COMPASS & TAPE

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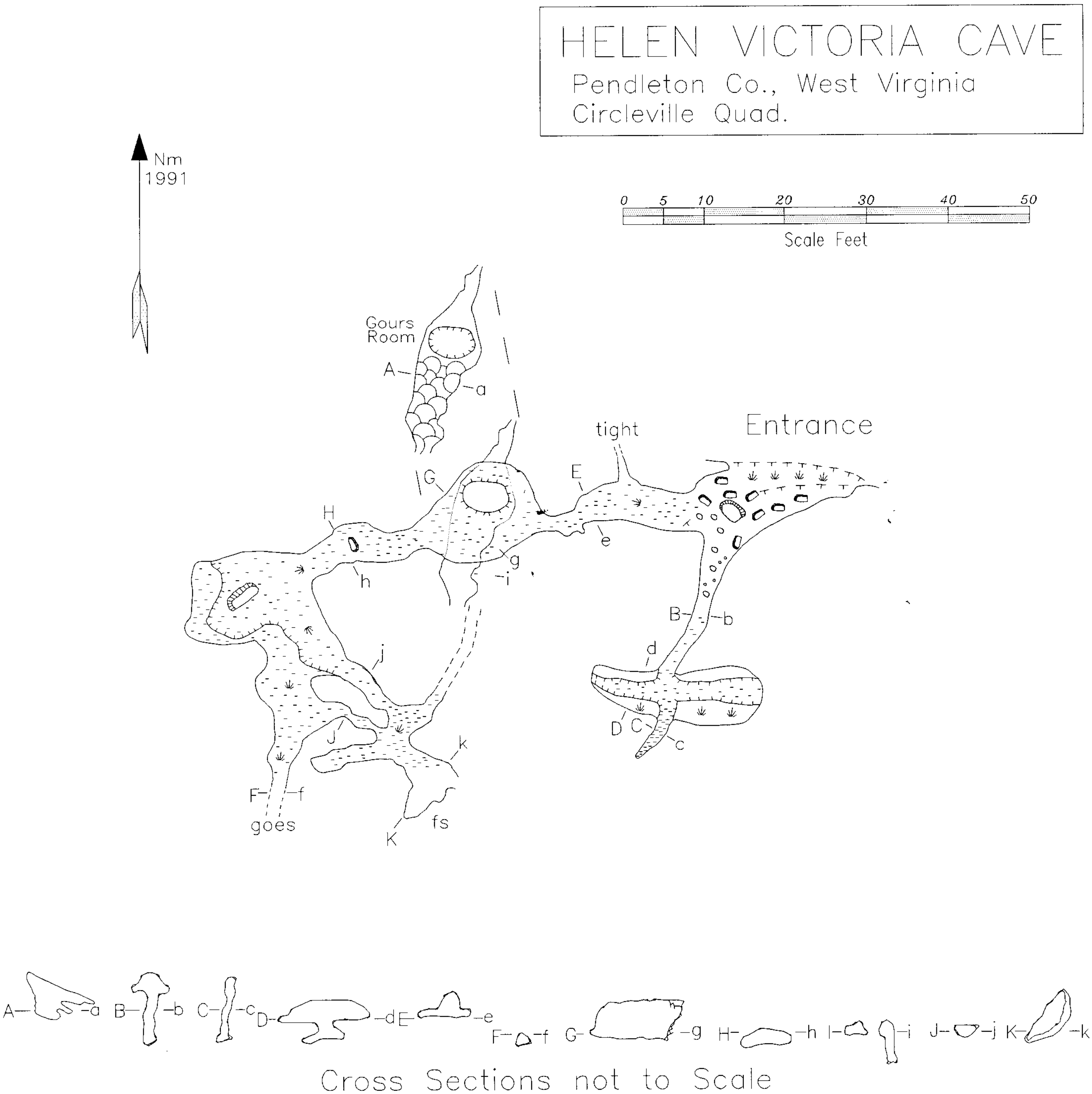

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Cover: A map created entirely by computer by Bob Gulden. The survey data for Helen Victoria Cave was entered into SMAPS to get to get the x,y,z coordinates. The coordinate file was then converted to an ASCII file for input to a BASIC program that would convert it to a DXF file. The DXF was read into AUTOCAD to make a drawing (DWG) file that generates a line plot of the cave. The cave sketch was then scanned into the computer, making a TIFF file. A program called "DRAFT" was used to convert the TIFF file into a DXF file. This was then entered into the AUTOCAD drawing file with a line plot of the cave. With the two files together, the line plot and sketch, using AUTOCAD he was able to draw the cave map.

Printed by members of the DC Grotto and the Potomac Speleological Club

WHAT'S IT WORTH?

by Tom Spina

Recently, I was contacted by a cave owner who... get this... wanted me to survey his cave. But they were concerned about the cost. Did I charge by the hour? By the foot? By the size of the finished map?

Actually I never gave too much thought as to the "cost" of a cave map. Here's an honest attempt!

What costs are actually incurred? Survey books, prints of working maps, computer supplies, vellum, mylar, sepias... all expended BEFORE the first blue line of the finished product can roll off the assembly line. And... how about labor?

Just for kicks, I'm going to use the recent re-survey of Paxton Cave in Allegheny County, Virginia as the guinea pig even though I was the only Italian involved in the project.

Thirty-two survey trips were logged between August 1988 and February 1991. During that time the cave was surveyed to a length of 38,191.9 feet. Records indicate that the total number of cave entries as a result of this survey was 365. A conservative tabulation of man-hours for the field work is 2,555. In the Tidewater area of Virginia, one might expect to pay skilled non-professional workers about $10.00 per hour. It would certainly be more in larger metropolitan areas. We'll stick with a laid-back $10.00 for this study. So... field work salaries would total $25,555.00.

How about supplies? Three hard-cover field books were utilized, costing $8.50 each. Additional soft-cover books were periodically used, but their owners never squawked about repayment. To compensate, we'll allow for another hard cover type. Four books at $8.50 plus sales tax total out to $35.53. Pencils are pretty incidental but you can't survey without 'em. Again, for the sake of a conservative estimate let's assume that one of those department store 69 cent specials lasted half the duration of the project and we figured on putting four teams into the cave each weekend. Eight pencils at 69 cents each including tax is a cost of $5.77.

For this project the duties of sketching and note taking were separated. The notes were entered in the aforementioned field books while sketching was performed on 8 1/2 x 11 inch sheets of mylar. One hundred twenty nine sheets were utilized in the survey in this application. A hundred pre-cut sheets run about $36.00. Add Virginia State sales tax and the per sheet cost is a shade under $0.38. Value of mylar for sketching: $49.02.

Depreciation of instruments and tapes isn't much but certainly merits consideration. If you can't survey 25 miles of cave without having to replace or repair you instruments you should quit using them as chocks. Twenty-five miles of cave figures out to about 1/10 of one cent per foot at today's prices. Tapes costing about $14.00 usually lose about 10% of their length form one end or the other after a half dozen trips but I usually keep mine cooking for about three miles. Again, this figures out to a tad less than 1/10 of one cent per surveyed foot. So we can see that for Paxton Cave, wear and tear on instruments and tapes cost us $68.00.

Now, what about working maps? Typically it took me a couple of hours to update the map after each work weekend. With 32 work weekends we tally up 64 working map hours. Again, at $10.00 an hour we've accrued a cost of $640.00.

Drafting supplies? I did the working map of the major part of the cave on two 24"x36" sheets of mylar. They cost me $7.27 including Virginia's goofy 4 1/2% sales tax. Then I used an additional 16 sheets of 8 1/2 x 11 mylar for upper and/or lower level details. Yet another $6.00.

How about the blue line copies of the working map? After each update I had four copies of the pertinent sheet made to distribute among the party leaders for next month's activities. At a cost of $0.15 per square foot, each update cost $3.76. The thirty-two updates totaled $120.32.

But, before the working map can go to press a bunch of data must be processed. We estimated 2 hours at the computer for each work weekend. Figuring, again, $10.00 per hour, we add $640.00 to the project cost. Computer supplies? Tom Kaye, project coordinator, informs me that the computer paper and four copies of the newly generated coordinates to accompany the working maps can hardly total $1.00 per weekend. Chalk up $32.00 more.

Now thus far we have a cost of $323.91 for materials and $26,830.00 for labor. But let's not forget Uncle Sam... or Governor Wilder for that matter! Adding Social Security and state Unemployment tax to our labor cost, we come up with a final labor cost of $29,393.58... BEFORE we begin drawing the final map.

The final map, including lettering, cross-sections, layout, cross referencing notes, data, and sketches, mishaps and other miscellaneous forms of miscellany, took 109 hours to draw. We'll again allocate $10.00 an hour to the draftsman. Thus another $1,090.00 in arrears. Add $103.88 to this figure for our politicians' salaries. And don't forget a 42"x84" gridded mylar for the original. I snatched up a 50 yard roll a while back for $200.00. Cost for this project: $9.75 with tax. Let's not forget the sepia mylars shot for appropriate organizations and individuals: one each for the Virginia Speleological Survey, the owner, the cartographer and the organization spearheading the project. Four mylars, each consisting of 24.5 square feet prepared at $1.50 per square foot... $153.62 with tax.

Now that the dirty work is complete we should distribute copies of the map to those worthy of such distinction. More times than not this includes those who participated in the project and about 10 more for speleo-dignitaries and sundry brown-nosing. In the case of Paxton we had 93 participants. Blue lines have been costing me $0.15 per square foot. That's $3.84 each or a whopping $395.52 for the batch!

So now the cost of the project stands at $31,470.26. All this for 103 blue line prints. Whew! That makes each copy worth $303.54. It appears that it will cost about 82.5 cents a foot to survey and map a dense maze cave in the 7 mile range.

Naturally the figures will vary greatly from one project to the next. The new map of Paxton Cave was drafted at a scale of 1 inch equals 30 feet. Obviously there was plenty of room for detail. The complexity of the cave and the amount of detail we wished to include dictated short survey shots. we used the "clipboard" sketching technique described in an earlier issue of C&T along with front and backsights. Generally, survey parties consisted of four members; a sketcher, note taker, and two instrument readers who also handled both ends of the tape. Each team emerged from the cave after 7 or 8 hours with about 360 feet recorded.

Now let's take the case of the Dry Cave (Greenbrier County, West Virginia) stream passage survey when Phil Lucas and I put nearly 3,000 feet on paper in a 15 hour trip. Only about $0.10 a foot for field work on this leg of the project against $0.67 for Paxton. Why? We knew the finished map of Dry Cave would be drawn at 50 feet to the inch. Passages in Dry Cave are relatively narrow and VERY linear. Longer shots (many over 50') did not sacrifice sketch accuracy. Besides Phil was sketching and he's damn fast!

The average shot length in the Paxton project was 14.29 feet. A total of 2,672 shots were made in surveying 38,191.9 feet, so we might be able to relate the "value" of the survey to the number of shots necessary to complete it. Of course the number of shots required to survey a cave can be related to the degree of accuracy, amount of detail, and scale of the finished map. And... the cave itself has a lot to do with all of the above.

One is not very likely to draw a map of a 30 mile cave at a scale of 1"=20'. For large scale maps detailing will not be as great, consequently the field work should go a bit faster on a per foot basis. Unless it takes all day to get to the survey area! Straightforward stream or canyon passage can be the most productive and efficient to survey while those with, as I call them IDIOTsynchrosies tend to take a good deal longer.

Now, all I've rambled about is COST. If I were in the business of cave surveying as a profession I would have ended up with exactly what I started with. That's no way to earn a living. With addition of overhead and profit I would have requested $41,408.00 to deliver 103 blue line copies and four sepias... allowing 24% overhead and profit. That's $1.084 a foot.

To be even more precise we'd need to determine the depreciation on drawing equipment (Rapidographs, triangles, lettering instruments, etc.) and costs of drawing supplies (ink, Scum-X, Pounce, erasers, tape... and on and on). Notice that driving time, room and board, vehicle depreciation and tolls were not included either. This could vary greatly depending on whether surveyors are motel camping or roughing it... whether they appreciate fine dining or can settle for scuz-in-a-can. Are they local boys from a smart piece up the road or aliens from the big city up north? Yeah, there's a lot to be considered when determining what our work is "worth" in a capitalistic society.

But before all of you start preparing proposals, estimates, and invoices for your favorite cave owner... remember free is better than cheap! Once you charge a nickel for a map, someone will want a dollar's worth! It's the basic economic principle that guides shoppers 'round the world... everyone expects to get more than what they pay for. When mapping becomes business, quality will see better and better maps with the passing of time. As much as we'd like to make it an interpretive activity. And interpretations are like... er, well... everybody's got one and few are willing to pay for any but their own.

So just disregard this article and go about your business!

THEORETICAL VS. EXPERIMENTAL COMPASS TILT ERROR

by Robert Thrun

When I saw Roger Bartholemew's article, "Tilt Error in Suunto Compasses Sighted with the Glass Rod Cylindrical Lens" (C&T, Vol. 8, No. 4), my first thought was "Don't we already know this?" Lang Brod had an article, "The Effect of Tilt on Compass Error" (C&T, Vol. 2, No. 1), that pointed out the same thing from a consideration of geometry. As far as I know, Lang was the first one to use a glass rod on high-angle shots with a Suunto compass. He was fully aware of the errors due to side-to-side tilt and installed a bubble level in his compass so that it could be seen through the eyepiece. The idea of the glass rod was copied and featured on an NSS News cover, but without the level and with no mention of the errors involved. There were no letters to the News pointing out the problem of tilt errors, so maybe the errors were not obvious.

The error formula, after Brod, is:

$$\tan e = (\tan i)(\tan t)$$

e = compass error
i = inclination of survey shot
t = side-to-side tilt of compass

Both the tilt and the error are usually small, so the tan function can be approximated by the angle, and we get a theoretical relationship for one of the quantities that Roger tabulated:

Azimuth Error (deg) per Degree of Tilt = tan i

I have added a column to Roger's table:

Inclination Angle (deg.)	Azimuth Error (deg.) per Degree of Tilt	Tan i
+24.2	+0.27	+0.45
+45.1	+0.83	+1.00
+63.4	+1.79	+2.00
+76.9	+3.99	+4.30

As you can see, the experimental error is a little less than the theoretical error. This might be due to the compass dial being read at a point above the optical axis of the compass eyepiece.

Roger mentioned using the compass drum as a level. The problem with this is that the drum is counterweighted at the factory for the latitude where the compass will be sold. At other latitudes, the drum is not level.

When I wrote my article "Don't Use Two Eyes With Your Suunto" (C&T, Vol 6, No. 2), a British reviewer commented that I did not present any "substantive evidence" to support my thesis. By varying the way I focussed my eyes, I was able to get any error I wanted, up to about 10 degrees. I thought this was sufficient evidence. I don't know what sort of evidence the reviewer wanted.

GPS--THE 90'S WAY TO LOCATE CAVES

By Tim Kilby

Recent technological developments may force us to rethink how we define and map cave locations. Global Positioning Systems (GPS) will soon replace transits, theodolites, topo maps, and compasses in determining precise earth positions. Describing the location of a remote cave entrance will be fast and accurate using one of the new handheld devices.

GPS is a new utility developed by our government for national defense but available worldwide to all. Twenty-four GPS satellites equipped with atomic clocks create an earth orbiting grid. The principles of operation are simple. Receivers here on earth use the satellite signals to triangulate the receiver's position. The GPS receiver calculates the distance to any one satellite by measuring the time it takes for the radio signal from the satellite's atomic clock to reach the receiver. The differential in time is then multiplied by the speed of radio waves (speed of light) to get the exact distance. If three satellite signals are received, the receiver can compute exact latitude and longitude. Add a fourth satellite signal and altitude may be computed also.

The current accuracy of single receiver units is about 20 meters, plenty accurate for craft at sea and twenty times more accurate than LORAN-C. Land-based "differential" GPS utilizes multiple receivers for 2-5 meter accuracy. Survey mode GPS receivers have an accuracy of an astounding one centimeter!

The implications of this technology in general are tremendous. U.S. troops were equipped with GPS units in the Middle East deserts and they proved highly effective. The Forest Service and Bureau of Land Management have joined other government agencies in purchased handheld differential GPS receivers for resource management tasks as diverse as locating and mapping habitats of endangered species, managing forest fires, documenting archaeological sites, and updating GIS (Geographical Information System) databases. Precise surveys of wilderness areas and large-scale surveys of cities are currently underway. Personally we can expect GPS to track our route directly to caves through car navigation systems. Pioneer Electronics is already selling a consumer unit in Japan that utilizes a CD-ROM image database of the entire nation's highway system. As long as we know where we want to go, we use GPS as we fly, drive, or hike to that location.

The one drawback for cave locating and many other applications is that the relatively weak signals are detected only on line of sight with the satellites. This eliminates locating a position underground, under a forest or jungle canopy, or within a building. This problem will surely be overcome by using multiple receivers or multi-frequency systems working together. Perhaps we may even see units that will work underground. That would mean dramatic changes ahead for cave surveying.

Several companies, Trimble Navigation being one, are selling GPS receivers now, but the cost is high, typically $8000 for a differential handheld unit. However, the cost is dropping with mass production. Major international corporations such as Sony, Motorola, Texas Instruments, and many others are competing to bring out GPS products. Magellan Systems Corp. has a recreational consumer unit available now. Caver-priced units are not far away. Meanwhile, cavers working with governmental agencies should ask about the availability of the government's units for cave inventory projects.

THE REALITIES OF MAPPING

C. A. Vesely

1. When you first begin to reduce the data, you are likely to discover that some crucial numbers were simply never recorded.

2. No matter how carefully you surveyed in the cave, loops never close. Inevitably you must decide whether it is best to resurvey the loop of to "fake it". You soon discover that there are dozens of different methods for closing loops, none of which really corrects the error, they all simply hide it in different ways. This totally destroys your original illusions that surveys are accurate.

3. When you finally begin plotting the points, you discover that whatever scale you picked is either too large or too small and you have to start all over again.

4. Of course the idea is to make the entire cave fit on one piece of graph paper (however large it is). When you're almost finished plotting points, the very last passage will run just an inch off your paper, so you must tape another piece to complete the cave.

5. When it comes to inking, that's where the fun really begins. Mistakes seem to multiply with passage density. Naturally the pen will make the biggest ink blob in the most heavily detailed area of the cave, just as you are adding the very last line.

6. When you go to rub-on the letters for the title, you invariably discover that you have used up all the letter "v" from your letters sheet and that you can't spell "cave". When you call your local art supply store the next day, they say they're all out of that font, but they expect another shipment in a couple of weeks.

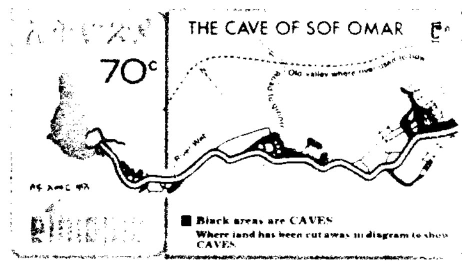
7. As you are rubbing on the letters to spell "Entrance", you realize that you've miscalculated the spacing and that the "E" is right on top of the passage wall. When you try to move it over, it goes off the edge of the map. You finally decide that anyone who's too dumb to know where the entrance is shouldn't be caving anyway, and decide to leave the word "entrance" off the map.

8. Between the drawing of the first draft and inking the final version, you decide to change the direction of 'up' on the map. However, halfway through inking it, you realize that you forgot to change the orientation of your formation symbols.

THE ONLY CAVE MAP ON A POSTAGE STAMP

by Rich Breisch

Except for promotions by show caves, cave maps seldom are published outside speleological literature. Only one cave map has ever been depicted on a postage stamp for any country in the world. This cave is not a commercial cave, but it is a tourist attraction in a remote area of the country issuing the stamp. This is a map of Sof Omar Cave in Ethiopia. The design on the stamp is shown below.



Sof Omar Cave and its exploration

Sof Omar Cave is named for the small village of Sof Omar in the Bale province of Ethiopia. It is located about 330 kilometers southeast of Addis Ababa, the capital of Ethiopia. The cave is located at a latitude of 6°50'N and longitude of 40°33'E according to Clapham and Robson (1967), but Courbon, et al. (1989) gives its coordinates as 6°55'N and 40°45'E. The cave is in Cretaceous limestone.

The first known visit to the cave by Europeans was by Arthur Donaldson-Smith in 1897, followed by Italians in 1913 and 1938. British cavers Chris Clapham and Eric Robson along with Kabir Ahmed mapped 8,000 meters of passage in the cave of Sof Omar in January 1966. The following year by the Ethiopian Tourist Organization published a booklet about the cave by Clapham and Robson. Robson drafted the Sof Omar Cave map which is included as a foldout map in the booklet. In 1972 the British Speleological Expedition to Ethiopia (BSEE) extended the cave to 15,000 meters of mapped passage. This cave has forty-two entrances and is by far the longest cave in Ethiopia.

Description of the cave map stamp

On 10 February 1983 Ethiopia issued a set of five stamps featuring the cave at Sof Omar. Only the 70-cent stamp is based on the map drafted by Eric Robson - not the more recent and more complete map by the 1972 BSEE. In fact Clapham and Robson's booklet is the basis for all five Ethiopian cave stamps. The cave map stamp closely follows the map in the 1967 booklet including showing surface features and the River Web. This river enters the "Ayiew Maco" entrance of the cave at an elevation of 1345 meters near the village of Sof Omar, and resurges 1.2 kilometers to the southeast at "Holuca". "Holuca" is the local name for "cave". The River Web runs left to right on the cave map stamp. The English inscriptions on the cave map stamp are:

a. Ethiopia
b. THE CAVE OF SOF OMAR
c. Black areas are CAVES
d. Where land has been cut away in diagram to show CAVES
e. River Web
f. Road to Ginnir
g. Old valley where river used to flow

This wording was taken directly from the map by Robson.

The River Web is the major river in the Bale province. The river flows through the cave and formed the major trunk passage of the cave. A considerable maze area exists near the resurgence (see map in Courbon, et. al.).

Ginnir is a village about 25 kilometers north of Sof Omar. North arrows on both the stamp and Robson's map point to the upper left, but the directions do not coincide. The arrow on Robson's map is labeled "magnetic north"; possibly the stamp design shows true north. I have detected other inaccuracies (i.e., artistic license) with the stamps of this set which show scenes from the cave, but this article is only about the cave map stamp and the map on which it is based.

Acknowledgement: Rick Banning provided photocopies of the Sof Omar stamps since I do not have them in my collection.

References:

Clapham, C.S. and Eric Robson (1967) The Caves of Sof Omar. Addis Ababa, Ethiopia: Ethiopian Tourist Organization, 12 pages plus foldout map of the cave.

Courbon, Paul, Claude Chabert, Peter Bosted, and Karen Lindsley (1989) Atlas of the Great Caves of the World. St. Louis, MO: Cave Books, 369 pages.

DERIVATION OF CAVE CLOSURE WEIGHTING FACTORS

by Tom Kaye

Because of the random error associated with the use of measuring instruments, more than one calculated location will be found for each junction point in an interconnected cave survey. In order for a map to be drawn, the best single location of each junction point must be determined. There are several ways to do this. Three common ones are: eyeball approximation, sequential loop closure, and simultaneous loop closure. A conceptual difference between these three methods is the portion of human judgement involved; total, partial, and none, respectively. The sequential loop closure method involves one or more qualitative steps in which the operator decides which loop to mathematically close next. The simultaneous loop closure method is based on the least squares determination of the positions of all the junction points in the survey using calculations of relative error levels (weighting) of different paths (strings) between the junctions, as well as the cave survey data itself. This article deals with weighting, which is used in the least squares calculations of simultaneous loop closure.

A statistically correct weighting scheme for strings is essential for a good least squares determination of the positions their ends. The weight of each string should relate to its intrinsic error propensity. The intrinsic error propensity of a string is derived from the compounded error propensity of each measurement in the string. The compounding of the error propensity in strings can be done in two ways: calculations involving both the spatial orientation and the length of each string, and calculations involving only the length of each string. The weighting described here is for the latter kind of calculation, which is much easier, and probably more efficient in terms of computer effort versus statistical precision.

The statistical measure of the variation (error) in a value is the variance. The variance of the result of several measurements can be calculated from the variances of each of the measurements using Gauss's law of propagation of error. If F is a function of several random variables,

$$F = f(A,\ B,\ C,\ \ldots\ .)$$

then the variance of F can be calculated from

$$\sigma_F^{\ 2} = \left(\frac{\partial F}{\partial A}\right)^2 \sigma_A^{\ 2} + \left(\frac{\partial F}{\partial B}\right)^2 \sigma_B^{\ 2} + \left(\frac{\partial F}{\partial C}\right)^2 \sigma_C^{\ 2} + \ldots$$

where σ_A^2 is the variance of variable A, etc., and $\frac{\partial F}{\partial A}$ is the partial derivative of F with respect to A, etc. The Gauss equation is calculated using the average values of the variables.

Survey shots are measured with three instruments, the tape, compass, and clinometer. Each of these has a random error associated with it. In order to apply the Gauss equation to survey error, we need to get an equation for each of the three spatial axes. Then we can derive an equation for the variance of each of them. The equations for the North, East, and Vertical vectors of a cave survey shot are:

$$
\begin{aligned}
N &= D \cos\theta \cos\phi \\
E &= D \sin\theta \cos\phi \\
V &= D \sin\phi
\end{aligned}
$$

The variances of these vectors are:

$$
\begin{aligned}
\sigma_N^2 &= \sigma_D^2 \cos^2\theta \cos^2\phi + \sigma_\theta^2 D^2 \sin^2\theta \cos^2\phi + \sigma_\phi^2 D^2 \cos^2\theta \sin^2\phi \\
\sigma_E^2 &= \sigma_D^2 \sin^2\theta \cos^2\phi + \sigma_\theta^2 D^2 \cos^2\theta \cos^2\phi + \sigma_\phi^2 D^2 \sin^2\theta \sin^2\phi \\
\sigma_V^2 &= \sigma_D^2 \sin^2\phi + \sigma_\phi^2 D^2 \cos^2\phi
\end{aligned}
$$

When evaluated at 0 degrees azimuth, the equations become:

$$
\begin{aligned}
\sigma_N^2 &= \sigma_D^2 \cos^2\phi + \sigma_\phi^2 D^2 \sin^2\phi \\
\sigma_E^2 &= \sigma_\theta^2 D^2 \cos^2\phi \\
\sigma_V^2 &= \sigma_D^2 \sin^2\phi + \sigma_\phi^2 D^2 \cos^2\phi
\end{aligned}
$$

These are the variances of the three axes of the error in a survey shot of D feet at 0 degrees azimuth and phi degrees inclination. The shape of the error zone is an ellipsoid whose axes are the three variances. I explained this in more detail in my article, Analysis of the Propagation of Error in Cave Surveys, in the Proceedings of the Eighth International Congress of Speleology, page 800. Much of the mathematics in that article is from its reference Data Analysis for Scientists and Engineers by Stuart L. Meyer (pages 225, 254, 263, 288).

As stated previously, the weighting to be derived here is for application in an algorithm that is independent of azimuth and inclination, depending only on the length of each shot. (This is, of course, not the most detailed kind of algorithm in terms of error propagation modeling, but it may be a best comprimise between efficiency and accuracy.) We therefore need to "get rid of" the azimuth (theta) and the inclination (phi). This requires an assumption and a trick.

The assumption is that the average absolute inclination in cave surveys is 10 degrees. This is probably a little low, but I haven't analyzed any data yet (and I'm not sure that the actual value is extremely important). In any case, 10 degrees represents an average of absolute values since the shape of the ellipsoid of error is independent of the sign of the inclination because the trig factors are squared in the variance equation.

The trick for removing azimuth from the picture is to consider two consecutive shots at right angles to each other. The error ellipsoid resulting from these shots is circular (an oblate sphereoid). Adding the variances of two ellipsoids whose azimuths are 0 degrees and 90 degrees azimuth is relatively simple (also there are no complex covariance terms). According to the Gauss equation, the variance of A where A=B+C is the sum of the variances of B and C. Hence we sum the equations above, respective to their axes. The 0 degree azimuth shot's variances will be as shown in the previous set of equations while the variances of the other shot at 90 degrees are similar except that the values for the N and E variances will be switched (evaluated at 90 degrees azimuth).

$$\sigma_{\Sigma(0°+90°)_N}{}^2 = \sigma_D{}^2 \cos^2\phi + \sigma_\phi{}^2 D^2 \sin^2\phi + \sigma_\theta{}^2 D^2 \cos^2\phi$$
$$\sigma_{\Sigma(0°+90°)_E}{}^2 = \sigma_\theta{}^2 D^2 \cos^2\phi + \sigma_D{}^2 \cos^2\phi + \sigma_\phi{}^2 D^2 \sin^2\phi$$
$$\sigma_{\Sigma(0°+90°)_V}{}^2 = 2(\sigma_D{}^2 \sin^2\phi + \sigma_\phi{}^2 D^2 \cos^2\phi)$$
$$(\sigma_{\Sigma(0°+90°)_N}{}^2 = \sigma_{\Sigma(0°+90°)_E}{}^2)$$

To get back to the weight for a single shot, we simply halve the constants in the resulting summed variance equations. We no longer need separate values for the North and East vectors, since they are equal (as is any other horizontal vector); Horizontal vector will suffice.

$$\sigma_H{}^2 = 1/2(\sigma_D{}^2 \cos^2\phi + \sigma_\phi{}^2 D^2 \sin^2\phi + \sigma_\theta{}^2 D^2 \cos^2\phi)$$
$$\sigma_V{}^2 = \sigma_D{}^2 \sin^2\phi + \sigma_\phi{}^2 D^2 \cos^2\phi$$

In the variance equations, we need values for the squared standard deviations for the tape, compass, and clinometer. Any assumptions in the angular standard deviations in degrees must be converted to radians before using them in the equations! The values I have used in a closure program are: 1.5 degrees for both compass and clinometer and 0.2 feet for the tape. (According to the survey data I have analyzed, the value for the compass should be more like 2 degrees. Unfortunately my 'analysis' used weighted cave closure data which was colored by my use of 1.5 degrees and 0.2 feet in the weighting factor derivation!)

To provide for an easily identifiable "bad" string, I used a chi squared value for 90 percent confidence (and 3 degrees of freedom) in the weighting factors (see the book by Stuart L. Meyer referenced above). This value is about 6.3, so I multiply all variances by 6.3. Substituting the nominal values, 6.3, 1.5 degrees, 1.5 degrees (both in radians), 0.2 feet, and 10 degrees vertical angle, we get:

$$\sigma_H{}^2 = 6.3/2 \ (\ (0.19696)^2 + (0.004548)^2 D^2 + (0.0258)^2 D^2)$$
$$\sigma_V{}^2 = 6.3 \ (\ (0.03472)^2 + (0.0258)^2 D^2)$$

A simultaneous closure program should report a horizontal error ratio and vertical error ratio for each string which is the closure adjustment of the string divided by the weight of the string. With the 90 percent confidence level, 90 percent of the strings should have error ratios that are less than 1.0. In my experience, rather more than 90 percent of the strings have error ratios less than 1.0.

OBSERVATIONS OF AN NSS MAP SALON JUDGE

by Ed Devine

I recently had the opportunity to serve as a Map Salon judge at the NSS Convention in Cobleskill, New York. The experience was much more work and effort than I had originally expected yet was very satisfying. It was a real pleasure to work with fellow judges Carol Vesely and Hubert Crowell. I look forward to judging in future Map Salons as it is challenging, enjoyable, instructive and a good opportunity to meet fellow cave mappers.

I'm writing this because I feel that my observations, as a Map Salon judge, may be useful for future judges, map entrants and those who wish to improve the map judging process. Besides, if I enter any maps myself this year, it may help!

The maps entered in the Salon represent a truly mind-numbing volume of work by surveyors and cartographers. They also require a lot of time to judge fairly. In the current system, a written critique is provided for each map entry by each of the map judges. The critique provides a formal, quantitative evaluation of each map and requires careful attention by the judges. In addition, following the awards ceremony, an open critique session is held wherein the judges must defend their evaluations. This overall procedure forces objectivity and fairness. The point scoring procedure is outlined in detail in Compass and Tape Vol 7, No. 3 and is an essential reference for aspiring Map Salon Entrants. These judging criteria are still developmental and imperfect and will doubtless be modified, with time. However, they do provide a distinct framework and are essentially sound.

Actually, I think there are some real fundamental problems with the whole concept of judging cave maps. First of all, we can't field-check the maps. This means we can't tell how representative the map is of the actual cave. We can't tell if the cartographer missed major cave passages or features. We can't even tell if the cave actually exists. Another problem is "map scale inflation" which describes the paradox of tiny, insignificant caves getting detailed, fine-scale maps, while huge, important caves get coarse scales. And then there's the issue of cave complexity. Can we really compare maps of super-complex caves, which may look ugly, at best, to beautiful maps of simpler, more straightforward caves?

This highlights what is probably the most important function of map judging. As I view it, the main purpose of this exercise is to promote cartographic interest and the establishment of map quality standards rather than awarding medals. In view of this, the most important map entrants may be the poorer ones rather than the better ones since these reflect a greater need for critique.

Thirty-seven maps were entered in the 1991 Salon. This really isn't many maps considering the size of the Society and the great number of maps that get published in the course of a year. However, since I spent, on average, about an hour on each map, a lot of time was required. Seventy-five maps would have been devastating.

No map entrant was perfect, which made the judging an interesting game because the problems were often very obscure. Some of the maps were pretty close to perfect but once again, there were always some "bugs". Those "bugs" which reflect my personal opinion were not applied to overall point scoring. Point scoring is strictly in accordance with the guidelines published in the Compass and Tape article.

Lack of cartographic or survey date was seen on several of the maps. This is a show-stopper for further consideration of the map for any award, according to the current judging criteria. This should be the survey date which is more important than the cartographic date (i.e. when it was drawn). This should be distinctly clarified on the map (i.e." Surveyed January, 1986, to June, 1990"). Several maps were nearly disqualified because the cartographer placed a date and a copyright symbol at the lower corner of the map with no further description of survey date. These dates appeared to be drafting dates and not survey dates, which is inadequate. However, after discussing the issue, the judges decided to let them go. This can be important; the drafting of a map may be done years after the survey is complete.

Cartographer and survey crew members or organization should be annotated on the map, but these were not judged criteria.

Several fine maps lost lots of points because there was neither a legend nor a reference to a map symbol standard. For this they lost a hefty 10 points out of 70 possible, which essentially threw them out of consideration for an award. Some cartographers drew a legend and others referenced legends. The symbol reference should be specific (i.e. NSS Bulletin 41, No. 2, April, 1979). Referencing "NSS Standard Symbols" is inadequate because there is no agreed NSS standard, at this time. I have a minor problem here - cartographers who listed the reference generally got all 10 points while cartographers who included a symbol legend as part of the map often had minor errors in it, such as symbols left out or inadequately described and they lost a point or two. This discourages the inclusion of a legend, which is unfortunate, because a legend is a superior, stand-alone device which really does look better on the map than just a reference.

While on the subject of legends, great care must be taken to include every symbol on the map. Slope, ledge, ceiling height change and other vertical symbols must clearly describe what is up and what is down. Such omissions cost a point off.

I think every map had a north arrow of some sort. True north is preferred over magnetic north since magnetic north changes significantly with time. If magnetic north is shown, a corresponding date and declination should be noted. For judging, full points are given as long as a north arrow of some kind is shown (Salon rules). I threw off a point when declination was included with a date which differed significantly from the survey date. I.E. 1965 magnetic declination is questionable when the survey was done in 1983 (it can really change a lot!). Personally, I feel that true north should be required for full points, but this is not Salon Policy. Another subtle bug: one map showed a magnetic north rosette with east, south and west annotated. I'm not sure that magnetic east is a viable concept.

One map lost a point because the true and magnetic north arrows were drawn much farther apart than the 2-degree declination which was listed. The north arrow must be precisely drawn on the map. Along similar lines, one map showed metric and foot scale bars drawn together such that the 90 meter scale equaled the 300 foot scale. 90 meters is 295.3 feet which is significantly different than was shown.

A statement describing the units on the map is necessary. Some cartographers lost points for this omission. Units on the map scale is not enough - you need a statement such as "all map units in meters".

Almost nothing on the map should be abbreviated. For example, "County", not "Co.", "Entrance", not "Ent.". A few cartographers lost points for this. However, as a notable exception, an abbreviation can appear as a map symbol and be described on the legend (such as TT for "too tight" or TL for "too low").

Ambiguous cave passage terminations should be annotated. I.E., is a passage that ends in dashed lines a pinch, a dig or a 10-foot high lead? I wanted to take points off for this but George Dasher insisted that this is a valid cave map symbol meaning "pinch to narrow, continuing passage". I think that a note on the map would be better.

Elevations on the map must reference something such as a USGS topographic quadrangle or a survey benchmark. "Mean Sea Level" may be an inadequate reference - the USGS maps apparently are based on a 1929 sea level standard.

A complete map must contain an entrance location, either as a description of latitude and longitude or as UTM coordinates. This is a fundamental component of a map and lack of a location therefore makes a map incomplete. This is fundamental cartography. However, entrance location specification is so controversial within the Society that it is not a requirement of the Map Salon. I like to see location on the map, although I also agree that it is inappropriate in some circumstances. Therefore, I gave a discretionary Perk Point for inclusion of the entrance location on the map.

Artistic flourishes on maps are discouraged unless they enhance the understanding or presentation of the map or are part of an organizational logo. However, if part of an organizational logo, the organization should be clearly identified. Several maps lost points because of unidentified organizational logos on the map (is it a symbol, or what?). These touches can enhance a map. However, if they are overly large than they can just as easily detract. Artistic renderings of cave entrances and passages were used to great effect on several of the maps, and Perk Points were awarded for these. In another case, a large drawing of a caver on the map detracted from the map because it added no information. Cartographers must be very cautious about this stuff.

Hand map lettering is perfectly acceptable and can be used very effectively. In fact, the medal winning map from this Salon was hand-lettered. Unfortunately, the vast majority of us probably could not pull this off. Typically, hand lettering just doesn't look that good and will result in loss of drafting quality points.

Passage cross-sections are an essential detail and I think every map included at least some. However, in some cases they were too sparse to adequately describe the characteristics of the passages and points were deducted. As a convention, cross-sections are typically viewed up or to the right, on a map. In other words, not necessarily the way they were made during the survey. However, this was not a judged criterion.

The Salon criteria do not directly provide for inclusion or lack of a map profile. This is unfortunate as profiles are difficult to draw and can greatly enhance a map. I provided 2 extra Perk Points for inclusion of a profile as an "Innovation". Profiles will indirectly benefit the cartographer when tied scores permit judging based on overall impact or other less objective criteria.

Points were lost because cartographers did not describe the type of survey ("compass and tape", "Suuntos and fiberglass tape", etc.).

Inclusion of a geological description is not required by the Salon criteria, although I included a Perk Point for this information.

On profiles, the tops of pits should include some of the surface detail rather than just the pit itself. In other words, don't just draw two parallel vertical lines ending at the top but add part of the horizontal surface too. However, this did not affect point scoring.

Misspellings resulted in a few lost points.

One map referred to a USGS topo map name without specifically calling it a USGS topo map.

One map showed flowing water with an unconventional symbol which did not clearly show the direction of flow. If there was no flow than a note would have clarified this fact.

Lack of vertical control was seen on several maps (i.e. no elevations or profile), and this was a show-stopper for further award consideration. A thorough profile precludes the need for annotated elevations.

Several maps lost points when state cave survey numerical identifications were included with the title block but defined. Although obvious in those regions where the caves are numbered, this is generally confusing and unclear (i.e., AL345 is meaningless to most cavers).

Large empty areas on maps should be avoided - better formatting of the map is probably necessary. Likewise crowded maps also resulted in point loss.

Maps of two large caves were entered which did not show a single place name or similar annotation within the cave ("Big Room", etc.). Inclusion of such information is important for interpretation and discussion of the map. (subsequent discussion with one of the cartographers revealed that one of the caves literally had no place names). This was not a judged criterion.

Bar scales should be annotated with a word rather than a symbol (i.e., FEET not ').

If a survey grade is included on a map, it must be specifically described (i.e., whose Grade 5 survey?).

At least one map did not include a map border. Some map borders were not straight-lined or right-angled.

Surface roads should have road names and/or route numbers shown.

Cross-sections should be drawn to scale of map unless otherwise noted.

Survey stations should generally not be shown on final maps except possibly for one entrance datum.

By convention, caves have entrances not exits.

Poor-quality drafting characteristics seen on the maps included ...

- Poor line thickness control ...
    - blobs,
    - breaks,
    - scratchy-looking,
- Limited range of line widths,
- Bad-quality copies entered in Salon,
- Overly-reduced map copies,
- Bad lettering, particularly ...
    - inconsistent lettering,
    - adjoining letters touching one another,
    - crooked lettering, particularly title,
- Borders with crooked and/or curved lines,
- Poor multiple-passage definition ...
    - badly drawn dotted and dashed lines,
    - lines intersecting for multiple levels (a slight break better),
- Cross-section lines touching the cave passage walls (a slight gap should be maintained),
- Trees drawn unrealistically small on a pit profile,
- Details on a profile which contradict details on a plan,
- Poorly-sized features, i.e., north arrow too big,
- Interior bedrock, such as pillars, clarified by blacking- out rather than using thicker line widths.

This article is much longer than I had originally intended but will hopefully serve some useful purpose. I hope that I have not made too many enemies although a little lively discussion would probably be good. I'll end with a request ... Could it possibly be arranged, as with the Photo Salon, for the judges to review the maps well in advance of the Convention so that the detailed judging can be done in a leisurely, thorough and comfortable manner?

THE USE OF "T.H.C." ON CAVE MAPS

by Robert Thrun

The NSS News recently published a cave map that indicated the cave has a number of feet of "T.H.C." The abbreviation was not explained on the map or in the article the map accompanied. The use of such an abbreviation is a bad practice because not everyone knows what it means. It is not in any dictionary or cave map symbol list.

On some maps T.H.C. is written out in full as True Horizontal Cave. I object to the use of the word "True", because it implies that any other measure of cave length is somehow phoney. I contend that if it takes 100 feet of measuring tape to reach from one point in a cave passage to another, then that section is 100 feet long. George Dasher uses the example of a wire sculpture. If someone had a wire sculpture of the cave and measured its length, he would measure along the length of wire and not along the shadow of the wire sculpture.

The use of the horizontal component as the length arises from the fact that most cave maps are plan views. If the length is not reported by the surveyors, then we have to measure the map to get the length, and what we get is the plan length or horizontal component of the total length.

The abbreviation T.H.C. could mean Total Horizontal Component, but I did not find such a use. The use of the word "component" would immediately alert the reader to the fact that what is being reported is not the full length. If someone wants to use Total Horizontal Component, he had better not abbreviate.

I became curious about practice of reporting True Horizontal Cave and the use of the abbreviation T.H.C. To track it down, I examined the maps in the Speleo Digest. I looked at the most recent Digests and then some early Digests to see what was the first use of the term. I counted the number of maps that reported T.H.C., horizontal cave, vertical cave, or similar terms. I considered THC and T.H.C. to be the same in my counts and ignored variations in capitalization. If a map had more than one cave, I counted it as one map because I am concerned with mapping practices. I did not count other terms, although I did observe some patterns of usage. The most popular term by far was "length", followed by "surveyed length". The term that most accurately described what was actually being reported was "Total Surveyed Traverse". Few of the early maps reported length at all.

The Use of THC and Similar Terms on Cave Maps

	Number of Maps
Speleo Digest - 1964	
length reported	1
Speleo Digest - 1965	
length reported	0
Speleo Digest - 1966	
length reported	3
Speleo Digest - 1967	
length reported	1
Speleo Digest - 1968	
length reported	11

	Number of Maps
Speleo Digest - 1969	
Indiana	
True Horizontal Cave	2
THC	2
(all 4 by C.D. Ritter)	
Tennessee	
True Horizontal Cave	1
(by Ron Zawislak)	
Speleo Digest - 1970	
Indiana	
THC	9
Kentucky	
THC	1
Tennessee	
THC	1

	Number of Maps
Speleo Digest - 1971	
Georgia	
THC	3
TVE	1
Indiana	
THC	6
True Horizontal Distance	1
True Horizontal Cave	3
Total Vertical Depth	1
Total Vertical Extent	1
Total Horizontal Distance	1
Total Horizontal Footage	1
Speleo Digest - 1986	
Alabama	
T.S.C.	1
T.H.C.	1
T.V.E.	1
Indiana	
THC	9
TVC	6
TVE	2
True Horizontal Cave	1
Horizontal Length of Survey	1
Kentucky	
THC	1
Ohio	
THC	1
Tennessee	
TSL	1
Virginia	
TSP	1
West Virginia	
Total Horizontal Extent	1
Total Vertical Extent	1
Speleo Digest - 1987	
Alabama	
THC and TVE	1
Arizona	
THD and TVE	1
California	
Total Surveyed Traverse	2

	Number of Maps
Indiana	
True Horizontal Cave	2
THC	27
TVE	8
TVC	1
Kentucky	
THC	3
Tennessee	
Horizontal Length	1
Vertical Extent	1
Texas	
Beaver Creek Bat Cave has Total Horizontal Length with a smaller number of "feet surveyed"!	
West Virginia	
Horizontal Extent	1
Canada	
TSL and TSD	1
Speleo Digest - 1989	
Alabama	
Length: Horizontal Tape	1
Arkansas	
THD	1
California	
Total Surveyed Traverse	6
Georgia	
THC	2
Indiana	
THC	16
Total Horizontal Length	1
Total Horizontal Cave	1
TVE	8
TVC	3
Kentucky	
Total Horizontal Cave	1
THC	1
Tennessee	
THC	4
TVE	4
West Virginia	
TSP	1
Mexico	
Total Traverse	1
Total Surveyed Traverse	1

BOOK REVIEW

by Rich Breisch

Babb, Robert II, James Hardy and Fritzi Hardy. (1991) The Precision Survey of Lechuguilla Cave. Professional Surveyor. May/June issue, pp 4,6,9.

Since this article appeared in a journal for surveyors, not cave mappers, much of the article describes the history and difficulties of Lechuguilla Cave or information which would be known to most NSS cave mappers. In this very precise survey, the surveyors used a "Pentax PTS-II05 electronic total station". The following extended quotation describes the obstacles encountered and the unusually precise method of conducting the survey.

> "In designing a survey approach, the team had to consider the following potential obstacles and their effects on maintaining accuracy:
>
> - No loops are possible for the main survey line (i.e., an open traverse)
> - Short sights (as little as 10 feet)
> - Steep sights (approaching the instrument limit of 55 degrees)
> - Constricted passages with unstable flooring (crew members moving near setups have caused noticeable tilting and movement of tripods)
> - Unavoidable poor tripod leg placements (due to the delicate nature of the cave floor)
> - Difficulties in setting permanent stations (for scientific and aesthetic reasons)
>
> The surveyors must also rely on mostly inexperienced and volunteer crew members. For this reason, each expedition begins with an in-depth surveying school.
>
> The survey is designed to be a constrained centering position, dual interlocked traverse. Two traverses are run side by side. their stations are set in pairs, one from each traverse, approximately perpendicular to each other's traverse line. The constrained centering position comes from the operation of the survey.
>
> In a given setup, after all the measurements are taken at the instrument position, the backsight position setup is moved to the next pre-foresight position setup. The current foresight setup becomes the new instrument position. The current instrument position becomes the backsight position, and the current pre-foresight position becomes the new foresight position. Since a given pair of tripods and tribrachs progress from pre-foresight position to foresight position to instrument position to backsight position and are not moved, the location of the survey point, as represented by the position of the tribrach on their tripod, does not change as the survey progresses through the position. Thus, constrained centering is obtained.
>
> At every station, angles are turned to five other points (plus reference points if available). Distances and vertical angles are then measured. The instrument is then reversed, and the measurements are repeated. This redundancy helps catch errors and gives enough multiple data to insure a good line through andy given area.
>
> Magnetic north is also taken at each instrument station to identify any magnetic anomalies that might affect the Brunton/Suunto surveys tied in the traverse. To facilitate target location and instrument pointing, the retroreflectors have been modified with a green LED placed behind the retroreflector in such a way that the LED appears in the center as a three-legged star. This provides an easily located target in the dark."

At the end of the first year of surveying by this method and after six week-long expeditions, the "Thundering Turtles" have mapped 1700 linear feet of passage in 2000 manhours of effort. I enjoy reading about nonstandard methods of cave surveying, but I question whether surveying at less that 1 foot per manhour is an efficient use of surveying time. I'm sure that the reason this survey was understaffed is that most surveyors were bored to tears.

Why survey at this slow speed? The author says the survey's value is to preserve a rare and dramatic phenomenon. I don't think so. A super-precise survey, such as this one, is of value in deciding ownership disputes, preparing for commercialization (such as locations for an elevator shaft or an entrance tunnel), or determining length or depth records. The first two of the above reasons do not apply for Lechuguilla, and who cares if the cave is 1570 or 1560 feet n depth rather than the currently accepted figure of 1565 feet? Incidentally, the authors never compared the accuracy of their survey with the much faster surveying done using Bruntons or Suuntos. The procedures described in this article sound interesting to me and would be fun to try for one day. I personally don't see the value in this precision.

Reviewed by Rich Breisch from article supplies by Al Breisch.

BOOK REVIEW

by Rich Breisch

Lange, Arthus L. and Mike Wiles (1991) Mapping Jewel Cave - from the Surface. Park Science - A Resource Management Bulletin, Spring issue, pp. 6-7

First of all, the title of this article is extremely misleading. The article is not about mapping Jewel Cave - it describes a new and experimental geophysical technique to detect cave passage. The authors used this procedure to make four transects over known passage of Jewel Cave in South Dakota.

Earlier, Lange had surveyed other caves using the natural-potential method, but these were done in areas with low relief. The natural-potential method measures the voltage generated by naturally occurring a.c and d.c. currents. Measurements are taken along a surface profile using a roving electrode tied through a long cable and meter to a fixed base electrode. An empty cave gallery provides a locally more permeable path for infiltrating water, and thus water is more likely to infiltrate over a cave roof than over surrounding rock. As a result the cave ceiling becomes positively charged relative to the ground surface, while the surface zone overlying the cavern becomes more negatively charged than its surroundings. In Jewel Cave the cave ceiling was measured almost 250 millivolts more positive than its corresponding point on the surface 40 meters above. The data for one transect is shown graphically on a profile of the cave passage and its overlying terrain. One can "sort of" see the correlation between cave. Even the author admits he does not know if the potential difference at one location is due to a fault or to undetected cave passages. The article would have been more convincing had the authors shown the results of all four transects rather than the one which best supported their thesis.

The article referenced two other papers by the senior author and others about the remote sensing of caves. I have not seen these, but they might have additional information useful for anyone attempting this method of cave detection.

Lange, A.L. and J.F. Quinlan (1988) Mapping caves from the surface of karst terrains by the natural-potential method. Natural Water Well Association, Second Conference of Environmental Problems in Karst Terrains and their Solutions, Proceedings pp. 369-390.

Lange, A.L., P.A. Walen and R.H. Buecher (1990) Cave mapping from the surface at Kartchner Caverns State Park, AZ. Paper presented at the Third Forest Service Remote Sensing Applications Conference, Tucson, AZ, April 9-13, 1990, Proceedings pp. 163-174.

Reviewed by Rich Breisch from article supplied by Al Breisch.

1991 CARTOGRAPHIC SALON
REPORT BY GEORGE DASHER
21 July, 1991

Judges:

Ed Devine	Vienna, Virginia
Hubert C. Crowell	Marietta, Georgia
Carol Vesely	Monrovia, California

All told, 36 maps were entered by 17 entrants. The maps were from:
Quintanna Roo; Sa Luis Potosi; Puteranas, Costa Rica; Tennessee; Illinois; Alaska; Alabama; West Virginia; Virginia; North Carolina; California

17 ribbons and 1 medal were awarded

11 Green - Honorable Mention

Herbert's Cave . . . . Laurie Adams
Swain County, North Carolina

Fountain Cave . . . . Charlie Lucas
Augusta County, Virginia

Piddling Pit . . . . Greg Springer
Pocohontas County, West Virginia

Rimstone Falls Cave . . . . Bill Balfour
Greenbrier County, West Virginia

Captain Soup Cave . . . . . . Carlene Allred
Tongas National Forest
Prince of Wales Island, Alaska

Nellie's Cave . . . . Greg Springer
Greenbrier County, West Virginia

Sotano del Aire . . . . Raul Puente
San Cayetano, San Luis Potosi

Macho Peek-a-Boo Cave . . Carlene Allred
Tongas National Forest
Prince of Wales Island, Alaska

Stove Cave . . . . Greg Springer
Greenbrier County, West Virginia

Madison Saltpetre Cave . . . . Charlie Lucas
Augusta County, Virginia

Smith's Hidey Hole . . . . . . Pat Kambesis
Jackson County, Alabama

5 Blue - Merit Awards

Cenote Carwash . . . . Jim Coke
Tulum, Quintanna Roo
(Special Class - Underwater Cave)

The Caverns at
Natural Bridge Village . . . . . . Tom Spina
Rockbridge County, Virginia

Galeria Grande . . . . Hope Uhl
Provincia de Punterenas, Costa Rica

Salamander Blowhole Cave . Laurie Adams
Green County, Tennessee

Packsaddle Cave . . . . Bob Richards
Tulare County, California

1 Medal - Overall Winner

Bananal . . . . Hope Uhl
Provincia de Punterenas, Costa Rica

The MINUTES OF THE 1991 ANNUAL SURVEYING AND CARTOGRAPHY SECTION MEETING
Cobleskill, New York

The annual meeting of the Surveying and Cartography Section of the National Speleological Society was held on July 2, 1991, in the basement of the Champlin Dining Hall, New York State University College, Cobleskill, New York.

In attendance were 28 members and friends of the Section. These people were: Bill Balfour, Barry Chute, Don Conover, Hubert C. Crowell, George Dasher, Doug Dotson, Frank Filz, Andy Franklin, Greg Clemmer, Bob Gulden, Russ Gurnee, Bob Hoke, Louise Hose, Tom Kaye, Robert Lenz, Kirk MacGregor, Charlie Maus, Angela Morgan, Nancy Pistole, Dave Seslar, Tom Shifflett, Bob Thrun, Hope Uhl, Jeff Uhl, Carol Vesely, Ann Wefer, Fred L. Wefer, Randy Winoker.

Chairperson Carol Vesely called the meeting to order at 12:53 PM, and immediately gave Rich Breisch's Treasurer's report. The Section has a total of $1,635.68 in moneys, $356.56 of which is a refund from the Yreka Convention.

Bob Hoke stated that there are some outstanding bills for the Section's newsletter, the Compass and Tape (C&T), 11 foreign issues, and several complimentary issues.

The Secretary, George Dasher, had nothing to report. The Editor, Tom Kaye, stated that he needs articles for C&T. Carol said that both John Ganter and Rich Breisch want to quit their jobs of Vice-Chairman and Treasurer, respectively.

There was no Old Business and no New Business.

Bob Thrun announced that he had finished a new version of his cave survey reduction editor and would like some feedback from Section members.

George Dasher said that the NSS Cave Surveying book is in serious trouble, and that he was having a short meeting with Tom Rea concerning the book immediately after the SACS meeting.

Tom Kaye stated that he needed cover material for the C&T.

Next was the election of officers. Carol Vesely was nominated for Chairperson, Doug Dotson for Vice Chairman, George Dasher for Secretary, and Bob Hoke and Hope Uhl for Treasurer. With the exception of Hope, all the nominees accepted, and a quick unanimous vote railroaded them all into office.

Carol made an announcement that everyone's membership had expired, and that everyone should pay Bob Hoke their dues. Then she adjourned the meeting at 1:04 PM.

Respectfully submitted by
George Dasher,
Secretary, SACS

EDITOR'S COMMENTS
by Tom Kaye

Below is the material that Bob Hoke, now the Treasurer of the S&C Section, sends to prospective members.

At the Convention, I stated that if only a small number of articles arrived during a quarter, I would rather wait for another quarter than put out a skimpy issue. Everyone there seemed to agree. So, that is why there has been no issue recently. I still plan to do two more this year, providing there are enough articles. The number of articles in a year (Volume) is, of course, independent of the number of issues.

Bob Hoke thought it would be useful to the membership to include the membership list in this issue. I though so too, so the following pages contain the list. If you have any address changes, please contact Bob Hoke.

National Speleological Society
SURVEY AND CARTOGRAPHY SECTION

The Survey and Cartography Section (SACS) is an internal organization of the NSS that is devoted to improving the state of cave surveying and mapping.

Membership: Membership in the Section is open to anyone who is interested in surveying and mapping caves.

Dues: Dues are $4.00 per year. The dues year starts with the issue of Compass and Tape that follows the NSS Convention. Anyone who joins the Section during the year receives any back issues for that year. Dues can be paid for up to 3 years. Checks should be made payable to "SACS" and sent to the Treasurer.

Compass and Tape: This is the Section's quarterly publication and is mailed to all members. It includes articles covering a wide variety of topics including equipment reviews, hints and techniques, computer processing, mapping standards, artistic techniques, publications of interest, etc. Compass and Tape is the primary medium for conveying information and ideas among the Nation's cave mappers. All members are strongly encouraged to contribute material and to comment on published material. Items for publication should be submitted to the Editor.

NSS Convention Session: SACS sponsors a Survey and Cartography session at each NSS Convention, at which papers are presented on a variety of topics of interest to the cave mapper. Anyone is welcome (and encouraged) to present a paper at the session. Contact the Vice Chair for additional information about presenting a paper.

Annual Section Meeting: The Section holds its only formal meeting each year at the NSS Convention. All Section business, including election of Officers, is done at that meeting.

Back Issues: SACS started in 1983 and copies of all back issues of Compass and Tape are available. The cost for each volume (four quarterly issues) is $4.00, plus $1.00 per order for postage. (For example, an order for two volumes would be $9.00). Single issues are available for $1.00 per issue, plus $0.50 per issue postage. Order back issues from the Treasurer.

Overseas members: SACS Welcomes members from foreign countries. The rate for all foreign members is US$4.00 per year and SACS pays the cost of surface mailing of Compass and Tape. If you need air mail delivery, please inquire about rates. We regret that all checks must be payable in US$ and drawn on a U.S. bank.

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