CANYONS & CAVES

Issue No. 22
Autumn 2001

Canyons & Caves

A Newsletter from the Resources Stewardship & Science Division Carlsbad Caverns National Park

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Edited by Dale L. Pate
Thanks to Paula Bauer, Bill Bentley, Bridget Eisfeldt & Kelly Bridges

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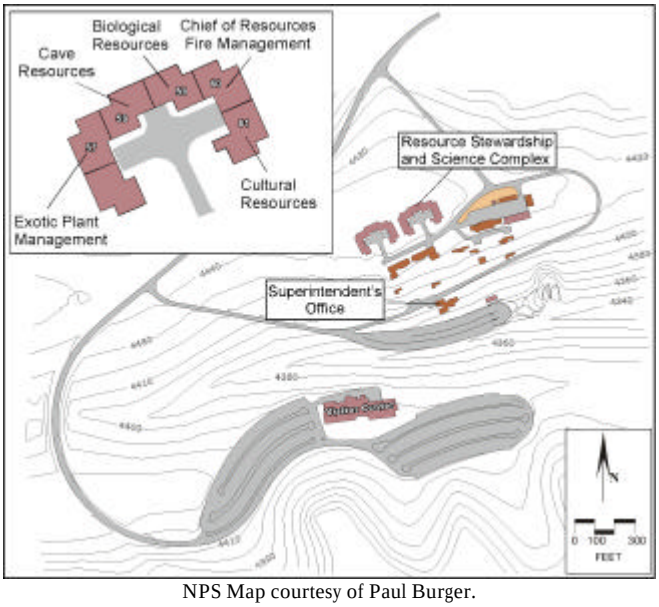
Cover Photo - A portion of Crystal Springs Dome in the Big Room of Carlsbad Cavern. NPS Photo by Dale L. Pate

Look for issues of *Canyons & Caves* at the following websites: http://www.nps.gov/cave/pub-pdf.htm Thanks to Kelly Thomas and Bridget Eisfeldt all issues can be downloaded as PDF files from the park website.
http://www.caver.net/ Once there, go to the *Canyons & Caves* icon. Bill Bentley has placed all issues on his personal website.

RESOURCE NEWS

THE LECHUGUILLA CAVE CULVERT PROJECT has finally been completed. Many thanks to all who helped with this project. The cave is once again open for approved scientific work, survey and exploration trips and the occasional management related trip. There are three approved survey expeditions planned for the remainder of 2001. The Cave Resources Office will lead one expedition the week of Nov. 4-10. Peter Bosted and Ray Keeler will lead one expedition the week of Dec. 1-8 and the Lechuguilla Exploration and Research Network (LEARN) will lead an expedition the week of Dec. 15-22.

DIVISION CHANGES - A number of changes have occurred within the Resource Management Division including a new name. The Division is now known as the Resources Stewardship & Science Division. It is composed of the Cultural Resources Office (moved over from the Interpretation and Visitor Services Division), the Fire Management Office, the Biological Resources Office, the Cave Resources Office and the Exotic Plant Management Team. Overseeing the Division is Chuck Barat as Chief and Amelia Tully continues to be administrative support. The Cave and Biological Resources Offices along with Chuck and Amelia's offices were located in the Superintendent's building, but have now moved up the slope to the north into recently vacated Mission 66 housing. The following map shows present office locations for the Division.



NPS Map courtesy of Paul Burger.

NEW CAVES IN THE PARK - Three new small caves have been discovered and surveyed within the last few months. This brings the total number of known caves in the park to 97.

REVEGETATION PROJECT - In the photo below, a landscape crew from HeadsUp Landscaping out of Albuquerque hand rakes in native seed, side oats gramma, sand dropseed and plains loveseed, and fertilizer along the route of the new water line. The first attempt reseeded approximately 70% of the area. This will hopefully complete this project.

(NPS Photo by Mark Bremer)

"TEMPORARY BUILDING" REMOVED - The "temporary building" (basically a double-wide trailer) that was placed behind the Visitor Center more than 10 years ago is gone. This rented structure served as office space and an employee

lunchroom for the Interpretation & Visitor Services Division. Office spaces have been moved into the vacated offices in the Superintendent's building and the employee lunchroom has been moved into the basement of the Visitor Center.

NOW YOU SEE IT! The "Temporary Building" on Sept. 21, 2001. (NPS Photo by Dale Pate)

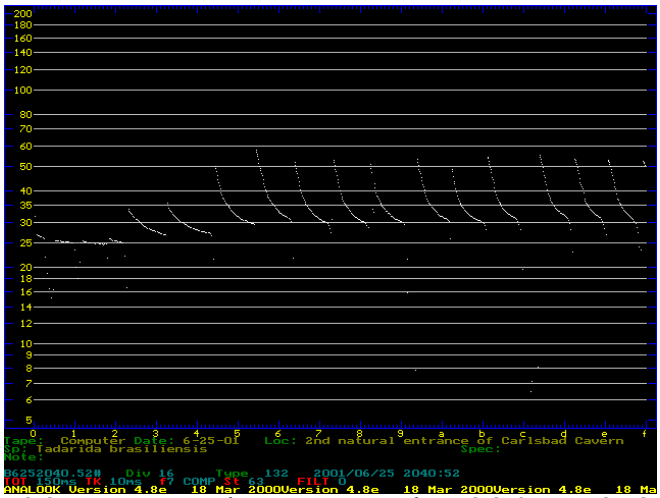
NOW YOU DON'T! Open space where the temporary building used to be. (NPS photo by Dale Pate taken on Oct. 13, 2001)

CORRECTION - The photo of cave crickets in the article titled "Cave Crickets" on page 8 of Canyons & Caves No. 20 was actually taken by Kathy Lavoie.

IDENTIFYING FLYING BATS

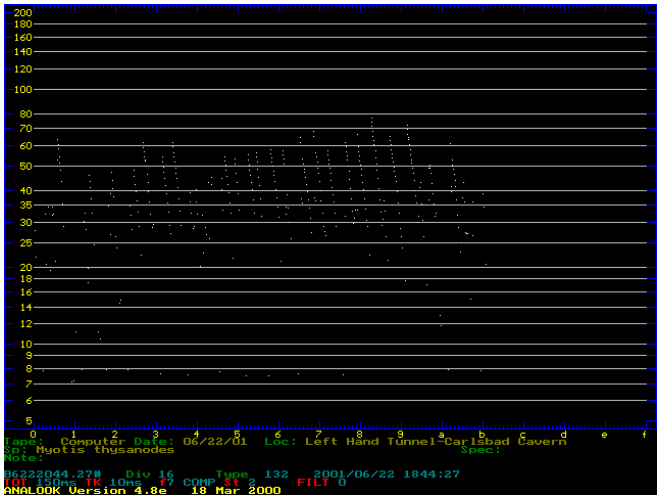
by Myra Barnes

Each night tens of thousands of bats emerge from Carlsbad Cavern. While more than 99.5% of the bats flying off to forage are Mexican Free-tailed bats (*Tadarida brasiliensis*) other species join them in the nightly spectacle. Previous research projects have shown that Fringed Myotis (*Myotis thysanodes)* and Cave Myotis (*Myotis velifer)* roost in Left Hand Tunnel. However, it has been difficult to determine how many bats of each species use this area of the cave. As we learn more about bats at Carlsbad, new questions arise. Do all of the bats in Left Hand Tunnel roost together? Do both species of Myotis fly out together? Do they fly out with the Mexican Free-tailed bats or wait until later? With the Anabat bat detector, we are able to answer some of these questions with minimal disturbance to the bats.

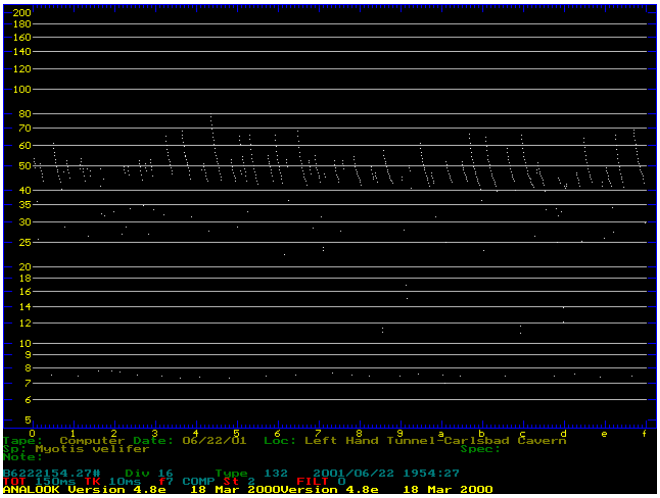


Echolocation patterns from a Mexican free-tailed bat (*Tadarida brasiliensis)* at the Second Natural Entrance of Carlsbad Cavern.

Using the Anabat with a laptop computer, echolocation patterns can be observed on the computer screen as the bat flies using echolocation. Patterns can be differentiated visually in real time and recorded for future reference. The three bat species known to roost in Carlsbad Cavern, Mexican Free-tails, Fringed Myotis and Cave Myotis, have echolocation patterns that are easily differentiated from each other. The call of the Free-tail is nearly horizontal, in the 25-30 KHz range, while searching for prey. During pursuit of an insect, the call is more vertical and ranges from 25-40 or 25-50 KHz. The Mexican Free-tailed bat is the only bat in this area that has this horizontal search call followed by a vertical pursuit call. The Cave Myotis call ranges from 40-60 KHz and the Fringed Myotis call is 25-60 or 70 KHz. Therefore, the three bat species known to roost in Carlsbad Cavern are easy to tell apart by echolocation pattern.

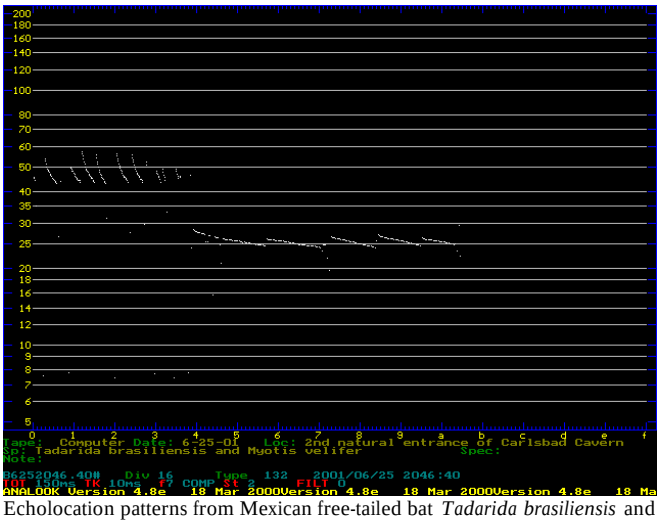


Echolocation patterns from Fringed myotis *Myotis thysanodes* in Left Hand Tunnel.



Echolocation patterns from Cave myotis *Myotis velifer* in Left Hand Tunnel.

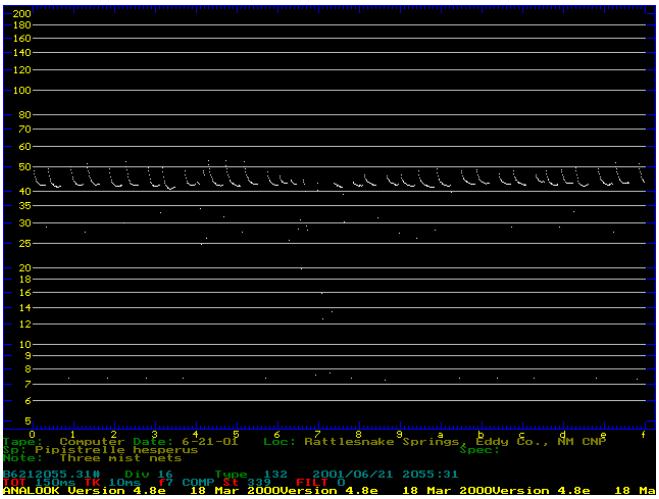
By using infrared video with the Anabat bat detector, we were able to estimate the number of Fringed and Cave Myotis entering the Underground Lunchroom from Left Hand Tunnel for the flight out of the cave. Simultaneous use of the Anabat for species identification and infrared video for counting, allows a population estimate that is usually accurate to within 10%. The Cave Myotis start flying out earlier than the Fringed Myotis with the Fringed Myotis joining in the last fifteen minutes of the dispersal flight. During the week following the Anabat surveys, Dr. Kenneth Geluso investigated the known roost areas for the Myotis species in Left Hand Tunnel. However, he was not able to account for the number of bats counted with the Anabat and video survey in the roosts he observed. Jason Richards said he thought there were some bats using the Right Hand Fork of Left Hand Tunnel. On the following night, around one hundred Cave Myotis and a small number of Fringed Myotis were observed and recorded with the Anabat in Right Hand Fork.



Echolocation patterns from Mexican free-tailed bat *Tadarida brasiliensis* and Cave myotis *Myotis velifer* emerging from Second Natural Entrance.

With the large number of Free-tailed bats flying out of the Natural Entrance, it would be impossible to pick out echolocation calls of other species in the presence of thousands of overlapping calls. However, usually only 200-300 bats fly out of the Second Natural Entrance. Using infrared video and Anabat, we determined that all three species emerged from the Second Natural Entrance together. Since this does not account for all of the bats roosting in Left Hand Tunnel, some of the Myotis apparently also use the main Natural Entrance. While most of the Free-tails use the main Natural Entrance, some also leave by the Second Natural Entrance.

During the late summer, observant interpreters reported two species of bats flying in the afternoon in the twilight zone of Carlsbad Cavern. One species is clearly smaller than the other. Are these afternoon foraging bats two of the known species roosting in the cave? Could they be young Free-tails getting additional exercise and food before their migratory flights to winter roosts? Capturing one of these high-flying bats during the daytime would be nearly impossible. However, echolocation patterns could be observed and recorded with the Anabat. The backwards J-shaped 40-50 KHz pattern obviously didn't come from a Myotis or Free-tailed bat. The small bat was a Western Pipistrelle. While they were common at Rattlesnake Springs earlier in the summer, they were not observed in Carlsbad Cavern. Whether they were overlooked in previous bat research or if they only use the Cavern in the late summer is not known. Pallid bats have been observed drinking from Devil's Spring in the late summer. With every new discovery, new questions arise.



Echolocation patterns of Western pipistrelle *Pipistrellus hesperus* at Rattlesnake Springs.

Bat echolocation patterns recorded at Carlsbad Caverns and echolocation audio recordings are currently available to those with access to Carlsbad Cavern's computer network. In the future, we plan to put some of these echolocation patterns and recordings on our website for those outside the park.

BELL CANOPIES

by Stan Allison

Bell canopies are present within numerous caves of Carlsbad Caverns National Park and the Guadalupe Mountains. An example of a bell canopy along a tour route is the bell canopy in the Christmas Tree Room in Slaughter Canyon Cave (Sorry, we don't have a photo of it at this time). Other notable

bell canopies in the park include the Mushroom in Slaughter Canyon Cave, the Liberty Bell in Lechuguilla Cave and Snoopy in Ogle Cave. The classic bell canopy is a mushroom or bell shaped feature that is attached to the vertical side of a stalagmite or a column.

The Mushroom in Slaughter Canyon Cave. This picture shows a large bell canopy with several smaller ones below. (Photo courtesy Ed McCarthy)

Bell canopies were first documented by Ko Hung in the Chinese record Pao Phu Tzu in around 300AD. In 1949 J.H. Bretz identified the bell canopy form, but incorrectly thought that they were formed on the surface of standing water like shelfstone. Later in 1954, D.M. Black came up with the currently accepted formation theory. Carol Hill expanded upon Blacks theory by correlating the extensive bell canopies found within caves of the Guadalupe Mountains with high evaporation rates.

Bell canopies tend to form in areas with high evaporation rates such as are found in the entrance areas of caves in the Guadalupe Mountains. These generally large entrances provide a portal for dry desert air to increase evaporation in certain areas. The bell canopy begins as a thin sheet of calcite-laden water flowing over the vertical side of a stalagmite, column or bedrock wall. As the water flows down the vertical side it deposits calcite in a thin layer of flowstone. However due to the high evaporation rates the water does not make its way along the vertical side to the floor. Instead the evaporation of the thin layer of water causes the calcite to be deposited in one area that produces the lateral or outward growth of a bell canopy (see diagram 1).

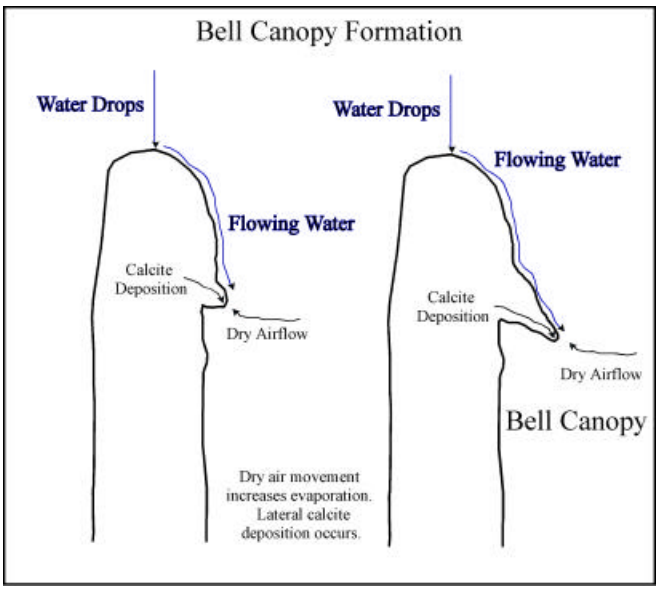


Diagram 1 - How Bell Canopies Form.

Not all bell canopies appear bell shaped. Some such as "Snoopy" in Ogle Cave have been modified by the later increase of water flow, which overpowers the evaporation and

The Liberty Bell in Lechuguilla Cave. Photo © Doug Warner.

thus deposits calcite along the entire vertical surface obscuring the original bell shape. Bell Canopies are only one form of flowstone canopies. Another form is the clastic canopy where calcite is deposited in a flat layer on sediments. These sediments are later washed away leaving a hanging, flat surface of calcite. Clastic canopies have a flat, planar lower surface, whereas bell canopies lower surfaces are usually not so flat.

REFERENCE: Hill, Carol and Paolo Forti. 1997. *Cave Minerals of the World, Second Edition*. 463 pp.

TRAIL MARKERS AT CARLSBAD CAVERNS NATIONAL PARK

by Tom Bemis & Dale Pate

Trail marking systems have been used in Carlsbad Cavern since its early exploration days. These marking systems were used for various reasons and have changed greatly throughout the years. Early explorers often left smoke marks on the cave walls to guide their way out. Other early accounts claim that explorers used the points of broken formations or the necks of empty bottles to point them to the entrance. As traffic increased in the cavern, some routes became well enough worn that no additional markers were needed. This had the unfortunate side effect, however of creating a jumble of worn paths throughout the cave, many paralleling each other. In addition, frequently missed turns quickly turned into well-worn paths leading nowhere.

Floor areas throughout Carlsbad Cavern (and most other caves in the Guadalupe Mountains) have seen lots of damage due to no one trail being designated for use. This photo taken in Lower Cave shows multiple trails over a capstone layer. The flagging to the left has only limited where people should walk since the mid 1990's. (NPS Photo by Tom Bemis)

One route marking technique, retired about a decade ago, utilized aluminum tags with reflective tape attached. One side of the tag, marked with green tape, indicated the route in; the other side. marked with red tape, indicated the route out. These tags were normally placed where one would just be visible from the next. These markers gave no indication of where one should step while traveling between markers. This led to very broad, well beaten "elephant trails" throughout the cavern.

The system now in use at the cavern utilizes surveyor's flagging tape to mark trails and other critical features. One of the main benefits for using flagging tape in this manner is that it is very noticeable and instantly conveys information to the cave visitor. Main routes through the caves of the park (trade routes) are flagged with double lines of **fluorescent orange** flagging tape with the understanding that one does not step outside of the flagged area (bright red tape was used in the early 1990's and may still be found in a few places). While this results in very heavy impact to a relatively small area within the flagging, the impact to the remainder of the cave floor remains relatively low. Keeping people to one trail helps protect untrammeled areas as well as gives areas that have been impacted time to recover. While the impacted floors can never return to what they originally were, over a long period of time they can begin the process of healing and allow natural processes to once again take over.

Double flagging a trail limits impacts to a small area and allows natural processes to return to impacted areas off the trail. (NPS Photo by Tom Bemis)

Other colors of flagging tape that are utilized are as follows: **Red and white** striped flagging is used to indicate to the visitor to use caution, either sensitive or delicate features or something dangerous such as a drop off is nearby. **Blue** flagging is used to denote a current survey station. **Blue and white** striped tape indicates a lead (passages that have not been explored or surveyed). **Orange and black** denote a science station. **Pink and black** indicate bones or other science related delicate features. Other colors of tape may have been used at times for various reasons, but will eventually be removed or replaced with one of these official colors.

The use of surveyor's flagging tape to delineate trails in caves of the park began in the late 1980's in Lechuguilla Cave. It was quickly recognized as a valuable tool to help protect other caves as well. By the early to mid 1990's, flagging tape was being utilized in Carlsbad Cavern, Slaughter Canyon Cave as well as other park caves. It became important to make sure

that everyone entering the caves knew about and understood the park's cave trail marking system.

Red & white striped flagging indicates to use caution around these fairly large, cemented cave pearls in Lower Cave, Carlsbad Cavern. (NPS Photo by Tom Bemis)

Confusion and damage can arise when flagging plans are not well communicated. For example, Wind and Jewel Caves in South Dakota use different colors of flagging to mark different trails than in the park's caves. Blue & white flagging is used to designate delicate areas in Wind and Jewel, while in Lechuguilla Cave blue & white flagging indicates unchecked leads. One can imagine the damage that could be done if a Lechuguilla Caver went into Jewel and didn't know the difference.

Surveyor's flagging tape is being used throughout many caves of the park to help protect cave features while conveying information to the cave visitor (whether scientist, caver or employee). Trail markers used in the past were mostly to help keep anyone from becoming lost or confused. While this still applies to the trail marking system today, its real importance is to help protect cave features while still allowing approved access to different areas.

THE GYPSUM KARST PLAIN AND THE CASTILE FORMATION

by Jason M. Richards

The prevalent landform in southeastern New Mexico is a vast karst plain consisting of mostly gypsum from the Castile Formation and equivalent formations. This karst plain stretches from Vaughn, New Mexico, south through Roswell and into Texas. When viewed from the air this karst landform looks like pockmarked bomb craters. Marjorie M. Sweeting in her book “Karst Landforms” describes the word karst as probably of pre-indo-European origin and originally denoting bare, stony ground. Characteristics of karst include vertical and underground drainage. Surface features include sinks, sinkholes, swallets, blind canyons and, of course, caves.

Example of vertical drainage. This surface drainage hole is 12-inches in diameter. NPS photo by Jason Richards.

Near the end of the Permian Period (about 230 million years ago), the marine conditions of the Delaware Basin drastically changed. The encircling growth of the Capitan reef restricted the basin to such an extent that evaporites of the Castile and Salado Formations (salt overlies gypsum from the Castile Formation in a different formation called the Salado) completely filled the basin and buried the reef complex. Uplift of the land during the late Tertiary Period (possibly beginning as early as 25 million years ago) along with subsequent erosion removed the soft evaporites from the Guadalupe escarpment. The Castile Formation fills the Delaware Basin and covers approximately 2600 square kilometers of southeastern New Mexico and West Texas.

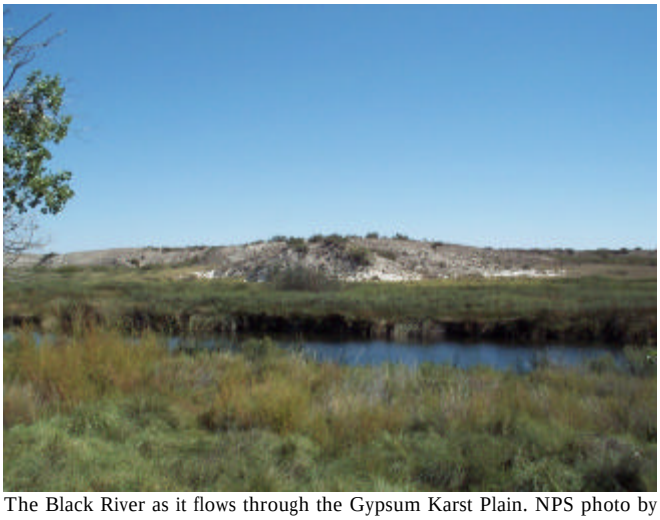
The Castile Formation was named by G. B. Richardson, a geologist that was working for the United States Geological Survey (USGS) in 1904. It is thought that Richardson named the Formation because of the resemblance the gypsum had to the soap cowboys and ranchers used for bathing.

While there are no known caves in the Castile formation on Carlsbad Caverns National Park, there are numerous caves located on adjacent Bureau of Land Management (BLM) land. Park’s Ranch Cave is a well-known cave that is formed in the Castile Formation. The number of gypsum caves south and east of the town of Carlsbad is staggering. It is not difficult to find a cave in this area that has never been entered by man.... entry by rattlesnakes, skunks and porcupines may be a different story. Questions concerning caves located on BLM land can be directed to Jim Goodbar in the local Carlsbad office at 505/234-5929.

Large sinkholes (sinks with cave entrances) may drain very large surface areas. Park's Ranch Cave is a good example of this type of cave. If there is a threat of rain, flooding can be a real possibility. It’s actually a good plan or perhaps just good common sense to avoid entering these types of caves during inclement weather.

Typical sink with a cave entrance. NPS photo by Jason Richards.

The Black River is also located in the Delaware Basin and flows through this gypsum karst plain. Caves that have formed around the Black River are also connected via underground water conduits to the Black River and some of its tributaries. Because of karst characteristics, large springs feed water to the Black River only to disappear into cracks and fissures leaving the riverbed dry. Further downstream, this water re- emerges once again. Less than ½-mile east of the Black River are water filled sinkholes that are probably part of this same underground conduit system.



The Black River as it flows through the Gypsum Karst Plain. NPS photo by Jason Richards.

A water-filled sink ½ mile east of the Black River. Note the Guadalupe escarpment in the background. NPS photo by Jason Richards.

The Gypsum Karst Plain is a neighbor of the Guadalupe Mountains and Carlsbad Caverns National Park and a very interesting area to explore, especially in the fall or early spring. The caves on the karst plain should never be entered by a novice caver and absolutely never when rain clouds are present. Rattlesnakes and other unpleasant creatures are fond of gypsum caves... beware!

References:

Hill, Carol. 1996. *Geology of the Delaware Basin Guadalupe, Apache, and Glass Mountains New Mexico and West Texas.* Permian Basin Section-SEPM, Publication No. 96-39, 480 pp.

Sweeting, Marjorie M. 1973. *Karst Landforms.* Columbia University Press, New York. 362 pp.

Consultation with Paul Burger, Carlsbad Caverns National Park Hydrologist