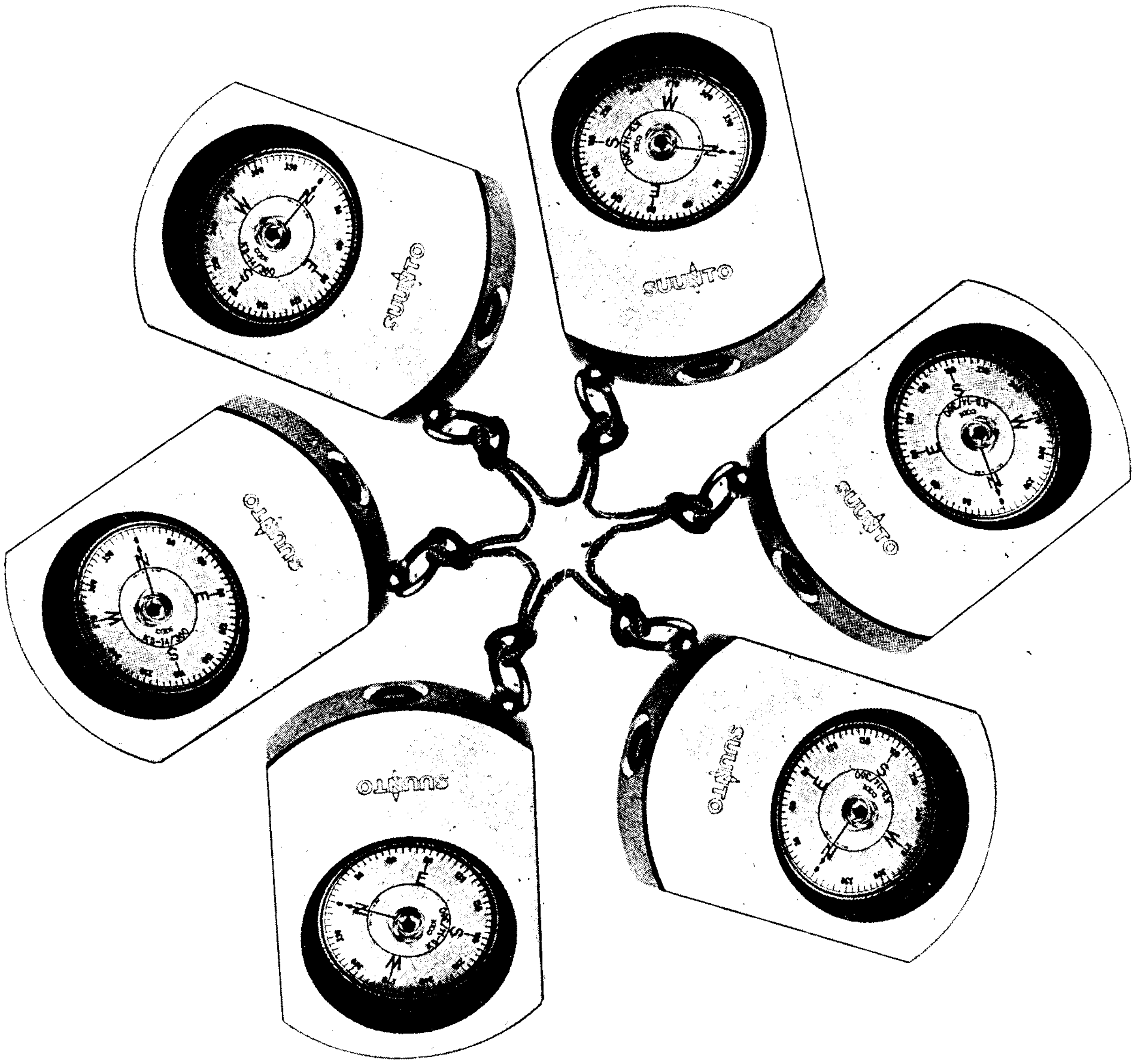
COMPASS & TAPE

Volume 10 Number 3,4 Issue 35 Winter, Spring 1993



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Survey and Cartography Section - 1992

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LRCF.'s
(LOTSA RIDICULOUS CAVE FEATURES)
by Dave Collings

One problem in the cave survey process that is not solved by the standard survey traverse is recording accurately the three dimensional aspects of passages. The survey traverse itself is a single course through the cave. It is a single line. Even when traverse lines are linked together in a cave with multiple passages, passage shapes are still not defined. There is no three dimensionality to your basic cave survey to match the actual space taken up (or not taken up, however you look at it) by the passage itself at a given point.

Our standard method of getting three dimensional passage information during a survey is to record "L-R-C-F's" (left, right, ceiling and floor distances) at each station. These distances are almost always estimated by a member of the survey party. The person drawing the map will then balance, juggle and blend these distances with the sketcher's representation of the cave in order to scale out the dimensions of the passages.

Compared to the reasonable accuracy of the survey traverse itself, our process of recording L-R-C-F's is primitive, inconsistent, and often unreliable. They rely on the visual estimates by a human being. Even at best, these estimates will vary from person to person, day to day, passage to passage, and even station to station. At worst, with someone who is inexperienced or is poor at judging distances, they will be no better than guesses.

Since the final map will reflect the quality of these distances, one could reason that they are at least of some importance. Just how much a significant error will "matter" will depend upon the scale of your final map, the amount of detail you want to show, if your data is going to be used beyond the map in some way, or if you really care or not.

In any case, too many cave mappers seem unable to give proper passage dimensions when called upon to do so (as hopefully every seasoned member of the survey party should be able to do). Or they become lost and unsure when complex situations arise. Or they aren't working well with the sketcher. Or, when the book person calls out "L-R-C-F's?" they simply respond "Huh?"

I haven't seen much written about getting good L-R-C-F. So here I go, leaping in to fill the perceived void.

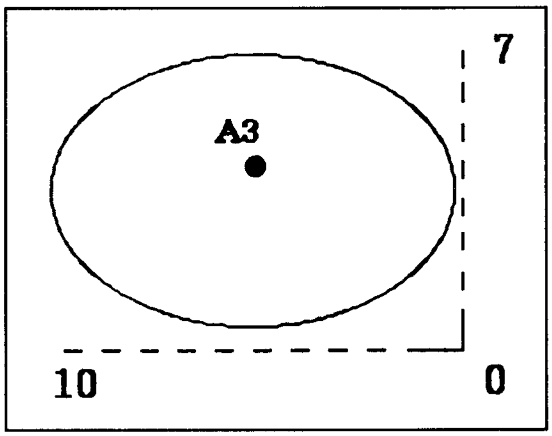
The Basics

The definition of "L-R-C-F" is fairly straightforward:

L is the distance from the station to the left passage wall
R is the distance from the station to the right passage wall
C is the distance from station to ceiling
F is the distance from station to floor

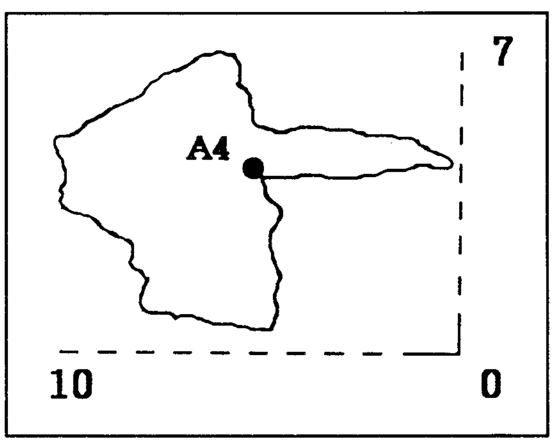
The only possible confusion here revolves around the ceiling dimension. Everyone that I survey with considers that dimension to be from the station to ceiling, NOT total ceiling height. In either case however, you should be sure you know just what your team members consider that "C" to mean, especially if the dimensions are being called out by someone you're not used to surveying with or who has little experience. And if you're giving L-R-C-F's for someone you haven't surveyed with before, you should be sure what is expected of you.

The principles of determining L-R-C-F's are simple in theory. Consider the example below:



Very cut and dry. Left is 5 Right is 5 Ceiling 3 Floor 4.

Unfortunately, unless you map in drainage tunnels all your life, you won't find yourself in many passages that resemble the example above. A more typical cross section in real caving life might be:



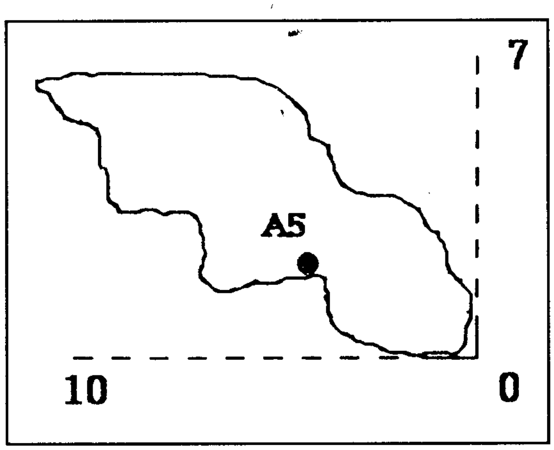
You could just give the furthest dimension to the walls, ceiling and floor. And once again, the dimensions would be left 5, right 5, ceiling 3, and floor 4 However, there is a way of handling this situation (which is more the norm than the exception) that allows you to better define the shape of the passage and locate detail on the sketch.

Slashes

The little creature "/" is very helpful in pinning down major detail in a passage. In the cross section directly above, the dimensions that I would call out to the book person would be left 3 / 5, right 0 / 5, ceiling 1 / 3, and floor 0 / 4. The idea is that the first number of the slash would be the distance to the closest "significant" passage feature and the second is the total distance to the wall, ceiling, or floor. Be sure that each number is a distance from the station, not between detail. In other words, don't call out the ceiling dimension at station A4, where 1 is the distance from the station to overhang and 3 is the distance from the station to the ceiling, as 1 / 2, with 2 being the distance from the overhang to the ceiling. Consider all dimensions relative to the station location, even when "slashing."

With the L-R-C-F's defined in this way, it will be easier for the person drawing the map to place detail where it belongs on the map. And cross sections will be easier to scale out also. And knowing if the station is on a ledge or under an overhang will make it that much simpler should you ever need to try and recover it in cave.

There is also no need to limit yourself to just one slash. If you feel you need more, use them. For instance:



To help me place those ledges on the plan map once I got home, I would consider the left dimension at station A5 to be 3 / 5 / 7 with all distances relative to the station. If you are the book person, be sure to write the slashed dimension with some care, as things can get a bit cramped. And if you are mapping in small passages and get some L-R-C-F's that aren't whole numbers, be sure to write them in decimal form and not as fractions (ie, 3.5 instead of 3 1/2, or 0.5 instead of 1/2).

Unfortunately, using slashes when determining L-R-C-F's doesn't make everything simple. Some cavers, when told how to use slashes will become "slash happy," and give dimensions to every little nubbin and every rock in 35 foot wide passage. [Here I have one thing to say: by and large the best people at giving L-R-C-F's are sketchers.] The way to approach their use is to give distances to those features in the cave that you believe are "significant" enough to be included on the sketch. Not every bit of detail will be. Just what is going to be included on the sketch depends on a lot of things, including whose sketching and what kind of passage your in A 1 foot high ledge is important detail in a 3 foot high, one foot wide crawl in a 50 foot cave. But in a large system drawn at 50 feet to the inch, that same 1 foot high ledge located in the middle of a big breakdown room is nothing.

Use the best judgement that you can. Learning how to sketch, or at least understanding the principles of sketching is important. Learning how to work with your sketcher is even more important.
People who have surveyed with one another often get effective and efficient as a team because they become accustomed to the way the other person does things. Learn to know what the sketcher expects from you. If you're unsure, then ask them if they are going to include a certain feature on the sketch. Get a feeling for the level of detail they are going to show. And then make sure you apply that understanding and make your own decisions about what to "slash" and what not to "slash". (In other words, don't ask the same question to the sketcher at every other station or you'll drive them crazy).

When your station is set in a really complicated area, with complex three dimensional spongework and no nice uniform wall or ceiling, and you can't really figure out what is wall and what isn't, you can do one of two things. Take a wild stab at giving the dimensions or tell the sketcher that he or she is much more qualified to make such intricate judgements such as this. In which case the sketcher will curse you and take a wild stab at it themselves. They won't worry to much about it though cause they'll be too busy working their eraser.

Estimating

All of the above advice assumes that you can judge distances with some degree of accuracy. There are no real secrets to estimating, though some people seem better at it than others. Much of this ability is probably attributable to experience, practice, and confidence however.

Confidence has its good and bad points. We probably all know the kind of person who will bellow out L-R-C-F's, compass readings, and theories on subaquatic calcarious oolitic stratification with such an air of certainty that we tend to accept what they say. More than likely they are no better judges of distance, bearing, or oolitic limestone than anyone else. They've simply learned that they can gain easy respect by bluffing their way through a situation.

But back to estimating. Practicing estimating distances is as simple as picking out a point, "guessing" the distance between it and you, and then measuring that distance to see how you did. Learn what fifteen feet looks like. What 5 or 30 feet looks like. Your estimations should improve as you get a better eye for how distances appear.

This kind of practice can be done anywhere, at home on the surface or in the cave while surveying. Realistically though, there aren't many of us who are going to pull our tape around the house and yard measuring things. We simply aren't going to do that. And so that leaves practicing while the mapping itself is going on.

Which is really a blessing in disguise. For estimating distances in caves is totally different than estimating above ground. Why? Because twenty feet in a crawlway looks totally different than 20 feet in a big room. You could stretch a tape 20 feet in a long, low, straight-as-an-arrow crawl and I'd swear it was longer than a shot twice as long that was taped in a room or in trunk passage. You may as well learn to develop eye for distances in the same kind of ocular-inebriating environment that you want to work in.

Here's what you do: make an estimation of the shot length every time a shot is taped (before the length is read of course). You'll experience 20 and 10 and 5 and 1.3 foot shots in all kinds of different looking places. It's best to keep the guesses to yourself though. Calling them aloud and with authority soon produces a very mad bookperson.

And you can also go ahead and tape those L-R-C-F's if the sketcher is busy sketching. Estimate them before hand and then measure them. You will get better. Word of caution: only do this if you won't be holding up your group. But if your sketcher is the one the mapping is waiting on, there is no sense lying around getting cold and whiney when you could be doing something productive. And there's nothing wrong with accurate L-R-C-F's (i.e., measured instead of estimated). Of course not all L-R-C-F's are measurable if you want to survive. That's why you have to learn how to estimate.

Tidbits

Deciding who is going to give out L-R-C-F's will depend on the makeup of the crew, the jobs each team member is doing, etc. Sometimes it will be lead tape, sometimes it will be a person in the rear I have seen two people collaborate on getting the dimensions while the sketcher is sketching.

Some book people will prefer to ask for L-R-C-F's, others won't care if they are called out at any point after the instruments are read. It doesn't really matter as long as the method is reasonably efficient and works. However, it is absolutely up to the person recording the data to make sure that dimensions are recorded for each station. This sometimes will mean reminding the responsible team member at each and every station.

L-R-C-F's should always be given in relation to the direction of the survey. In other words, the left wall is the wall to the left of the station as one faces in the direction that the survey is proceeding. Sound simple? Tell that to an instrument reader who is reading backsights and giving L-R-C-F's. Somewhere throughout the course of a trip that person is going to give the Left and Right backwards. If you're that person you may want to turn around in the survey direction before giving dimensions (if you can) If you're the book person, you may want to remind/question the dimension-giver every once in a while or when the distances sound out of whack. Yep, that means if your book you're going to have to pay attention too, even if you don't have to sketch.

Dumb End

If you think taping L-R-C-F's is overkill, don't want to waste the time, effort, etc., I can't totally disagree with you. It's hard to change your methods to produce higher accuracy when those new methods entail more effort on your part, or slow the process down. Sometimes it's just easy to be set in your ways and not feel like doing it the new way I fall into that way of thinking, without thinking, all the time.

But even though there isn't much of a call for measuring L-R-C-F's out there right now, that's where it's going to go. Certainly when reasonably priced electronic devices to measure distances accurately against irregular surfaces are produced, we will be aiming them at the walls of our caves.

Caves are today being resurveyed that were mapped not just back in the fifties and sixties, but in the SEVENTIES! The major reason for remapping is the change in surveying and map drafting standards.

Twenty or thirty (or fifteen) years ago, there was no compulsion to practice many of the techniques and ethics we do today. It was a very, very rare survey that took cross sections at every station, had good vertical control, produced a highly detailed sketch, etc. These are things that most surveyors bred in the last 10 years take for granted (hopefully they do, anyway).

Times change, but I'd like my maps to hang around as long as possible I don't want them to be redone in ten or fifteen years because of slight changes in technique, standard, and ethic. Not after my friends and I put so much time and effort into doing the damn thing in the first place. It's stupid to not make a survey and map last as long as possible. And if that means I'm going to have to put forth a little more effort to do something as simple as measuring L-R-C-F's, or taking backsights, or sketching to scale and angle with a protractor and rule, I will.

Yawn. End of sermon.

[reprinted from Virginia Cellars, Vol.4 no.1, June 1992]

SURVEY CHEAT SHEET
by Howard Kalnitz

All right the passage has a pit in it - do those little lines go in or out? How do I show a slope? What does a ceiling channel look like?

You're surveying - maybe for the first time, maybe the hundredth, and you forget how to draw a certain symbol. You think you're drawing a climb. Next week your friends show up with rappel gear and find they really need a bolting kit. People laugh at you. Your popularity plummets. You are reduced to caving with strange people from Kentucky named Bo who like to talk about boys locker rooms.

You can prevent this - included as a bonus in this issue is a survey cheat sheet. It shows many of the most popular survey symbols, and shortcuts.

This guide is designed to be included in the back of your survey book - going everywhere you go, and some places you can't. Remove it from the issue, or copy it if you want. Fold it in half. Laminate it with plastic contact paper. Fold it in half again and punch holes in it that match your survey book. Presto!

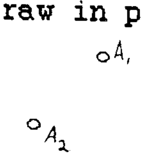
[reprinted from *The Electric Caver*, Vol. 19 Edition 12, December, 1992]

SURVEY GUIDE AND SYMBOLS

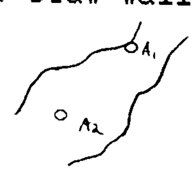
1. DISTANCE: TAPE POINT TO POINT
2. BEARING: POINTS CAN BE ABOVE OR BELOW POINT BUT MUST BE IN SAME VERTICAL LINE
3. ANGLE: POINTS CAN BE TO EITHER SIDE BUT MUST BE IN SAME HORIZONTAL LINE IF ONE STATION IS ABOVE THE OTHER SHOULD BE ABOVE BY SAME DISTANCE

TIPS

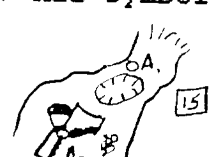
1. Draw in points



2. Draw walls



3. Add symbols



4. Record dimsional data

L 10 R 15

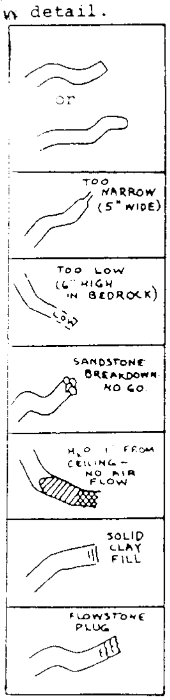
Ce 15 FL 2

P.t 15 15 feet deep

5. Cross section

It may help if you draw in a person size stickfigure

Passage Terminations. Always write down cause of termination in detail.



Use this symbol only if the passage ends in a solid rock wall.

Too narrow. Sometimes helps to note for whom it was too narrow!

Too low.

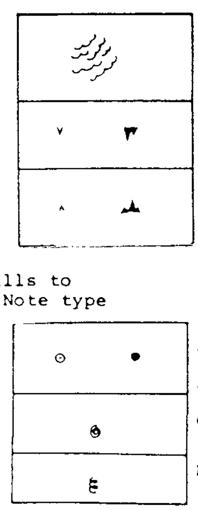
Breakdown.

Siphon.

Passage fills to ceiling. Note type of fill.

Flowstone.

Formations.



Flowstone.

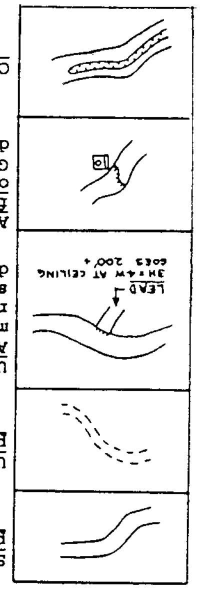
Stalactites.

Stalagmites.

Column. (Ambiguous. Define this symbol when you use it.)

Gypsum flower.

Helictite.



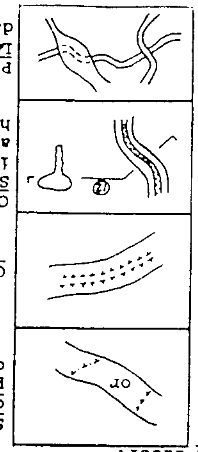
Surveyed cave passage.

Unsurveyed cave passage.

Unexplored passage. Always include dimensions, vertical relationship to survey passage, and distance explored.

Abrupt drop in floor. Hatchures on downward side. Give distance of drop in feet.

Canyon in floor.

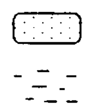


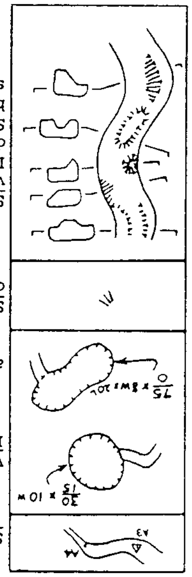
Sudden drop in ceiling. Hatchures point toward lower ceiling.

Ceiling channel.

Cross section. Short lines point in direction of view and up. Passage height in feet.

Passages crossing. Lower level is dashed or omitted.



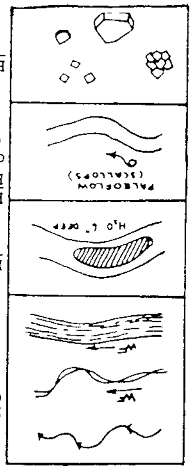


Survey stations.

Vertical shafts. Label with $\frac{\text{height}}{\text{depth}}$ x diameter at level of survey.

Slope. Lines diverge downhill.

Slope. A more versatile notation. Lines trend straight down the slope. Short dashes show break at top of slope.



Streams, showing direction of water flow.

Ponded water.

Paleoflow direction. From scallops, rimstone dams, waterfall ledges. (Scallops work like this.)

Breakdown.

SUUNTO INSTRUMENTS
by Mark Minton

Suuntos may be serviced by a number of authorized service centers. I presume there are some in Europe and possibly even in England. In the U.S., there are two I know of, Ben Meadows Co. and Forestry Suppliers, with the former being slightly less expensive. Both have toll-free telephone numbers. They also sell reconditioned used Suuntos at a substantial discount from new ones. I recommend the used ones, as they are good as new. I have sent in really trashed instruments and had them come back looking great. I suspect in some cases, that they just pitch the guts and only salvage the housing.

One can also do some work one's self. If the instruments are simply fogged up, the back can be popped off (with difficulty), and the little set screw under the dab of red plastic on the front undone to release the working element, which is sealed in plastic. The case and eye hole can then be cleaned and dried (an ultrasonic cleaner works well for this.) I dry everything under vacuum before reassembly. Then seal the edges around back cover, front, and eye hole with waterproof epoxy glue.

It is also easy to add flush ports while you have the instrument disassembled. There is room to drill two holes, one on either side, between the eye hole and where the plastic housing starts. These can be tapped and closed with brass or NONMAGNETIC stainless sell screws with O-rings under the heads. Then if fogging is a problem in the field, just undo the screws and rinse and dry the interior. A pipe cleaner may also be used as a small brush to clean out a film of mud that may get left behind by dirty water. I have installed such ports on all of my instruments, and they have kept us from aborting more than one survey. There is nothing worse than investing several getting to some particularly remote spot through much grimness only to have the instruments fog after a few shots.

[reprinted from The BEXAR FACTS, No. 92-9, September 1992]

BASIC CAVE SURVEYING IN ALASKA
by Carlene Allred

In our great state of Alaska, we cavers encounter some special problems because of the inaccessibility of limestone areas. Unfortunately, most of our trips must be In the form of organized expeditions even though we may prefer the "spur of the moment" informal style. On the other hand, the remoteness makes Alaskan caving very appealing, and we have discovered that expedition style caving can be a lot of fun. Because our caving areas are expensive and difficult to get to, we must take extra precautions to make sure that our survey notes are of high quality and without blunders. We cannot simply dash back into the cave to resurvey something once we are back home. While on our expeditions, we have been plotting out as much gathered data as possible to ensure completeness and catch blunders.

Why make a map of a cave? Here are some possible reasons:

1. You may need something to do while caving to keep from getting bored.
2. Turning out a cave map is the only proof that you have really explored it. It is also proof of length and depth measurements.
3. Careful sketching of passage features in a notebook results in a more thorough exploration method. Good surveyors usually find things that mere explorers overlook.
4. The mapped lay out of a cave may be important to surface concerns such as logging impact, road building, waste disposal, etc.
5. Cave maps are used for studies in biology, hydrology, geology, etc.
6. A nicely-done map may give worldly credibility to a cave when that is desirable.
7. Putting together the data and drafting the map can be a lot of fun.
8. By studying a cave map, one can quickly become familiar with the basic characteristics of a cave. A good map can be followed underground, and this is especially important to rescue teams.
9. Mapping as many caves as possible may be like counting coup. The more the better.

Different individuals and organizations use differing methods and formats when surveying caves, and the results varying quality and map type. When mapping a cave, be sure to have in mind the way the cave will be portrayed on the final map. For example, a pit cave will need to have a good profile drawn with exact depth measurements.. because on the final map the profile view will be more important than the plan view.

Some surveyors produce only line maps which, in my opinion, are very dull. A line map shows only a single line to represent a passage of survey line. This type of map is necessary, though, when the map of a giant cave must fit on a standard size piece of paper. Line maps of three-dimensional mazes look like indecipherable scribbles, but they do show cave bounds and joint patterns. Surveying for this type of map will go quickly, since no time-consuming sketching is needed.

Detailed maps show a variety of features within the passages and have many uses. If the surveyors do a thorough job, then several types of maps can be drafted from a single set of notes. An example of this would be the maps put out by the Lechuguilla Project. We all have seen the computer line maps published in NSS News. There is also a multi-color version produced by a computer that portrays passage depths. In addition, the project is also producing beautiful hand-drawn detailed maps in quad format, at one inch to fifty feet. Three-dimensional maze areas are being portrayed in multiple levels. I don't know how many quads there are at this time. Cavers are using copies of these detailed maps to get around underground. As a sketcher for that project, I was required to "sketch to scale" in detail, both plan and running profile, in each passage we explored. For this I needed a protractor and ruler for in-cave computation. I found this method to be exhausting and very time-consuming, but we produced a thorough set of notes. Also, by sketching to scale, the blunders are supposed to be caught and corrected while on the spot.

TONGASS CAVE PROJECT 1/a
TONGASS NATIONAL FOREST, ALASKA

CAVE: BLOWING IN THE WIND CAVE
AREA OF CAVE: POWIE : NORTH FACE OF 2424 PEAK
OBJECTIVES: SURVEY TO TOP OF ROOM DROP
Data Entry Date/Initials: ✓
DATE: 7/29/89
SURVEY DESIGNATIONS:

SURVEY STATIONS:	TIE INS:
B1-B9	BE A3
C1-C3	C1-B5
D1	

PERSONNEL:
*denotes leader
SKETCH: WIN WRIGHT
INSTRUMENTS: MILES HECKER, KEVIN ALLRED
LEAD: Rick Bridges, STEVE MIER, MILES HECKER
BACK:
OTHER: 380.5
Tape's Units of Measurements: Tenths ✓ Inches ___ Meters ___
SCALE OF SKETCH: 1: 50'
Compass Type & ID: BRIDGES' SUUNTOS
Compass Test: IN: OUT:
DATE & TIME IN: 7/29 13:30
DATE & TIME OUT: 21:30 7/29
Clinometer type & ID:

Figure 1.

TONGASS CAVE PROJECT

STATION	DISTANCE	BEARING	VERTICAL ANGLE	LEFT	RIGHT	CEIL.	FLOOR
A3				4	0	15	1
	14.8	BS 285	BS -66				
B1		FS 136	FS +10	2	3	6	10
	17.2						
B2		FS 176	FS +10	0	3	2	1
	8.3						
B3		FS 134.5	FS -10	4 5	0	2	3
	13.6						
B4		FS 143	FS +5	0	4	3	4
	4.0						
B5		FS 135.5	FS -21.5	1	P	4	3
	27.0						
B6				10	5	15	5
B5		FS 209.5					
	7.6	BS 28.5	BS -38.5				
C1		FS 294.5	FS -7.5	80	8	0	7
	30.9						
C2				4	5	1	3
	30.6	314.5	-0.5				
C3				10	5	15	0

NOTES

Figure 2.

In the cave

Dress warm. The other members of your team won't appreciate it if the trip gets aborted because someone is cold. We spend a lot of money getting to our caves and we hate to see it wasted.

Each survey team involves a number of jobs. There needs to be a recorder, an instrument reader,, a sketcher, two tape stretchers, and a lead. One person can do all of this in solo fashion, but this is lonely and time-consuming. A typical team will consist of three people. One person will be the instrument reader and tape holder, another person will serve as sketcher and recorder, and the last person will be the tape holder and lead. In a crawlway, too many people can get into each other's way, so a team of two will be better in this case. A team of four is nice in large passages.

The easiest job is the lead and tape holder. This person determines stations, pulls the tape ahead, says "chain", and shouts out the length of the shot if he/she is holding the reel end. This is my favorite job, but invariably I always end up being the sketcher instead. Stations may or may not be marked, but they need to be chosen with the positioning of the instrument reader in mind. Many cavers, including me, think that marks on walls deface caves, so flagging tape can be used instead. Some people make a spot of carbide soot at each station, and in some caves this can later be wiped off. If you aren't able to completely finish mapping an area of a cave, then you must leave a temporary or permanent station that can be relocated. It must be such that it will not be washed away by floodwaters or be disturbed by someone. This can be an obvious point on a landmark that can be described in detail in the notebook. It may be good to have these scattered throughout the cave for future references. Also, remember that there should be a station at the entrance for surface tie-ins. In some projects, markers are left at every single station. As you determine stations, be sure that you place on at every side lead.

Sketching takes the most amount of time and is always the bottleneck of the survey. Not everyone can sketch, so good sketchers are always in high demand. It is a good skill to have if you want to get into someone else's project. The survey cannot progress any faster than the sketcher can sketch, so the sketcher controls the survey. He/She is responsible for making sure that every nook and cranny gets looked into and that all passage features get recorded, such as drops, airflow, ceiling features, streams, geological observations, bones, leads, fill, etc. (see figure 3). When you use nonstandard symbols, be sure to include a key in your notes.

Sketching can be done to scale (see figure 3 for an example by Win Wright), not to scale, or something in between. The person who drafts the final map likes to work from notes that are to scale (proportionate and directional) because they are easier to understand. This is particularly nice when the sketcher is someone other than the drafter. Personally, I prefer to sketch maze areas to scale to eliminate my own confusion, and simple linear passages not quite to scale to speed things up. Be sure to sketch at a scale that is as large or larger than that of the final draft. For caves in southeastern Alaska, we have found that the best scale to sketch at is one inch to twenty feet. For large rooms, the sketch takes several pages.

The instrument reader uses a compass to measure azimuth (or bearing) from point to point, and an inclinometer to measure inclination or vertical angle. Kevin and I have found that we get best accuracy using a Brunton, medium accuracy using a Silva Ranger with clinometer, and lowest accuracy using Sisteco instruments. Speed of use is in reverse order. Use whatever works best for you. For even higher accuracy, use a tripod mounted compass. The Instrument reader needs to watch out for magnetic fields which may deflect the compass needle. At our home we cannot survey our own property because of all the magnetism in the rock below. Items such as headlamps, reflectors, and pocket knives can cause errors if they are too close to the compass. Test yourself with all your gear on to see if your gear has magnetic fields which affect your instruments.

There are backshots (BS) and foreshots (FS). The latter means that azimuths and inclinations are from a lower numbered station to a higher-numbered station as you progress into the cave. On a backshot you sight instead from a higher-numbered station to a lower-numbered one. In some surveys both foreshots and backshots are taken between all stations for accuracy. This method may create extra confusion for some.

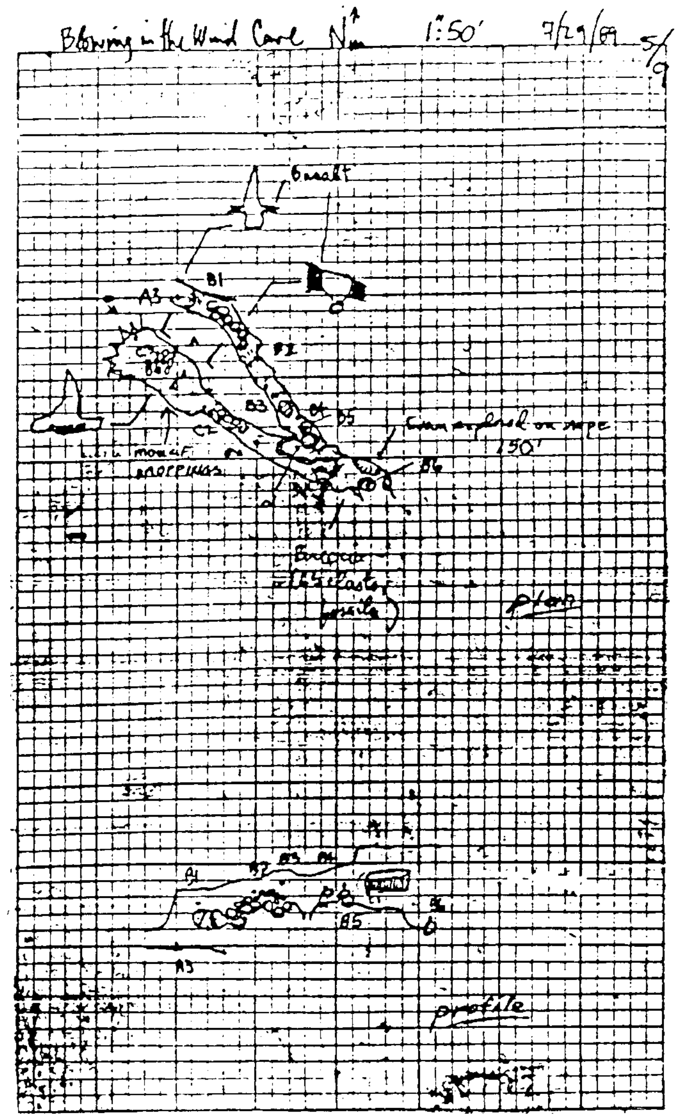


Figure 3.

The distance from point to point is measured with a fiberglass tape. Steel tapes tend to break easily. Kevin and I prefer a fifty-foot length of tape. In most Alaskan caves tapes tend to wear out earliest in the first sixteen feet of the tape, and rarely is a bulky hundred-foot tape needed. We prefer to work in feet and tenths for two reasons. A foot is a good unit for cave measurement estimations. For example, the distance (approximately) from a point to the left wall of the passage may be called simply two feet. If meters were being used, it would be called 0.6 meters. We think that decimals are awkward to work with when the surveyor is tired and muddy. For point-to-point measurements, we like to use tenths of feet be cause of ease in future computations. Use whatever units you feel most comfortable with if you are going to draft your own map.

Note the spaces on the right-hand column (in figure 2) for measurements from point to left wall, right wall, ceiling, and floor. These measurements denote passage width and height and are very important. There are two ways to record these. Be sure to indicate in the notes which method you use, A or B. Method B should only be used if you are sketching very close to scale and doing profiles. Kevin and I prefer method A. We like to use 4-1/2 x 7 -inch printed "Rite in the Rain" notebook paper when we can get it. Actually, any blank sheet of paper can be made to work.

Styles

Cave surveying can be done in one of three styles:

1. Survey what has been explored on a previous day.
2. Explore your way in, way out.
3. Survey as you explore.

Current custom among cavers dictates that we survey what we explore. That usually means both jobs in one trip.In times of old, cavers explored first and then mapped on a later day. That meant that a few lucky people quickly explored all the cave and left anticlimactic mapping for others. Combining these tasks saves time in the long run and provides incentive for mappers. This is especially important for us Alaskan cavers.

If you choose to explore in and survey out, the tedious mapping doesn't interfere with the ecstasy of exploring virgin cave. The only drawbacks are:

1. You may not have time to survey all that you explored.
2. Then others would call you "Scooper" and you might end up with a worthless hanging survey.

(3. Also, your survey numbers will run backwards.)

If you decide to survey as you explore (as is the most common method used today), then you survey <u>exactly</u> what you explore and no less.

When you leave the cave, the first thing you need to do it go over all of you notes and make sure that everything is clear and readable while it is still fresh in your mind. If your notes are left in someone else's pack, then there is a good chance that you will never see them again. As soon as you can, copy everything and place each copy in a separate depository. Otherwise, you may lose your only copy.

Now draft up your map.

The easiest way to learn and to understand all this is to <u>do it</u>. Go practice on a local glacier cave, mine, or other cave.

For more information, here is a reading list:

Thomas, Woodrow. September 1990. Why Survey? <u>NSS News</u> 48(9).
Ganter, John. June 1989. Will We Map As We Survey? <u>NSS News</u> 47(6).
<u>Compass and Tape</u> Volumes 1 and 2 (for basic information)
<u>Compass and Tape</u> Volume 3 and onward (for more in-depth information)

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CALIBRATION OF THE KVH DataScope™

By: Hubert C. Crowell

The KVH DataScope™ is a Monocular, Gimballed, Fluxgate compass that could prove very useful in cave surveying. With a resolution of 0.1 degree and an accuracy of +/- 0.5 degree, combined with ease of use with a through the lens digital display, it has become my compass of choice for the future.

In testing the DataScope™ I found that the accuracy is much improved by the way it is calibrated. The manual describes two methods of calibration, the Hand Held Method and the alternate Remote Method. Both involve taking eight sightings at 45 degrees starting at any point and turning clockwise. The calibration is fully automatic and the display instructs you when to move to the next sighting, you then hold the compass steady until a good reading is made.

To test the compass a holder was made as described in the Remote Method to hold the compass level and steady. A piece of cardboard was then cut with lines at 45 degrees. Eight readings were recorded by rotating the compass to each of the lines. A distance of 10 units was given to each reading to form a loop closure and then plotted to find the error.

The compass will give you a grade at the end of the calibration procedure to let you know how well the unit is calibrated on a scale of 1 to 10 with "Bad 1 - Bad 5" and "Good 6 - Good 10". I could obtain a Good 8 in both the Hand Held and Remote Methods and the compass does not require that the readings be at exactly 45 degrees but be held as steady as possible. **In all cases the Remote Method resulted in better accuracy even with the same grade.**

Figure 1 is a calibration of "Good 8" using the Hand Held Method, the closure error was 1.33%.

Figure 2 is a calibration of "Good 8" using the Remote Method, the closure error was 0.14%.

Bearings	Variance
57.9	+1.3
104.2	+1.1
150.3	+0.1
195.4	-0.3
240.1	-1.4
283.7	-0.8
327.9	-0.3
12.6	+0.3

Plot using a distance of 10 units.

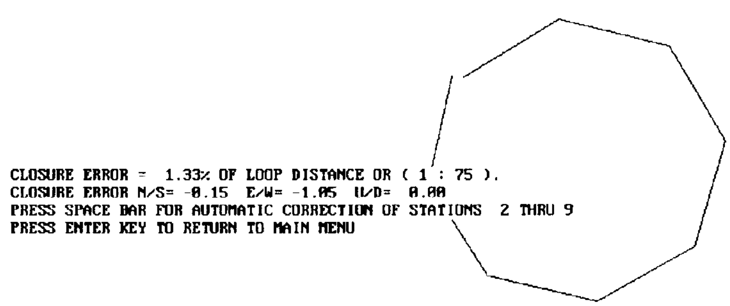

Figure 1

Bearings	Variance
59.2	+0.3
104.3	+0.1
149.2	-0.1
193.9	-0.3
239.2	+0.3
284.0	-0.2
328.8	-0.2
13.9	+0.1

Plot using a distance of 10 units.

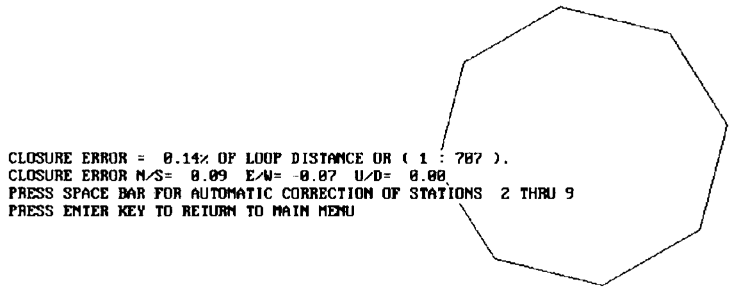

Figure 2

Slightly better readings could be taken by using the continuous display mode thus avoiding pressing the button. You can place the compass in the continuous mode by pressing by pressing the green and black buttons simultaneously then releasing, or by pressing and holding the green button down. The average reading is displayed until the green button is released, then it is stored in one of 9 memory locations. The slight movement of releasing the green button can result in a change in the reading.

Calibration is only required when changing the batteries or operating in a location where the magnetic field is widely different from where it was originally calibrated. I would strongly recommend the Remote Method with a grade of "Good 8" or better. I was able to obtain a "Good 9" on one calibration but have yet to obtain a "Good 10". Figure 3 shows the results of the "Good 9" grade and using the continuous mode and Figure 4 shows the results of the "Good 8" grade using the continuous mode.

Bearings	Variance
59.3	+0.4
104.2	-0.1
148.9	-0.3
193.9	0.0
239.2	+0.3
284.1	-0.1
328.9	-0.2
13.9	0.0

Plot using a distance of 10 units.

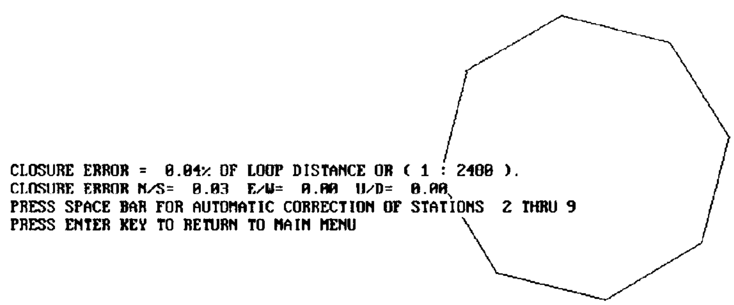

Figure 3

Bearings	Variance
59.4	+0.6
103.9	-0.5
148.9	0.0
193.9	0.0
239.2	+0.3
284.1	-0.1
328.8	-0.3
13.8	0.0

Plot using a distance of 10 units.

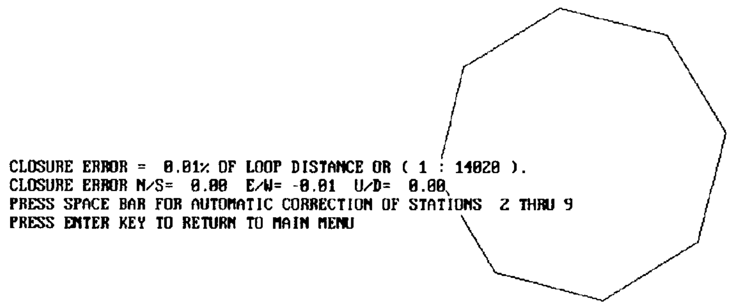

Figure 4

When plotting the loop, errors may cancel each other out, resulting in a smaller closure error. Note that the variance from the perfect 45 degrees is greater in figure 4 than in figure 3 but the closure error is smaller. Taking this into consideration the closure error may still be our best gauge of accuracy.

You can also enter the local variation (declination) to true north and this correction will be applied to all readings until cleared or the batteries are replaced. I have not discussed all the features of the DataScope™, only what I felt was the most important for cave surveying, and yes, the display can be illuminated for use in total darkness.

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