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*Digging Rescue
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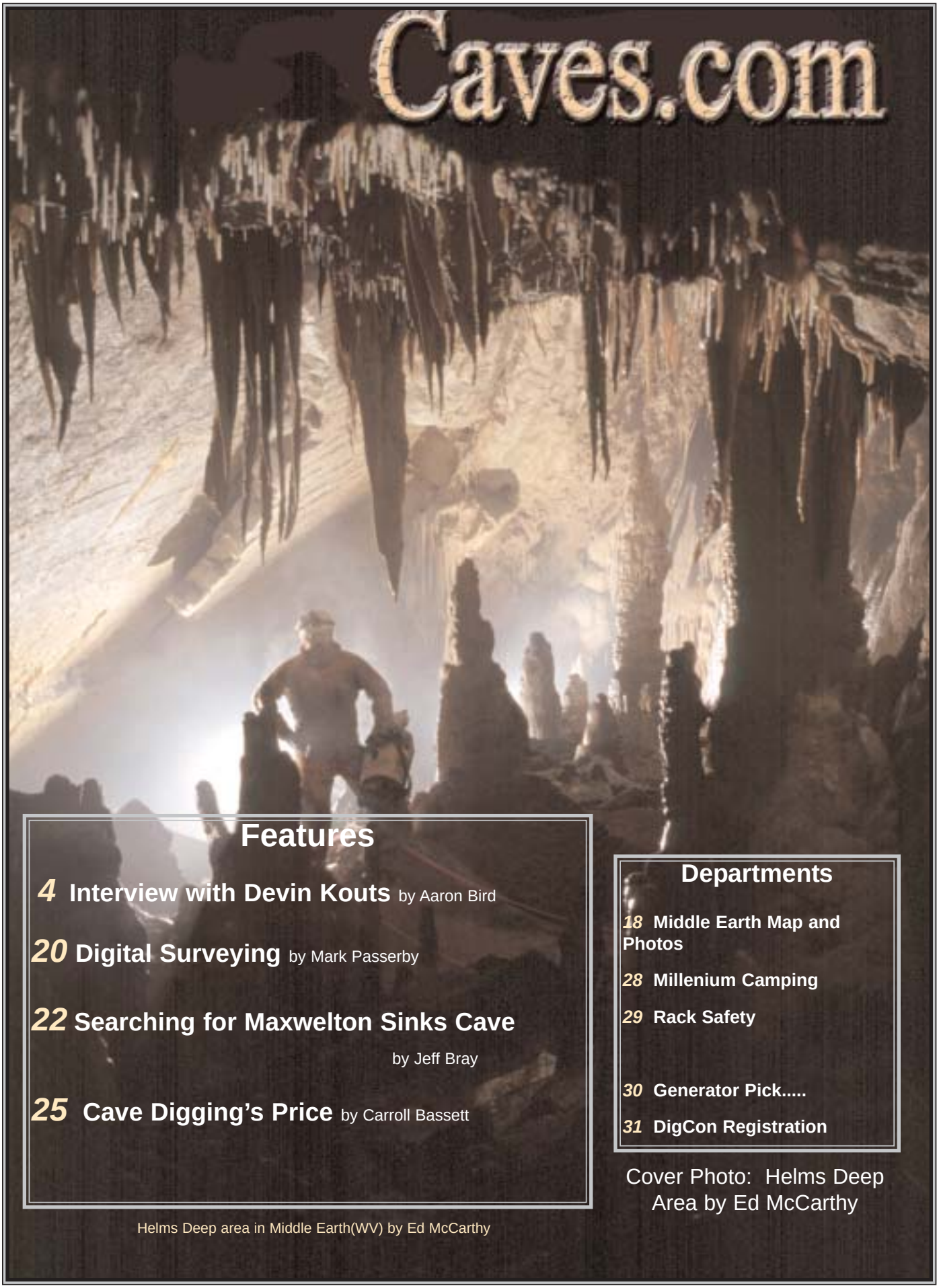

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Cover Photo: Helms Deep Area by Ed McCarthy

Helms Deep area in Middle Earth(WV) by Ed McCarthy

Interview with Devin Kouts January 24, 2003

Aaron: You cave mostly with Potomac Speleological Club (PSC). Yes?

Devin: Mmm, hmm.

Aaron: How did you get involved with them?

Devin: I got started with PSC when I was a boy, and my father was a caver and a member of the PSC. He had gotten into it through a couple of his friends and at about the age of 11, my dad started taking me to PSC meetings here in Arlington and we got into caving with that group of people and at the same time we were also caving with a lot of D.C. Grotto people. There's a lot of cross fertilization between the two clubs. So, that was back is the late seventies, say 1978.

Aaron: Wow, you've been caving well over 20 years then, huh?

Devin: Yeah, what's it, something like 25 years now?

Aaron: Wow, that's great.

Devin: Yeah.

Aaron: Has most of that been in West Virginia and Virginia?

Devin: Um, yeah, early on it was mostly in West Virginia and Virginia. I did a little stuff down in Chiapas a few years back. I went to Belize last year, and worked down there on some very large cave systems that are being surveyed. So, I've been broadening my horizons a bit. I haven't been able to get down to TAG, though. I really want to do that.

Aaron: Yeah, that's a fun place to go caving. That's for sure. O.k. Well, I know you through surveying in a big cave in German Valley. Tell me how you got into surveying.

Devin: That's sort of interesting. I caved basically from age 12 to 17 with the PSC, and then at age 17, I went off to college and the service, and you know, life, and getting a job and everything. I was gone from caving for ten years. I came back into it at age 27.

Well, I happened to be living in the vicinity of the PSC, where they have their meetings. So I went ahead and got a hold of them, and started caving again. It was in the first couple of months that I was hanging out with my old buddy Miles Drake, who I had known as a kid and caved with when I was a kid.

Miles and I had been looking around at some different new caves and doing a little ridge walking and stuff. I had done some ridge walking on my own and gone out and found a cave that was relatively unknown to anybody, and it wasn't a large cave, maybe 150 ft, but it was unmapped. Miles said, "Well, you know, when you find caves like that, you really do need to survey them, and not just go play around, but record what's there while you're at it."

Well, as far back as when I first got into caving, I'd always been very interested in cave maps, and I used to doodle in high school drawing cave maps in my text books and things like that. So when Miles said I should survey these caves and map them, it sparked a latent interest in me, in doing cave surveying and cartography. So it was within weeks that he took me to Twisted Fissure Cave for my very first survey trip, and that's where I learned to survey was in Twisted Fissure. I guess I had a natural ability for sketch because I was sketching fairly well by the end of the trip, and I think it was just three months later that I basically took over the Twisted Fissure survey. Nobody else seemed interested in exploring the cave, so I stepped up to the plate and kind of led up the troops who were interested in spending time in there.

Aaron: And that's a Taylor Run project?

Devin: That is how the Taylor Run project got started. That was in October of '94. And it was a discovery that Miles Drake and Doug Medville had made, that particular cave, but after just a couple of months of surveying in there, they were having difficulty continuing the project, you know, getting back up there. So, I was young and enthusiastic and I decided I'll go up there and keep surveying. I was able to marshal enough interest amongst other people to keep the survey going. So that was where I learned to survey, and then it turned into a very big survey project. We worked in Taylor Run for a period of seven years, and surveyed something just over five miles of virgin passage across probably a dozen different caves up there.

Aaron: Yeah, that's a pretty amazing little pocket of caves.

Devin: Yeah, it's a great exposure of limestone up there, above Gandy Creek in Randolph County and it has much more potential to it. It's a little difficult to work on because you have to basically camp out when you get up there. It's fairly remote. It's

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very cold in the winter time. You can't work up there between December and May and, so it's pretty rustic. There's a lot more potential for a lot more cave up there.

Aaron: How is it that there's so much cave so high up on the mountain?

Devin: Well, it just works out that that's where the limestone was. It's not down in the Valley. It's basically on the flanks of Middle Mountain. There's a large exposure of Greenbrier limestone that runs along the length of the mountain and if you look at a topo map of the area you can actually see some very large sinkholes and this is near the town of Witmer, WV, you'll see these sinkholes. And, so we sort of drew our interest to that area, and we were actually introduced to the area by a local caver from Whitmer who had been ridge walking around there and had spotted a couple of holes.

Aaron: So, did that somehow lead to Gangsta Mapper projects? Were they involved with this Taylor Run project?

Devin: No, actually, the Gangsta Mappers comes in from a different direction. I don't know their first cave survey, but what happened is the Gangsta Mappers was a group of surveyors from a number of different clubs around the Virginia Area Region(VAR), different grottos, who would get together and survey in large caves, and their modus operandi is to survey big caves, the kind that are large enough that small groups of surveyors would be overwhelmed, and focus on caves that have been mapped in the past, but have been mapped poorly.

So, the Gangsta Mappers tend not to do virgin caves, you know, I mean, they'll do virgin if they happen to find it, but they focus on known caves, like I know they did New River Cave, they did Paxton's. Paxton's was one of their earliest. Then they went on and surveyed Bowden, and after Bowden, um, they started two caves at once. Basically, they're doing Breathing right now, and Cassel Cave at the same time.

Aaron: And in almost every case they've found quite a bit more passage.

Devin: Oh, yeah. Yeah, they're notorious for that - they do a very methodical job and survey in great detail, and there are some very experienced people there, so they really know how to push a cave and they've always come up with new passage.

Aaron: And so do you go on some of the projects with them?

Devin: Um I have been involved with them on just a couple of their most recent projects. For instance, in Cassel, I've done quite a bit of survey in there. But they're so well manned, so well staffed that I figure, you know, they've got it covered, so while they're doing their thing, I can be off doing other projects and keeping the ball rolling in other areas. So they're not the main focus of my survey efforts. I would say since closing down the Taylor Run project in 2001, I've tried to loan myself out to other survey projects that are ongoing, such as the Germany Valley Karst survey, and the Highland County survey. It was great; I had a lot of support on the Taylor Run project, and now I'm trying to return the favor to all the people who supported me on that. I want to survey for them on their projects.

Aaron: What are some significant recent developments in the Highland County cave survey? I know there's been a lot of work over the past couple of years.

Devin: Well, the Highland County survey has focused a lot on the Bullpasture Mountain. If you look at the way Bullpasture Mountain lays out, it is in a very good position and it has some good limestone under it such that it could offer up quite a big system. There's a lot of water movement around there. There's some good air moving through some of the caves, and there are a lot of holes. And right across the river from Bullpasture Mountain is the Chestnut Ridge Cave System and Butler and all that.

Aaron: Yeah, Chestnut Ridge is big.

Devin: Oh, yeah, it's huge: 22 miles. So, basically what Highland County survey is doing is focusing on the limestone just to the northeast, along the strike, on the next mountain. And they have some pretty decent prospects and they're holding out hope that they'll bust into

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something similar to Chestnut Ridge, over there. They did come up with a very nice cave a couple of years ago that I got to do a survey trip into called Five Springs. And that one

went over a mile within probably the first three or four survey trips. I don't know what the current length is, but I know it's probably - I'm certain it's well over a mile and a half. And then on top of that they did find numerous small caves that they've surveyed up on Bullpasture Mountain. I think last year they set a personal record for themselves when they accomplished fifty new cave surveys in a twelve month period.

Aaron: Wow. That's quite a lot.

Devin: Yeah, they're pretty hard charges, and they get a lot of support down there.

Aaron: Now, a lot of the people doing that project are also working in Germany Valley? Is that correct?

Devin: I wouldn't say a lot. I would say a number of... probably a half dozen of the people in Highland are also pretty heavily engaged in Germany Valley.

Aaron: Germany Valley has had some pretty interesting recent discoveries, too, I understand.

Devin: Germany Valley has been a really fun project. We got this started in 1999 really, this most recent series of exploration and survey that's going on there. It's a pretty good story.

First of all, Germany Valley is very important to the NSS because it's where the NSS got its start in caving. It's not the very first caving that members of the nascent NSS started, but the two grottos that started the NSS - the Washington D.C. Grotto and the Pittsburgh Grotto - would travel out from those two cities and meet in Germany Valley and explore caves like Schoolhouse and Hellhole and Lawrence Dome Pit (also known as Fieldhouse) and some of the other caves in the Valley. And it was such a popular place that in the early '60's, Pittsburgh Grotto opened up a field house in Germany Valley.

The PSC took over that field house from Pittsburgh Grotto shortly after it was opened, and managed it from the early '60's up until the mid-'80's, when the field house was bought out from under them by the local quarry, and they were forced to leave the Valley, basically. They had nowhere to stay.

So, after the mid-'80's, exploration in the Valley definitely slowed down, but in the late-'90's, a group of us worked with, um, actually two people: Gordon Brace and Rick Lambert; they got together and spoke to a couple of local landowners there and got permission to do some ridge walking in the southern end of the Valley. One of those landowners was kind enough to allow us to use an old abandoned farmhouse on his place as kind of a field house to work out of, and we've been doing this on a monthly basis since 1999.

Well what this has allowed us to do is over time get to know more of the local landowners, and make friends there in the Valley and gain their trust, and then slowly spread out and cover more and more acreage. So, since 1999, in the last four years we've gained access to easily 50% of the limestone in Germany Valley and we've walked it all.

Aaron: [chuckles] Wow.

Devin: Yeah, and we continue to rewalk it because there's a lot of land out there. Well, you walk it once and you miss the hole. You walk it again and you find it. We've found a lot of new caves. A lot of people won't believe that because there are so many known caves in Germany Valley [that] so many known caves get rediscovered and renamed over time, but we've done so much walking around and research on what's known about the Valley that we were able to document the contents of the Valley more accurately and that got published in the Pendleton County Bulletin, WVASS Bulletin #15, a couple of years ago.

Outside of what was known we've been able to come up with a number of unrecorded caves, not all of them virgin, certainly some of them have been pushed. For instance one cave, called Laeger cave, was found by Herb Laeger many years ago. Herb's still around; I spoke to him recently. He was down caving in Mexico, and he was quite happy to learn that we had found the cave that he had originally found and that we'd actually named after him. But outside of those discoveries, we've found some new caves, and some of those have actually turned into very large caves with incredible potential to become extremely large.

Now, one of the first large discoveries we had was a cave called Con Cave. That was discovered during the NSS Convention in the year 2000 that was being held at the OTR campground over in Elkins. Some cavers, from I believe it was New Jersey, who were friends with some of the Germany Valley Karst Survey people / cavers went over to Germany Valley with us during the NSS Convention and they took a walk up one of the well known ravines there in the Valley.

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It was a hot summer day, and they happened to feel a little cold air as they were walking up the ravine. They got to poking around and found a narrow crack that was blowing air. Well, that sparked a lot of interest, and we had the assistance of our new friend Tom Barton from up in the Northeast, so over a series of several weeks we started widening the crack with, you know, technology Tom taught to us, and we were able to follow this crack for probably 100 feet into the limestone before we hit a pit. And from there on the cave just took off. We've surveyed about a half mile in Con Cave. It's a tight, tortuous cave but, it's very sporting and a lot of fun. And we had high hopes that it would lead us into something incredibly big, but so far it hasn't done that.

The other really great cave we have in the Valley is something that we found Memorial Day, 2000. We had just been working in the Valley for a few months, when Gordon Brace and I and a couple of other cavers, Lewis Carroll I believe was among us, decided to do a little ridge walking in a ravine we actually hadn't been up and down very thoroughly. And as we were walking through the weeds, Gordon first noticed some grass blowing in the breeze, just some moving grass, and he called me over. We thought it might have been an animal, but when we got close it turned out to be a small crack, 8" by 2", that was just howling air, and blowing around the brush nearby.

So we took on that project, started digging there, and it turned out that we were in a very hard rock unit known as the McGraw-McGlone. It took us; you know we dug and dug for months on that. Pete Penczer has written a wonderful article on the dig experience at Memorial Day, and that article was in PSC Caver (Nov. - Dec., 2002). But over a period of many months we worked at this hard rock dig without the technology that Tom Barton was able to lend, and we only got about six feet of progress in the hard rock.

We let the lead sit for quite some time because we knew we had ways of getting the cave open but the farmer had livestock nearby and things like that, and we really didn't want to upset his farming operation, so we probably waited for about eighteen months before we went back to the cave and actually did some more work on it. And with just two more feet of digging we broke into big walking passage. So, Memorial Day, after that break-in back in spring 2001, has grown to just over a mile in length and the majority of that surveyed length has come within the last two months.

In December of 2002, a group successfully pushed to the top of a pit that was at the very end of a very incredibly tight crawlway. The crawl is so small that people larger than Miles Drake simply won't make it. We only have four people in our entire group that can fit, and Miles is one of them. They got to the end of this 90 foot crawlway that's just

Entering the Puppetbuster

howling air and were able to set bolts at the top of this pit. Pete Penczer, Miles Drake, Ralph Hartley, and Rick Royer got to the bottom.

It's a 125 foot drop into borehole passage. At the bottom of the rope, the passage is about 20 feet wide and probably 100 feet high. Now, since then... of course they surveyed the day they dropped into it, and on that very first day they surveyed 2100' of borehole. They pushed the cave to a depth of 355 feet below the entrance where they hit what looks like a sump. It's actually just a big lake that's very deep and it goes wall to wall in the cave. And the walls are, you know, 20 feet apart. And then in the upstream direction they surveyed probably 1500 of those 2100 feet and that day they turned around in borehole 20' by 30' in dimension and came back out. Borehole was still going. It was just 4 in the morning and they needed to get out of the cave.

They went back last month and they continued their survey and they added I think, another 1700 or 1600 feet of survey to extend the cave to over a mile. It stands at 1.17 miles at this time. This cave is in the southern end of the Valley, and it is going north. We still have a very long way to go until we get to the area of Fieldhouse Cave, which is about the middle of the Valley. We're over a mile south of there. But it's borehole passage. It's following strike of the Valley. So everything looks very promising. We think we're going to see a lot bigger cave out of Memorial Day.

Aaron: Wow. That's pretty impressive. So are more trips planned back into the lower part of Memorial Day Cave?

Devin: First let me give you the name of the project: we call ourselves the Germany Valley Karst Survey, and we're not a closed project. We're an open project. We invite cavers to come and work with us but there is a requirement: we don't want people to show up and expect to survey great booty from the beginning.

Everybody who is a part of the project has spent years exerting themselves on project activities. You basically earn your right to survey the really good cave in the project. If you show up month after month and really contribute, well then when the

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good cave comes around, you're going to be first in line. We've had a few people contact us after they've heard that we have a big new discovery, they want to go survey, and it doesn't work like that.

Typically we have anywhere from a dozen to two dozen people show up each month. With that much manpower we have to spread it out and work on different things. Every year we get access to more and more acreage and the acreage up there comes in packages of 500+ acres at a time per landowner.

We recently got access to somewhere in the neighborhood of 1200 acres between two landowners. So we've been very busy walking and digging on those landowners pieces of property and they're pleased to have us. So that occupies some of the people in the Germany Valley Karst Survey. At the same time, others are still doing work in Memorial Day; because of the very tight passage leading to the big stuff… it constrains who can go in there. It prevents probably 90 percent of our people from getting into that part of the cave so there's just a small group of people who go back and survey every month.

Now what we're doing in Memorial Day is working to improve the quality - the comfort...of that very tight passage that leads to the top of the 125' drop. It's going be a large project because the crawl itself is pretty far into the cave. It is at the bottom of a 50' drop that you have to go down before you even get to the crawlway, and we're going to need a lot of equipment to make that passage more passable. So its going to take a few months of moving equipment and bodies in there and doing work before we'll have something normal-sized cavers can get through.

At the same time, we're going to be pushing some other leads that could potentially be bypasses. We have a bolt climb at the top to a lead at the top of a dome pit and that could actually give us a bypass that could take us beyond the small passage.

For the foreseeable future, we're going to be doing that in Memorial Day Cave and we're going to continue surveying the borehole.

We're actually really excited about the potential in Germany Valley, because we have learned through our efforts over the last few years that there is big cave in Germany Valley. Everybody thought the only big cave was in Hellhole, and everything else was pretty short. What we're learning from the geology there is that there are short caves within 100' to 150' of the surface. That's what the local geology supports.

There's large cave - long pieces of trunk passage, miles in length - if you can get down to about 300' below the surface. The problem is that it's very difficult to do because of the geology. What typically happens is that you get down 100' or so, maybe 150', and you hit some very hard limestone with some very tight cracks and you have to make those cracks bigger before you can get into any larger borehole passage. We've started doing that more recently and we're having some pretty good success.

One cave we have a lot of excitement about is a well-known historic cave a lot of people have been in, called Ruddle Cave. Everybody has known the amount of air flow at the entrance of Ruddle for thirty or forty years now. We have finally gone into Ruddle and followed the airflow and everybody knows the crack the airflow goes into. We have started working at that crack and we're going to try to follow that and see if we can follow it similar to the way we did in Memorial Day Cave.

Aaron: Does Hellhole go through this hard layer of limestone as well?

Devin: Yeah, Hellhole does. These harder layers of limestone were penetrated pretty quickly in Hellhole, so cavers don't even know when they pass through it. The passage in Hellhole is so big that you don't really run into this hard layer of limestone. When you drop in the entrance, you're immediately in the big stuff. Hellhole is a pretty unique situation. Such a shame the cave is closed to cavers year round.

Aaron: Do you think that this hard layer of limestone acts like a "cap rock" and contributes to the cavern development in the lower limestone?

Devin: I don't know that it contributes to it, so much. What facilitates the large cave under that "cap rock" is the solubility of that limestone underneath it.

Aaron: Oh, O.K.

Devin: Water can get through the hard limestone and create cave below it, but cavers often can't get through that "cap rock."

Aaron: [chuckling]… at least not many, yet. So there are other caves in the Valley in addition to Memorial Day Cave that could take you guys through the hard limestone and into the softer stuff below. Ruddle is one of those. Are there others?

Devin: There are a couple of others that we have that we're very interested in that move some pretty good air. One we call Flad the Impaler which is a brutal cave 300' in length. Its like a miniature Schoolhouse; it has a lot of vertical up and down, but it moves a lot… a respectable amount of air. So we're interested in that.

There's also one called Liquid Groundhog, which is an 80' deep pit that has a breakdown pile in the bottom. There's good air moving in the breakdown so we want to look at that. A cave I mentioned earlier, Laeger Cave, has some blowing cracks at the bottom of it. So again we would be back to widening cracks to get to more cave.

Something else that we recently came across is a well-known, but obscure cave in Germany Valley that doesn't get a lot of visitation called

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Coon Cave. A group went in there including Kevin Flanagan from up in the Northeast and Mike Frisina about six weeks ago, and they were bopping the pits in Coon Cave. There are a lot of pits in the cave and they got to the bottom of one of the pits, and they found a message in a metal tube from somebody in the Pittsburgh Grotto, who had just left his initials. The date on the note was I believe, from 1959.

Aaron: Oh my god!! That's amazing!

Devin: Yeah! So it had been in the cave for 40 years. They have a photograph of it and I hope to have a photo of it pretty soon. So it was one of those old Pittsburgh Grotto cavers.

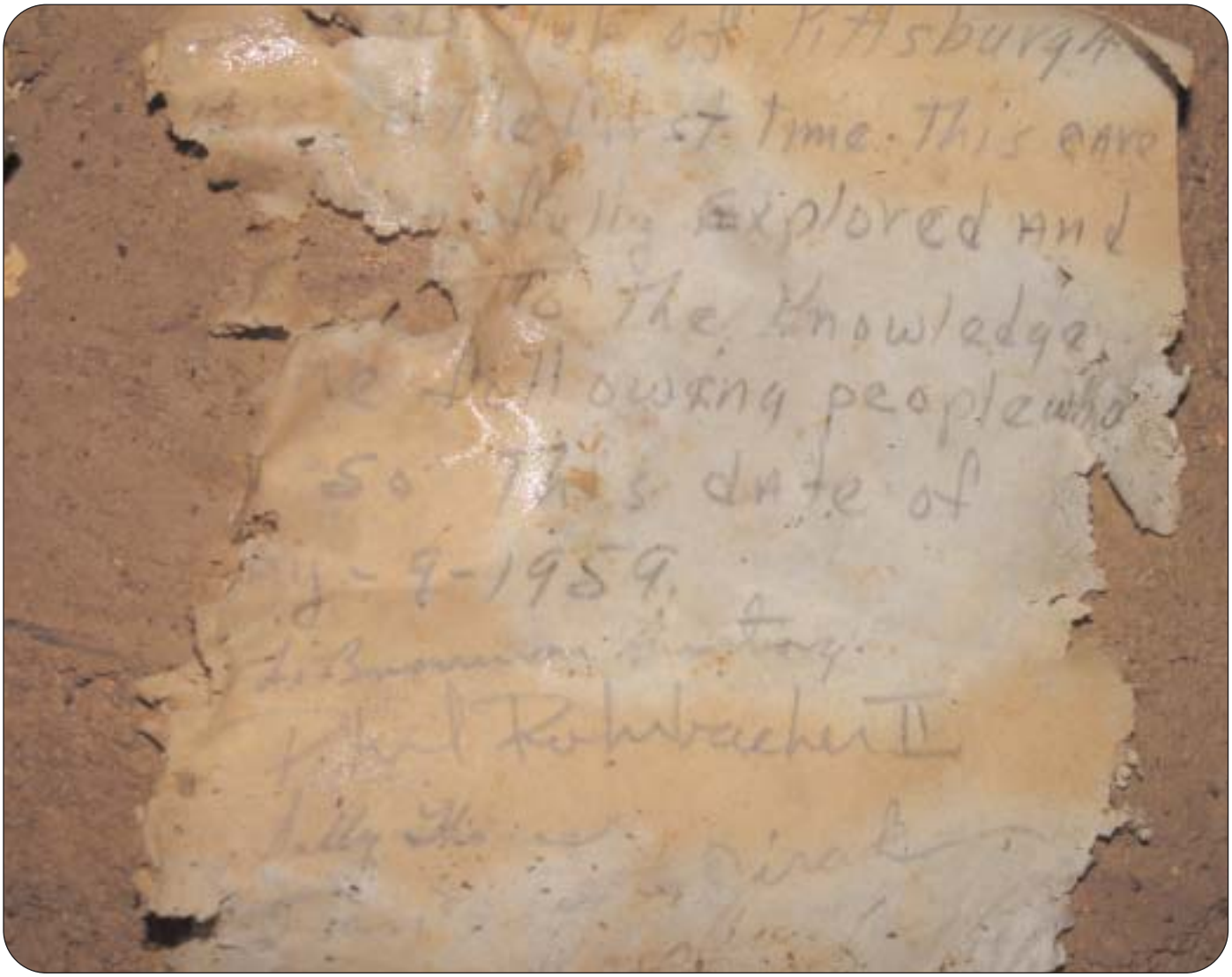
So, on that particular trip they were in there to work on a dig, and try to get into another dome or lead or something. Mike took a little time to poke around more thoroughly and went into a lead that had been checked before, but not well enough, and found a crevice blowing air in his face at a rate of about 20 miles per hour, which was his estimate.

They diverted their attention to that and worked for probably six or eight hours that day pulling big rocks out of that tight lead and they're now looking down a crevice about 15 or 20 feet. They'll have to widen the crevice, but they have a huge gale of air blowing out of it. So it looks like Coon Cave has the potential to do something similar to what Memorial has done.

Aaron: Is it possible they're all sharing the stream? Or are these going to be different flows at a water table? I believe you mentioned the lake in the bottom of Memorial Day. Is that a water table lake or stream?

Devin: That's a water-table impoundment, but it's so deep and only one survey team has ever been to look at it and they couldn't detect any water flow or any underwater passage going out from it. They're going to take a closer look at it. The passage that the lake occupies continues out of sight around the corner and they couldn't get around the corner because they would have had to swim, so they really don't know how large that little lake is.

Now Coon itself is up against the flanks of North Fork Mountain, so its more on the eastern side of the Valley, so it probably doesn't have a lot to do with Memorial Day, but you never know because Memorial Day is heading east in a big way. That's kind of strange because most caves



in West Virginia, especially in that area of Pendleton County, are strike oriented and run northeast and southwest.

Memorial Day, until the last few hundred feet of survey, has not been strike controlled at all; it's gone all over the place. It has gone straight north, straight south. It has looped around in curly Q's, and up and over itself at least two different times, and zigzagged back and forth to the east. Only the last few hundred feet of the last survey trip in there did they actually turn northeast along the strike. That's kind of taking it towards Coon.

Aaron: O.k., and that's with no discernible water flow direction?

Devin: No. If you head towards the northeast, you're actually climbing in elevation. You appear to be going upstream. So we're getting closer to surface level, which is not what we'd expect at all. We thought we would have been going deeper as we went to the northeast, but we seem to be heading upstream in the cave, and that's pretty strange. We're still trying to figure out the development of Memorial Day Cave.

Aaron: And it's climbing up the anticline or going down the anticline?

Devin: It's actually heading mostly straight east, across the anticline.

Aaron: So, perpendicular to the anticline.

Devin: Yes, very much perpendicular to it.

Aaron: Wow. O.k. Could it be fault controlled?

Devin: We thought about that. I don't know that its fault controlled. We're looking for a fault in there because the geology is doing something strange. We can tell that, and we think there may be a fault involved. The way the passage is formed, it doesn't look like its fault controlled at all. It's just doing something very unique on its own.

Aaron: Wow. Those caves in that Valley are just amazing.

Devin: They are.

Aaron: Yeah. Speaking of which, we haven't spent any time talking about the survey of summer 2002. You were heavily involved in that, I believe.

Devin: In 2002, the Germany Valley Karst Survey got an opportunity to survey in a wide number of caves across the Valley, and it was known that there were some good leads out there. Throughout the summer, a number of people, yourself included, got into the Valley and were able to survey some of these leads. Did you really ever get into any of the good stuff, Aaron?

Aaron: Yes, quite a bit of it… probably one of my personal best summers for virgin cave ever.

Devin: Throughout the course of the summer, the survey crews were doing pretty good work, and then at the end of the summer a breakthrough came that gave up something like 3 miles of virgin passage over the next four weeks of survey. Prior to that, two and a half months worth of work had only given up a mile and a half of passage. Things definitely opened up there in the last four weeks. So, throughout the summer we managed to survey four and a half miles of new cave in the Valley.

Aaron: Now, you were involved in that because you're involved in Germany Valley Karst Survey, of course, but also because of your experience in surveying.

Devin: I can thank Miles for it, but now I'm just a huge survey fan. But I also enjoy cartography too. This particular survey project needed somebody to cart up all of the new passage that was being turned up, and so I decided, you know, absent anybody else stepping up to the plate, I would go ahead and do it. I happened to have some good technology available to help run the project and to organize the data and to crank the working maps out fairly quickly. So I was more than happy to do it. It actually taught me a lot about how to run a large survey project like that from a cartography and survey control perspective.

Aaron: So what are some of the tools that you use?

Devin: Well, one of the most important things was the ability to communicate information to the surveyors, because in the first few weeks of the survey, activities were really inefficient because the surveyors didn't know where the leads were. They didn't have reasonable working maps to work with in the caves. All they had was verbal directions from somebody who wasn't going to go with them, and most of these surveyors had never been to those particular caves. So, what I focused on first was getting some means of sharing all this information. It was a lot of information and it was changing on a weekly basis. So what I did was I talked to a guy in our club and he runs an ISP, and I got some web space on one of his servers. He donated it to the project.

I have some experience building websites. So I put together a simple website to organize the different types of information that I knew the surveyors would need in order to be a little more efficient week after week. Some of the things that we started putting up there were, naturally, the schedules, who was going to be in which cave on a given weekend, and as we learned a little bit more about the survey and where we needed to focus, a plan of activities and actions of what people needed to be doing.

I was able to review the data after each survey trip and start building a lead list. That helped people a lot, to know where the leads were, and how they could get to them and survey them more efficiently. And so after about two weeks of having the

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survey server up, things got a lot more efficient. People were regularly checking the survey website, and I was keeping it updated. Usually by Thursday evening, people could get out there on the server and have a look at the updated lead list. They could see the survey notes from the previous week. If possible, I was trying to keep the working maps updated too, so people could have a look at the working maps and see where things were going. It turned out to be a huge boon.

Some of the things we added to enhance the site over time is that people were carrying a lot of digital cameras in the caves this year, and there were some great photos coming back from the caves and from the surveys. I was able to put some really nice photos on the website. That actually helped motivate people to get in there and really contribute and work harder on the surveys, when they were seeing the kinds of things that were coming back from surveys that other people were doing.

I actually host a few different project websites out there. One of them is the Germany Valley Karst Survey. And then the other is Shaver's Mountain; there's a small project going there. And the Taylor Run, of course. Gangsta Mappers is hosted in the same domain.

Aaron: So the surveyors would bring data, and then what happens to that data?

Devin: That was a very important process that we had to work out early on, and it was a little tough to get everybody to do it correctly in the beginning. Once they saw the results of doing it correctly, everybody really made an effort. At the end of the survey weekend, basically the survey trips into the caves were twenty-four hours in duration, or pretty damn close, people would come out and before they were allowed to leave on Sunday - they would come out of the cave on Sunday morning and come back to the field house and crash - normally I or Gordon Brace or Lewis Carroll would be there to meet and greet them and demand the survey notes from them. So, we made it an imperative. Survey notes always had to go home with Gordon, Lewis, or me. By Sunday evening, the notes would always wind up in my hands.

Now, it was kind of convenient that I was both cartographer and the website developer. I could take those survey notes and scan them in within just a couple of hours and I could get them published on the website within a day or so. At the same time I could work on morphing them up into a working map. And I do that using Ralph Hartley's software application called Carto. Once people realized that they couldn't take the survey notes home with them [chuckle from Aaron], and that they had to leave them with the project control, they agreed with the process.

Aaron: I was one of those, at least on the first time

Devin: Yeah, well it's kind of a novel approach. Everybody's used to keeping their notes.

Aaron: But, I agree with you completely. I'm glad that I was, uh, re-educated.

Devin: This actually is the new way of doing business. But you see the results. All of the paper is archived and will go into the PSC library so it will always be accessible. There are always digital copies of the notes available from the web server, so that people will be able to go out there and get to them anytime they want. So, it's not just their notes, but everything everybody else has who mapped also. So really, it worked out very nicely. By the end of the year it was a pretty well-oiled machine. We had schedules up and we had working maps going all the time and we had survey notes that people could analyze.

A lot of the guys who survey were very interested in reviewing the notes - not just their notes but other notes - and looking at the survey data, and the actual line plots that we build week after week. It's very good for the project that you actually have these other pairs of eyes examining your data because they turn up errors. It's a form of quality control when your peers review what you're doing. One of the guys to whom I'd like to extend a personal thank you is Rick Royer. He's very good with the survey tool that we're using; Rick would go in there religiously week after week and examine the data for errors. When he would find them, which he invariably found errors, he would send the corrections to me. That improved the quality of the survey quite a bit.

Aaron: Oh yes, absolutely. After your experiences so far with managing a large cave survey project, is there anything that you would add or change?

Devin: Recommendations for survey projects in general?

Aaron: Yeah, what would you do differently or what would you like to say about it?

Devin: Well, I don't know that I would do things too much differently because I, and the guys that I survey with, have been doing it well together for so many years. We've gotten the bugs pretty well worked out. The thing that I would recommend that all survey projects do, whether they're large or small, is always work in pairs, no matter what part of the survey process you're working on. Naturally, when you're out there collecting, you want a survey team of three to four people. That way you have more people collecting data and it's a little more accurate. What follows, which is very important too, is the processing of the data: you don't want just one guy entering the data and developing the line plot. You want two people there at the keyboard entering the data, one keying the stuff in while the other's reading it. After it's

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keyed in, they go back over it and reread it to double check everything. So, you know, do these things twice - you'll catch a lot of errors. Then after it's entered, give it to somebody else, a third person who's willing to look at the data and test it and see if they find any errors. That could happen too.

The same thing with survey notes: don't trust them solely to one person. Always take your survey notes, make copies of them. Your originals, or what you call your master copies, those need to be archived and protected. You don't want to work with them. You don't want to take them back in the cave. You take them home, photocopy them or scan them on your scanner, put them in your computer, and then the paper copies, the originals, get archived away, somewhere safe, so that they won't be lost or destroyed. Make sure you give a copy of all your survey notes to a second person. So, for instance, I have a digital copy of all the notes. The master copies go to the PSC library, and a digital copy will be burned to a CD. That CD I can give to anybody I like; I've actually given it out to three or four people in the project. So, whether you're working digitally or in paper, make copies of stuff and share it, so that stuff doesn't get lost or destroyed.

Again, if you're reducing your data and building your working map, it's important that for your working map you get other eyeballs, other people. Bring in a partner to look at the working map you're drawing, and allow them to critique it as you're going along drawing it piece by piece. Send them what you've done, and allow them to comment as you're working. If you're doing a really big cave, something that's miles long, you don't want to draw the whole thing, and send it off to someone for their opinion on it, because it's too much for them to try to critique, or if they do critique at all, you're going to find they'll come back with so many errors that you're going to be unwilling to try to fix that entire map. So do it a piece at a time.

We've learned a lot about doing these kinds of surveys and the biggest thing is to work as a team, do everything together, put multiple eyeballs on every aspect of the survey, and you'll come up with a much better product.

Aaron: Sounds like some pretty good rules to follow as far as managing large-scale cave projects.

Devin: There's one other thing that I would add too. I can't ever emphasize this enough. A lot of us take this for granted. But everybody should do this. Always, always, always shoot both forward and back sights on every shot. You should never have a single-sighted shot. It is incredible the number of errors that you can accumulate if you're only doing foresighted surveys. To us, the foresight only survey is basically worthless.

Aaron: Good. I was hoping you would add that comment in there. If not, I was going to prompt for it.

Devin: Good.

Aaron: Yeah. In working on large-scale survey projects in Germany Valley, I have learned so much about surveying, and just why it matters so much to collect both foresight and backsight data.

Devin: That's the kind of knowledge you get from working with a big group of surveyors like the Germany Valley crew or the Gangsta Mappers. There are a lot of really smart old birds out there in the caving community, and they can share a lot of insight.

Aaron: Yup. A day with Bob Thrun is definitely an education. At least it was for me.

Devin: It's an education, alright.

Aaron: Yeah, I learned an awful lot about surveying the day I spent with him.

Devin: I agree, and Bob is a great one to learn from. He's very meticulous. The rules that we're applying now, Bob has actually applied for decades. We can go back to his records. He is so methodical with his data collection, he can go back into his records from the late-'60s when he got into cave survey, and pull out working maps and survey notes and share these things with you. And all his stuff is nice and reliable, and it's legible and you can continue to use it. Unfortunately, I can't say that for all the other caves that surveys extend that far back in. Quite often the notes are totally lost. For instance, you'd be hard-pressed to come up with a lot of the early survey notes from Simmons-Mingo. People just wander away from caving and they take the notes with them, and eventually they wind up in a dumpster somewhere...the notes, not the people.

Aaron: The internet played a pretty large role in the large-scale survey project you worked with. But as you point out, it's not impossible to do without it, as Bob has demonstrated in using his method since the late-'60s.

Devin: It's a little more challenging to do it manually, especially when you have as many surveyors as we tend to draw. If you have a project with 40 surveyors, it's basically impossible to get copies of the lead list, the working map, and the survey notes out to 40 surveyors on a weekly basis via snail mail. You have to have something like a web server to do that.

Aaron: Yeah, and now with everyone using the internet, people don't really have any excuses to not do it.

Devin: Exactly. I don't think there was a surveyor in the 2002 summer survey that didn't have internet access and we had well in excess of 40 people working on that project.

Aaron: O.k. Well, let's see. I guess we went over the manage-

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ment of the project. How about some specifics about Compass and Carto and data reduction? Can we talk about that a little bit?

Devin: Sure, let's talk about that. Actually let's start out with a couple of things that just came to mind. We're trying to improve the quality of our survey and we have a lot of engineers involved in the surveys that we do. We're always kicking around ideas about how to improve cave survey.

Naturally, what it seems to boil down to is the ability to collect accurate data quickly... so getting more data more quickly will allow you to represent the cave in higher fidelity, shall we say. Those kinds of devices don't exist yet. They are surveying in Wakulla with a radar mounted on a sled. You know, we can't afford anything like that. Improved survey technology is still pretty far off. I believe you and I have even had a conversation on this topic last summer.

Aaron: I recall that we talked about the 3-D mapper used by the Wakulla project members.

Devin: In the interim, while we wait for those devices to appear commercially, we have started using some other devices that have definitely improved our accuracy and ability to collect data that we wouldn't normally be able to collect accurately before. An example is a laser range finder.

I first used one of these when I was surveying in Belize in some tremendously large borehole passage. The project lead brought a couple of these things from the States and we could have used them for shots up to 300' long for distances. Now naturally we wouldn't do a survey shot 300' long: it would be too inaccurate on a compass.

What we typically wound up doing, surveying through this borehole, was survey shots measured with this laser out to 100' to 125' and we could get very accurate ceiling measurements. This was important in this cave because very often the ceiling was 140' to 150 feet over our heads, and that's the kind of data you could never collect without a laser range finder.

Aaron: Absolutely. We recently used laser range finders in the Fault Chamber in Bobcat Blowhole, just two weekends ago, to get real accurate ceilings heights. In fact some of the traverses we surveyed with the lasers as well. Now... how do you feel about the accuracy of those on high angle shots for the actual cave survey?

Devin: I was very pleased with them, but what you need to do to improve the accuracy of the shot is to give the laser a target. When we were surveying with them down in Belize, the laser would normally be on the point station and the guy would measure back to me - I was sketching. I would put my sketch book on the station, and he would shoot to my sketch book, which was wonderfully reflective... just a nice yellow book and that increased the accuracy of the shot tremendously. Now naturally you can't do something like that when you're shooting ceiling heights, but even if you have a relatively accurate ceiling height, it's a lot better than what we normally do.

Aaron: Right. Exactly... and the same goes for left and right distances in large passages too.

Devin: Exactly... and I know for a fact that Peter Penczer has brought his own laser range finder the last few weeks and was using it in Memorial Day a few weeks ago to survey, and he was recording ceiling heights in there up to 110'.

Aaron: Wow!

Devin: What was your biggest ceiling height in Bobcat Blowhole?

Aaron: Eighty feet.

Devin: I'm looking forward to having one of those on the survey next summer because there are some pretty big domes that need to be measured in the cave.

Aaron: Yes. There are some large voids in there...

Devin: Some you can't even see the top of.

Aaron: O.K. So do you believe, side by side, the laser range finders can give us numbers similar to a tape?

Devin: A tape? Easily.... especially over longer distances, because at longer distances you get tape sag, and nobody even tries to compensate for that. We just accept it as part of the survey, and I have a feeling that tape sag and the potential error in a laser range finder are pretty comparable. So, I'm comfortable using them.

Aaron: What about for vertical shots within the survey itself?

Devin: Having not done enough comparisons between laser and tape on actual vertical shots, I don't know. I have compared laser to tape on multiple horizontal shots, basic survey shots, and it always came out quite comparable, so I don't know that a vertical shot would be that dramatically different. Maybe if it was an extremely long shot, like a hundred foot shot or more there could be a difference... but that's an interesting question you pose: I couldn't really offer an opinion. I would have to just go with, "Yeah, its going to be O.K." Why did

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you guys have reason to suspect it?

Aaron: I was keeping the book, and I let them use the laser range for horizontal and of course to get left/right and up/downs, but I just wasn't comfortable with them doing it for the 90-degree shots that we had. Actually I encouraged them to not do it for any of the high-angle shots we had... I didn't have anything to base that on really, except that high-angle shots should be avoided entirely.

Devin: Well... the next time you go, have them do it both ways: tape and laser.

Aaron: Yeah. Now we did do some of the shots like that, and in one case we had an error of two inches...

Devin: Over what distance?

Aaron: About twenty feet. I think what happens is that the further out you get the more error you can get just because of the wobble of the holder. We tried laying the laser down on a backpack to keep it real stationary and then shoot toward a reflective surface. A survey book works, but you know what works really well is a piece of calcite [chuckles]... if you happen to have one lying around, which we happened to have in this cave, but even then it was real hard to lock on to the distances over 100' in length.

Devin: Oh. Well, I'll have to keep my eye out for that. We didn't have that much of a problem in Belize, but we were in very big, wide-open borehole.

Aaron: I agree that they have a place. It's quick and probably accurate as long as you can keep the instrument clean. Now there are some cases where it won't work, but we lucked out in that we had a giant room to survey, and it was dry, and a perfect place to use them. Had it been a low stream crawl, then some people would be out a few hundred bucks per unit.

Devin: That's not the place to use them. Otter Case makes a really good box that those things fit into very nicely, and we used those down in Belize to keep ours protected. We were surveying in a river cave, so everything got completely soaked.

Aaron: What about the digital inclinometer?

Devin: I've not tried one of those, so I don't know how well it might work.

Aaron: We had one of those in Bobcat as well, and again I was real reluctant to believe the numbers that were coming from it. We went with the traditional method, but occasionally did a digital shot, and in one case we did it, we had a forward inclination of about twenty degrees, which is about as high as you want to go. The backsight was giving us like minus 27 degrees, and so something was obviously wrong. That's when we whipped out this digital inclinometer and he got like 24 degrees going forward with it and we did the backsight again and got like minus 23 or 24 degrees, so it was giving us more consistent numbers than the users were giving. It could have been a situation of the instrument people not being able to get their instruments in close enough to actual station.

Devin: I'll have to watch for them. I haven't even seen them in the flesh yet.

Aaron: I think its something that's going to have to prove itself before it replaces our current tried and true method, but if the technology can come along, then these electronic instruments are going to revolutionize surveying, as the software packages and the internet have done.

Devin: Oh yeah, definitely. Let's talk a little bit about the software.

Aaron: O.K., yeah.

Devin: I've been a fan of Compass for a number of years. It has its detractors... For the purpose of working to develop maps that are accurate, given the constraints in which we work - our data collection isn't exactly accurate - I don't really have any issues with some of the complaints that certain people have with Compass and the way it closes loops.

So I've used Compass for a number of years and I'm quite comfortable with it, but something that has actually been a nice innovation in the process of making cave maps is a software application that Ralph Hartley developed which he calls Carto.

What Carto allows you to do is import the line plot Compass generates and you can display that line plot inside Carto. You can also import a scanned copy of the cave sketch - the survey sketch - and if you have the stations marked on your sketch, which any good sketcher will do, you can map the stations in the line plot to the stations drawn on the cave sketch and then Carto will render or morph that cave sketch to fit nicely onto the line plot. What you can do using this, is you can actually come up one segment of cave sketch at a time with a very nicely laid out working map that actually gives something very legible that surveyors can work with. You can use it to understand the cave early on in the survey, you don't have to wait for a final map before you actually get to the see the cave as one consecutive piece of cave. You quickly morph something together in just a matter of hours after you get out of the cave. Carto has been a real godsend… it's a wonderful tool that Ralph has come up with.

Aaron: I was real impressed with that when I was able to see what you guys were able to do with it in the Germany Valley survey last summer, and we have recently been using it a lot because we saw just

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how well it worked. It took us a little bit of time to learn, but we just followed John Ganter's tutorial and got started with it. We've found that scanning the sketches at lower dpi (~100) doesn't give us enough detail. We've also tried at a higher dpi of 300, but Carto wouldn't morph these scans, and Freehand doesn't accept the scans that use up a lot of resolution. I've noticed that the Carto plots you guys make have great passage wall detail, and that the stations line up nicely. How do you do this? Also we've had some trouble with the correct settings for the export file from Carto. Could you give us some guidance about the dpi scans, the passage snipping, and how to set Carto for export?

Devin: Ralph and I have discussed it and agreed that 125-150 dpi is the minimum you want to scan. Anything less doesn't capture enough sketch detail to be drawn over later.

As for snipping (or bounding) the walls. I generally crop the image down, but leave some space around the passage walls. Then I use the bounding tool in Carto to eliminate some of that surrounding space from the final morph. Ralph seems to take it one step further, and he "erases" the graph lines and everything that falls outside of the cave walls from his original segment jpeg. That's how he gets that very clean look on the Memorial Day map. I may do this with my map, but it takes a little more time and effort.

Also, you're correct to trim the "ends" of passage segments cleanly. It helps line them up much more accurately and give a cleaner morphed map. When I export from Carto I usually use dpi, and then export at a 150 dpi factor. Therefore if I want a 7 inch wide print (to fit on 8.5 x 11 paper) I print it out at a 7x150 or 1050 pixel width.

Aaron: Do you know how it works? I had to install Sun's Java to get it to work, so is Carto a Java program?

Devin: Yeah, it is a Java program, so you need to load Java onto your computer to be able to use it, but Java is free so it's not a big deal. You do want to work with John Ganter's tutorial that he put together; that will get you started. Now I have been working with Ralph recently and Ralph is very open to input and suggestions. I've been working with him to try to improve the user experience of Carto. I'm a computer systems engineer professionally and I've gotten some experience in designing software and user interfaces and so Ralph has implemented a few of my suggestions which makes it a lot easier for a user to jump right into Carto, start up a map, and begin dropping in the different pieces one needs into the map in a much more logical work flow. The user interface is seeing some improvement and enhancement now, which is something the earlier version really suffered from.

Aaron: Do you use some kind of sketching or drawing program with the export from Carto to make a digital cave map?

Devin: Yes. I've played around with a few of them and since the mid-90s, I've used Macromedia's Freehand to draw my digital cave maps. I started doing digital cave maps back with the Taylor Run Project. I've tried a few others, such as Corel Draw, that's what they were using in Belize. I've also worked with Adobe Illustrator. Those packages have their benefits, but I haven't found anything in them that made it worthwhile to move away from Macromedia Freehand, so I continue to use that now to do my maps.

Aaron: I agree. That's what we've been doing too; however, my experience with this is quite limited. Bob Kirk and I have been spending our time learning how to do this and we've been using Freehand, and playing with how to trace the lines, and how to import and export. Something I've found that's really critical is to keep control of your number of pixels per unit of measure, so that when people zoom in on the cave map, if you want to look at just one room, you should be able to clearly see a boulder or the outline of a pit. In our original attempts with it, we weren't able to keep the resolution very good, but lately we have been able to do that.

Devin: At that's in exporting from Carto?

Aaron: Yes, exporting from Carto, as well as what size to work with in Freehand. So we're learning as we're going. Can you give us any pointers on this?

Devin: I set my dimensions to how I want my exported map to appear. For instance, if I have a piece of the entire cave or just a piece of the cave, I will export it to be a certain dimension, maybe 6 inches by 6 inches. I believe that the default export in Carto is like 96 dpi, so because most of my stuff is presented on the web, if you look at it in 6 inches by 6 inches, it will look pretty good. I haven't really tried to increase the pixel depth for those who want to zoom in on passage detail. So that's a good point; you guys are actually doing some things with it that I haven't bothered to get around to yet. We know now that dpi of 300 is probably too much for the scan detail; however, 180 dpi seems to work better.

Aaron: Now one of the problems that we had was with the jpeg files. The default saving setting was 5, which appeared to be a medium level, but this didn't give us enough detail. So I increased it to 9 or 10.

Devin: By reducing the quality jpeg export of 5, you are increasing the compression factor in a jpeg. So when you begin to compress, you're throwing away pixels, so that makes your jpeg a little fuzzy looking.

Aaron: Yes it did.

Devin: By increasing the number, you get a larger file size, but 100 kilobyte versus 1 megabyte file size… its well worth it to go with the higher quality.

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Aaron: We're working with grayscales, so our file sizes are even smaller, since they're not color.

Devin: Going to grayscales you're definitely saving a lot of space.

Aaron: Let me tell you what we're doing with this: in Bobcat we have a passage that is typically two feet wide to five feet in width -in some places its wider - so when you put that down on the cave map and zoom way out (especially in comparison to the Fault Chamber), its essentially a line. What I wanted to be able to see are the relevant features of the sketch, like pools of water and the arrows indicating stream passage, and so if someone zoomed in, I wanted them to be able to see these features and be able to see the detail. At 300 dpi, we are able to do this, but the file size is getting very large. However, once the digital trace is done, which happens with vector graphics that retain their detail down to extremely small details, the scan and/or Carto plot can be removed and what's left is the digital version of the map, which isn't as large.

Devin: I would love to see what you've done, and I'm sure Ralph would love to hear that you're using Carto.

Aaron: We're pretty gung-ho about this whole Rader's Valley project and we'll probably have a continuation of our map in just a couple of days. So what I learned last summer about the sharing of information using Carto and scans of cave sketch, added with our enthusiasm level of the group, has really helped to keep up the excitement and focus of our cave survey projects.

Devin: When people get to see the map growing in front of them, it really keeps people involved and excited.

Aaron: Carto, as far as I'm concerned, has completely revolutionized the cave surveying experience.

Devin: I completely agree.

Aaron: Now let's switch gears back to Compass… I'm curious if Compass has the ability to do error analysis?

Devin: Yes, it does. It has some basic tools to allow you to examine the survey data you put in and look for blunders.

Aaron: I don't know how that works. Can you explain it?

Devin: Sure, without having it in front of me, off the top of my head there are a couple of things in there. One, as Compass is doing loop closures, it has a method of predicting what the loop closures should be. It uses statistics to estimate what the amount of the error should be, and it will go through the survey data and return a value for the quality of a particular loop. If it falls outside, say one standard deviation, of what Compass calculates the error should be, it will report that as "quality of loop," as a good loop or an O.K. loop. I think if it is over two standard deviations, it reports it as a bad loop. That feature is actually done for you automatically, and you can get to those reports after you process the survey file, there is a menu item you can pull down -I think its 'View ' Blunders-and it just generates a text report of the quality of all the loops that are in there.

Aaron: Is it possible to enter front sights and back sights in Compass?

Devin: Yes it is. I put that suggestion to Larry a long time ago. People were using Compass - early versions of it - to enter front and backsights, but what they had to do was to enter one shot as a frontsight and enter a second shot as a backsight, and I convinced him to concatenate all that onto one line. It changed his data format a little bit and improved his software, and that was back in the mid-90's when he did that.

Aaron: How does that work? What function in Compass do you use to enter foresights and backsights? What I see in Compass is that only the frontsights can be entered.

Devin: That is the default that you're seeing. As you're in the Project Manager, and you're creating a new survey, there's a window there where you type in the name of the survey, look at the bottom of that window, there's some folder tabs at the bottom of the window, and one of those is "Options". Click on "Options" and that's how you setup how you want the editor to display. In there, you can "Turn on Backsights." Personally, I would like for that to be the default.

Aaron: Is there any error analysis possible with the frontsight and backsight data?

Devin: In addition to the activity where Compass processes loops, there is something that Rick Royer turned me onto. There is a tool that will look at the survey data and compare the foresights to backsights and report errors in excess of some median that you set. I believe the default is greater than two degrees. So if you have foresights and backsights that are off by 2.5 degrees, or greater, they're going to be reported to you. This is a good way to check for the data that was keyed in, whether it was keyed in accurately. It's a really wonderful thing.

Aaron: Is there any more formal error analysis available than that? The foresight data and the backsight data can be thought of as two different surveys, as you mentioned previously, and people would put in both as different stations and look for differences that were apparent in the line plots. I suppose its possible to do that and then at the end of two, long linear sets of data, to look at the differences between the two end points and come up with some measure of error that way. Perhaps take the mean of them and find out the difference the two are from the mean. Is there any way of doing

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that?

Devin: In Compass I don't think so. I know what you're getting at, and it sounds like an entirely desirable way of looking at the data, but I don't think Compass has that kind of ability built into it.

Aaron: So what do you do as a Survey Manager when you encounter survey data that is different by, say, three degrees?

Devin: [Chuckling] I scold the guy who gave me that data… One of the aspects of a survey is that the surveyors have to live by the rules, and the rules are that we accept no greater than 2 degrees of error for any shot, and if they can't overcome that, then there are some extenuating circumstances where I will allow it to slide. For instance, if it's a high-angle shot I will increase the amount of error they are allowed to have. I started doing that after a conversation I had with you last summer, where you convinced me of the wisdom of that… for safety reasons in very vertical situations. I mean I had thought about it before, but after hearing you say it, I agreed, "He has a point."

Aaron: Yeah… environmental considerations… like major vertical exposure.

Devin: Exactly.

Aaron: So do you know if anyone has done some work in the area of foresight and backsight error comparison? If you enter the foresight and you enter the backsight, and look at them and compare them and can be notified when there's a difference, then that's great. If the data are both good, then all you really had to enter were the foresights (or the backsights), but if there's some measure - I think what we're talking about is systematic error - of the differences, then maybe that can be used to adjust the survey. Why not just take the average?

Devin: There are entire books written on methods for conducting survey [not necessarily cave survey], and closing loops in survey. One of the methods is known as the least squares method. The simple approach of taking the average, as I've learned from Larry Fish, results in apparently destroying the data that has errors that you could extract from the survey data. That's why you never average the foresights and backsights of the data; you can lose valuable information about the loop closure.

Aaron: That sounds like it makes sense. But, not talking about loops, instead talking about linear surveys where a little bit of a difference in error of the user and/or error of the instruments will grow great deviations - in three dimensions - perhaps taking the passage 50 feet to the east, when the passage should have actually been going in a different direction. It seems to me that if you can enter both foresight and backsight, then at the end of a linear set of data, you should be able to find out how far apart the ending points are. Maybe it's just something that can be done in Compass by treating the foresight and backsight data as two different surveys and using the Compass Measure Distance tool to find out how far apart they are.

Devin: Any shot you take is bound to have a good chance of having error in it. You could do as you said and tie the surveys together at one point, and then examine how far off the two end points are from one another, but I don't think you're going to see consistent results from survey to survey.

Aaron: I wonder if there would be any factors for which there would be consistent results. Perhaps factors like surveyor, instrument, passage type, or length of traverse would show up as consistently affecting the linear survey error. It certainly seems like an area of study where it would be worthwhile to try to extract out what those factors are.

Devin: I would agree. That would be a really nice feature if any survey application could do that: take all the foresights and build a traverse, then take all the backsights and build a traverse, tie them together, and present them and show how one compares to the other. From what I know of my Systems Engineering background, error is additive and each situation where you're recording a new element of data, you have to consider all the factors: the environment of the shot, the condition of the equipment, the skill of the surveyor, and consider that in each shot those conditions are going to be different every time.

Aaron: Coding those variables into a formal study design would be a pretty tall order.

Devin: The cave is always changing, the equipment could be getting less and less accurate, and the surveyor is definitely getting more and more tired.

Aaron: Perhaps the data could be extracted from controlled environments, like survey courses on the surface.

Devin: Yeah, and I think the way you would have to do it is from massive amounts of data and do statistical analysis of the data.

Aaron: Right now WVACS is in the process of developing a survey course on their property in Greenbrier County, WV, and I think that is something they might be interested in doing because people will be surveying that course to check their instruments, to check themselves, and to practice.

Devin: If they record their data consistently, you can study that over time.

Aaron: That would be a really interesting thing to work on. Currently the importance of foresights and backsights is in the surveying itself, to check that the collected data is close for the reported values. If you're greater than 2 degrees, take another look at it and see if the data can be made to be in better agreement. I'm

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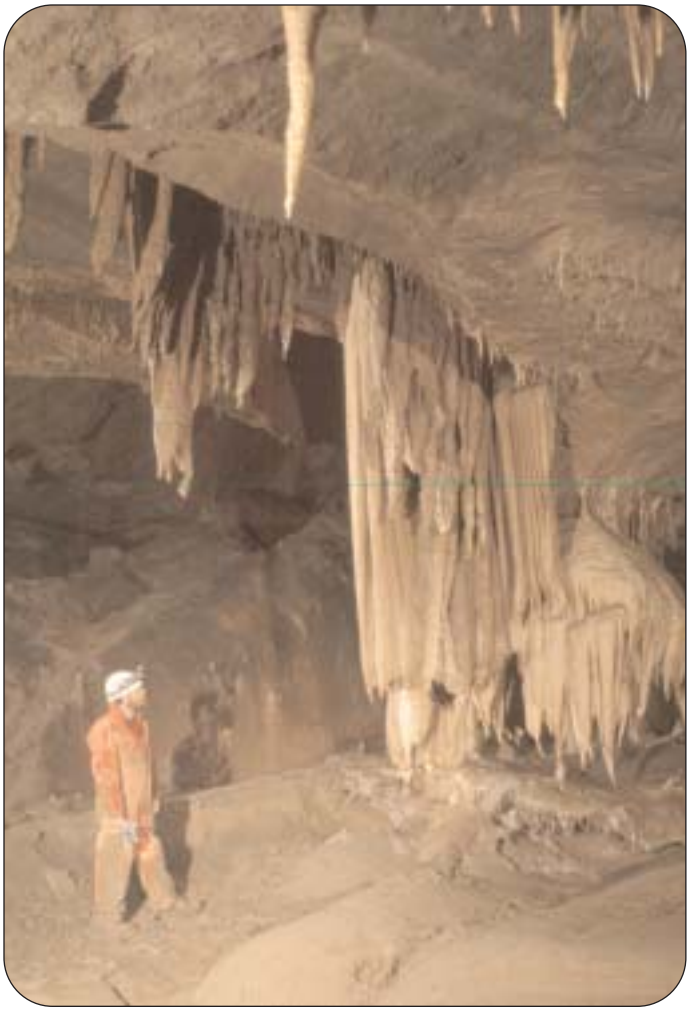
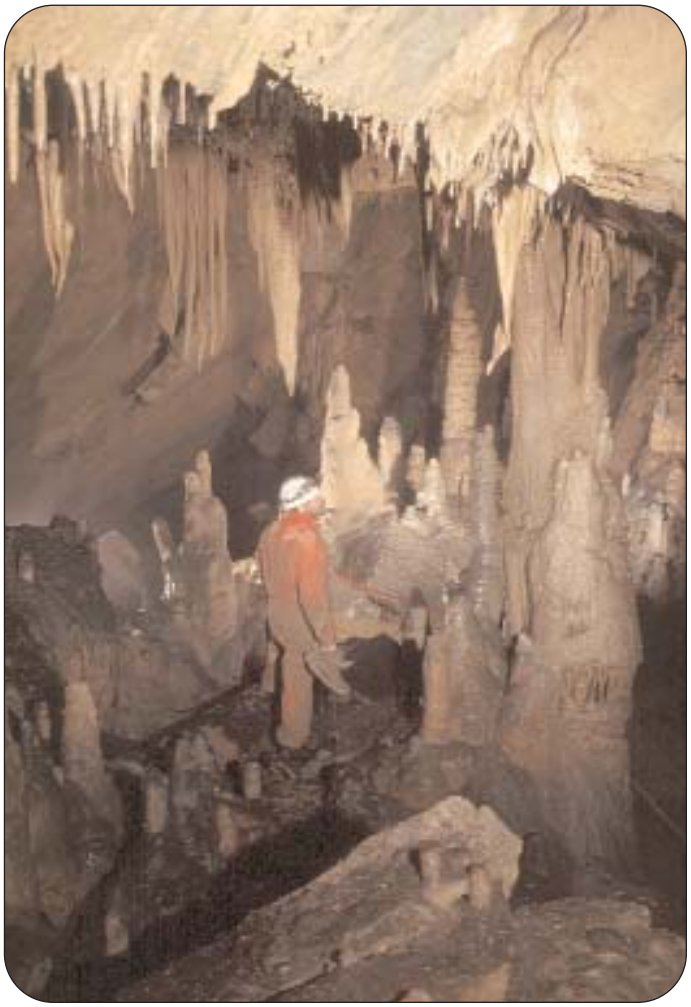
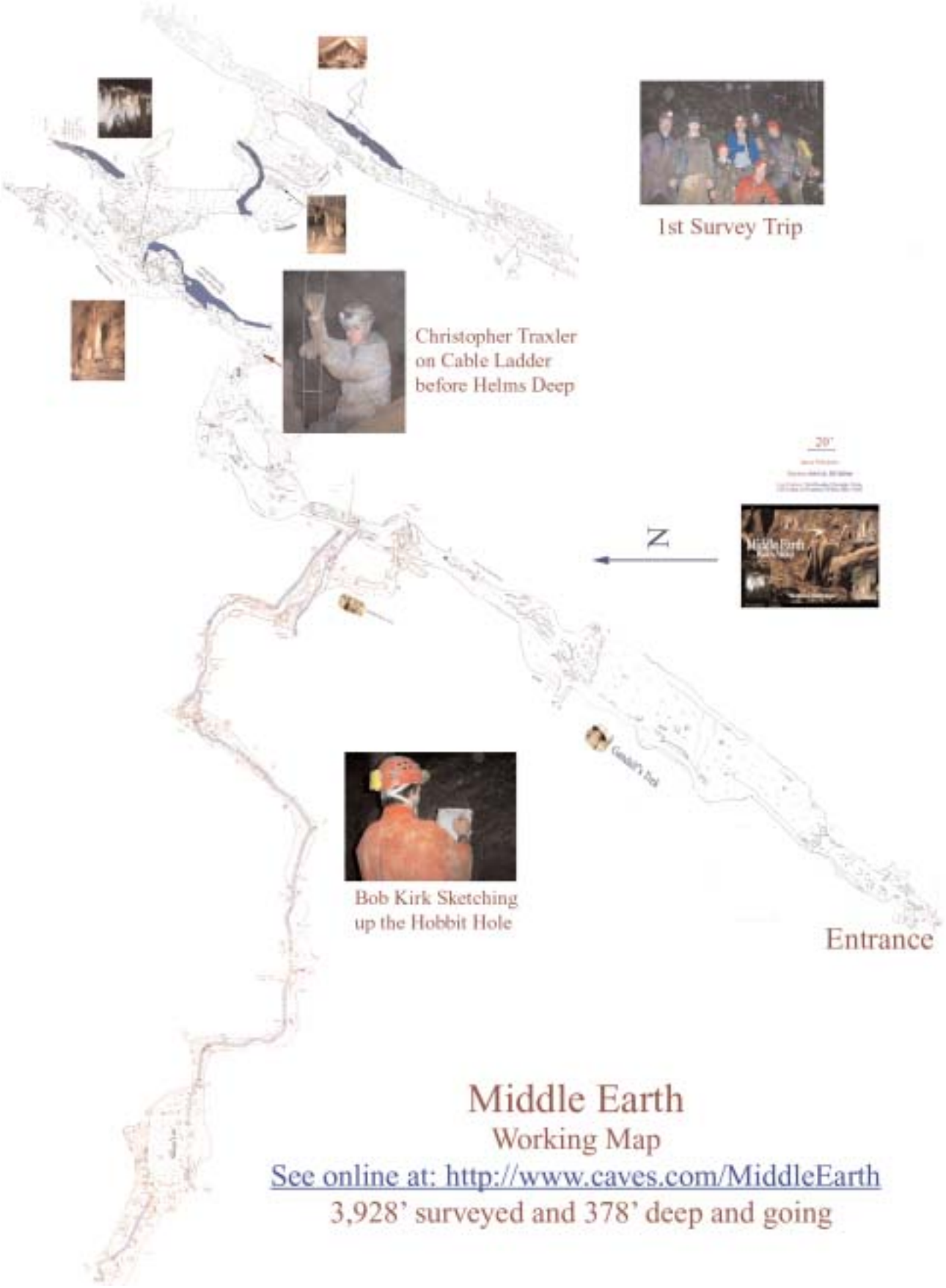
Middle Earth was recently discovered in Greenbrier County WV, and with that has come many great surprises. The area in these photos is named Helms Deep, which was photographed in March 03' by Ed McCarthy. Exploration continues with over 3,900' of cave mapped and a depth of 378'.

Raders Valley Project/West Slope Project---We are actively seeking cavers interested in surveying, digging, and documenting many of the known caves in what we have termed the Western Slope Project Area. It basically claims a stake from Williamsburg, WV to Alderson, WV and contains a bunch of caves needing documentation. There is also another area near Raders Valley that holds promise of a substantial cave system and remains largely unchecked. Project weekend have been set as the 2nd weekend of each month. If interested contact Mark Passerby at: 517-896-4376 or mark@caves.com






1st Survey Trip
Christopher Traxler
on Cable Ladder
before Helms Deep
N
Bob Kirk Sketching
up the Hobbit Hole
Entrance
Middle Earth
Working Map
See online at: http://www.caves.com/MiddleEarth
3,928' surveyed and 378' deep and going

thinking that there is more information that can come out of the collection of both fore and backsights, and that's why I had originally asked about it.

Devin: You're right. I had kicked around a similar idea last summer in Germany Valley and it really does boil down to collecting a lot of data and doing statistical analysis to be able to find differences in what you're seeing. There are just so many variables in there from caver to caver, instrument to instrument, and cave to cave.

Aaron: I wonder if the electronic instruments - as they become more and more available - if they would help, at least in the data collection, if they could remove some of the variables and reduce the error.

Devin: That's possible, but to be honest, if you want to improve the accuracy of the data, the compass is the last place you would want to try, because the compass is now the most accurate and consistent of the whole equation. What you want to do is decrease the error introduced by the caver or decrease the size of the error caused by the environment.

Aaron: Sometimes the error caused by the environment is reduced when cavers use new clothing to keep themselves warmer and thus are better able to function. Also staying in shape and eating well before going on trips can help the caver/surveyor better handle the situation and thus give better accuracy to the survey. It's interesting to think about anyway.

Aaron: Well, we've been at this for a while now, and we've touched on a lot of important topics, so maybe it's about time to wrap things up.

Devin: Yeah, I think you probably have enough to write a little something by now.

Aaron: O.K. Thanks for you time.

Devin: It's been a wonderful chat, and I look forward to seeing you in Germany Valley again this summer.

Aaron: [Chuckling] Alright sounds good. Nice talking with you.

Devin: You too, take care.

Digital Surveying

by Mark Passerby

Perhaps nothing is changing faster in caving than the surveying process. Every part from the data collection to the final map is and has undergone major digital changes, and the movement is rapid towards even better, faster, and more useful processes. Here is a list of some of the things that perhaps will change the way many of us survey.

Disto Laser Measure

Range of measurement: from 0.2 up to 200m (0.7 up to 650 ft) with an accuracy of +-3mm (0.1 in)
www.disto.com

NOTE: We have used the basic unit for many trips now, and are completely satisfied with the performance.

Digital/Laser Inclinometer

We had a chance on 4/5/03 to test the Digital Inclinometer www.mytoolstore.com/checkpnt/680.html and have found it to be one highly accurate device! Instead of +2 degrees you can lock it on the station and get a reading of +2.4 degrees. The issue of settling is not an issue actually although you may have to wait 2 seconds or so for it to settle i.e. between +2.4 & +2.7. In other words the unit doesn't bounce between say 2 and 5 degrees....only the tenths have to settle out.

Water Resistance---I simply used silicone to seal around all areas that could be a potential problem i.e. around the rim of the LCD readout area, around the plastic shield that surrounds the LCD readout, and around the 9 volt battery door. I then put it in its case(not waterproof) and carried it into the cave. When the survey began I dropped the unit into a ballistics pouch that hangs around my neck while surveying and used the unit without removing my gloves so it suffered a bit of moisture and mud there. After the survey I threw the unit in the ballistics pouch into my pack and ended up throwing my sons soaking wet gloves on top of that. The unit during the trip out thus was exposed to a substantial amount of moisture and showed no sign of damage. Sitting here on my desk it is covered with a substantial amount of dried mud from the trip and still works perfectly. FINAL TEST: The final test I just finished and that is a complete submersion in my sink in full running water.....and the unit is just fine and unaffected by the direct water pouring continuously over it.(make certain to seal with silicone before trying to wash or bring in cave)

Simple to Operate---This is where

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this things wins out hands down.

1) Using thumb turn on the digital readout and leave thumb in place on this button while targeting the next station

2) On the back of the unit is a brass srew that you twist to turn on the laser then place the center of the brass screw on the survey station and target the next station

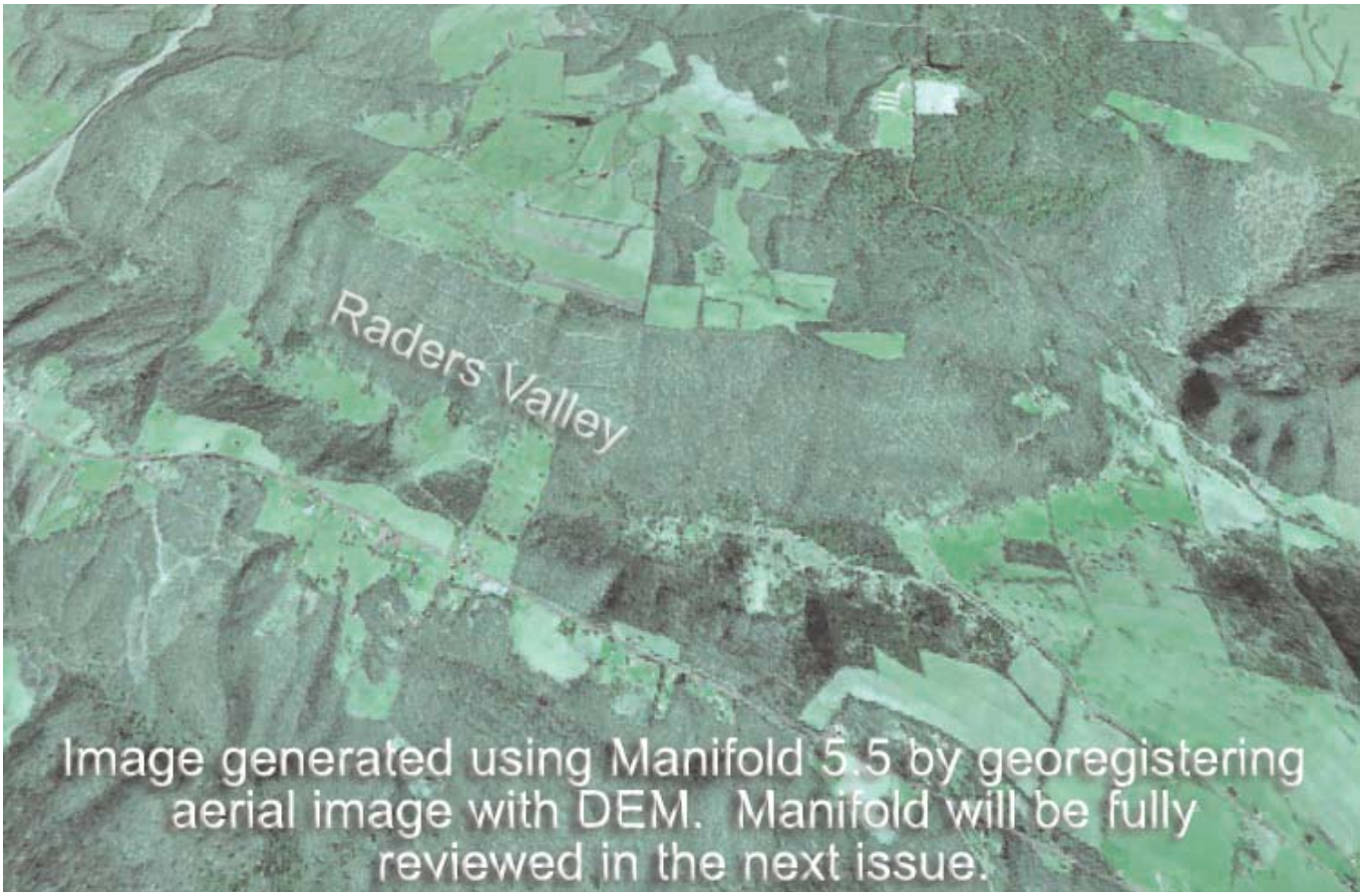
3) Keeping your eye on the laser...steady it on the next station and using your thumb press the button to "hold" the reading(note: this also turns on the backlight so reading is quick and simple and accurate in tenths). The whole process is real quick, real comfortable and real accurate.

Laser Line Function---The optional Lens Adapter Base and the Line Lens are MUST HAVES as well. Here is how these will be used on our next trip. The Brunton 8099 Eclipse is the compass we have chosen to test and it hopefully will become the centerpiece of our finished unit. It will be mounted at a point above the inclinometer so that it is not effected by the unit. Then using the line laser to project a perfect vertical line down the passage this will be aligned to the station and the azimuth read. How accurate will this be?
Exactly the accuracy of the compass itself even on a high high angle shot. The laser line projected down the passage is quite impressive and highly visible. The unit will be placed on the survey point and read quickly for the vertical shot then brought down to a horizontal position. At this point the line generator is effortlessly slid onto the adapter and line aligned with the next survey station. The Eclipse or another similiarly accurate easy to read compass is then read for azimuth. All of this from a comfortable reading position and in my opinion what will be a high degree of consistent accuracy. NOTE: mounting the compass is something we still must do and I will post pictures of the finished unit on the website when it is complete.
A Note concerning digital compasses: I purchased a Bushnell Digital Compass to check for accuracy and was not pleased with the results so it did not go in-cave with us. I have tried others and my conclusion is digital compasses aren't there yet.

Manifold 5.5

“by far the best GIS investment for the money..handsdown”...Morris Hall

My limited experience with GIS software at first made Manifold and other GIS programs seem too difficult, but 20 minutes into using Manifold and I was convinced otherwise.
One of the most important features is the georegistering, which can function much like Cartos. Using this a working map can be quickly registered and redrawn by Manifold to align with the line plot generated by programs such as Compass or Winkarst. More on how this inexpensive GIS software performs and can aid in the study of a cave project area will be in our next issue.
http://www.manifold.net



Searching for Maxwelton Sink Cave–2002 Style

by Jeff Bray (Photos by Jeff Bray unless noted)

(NOTE: This article was written in, let's say, "real time." As the project progressed, so did this article, with portions being written both before and after the actual events. Please keep this in mind when reading this article, one year in the making!)

Maxwelton Sink Cave has eluded many since its closure in the early 1970s. Since the WVCC-attempted purchase had failed, the next attempts to get into the cave had to take place away from the original Cove Creek Entrance. Dave Scott has land that overlies the cave further to the south of the original entrance, so his property was targeted for the next attempts. Many digs were conducted from 2000 till 2002 at various locations on this property. One, costing over 1000 dollars that made use of a trackhoe from Union Concrete, still provided no cave, although it did have some airflow at one time.

During the winter and spring of 2002, myself along with Dave Scott, Tom Malabad, Bill Liebman, and Ed Swepston conducted a

series of three microgravity traverses (a geophysical method that can identify minute changes in density) on a part of the property that, after being surveyed by Dave Scott from the Cove Creek Entrance to his property, seemed to overlie a section of cave called Heaven. This section of cave ended in breakdown, and by our best guesses and the help of some of the folks that had been in the cave for the original survey, was a passage with dimensions of about 10 feet by 10 feet. The three microgravity traverses each produced a 30- to 40- microgal anomaly (microgal is a unit of measurement of the earth's gravitational force) that could be correlated to each other.

Bearings were also taken between the anomalies that seemed to match at a few points on the map along that passage. The decision was made to drill an exploratory well at a site along those anomalies to see if we would in fact intersect cave passage.

On July 24, 2002, Tuckwiller Drilling came out and performed the drilling. We expected to hit the cave between 60-100 feet, based on the anomaly and drill hole data from another nearby project. Good bedrock was hit at a depth of 15 feet, and a small void was hit at 30 feet. Then nothing. At 100 feet, we decided to go 20 more feet. At 105 feet, we hit a void that appeared small, then we stopped at 125 feet. We then sent a camera down the hole to see what we had. The void at 30 feet appeared to possibly be a small window to a cave passage. We continued down, and at 105 feet, we hit the larger void. But instead of going back into limestone like we originally thought, we actually drilled down a wall, with rock on one side of the borehole, and void on another, for most of the next 20 feet. It appeared we had found good cave passage, with airflow traveling down the hole, and flowing water, about an inch deep and clear at the bottom. Also, the rock dust appeared to have been sucked into the cave.

A video camera was sent down the hole the following day to attempt to figure out the direction of water flow and get some scale, as well as to see if there was some passage down there. The scale ideas didn't work, but I believe I was able to make out a rock that appeared to be a 3-foot-tall piece of breakdown. Using this, I estimate the passage to be about 10 feet in height, where it is traversable, and about 6 feet in width. Water was found to be flowing north, into the hillside. We appeared to have drilled in the eastern wall. Carroll Bassett and Dave Cowan helped with the video shoot, and we came away with a nice video.

Dave Scott, Bill Liebman, and myself continued the microgravity traverses on August 12 and 13, 2002. We conducted two more–both down in the sinkhole below the well. Both of these lines produced anomalies as well, with the line higher on the hill producing roughly a 10-microgal anomaly, and the lower line producing about a 15-microgal anomaly. I believe this is the lower passage seen in the well, and the higher passage has ended in breakdown in the hill. I also think the sinkhole we ran the lines through is filled with breakdown–I don't suspect much solid rock. The test for these lines will be conducted on August 14, 2002 when we bring back the trackhoe from Union Concrete to dig us another hole, about 200 feet north of the first one from the Spring of 2001.

The trackhoe dug for one and a half days, leaving behind a deep hole (about 20 feet deep and 20 feet in diameter), with two good blowholes at the bottom. One blowhole was surrounded on three sides by very solid rock, but the other blowhole, on the north side of the

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Photo by Bill Liebman

pit, was all breakdown, with cave formations, and moist and sometimes wet rocks. The rock was dipping more this direction also. It is now thought (at least by me) that the cave lies about 10 feet down and maybe about 5 feet over (south) from this blowhole. After a meeting between myself, Dave Scott, and Bill Liebman, we decided to commence digging on site Thursday, August 22, 2002 and Friday the 23rd. We'll be using a D-8 bulldozer and the excavator, and I think if we move the pit over 5 feet, terrace it, and dig down 10 feet, we'll be in something. The hole was now 40 feet deep, and roughly 30 feet in diameter.

Also worth noting, when we got these two blowholes in our new pit, all the air that was blowing in the old trackhoe dig and the well stopped blowing. Also, an air trace was done from the well to the pit and it took eight minutes for the positive result.

The dig continued by hand after the trackhoe and dozer left. Work was started before OTR with various high points along the way. A number of people, mostly the Monroe County Cave Survey crowd along with Carroll Bassett, Dave Scott, Dave Cowan, and others, also helped out during this time. We began to use the straw-poppers to blast the tighter spots, with the intention of making the passage big enough for the larger folks in the group to fit. A pit was found near the hole at the base of the open pit (now the entrance since there actually is some cave there). This pit went down about 15 to 20 feet, but while more work was being done on this, a slot leading to more cave was found by Chris Printz, and opened (found on September 14-15, 2002). This continued, so the slot (now called the Printz Pinch) was enlarged so everyone could fit (September 21).

On September 21 and 22, a great deal of rain came through the area and caused a major rock/mud collapse in the open pit. The group came out of the cave on the 22nd just before a great deal of mud collapsed near the entrance. This ended work for a few days.

Carroll Bassett along with Dave Scott cleared out the mess that had fallen on September 29, and the two, along with myself, finished cleaning the open pit on the 30th, intending to also construct a lean-to which would help keep more debris from scaring diggers. We went into the cave, and once inside, noticed that things were not too bad. We brought the drill in the cave to the last spot we had left the week prior, and set off 3 straw-poppers, later dubbed "the money shot." This was very productive, and opened this slot large enough for all of us to fit. Carroll dropped down, and found a hole that continued down. He slithered down it, noticed a formation. I followed and soon the two of us were in a comfortable room (only comfy due to size, not lack of breakdown). We heard a stream flowing in the distance, and looked over a mud mound and saw a large passage (possibly 15 feet tall, 7 feet wide) below us! We had intersected a passageway with large breakdown and a stream, via the passage's ceiling! My light was going out, and we needed some vertical gear, so we left. We called Dave Scott (who had to leave for a while) and told him to plan to cave the next night after work.

So on the evening of October 1, 2002, Dave Scott, Carroll Bassett, and myself entered the cave around 7:30 pm to rig a cable ladder and descend into the large passage below. At about 8 pm, while Carroll was climbing down through the money shot, a large rock (about 1000 lbs.) came down on his arm, pinning his right side, and cutting off circulation to his arm. A rescue then commenced. Dave stayed with Carroll and I went out to get help and coordinate. Bill Balfour, Daryl Trusty, and others helped use two car jacks, under Carroll's direction, to hoist the rock enough to free Carroll's arm, and he was able to come out on his own. But this incident did end the exploration for the day; still no one had made it into the large passage below.

Digging then continued to enlarge the entrance, and then to take out any rocks that may be a danger, even if it was questionable. On one of these days, Saturday, October 12, 2002, a large group was digging. Carroll Bassett was outside with Tim Bleech, Pam Tegelman, and Vonny Droms. Dave Cowan and myself were digging inside the entrance, making it a hands-and-knees crawl. Dave Scott, Tom Malabad, and John Kerr were inside digging and securing. The latter three decided to attempt to drop into the larger passage. Being a smaller team, they were able to squeeze through the spot that was thought to require a cable ladder. It was tough to get back up, but they made it back up. But before coming up at around 2 pm, they were able to confirm that this was in fact the Heaven Passage in Maxwelton Sink Cave. They spotted footprints, survey stations (S167 and S180), and the well that we had dug! Everyone was excited, and we stabilized the entrance after they had come out and celebrated.

A meeting took place on the night of the 13th to figure out what was next. We decided that a project would be set up, a lease with the WVCC would be written, and that we would assess our current entrance, stabilize, and construct the culvert entrance. While we were talking about these, the following day on the 14th, we decided to try to learn more about the void in the well at 30 feet down. We got more video, much better video, and have decided to send the small group back into the cave once more to see if they see the well in any upper leads in the

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cave, and maybe survey any upper leads, tying into the well inside the cave. This is to happen on Monday, October 21, 2002.

This actually didn't happen until Saturday, November 25, 2002 due to some technical delays. Tom Malabad, Tim Bleech, and Dave Scott entered the cave with Carroll Bassett, Dave Cowan, Pam Tegelman, Kristen Matak, Bill Balfour, and Jeff Bray on the surface. Thanks to a mud plug at the 42-foot mark in the well, we could not drop a phone line all the way to the bottom passage as planned. But we did drop it into the 30-foot void, along with a strobe light built by Carroll, and a loud and annoying device we borrowed from Ed Swepston that we called the mine screamer.

The group ended up surveying 500 feet, starting at the end of a higher

gypsum passage and surveying all the way out. No connection was made to the well in a higher void, but good data was collected and correlated with the microgravity lines and surface survey to give us definite locations for all the various surveys done with this project. They also took pictures of the scary rocks in the breakdown section. One section of the passage on the way in to the main cave had filled with some smaller rocks, but no catastrophic collapse had taken place, despite some colder temperatures that had taken over the area recently. The headwall still looked good too.

The next day Dave Cowan brought his backhoe over so that we would have it ready to possibly dig down the well to the 30-foot void during the winter. We are considering the lower void and pit entrance closed for now, except for one trip into the upper room that was found before the Printz Pinch to see how close it is to the upper gypsum passage.

The group took Thanksgiving off, and digging with Dave's backhoe commenced on Monday, December 2 and lasted pretty much 3 days. We dug down and exposed pinnacles of limestone with deeper pits of dirt and clay. The well, now plugged by a contraption constructed by Dave (which later proceeded to find its way down the well when the rope broke, joining a long metal rod which was used to unplug the mud plug at the 42-foot depth and which had fallen the day before), was found to have actually intersected bedrock in one of the pinnacles, at about 5-6 feet in depth. There is a deeper pit of clay about 7-10 feet below the surface. Digging will now continue during the winter here. I'm sure the folks working up in the airport's control tower will be glad to hear this news, since I'm sure we've provided many minutes of entertainment for them since we started.

It's now been almost a year since that very frozen day that Tom Malabad and myself stayed on the property freezing our, well, you know, off until midnight, collecting microgravity data. But it seems as if that late evening, and all the other long days and nights put in by many will finally pay off. Special thanks go out to the following for all their help: Tom Malabad, Dave Scott, Tim Bleech, Chris Printz, Carroll Bassett, Dave Cowan, John Kerr, Bill Balfour, Bill Liebman, Pam Tegelman, Pat Smith and many others, including others from the Monroe County Cave Survey who have taken time from our normal projects in Monroe County to work on this. Stay tuned for updates as the crew continues to make this cave accessible for everyone again.

Maxwelton Sinks Cave; Cave Digging's Price, Lessons and Rewards

by Carroll Bassett

Foreword

I began thinking about this report soon after the event described herein. Feeling that a brief history leading up to the event was important to understand the circumstances, I have included an extremely abbreviated version. The conclusions on the events are mostly my own. Discussion and responses are encouraged and important to this community. My goal is to, in some small way, make digging safer.

A Short History

The original entrance to this cave was at the end of a blind karst valley fed by a small stream which had been dug open in the late 60's only to be permanently flooded shut in 1971 by hurricane Agnes. Before this unfortunate event however over 10 miles of passage had been surveyed and mapped with many more leads left to explore.

With the auction of the property in the late 90's, the West Virginia Cave Conservancy (WVCC) began a difficult and frustrating series of negotiations with the new owners, an investment group who planned to develop the remaining property. After a verbal agreement was arrived with the new owners, a survey was completed on the approximately 5 acre piece comprising the bottom of the karst valley, most of which had been designated as flood plain and undevelopable under FEMA regulations. Upon entering into an agreement with the Greenbrier Valley Economic Development Corporation (GVEDC), a state funded entity created to bring industry into the area, the new owners abandoned on their agreement with WVCC.

A new round of negotiations with the GVEDC produced another verbal agreement but this time the surveyed property was to be donated to the WVCC in return for public acknowledgment of their generosity and environmental concern. The amount that the GVEDC agreed to pay to the new owners, which was essentially state money, was more than three times what they had paid at the original auction 6 months earlier.

The jubilation of the new owners at their windfall was to be short lived however. Apparently state law dictates that any development with public money requires environmental impact studies before transactions can be finalized. The results of the study indicated that development might directly threaten at least two endangered species. These results may have led to a suspected withdrawal for political reason the GVEDC takeover. Consequently, the owner was alienated from the caving community due to some kind of environmental trump card to ruin their very profitable deal. This, of course, was not the case and destroyed our chances to acquire access to the property at the old entrance.

With no chance of gaining access to the original entrance and most of the original survey data either lost or of questionable accuracy, any hope to gain an entrance to the cave seemed unlikely until Dr. Dave Scott purchased property he believed overlaid sections of the cave. He expressed an interest in trying to gain access to the cave below and digs were undertaken both manually and with mechanized equipment (i.e. track hoe, which was financed by Dr. Scott). These digs were frustratingly unsuccessful and hope of opening the cave waned until Jeff Bray started studying the area for micro-gravity anomalies. His work indicated passage at a number of locations and a six inch test well was drilled at one of the most promising spots. A modified black and white surveillance camera was lowered into the well and voids encountered at 30 and 105 feet were remotely video taped. The 30 foot void did not seem particularly promising but the 105 foot void contained larger passage and a stream flowing almost due north. This corresponded with the existing map of the cave to indicate we had probably drilled into the "Heaven" passage of Maxwelton Sink Cave.

105 feet straight down is a very long way to dig especially when it is mostly solid limestone so it was decided to try a second dig with the track hoe. A spot about 100 feet south and downhill from our drilled hole that had indicated passage in the previous micro-gravity study was chosen.

Digging proceeded well and at 38 feet down from the upper edge of the hole we found breakdown with good air flow. Being at the limit of the reach of the track hoe we began digging by hand in a mostly horizontal direction following the air.

Over the next several weekends an extremely dedicated dig team, of which I was a member, made excellent progress. Traditional digging techniques were used to remove small rock and dirt while micro-blasting was used to open spaces between the large breakdown blocks. This technique also helped to reduce rock blocking our progress to manageable sizes. By the end of September we had dug our way approximately 70 feet to the top of relatively large passage with a stream running through it.

In the Blink of an Eye

On the evening of Oct. 1, Dr. Dave Scott, Jeff Bray, and myself, in a state of high expectation, prepared to enter for the first time in 30 years what we believed to be Maxwelton Sink Cave . I took the lead and on our way in disturbed something which unleashed an avalanche of rock upon myself. After kicking a number of smaller rocks off my legs I realized that my right arm and knee were pinned by what I was soon to realize was a 1,000 pound plus slab of breakdown. Pressure on my right knee was not severe but I was unable to move it; pressure on my right arm between my elbow and shoulder was extreme. My disbelief at the predicament very soon gave way to the harsh reality of my situation. No amount of effort that I made even began to move the rock pinning me and although I could move

Continued on Page 26

my right forearm and fingers my entire right arm was becoming progressively and ominously numb. Luckily I remained conscious and Jeff went outside to call for help while Dave stayed with me. My arm being subjected to so much pressure became the priority and we called for the screw jack and handle from my Toyota pickup to be brought in. It soon arrived and with my free left hand I placed it just above my right shoulder while Dave cranked the handle from his position in the tight passage about three feet above me. Positioned horizontally between the wall of the passage and the rock pinning my arm the jack now shifted the rock slightly putting greater pressure on my right knee. Backing off the jack returned the rock to its original position relieving the added pressure on my knee but my arm was still badly pinned. We realized that to free my arm we would have to chock the slab somewhere down by my ankles but to access them Dave would have to pass over me and the slab on top of me. Four feet directly above the the slab was another 200 pound slab hanging vertically and held in place at its upper end by the breakdown that made up the ceiling, not an easy choice but at this point seemingly the only option. Summoning up a good deal of courage as well as the aid of the appropriate spirits Dave made his move and made it across the slab without further deterioration of the situation. My arm now was completely numb and yet extremely painful. It seemed to be dying and I deeply mourned its apparent passing.

Having made it across the slab, Dave became energized with optimism. I think this was a turning point for both of us. Even though I was not yet free the problem and its dangers seemed suddenly more defined and the solution seemed within our grasp. Dave placed the the jack under the slab and raised it slightly. Attempts to chock up the slab did not work however, the available rocks and the geometry of the the space he attempted to fill with them were incompatible, they slid out from under the slab as he lowered the weight of the slab onto them. We realized we would need a second jack, one for raising the slab by my feet and holding it up and the second to slide it off my arm. A second jack quickly arrived. By this time the call for more cavers to help had been answered, and Mike Corbett took up the position above my head where Dave had previously been.

I positioned the second jack with my left hand as in the previous attempt to free my arm. Mike cranked the handle until the jack made solid contact with the passage wall and the slab. Dave then started cranking up the slab at my ankles and within a minute or two I was able to move my right knee from the space it was trapped in. Mike then carefully began to crank more on his end and within another minute I was able to drag my arm from the constriction.

I had been pinned for an hour and a half but it felt more like a week as I pushed myself up from the semi prone position I had been in. At the point when I was again standing the chilled blood trapped in my arm and now circulating through me lowered my body temperature to the point that I began to shiver uncontrollably and I could barely catch my breath, instant hypothermia. The shivering subsided after about a minute and I crawled another ten feet and rested as Daryl Trusty, caver/paramedic, checked me out. I got the “good to go” and mostly under my own power crawled the last forty feet to the entrance where a helpful boost popped me out. I had made it out but the struggle was far from over.

Almost four months later nerve function has returned to my right hand to allow simple grasping motions and slow typing (definitely faster than one hand typing). To get to this point I have undergone painful nerve studies, acupuncture, osteopathic manipulation, STEMS treatments and masses of physical therapy. I list these things only to give an idea of the repercussions of this incident. Although a serious situation, it could have been a lot worse. I consider myself lucky to have not been hurt any more than I was. Initial projections by my doctors for recovery agreed on about six months. Given the rate of recovery thus far I would say they were right on target and I am very grateful.

As a result of this incident I have had a fair amount of time to consider many of the aspects of it and have come to some conclusions I hope might be useful to others.

The Scary Truth?

Dig long enough and something is going to fall on you!

If you are VERY LUCKY you will simply crawl out from under it or push it off of you with no ill effects other than a bad moment.

If you are JUST LUCKY, someone will be able to help get you out and you will recover EVENTUALLY.....

If you are NOT SO LUCKY, you will be rescued but will sustain permanent injury to one degree or another, possibly after a long and miserable struggle involving many others.

If you are UNLUCKY you will DIE, maybe after a long and miserable struggle by yourself or with others trying to help you but you will be dead and your rescuers, friends and family will suffer. Would a quick death help here? Not anyone else but you.

I wouldn't deny this before the accident if asked but I wouldn't have written this then either. So if this is the truth, and it is for me now, was I in denial or just ignorant? Will this be true for you after an incident or is it true for you now after reading this? If not true to you now, are you in denial and if so why would anyone want to cave or dig with you? These questions are rhetorical and need to be answered privately first and then maybe discussed with others. At this point I believe that these are the facts and they need to be faced.

In my mind facing these facts has not eliminated digging for me but it has convinced me that we need to be prepared as best as we can to deal with these incidents quickly. We need to have some plan in place before an emergency.

Continued on Page 27

So It Happens and Someone is not VERY LUCKY

In any dig if there is a collapse, shift, etc. and someone is trapped, time will be of the essence especially if they are pinned or otherwise in close contact with the passage. “Self rescue” should start immediately by your party as well as alerting others outside the cave/dig to a possible callout. If you have been digging for any length of time you have probably already performed some small self rescue but do you have available equipment for the probable inevitability of a more serious event?. Nearby? Prudence would put some thought into what you might do well before an incident and have ready at least some gear and expertise to deal with the problem quickly.

Besides the normal tools of the trade, i.e. dig bars, buckets, shovels, hammers etc., I would have nearby what I am calling a “Crunch Pack”. This would consist of a durable bag containing at least but not limited to the following:

2 small mechanical screw jacks with handles found in small cars and light trucks. Small hydraulic jacks do not operate well in all positions so they should be avoided. An exception to this would be a “port-a-power” set which uses a remote pump. These tend to be large and not as dependable as mechanical jacks but they can do some amazing things in a small space.

20 wooden wedges. A good size would be 3” wide by 8” long by 1” thick and made from oak*. These wedges will allow shimming and wedging rock that may be unstable. They also can back up progress made with jacks and be used to favorably position jacks when jacking surfaces are slightly out of parallel. They can be used as cribbing when stacked in “opposition” to themselves (thin end on fat end).

I would encourage the reader to play with these tools and feel free to add any other equipment they think important to this short list. This is meant as only a minimum but bear in mind that if the “crunch pack” gets too big it may not always make it to the dig where it may be needed quickly. If you need something quickly you'll need it that much more.

These tools are for dealing with rock and in the case of an engulfment buried by loose materials, the victim is more likely to suffocate from lack of air or an inability to breathe because of compression from the engulfing materials. Obviously in these situations you will only have at most a few minutes to act before the incident becomes fatal. Engulfment should be carefully guarded against as it is most often fatal.
Commercial excavators are bound by many safety rules as a result of hundreds of fatalities from engulfment incidents.

Since diggers have higher risk than the general caving population (excluding divers) it would also seem reasonable that they should gain some cave rescue knowledge and certainly some practical first aid training to offset this risk. If you find yourself needing to call for help in a dig accident the combination of rescue training and digging skills seems far more likely to lead to a good outcome. Besides, the rescue community will gain from your participation and I believe you will to too. I know that the people that responded to my incident were far better diggers than rescuers and had I not been able to direct my own rescue the outcome might not have been as favorable. If nothing else it would have taken much longer which in my case might have led to further damage to my right arm. This is debatable of course and by no means meant as criticism. I was really glad they were there.

This leads me to the last big point I want to make in this paper and that is in what cave rescue circles refer to as “psychological considerations”. After I realized just how serious a situation I was in, I became extremely focused on figuring out how to solve my dilemma. In retrospect this seems like a defense mechanism and a good one at that. The greatest threat to that focus was the look of fear in the eyes of my rescuers in the early stages. When I encountered this I could feel my resolve weaken quite noticeably and only through sheer stubbornness was able to maintain my commitment to free myself. Conversations about how bad things look are counter productive to someone who needs help, but your patient may pick up on your fear in ways that are more subtle. If possible this should be guarded against. What is required is a kind of professional “can do” attitude grounded in competence. That confidence experience yields. Fear has no place in rescue only because it tends to degrade I.Q. and erode the necessary confidence a patient needs; concern on the other hand is the reason anyone gets rescued, a thin and difficult line to walk.

I hope this has been of some use to you, my apologies for stating the obvious if it has seemed that way. My intent was to share my experience and conclusions with you in the hope that my words might spare someone this ordeal.
DIG SAFE!

*Larry Fisher has made up 100 of these oak wedges which are available as a service to the digging and cave rescue community at cost for $1 each plus shipping. Call 304-497-4311 for details.

After word

Since the events of 10/1/02 there have been 2 trips into what is indeed Maxwelton Sink Cave so all our efforts have not been in vain. We are working on a new and more stable entrance at which time, hopefully later this year, the cave will at last be open.

Cool Link

Speleogenesis and Evolution of Karst Aquifers

A great virtual scientific journal

http://www.speleogenesis.info

Millenium Camping

by Terry Byland

Every cave is different and the exploration is different. So the way you are able to camp will vary also. In Scott Hollow we have what we call an advance camping system. We call it Millennium camping. We are fortunate in that the two-mile trek to camp is big borehole so trekking to camp is relatively easy, affording us the opportunity to take whatever we want to camp as you will see in the pictures.

Lets start out with the living room, which is the first thing you see as you enter our camp. The chair on the left is a blow up chair we brought in. These are the easiest to transport and the most comfortable. Many of nights after a hard caving trip some have fallen asleep in these. But most have felt material on them, which will get moldy really quick. To fix the problem temporarily we have covered them with plastic. But nobody likes fungus in camp.

As you can see from the picture we have a couple of fold up chairs we hauled in. They hold up great and are very comfortable. In the center we have made a coffee table out of PVC pipe and plastic tarp. Not pictured is a chair that was made out of PVC pipe and an air mattress. The chair is a PVC pipe frame that supports half of an air mattress so you can recline.

Next we go to the kitchen. We took an ally way and leveled it out and built countertops. On the left we built two flat level shelves covered with plastic. In the middle we have

two-burner propane stove for boiling water and scrambling eggs in the morning. On the right we have two propane ovens. This has changed camp cooking a lot. We cook steaks, chicken, pizza, biscuits, lasagne, potpies, and chocolate chip cookies. The ovens get pretty hot so some put their wet clothes on top to dry. I found out the hard way they can get too hot as it melted my poly pro.

We all have picked out our own living quarters. On both sides of the room are hills. We named one “GLACIER HEIGHTS” and the other is” THE HEIGHTS”. The floor around the living room we call the ghettos. We all have an air mattress and sleeping bag. Well, except Jeralin Molinaro from New Jersey. We call her sweet pea because she has three air mattresses. Some of us have our own clothesline and plastic containers to keep clothes and other supplies dry. We keep all these things up at camp for months. As long as you keep them sealed tight they will be fine.

We light the room up with three propane lanterns. We call them the three suns. We have built a filter system for water so we can use the cave water. We have a one hundred cd music systems that bounce the sound off the wall (Picture two on the right). We have leveled all the trails, put in steps and built up walks ways with stonewalls. The Glacier heights being the more luxurious area have cobblestone walkways.

We use a side passage as a bathroom. We have a gallon bucket we fill with dirt and take with us to the bathroom. Maybe someday we will have a whole new floor built in there. The cave actually does real well on handling the problem.

We have only two rules. One is everybody has to bring in a propane tank and no muddy clothes touch anything. At the end of a hard weekend of digging, blasting, surveying, or bolt climbing we retreat to our camp for food and dry clothes. After dinner we crash into the chairs for an evening of enjoying tunes, talking and some engage in a game of chess. As our new discoveries continue to happen we will eventually have to move our camp further in creating camp 2 which will probably be much more primitive. In the mean time I will sit in my lounge chair eating a chocolate chip cookie while listening to Pink Floyd enjoying our Millennium camping.

At just 10.2 ounces the Petzl Stop is a great device for many vertical pitches. The gated eye allows threading of rope without removing the device from the rope. Available online at http://www.caves.com/imo

In a feature article in our last issue by Scott McCrea titled “Danger: Don’t Feed the Micro Rack” we received a response from Carroll Bassett of BMS Rescue. BMS among other things manufactures micro racks.

Rack Safety

by Carroll Bassett

Pictured above: Long frame and short frame micro-racks.

Scott's point is well taken and his advice to use your other hand (aka balance hand, not your brake hand) to not only spread the bars but to hold the fourth bar closed when feeding stiff rope makes good sense. If you routinely find yourself feeding rope (either because your rope is very stiff, you are a light person, or the rope weight acts to create too much friction) we strongly suggest that you switch frames to the longer version (BMS will be happy to switch your frame for $20US plus $6US shipping). This adds only about an ounce and just over an inch in length to your Micro-Rack and seems to solve most feeding issues our customers have had in the past.

If your problem persists and you are still uncomfortable with either a mini-rack or Micro-Rack a bobbin type device or a full sized rack may well suit your needs better.

Another approach to solving this possible problem is to make the fourth bar latch harder. This will increase the force that it takes to open and close the fourth bar with the result of making it less likely to open inadvertently. This adjustment is quite easily made to your Micro-Rack without disassembly. Essentially all that is required to increase the latching force is a tap to the slotted end of the 4th bar thereby closing the slot a small amount. If you find after tapping the bar it is too hard to engage with the frame properly you have probably closed the slot a bit too much and will need to open it a little. A rod slightly larger than the slot can be lightly tapped into it with the effect of opening the slot slightly. Check the latching action after each adjustment to make sure of the bar's proper functioning. Older racks should be checked periodically as wear from use can lessen this latching force. Anyone who feels uncomfortable with making these adjustments themselves is welcome to return their Micro-Racks to BMS along with the return shipping (see above) for a free tune up.

Mini-racks made by other manufacturers with aluminum bars may have some issues with cracking so the manufacturers should be consulted first before any adjustments are made. Using a QAS (quick attachment safety) is highly recommended when approaching an edge especially before one has fully loaded the rope. For those of you unfamiliar with this technique I will briefly describe its components and their use. A QAS generally consists of a personal ascender or rope grab which has the ability to be attached to a rope quickly with one hand and a tether that securely connects it to the users harness. The length of the tether should allow attachment above your descender but not be so long as to not allow easy reach when fully loaded on rope. It is generally clipped to the balance hand side of the rappelers harness to make it easy and fast to attach to the rope when on rappel. As one moves down the rope towards the lip the cam is held slightly open with the balance hand to allow progress. To stop progress the cam is allowed to engage the rope. This adds somewhat to the complexity of a system but is easily mastered with a minimum of practice and adds another level of safety when negotiating a lip, generally accepted to be the riskiest part of a rappel. After passing the lip the QAS can be removed and the rappel completed. This is especially good for beginners to gain confidence and can be taught on steep slopes for gaining experience before a real drop.

The auto-block is another rappel safety technique worth knowing and simply puts the ascender below the rappel device. Rather than a mechanical ascender a small prussic (6-7mm acc. cord) is tied onto the rope below the descender and then attached to the leg loop on the rappelers brakehand side usually with an oval or triangular quick link . Be sure to tie your prussik carefully and dress it properly. This should be rigged as short as possible so not to allow the prussik to ride up into your descender when loaded. To move down the rope the prussik is broken with the brakehand and rope allowed to slide through. To stop simply let go of the prussic and it will grab the rope stopping progress. Since the prussic only receives a small proportion of the users total weight (most of the users weight is on the descender above) it is relatively easy to continue a rappel after stopping by breaking the grip of the prussic. Again, practice with this technique on a steep slope to gain expertise and confidence. This is especially useful for the first person into a pit to use as there will be no one to bottom belay you in the event of an emergency.

Readers should be careful to understand these concepts fully before using them and always practice the highest standards of safety when on rope. Whenever in doubt seek out competent training and advice. Be safe and enjoy.

Carroll Bassett for BMS

DigCon 2003

Come join us in Renick, WV for the annual Diggers Convention! Presentations and discussions on muzmining, soda straws, safety, and other topics relevent to caving and cave digging. It will be a great time and a chance to share ideas, successes, and projects with others! We hope to see you there.
Register below or online at:
http://www.caves.com/digcon

Where: Renick, WV at the West Virginia Association of Cave Studies Field Station

When: June 5-7, 2003

Event includes: Continental breakfast daily, banquet, keg party, muzmining classes, soda straw discussions, micro-shaving hands on, caving & digging plus slide shows and presentations on Friday and Saturday evening. Pre-registration is $45.

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