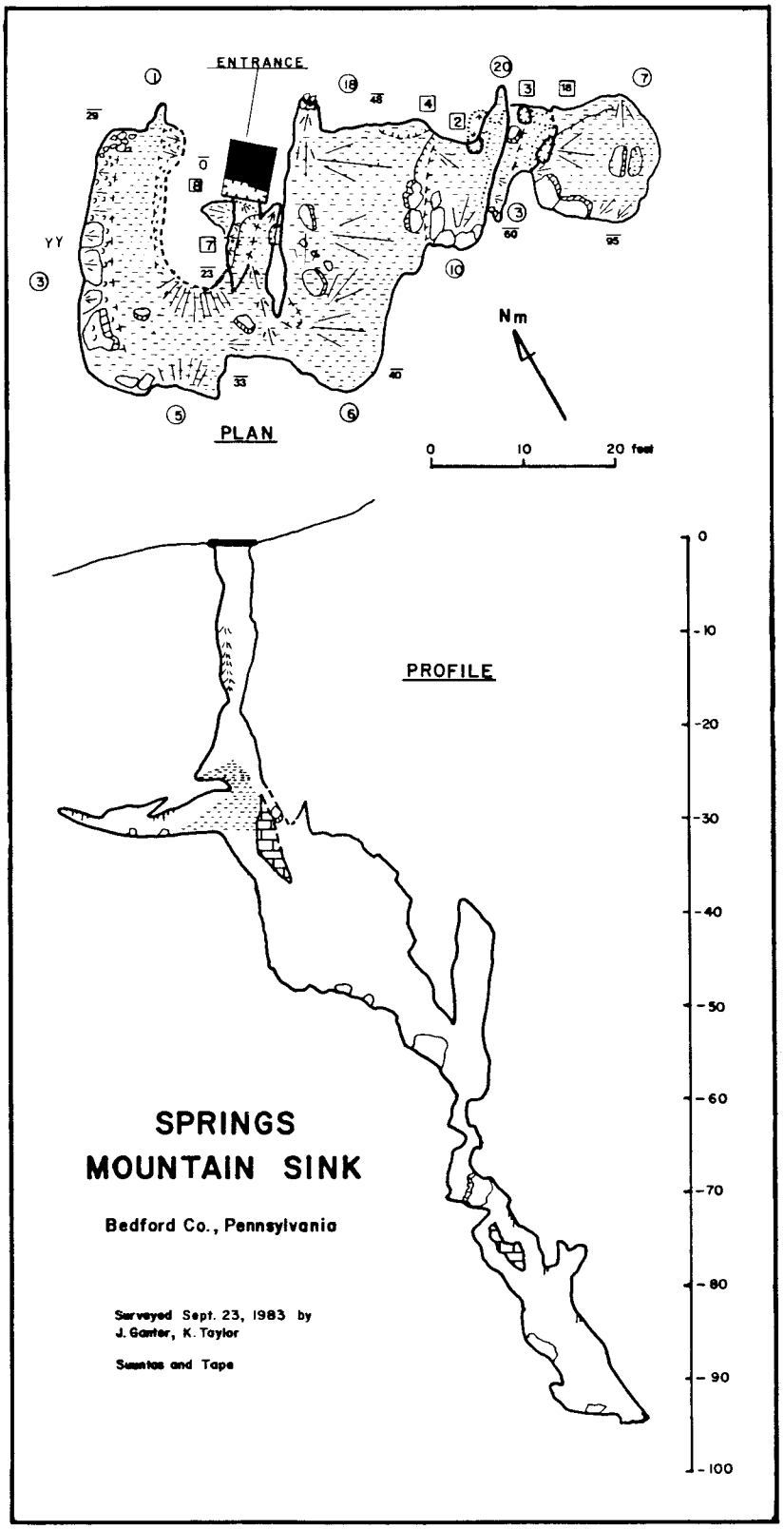
COMPASS & TAPE

Volume 1 Number 3 Winter 1984



Quarterly Newsletter Of The NSS Survey & Cartography Section

COMPASS & TAPE

Volume 1 Number 3 WINTER 1984

Compass & Tape is the quarterly newsletter of the Survey and Cartography Section of the National Speleological Society. Dues are $4.00 per year and include 4 issues. When paying dues, please give your NSS number and make checks payable to the NSS Survey and Cartography Section. Subscriptions for those who are not NSS members, grottoes, etc. are also $4.00 per year. The dues year begins at the annual NSS Convention. Those subscribing or joining the section after Convention will recieve all back issues for the year.

Submissions and General Communications

Please send articles, maps, letters, comments, dues, address changes, etc. to : John Ganter
RD 3 Box 742
Bedford, PA 15522
814-356-3553

COVER: Springs Mountain Sink, by John Ganter. Look Mom, no cross-sections ! For you geologists; what geological symbol is being misused ? (Hint: Do you think the bedding is really horizontal ?)

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From The Editor

The first thing that readers are likely to notice about COMPASS & TAPE #3 is that it is riding along with #2. The reason for this somewhat extraordinary phenomenon is that #2 was stranded on a floppy disk for so long that #3 caught up ! I apologize for this delay, and am reasonably sure that it will not occur again.

Bill Torode recently sent me his 150 citation Bibliography of Cave Surveying. Covering the years 1939 to 1982, it lists just about everything ever written on the subject, in both the US and foriegn countries. It will be featured in an upcoming COMPASS & TAPE. Also on the way is a discussion of the philosophy of cave surveying, by Doug Medville and some articles on lettering techniques, drawing profiles, funny little things you probably didn't know about topo maps, etc.

Which reminds me... we need your contributions ! Notice a certain monotony about the cover ? Send maps ! I also just found out that we can publish 11 X 14 inch sheets at no additional cost. YES-- your map can be a centerfold !

Last, but certainly not least, I'd like to thank George "Wild Man" Dasher for his excellent contribution. With at least three cave maps in the 3 to 5 mile range, George is certainly qualified to write on this subject. Read and heed...

John Ganter, Editor

NEW SUUNTO

Correct me if I'm wrong, but Suunto seems to have introduced this prismatic Clinometer fairly recently. It appears that one uses it by looking through(or past) the small, raised housing with one eye, which simultaneously sees the reading by means of the prism in the housing. I wonder if this feature will appear on Compasses, and, of course, if it has any value for cave surveys. Additional info from readers would be greatly appreciated. --Editor.

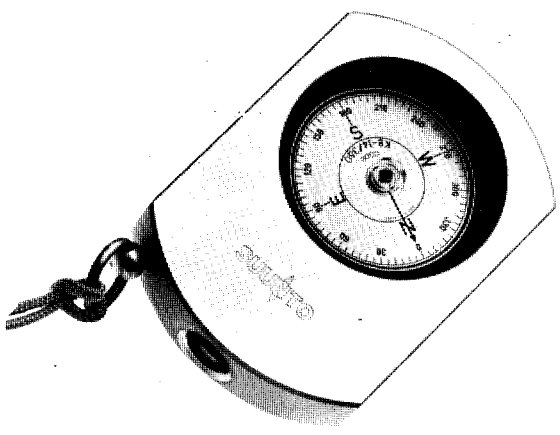
CAVES AND ARCHEOLOGICAL SITES

Certain caves and archeological sites are shown on Geological Survey topographic maps, but there is a longstanding controversy over the propriety of showing these features. Those who advocate omission of such sites are, for the most part, certain speleologists or archeologists (by no means all) who contend that showing them can lead to their damage or destruction by curiosity seekers or vandals. The view that these features should be shown as fully as practical is held by others who believe that maps should be as complete, accurate, and informative as possihle, or who have a special need for the location information.

Geological Survey practice is to show only those caves and archeological sites that are well known and that are protected and controlled by a Federal, State or local organization for educational purposes, and those that are exceptionally prominent and have marked physical landmark value. The existence of less important caves or archeological sites is not investigated. If a cave or archeological site of apparent significant interest is discovered by chance in the course of field surveys, it is reported to a cognizant public agency or scientific society for a recommendation on whether or not the feature should be shown on the map.

(From Maps For America by Morris M. Thompson, U.S. Geological Survey, 1979)

(Editors Note: The locations of Cass Cave, Cassell Cave, and the Snedegars North entrance of the Friars Hole System are shown on West Virginia 7.5' topo quads. Oddly enough, no other cave entrances (at least that I've noticed) are shown on other quads. One wonders if the USGS is adhering to their stated policy. Personally, I don't think any cave entrances should be shown. Comments ?)



THE EVOLUTION OF CAVE SURVEY TECHNIQUES IN THE WEST

by Bill Storage

Are we not men ?

Here I sit in my rented Toyota Corolla at 7:15 a.m. in the parking lot of Rockwell International Corporation. I am here for a meeting that starts at 8:00, but I am not a chronically early person. Had I not inquired to four different people about the route to Rockwell and gotten four different answers, the sense of doubt that caused me to arise early might not have materialized, and this report would have been either more coherent or non-existent. But my alarm rang at 3:00 a.m. Eastern Daylight Time, and the traffic was light. Now I'm here at Rockwell, the sun has come over the mountains, and this is California -- where art abounds.

It seems to us serious easterners that Californians continuously risk their reputations by riding the trendy waves of fashion. I recall the 1983 NSS Convention. Doug and I are somewhat confused. Patty Riley has brought a bit of California to West Virginia. Her hair stands straight up on top. Even bangs, neatly trimmed, tell us this is no accident. Easterners might call it, along with any other style that scares us, "punk." California fads are too strange for us. We fear the new.

Here in California, I was told, the caves are, except for a few holdouts of the greedy CRF, fully explored and mapped. I heard that cave exploration had all but ceased. There is little cave forming rock, and, as a result of nearby large population centers, it has been thoroughly searched. Funny thing, I thought, that on my previous weekend's trip to Soldier's Cave in Sequoia National Park, I had peered into a number of good-sized holes in breakdown to apparent virgin crawlways. Have Californians taken a serious look at Soldier's Cave ? Are they astute ?

California freeways are not terribly fair to outsiders. I knew, this morning, that I had wanted to go west on route 91. But when I got to where 91 should have been, I found a sign that said, "Artesia Frwy." I've never heard of Artesia. My choices of direction were "Fullerton" and "Compton" and I've never heard of them either. The map helped some and the other drivers were tolerant. California seems to have learned give-and-take.

As I drove, KROG announced today's featured artiste, Devo. Devo's tunes are simple melodies of a style easterners might well call "punk." Repeatedly Devo reminded me in song, "to take/ time out/ for fun." Last night I saw half of L.A., skateboarding along the

boardwalk at Redondo Beach. Here at Rockwell, employees rollerskate at lunch. In D.C. we play bridge and read the Post. Have we no fun ?

"Are we not men ?" Devo asked in the next song, Jocko Homo. The implication is that we are losing essential qualities that make us human. Machines are incapable of abstraction. They have no fun. All work and no play make Jock a dull boy.

"Are we not men ?" I recall this line as repeated by the zombies in a bad old movie starring Charles Laughton. The zombies are cheap labor for some evil guy with an island mansion. Every morning in Akron, Ohio, six thousand proles report to work at Goodyear. They play cards at lunch. They watch TV when they get home. Is this our fate ?

I recall the map of Soldier's Cave. Not very impressive by West Virginia standards. A lot of dotted lines, no ceiling heights, and no floor detail. No north arrow. Now it occurs to me why. These mappers drive the California freeways. "Ruby's Route," the map says, and then there's a small arrow, "to Pool Room." Maybe Compton and Fullerton are down there. How could thousands of visitors leave a cave in such good shape and it's map such a mess ? It's easy. They took/ time out/ for fun.

Hundreds of cave explorers show up with their meal tickets for the first 1983 NSS Convention breakfast. Most wear blue jeans and T-shirts with words on them. Doug and I have sat down with our trays of Davis and Elkins college food. Patty Riley stands in line wearing a leopard print shirt. Keen-eyed cave explorers silently make their analyses.

Doug asks, "How does she get her hair to do that ?"

"Is that a real tattoo ?"

* * * * * * * * * *

(Note: The preceding article originally appeared in the December, 1983 D.C. SPELEOGRAPH, as the third installment in Storage's "A Short History Of American Cave Exploration." California caver Carol Vesely subsequently wrote a reply (February, 1984 SPELEOGRAPH) in which she pointed out that the Soldier's Cave map which Bill mentions was made in the 1950s, and thus best compared to the work of Davies in West Virginia, and also that California cavers took home 5 awards in the 1983 Cartographic Salon. --Editor.)

Geodetic Control

by John Ganter

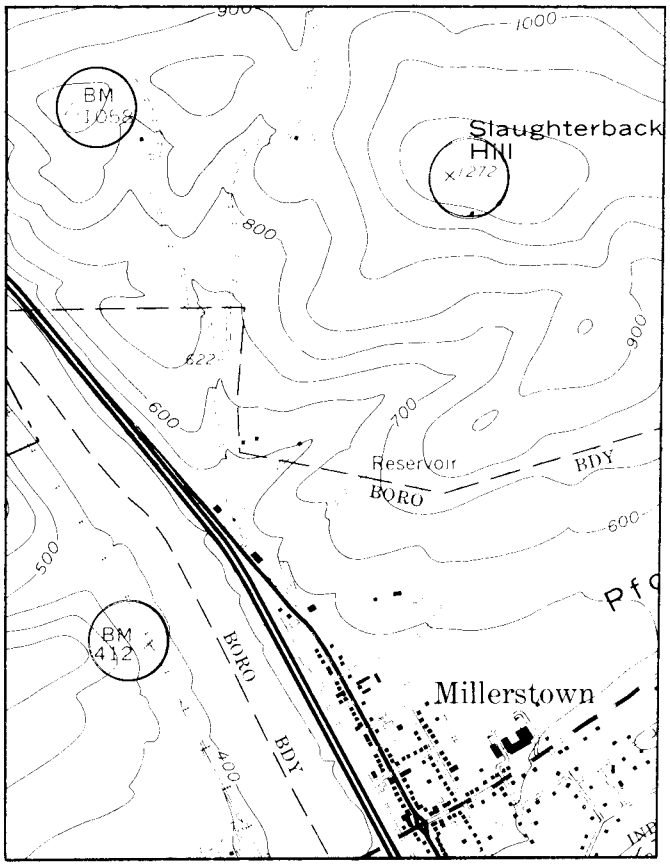
Finding the relationship of a cave to the rest of the world, or at least the county and state, is a fun and useful thing to do. This can be done in a number of ways. One is to hover over a USGS topo map and choose a likely looking spot. Taking the coordinates and elevation from this simple visual inspection will usually suffice for small caves, but if you are doing a detailed survey project, like relating multiple entrances or trying to determine where two caves are in relation to each other, you may want to make use of the system of geodetic control which covers our country.

The most visible aspect of geodetic control is the geodetic control point. These come in three flavors. A monument is a marker, typically a low concrete post, the location of which has been determined accurately in three dimensions: latitude (degrees north/south), longitude (degrees east/west), and elevation (feet above average sea level). The measurements are usually given to 1/10,000 of 1 second for the latitude and longitude, and 1/1000 of 1 foot for the elevation. (There are 60 minutes in 1 degree, and 60 seconds in 1 minute.) A benchmark, typically a bronze disk set in any bizarre location that can be found, has it's location defined in only one dimension; elevation. This is given, like the monument, to 1/1000 of 1 foot. A spot elevation is just that; the elevation of a spot on the earth, often a saddle, hilltop, or road intersection, with no marker. These are given to the nearest foot, and should be accurate enough for most cave surveys. Use of a spot elevation is much more accurate than trying to interpolate between contour lines, which are generallized when the map is created from the elevation data.

These geodetic control points are established by a number of state and federal agencies, mainly the US Geological Survey and the National Geodetic Survey (formerly known as the US Coast and Geodetic Survey.) These agencies publish separate lists, although they often reference each other's points and those of other agencies.

So let's say you have found a tablet or monument and wish to know it's location. Check the appropriate 7.5 minute topo quad. The control point may or may not be labeled on the map. If it is, the elevation to the nearest foot will be noted. (Ocasionally, the elevation will be given on the

marker itself.) If the control point that you have found is not shown on the map, copy all of the information on it and write to the appropriate agency (see list at end of this article). If you can't find a control point in your area of interest, don't despair. They are very good at hiding, and, at least in my limited experience, are often not shown on quads. The USGS and National Geodetic Survey can help- they publish lists and maps which give the locations and descriptions of all of their marks. The lists are divided into horizontal and vertical control. So if, for example, you're in need of elevations only, for a certain area, write to both the USGS and NGS and request a price for vertical control lists for that area. You may also be able to find these lists at the state geological survey, or local courthouses and the like.



LEGEND

BM △ monument

BM X benchmark

X spot elevation

(circles are for illustration only)

DESCRIPTION OF BENCH MARK

Designation K 256 State West Virginia County Pocahontas
Nearest town Slaty Fork County Pocahontas Chief of party R. Gerrish
Distance and direction from nearest town 4.3 miles north Leveling date 6-62
Character of mark A C&GS bench mark disk Stamping K 256 1962
Established by C&GS
Detailed description 4.3 miles north along the Western Maryland Railway from the Post Office at Slaty Fork, at milepost 57-19, on top of the south end of the east headwall to a railroad bridge 575 over a small stream, 6.4 feet east of the east rail, 1.2 feet west of the east end of the headwall, and about 1 foot below the level of the track.

DESCRIPTION OF BENCH MARK

Designation L 256 State West Virginia County Pocahontas
Nearest town Slaty Fork County Pocahontas Chief of party R. Gerrish
Distance and direction from nearest town 3.9 miles north Leveling date 6-62
Character of mark A C&GS bench mark disk Stamping L 256 1962
Established by C&GS
Detailed description 3.9 miles north along the Western Maryland Railway from the Post Office at Slaty Fork, at milepost 57-4, on top of the southwest end of the southeast abutment to a railroad bridge 571 over the Elk River, 5 feet southwest of the southwest rail, 1.6 feet northeast of the southwest end of the abutment, and about ½ foot below the level of the rail.

DESCRIPTION OF BENCH MARK

Designation M 256 State West Virginia County Pocahontas
Nearest town Slaty Fork County Pocahontas Chief of party R. Gerrish
Distance and direction from nearest town 3.0 miles north Leveling date 6-62
Character of mark A C&GS bench mark disk Stamping M 256 1962
Established by C&GS
Detailed description 3.0 miles north along the Western Maryland Railway from the Post Office at Slaty Fork, on the inside of a long curve with tangents extending north and west, between the track and the Elk River at milepost 56-6, 102 feet southwest and across the track from the north end of a large shale cut, on top of the southwest edge of a rock that is about 15-by 7-foot wide at the northeast end, 21.4 feet west of the west rail, 10.0 feet northwest of the milepost, and about 4 feet below the level of the track.

LINE 104
(Second-order)

The field work (L-19054) was done in August and September 1962 by a party supervised by R. R. Gerrish.

These elevations are based on a supplementary adjustment of 1964.

Bench Mark	Adjusted Elevation (Meters)	(Feet)
K 258	519.937	1675.239
L 258	570.158	1870.595
M 258	646.659	2121.515

LINE 105
(Second-order)

The field work (L-19069) was done in May 1962 by a party supervised by R. R. Gerrish.

These elevations are based on a supplementary adjustment of 1964.

Bench Mark	Adjusted Elevation (Meters)	(Feet)
A 258	737.266	2418.647
Z 257	750.815	2463.302
J 256	760.101	2493.765
K 256	768.319	2520.727
L 256	771.523	2531.236
M 256	777.268	2550.087
N 256	790.495	2593.482
P 256	800.384	2625.926
Q 256	805.942	2647.442
W 245	814.080	2670.861

TYPICAL BENCHMARK DESCRIPTIONS AND ELEVATIONS

Notice that since the coordinates of the benchmarks are not known, they are described in detail.

EASTERN NATIONAL CARTOGRAPHIC INFORMATION CENTER
US Geological Survey 536 National Center, Reston, VA 22092

WESTERN NATIONAL CARTOGRAPHIC INFORMATION CENTER
US Geological Survey 345 Middlefield Rd., Menlo Park, CA 94025

NATIONAL GEODETIC SURVEY
US Dept. of Commerce, Rockville, MD 20852

Demented Mental Wanderings Of A Frustrated Cave Surveyor

by George Dasher

Upon receiving my first issue of the Survey and Cartography Section's COMPASS & TAPE, I felt compelled to write a "Helpful Hints" article. I forcefully tried to stop myself from doing so by various and sundry methods, but I seem to be on quite a letter writing binge lately. I hereby apologize to one and all who are familiar with the contents of this essay. This is not intended to be a how-do-to-it gameplan, but rather just a few odd stories from my shady and morbid past.

A cave survey can be broken down into three stages: Collecting the data, compiling the data, and drawing the work and final maps. In this article I intend to to blur all three steps into an unmanageable, but happily compatible, conglomeration.

The Survey

The first stage, collecting the data, is the in-cave portion of the project. On the majority of survey trips there are five jobs--taping, instrument reading, marking stations, sketching, and note-keeping. The last two positions are normally handled by one person. A second individual usually reads the tape, shoots backsights, and marks the station number. The third caver holds the "dumb" end of the tape and shoots the compass and inclinometer. If there are more than three cavers, these jobs are further broken up. If, like on many of my trips, there are less people, the positions are compacted.

Before starting to survey, write in the book who is on the trip, the date, where you are in the cave, WHAT CAVE YOU ARE IN, whose instruments you are using, and any other information that seems relevant at the moment. Don't squeeze all this data into the upper right hand half inch of the sketch, it is important--use a whole page. Also make sure each person's name is spelled correctly; a mis-spelled name in the survey book is offen mis-spelled on the final map.

When beginning a survey--particularly on a large project--tie your survey into an existing station. This will endear you to those people compiling the data and definitely facilitate future work. Over the long and tedious years, I have always been amazed at the number of hard core, experienced surveyors who neglect this minor detail. Many of these people are still happily mapping--I sincerely hope they have improved their technique a tad.

Don't start sketching between the first and second station, begin BEFORE the first station. Another situation that has surprised me is numerous occasions the beginning of the survey is left unsketched. This is extremely true at junctions. Each team assumes that another group has mapped the tie-in area. It is the exception, not the rule, that someone draws an important junction at the start of a survey.

Build off previous surveys and start the first at the entrance. Do not jump to a more "fun" area and leave major areas of the cave unmapped. When you discover errors and close loops--notice I do not say "if"--you will only have more of the cave to "move" on paper if you have used a hopscotch rather than a systematic method to map the cave. If possible though, try to save an easy portion for a day when enthusiasm is low or non-existent. An ideal area to preserve is one that connects to the remainder of the cave by only one station--this type of segment will not effect other areas of the cave when it is finally mapped. Don't give these easy areas to a team of unmotivated one-time surveyors--they can suffer though the nasties right along with your hard-core regulars.

Each survey station should be a individualized number--use letters liberally. Many, if not most, computers today have no trouble compiling a mixed mode survey station such as AG123 or ?12. Many people prefer to assign each survey a separate letter, occasionally using letters BEHIND the number for side passages; i.e., B12A. Another method is to simply number the stations from 1, beginning at the entrance. The first station of each consecutive survey becomes the number chronologically after the last station of the previous survey. Don't forget that each cave should have a 0.0 Datum, usually the first station, located prominently near the main entrance and displayed on the work and final maps.

If you are conservation minded and place only dots at stations, number every third or fifth station--this facilitates finding a tie-in. When terminating a survey in a linear passage, label the last two or three stations so that the next team may more easily tie-in. In a linear water passage, mark the final half dozen stations before quiting for the day. Twice I have seen cavers deep in a system become frustrated at not finding a station and mark foot high station numbers. Too much conservation can lead to this sort of thing as well as to resurveys. Only once did I take a wire brush and erase all the stations in a given area of a cave. On a later trip we re-entered the "cleaned" area thru a small crack in the breakdown and could not tie in. If you are sure of your accuracy or working in an extensive maze area, it is not necessary to close all the loops. Some very experienced surveyors and map-drafters never close loops. Unfortunately, on the above-mentioned day, I wanted to tie-in badly.

There are three ways to maintain a lead list. The first--mentally--is only practical in a small cave being mapped by very few cavers. The second is to mark the leads on the work map. I would recommend using large off-color question marks. This system works well in a cave of intermittent length, say less than three miles long. The final method, which should be used any time you map a long cave, is to maintain a written lead list AND prominently display the leads on the work map. The written list should include the lead's location, a written description of the lead, the date it was mapped, the name of leader of the team that found it, the code of survey trip, and the number or page of the trip report in the project log book. I would recommend giving all surveys a reference number or code, even in a very short cave. I have also maintained a personal trip report logbook for most of the nine years I have been caving.

More than four people mapping in a trunk passage will abort the trip--at least one person will get cold or bored and force the survey party to quit the cave early. More than three in a crawlway will have a similar result. Greater than five cavers in any manner of passage is a leapfrog survey. I try to keep everyone on my survey trips somehow busy--my theory is everyone who is doing nothing is becoming cold. Only once have I attempted to solo cave survey. I found it tedious and tiresome--finally I knocked my "point-man" candle down into a crack in the breakdown and happily aborted the trip.

There are two kinds of leapfrog surveys, each requiring two teams. In the first type, the first party maps the beginning portion of a linear passage. The second group travels several hundred feet into the passage and then begins to survey. When the first party reaches the second team's first station, they tie into it, quit mapping, and continue into the passage until they are several hundred feet past the second group. Here they begin their second survey. When the second team reaches the first station of the first party's second set of stations, this group ties in and "leaps" over the first team. The two parties continue this madness until they run out of time, enthusiasm, or passage. The second type of leapfrog survey is much simpler. Here each of the two teams map alternating leads radiating from a main passage or a large room.

How long should a tape be? A cave survey tape should not be longer than the number of feet equaled by one inch on the final map. If that map scale is one inch equals 50 feet, use a 50 foot tape and no more. If the scale is one inch equals 100 feet, a 100 foot tape can be used. Utilizing this rule will result in a better quality sketch. The lifetime of a caving tape is controlled, not by when it breaks, but by how fast the numbers abrade from the tape. If you want the tape to last, wash it! An inch is a totally worthless unit on a cave survey--buy tapes only in tenths or meters. Purchase fiberglass survey tapes; steel is antiquated and is hard to handle--they kink and then break quite commonly. While mapping, continually scan the tape to make sure it has not become knotted.

Blunders

The most common cave surveying blunder occurs because a portion of the the tape has broken off. Knot the tape or cut it off at an even increment near the break. Note in the book what has been done, and then write each number as it is read. Trying to remember a certain "starting position" on the tape will become a dismal failure as the team becomes tired. DO NO adding or subtracting in the cave--even of small or even increments.

A second cause of errors is thru mis-communication. The notekeeper should always call back any number shouted to him. If the tape person yells "12.6", the notekeeper should shout back "one-two-point-six"; i.e., the number should always be called back in a different mode. The instrument man or tape man should LISTEN to make sure the number was shouted back correctly. If he or she does not do this, wake him or her up. Use violence if necessary. Unfortunately, there are a few people who can even say "OK" or "Roger" to the notekeeper in their sleep. Some, upon request, will begin to pay attention; others will agree with the same absent-mindedness. I have found no sure-fire method of forcing these second group of people to pay mental attention to the survey. In the occasional stream passage where the roar of the water is too loud for verbal communciation, I have had some success using hand signals--here, as is often the case in wet caves, an electric lamp is an asset.

There is virtually no cure for a third type of blunder--a notekeeper who hears one number, and correctly yells it back, and then writes a second number in the book. We all make these kinds of silly mistakes when we are tired.

When entering rooms, particularly complex rooms, it is not necessary to use the entire length of the tape. Bill Douty used to shorten his shots to three to five meters in rooms, just to benefit the sketcher. The longest shot is very seldom necessary and, when used, often handicaps the sketcher. A liberal use of splay shots also vasty improves the quality of the sketch. The person who is sketching should have total control over the length and location of each shot. Remember, more passages and rooms are resurveyed because of a poor sketch than for any other reason. Splay shots, as well as circumference surveys, should be carefully subtracted from each day's work so that a more accurate length of the cave can be obtained.

Zig-zagging down a linear passage helps to delineate each wall more accurately. The same technique can be used to define breakdown and streams. Remember, if God had wanted point-persons to stay dry, he wouldn't have invented novices.

Never trust the other half of a leapfrog team to chain shots using only a portion of a "long" tape. As they become tired, this team will begin to use the entire tape, chaining longer and longer distances and putting more and more of a strain on the tired sketcher. The resulting sketch will not be impressive, either in the cave or on the work map, and while remapping the passage you will have some downright impolite thoughts about the original mapping party. Keep the long tape on your party--even if it is in inches!

Sketching

However, when push comes to shove, there is only one important habit for the sketcher to cultivate--this is to SEE what is in the cave passage. Begin with the walls: many people drawn them as straight lines, but surprisingly caves usually have very irregular walls--draw them as such. THE SKETCH SHOULD ALSO SHOW WHEN A PASSAGE TURNS. Next, note what is on the floor, is it sand, silt, bedrock, or rimstone? Even that pool of water that causes the instrument person so much vocal concern in a crawlway can be included on the sketch. So can the one breakdown block on which the tape person put the station--or the carpet of breakdown you been walking on for the lifetime you have been in the cave. Do not forget drop-offs, slopes, and sudden changes in the elevation of the floor. Include speleothems and then carefully note all ceiling changes and channels. PROMINENTLY label the survey station. Finally, draw the cross-section. Remember the order: walls, floors, decorations, CEILINGS, survey stations, and cross-sections. It is most important for the sketcher to SEE at what he or she is looking.

Always sketch at a scale larger than the scale of the work and final maps. If the map will be at 50 feet to the inch, sketch at 30 feet to the inch in a trunk passage or at 5 feet to the inch in a crawlway. This is an easy way to gain detail on the map, add speed to the survey, and allow the sketcher to work with a coarser pencil point. I prefer to use a relative sketching scale, paying only general attention to compass directions and little attention to precision scaling of cave features. I also feel this method more easily facilitates drawing the work map. You do have to pay close attention to left wall, right wall, floor, and ceiling dimensions--without these, precision sketches and cross-sections cannot be reconstructed on the work map.

I like to draw the work and final maps at 50 feet to the inch, 80 feet to the inch, or 10 meters to the centimeter--these last two are about the same scale. Anything larger than 50 feet to the inch is just to unweildy and anything smaller than 80 feet to the inch results in the loss of too much detail. I am not particular about metric or standard units, but before I switch totally from standard, metric light-blue graph paper will have to become much easier to obtain.

When arriving at the end of a passage, note carefully how the passage terminates. A lead ending in a four inch crack should have that slot and the distance you can see into it shown on the sketch. Write down the distance between the last station and the end of the lead and then how far you can see down the portion of the passage that is too small. A passage terminus that is completely closed off should not be displayed on the map by a question mark. This may cause a later survey team to waste an entire caving trip rechecking that passage. It is often wise to mark on the sketch, and then the work map, if the lead is blastable or digable. A written description of the passage terminus will often be helpful in later years, especially if the project endures beyond your caving career. In addition, make mention of rigging points--or lack off--for any vertical pitch encountered while surveying.

Recording Data

During my caving lifetime, I have encountered a whole gaggle of different methods for keeping notes--the worse is the idea that each shot has to be restricted to a single line. I have found the WVACS (West Virginia Association of Cave Studies) method the best to use in the cave and while compiling the data after the mapping trip. Where it really shines, is several months or years later when you are reviewing the data for someone's compass error or mean tape length study. I suspect the method used by the CKKC (Central Kentucky Karst Coalition) is very similar to the WVACS system. The from-station is placed on the left of a single line, while on the right of that line two spaces are used for left/right and floor/ceiling. Care should be used while compiling the data because some cave surveyors use floor/passage-height. Passage-Height is the entire height of the cave passage, not the distance from the station to the ceiling. The line below the station information contains only the taped distance and the instrument readings. The to-station line is formated the same as the from-station line and is below the instrument reading line. This to-station line is also the from-station line for the instrument reading line below it. Using this system always results in a left/right floor/ceiling for each station. Some methods do not do this. Backsights are circled and the inclination of each circled backsight is known to be a backsight. An example of this notekeeping manner is displayed in Figure One.

To reiterate, NO adding or subtraction of compass or tape readings should be done in the cave. Tired people make ridiculously simple mistakes. If the middle of the tape is used to chain a shot, do not do any calculations, write the number as 36.4-15.6. This is just a valid number as 20.8, but this method will allow rechecking of the raw data if a mistake is encountered. On backsights, write the uncorrected backsight. Not marking the backsight or writing down a corrected backsight eliminates any chance of locating errors once out of the cave. If it is worth your time to take backsights, WRITE them down--data lost can not help correct mistakes. And mistakes unretrievable outside of the cave are resurveys in the cave.

I use a slightly different method of writing left/right floor/ceiling. One, I might add, that enhances my manner of sketching. If it is two feet to a false ceiling and 4 feet to the real ceiling, I mark down 2/4. Similarly, if the station is on a breakdown block or shelf which extends to the left and the left wall is three feet away, I will write 0/3 for the left wall. One half foot is written as .5. Typically, my left/right floor/ceiling will be: 2 0/3 2/4 0/.5. A cross-section of this particular passage is shown in Figure Two. A intersecting passage is marked as "P" and is always be written as X/P, where X is the distance to the hypothetical wall of the passage you are surveying. Some people mix metric tape measurements with English unit left/right floor/ceilings--I think this is a very poor idea.

In the cave, take cross-sections at every station, you never know what cross-section will fit or will not fit on to the map. So it is handy to have a good number available. Bill Douty used to have oodles of chronological circled numbers on his work maps. From these numbers, he would access a 3 by 5 inch file system. Each file card contained only a number and a cross-section, drawn to scale. When drawing the final map, Bill would reference his file system for any and all needed cross-sections.

Another of Bill Douty's ideas was to use a regular drawing or drafting pencil for in-cave sketching. He kept the point sharp by scratching it on a sheet of fine-grain sandpaper glued into the back of the survey book. Bill was very proud of this technique. I have always used mechanical pencils, but I am becoming more and more flustrated with the expensive and temperamental little devils. I suspect that soon I will switch to Bill's method. Bill also claimed that a person should never erase while sketching; but then he occasionally did have some really weird ideas.

Draw The Map !!

Make sure your in-cave work is compiled and drawn into a work map. THIS IS THE MOST IMPORTANT RULE OF CAVE SURVEYING. Again, I have always been astounded by the number of people, who after doing a ton of surveying, make absolutely no effort to see their data added to a work map. I suspect there is much more unused survey data permanently stored on closet shelves or in cluttered basements than incorporated into all of this country's cave maps. Nothing in cave surveying suffocates enthusiasm as quickly as a large amount of uncompiled and undrawn data, usually optimisticly and hopefully drawn into the work map by one person within a relative short time period.

Concerning Suuntos--there is no use for a brunton on a cave survey other than to increase the frustration factor of the entire mapping party. Always seal your Suuntos with waterproof bathroom caulk. Roberta Swicegood was correct that epoxy does fail in time--actually it super-drys and falls off. In addition, epoxy only severely hinders anyone attempting to take the Suuntos apart for cleaning. Roberta was also right in that at best, this is only waterproofing--the only sure method of keeping instruments dry is to keep them out of the water. I remember once in a high canyon streamway in Laurel Creek Cave where the water was but two feet deep, I discovered I was suddenly alone--Jim Via, the only other person on the survey, had mysteriously disappeared. I finally located him literally at my feet; he had tripped and fallen face down in the water; only a hand was above the water--but it held my Suuntos. That is how you keep the instruments dry! By the way, cavers only get hypothemia on tourist trips, photo trips, and during rescues--cave surveyors just keep on shakin' and shootin'.

Remember, you have to hold a Suunto compass level to achieve an accurate reading. The crosshair should be perpendicular to the dial and the dial should float freely. Moving the compass slightly in one direction and then in the opposite direction before reading the azimuth is an easy leveling check. If the instrument is level, the dial will move; if it is not level, the dial will stick and try to stay in one position. You can check the accuracy of a Suunto inclinometer by shooting a level station and then rotating the instrument 180 degrees and reading the back of the dial, which has an increment marking zero. This increment should line up with the same station that the conventional zero point indicated was level.

I have discovered that wire-rim glasses do not seem to effect Suuntos so much when the glasses are new, but rather the magnetic field seems to increase with the age of the glasses. I won the compass course three years ago at O.T.P., but this year came in close to last place with the same pair of glasses. A consistent five or six degree difference between foresights and backsights is very common when a metallic object is effecting one of the instruments.

You can replace the insides of worn out Suuntos for about half the price of a new pair. The result is a very high quality product. Only the aluminium case displays the age. It is the plastic eyepiece that wears out first--usually because people have scratched it while trying to remove silt or water from the outside of the lens. If water or water vapor enters one of your

instruments, evaporate it out between trips with a high intensity reading lamp. Be forewarned, once water has gotten into a Suunto, each wet trip necessitates redrying the instruments. The only cure is to take the Suunto apart, thoroughly dry it out, and rechaulk it after replacing the plastic insides. Do not leave a Suunto in a wet cave pack overnight or on the drive home. I know of at least one pair that was clear during the last shot in the cave, but after a night in a wet cave pack, were completely fogged.

Suuntos should always be cleaned after a mapping trip--on a combination photo and survey trip, clean your instruments first, your camera second, and your car last. Surprisingly, the plastic face of a Suunto will melt if a carbide lamp is held too close to the instrument--this really shortens the survey. Offer to pay for all burnt instruments--it makes the owner feel much better. If you send your worn and beaten Suuntos to Forestry Supply in Mississippi for repairs, do not ask if they think your instruments are in bad condition. Forestry will only reply "You should see the ones we receive from SCUBA divers". And to think I even sent them an inclinometer with a burnt face!

The one advantage bruntons have over Suuntos is that they can be taken apart while in the cave in an attempt to get out the water. However, by this point on most surveys, the cavers are usually more waterlogged than the instruments and it is time to leave the cave.

When shooting near vertical shots, it is sometimes possible use the tape as a plumb bob and then shoot to a point closer to horizontal. Better yet, make that second point an actual station. I make very liberal use of vertical shots; but, keep in mind the tape does make a poor plumb bob on distances greater than about fifteen feet. Occasionally, you can weight the tape with a small rock. I have to agree with Bill Steele in that there is no survey-reason to be afraid of most pits; however, it is often easier to map up a drop, rather than down. This is particularly true when against a wall. For a really long drop, I would recommend finding a professional surveying friend and borrowing a long tape. Only on vertical pitches is the longest shot usually the best. Here I would try NOT to take a vertical shot unless the pitch can be plumbed with a weighted wire or rope and there is no wind. Remember to tie people into a rope at all times and that much of the added metallic vertical gear will effect the compass. Also the tape as well as the rope will cause rock-fall. If everything begins to go wrong, you can be ABSOLUTELY SURE that at least a half dozen rocks are just waiting to jump down the pit and hit someone.

In days of olde, survey parties would only map leads that had been investigated by explorer teams. Now people try to survey while they explore. For most cases, this is a good rule; however, if morale is low or if the passage turns nasty, reconning is sometimes the best way to inspire enthusiasm and speed up the mapping process. If you know what is ahead, you can best plan how to map the passage. You can also decide whether to endure and continue or to crap out and come back on another day.

Draw the work map within the first day or two after the caving trip while your memory and enthusiasm is still fresh. This map should be updated after each trip into the cave--otherwise you are just playing surveyor and misusing your I.R.S. deduction. Herpes, appendicitis, work, or marriage are not adequate excuses for immediately drawing the work map; however, your computer going down is a a valid reason. Do not draw a cave mapped with metric units on inch-grid graph paper--this will necessitate redrawing the map at a later time. And before drafting the final map, remember the cave was mapped using magnetic north, not true north, and compensate in some manner.

Reducing The Data

All data sheets should list not only the x, y, and z coordiantes, but also the raw distance, azimuth, and inclination for quick and accurate spot checks. ALL data should be checked at least once before drawing any kind of map. In addition, my printouts list horizontal and vertical distance between each station. This is an asset when drawing scaled cross-sections and for correcting small horizonal errors that have escaped prior data checks. God created computers especially for cave surveying--all other uses are secondary. Most computers are a pain-in-the-neck and hard to use--Digital Equipment Corporation's products are an exception. Protractors, adding machines, and programable calulators are antiquated relics.

My penciled work map and inked final map, with the exception of all the corrections and erasures, are exactly the same. Some folks like to redraw their work map before beginning the final map, but I feel this is an unneeded and extra step. MAKE SURE there are vertical elevations on the cave maps--otherwise there will be no indication of how the cave trends in this dimension. In addition, each caver that takes your map underground will suffer from a moral obligation to find new passage; it is therefore wise to leave a blank area under the legend for the addition of subsequent survey trip data.

When you finally become involved in drawing the final map, do not use less than a 0 size rapidograph point if you intend on reducing the map. Then again, if--like Bill Douty--you would prefer that cavers do not reduce your map and take it into the cave, use many pens smaller than 0. I use a 2 or 2.5 pen rapidograph size for passage walls; a 1 for cross-section lines, cross-sections, and ceiling change symbols; and a 0 for passage and cross-section detail, lettering, ceiling height symbols, and so forth. Larger size pens are good for the cave name and borders. Clean thou radiographs religiously--they last longer and produce a better product if kept clean. Rub-on letters and symbols are nice, but they tend to wear off when you least expect it, particularly if you use a blueline machine to make copies from your original. I limit my rub-ons to the N.S.S. water depth symbol, which I find very difficult to draw. I prefer the N.S.S. symbols in the April 1979; Volume 41, Number 2, issue of the N.S.S. BULLETIN. These seem to be a prevalent standard of this country's cave mappers. If God and the editor of this rag were willing, a copy of the basic symbols from this bulletin are included somewhere in this issue of COMPASS AND TAPE.

I prefer to draw my work and final map on fade-out blueline graph paper and then make a ammonia or photographic mylar copy of the final map. This method allows corrections of most of the cartographic errors on a more-easily correctable paper, but to still have a heavy duty original to make copies from. In addition, I can use the cheaper steel radiograph points--they do not wear out as fast on paper--and rub-ons have only one chance to come off, that is when the mylar copy is made. It is still possible to make small changes on the mylar. Because ammonia mylars and blueprints fade over a long period of time, I have my paper original photographicly shot and reproduced. It is more expensive, but this black line copy will not fade.

Whelp, that's all I have to say--wasn't it interesting!! Didn't hurt a bit, did it?? Or did it??

STA / DIS	For Azi	Bac Azi	Inc	L R	F C
K1				½ 0	1 3
30.5	147.5	325.0	±0.0		
K2				0 3/P	1 1
12.2	131.0	311.0	-.5		
K3				2 0/3	2/4 0/.5
20.2	348.0	165.5	2.0		
K4				0/P 4	2/4 0/1
6.4	(16.5)	197.0	-18.0		
K5				½ 0	4/8 0/2
18.7	201.5	20.5	6.0		
K6				7 0/1	3/7 0/2

FIGURE ONE
WVACS Notekeeping Method

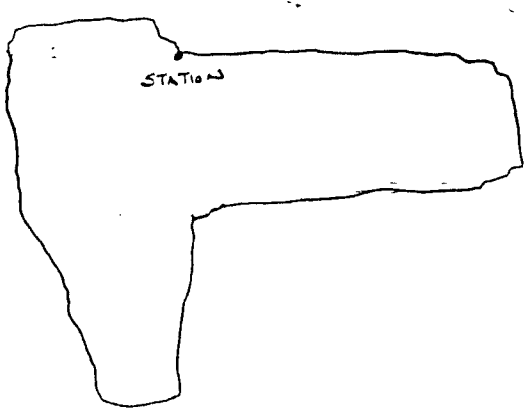


FIGURE TWO
Typical Cave Cross-Section

(Editors Note: This article also appeared in the February 1984 WEST VIRGINIA CAVER, which George edits. I have taken the liberty of adding a few subtitles to this version.)

FOUND IN BOOKSTORE DUMPSTER: Ten copies of "Surveyors Field Notes for Civil Engineering 114". Designed for a university-level surface surveying course, but contains much useful and interesting information on notetaking, contours, geodetic control, rules and tips for plotting contours, etc. FREE to section members, while they last. See the Editor or send him $1.05 to cover postage. 30 pages, double-spaced; numerous illustrations.

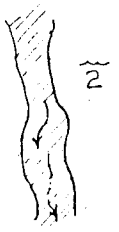
*** CAVE MAP SYMBOLS ***

[From the April 1979; Volume 41, Number 2, N.S.S. BULLETIN.]

PASSAGES --->

Entrance
Drip Line
Passage
Cross-Section
Vertical Pit
Pit Depth
Ceiling Height
Bedrock Pillar
Lower Level
Upper Level
Abrupt Drop
Upmapped Passage
Slope
Measured Slope
Continues, Too Low
Continues, Too Narrow

HYDROLOGY --->



Water Passage
Water Depth
Water Flow
Intermittent Water Flow
Small Stream
Intermittent Stream
Sump
Waterfall
Conjectural Stream
Small Rapids
Large Rapids

SPELEOTHEMS --->

Small Stalactite
Small Stalagmite
Large Stalactite
Large Stalagmite
Small Column
large Column
Stalactite over Stalagmite
Helictites
Flowstone
Draperies
Soda Straws
Shield
Boxwork
Spar
Anthodites
Rimstone Dams

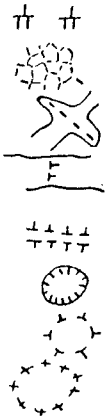
SPELEOCLASTS --->

Large Breakdown
Small Breakdown
Fallen Speleothem
Sand
Clay or Silt
Cobbles
Chert
Vertebrate Remains
Invertebrate Remains
Large Feces
Guano
Vegetal Debris

CULTURE --->

0.0 Datum
Elevation above 0.0 Datum
Elevation below 0.0 Datum
Marked Survey Station
Pavement
Artificial Wall
Paved Trail
Trail
Ladder, Lower End Open
Stairs, Lower End Open
Gate
Dam
Bridge
Saltpetre Vat
Guardrail
Pictograph or Petroglyph
Archaeological Excavation
Occupational Debris
Boardwalk
Well Pipe or Casing

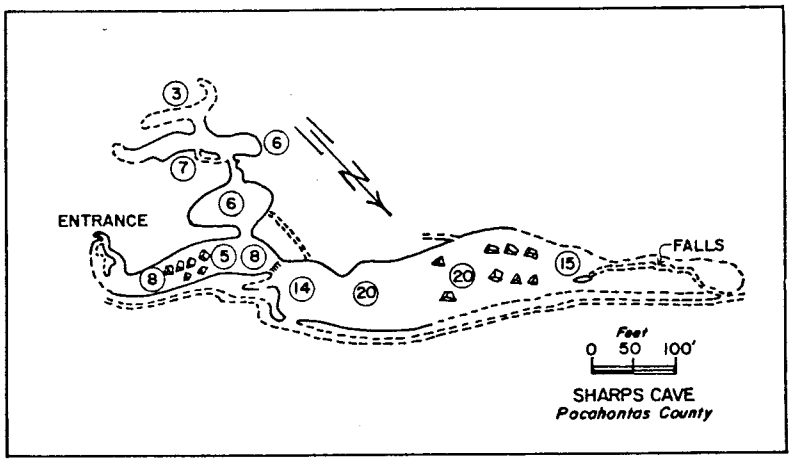
SPELEOGENS ---->



Bedrock Floor
Mudcracks
Joint-Controlled Cavity
Change-In-Ceiling (Lower Side to Hatch Marks)
Ceiling Channel
Pit
Dome
Domepit

(Drawn by George Dasher)

They took/ Time out/ For fun



COMPASS & TAPE
c/o John Ganter
RD 3 Box 742
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