



the
TEXOS COVER

a magazine written by and for cavers

June 2015

Caveatron

revolutionizing cave mapping

Cross Grotto Caving

arkansian and texan cavers

TSA Spring Convention

photo and cartography salon winners

TSA SPRING CONVENTION 2015 SALON WINNERS

Congratulations to the winners of the 2015 TSA Spring Convention Photo and Cartography Salons. With quite a few truly amazing submissions to choose from: 19 photo prints, 12 digital and 9 maps, competition was fierce.

Photo, Print

1. Galen Falgout
2. Jake Kirk (to be featured September cover)
3. Mike Harris (cover)

Photo, Digital

1. Bennett Lee
2. Travis Scott
3. Travis Scott

Cartography, Less than 100 meters

1. Marvin Miller, Lost Pothole
2. Marvin Miller, Turquoise Sink
3. Ben Hutchins, Falling Animal

Cartography, More than 100 meters

1. Peter Sprouse & Gill Ediger, Jaguar Maw



Clockwise from left.
1st Place Print: Galen Falgout
'Angel Wing' - unnamed Arkansas cave
1st Place Digital: Bennett Lee
2nd Place Digital: Travis Scott - Midnight Cave



The TEXAS CAVER

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Articles, announcements, artwork, photos, and material for publication are ALWAYS welcome and may be sent at anytime to the Editor.

All submissions must be submitted to the Editor in electronic form, either via email attachment or DropBox (ask for details as needed). Please do NOT imbed images in word, email body, or pdf, as this decreases resolution and you will be asked to re-submit.

The editor reserves the right to edit inappropriate material, errors in spelling, grammar, or punctuation, and to edit for clarity. In the event of significant changes the author will be given an opportunity to review the changes prior to publication.

SUBMISSION DEADLINES

While submissions are welcome anytime, deadlines for consideration in upcoming issues are:

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2nd Quarter	May 15
3rd Quarter	August 15
4th Quarter	November 15

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PHOTO CREDITS

FRONT COVER

MIKE HARRIS

'Petrified Spider'

Midnight Cave

BACK COVER

MIKE HARRIS

Midnight Cave

FROM THE EDITOR

Photo Credit

Correction

March Issue

In the Tumbling Rock story by Walt Olenick, photos were credited to Walt, however, they were taken by Rae Nadler-Olenick.

EMERGENCIES

FOR CAVE ASSISTANCE, CALL THE CLOSEST COUNTY NUMBER:

BEXAR	210.865.2061
COLLIN	214.202.6611
HAYS	512.557.7965
MIDLAND	432.438.5076
SUTTON	325.450.3905
TRAVIS	512.663.2287

FOR LIFE THREATENING EMERGENCY: 911

CONTENT



i
TSA Spring Convention
2015 Salon Winners

04
A Fantastic Time in
Ellison's Cave



06
The Caveatron

14
O-9 Well Survey Finale



16
TexArkana Caving

24
F.U.D. For Freedom



TEXAS COVER

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Texas Speleological Association is an unregistered, nonprofit internal organization of the National Speleological Society, and represents the greater caving community in Texas.

The TSA is comprised of both independent members and local grottos, and supports cave exploration and studies in and around the state of Texas.

The organization holds business meetings three times per year, organizes an annual spring convention for Texas cavers, and sponsors caving projects and events throughout the state.

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Passing of Scott Harden



Scott Harden, an active caver, geologist, biologist, mountain climber, and friend passed away March 13, 2015. He was a UT graduate, and a very active caver in the 70-80's. He spent a few years caving in the Austin area, made numerous trips to Golandrinas, New Mexico, among numerous other caves, and climbed Popo and other high peaks in Mexico. After moving back to San Antonio, he was actively caving and involved with several projects including Honey Creek and Sorcerers.

Scott spent many years caring for his ailing parents in the 90's and until his mom passed away in 2011. He didn't cave often in the years he cared for his parents, and by the time they were gone, his health had declined to the point where he couldn't do much. Gary Poole and I each tried to take him to Cold Spring on the Medina River, but he was unable to make the trek to reach the spring. He constantly emailed his friends with humorous, goofy, and even insulting notes numerous times each day. When those emails stopped, and he didn't answer his phone, several of us were concerned. One of his friends went to his house, and when he didn't answer the door called the police, who discovered Scott dead inside. He was a few months shy of 60 years old.

My last caving trip with Scott was to Three Whirlpool Cave in 2003. We used my canoe to get to the cave entrance and Scott went with me to the water passage to measure the water flow. He did a great job of explaining the geology of the area, and searched for critters in the water passage but found none.

– Kurt Menking

After Caving Eats

We've all felt that voracious appetite stirred up by a long, exhilarating cave trip. Whether it be surveying, exploring, restoration, digging or ridge-walking, we are starving and looking for a great meal. For those times that an after caving eat-out is in order, Geary Schindel came up with the idea of a restaurant recommendation/review for the Texas Caver. Austin, Dallas, Houston, San Antonio, Carta Valley - any caving area and in between, to guide hungry cavers. If you have a favorite eatery you would like to share, here is your chance to be a restaurant critic!



BILL AND ROSA'S KK STEAKHOUSE

7400 County Road 525, D'hanis, Texas 78850

Critiqued by Geary Schindel

Travelling on Hwy 90 between Hondo and Uvalde? Bill and Rosa's KK Steakhouse is located just north of the railroad tracks and Highway 90 in downtown D'hanis. This landmark eatery has great traditional Texas meal, the portions are Texas size, the service is top notch, and the ambience, well you can't get more Texan. The dining room is filled with stuffed animals, antiques, and old signs, the unpretentious atmosphere is kind of like your crazy uncle's place. Though the clientele is mostly local, the wait staff is very friendly and have been known to go out of their way to accommodate cavers. They usually have a lunch and dinner special, have excellent steaks and are noted for their BYO Burger and Chicken Fried Steak. The real secret weapon is the music of Tommy Mason. He is a talented musician that has a great range of country favorites and encourages people to sing along. Between the food and the music, Bill and Rosa's is worth planning around your cave trip.

A FANTASTIC TIME IN ELLISON'S CAVE

by Chris Lafferty

During the 2014 NSS Convention in Huntsville, I had the opportunity to visit Ellison's Cave. With the guidance of Aaron Polsky, a friend from Scottsboro, Alabama, seven cavers headed to Pigeon Mountain on Wednesday with the intent of entering the cave early Thursday morning to a part of the cave called the Attic. The Attic was the perfect spot to rig a rope to bolts in a shelf of limestone on the ceiling and have an unobstructed drop into Fantastic Pit, at 586 feet the deepest known pit in the lower 48 states.

In the group were Tom Rogers, Lydia Hernandez, Galen Falgout, Ellie Watson, Evan Strickland, Aaron Polsky, and myself. Unfortunately, Galen and Ellie did not enter the cave with us that morning, choosing instead to stay at the campsite and rest after Galen came down with an upset stomach. The rest of us drove to the Blue Hole, a spring at the base of Pigeon Mountain that serves as a resurgence for the cave, and geared up for a short but brutal hike up the mountain. We intended to bring radios to communicate between the top and bottom of Fantastic, as the waterfall in TAG Hall normally drowns out most communication. We forgot them on the drive out, but settled instead for an air horn we found inside Don Arburn's truck (aka Mobi).

We took turns hauling the ropes, with Evan taking the first shift carrying my previously unused 682 foot rope, purchased specifically for this cave. Aaron and Tom wore shorts on the hike up, something they probably later regretted after we plowed through a mile of dense poison ivy. We saw a number of small cave entrances and took several breaks along the way. During a long 20 minute break, Aaron mentioned he was not entirely sure we were on the right trail, and we might only be halfway to the entrance. We gritted our teeth and continued the climb, only to thankfully find the entrance we wanted some 30 feet from where we had taken the long break.

Entering the cave, we headed down a shallow walking stream passage until we got to the first drop in the cave from the entrance we took. Climbing up some breakdown, we rigged a rope for a 125 foot

drop called Warm Up Pit. The rig points for Warm Up Pit were an interesting site. There were a couple of bad bolts around the area, and the entire top of the drop had deep rope grooves cut into the limestone from the many cavers who had visited the cave previously. Some were more than an inch deep!

We dropped the pit and proceeded deeper into the cave. After a short 30 foot climb and a few traverses, we got our first surprise. Before entering the cave, Tom Rogers had stuck a foot loop for his ropewalker around the air horn to protect it and placed it inside his pack at the top. He chose to Texas up the short nuisance climb with his QAS and knee ascender instead of putting on the other foot loop. As Tom was clipping into a traverse line his pack brushed the ceiling. Immediately, everyone got a surprise, especially Tom, as an air horn right behind his head sounded off in the cave. We got a few more blasts and a few more laughs from the horn a few more times before we reached the top of Fantastic Pit a short while later.

The Attic portion of Ellison's is small relative to the pit. There's a low crawling to get to it, and you can touch the ceiling while standing. Years of carbide lamp soot mark the ceiling in certain locations. Looking over the edge of Fantastic Pit, multiple bright lights could not reach the bottom. Instead, it was just a black pit that belled out after a ledge (known as the Balcony) 70-80 feet down. The pit was slightly misty from a waterfall below us. Apparently, the waterfall can be fairly large, but it was just a small shower the day we were in there. I fed Aaron the uncoiled rope and he rigged a traverse to a small bolt 10 feet behind the pit and then rigged to two bolts in a small shelf of rock over the pit.

Immediately after rigging the rope, Aaron brushed his hand past a Petzl NAO light he had loosely girth-hitched to a biner on his harness. The light was knocked off, falling into the pit! It hit the Balcony on the way down, turning itself on. It then continued to fall down the pit in a spiral, illuminating the walls of the pit

with a ~400 lumen spot. It was a really impressive sight. I recall having a short conversation as the light fell with Lydia, Tom, and Evan, who were not close enough to the pit to see it fall. Unfortunately for Aaron, the light went out with a crash at the bottom.

After seeing a brief exposure of the pit from the falling light, we began to drop the pit. Aaron went first to retrieve his lost light, enjoying the drop despite his loss. He took it upon himself to bring a 24 inch rack into the cave along with a small micro-rack for Warm Up Pit. I followed after him. Fortunately, the rope was relatively clean, and I had no problem moving on four bars at the top after I swung out into the pit. It was a great drop with a great view. I was able to clearly see the walls of TAG Hall and Aaron's light (on his helmet, not the dropped one) at the bottom in the distance. A very small waterfall fell alongside me on the way, emerging from somewhere beneath the rig point.

Upon reaching the bottom, Aaron rushed over with a smile on his face. He was holding the light he dropped, now in two pieces. The light appeared to have hit the rock floor, and the battery separated from the light, breaking a retaining clip on the plastic battery connector. He said, "Look at this," and plugged the battery back into the light. It turned out the light still worked! He placed it on his helmet and used it the rest of the trip.

Tom and Evan dropped the pit afterwards. Lydia chose to stay at the top of the pit, not feeling up to a long climb back out of the cave. We quickly ate lunch, several foot long subway sandwiches we packed in, and went to explore some of the lower cave before returning to Lydia at the top of Fantastic.

We intended to explore the lower portions of the cave for just a short while, but unfortunately became lost for almost three hours when finding our way back. The lower cave passage below TAG Hall is a jumble of breakdown that generally follows a stream. The water

was no more than a foot or two deep where we explored, but Aaron mentioned it has been higher in the past. The cave hadn't taken a lot of water before our trip. Numerous cairns littered the bottom, and they didn't help in the least in finding the way back to the pit.

We eventually found the way back and began the climb out. Aaron preferred to climb solo with his ropewalker and took the lead. Evan followed with his Frog System. Tom and I were last and climbed tandem with me on a Mitchell System and Tom on a ropewalker.



Tom and I decided to try taking a short nap while we waited for the blast of the air horn to signal that Evan was off rope. I pulled out a polypropylene balaclava and Tom a ridiculous looking Mylar space blanket. We didn't have to wait long though! Evan practically flew up the rope in 30 minutes. Lydia was waiting patiently at the top, having napped and explored a little while we were gone. We set off to Warm Up pit after hauling and coiling the rope.

We had one more surprise on the way out;

Aaron slipped while carrying the big rope across a traverse. Fortunately, he was clipped into a permanently rigged traverse line which kept him from sliding down a deep hole in the Attic's floor. The rest of the short distance to Warm Up Pit was without incident.

We took turns climbing solo out of Warm Up Pit. I was the last and strapped the rope for Fantastic Pit and a spare 150 foot rope to a pulley. I hauled both ropes out with a simple 2:1 as I climbed and remained on rope to lift them up over the slight lip. We exited the cave as the sun was setting, and enjoyed the hike down the mountain much more than the climb up.

Ellison's was a great cave, and I had great company on the trip. I'd be happy to return someday.

THE CAVEATRON

QUICK AND EASY 3D CAVE MAPPING FOR CAVERS

By Joe Mitchell



What if a device existed you could carry into a cave to make a 3D map of it that could be viewed on your computer or even printed as a 3D Model? What if it could also record traditional survey data with an accuracy similar to conventional instruments but far more quickly and repeatable? What if this device was handheld and designed specifically for cave survey, reasonably simple to the average caver surveyor and based on existing techniques? And what if it was affordable for the average caver?

Meet the Caveatron, a new electronic cave survey tool. You can use it to take your distance, azimuth and inclination measurements in a few seconds and then view your line plot. You can travel down a passage with it and scan the walls to produce a 3D point cloud. You can also scan rooms and alcoves by rotating it in place. Since it produces accurate and detailed measurements of the cave

walls, it can greatly reduce the amount of hand sketching required and the data can be used to produce maps with a level of precision previously unseen except in the most detailed of surveys. Handheld and relatively compact, it is designed to be easy and practical to use in a typical cave environment and operate for many hours at a time.

Development

A few years ago, I started to get interested in how you might use electronics to improve cave mapping. I participated in the LIDAR survey at Devil's Sinkhole, which was impressive but the equipment was big, heavy, slow and very expensive. I also saw some small survey equipment cavers were making such as the DistoX and the Shetland Attack Pony, which were also very nice and can speed up a survey by taking shot data, but were not

exactly what I was looking for. The time consuming part is sketching, and I wanted to find a way to make it faster and more accurate. Rather than waiting for someone to make the cave survey device I wanted, I realized that my job as an electrical engineer meant that I had the some of the knowledge and skills to do it myself. I got two of my fellow co-workers and cavers Steve Gutting and Gregg Williams involved since Steve has lots of soldering and electronics assembly experience and Gregg has extensive machining experience and could help with mechanical design.

My first idea was a basic device that produced LRUDs (left, right, up, and down) measurements continuously along a passage. Since a laser solution seemed too big and costly at the time, I thought ultrasonics might be the way to go. I had worked with some small ultrasonic sensors previously that were relatively inexpensive, so I tried them out in a cave and they seemed to work well. The idea for the first prototype of the Caveatron was to use four of these to get the LRUDs and to somehow to figure out the position of the ultrasonic sensors as you move. Getting compass angle and tilt was not too hard since small electronic modules with a magnetometer and accelerometer were not too hard to come by. Distance was another matter. Laser distos (rangefinders) would be the best solution, but they are almost all made with proprietary interfaces and there is no real way to communicate with them (except for some very expensive industrial Models). As an alternative, I came up with the idea of using a remote transponder with its own ultrasonic emitter that sent a pulse to a receiver on the main unit. An infrared LED in the main unit was used to send a signal to activate the transponder's ultrasonic emitter. The time from sending the IR pulse until receiving the ultrasonic pulse gave a pretty accurate distance measurement (to a centimeter or so) at up to 15 m away.

The first prototype had a very basic interface with a numeric membrane keypad and a 2-line text LCD. It stored the LRUD data on a built-in SD card. After a few cave tests, it became obvious that the Caveatron had a lot of potential, including being used to take the regular distance, azimuth and inclination shot data. It also seemed that if it was going to do all these things, a better way of controlling it was needed. I came across some low cost touchscreen displays which would not only allow me to make whatever user interface I needed, but also allow data to be displayed to the user instead of just being stored. So I set out to build the first complete prototype including the display, the LRUD ultrasonic sensors, and added a laser pointer to accurately align it for taking shots and LRUDs. This prototype ran on 4 AA batteries. During testing, it worked

well and was it pretty cool to watch it build up the LRUDs as you walked through the cave. This version was tested in several caves and presented at the 2013 TSA convention. However, with further testing some problems became apparent. First the compass calibration was erratic. It would stay relatively good for a time but then suddenly change for no apparently reason (found to occur when replacing the batteries). Another problem, which became apparent on a longer trip in Deep Cave, was that after a few hours the ultrasonic sensors would start to behave erratically and eventually just quit altogether. After coming out of the cave, they would then go back to normal. I concluded that humidity was the cause, which was a major problem since it would only allow use for short periods.

About this time, I came across a low cost LIDAR scanner that was used in robotic vacuum cleaners and discovered that some people had figured out how to hack it and use it for other purposes. This LIDAR scans a full 360 degrees at 1 point per degree at 4.5 rotations per second. This sounded very interesting, so I bought one to try it out. Sure enough it seemed to work, so we built a new prototype based on previous version – still using ultrasonics for distance and a transponder – to test out the LIDAR in a cave. We tried it out in Robber Baron and after looking at the data, I was blown away by how great the data looked. You could view the cave in 3D and when looked at from inside the cloud, it was very recognizable! At this point in time it was only a point cloud, so still crude, but after working out more sophisticated post-processing of the data to get rid of noisy points and add surface normal, I discovered that it was fairly simple to render this point cloud into an actual surface to make solid walls and get a truly realistic looking 3D Model that you could “explore” both inside and out. This was far better than what I had originally set out to do and nothing else like this existed at such a low cost and small size.

The final piece of the puzzle was finding a laser rangefinder to replace the ultrasonic transponder. I came across a blog where someone had found a disto with a hidden serial port that seemed to work. I ordered one and sure enough, it was possible to command it and get distance measurements back over that connection. It worked well and reliably acquired distance data out to more than 45 m at up to 3 measurements per second.

One issue with incorporating the LIDAR is that it generates a lot of data. The original processor I was using (an Arduino Mega 2560) only had a 16 MHz 8-bit processor with 8kB of memory and 256kB of code storage. This was clearly not enough since LIDAR data was being lost and the touchscreen I was using exhibited slow

refreshes. Since I had become familiar with the Arduino platform, I wanted to stick with it and fortunately they had just come out with a much faster design, the Arduino Due with an 84 MHz 32-bit ARM processor with 96kB of RAM and 512kB of code storage. The downside was that it used a different voltage and the different type of processor would require modifying portions of the code. Between all the new components, and the increasing complexity of the software, I concluded that I needed to redesign the system and rewrite the code from the beginning to be more flexible and easier to work with. The user interface components were written into a separate library, the GUI code was redesigned to be interrupt based and the code was re-written to divide it up into smaller re-useable modules.

Since I was essentially starting over, I wanted to use what I learned from the early versions to make this one even better. First, switching to a built-in rechargeable battery was necessary to avoid the calibration challenges I encountered with replaceable batteries. A 4400 mAh Lithium-ion battery pack was selected to provide more than 8 hours of run time. The next piece was the touchscreen. The previous one had a low resolution and the two fonts it provided were too limiting for the GUI and hard to read. I found a new LCD that was slightly bigger with a brighter screen and with almost double the resolution (480 x 320 pixels) for about the same price. It also included an SD card slot that was more than 8x faster and a font chip with a wide range of sizes that were much more readable. It could also save images on the chip, so I could use it to store the on-screen button icons that Jill Orr had so generously created.

Other changes included a real-time clock with a small replaceable button cell that keeps time regardless of whether the Caveatron is powered on or off. A battery monitor board measures the charge of the Li-Ion pack and another board safety regulates charging of the battery. Other electronics provide the various voltages needed throughout the system. A piezoelectric buzzer is used to provide audio tones while taking shots and passage scans to reduce the need to look at the screen for feedback. About the only thing that didn't change was the compass module, although a newer version

was chosen with double the accelerometer resolution.

Design

The Caveatron has two components: the main unit and the LIDAR module. On the right hand side of the main unit is the recessed On/Off push button switch with a red ring LED built into it to indicate when battery charging is in progress. On the left side is a capped mini-USB port that is used to charge the battery, connect to a computer to download data, and update the firmware. In the front is a small window for the laser rangefinder and in the rear are two rings for the neckstrap. On top is a metal rail for mounting the LIDAR module and a connector with a rubber cap for connecting the LIDAR module cable. Finally, the top has a cutout for the recessed LCD touchscreen.

The LIDAR module has two rail mounts on the base to attach it to the main unit, which are tightened by hand with small thumbscrews. Near the front are windows around all four sides through which the LIDAR scans. A curved window would have been nice to avoid having to have corners (which obstruct a small part of the scan area) but curved windows severely distorted the distance measurement.

Separating the LIDAR from the main unit was done for several reasons. Since the LIDAR unit is somewhat sizeable in diameter (about 4.5") and must protrude in front of the system to enable 360° scanning, the overall shape of the system is not particularly streamlined. By making the LIDAR removable, the system can be

made more compact for transport, or alternatively the Caveatron can be used without the LIDAR unit at all, making it a more compact conventional survey instrument. Finally, a more advanced (but far more expensive) LIDAR could be used if more range or resolution is required.

Both parts use off-the-shelf heavy-duty electronics enclosures made from ABS plastic with integrated O-rings to protect against dust and water penetration. Each of the connectors also has a sealing gasket and another is used around the touchscreen. The windows are glued into place with silicone sealant and, along with the touchscreen, are recessed to reduce the risk of scratches or impact damage. The touchscreen



Main Menu

is also covered with a screen protector. Although the Caveatron is probably not suitable for water caves, it should do fine in Moderately wet and muddy environments.

Operation

Having surveyed caves for quite a few years, I wanted to make its operation familiar by using and building on existing survey techniques. The basis of a cave survey is the line plot, which is also used by the Caveatron as the skeleton on which the LIDAR point cloud scans are built. Just like conventional surveys, stations are set and the Caveatron is used to measure the distance, azimuth and inclination between them. All the LIDAR scans are then referenced to these stations. For instance, if you are doing a scan as you move down a passage (a traverse), you walk toward a particular station while the Caveatron continually measures its location off of that station. The coordinates of the point cloud for that section are based off the position of that station as determined from the line plot. Since only a single station is used to position each scan, you can make as many different traverses as you want to a particular station to build up a larger area or get additional coverage for areas that may be shadowed in particular positions.

One thing that is a bit different from a conventional survey is the use of a retroreflective card that is held on the station to which you are shooting. This was needed as a way to solve the problem of being sure that you were actually measuring the distance and direction to the station when doing a passage scan with the LIDAR. Since it is impossible to hold the Caveatron perfectly on station while traversing with it, the scan point wanders around quite a bit. The laser rangefinder has been modified so that it only gets valid readings when it hits the retroreflective card and all other surfaces are ignored. So, as you move down a passage with the Caveatron, you don't need to be pointed exactly at the station continuously, just from time to time. The Caveatron does the rest, filtering out off-angle measurements and interpolating between valid measurements. Having the card also helps with the accuracy of station-to-station shots in that it ensures you are actually pointed exactly at the station and not measuring something next to or behind it.

Each survey is stored in a different file, so at the



Shot Screen

beginning of a new survey, you enter a name for it (typically the cave name) and the date is automatically added to make it distinct. To take a shot, you enter SHOT Mode and enter in the names for the “from” and “to” stations (the “from” station is pre-filled from the previous “to” station but can be easily changed). At this point the red laser comes on so you can align the Caveatron to the station you are shooting to. You have the choice on the screen of selecting which of the bottom corners to measure from, depending on which is more convenient. You can also hold it at an angle or upside down if your station is on the ceiling, and this is accounted for in the software. A large

button covering most of the screen is used to activate the shot and an audible tone indicates when the shot has started and finished. A shot takes about 3 seconds, during which 3 distance, measurements and 900 azimuth and inclination measurements are taken and averaged. At the end of the shot, the measurements are shown on the screen and the shot can be accepted or redone. If a problem occurred, such as the Caveatron moved during the measurement, the shot will fail which is indicated by a special low-pitched tone.

PASSAGE Mode is the main method for taking LIDAR scans. It is done by gradually traversing the Caveatron (by walking, crawling, climbing, etc) toward the reference station. As with SHOT Mode, PASSAGE Mode starts by entering the station to which the traverse will be made (again auto-filled from the last shot) and a traverse number. After pointing the laser at the station and getting a starting position, the LIDAR scan begins. As you move down the Passage, you attempt to keep the laser pointed at the card. It's not required to constantly hit the card as that would be nearly impossible while moving, but just to hit it periodically and not stray the laser pointing angle too far away. The Caveatron beeps whenever it gets a valid position reference off of the card, so you can tell when you hit it. If you move too fast either forward or backward, too much time passes between valid measurements, or if the angle strays too far from the card, the Caveatron will stop the traverse. When the traverse is finished, colored statistics are shown in the screen to tell you if the traverse data is good (green), so-so (yellow) or not acceptable (red). You can then chose to do another

traverse, redo the previous traverse or return to the main screen.

Although a fair amount of processing has been incorporated to filter out poor data, account for the jostling and motion that accompanies a traverse, and protect against blunders, the quality of a LIDAR scan does depend on some operator skill. Without trying too hard you can get at least reasonable data but it may have accuracy issues or be somewhat sparse in coverage. However, with more careful use, you can get higher precision and more detailed coverage. Through practice, I have found that you can learn to hold it more carefully to improve accuracy even while moving through rough terrain, travel at a good smooth pace to increase scan density, and hold the Caveatron in such a way as to get the best coverage.

The last survey mode is ROOM Mode which is used to capture LIDAR scans of areas that PASSAGE Mode might miss, such as alcoves, passage corners or ends, or rooms that don't continue. This Mode is probably the best way to safety scan pits. The idea is to descend to a certain point, stop and scan, descend a bit further and repeat until you get to the bottom. In ROOM Mode you don't move while scanning, you just rotate the Caveatron around an arc or complete circle while holding it at a fixed location. This is best done on a rock but can be done hand-held in the air if you can rotate it steadily enough. This Mode does require a station to reference its position, so you start by entering the reference station and a splay number and getting a reference shot to the station. The LIDAR scan begins and you slowly spin the Caveatron on the reference point until the desired area is covered. As with other Modes, statistics and redo options are displayed after the scan is complete.

A fourth measurement Mode, MANUAL Mode, is also provided to obtain quick distance, azimuth or inclination readings without having to enter station codes. Both shots and continuous readings can be taken. However, in Manual Mode, no data is saved, only displayed on the screen.

Besides the measurement Modes there is a SURVEY menu and a SETTINGS menu. The SURVEY menu is used for initial survey setup, to view statistics for the current survey (such as length, depth and number of shots) and the line plot of the current survey. Plan and profile



Shot Results



Line Plot

views as well as station labels can be displayed. Loop closures are detected and indicated on the screen so you can quickly see the quality of the closures by how close they are. The current station is also highlighted to quickly orient your position. In the SETTING menu there are a variety of functions to set the date and time and view information about the system and SD card, and perform re-calibration. When the LIDAR is attached, a screen is available to show a live view of the scan, which helps in determining if you are getting the coverage you want.

Calibration

Proper calibration is important when dealing with electronic accelerometers and magnetometers and it can be challenging to get reliable and reasonably accurate readings with these types of devices. A great deal of development effort and code was put into handling the calibration and make it as transparent to the user as possible. Most of the calibration is done once, at the time of assembly, and does not require any user intervention. This is the case for the accelerometer, which is calibrated by carefully leveling the Caveatron, taking readings in all six orientations and computing the nine calibration parameters.

For the magnetometer, things are more complex since measurements can be affected not just by physical misalignment but also by the onboard electrical currents (soft iron) and metal inside the enclosure (hard iron). Only the physical alignment can be calibrated during assembly. This is accomplished by placing the Caveatron on a

rotating, non-metallic platform, outdoors away from other influences, and rotating it to a number of known angles measured with a Suunto. Unfortunately, the hard and soft iron values vary over time so need to be occasionally recalibrated by the user. This posed a challenge to make recalibration as simple as possible and able to be done in the field without any special equipment. Computing all 15 of the calibration values requires some rather sophisticated math involving eigenvectors. Although more simplistic computational approaches exist (usually ignoring soft iron effects), after experimentation these did not seem to produce accurate enough values. Thus, the more complex method was implemented.

To perform the user calibration, one only needs to find a location away from magnetic influences and rotate the Caveatron through as many angles as one can over a full sphere of directions. Although simpler methods ignore this, for accuracy it is important to get a reasonably uniform distribution of points. While rotating, the software automatically figures out if enough data has been collected over each section of angles and a progress bar is shown on the screen indicating how much of the total required data has been captured. The process typically takes about a minute or so to complete and when the system determines enough data has been collected, the calibration values are automatically calculated, displayed and stored in onboard memory. These can be updated as often as you wish, but it has been found through testing that the calibration is relatively stable over many days or even weeks.

Post-Processing

Although the onboard processor can handle some basic filtering of the incoming LIDAR and position data during scanning, it can't generate the point cloud. For that I needed to write custom software that can run on a Windows or Mac computer with one program to view, download, and delete the files stored on the Caveatron and another program to post-process them. The first step of post-processing is to generate an X,Y,Z coordinate file using David McKenzie's Walls cave survey software. The shot file generated by the Caveatron is already in Walls survey file format, so is easy to import, view and process a line plot.

The output station list file from Walls is then loaded into the point cloud processing software along with the LIDAR data file from the Caveatron. This software brings up a list of the traverses and room scans, one or more or all of which can be selected to begin the point cloud processing. Alternatively, selecting one of these also allows you to manually step through it so you can view the data in graphical form as single cross-sections. The software automatically applies additional filtering to get rid of bad data and noise, interpolate the Caveatron position between valid measurements, remove excessive motion, compute the directional normal for each point, and then stitch all the traverses together into a single file with the absolute X, Y, Z coordinate computed for each point. The program saves a text file that can then be easily loaded into one of several freely available point-cloud viewing programs such as Cloudcompare or Meshlab. To take the

SPECIFICATIONS

	Distance	Azimuth	Inclination	3D Scans
Sensor Type	Laser rangefinder	3-axis magnetometer	3-axis accelerometer	Single-axis rotating LIDAR
Measurement Range	0.13 – 45 m	360°	+/- 90°	0.05 – 4 m over 360°
Resolution	1 mm	0.1°	0.1°	1 mm 1° (angular)*
Accuracy	, ± 5 mm	, ± 1.5°	, ± 1.0°	several cm (depends on many factors)
Measurement Rate	1/sec	300/sec	300/sec	4.5 rotations/sec (1620 points/sec)

data processing one step further, Meshlab has a function to turn the point cloud into a rendered mesh through a surface reconstruction algorithm. That creates a 3D file that shows the walls of the cave as a solid surface allowing you to fly around or through the cave on your computer. As a final step, Meshlab can export a file suitable for 3D printing so you can make your own physical cave Models!

Testing

The final version of the Caveatron has been tested in several caves. At Robber Baron, over 400 m of the cave has been surveyed on multiple trips. At Deep Cave the entrance area was surveyed and at Devil's River State Natural Area, two small caves and one shelter were completely mapped. A comprehensive test was performed at Whirlpool Cave, where 240 m from the entrance to the Travis County Room, including both routes, were surveyed on a single trip that was about 7 hours in duration. On this trip, we attempted to be as thorough as possible, scanning all the alcoves and side rooms along the way. Discounting breaks and lunch, the average survey rate was about 40-50 meters per hour. One of the crawlways was quite wet including plenty of mud, standing water and ceiling drips, giving the Caveatron a good test of that type of environment. At the end of the day, the battery was still holding up and the Caveatron was working normally. All of the data from each cave has been rendered into solid surface Models revealing the caves like they have never been seen before. Robber Baron, Whirlpool and one of the Devil's River caves have also been 3D printed with the Whirlpool Model being more than 30 inches long. 2D maps are great for showing you the general configuration of the cave, but there is a lot they don't capture. Even though I've been in Robber Baron hundreds of times, being able to hold the cave in your hands or view it in 3D on the computer shows you things about the cave like slope, bedding planes, passage shapes and relationships between parts that were not obvious before. Combining the speed at which surveys can be done with a whole new dimension of measured detail has the potential to dramatically change the way we can survey caves.

What's Next

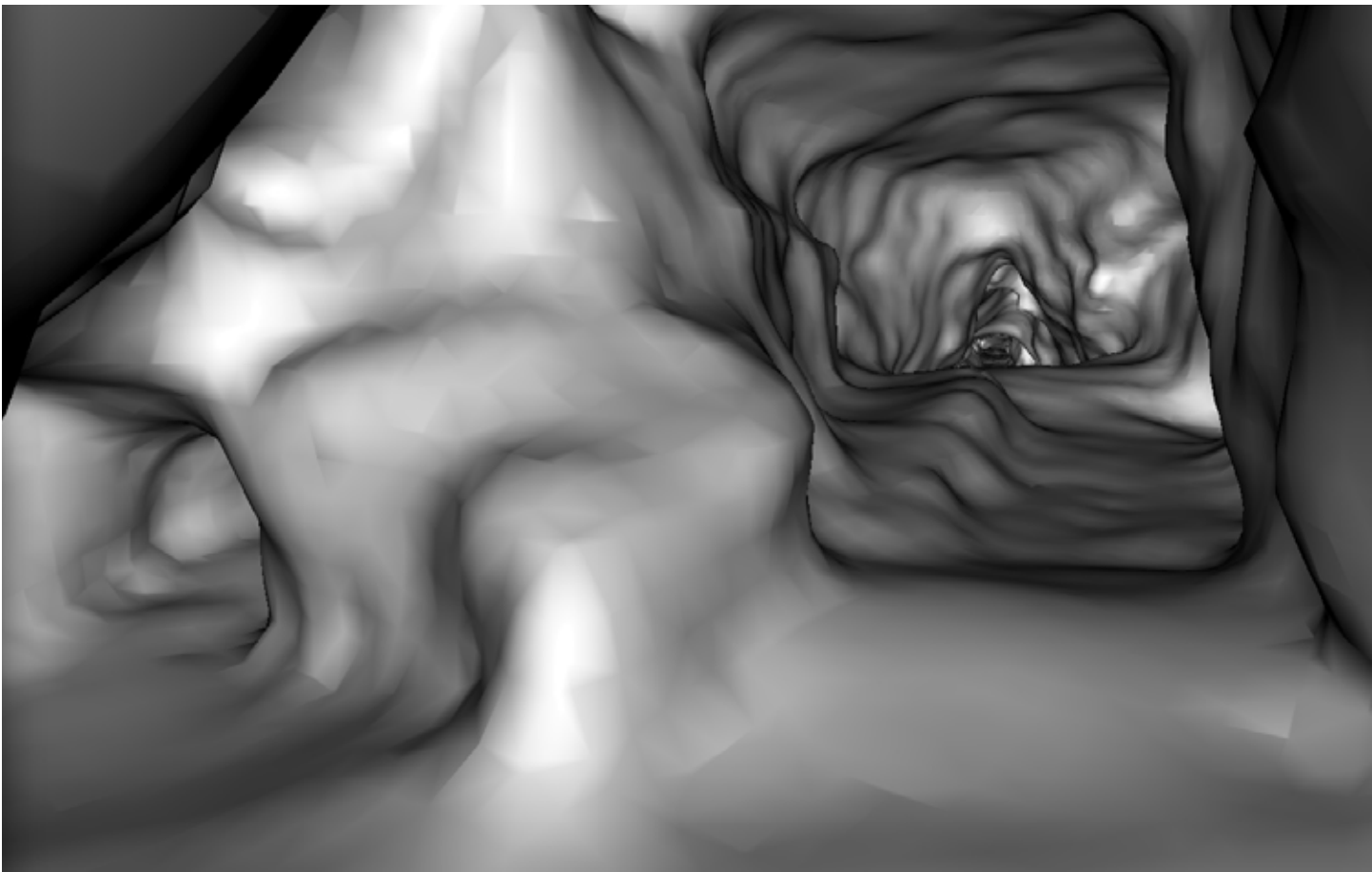
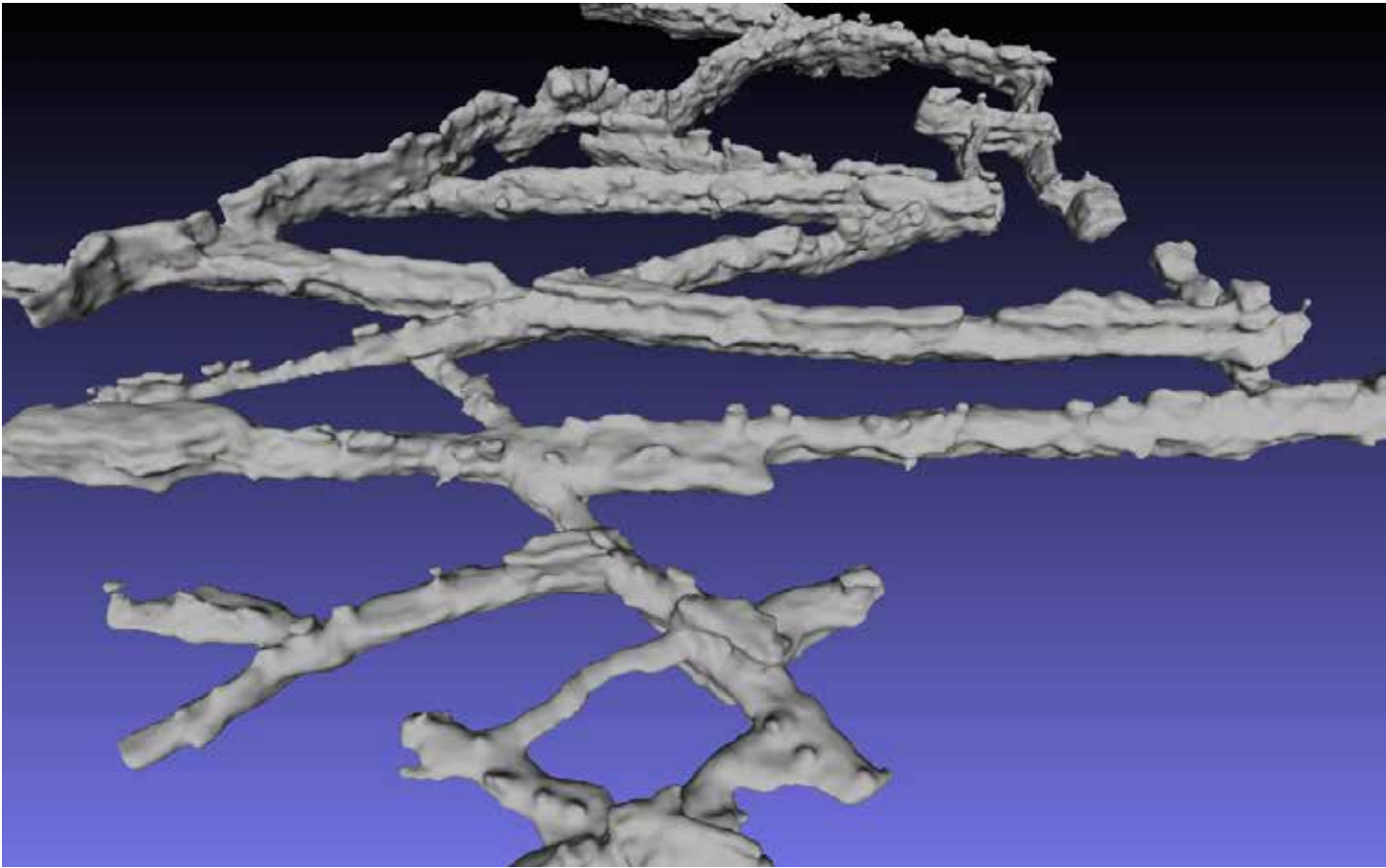
Although the design and software are now mostly complete, a lot of manual work is involved in assembling the Caveatron with some of the most time consuming labor being the wiring. We are currently preparing a printed circuit board layout that will combine most of the individual electronics modules onto one board, eliminating most of the wires. One more challenge

remaining to solve is to create a better front cover for the LIDAR that doesn't cut off as much of the corners as the current one. Five additional Caveatrons are currently being assembled to distribute for field trials. A webpage will be setup soon on the Texas Speleological Survey website with more information on the Caveatron including downloadable cave Model files. And of course there are lots of caves to get out and survey! My eventual goal is to not only figure out how to make these available to sell but also to open source the design so that anyone with the right skills can build their own.

Lots of people have helped out with this project so far. Steve Gutting has helped with the electronics design, has done most of the wiring and electronics component assembly, and is working on the circuit layout. Gregg Williams has helped with the enclosure design, has done most of the machining work and is currently preparing drawings for producing more. Gregg also printed the 3D cave Models. Jill Orr developed the icons for the user interface and Ellie Falgout developed a logo and originally came up with the Caveatron name. Many cavers have been involved in testing, most notably Evelyn Mitchell and Mike Harris. This project is for cavers, and I would like more cavers to be involved, so if you are interested in helping, please contact me at joemitchell@satx.rr.com.



Plastic model of Whirlpool Cave



Top: Oblique print of Robber Baron Cave. Bottom: 3D rendering of the Entrance Room in Robber Baron Cave

O-9 WELL SURVEY FINALE

By DJ Walker

February 6-8, 2015 David Ochel lead a trip to O-9 Well enlisting the assistance of only Andrea Croskrey and me (DJ Walker). Other than having a good time, the objective of the trip was to finish the survey of an upstream passage. This passage was the last segment required to complete David's survey project of the whole cave. The trip would include two firsts for me: this was my first trip to O-9, and my first survey trip.

The trip embarked Friday evening around 19:00. We stopped in Fredericksburg for dinner and continued toward Ozona, TX. As we careened Westward on I-10 a thick fog began to set in. By the time we reached the turn-off from pavement to the caliche road, all three of us were engaged in route finding. Despite the dense fog, we rolled into camp about 23:30, pitched our tents and retired for the night.

The morning sun was our alarm clock, and we began to stir. We prepared a highly nutritious breakfast of Ramen noodles, and enjoyed hot coffee courtesy of a Jet-boil.

John, the lessee of the property stopped by to say hi as our breakfast settled. After a brief conversation with John, the cave was rigged and we donned our gear. The passage we planned to survey has standing water and we had decided wetsuits were in order,

but we would carry them from the entrance to a junction room where we would reconfigure for the wet survey.

We rappelled the 40 m entrance pit which included a rebelay and a redirect, reaching the bottom of the entrance pit about 09:45. Though the downstream funhouse was calling, we started our progress upstream, passing through several pools of water, climbing over breakdown, and meandering through passages that started off as comfortable walking passage and reduced in size as we went, with several sections of belly crawling. We reached a junction room that opened up and contained the turn toward our intended survey. This junction room is where we had previously agreed we would reconfigure into our

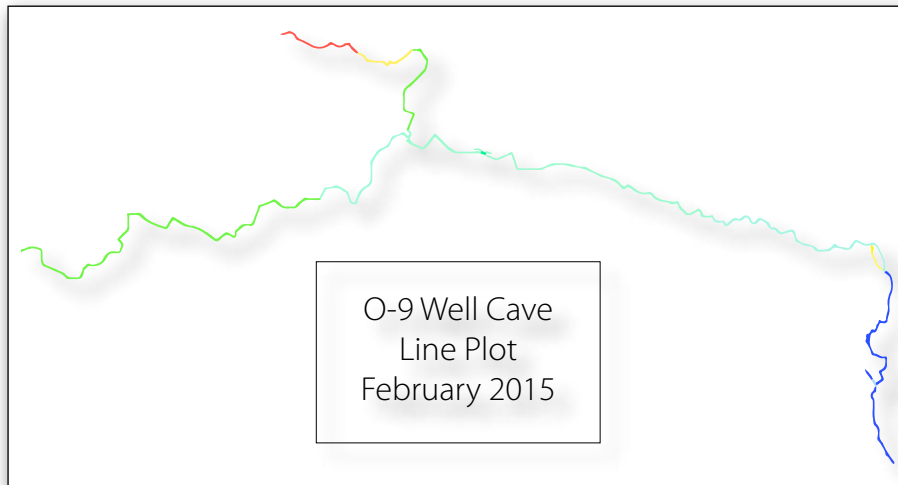
wetsuits. Once covered in an armored coat of neoprene, we ducked through a small opening into a passage that required hands and knees, or belly crawling through the mud until we reached the beginning of the survey. The last survey station was set in a small room at the beginning of a narrow, low passage named 'Perverts Alley'.

We were covered in mud and started surveying. This being my first survey trip, I took a few shots between the last two stations for comparison with the previous survey. It was a few degrees off, and after reshooting it a few times I managed to develop the desired accuracy within ± 2 degrees. David decided he would take lead on tape, Andrea would sketch, and I would read instruments. Perverts Alley was a belly crawl through water, mud, and sometimes rocky floor. I found it difficult to work the instruments without covering them in mud. How Andrea managed to collect data and sketch without destroying the note pad I will never know. With each shot we found the

passage continued. After four hours and 13 stations, it ended in a constriction and small impassable passage leading upward. This was a rather unexpected termination point, but welcomed after a somewhat difficult last few hours. This short paragraph poorly describes our team documenting

297' 90 m of survey that was a complete pain in the rear to obtain, even so, I enjoyed learning surveying very much.

We returned to the small room where the survey began and collected our belongings for the trip back to the junction room. Once there, David and Andrea ditched their wetsuits, but I decided to keep mine on. The larger passage between this room and the entrance was a welcome change. I rather enjoyed taking more time to look around and appreciate the structure of the cave. Once we were all back at the bottom of the entrance pit, the sun beckoned our return up. Andrea decided the warm, sunny forecast for the day sounded pretty good and headed to the surface. David and I continued on with our plan to



enjoy the lower part of the cave and visit the Mud Room.

As we left the entrance pit, I found myself swimming through pot holes and rappelling into large rooms with beautiful flowstone and rimstone dams. As I stated earlier, this was my first trip to O-9 Well. I have since surmised that this is the best Texas cave I have visited to date. I have been spending a lot of time in the TAG area the last few years, and O-9 ranks right up there with some TAG classics. Vertical wonderlands are my cup of tea, and O-9 Well with its six pitches from the surface to the bottom, filled my tea cup right up. We waded and swam through a little over a dozen rimstone pools. The pools ended with the water pouring over into the next pitch, a 20 m free hang rappel beside a very active flowstone waterfall with a rather large rock flake extending out from the wall and wrapping around the waterfall. It was spectacular. From the bottom of the waterfall we clambered through a small breakdown pile where we continued downward through a series of rappels and pools. This section of the cave reminded me of the canyon lands of Utah, minus the sun rays beaming in from the open top of a canyon. As I disconnected my micro rack from the last rappel, I turned around to find a large mud pile (hence the name "Mud Room") at the bottom of a 220' 67 m dome. David and I scrambled to the top and sat for a while, discussing various things and enjoying the beauty Mother Nature created.

Soon we started our ascent through the marvelous passages we had negotiated downward. One major advantage of doing the downstream trip was that it offered David and me the chance to wash off the mud that covered our gear and bodies. Before long we emerged from the cave to find night had fallen and the air to be brisk. A persistent breeze blew from the north west and as I stood on the surface, I shivered as the cold air blew across my wet body. I very quickly ditched the cold wetsuit and jumped into dry clothes. Ahh, the warmth was comforting. Andrea had planned a group meal of quesadillas and had chips and salsa spread out on the camp table. Soon there was guacamole to boot. She filled us in on the state of camp when she arrived from the cave. Evidently the cows who range the pasture where we set-up decided to stir the camp up a little. She found our table and various items strewn about, and they did a number on David and Andrea's tent, breaking one pole and bending several others. Things were patched up and would fare the night, but the damage was done. We spent a few hours eating mighty fine quesadillas, having a few beers, and enjoying each other's company. The sky was clear and stars abundant,

the Big Dipper standing up on end, handle pointing straight down and the North Star shining high and bright.

After a fitful night's sleep we packed up camp. During the drive toward Ozona we decided to have a late breakfast at a local café. As I stared at the menu full of traditional breakfast options, the enchilada plate on the dinner menu caught my eye. Who decides what food is breakfast and what is dinner anyway? I can make my own mind up about that - I had a plate of cheese enchiladas!! The rest of the trip to Austin was uneventful.

This trip was very enjoyable on many fronts. Spending time with David and Andrea was great. They are wonderful people and were willing to put up with me for the weekend! The art of surveying was fun and I very much appreciated David and Andrea sharing their experience with me and taking the time to teach me how to read instruments. I hope to continue to expand my survey skills, and imagine that only surveying in a slightly larger passage, not filled with muddy water could be even more enjoyable than it already was. O-9 is a fantastic cave and holds the beauty and challenge that draws many of us to caving and I look forward to my next trip there.



TEXARKANA CAVING

THE TALE OF A YEAR OF SHARED CAVING TRIPS BETWEEN TWO INTREPID GROTTOES AND HOW IT CAME ABOUT. THIS IS A COMPILATION OF THREE TRIPS BY THREE AUTHORS, AND TWO UNLIKELY GROTTOES FORMING A SPECIAL FRIENDSHIP.

HOW IT ALL BEGAN

by Jill Orr

In 2012 when I volunteered to be Trip Chair for my grotto, I had high aspirations of getting us into caves that were not commonly visited. I belong to the Bexar Grotto (BG) in San Antonio, and had only been caving for four years. There were plenty of local caves that I haven't visited, but I had a strong desire to create exciting, unique trips for my Grotto. And I had big shoes to fill from the example set by our previous Trip Chair, Joe Ranzau, who's two special trips took us to Bustamante in Mexico, and the The High Guads in New Mexico, as well as interesting local caves.

Asking around, I quickly learned however that it was virtually impossible to get us into the non-usual local caves. It wasn't looking good. But then I hit on an idea – maybe some non-Texas grottos would be interested in taking turns hosting trips with us. Wow! If it worked we could see caves we never would otherwise have access to! Where to inquire was the first step. It had to be a neighboring state, and I had already been to New Mexico. East then.

Even before I was a caver, I knew that Arkansas had caves. Arkansas was close (by Texas standards), and I had never been there; that was my criteria for searching for a willing grotto. I contacted the Boston Mountain Grotto (BMG) and my email was forwarded to their Trip Chair, Ashley Totten. I presented my idea to Ashley and offered for our grotto to host the first trip; it seemed only fair since I was asking them to let up to ten virtual strangers into their caves. Ashley told me later that they had debated the idea at their meetings and that it was my offer to host the first trip that really helped, but even better, BG member Ellie Falgout's best friend from childhood is BMG member Deitra Roberts. It was fated – the trips were on!

I offered Ashley several choices involving Deep n Punkin, Logan's, Honey Creek, and Robber Baron caves as we began trading e-mails with suggested dates and itineraries. We did this for almost three months before we finally spoke on the phone and then what

a shock! The person I had been imagining as girl all that time turned out to be a guy!!! An e-mail address containing the name 'ashole' should have been a clue.

The first trip.

The confirmed Arkansas number for that first planned spring trip to Texas ended up being only two, so we agreed to postpone it until December between Christmas and New Years. Bexar Grotto went on the 'BMG' trip anyway and, um, well – what happened at Deep n Punkin, stays at Deep n Punkin. It's better that way.

Now it was BG's 'turn' to visit Arkansas. The trip included BG members: Tom Flores, Randy Goldstein, Steve Gutting, April and Frank Hertzog, Bennett Lee, and Jill Orr. Driving into the campsite, we knew we were going to have a great time because a Texas flag bandana had been hung at the entrance to welcome us. Their campground is owned by cavers and has all the conveniences of a covered picnic area, wall-less cabin up a flight of stairs, central fire pit with benches, a protected hot tub, and an enclosed loo. Our Boston Mountain Grotto hosts were Ashley Totten, Scott Sutton, Chris Collins, Deitra Roberts, Brent Biely, Summer Biely, Don Locander, Kyle Moore, Derek Thompson, Meghan Gallo, and Joe Ray of the MOLES Grotto, hanger of the welcome flag.

We were shown two gorgeous and spacious caves over that weekend. The first cave required a 15 minute hike up a steep mountain trail of chert. At the entrance Ash split us into two groups: Adventurous, and Take-Your-Time cavers. Lead by Don Locande, the Adventurous group made a loop through the cave over challenging climbs, enormous rooms with lush flowstone formations, beautiful colors, and a large pond with an exquisite lily pad formation in the center. Nothing was wanting in that cave.

Leading the Take-Your-Time group enabled Ash to gain a new appreciation for the huge entrance room. He commented on how they normally blow past it to get to the back areas of the cave so he



Photo by Bennett Lee

The first Arkansas cave trip. Left group, clockwise from left: Chris Collins, Steve Gutting, Frank Hertzog, April Hertzog, Ashley Totten, Scott Sutton. Right group: Unknown caver, Jill Orr, Roc Pursley

had never before noticed how beautiful it was.

The difference between Arkansas and Texas caves was obvious immediately. The cavernous, chilly passages were more highly decorated than most of the warm, tight passages we are used to. We loved comparing Arkansas caver fashions with Texas. We dress for heat and grabby passages, they dress for cold, breezy rooms. Arkansans wear wildly colored thermal tights under cut-off Carhartts. I made sure to warn them they wouldn't need those in Texas. The BMG were fascinated over the camera gear that Bennett carries. It weighs almost as much as he does, and his camera's cave pack is almost four feet tall. Cavers all over Texas have learned to run away when they see him coming with his pack.

2012 MOLE LABOR DAY SUN-OFF

by Ellie Falgout

When my buddy Jill Orr was elected as Bexar Grotto Trip Chair, I could tell she had big plans and I wanted on board. She explained to me that she had been in touch

The second day, a much reduced group dropped into a vertical cave, and were awed again by huge borehole passage, smoothly sculpted layered walls, and stunning vistas. We don't have many vistas in Texas caves.

Scott Sutton cooked a delicious Sunday breakfast of bacon and eggs for the whole group, and we sat around trading caving stories just like back home. Afterwards, we helped clean up the camp ground and hung around with Joe Ray for a while longer. Saying good by with hugs and hand shakes, we left our new friends and headed home with fantastic memories and a new anticipation. The trip was so enjoyable for everyone that we were invited to come back to Arkansas for their Annual Labor Day Sun-Off Reunion weekend.

with some grottos in Arkansas to see if they had any interest in a sort of trip exchange where the Bexar Grotto would take them to some Texas caves in exchange for

a look at their local wonders. When Jill told me that she had contacted Boston Mountain Grotto in Arkansas, I was floored and exclaimed, “That’s my best friend’s grotto!”

My best friend Deitra Roberts and I grew up 20 minutes apart from each other in an area filled with caves. We both visited a few caves in our youth but neither of us grew up as cavers, or even knew they existed. Now we live a 12 hour drive from each other and are both cavers. When I fell in with the cavers in 2008, I instantly started bugging Deitra to get into caving with her local grotto. I had visited several fantastic caves in Texas & Mexico and wanted by best friend to experience the joy I get from caving and the caving community. To my excitement, she joined the NSS two years later!

If Jill’s grotto trip exchange idea panned out, I would get a chance for my San Antonio grotto buds to visit my best friend, meet her new caving friends, and visit some shiny Arkansas caves. Soon Jill told me they were on board with the idea. The stage was set and what would play out was a string of delightful trips between Bexar Grotto and Boston Mountain Grotto.

Texas was actually the first trip exchange destination and Jill had planned a full weekend of caving for our new friends but it didn’t pan out, so BMG hosted the first trip with Ash Totten as the Recreational Planner. That weekend a few lucky Texans got to visit a few of Arkansas cave treasures. The grotto fed and sheltered six Texans and lead them into the caves of the hill country. Unfortunately, I was unable to attend the first grotto trip to Arkansas but I enjoyed hearing stories from grotto members and seeing Bennett Lee’s trip photos and grotto presentation of the caves they visited. They seemed to hit it off and a cross-grotto relationship was formed.

With newfound connections, the Bexar Grotto

was invited to attend the 2012 MOLE Labor Day Sun-Off, a weekend dedicated to excessive caving and partying. Five Texan’s were able to hit the road to have a look at the Arkansas caves they had heard so much about. Bennett Lee was the only returning visitor from the first trip to Arkansas and Joe Schaertl, Tom Rogers, Galen Falgout and I were new converts excited to have some fun and see new caves. With cars loaded, our car of three cavers hit the road heading up through Louisiana planning to meet the two others in the hills of the Ozarks after our 989 mile drive.

We arrived to a lush campground along a river bend and walked around to announce “The Texans have arrived!” We were greeted by a super laid back group with the perfect mix of campfire, sauna, and good food. Evenings were spent relaxing under the stars by the river and days were spent caving in places we had never seen.

We explored two stunning Arkansas caves and knew we had come to the right place. The cave Jim Terry took us through on the first day was a joy to see. We were awed by the towering formations and river passage. Joe Ray led us through the second cave on day two. Still thrilled from the first day of caving, this cave presented us with another great time and cave formations we do not see often in Texas – walking through huge borehole passage we experienced endless formations. For some newer cavers, this was their first time to experience this larger scale of caves.

Caving with different grottos expanded our grotto’s cave scope. We got to see extravagant Arkansas caves and learn about different caving fashions like hot pants and “pigs”. It was great to hang out with new and old friends – and be reminded that cavers are a pretty good group the world over.

TEXAS BOUND – AT LAST!

by Ashley Totten

With full bellies from holiday feasting and a slight restlessness from cabin fever, myself and two other Arkansas cavers, Joe Ray and Chris Collins, set out the day after Christmas from Fayetteville Arkansas. We had our sights set on the greater San Antonio area and the karst hills beyond. 2012 had already seen the blossoming of a lovely inter-grotto relationship between the Boston Mountain Grotto and the Bexar Grotto of San Antonio. We greatly enjoyed hosting a gaggle of friendly Texas cavers on a couple of long weekends focused on sharing some of our greatest underground assets. So, we decided, with the year winding down and friendly relations already

solidified, that it was time to travel south and west and brave the sheer girth of the state of Texas to sample some of their hospitality and their underground playgrounds. Holiday obligations and untimely illnesses had pared our troop down to the above mentioned three, as well as Deitra Roberts, Brent Biely and Terry Mitchell who all wound their own paths towards Texas. Though few in number, all were excited to explore caves outside of our familiar Ozark Mountains, and a rendezvous was arranged at our Texas benefactor Jill Orr’s house in San Antonio.

The drive was long and the traffic bleak, but after an unseasonably cold night at a KAO campground we

arrived in San Antonio. After a brief stop at the Alamo to count bullet holes, we arrived at Jill's house where fellow Texas caver and photo-phenom Bennett Lee joined us. Though Joe Ray left us to visit his uncle for the afternoon, Deitra and Brent soon completed their own epic drive and joined us there, and we all piled into vehicles to drive a short distance out of San Antonio into the nearby limestone hills in search of Logan's Cave. With the AR cavers gawking at the desert karst landscape and the proliferation of excellent cacti, we arrived at the cave, geared up and ventured through the boxy gate to Logan's.

Arrival and Logan's Cave.

It was here, with glasses that had instantly fogged over, that I finally realized that I wasn't in Ar-Kansas anymore. The sheer heat of the cave (around 80 degrees) stood in stark contrast to the constant 59-60 degree temperatures of Arkansas caves. All else seemed to be in order though, with carbonate rock above and below and comfortable black voids occupying our peripheries. After defrosting my glasses, we set about exploring the highly grabby and grindy Logan's cave. With relatively few decorations, the main appeal of this cave was its challenging squeezes and climbs, many of which grabbed and ripped at our clothes and pads. I was extremely appreciative of my Joe Ray crafted knee pads/tank treads which had never failed me in equally abrasive Ozark caves. The cave trended downward in a corkscrew with periodic canyons cutting through the various horizontal levels that we traversed between climbs. As we worked the bodily kinks out from our long drive, we eventually ground down to a large room towards the bottom of the system where some leads were poked and some pictures were taken of Jill investigating a window squeeze in the chamber. Her efforts left only her legs visible as they dangled disconnectedly from the wall of the chamber. From there, a different, but no less squirrely route was taken to clamber back up to the entrance room to complete a nice little loop trip. Though only a three or so hour long trip, it was time to pile back into vehicles and make towards town so that Jill and Bennett could get prepared for the dinner party at Jill's which would bring our last remaining Arkansans and several more Texas cavers into the picture.

After returning to town and cleaning up, we settled into a nice evening at Jill's enjoying a fine potluck and various things with which to wash it down. Fellow Texas cavers Tom Florer and Joe Schaertl joined us along with Terry Mitchell, our illustrious president of the Boston Mountain grotto, who had just completed his own solo march from northwest Arkansas. We swapped lies for

several hours before retiring to various couches and air mattresses at Jill's or down the road at Bennett's.

Carta Valley.

In the morning, we parted from our Texans to allow them to wrap up their townly matters (i.e. prepping to cook us more awesome food). We set out with a GPS waypoint to help us wind our way west towards Carta Valley and the TCMA (Texas Cave Management Association) cabin that would be our desert abode for the next couple days. En route, we decided to make a stab at taking the guided tour at the Caverns of Sonora. Unfortunately our timing was bad for the tours and our jaunt only allowed us some bothersome vehicular interactions with a gaggle (or flock?) of pea-hens that apparently guard the grounds at Sonora. Undeterred, we set out again and soon abandoned pavement at Carta Valley, and found ourselves driving through the dusty cacti, wishing that we were bold enough to "bump" rather than manually open the numerous bump gates that blocked the road. This apparently allows trucks with cattle guards to ram a gate that will then swing open long enough for the truck to pass through (hopefully). Bump gate technology has not yet reached the Ozarks where cultural diffusion is generally accepted to be rather slow.

We were the first to arrive at the quiet little cabin in the desert and we set about exploring the grounds and settling in for the weekend. The cabin had all the amenities except for potable water and a flush toilet, but the view from the outhouse was well worth braving even the coldest morning toilet seat. The walls of the cabin are peppered with cave maps, pictures, and bumper stickers particularly geared to the lewdness and wit of cavers. The two bedrooms stacked to the ceiling with bunks adorned with various personalized engravings and hangings spoke to the fact that this cabin is clearly an oft used and much beloved coven for cavers.

After settling in for an hour or so, Jill and Bennett joined us at the cabin with bags and coolers filled to the brim with the weekend's food. The fridge was stuffed and a question was posed: to eat, then cave or cave, then eat. The answer to this order of operations question is of little import to you the reader, no doubt, but it did play out more significantly for the author as my delicious pre-cave spaghetti dinner ended up later in the front yard of the cabin (too much guano inhalation or perhaps too much inverted breakdown scrambling; I really didn't drink that much – I swear!). But I digress.

Just after dinner, Texas cavers Gregg Williams and Wade McDaniel arrived, but opted to settle in rather than

drop Punkin. Our BMG boss-man Terry, who was feeling a bit under the weather, opted to also hold down the fort (while digesting). As the darkness of the desert set in around us, the rest of us (2 Texans and 5 Arkansans) piled into Bennett's dad's massive diesel land yacht and plowed down a rutted and bouldery road that rivaled anything the secluded hills of the Ozarks can offer. Ten minutes later we were parked on a slab, geared up and walking the few hundred yards to the cave.

Punkin Cave.

Now, as Ozark cavers, most of us think pit; we think sinkhole. There's no sinkhole at Punkin. The flat slabs of stair-step limestone along the hill we were descending simply gave way to an open void that could easily swallow a wayward deer, a four-wheeler, or both. The pit was roughly 12 feet by 30 feet and the walls immediately belled out below the lip, giving rise to a massive chamber 50 feet below, strewn with boulders and doused in guano. The pit was well bolted, and by the light of a full moon, I dropped into the pit first. I was followed by Chris, Brent, Deitra, Joe Ray, Jill, and finally Bennett. Chris had just finished vertical training back in Arkansas and this was his first rappel in a cave. His training paid off as he continues to exist to this day. The bottom felt very much as I'd imagine an open air pit in Mexico would, with a photosynthetic ecosystem of lichens and mosses and a beautiful view of the sky with the full moon shining through the pit entrance. The floor of the pit was covered in magnificent paleo-dunes of bat guano that kicked up into clouds with every step.

Though Punkin appears to be a single dead bottom pit, the breakdown below continues for thousands of feet as it winds its way through and around the debris cone from the pit formation. Most of the group opted to poke around a little and then focus on either helping Bennett photograph the pit and the full moon above or climb the rope several times for practice. After Deitra found a way into the break down that looked better than the one Brent found (i.e. it didn't try to eat you and bury you with sand and guano); Jill, Chris, and I spent the next 45 minutes winding through the breakdown. The path trended down and was extremely squirmy and sandy. Often a wiggle down the next crack meant a mouthful of sand on the way back up. The way was not obvious and every next bend that we discovered tucked into the geologic jumble seemed more likely to peter out than continue. Many dead ends were found, but a room filled with the only bats seen that day marked our turn around point. We scrambled back up to the others and then up the rope. It was past 11pm and time to get back to

the cabin, meet the rest of the Texas cavers that were arriving and, more importantly, conserve our energy for the next day's underground destination: Deep Cave.

When the seven guano covered cavers returned, we found a cabin filled with the rest of the weekend's participants. Texas cavers Ellie Falgout, Galen Falgout, Tom Florer, Tom Rogers, and Joe Schaertl had arrived to compliment Terry, Gregg, and Wade, and the remainder of the evening was spent getting to know one another and drinking and swapping tales. Though my night was short lived (as mentioned above), many stayed up late looking at pictures on Bennett's computer, helping Chris with his design work for the new BMG logo and working to obliterate the sweets that Ellie had brought.

Deep Cave.

The morning dawned clear and cold, but most folks awoke early, looking at least slightly more motivated than hung-over. While throwing gear piles around, eating breakfast and caffeinating ourselves, our last Texas caver, Mike Harris arrived. We'd seen a picture of Mike inside the cabin grasping a beheaded body-length sized rattlesnake and we were all eager to meet the legend. With some burly handshakes and hugs from the Texas crew, Mike joined our ranks and after some man wrestling between Gregg, Wade, and Galen, we posed for a group picture and set out towards Deep Cave.

Our path took us past Punkin which was quite a bit more impressive by daylight, and after peaking into a second entrance that windowed out into the pit chamber below, we continued down the hill, across a small ravine and up the opposite hill to come upon Deep Cave. The entrance to Deep is a 10 foot long overhang sunk into solid bedrock and the cave sloped down quickly from there. However, the entrance was initially neglected as the Arkansas cavers were introduced to a Deep Cave tradition. Mere feet from the perfectly passable entrance to the cave lay another much smaller hole in the bedrock, slightly larger than Gregg's boot. Though Gregg wears a big boot, the hole was ridiculously small for a cave entrance and therefore had to be attempted. Ellie was the first to attempt the squeeze and she sunk her lower body through the hole but then lodged with her upper torso sticking up from the bedrock like a bizarre cactus. With the shedding of her pants on the second attempt, she was able to amazingly squeeze through the hole, drop into darkness and reappear from the real cave entrance wearing only a smile and underwear. Joe Ray was the next participant, and his small wiry frame passed almost effortlessly through the hole without the



Photo by Bennett Lee

Lunch break in the Helectite Room, Deep Cave.

shedding of clothes. Bennett and Brent also attempted the squeeze but Bennett was cut off at the waist despite disrobing and Brent's attempt fared only slightly better as his shoulders and chest lodged him in the bedrock. No one else attempted the squeeze after Brent, so we all took one last look at the desert sky and headed underground. The time was about noon, which was a good thing according to Gregg's proverb: "A gentleman never caves before noon."

The first thing that struck us aside from the wall of heat and humidity was a few scorpions lurking in the twilight zone amongst old chewed up formations. Apparently these are fairly common finds in Texas caves, along with occasional irritated porcupines; of which there were thankfully none today. The cave sloped down steeply

into a considerable room where some ailing mud steps aided us in winding down along the left wall of the room and into breakdown squeezes and climbs. Mike stopped to work on improving the mud steps, but the remaining 15 of us fanned out like a human accordion through the ensuing climbs and squeezes as we worked our way toward the Forest of Columns and then the Helectite Room.

The Forest of Columns is quite impressive, offering a view of dozens of large and beautiful stalagmites and columns that littered the steep slope we continued to navigate. As we worked our way down and through these giants, the opposite wall began to choke up with large swaths of highly irregular and chewed up helectites. We continued down alternating between scrambling over



Photo by Bennett Lee

Getting ready to head to Deep Cave. BMG and BG members, left to right back row: Terry Mitchell, Joe Ray, Galen Falgout, Ellie Falgout, Tom Florer, Brent Biely, Dietra Roberts, Wade McDaniel, Bennett Lee. Front row: Chris Collins, Ashley Totten, Tom Rogers, Jill Orr, Gregg Williams, Joe Sheartyl, Mike Harris

large breakdown blocks and darting through hands-and-knees tube passages until we arrived at an impressive bear claw mark on a muddy breakdown block. Both the presence of the bear and the large and ancient dripstone formations seemed out of place in a desert and bespoke of how different the climate of this region must have been thousands of years ago. From there we crossed the wonderfully and aptly named Bridge of Khazad-Dum (a perfect breakdown block bridge) and soon arrived at the Helectite room. As many of us shed sweaty layers (a permanently shirtless Tom Rogers being an exception), we waited for Bennett to catch up with all his camera gear; a process slowed by the fact that all the Texas cavers have learned to avoid Bennett and his ominous camera boxes lest they be drawn into Sherpa duty.

Lunch in the Helectite Room on a large breakdown block was not only comfortable, but also beautiful as the entire largely flat ceiling above us was covered with fine soda straws, thick with bizarre helectite protrusions.

We lounged in comfort and ate while Bennett and some reluctant helpers photographed the occasion. Group shots of various levels of seriousness were taken until Gregg's surprise mooning of the camera rendered the photographer disinterested and slightly disoriented.

After lunch, we backtracked across the bridge of Khazad-Dum and the Forest of Columns to take another passage that we'd passed on our way in. This passage continued to offer views of helectites and various mites and tights while scrambling in and out of breakdown towards the Crystal Waterfall. This feature dominated the end a crack we'd been traversing and was the prettiest and most lively flowstone formation we'd seen yet. White with a yellowish tint, it oozed over several tiers to block off the passage on the level we'd been traversing. However, a corkscrew around and through some more breakdown squeezes led to more passage and eventually to Gotham City, where we would spend about 45 minutes route finding. Terry, Tom Florer, Ellie, and Gregg called it a day at

the Crystal Waterfall, but the rest of us bumbled around in Gotham City where nearly every surface was covered with popcorn and small calcite spars, making movement difficult and route finding tedious. As the remaining Texas cavers fumed over being perplexed in a region they'd been through before, your humble author stood wedged in a ceiling canyon resting, unknowingly concealing the survey station that indicated the path they were searching for.

Though it took a while, Bennett finally scrambled over me to investigate the ceiling canyon and recognized the way on. With the route found, an upper level crawl yielded another sloping and popcorn encrusted room called the Metropolis. Here marked a junction between the high path to the recently discovered Butterscotch Room to the left and the route into the breakdown that would complete the loop back to the entrance on the right. We bid farewell to Galen and Joe Ray at this point as they started up towards the entrance. The rest of us pushed through an awkward back bender squeeze and into the Butterscotch Room where a large and dominant flowstone awed us with its delicious color of... well, butterscotch. This was truly the prettiest flowstone of the day. Furthermore, in an alcove below and offset from this room, an absolutely spectacular helectite menagerie lay waiting. From here, all but Bennett and Jill began the plod back to the entrance with glazed over eyes from crystalline overdose. Despite the pleas for help with holding flashes, the thought of surface air and cold beverages led us towards a sweaty and grueling exodus.

Though shorter overall (maybe), the completion of the loop offered utterly exhausting and hot crawls and scrambles that left my glasses and body fogged. All I remember distinctly was Chris' hell-bent goal of destroying the ridiculous Santa Claus t-shirt that he was wearing underneath his bib-overalls. He succeeded in this, but paid for it with a body-weight-halting-crotch-snap on a nasty little chert nob. Chris named the formation, but you'll have to ask him, as it won't be repeated here.

Aside from Jill and Bennett, our group was the last to exit for the day and after cooling ourselves in the evening air, we began our trek back up to the cabin. Along the way, Chris stepped off the trail to check how his chert-to-crotch interaction had worked out and the rest of the group somehow missed him as he then proceeded up to the cabin. Joe Schaertl and myself grew concerned enough when we'd arrived back at Bennett's truck that we walked all the way back to the cave in case he'd gotten lost or fainted from the shear gnarliness of his bludgeoned nether regions. Thankfully this wasn't the case and we found him happily one beer ahead of us back at the cabin.

As the first few beers settled on empty stomachs and the crowd grew restless at the cabin, Chris and Ellie and others rose to the occasion to piece the directions that Jill had passed on in the cave to begin the prep for our magnificent dinner of marinated pork loin, mashed potatoes with horseradish, and numerous other sides. Jill, using some form of karst-telepathy no doubt, dutifully aided despite still being underground a half-mile away. The dinner was fantastic and Jill and Bennett returned just in time to help finish and enjoy it.

From here the night progressed as many nights among cavers do; with glorious tales of underground adventures, good food, drink, camaraderie, and a fair share of silliness. Gregg brought forth his lethal "mandatory" moonshine and worked vigorously to persuade everyone to help him empty the massive and ornate stein. Though it took many expletives, I think he succeeded in getting everyone to help him in his quest. As a final treat after dinner, Bennett loaded pictures from this trip and several others into a massive and excellent slide show. The night continued, more lies were told, and laughs were had. Tables were walked on and bottles were emptied. Eventually, bodies were slowly deposited on bunks, couches, and in tents as our Texas adventure drew to a close.

In the morning, after a frantic cleaning effort that returned the cabin to the same state of its former cleanliness, we sadly bid our farewells to our new Texas friends. Hugs and handshakes were distributed and we all chatted about the success of our continued inter-grotto "sisterhood." We bounced dates and locations around for a 2013 rendezvous as well. With this in mind, we set out again through the desert with its bump gates and cacti, aiming for one last pass at Caverns of Sonora to see if we could convince the roaming pea hens to let us jump on a tour.

...Miles later, we had succeeded and were even more overloaded on calcite wonders. Sonora won't be described here, as I lack the words to describe such a beautiful cave. You'll have to see it for yourself. Sonora was the icing on our Texas Karst experience. But, as grand as a tour cave can be, nothing beats wild caving with new friends in strange places.

(Note: Ash modestly didn't mention that while in Texas, Joe Ray presented all of the Texas cavers who had caved with him in Arkansas with scarves that all the BMG grotto members wear. Thanks Joe Ray! Three years later, Texas cavers continue to visit the BMG, but we've yet to lure them back! - Jill Orr)

F.U.D. FOR FREEDOM

by Saj Zappitello

LADIES, THIS ARTICLE IS FOR YOU. GENTS, YOU ARE WELCOME TO READ IT TOO, BUT FAIR WARNING FOR GRAPHIC POTTY HUMOR. F.U.D. STANDS

FOR FEMININE URINATION DEVICE.

This is an honest review; I was not paid or compensated for this article, and brand names are mentioned solely for the reader's edification.

First, for background and entertainment value, my story: I was lucky enough to grow up camping, and as a result, I learned how to pee outside at a young age. Even as a child, especially as a child, I knew that the boys had it easier. They could pee without taking their pants off. They didn't have to hide behind something to pee – simply turned their backs. They could remain standing tall above the chiggers and poison ivy. Also, there's that whole writing in the snow thing (that's just cool). I was jealous, and honestly, being able to pee standing up has been a lifelong dream of mine. There is certainly an art to squat peeing in the woods. You should choose a secluded spot with a slight downhill slope, face downhill, target an absorbent patch of loose soil, hold your pants forward, keep your feet wide, and try not to rinse the dust off your boots -- or heck, it's sterile, go ahead and rinse your boots if you want to. Of course, the perfect pee spot is as elusive as the wily snipe. Then when I started caving, there entered a brand new challenge in my experiences of urinary composure...

peeing in a bottle. For years I used wide-mouthed collapsible nalgens. This was not a disaster, but not super satisfactory either. As a caver in Texas and Mexico originally, where the caves are warm and sometimes downright hot, jeans and a t-shirt are generally the beginner caver uniform. There are water caves, where we wear wetsuits, and no one pees in their wetsuit (right?). Well, really no one pees in their wetsuit when you are hours down a dry passage with no water in sight, and taking off your whole wetsuit to squat over a bottle involves grit and discomfort for the rest of the day (exponential grump factor). Expanding my caving experiences into new and colder climates included a new challenge... the cave suit. The cave suit is a one-piece overall style garment, and if you need to bare your bum to heed the call of nature, you have to spend a few minutes taking the whole thing down to your knees. Generally, warm polyester or wool garments are worn underneath and further complicate "alone time" while trying to relieve one's self.

As my caving career progressed, so had the technology of the feminine pee funnel. I decided that I had to have one; it was going to change my life... (eventually). The first pee funnel that I tried was the "Go-Girl". Flexible and compact it folds up into a tiny package, and tiny and compact seemed perfect for caving. I

practiced and practiced before a big cave trip. I felt like an expert. Then on the first day that I used it, it leaked completely, and I pissed my cave suit big time. The soft-sided silicone it was made of buckled, and I had trouble keeping my base layers out of the way. Luckily I had an expedition weight polypro on underneath to soak it all up. I proceeded to pretend everything was fine, and cave like a big girl (one who took her suit off to pee for the rest of the trip). I have since learned that many women cut the tip off of the "Go-Girl" to prevent backing up and flooding of the pants, and that they also take their pants off to use the darn contraption. The benefit at that point merely being that all of your pee ends up in the bottle, not in the cave, and not in your pants.

I came home with a new goal. Research the piss out of pee funnels and find one that would work in my cave suit and in my life while keeping my pants dry. I met a Slovenian woman who had cut the spout off of a plastic watering pitcher and sanded it smooth to use as a pee funnel. I was prepared to get this crafty, but I decided to check the internet for inspiration first. After my experience with the silicone collapse, I was sold on hard-sided rigid plastic funnels. These won't buckle under pressure, and they also push your pants out of the way. An additional benefit of the rigid-sided funnel is that



PStyle



Freshette



The Watering Can – a crafty alternative

you can use the back lip as a sort of squeegee to remove drips, then you just dry your funnel and carry on your merry adventurous way. (Backpacking tip: In my opinion, it is not nearly as gross to reuse material to dry your funnel as it is to reuse material to dry your delicates.)

My two favorite brands

#1 the PStyle: Don't be fooled by the open trough design, it works like a charm. The trough is sized just right and makes for easy cleaning. The rigid plastic pushes your pants out of the way, and the instructions are the best I've ever seen. As long as you can keep your pelvis upright, peeing in a bottle is a breeze (with no breeze on your bottom). Takes up a small amount of space, but not too much, and it is very lightweight. The price is right too. I usually find them for around \$12.

#2 the Freshette This is just as effective as the Pstyle, but twice the cost, usually around \$20. It is a little more challenging to dry and clean, since it's a closed funnel. The Freshette is shorter, which provides less clearance of the pants, but there is a tubing attachment that extends the end of the funnel to a reasonable length. This results in a slightly different

packing configuration than the PStyle, but overall a similar volume.

Other options

The Go-Girl: Pros – super light and compact, relatively cheap. Cons – caving in piss all day or having to take your pants off to pee. Remember to cut the tip off if you go for this option.

Do-it-yourself: Cut the spout off of a plastic watering pitcher and sand it to your preference.

Big-gulp cup: In a pinch, this is the queen of wide-mouth bottles, though you still have to take your pants off. I have gotten 1st hand reviews that this is a good option for using around camp when privacy is limited. For use in-cave, you also have to carry a lidded bottle and take a minute to perform the extra step of pouring your pee into the bottle for transport. The cup is bulkier than a funnel, but a cheap alternative when options are limited.

There are several brands that I have not personally tried or gotten 1st-hand reviews on, so feel free to explore whatever works for you. I have read positive online reviews about using a simple mechanic's funnel, but I prefer the contouring of a ladies' designed funnel.

Practicing at home before you flaunt your pee funnel skills in

public is a must. Always hold the funnel tightly against your body to prevent leakage, and make sure you position it correctly. It is also imperative to practice at home in a variety of clothing. Learn how to deal with blue jeans, elastic-waist pants, and coveralls. Did you know that the boys have to aim for the side of the commode to keep the water from splashing all over the place? They also usually learn the hard way: don't pee upwind. In the woods, similar advice applies as when you are squatting, look for an absorbent patch of ground, aim downhill, and watch out for your shoes! In the urban jungle, concrete splashes no matter if you are squatting or standing. I admit that I still get a little shy about blatantly peeing with my back to a crowd, and it does confuse some folks, but the freedom is unbeatable. I confused and embarrassed an international group of men at a unisex pee corner during one caving convention. My most recent achievement includes not only peeing successfully without taking my pants off, but I was able to pee without taking my vertical caving harness off... several men have confessed that they can't even do that! With my funnel in hand, I am no longer jealous of the boys because I can enjoy the perks of being a woman AND pee standing up!



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