result in an uneven distribution of settlement. This causes alignment problems and cracking within the structure. In severe cases it is not uncommon for sections, or even entire buildings, to sink several feet.

Karst regions frequently contain steep walled valleys. This fact, coupled with the relatively high mechanical strength of carbonate rocks, leads engineers to believe that karst regions are good places to build dams. Unfortunately, these dams usually do not hold water as well as the engineers would like. Once the dam is built and begins to fill, it raises the water table in the surrounding region. Raising the water table often causes reopening and increased dissolution of subsurface drainage channels and cave passages. Many of these simply bypass the water around the dam and drain it down valley.

Several solutions to this problem of water loss have been tried with varied degrees of success. One attempted method consisted of pumping grouting into all the subsurface drainage channels that could be found, but for every channel plugged two more remained unlocated. The most successful method has been to cut down into the bedrock during dam construction and create a wall or curtain of grouting that extends as much as one hundred meters below the dam foundation and into the surrounding valley walls. However, this can be a very difficult and expensive technique (White, 1988: 369-371).

The classic example of dam construction in karst regions is the Hales Bar Dam near Chattanooga, Tennessee. The original project, started by a private company in 1905, was estimated to cost three million dollars and was to be completed in two years. In reality it cost $11,536,889 and took eight years to finish. Soon after the dam began filling with water, boils developed downstream with water leakage estimated at 1700 cubic feet per second. The Tennessee Valley Authority took over in the late 1930's and began experimenting with solutions. By the late 1940's and millions of dollars later, the TVA finally succeeded in lowering the amount of leakage to acceptable levels (White, 1988: 369-371).

Weathering of limestones and dolomites yields good soils for agricultural use. Relatively flat karst valleys are frequently turned into farmland, while those with more rugged topography tend to be used for grazing. In either instance the protective covering provided by vegetation is destroyed and erosion takes over. The typical karst topography, in association with the lack of significant filtration, tends to increase dramatically the rate of soil erosion. Storm runoff carries soils into nearby drainage cavities where it is quickly transported. Once the soils are lost, it is almost impossible to reclaim the area and the land is usually abandoned. Consequently, many karst areas, especially in third world countries, have become barren and lifeless.

Lack of surface runoff, rapid infiltration, and the unique subsurface drainage combine to make water the largest management and human hazard problem in karst regions. The karst hydrologic system causes difficulties in water retrieval and is extremely susceptible to human impact. Additionally, because of the rapid rate of water transportation, droughts can have severe ecological effects.

A typical flood hydrograph for a karst region will almost always show a characteristic flashy response. This is due to the lack of substantial infiltration and the easy access of water to drainage channels. Under normal conditions, the karst drainage systems can handle the three to five year event without any appreciable difficulties. However, the one hundred year event tends to be of a more catastrophic nature since the subsurface drainage is limited by the size and capacity of the solution cavities. So when water levels increase, it tends to pool in depressions and sinks. This is the cause of "phantom lakes" that appear in certain regions every few decades. In Centre County, Pennsylvania there is a depression two kilometers in diameter and twenty meters deep. The relatively flat bottom is normally used for agriculture, but when Hurricane Agnes passed in 1972, a lake ten meters deep and one thousand meters in diameter appeared and remained for several months (White, 1988: 386).

The urbanization of karst regions can have severe and detrimental effects on the ability of the drainage network for the area to absorb flooding events. Increased runoff from roads, parking lots, and buildings is often drained directly into sinkholes or drainage wells, which are frequently drilled through to subsurface caverns. This results in a larger volume of water draining into the system than can be accommodated, so it backs up and floods low-lying areas and depressions. High water, combined with surface collapses from the increased erosion frequently cause major property loss and damage every year in karst regions.

The rapid water movement and lack of substantial filtration frequently results in serious pollution of karstic groundwaters by human activity. These groundwater systems do not have the cleansing ability found in other regions, but simply transport the pollutants like a surface system. Unfortunately, karst systems quickly flush the pollutants out of sight, and therefore, out of the mind of the dumpers. Consequently, attempts to clean up these regions and to prevent further dumping typically meets with failure.

Sinkholes have historically been used as dump sites, particularly in agricultural regions where these unfarmable depressions are seen as wasted space. Even municipal dumps have been located in sinkholes. Both solid and liquid wastes are routinely disposed of in sinkholes and either wash or slump directly into the underlying conduits. Once in the conduit system, the material gets absorbed into the sediment and decays, providing a source of contamination for long time periods. More importantly, the often intricate subsurface drainage systems allow the pollutants to travel great distances before resurfacing, making source tracing difficult, if not impossible. Pollutants from several Missouri municipal dumps have been traced to springs twenty-five kilometers away (White, 1988: 391).

Another common source of pollution in karst regions is overflow and leakage from sewers, septic tanks, disposal wells, and pipes. Because of the soluble nature of carbonate rocks and soils, the introduction of water results in soil piping and the creation of solution cavities. Frequently, the leakage from these containment systems drains into the subsurface water systems with little or no filtration.

A similar situation arises in the form of gasoline and hydrocarbon pollution from broken or leaking storage tanks and pipe lines. This type of pollution is extremely disastrous because it completely destroys the fragile ecosystem in the area and makes the area unsafe for human use. There is also a risk of explosion as vapors rise through cavities toward the surface. Explosions in basements and wells have been linked to such situations. Pless cave in Indiana was flooded with 1500 gallons of gasoline from a leaking gas line in 1985 (Pender 1986). Preliminary trips into the cave recently suggest that parts of the cave are recovering. A full scale research project of the cave's attempt to recover is under way, and the results will soon be available.

## CONCLUSIONS

I. Many of the problems and hazards in karst regions, like sinkhole dumps, are the result of ignorance on the part of the people who live and work in those regions. Widespread public awareness programs need to be implemented to reduce the lack of understanding and heighten environmental awareness.

II. Scientific research in regions of karst topography is limited when compared to other areas. For example, most cave passage surveys are done by individuals with no formal scientific background, but simply an interest in caves, and many are never published. Federal and private research programs should be established to reduce this lack of knowledge.

III. Regions that rely on karstic waters for consumption and use need to increase water quality monitoring to reduce health hazards associated with water pollution.

IV. Municipal areas need stronger zoning and building codes to prevent serious damage from ground collapse. These should include restrictions on building location, stronger ground testing measures prior to construction, and limitations on waste disposal and sewage treatment.

V. Higher standards and monitoring of agricultural practices within karst regions is needed. Some limitations on the use of fertilizers on areas with known sinkhole development should be included.

VI. There are currently twenty-three states that have Cave Protection legislation (Stack 1991). With the exception of Florida, no state protects the individual from related hazards. These numbers should be increased to include all states with karst topography.

VII. Clean-up programs need to be implemented in the areas to prevent continued contamination from old dumps and spills.

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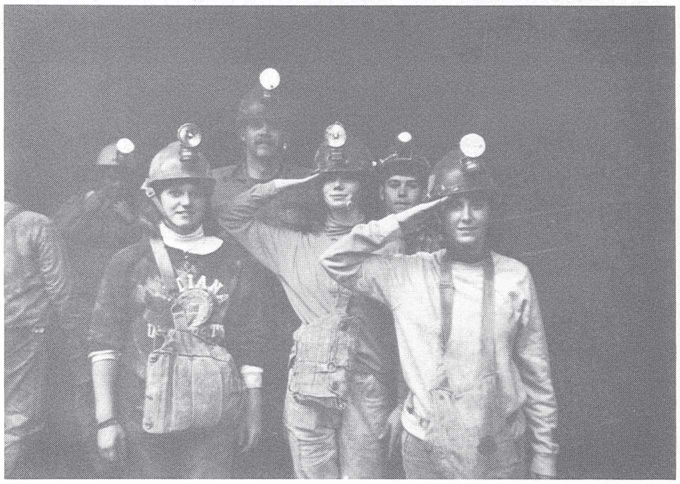
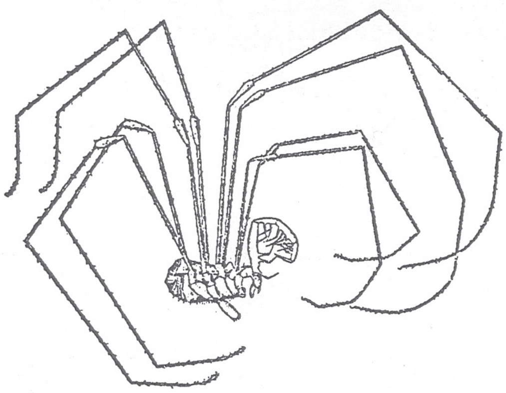
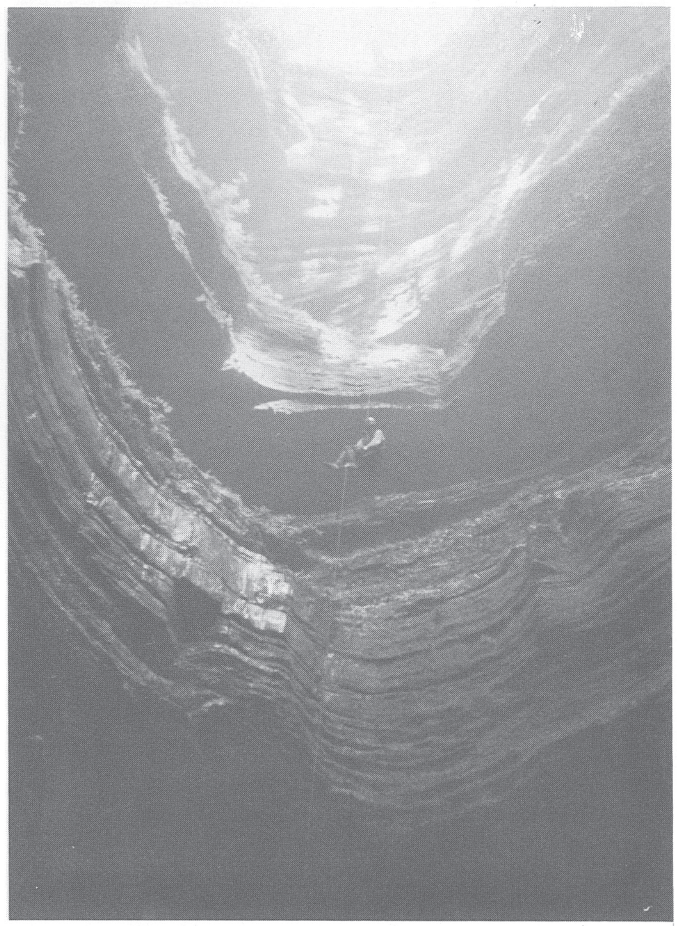
# WUSS SALUTES



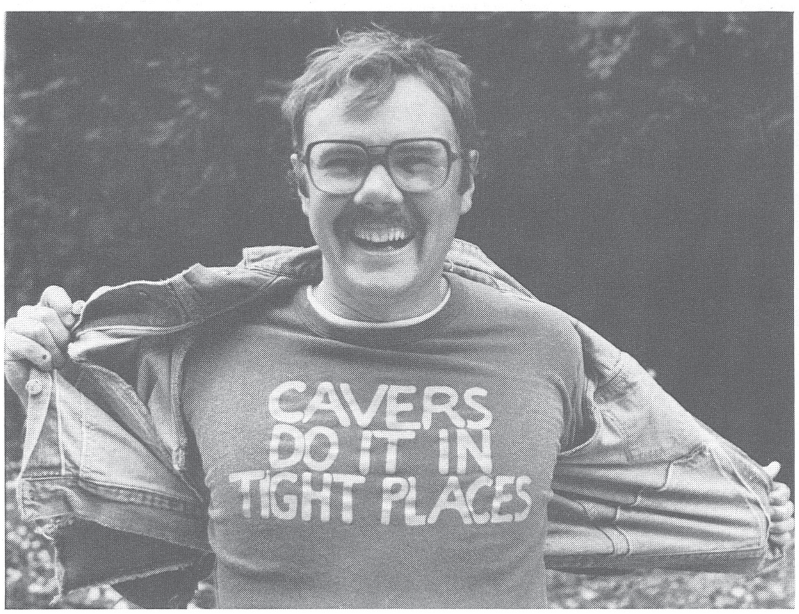
Δ W.U.S.S. Salutes ten years!



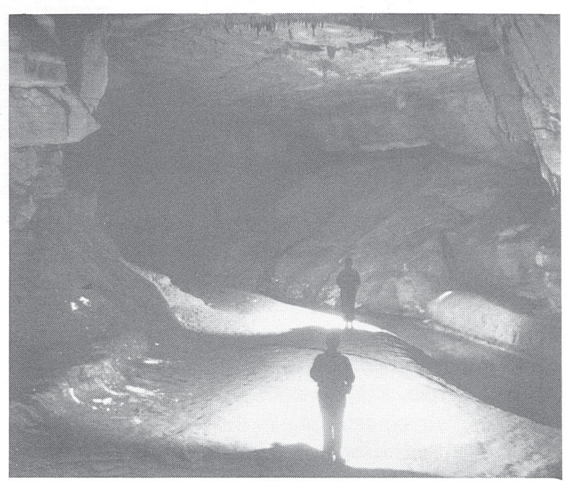


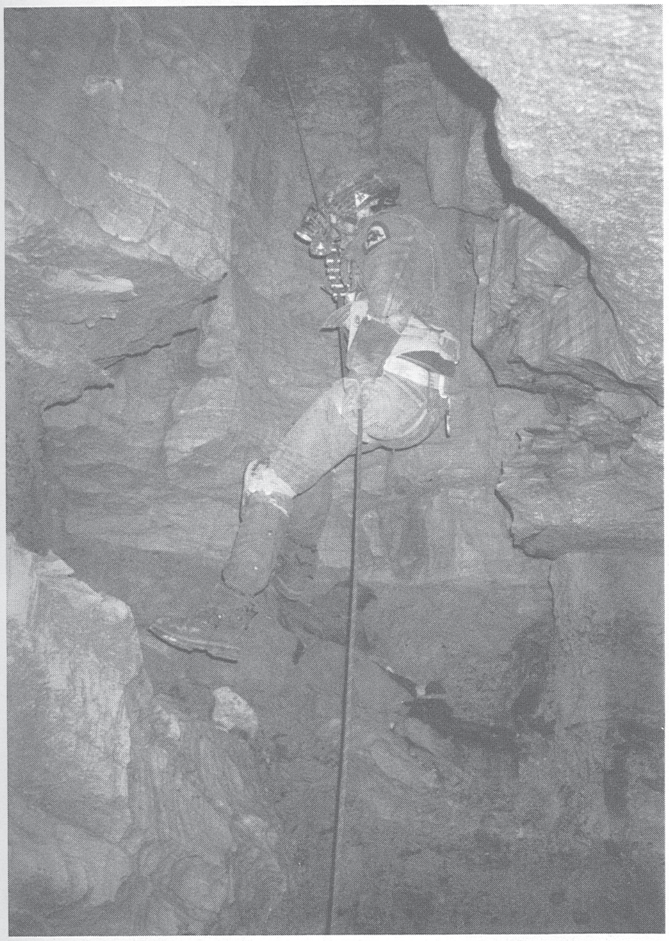
Δ Neversink Pit in Alabama

∇ Our fearless leader



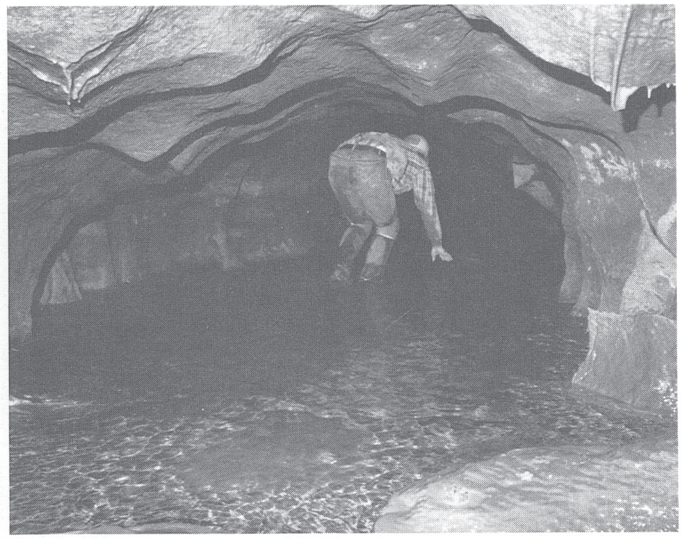

∇ Salamander-Crystal Cave in Indiana





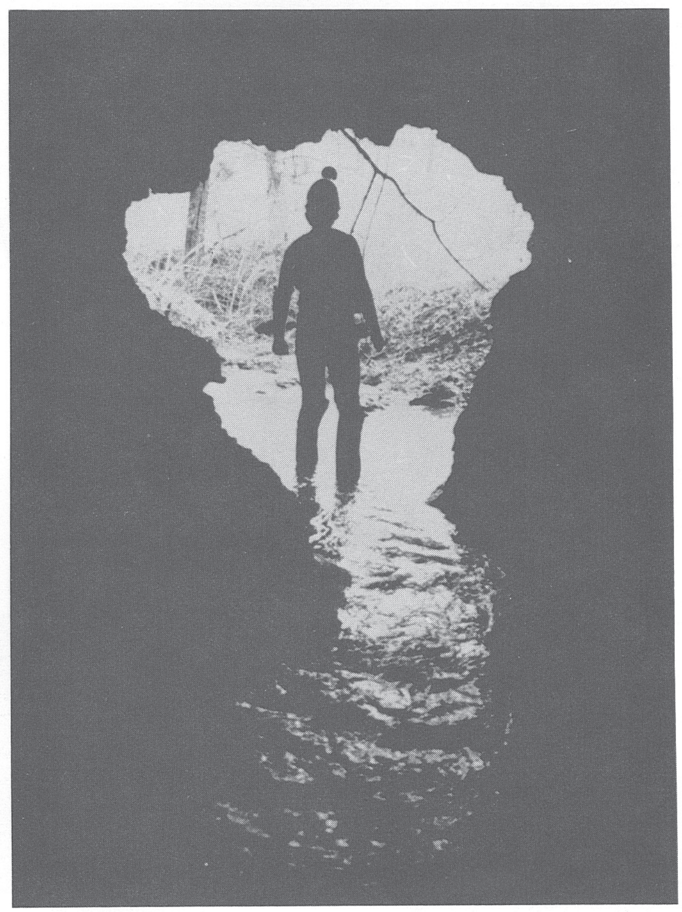
Δ Saltpetre Cave in Carter County, Kentucky

∇ W.U.S.S. members after a day of caving

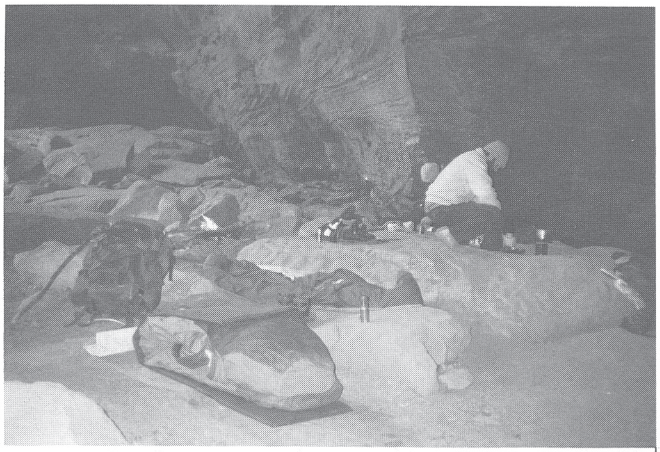


Δ Cave in Ohio

∇ Freelands Cave in Ohio

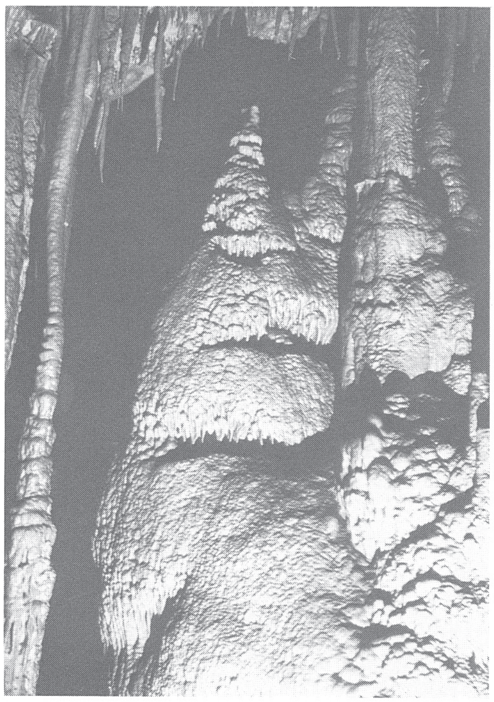


# TEN YEARS

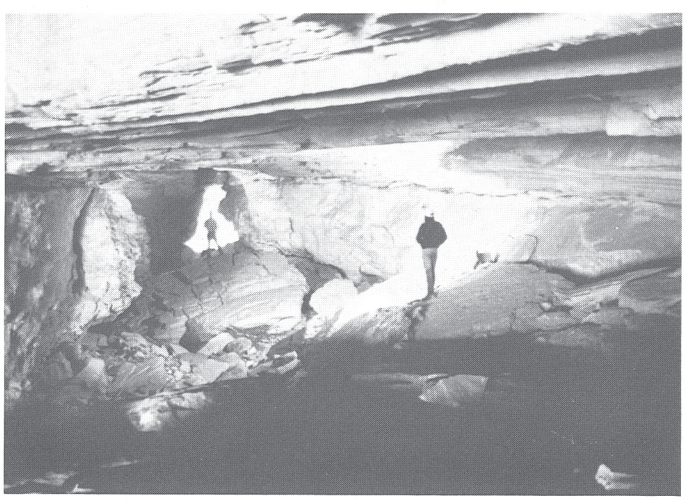


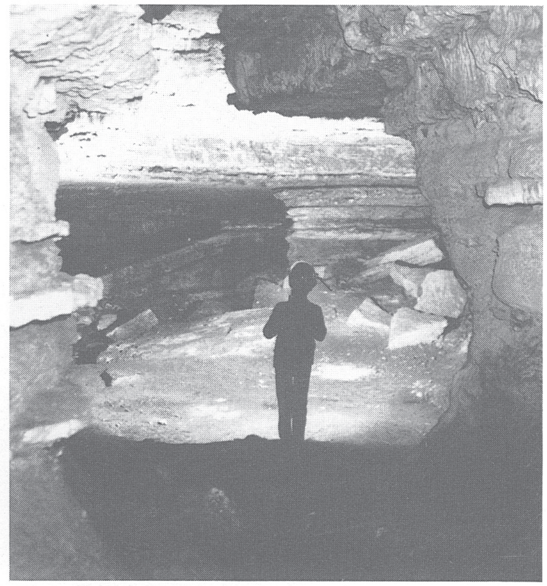
Δ Camping in Red River Gorge in Kentucky

∇ Cedar Ridge Cave, Tennessee

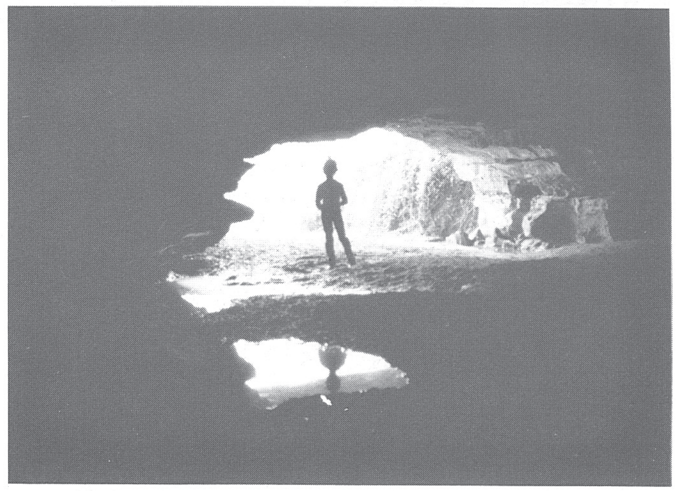


∇ Natural Tunnel in Carter County in Kentucky



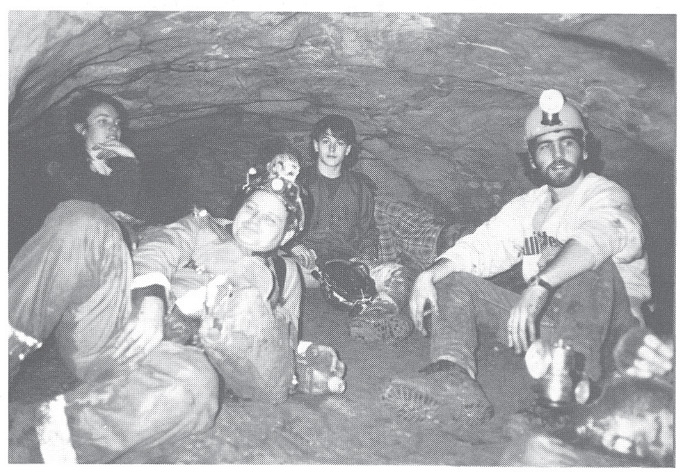


Δ Trout Cave in Pendleton County, WV



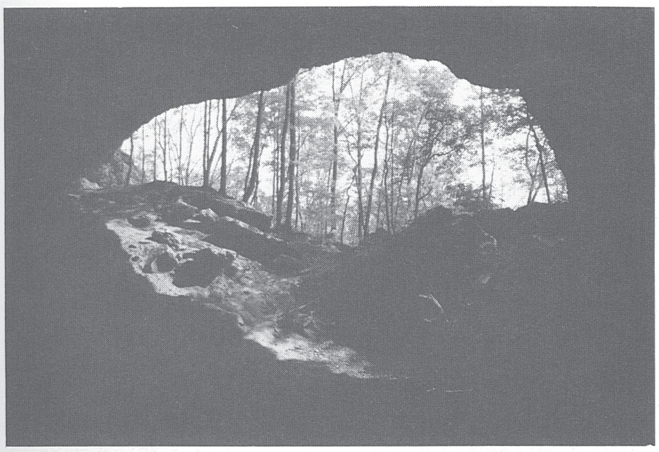
Δ Old Town Cave, Indiana

∇ Relaxing in Sloan's Cave in Kentucky

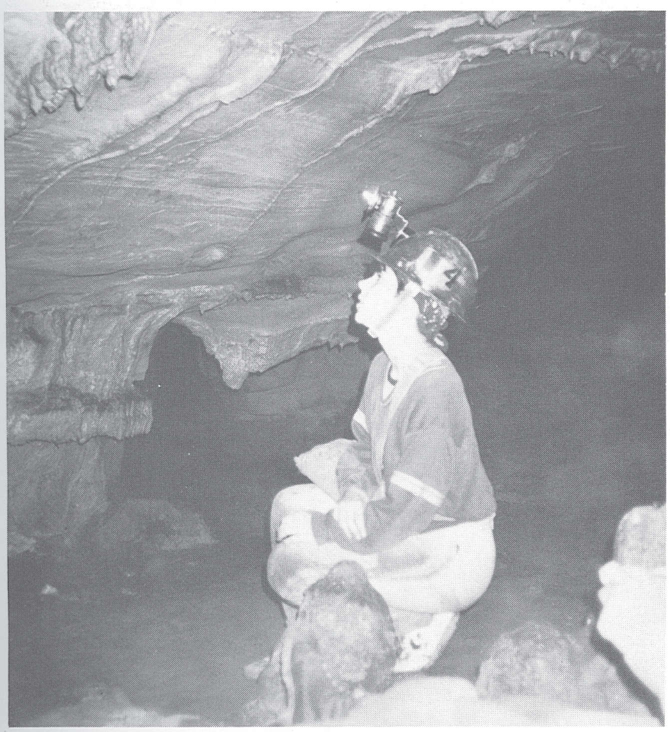


Δ Three Bumps on a log

∇ Natural Bridge in Carter Co. State Park in Kentucky

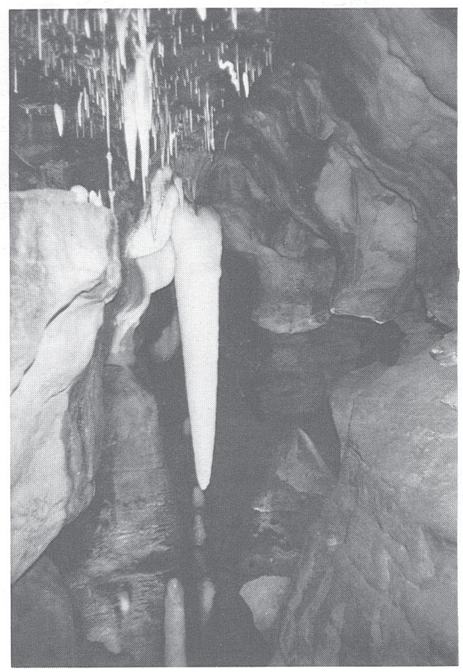


∇ Bat Cave in Kentucky

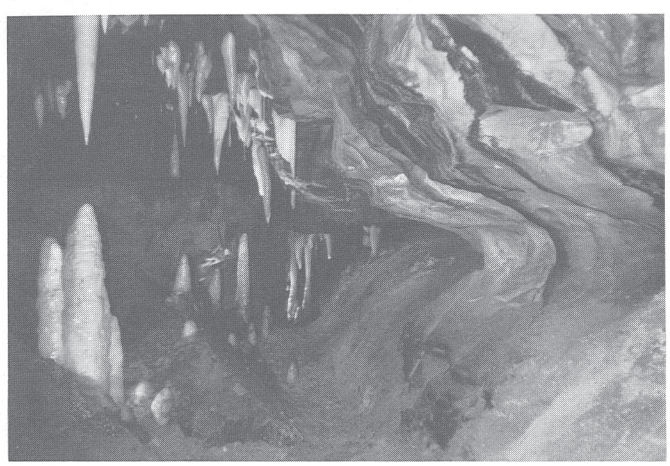


Δ Learning the ropes

∇ The Crystal King in Ohio Caverns



∇ Ohio Caverns in Liberty, Ohio



# A Review of "Charting the Splendors of Lechuguilla Cave" published in National Geographic, March 1991

*by Philip Mumford*
*NSS 31113*

Spectacular, magnificent, awesome are only a few of the words that serve to describe the photographs of the wonders of Lechuguilla Cave presented in the article. The author, Tom Cahill, and photographer, Michael Nichols, joined other cavers for several four-to-five day expeditions into the cave, exploring and mapping its passages.

Lechuguilla is located five miles from Carlsbad Cavern, New Mexico within the National Park Service boundary. Entrance into the cave is controlled by permit from Lechuguilla Cave Project (LCP) which has the responsibility to map and conserve the cave. The pristine and delicate environment of the cave has spurned efforts to preserve and protect its beauty for the future. Everything that is taken into the cave is removed and care is taken to minimize damage to any feature along the way. Tarps are laid down to catch the crumbs from meals, special non-marking boots are used, clothes are removed to avoid fouling the water if a lake must be crossed, and plastic bags serve as toilets for removal of human waste from the cave.

Such care is taken because biodegradation is very slow in Lechuguilla due to the rubble clogged entrance pit which existed before it was breached on May 25, 1986 by Dave Allured, and others. These cavers were digging at the bottom of a 90-foot deep pit once called Misery Hole, then Lechuguilla. Large cave was expected somewhere below the rubble due to winds whistling through the rubble as the cave "breathed"—that is when the surface barometric pressure changed, the air inside the cave attempted to equilibrate with the environment either by inhaling at high barometric pressure or by exhaling at low barometric pressure. The hole through the rubble has since been replaced by a gated, narrow culvert. Winds speeds as high as 65 miles-per-hour have been recorded at this entrance.

Lechuguilla was formed not by the action of the ground water percolating along faults and bedding planes in the limestone forming carbonic acid to dissolve the rock as are most caves, but by the more powerfully corrosive sulfuric acid produced when hydrogen sulfide rose from nearby subterranean oil reservoirs along the Guadalupe escarpment and reached the water table. This process dissolves the rock from the bottom up creating a pattern of rooms and passages which are difficult to predict and very difficult to explore. Caving in Lechuguilla is likened by the author to climbing up on top of a table, crawling across, and then climbing back down. It does not seem too bad except that it is an endless repetition of climbing, crawling, climbing, in the dark drop-offs to traverse and 68 degree temperature with 100 percent relative humidity to endure at the same time.

In addition, the drive to preserve and protect the beauty of Lechuguilla is paramount, forcing cavers to place themselves sometimes at risk to a fall rather than mark a formation by touching it. But even with the heat, humidity, and constant maneuvering to progress through passages, the spectacular wonders of the cave beckon. Everyone who enters Lechuguilla would like to "scoop booty"— look at a new part of the cave for the first time— and, for now, the cave still holds unexplored leads for the determined explorer to investigate.

# Caver's Delight

*by Linda Bond*
*N.S.S. 31581*

One fine spring day, Polly and Bill, my husband Larry, and I had the privilege of crawling into Canyon Cave. I endured hours of hard caving and my first cave rappel. It is difficult for me to choose the precise words to describe my feelings during that underground jaunt. How about apprehension? Fear? Sheer terror?

As I crawled down that dark hole in the hillside, questions raced through my mind. What challenge or mishaps waited below? Did I dare step over the lip of the pit with my life depending on one rope? Could I crawl through tight winding tunnels without freaking out?

Apprehension began as I crawled (I didn't dare walk) to the 55 foot drop-off and used one eye to peer over the edge. Just how far and how fast could I fall? Just how many parts of me could be bruised or broken before I hit bottom?

With lots of reassurances from Larry, "Get down that xoxo rope!," I backed very, very cautiously to the lip and stopped. Fear took over. Somehow I managed to utter these words: "Larry, Larry, Larry, I'm scared." I was struck: a 55 foot drop behind me and Larry in front of me. Larry refused to let me chicken out! He yelled, "Throw some weight backwards into that rope!" I thought, "Sure, and throw my life away!" But I had no choice.

Sheer terror controlled me the next 50 feet as my left hand locked with a death grip onto that rack. Although I wore gloves, my fingerprints became permanently imprinted on Larry's rack! After I managed to get within about 14 feet of the bottom, good old Bill started encouraging me with orders like, "Get those feet spread apart!" and "Don't you dare let go of that rope!" Down. Down.
Down. "Thank God." Ground.

Of course, Canyon Cave's perils were not over with that 55 foot rapel. As we crawled through what looked like 2 foot worm holes but felt like 2 inch worm holes, apprehensive thoughts flooded my mind. "If an earthquake shook Kentucky, would I be buried under tons of rock?" "Would I lose my light?" "Would I starve to death?" "Would I ever see sunlight?" Surely, whoever scratched "Hell" on that rock above my head experienced the same fears.

Since walking upright through the tunnels proved hazardous to my head (somehow I managed to get my helmet stuck three times), I hit the cave floor crawling. Sometimes crawling on my hands and knees, sometimes on my stomach, even on my back! After crawling through what seemed like endless miles of dirty, muddy, wet passages, I heard five very welcomed words, "It's time to start out!"

In order to get out, first, I had to climb across the edge of GARGOYLE PIT. Gargoyle PIT meant fear. I inched around that seemingly bottomless pit never daring to peer over the edge. Who knew to what depths that pit sunk? Bill didn't help any with his reassuring shouts of "Gee, don't fall, sure is a long way down to the bottom! It'd take days to rescue you!"

No caving trip is complete without one caver getting stuck. So of course, that caver had to be me, and of course, of all places, I got stuck above that bottomless Gargoyle Pit. Bill snidely remarked, "Why don't you look where you're climbing? I look around, and you're under a rock." Sure enough, as I searched for hand and foot holds, my head met an immovable rock! I saw a very small opening to my right and thought, "Sure, I can squeeze through!" Wrong. I proved too wide or that hole proved too narrow, and I was one stuck caver. Larry shook his head, maneuvered under me, and pushed me straight up. It hurt, but I kept on climbing

One last climb remained. Polly started first and kept calling out, "You can do it! It's not so bad." I had my doubts as I crouched near the edge of yet another bottomless rift. One thought filled my head, "I'm going to die in this hole." But again, with no alternative, I climbed.

Ultimately, I stepped outside into a lovely spring evening. I wearily turned to Larry and asked, "When can we tackle this cave again?"

# The Bat

*by*
*Ogden Nash*

Myself, I rather like the bat.
It's not a mouse, it's not a rat.
It has no feathers, yet, has wings,
It's quite inaudible when it sings.
It zigs and zags through evening air,
And never lands on ladies's hair.
A fact of which men spend their lives
Attempting to convince their wives.

# Calcium Carbide

*by*
*Alan Wallace*

My earliest memories of calcium carbide were of my grandfather using it in his cap light when going coon hunting. My grandfather was also a coal miner. However, I really became interested in calcium carbide after my first cave trip. Several of the experienced cavers were using it in their helmet lights. I did not know where it came from, but I knew acetylene gas was produced when water was added. Actually none of our group knew how calcium carbide was produced. One thought it was mined, and another said it was a by product of acetylene gas. So to learn more about it, I looked to Webster's dictionary.

According to Webster's, carbide is a "binary compound composed of carbon and a more electro-positive element. Example: calcium carbide." The *Condensed Chemical Dictionary* describes it as a "greyish-black crystal like compound ($CaC_2$) obtained by heating, pulverized limestone or quicklime with carbon, coke, or anthricite in an electric furnace: used to generate acetylene gas and to desulphur iron ore and in the manufacture of hydrogen and graphite." A chemist friend from our caving group found several additional sources of information for me.

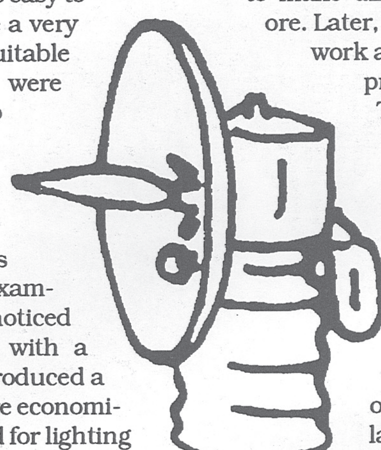
The first calcium carbide was actually produced by an accident, as were many products of the nineteenth century. In 1892, a French scientist, Henry Moissan, was experimenting with electric furnaces. The furnaces were typically lined with limestone. Limestone was easy to shape into blocks and was thought to have a very high melting point, thus, making it a suitable refractory material. The heating elements were carbon arc rods. His furnace was used to heat ores, chemicals and liquids.

Following an experiment, Moissan noticed that some of his limestone bricks had partially melted and flowed to the bottom of his furnace, where the carbon rods were located. He removed this material to examine it, possibly placing it in water to cool. He noticed it reacted violently and produced a gas with a pungent odor, and the gas, when lighted, produced a soft yellow flame. If it could be produced more economically, Moissan thought the gas could be used for lighting residences. He described his findings in a paper and applied for a patent.

Interestingly, in the same year, an American, T.L. Willson, was also experimenting with electric furnaces. He found that by combining coal, tar, and other forms of carbon with lime, he could produce a solid material that produced a flammable gas when water was added. He patented his discovery and began the manufacturing process of calcium carbide on a large scale. Apparently, Moisson and Willson were unaware of each others' experiments. Moissan's patent became lost, and Willson eventually claimed both patents.

The early production methods were crude, but functional. The furnace was a heat resistant structure. A bed of carbon (coal, coke, anthricite, and graphite) covered the bottom of the furnace. The livestone or quicklive was placed upon the carbon bed. When the furnace was heated to approximately 2000-2200 degrees Fahrenheit, the lime would melt and percolate down through the carbon bed. The carbon would not melt at these temperatures, but it would be "eroded" by the liquid livestone. By this process the limestone actually took on carbon atoms. This liquid, calcium carbide, collected at the bottom of the furnace and was "drawn off" through spigots and placed into molds of various sizes to cool. These ingots would later be broken, crushed into smaller pieces and grated into sizes for sale and shipment. Carbide is still sold in different size pieces. A modern carbide furnace can produce up to 250 tons a day and operate 24 hours a day.

The carbide industry was most productive from 1945 to 1965. By 1975, the carbide production had dropped to a third of what it was in the fifties. Calcium carbide was used extensively in industry and used limitedly in home lighting. The steel industry used it to make different types of steel and to desulpher iron ore. Later, another product, ethylene oxide was found to work as well as calcium carbide in the steel making process and was more economical to produce. This is the biggest reason for the decline of the carbide industry. Now the biggest use of calcium carbide is the production of acetylene gas for the welding industry, but don't forget the caving community!



For those readers who have never used carbide while caving, let me list some advantages and disadvantages. Carbide lights produce a cheap efficient light system. With a miner's style helmet light, one filling of carbide, approximately two tablespoons, may last two to three hours. The cost of a quart size can of carbide, usually two to three pounds, is about five dollars. This is a real savings over using batteries. Plus extra carbide is less bulky and less weight than extra batteries. What is so bad about that? Through a series of reactions, the calcium carbide changes to calcium hydroxide, $Ca(OH)_2$, a smelly, corrosive powder that is poisonous to man as well as animals and cave life. Its disposal has been an issue for years. Do not leave spent

Carbide in the caves! Carry it in a ziplock bag and dispose of it properly outside the cave. Some cavers may prefer electric lights because they are slightly less mechanical.

So, if you are planning your first cave trip, and you have never seen a carbide light, I'm sure the first caver you meet who is wearing one will be glad to show you how it works. While you are sitting in the mud, ask him/her where calcium carbide comes from. I'm sure you will get more than one answer.

Special thanks to H., Dan, Monika, Claire, Julie, Julie T., Rachel, Tracy P., Keith, Scott, and WUSS.

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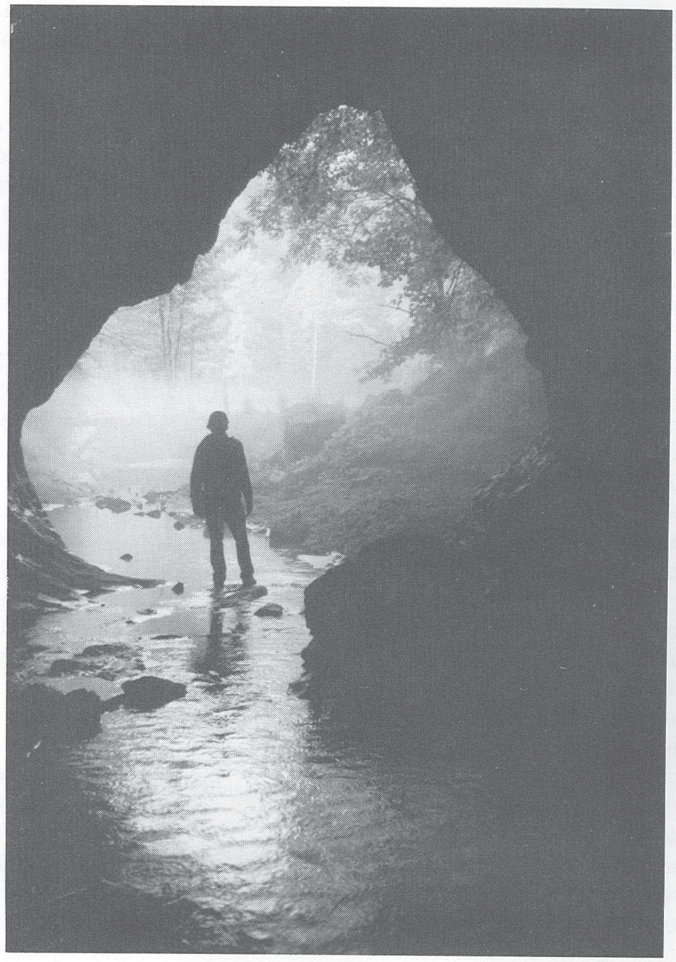
**RESOURCES:**

1) *Lighting by Acetylene*, Fredrick Dye, Publishers, Spon & Chamberlin, 1902.

2) *The Manufature of Carbide of Calcium*, Charles Binyham. Publishers, London & Raggett, 1916.



*Piercys Cave in Greenbrier Co., West Virginia.*
*Photo by H. Hobbs III.*

# Natural Encounter

*by*
*Tom Stitzel*

A solitary creature,
a hunter,
black-shadowed
in the gray haze
of
winter air,
sinewy-muscled
for
survival,
scouts for prey,
powerfully silent
in
its quest.
It pauses in its hunt,
occasionally
looks my way,
considering,
seemingly
recognizing me.
Does it see in me a ghost,
a domesticity
it
fleeting recalls
before this lone,
wild
existence?

It approaches
as one approaches
a
vague dream,
indirectly,
wary of any closeness,
but with a need
it's
suspicious
I might attempt to fulfill.
Heading in my direction
in
an arch,
almost circling,
it seems to bait me,
daring,
"Make a familiar gesture!"
Passionate brown eyes
flick glances
in
my direction,
but
never with enough commitment
to convince me
that
I exist.

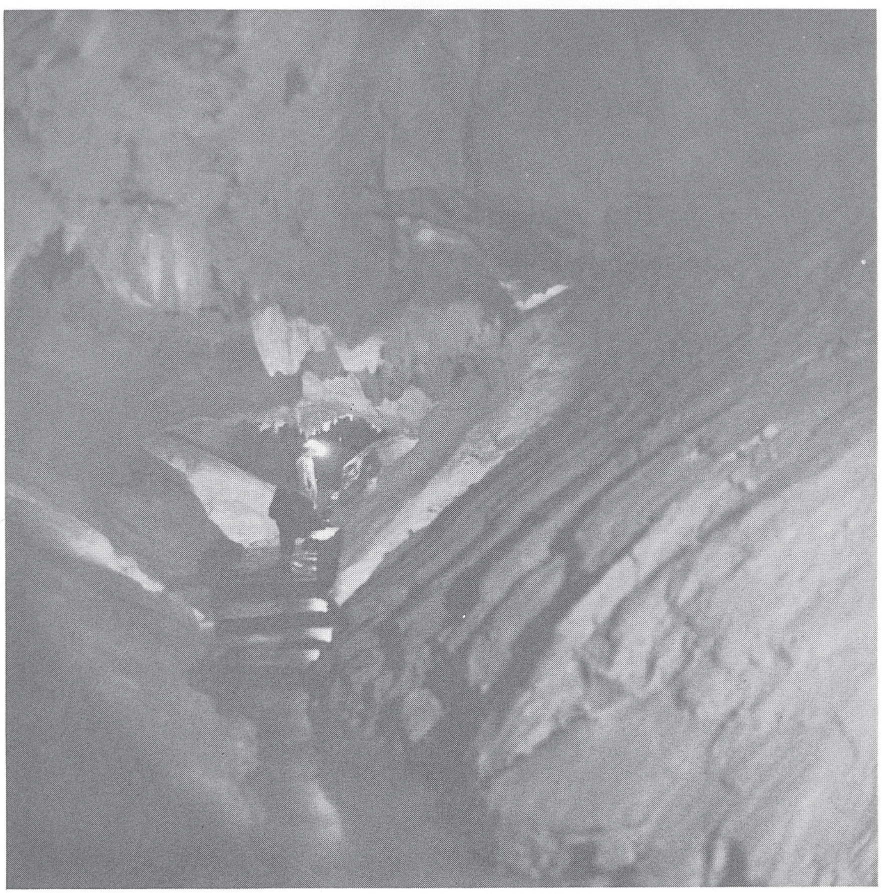
Remaining aloof,
evasive,
it traverses a course
that suddenly
sends it off on the trail
of
another quarry,
by-passing me.
The encounter is
brief,
oddly intimate.
I have witnessed it before
and
I will again as
we, both, retreat to these
same
lonely haunts.
It manifests midst my solitude
where
together, yet apart,
we share a space,
a time.
I would even say
we share a life
then
it is gone.

TAKE NOTHING BUT PICTURES

KILL NOTHING BUT TIME

LEAVE NOTHING BUT FOOTPRINTS

*Rappel into Hooper's Well, Alabama. Photo by H. Hobbs III.*



*Front section of Pless Cave, Lawrence Co., Indiana, circa 1970. Photo by H. Hobbs III.*