Carlsbad Caverns National Park
Carlsbad, New Mexico

National Park Service
U.S. Department of the Interior

CANYONS & CAVES

A Newsletter from the Resources Stewardship & Science Division

Issue No. 38 **Winter 2008**

A bobcat strolls across the yard at the historic residence at Rattlesnake Springs while attentive turkeys move in the opposite direction. Photo taken on Sunday morning, December 14, 2008 by Jan Lemons.

Compiled and produced by Dale L. Pate
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All issues can be downloaded as a PDF file from the park website
http://www.nps.gov/cave/planyourvisit/brochures.htm
Address: 3225 National Parks Highway, Carlsbad, New Mexico 88220

RESOURCE NEWS

CANYONS & CAVES – After a 3 ½ year hiatus, this popular Division newsletter is back. Begun in Spring 1996, this publication was produced through Summer 2005 to provide accurate, up-to-date information on resource management activities and other events relevant to the park through the Resources Management and Visitor Protection Division (RM&VP). In 1996, the RM&VP Division was split into two separate divisions; the Visitor Protection Division and the Resources Stewardship & Science (RS&S) Division. All past issues of *Canyons & Caves* (37 of them) can be downloaded as .pdf files from the park's website in the following location:

http://www.nps.gov/cave/planyourvisit/brochures.htm

Initially begun in 1995 as a newsletter from the Cave Resources Office titled *Carlsbad Cavern Underground*, Gary Vequist, RM&VP Division Chief understood its potential value and asked that the newsletter be expanded to include activities from the entire Division. Thus, Canyons & Caves came into being as a quarterly newsletter. If you want to receive notification that future newsletters are available to be downloaded from the park website, please let the editor know at the following email address: dale_pate@nps.gov

TOTAL NUMBER OF CAVES IN PARK – Since last reported in Canyons & Caves Spring 2005 (Issue No. 36), two more caves have been documented in the park's backcountry bringing the total number of caves to 113.

PROJECT UPDATES

NEW OUTFALL SEWER LINE – Summer 2008 saw the completion of the new outfall sewer line for the park from the Visitor Center down to the sewage lagoons. Included in this project was a new pump and line from the restrooms in Bat Cave Draw up to the Visitor Center as well. This new line is double-walled within the limestone areas and runs south from the Visitor Center under the eastern parking lot as a buried line. At the escarpment's edge, the new line was brought to the surface and run down the escarpment mounted on pillars for stability. Once off the escarpment, the line becomes a single-walled pipe and is buried once again along the edge of the existing roadway to the sewage lagoons. New liners were also installed in these lagoons.

The completion in the summer of 2008 of a new double-walled outfall sewer line from the Visitor Center to sewage lagoons off the escarpment is a major milestone in the long-term protection of Carlsbad Cavern. (NPS Photo by Dale Pate)

This new line replaces the old outfall line that led east from the Visitor Center as a buried line running for the distance of about 1 mile directly over most of Left-hand Tunnel before turning south and heading down the escarpment to the lagoons. Numerous leaks and overflows were documented from this aging outfall system. The new line will provide much better protection for the long-term health of Carlsbad Cavern.

IMPROVED VISITOR CENTER – Long awaited, the rehabilitation of the Visitor Center was finally completed in the Summer of 2008. This project addresses a number of issues and provides better service to the park visitor including restrooms that are located outside the main building near the front doors. Despite the new restrooms and a few other minor additions, the overall footprint of the building and its associated sidewalks is less than that encompassed by the old structure.

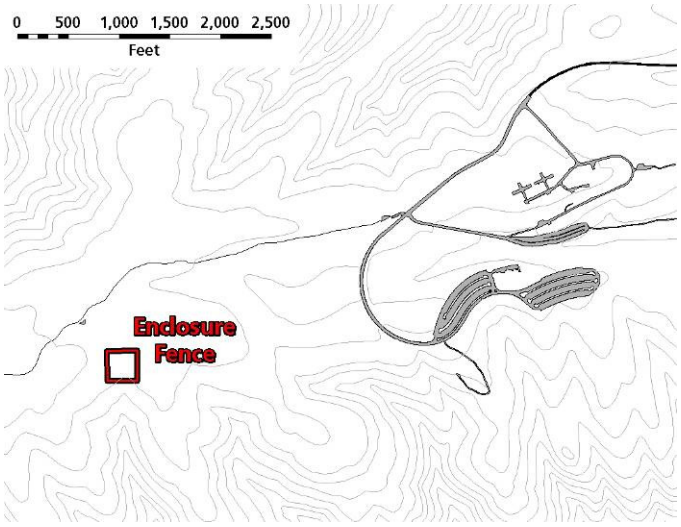
A large array of solar panels marks the main entry into the newly renovated Visitor Center. (NPS photo by Stan Allison)

PARK HAS A NEW CONCESSIONAIRE – The Carlsbad Caverns Trading Company (CCTC) became the park's new concessionaire following a bid process completed in 2007. CCTC can be found in the newly renovated west end of the Visitor Center. Along with a restaurant and gift shop, CCTC will also continue to provide minimal services in the lunchroom area of Carlsbad Cavern. Many of the current structures in this area of the cave will be removed in the coming months as they redesign and rebuild the minimum infrastructure needed to accommodate visitors while maintaining a cave-like environment. The park is looking forward to working with this new concessionaire as changing times bring new ways of providing key services to visitors.

After about 80 years of service, Cavern Supply will no longer be the concessionaire for the park. Beginning around 1928, Cavern Supply provided food service in Carlsbad Cavern before the elevators were installed in 1930. They also provided food service and gift sales in a restaurant and gift shop in a building near the natural entrance until the late 1950's. With the completion at that time of a new Visitor Center built around the elevator shafts, Cavern Supply moved into a larger space and continued to serve as an integral part of the visitor experience to Carlsbad Cavern. The old Cavern Supply building was then demolished. The current bat flight restrooms are now located where this older building had been.

From the time when this was Carlsbad Cave National Monument through to the present, Cavern Supply served a vital function and was instrumental in providing key services for visitors to Carlsbad Cavern .Their long-term commitment to the cave, the park, and the local community has been monumental and they leave a legacy that will be hard to follow.

FENCED ENCLOSURE REMOVED – A large 300 feet long by 300 feet wide and 6 feet high fenced enclosure that was located south of the Loop Road and about 4,000 feet west of the Visitor Center has been removed. This structure which was located in designated wilderness was one of several structures that have been identified as unnecessary and slated for removal.



Location of Loop Road Enclosure that was removed in the summer of 2008. Map provided by Peter Lindstrom.

This enclosure along the Loop Road was removed during the summer of 2008 by members of the Youth Conservation Corps led by former Roads and Trails supervisor Jimmy Sillas.

Stan Allison checks the lock on the gate into the fenced enclosure along the Loop Road. (NPS Photo by Dale Pate)

Other structures still slated for removal are as follows: (1) another fenced enclosure (also within designated wilderness) 300 wide, 600 feet long and 6 feet high which is located on top of Yucca Mesa; (2) Putman Cabin – a small deteriorating wooden structure located just outside designated wilderness on the western edge of the park; and the (3) horse corral located near the end of the Loop Road. We are hoping to remove the remaining enclosure and the horse corral during the summer of 2009.

CAVE EXPLORATION & SURVEY UPDATES

Stan Allison

CARLSBAD CAVERN

Exploration and survey continue at a steady rate in Carlsbad Cavern. The resurveyed length of Carlsbad Cavern is currently 28.3 miles or 45, 538.1 meters. The official length of Carlsbad Cavern is 30.9 miles which is the length identified from the old cave survey. The old survey data contained redundant surveys that created an artificially high length statistic. 0.75 miles of new survey was accomplished in 2008.

The Cave Research Foundation (CRF) finished the majority of the survey in the Lower Cave area in 2007, leaving only a few small leads still to be surveyed. Total length of this area is 4.85 miles. The resurvey of Lower Cave began in 1996. After finishing the Lower Cave area, CRF began surveying in the New Section of Carlsbad Cavern located east of the Hall of the White Giant.

In 2007 Dan Montoya and crew completed their resurvey of the F-Fissure in the New Section. They have since moved on to surveying an area called the Grand Ballroom located under the Guadalupe Room.

LECHUGUILLA CAVE

The survey length of Lechuguilla Cave is now up over 125.2 miles or 202,010.1 meters. Several recent exploration and survey trips have been completed and the overall length could change once the database has been updated. In 2008 eight survey and exploration expeditions were undertaken.

John Lyles in Northern Lights area of the Far East.
(Photo © Andy Armstrong)

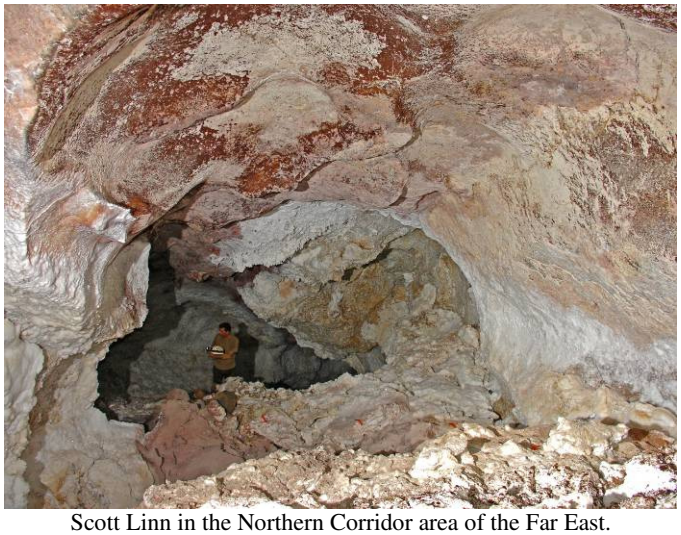
Highlights of recent explorations include the discovery of the Emerald City area on the Peter Bosted and John Lyles expedition in November 2007. This area was discovered via a small crawl near the Sewing Room in the Western Branch of the cave. The name is derived from the discovery of an unidentified green mineral associated with gypsum. One of the better leads left for a future expedition was the discovery

of a 230 foot high dome. The Emerald City discovery fills in a blank section of the map south of Hudson Bay.

In January 2008, participants in the John Lyles expedition made a significant discovery in the Far East section of the cave. Once again a tight lead was pushed to a new area which was named the Northeast Corridor. Large passages led to the base of a 170 foot high dome that was left as an exciting climbing lead. Selenite chandeliers were also discovered in this area. Prior to this discovery, no chandeliers were known from the Eastern Branch of the cave even though the Southwest and Western Branches contain numerous large chandeliers.

Lechuguilla Cave passed 200 kilometers of survey on the May 2008 Peter Bosted and John Lyles expedition.

In July 2008 an unfortunate accident occurred above the Chandelier Ballroom when a climber trying to access a high passage via technical climbing fell approximately six feet and suffered a compound fractured forearm. The climber's teammates responded extremely well and were able to perform a self-rescue of the caver in less than 14 hours. Self-rescue enabled the injured caver to exit the cave much more quickly than a full carry-out rescue and also greatly reduced impact to the cave that a full rescue would have caused. Several lessons were learned from the accident that can be used to prevent future accidents. The main lesson learned was not to underestimate the seriousness of a ground fall when beginning a technical climb.



Scott Linn in the Northern Corridor area of the Far East.
(Photo © Brian Kendrick)

The quadrangle maps of Lechuguilla Cave were updated in 2007. Copies of these quadrangles can be obtained by those performing research and survey in Lechuguilla Cave by contacting Stan Allison, Cave Technician or Paul Burger, Park Hydrologist/Geologist.

You can find more information on Lechuguilla Cave in the park-generated *Lechuguilla Newsletter* which can be found at: **http://www.nps.gov/cave/planyourvisit/brochures.htm**

SLAUGHTER CANYON CAVE

The first known map of Slaughter Canyon Cave (SCC) was a sketch map by Robert Nymeyer made in 1939 using a compass and pacing for distance. In 1956 G.W. Moore, A.F. Hewitt, P.T. Hayes, and R.P. Hayes surveyed and drafted a map of SCC using compass, clinometer and tape. From 1972-1973 the CRF surveyed SCC and produced a map that is still in use today. Since modern survey standards have been greatly improved, especially in regards to sketch detail, a resurvey of SCC was initiated in 2004 by Pat Kambesis and Mike Lace at the request of the park. In October of 2008 Pat Kambesis led a national CRF expedition that essentially completed the majority of the SCC survey project. Currently SCC's surveyed length is 2.14 miles or 3,444.6 meters. Mike Lace and Pat Kambesis are in the process of drafting a map of the cave.

A DRAFT ROCK ART MANAGEMENT PLAN

Emily Brandenburg

As a volunteer here at Carlsbad Caverns National Park (CAVE) sponsored through the Student Conservation Association (SCA), I was given the privilege of developing the first draft of a management plan for the rock art in our park. We know of 29 prehistoric rock art sites to date, as well as numerous historic inscriptions and other markings found mostly within caves. A plan was needed to help properly manage and protect these non-renewable and irreplaceable archaeological resources.

The draft plan focuses on inventory, research requests, identification, evaluation, and protection/preservation to assist park managers in effectively managing rock art. Only 10% of CAVE has received a formal archeological survey; about 4500 acres out of 45,000 acres. With the help of folks from the Cave Resources Office, this draft plan also includes guidelines on how to proceed when a previously unrecorded rock art site is discovered.

Another important aspect of the draft management plan is a focus on Native Americans. There are 14 Native American tribes who express affiliation with CAVE and their viewpoints will be taken into consideration when completing this draft plan.

We must take every precaution to help protect the cultural and natural environment of this beautiful national park. While this plan has given the Cultural Resources Office a nice jump-start on rock art management, more work is still needed to produce a final management plan.

I want to sincerely thank all of the employees of Carlsbad Caverns National Park for making my internship such a great experience. Never have I worked with such fun and intelligent people. Carpe Diem!

ROADSIDE CACTI AND SUCCULENT RESCUE

Meredith Gosejohan

The next big plant revegetation related activity will be the Walnut Canyon Roadside Salvage project, scheduled for January or February 2009. We are anticipating that thousands of cacti and succulents will be salvaged from the 3 foot-wide disturbance corridor along Walnut Canyon Road. The road will be repaved in 2009 and 2010, along with the remodeling of the Visitor Center parking lots and removal of Bat Cave Draw parking lot. Heavy equipment used to pave the road need a minimum of 3 feet of clearance from the edge of the pavement on each side of the road. All of the plants will be salvaged by hand (without using any heavy equipment) because of difficult salvage requirements and the rocky substrate in which they grow. Top growth of woody plants will also be trimmed and saved to use as vertical and horizontal mulch in upcoming restoration projects. Topsoil will be collected and set aside prior to disturbance and will be replaced following construction. The disturbed area will then be re-seeded with grass seed from our own native grasses being grown at Natural Resource Conservation Science Plant Materials Center in Los Lunas, NM. Once parking area in Bat Cave Draw is removed, the area will be revegetated using the salvaged cacti and succulents from the road disturbance area. Although most people might not anticipate much plant diversity so close to the road, the anticipated number of individual species salvaged will number in the teens!

Nipple cactus and prickly pear to be saved by hand salvage prior to construction disturbance along Walnut Canyon Road. (NPS Photo by Meredith Gosejohan)

DISTURBED LANDS RESTORATION IN CARLSBAD CAVERN

Paul Burger

Since the 1920s there have been several generations of trails constructed through Carlsbad Cavern to facilitate visitation. Rubble from the construction of two elevator shafts and other fill material was used to construct trails and fill in low areas. Wooden stairs and bridges and galvanized steel ladders were installed in off-trail areas. Habitat for native fauna was buried by rubble and dirt. Past studies have shown that the deteriorating wooden structures provide nutrients for non-native microbes to thrive and for native microbes to overpopulate. The galvanized steel structures are becoming badly corroded and shed metal, paint, and other materials into the sensitive cave environment. As the steel and paint deteriorate, they introduce iron and other chemicals into cave pools and the cave floor, changing the chemistry and altering the cave ecosystem.

Years of visitation have left trash, dust, and lint throughout the cave trail system. This provides a nutrient source for a wide variety of microbes and algae and has upset the balance of the cave ecosystem and caused real damage to cave formations. As lint and other organic material (such as wood, sunflower seeds, and chewing tobacco) decompose in the cave environment, carbonic and other acids are created. This acid can dissolve the calcium carbonate, etching the surface of the cave formations. In places where the calcium carbonate re-precipitates out of solution, it can incorporate dust, lint, and other materials and cause permanent discoloration of cave formations.

Though restoration activities have taken place for years in Carlsbad Cavern, the park more recently began development of a comprehensive restoration strategy to provide prioritization for restoration activities. A list of prioritized projects was generated in anticipation of needed funding to restore some of the higher priority items found on the list.

Thanks to the support from NPS Disturbed Lands project funding, the Cave Resources Office was able to hire two seasonal cave technicians, Shawn Thomas and Steve Record, to work on these prioritized restoration projects throughout Carlsbad Cavern. The ladders in Left-Hand Tunnel were replaced and the areas impacted by the old ladders were restored. The ladders along the route to the New Mexico Room were replaced and the areas impacted by the old ladders were restored. There is still some wood to be removed from this route, but the majority of the large, rotting wood pieces have been removed.

The steel walkway to the Mystery Room was removed and replaced with a nylon rope. The areas beneath the walkway that were blanketed in a fine dust of paint and metal dust have been restored. The replacement rope is much less visible than the walkway to visitors on the Kings Palace tour and should now have less impact on their experience in this part of the cave.

In addition to the heavy work of removing and replacing ladders, Shawn and Steve removed lint along the Big Room route from Billing Dove Tunnel to the Sword of Damocles. In the Main Corridor and the Big Room, they cleaned the black staining from past trail spraying off of natural cave walls and restored those areas to a more natural appearance. In all, they removed more than 200 pounds of wood debris and other materials associated with old wooden structures and other trash from around the trail system. While there is still more work needed, and luckily the park receives thousands of hours of volunteer support each year, this project succeeded in removing some of the most critical impacts from the cave.

WEIRD GREEN DISKS AND ALIEN INVADERS?

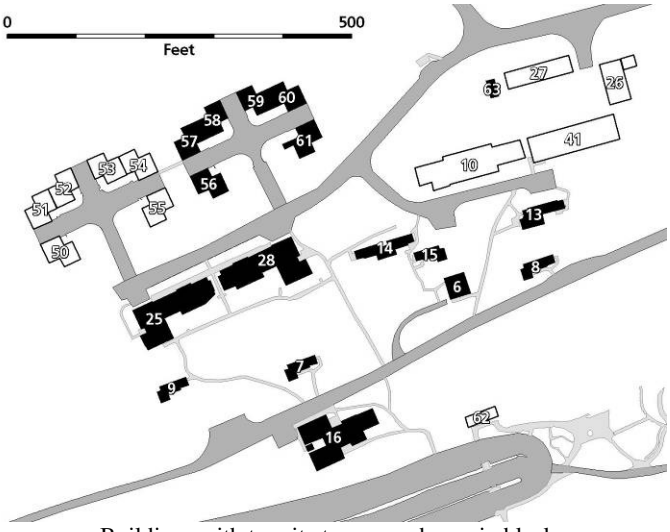
Renée West

You may wonder, especially if you're new to the park, why most of our buildings are surrounded by weird green disks on the soil. And who is that guy who walks around the disks every month with a beeping probe? Well, it's not an alien invasion. It's just an attempt to protect our historic structures and other building assets from *native* invaders – termites.

The disks are actually the visible portion of buried termite traps, technically called bait stations, a recent technology to try to outwit those persistent wood-eating insects. The guy with the probe is a professional pest control operator from the company hired by the park to install and monitor the stations.

This green disk marks a termite bait station. NPS photo.

Termites forage randomly and do not seek out buildings; however, once located, building timbers provide a concentrated food supply. It's not until they begin feeding on buildings that they earn the official label of 'pest.'



Buildings with termite traps are shown in black.
Map by Peter Lindstrom.

Termites from some of our buildings were identified as *Reticulitermes hesperus* (western subterranean termite). They are native termites, common throughout southern New Mexico, and as such are not pests, but rather constitute an essential part of the Chihuahuan Desert ecosystem. Their activity recycles nutrients that are essential for plant growth.

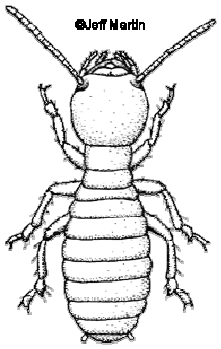
As Robert L. Smith of the Arizona Sonora Desert Museum states "…because our aridity severely limits the abundance and distribution of wood decaying fungi, without termites, we would soon be neck deep in cellulose in the form of…wood, dead grasses, cactus skeletons and dung…"

"Eventually…the whole desert ecosystem as we know it would simply collapse."

Smith also points out that on its own, dried cow dung decomposes very slowly. Research conducted in southwestern deserts and desert grasslands by New Mexico State University's Walt Whitford estimates that without the action of termites, cow pies would smother the land, covering 20 percent of the surface in 50 years. Hmm…

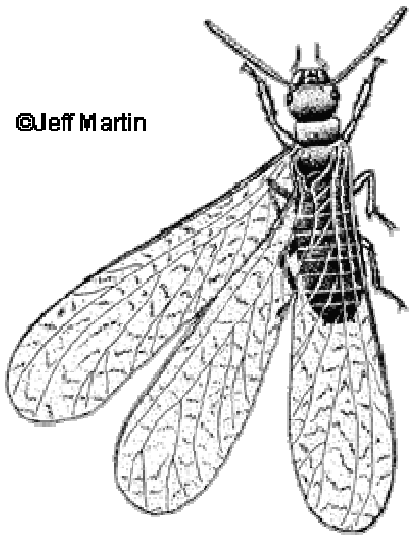
Traditional termite treatments can't be used here because they require deep soil trenching (we have only thin soils and rocks) and because of the likelihood that traditional chemicals will percolate into the cave, harming cave invertebrates.

Termites forage randomly and cannot be attracted to bait stations. We have to monitor and wait for them to find the baits. Once termite activity is detected in a bait station, the wood bait is replaced with pesticide-treated bait. Termites feed on the treated bait and take it back to the central colony nest where it is spread to other termites as part of their mutual grooming and feeding habit.



Reticulitermes sp., worker

There are currently 13 park buildings surrounded by 389 bait stations (including the Rattlesnake Springs residence and the Mission 66 'pod' of Resource Management offices). All but three of those buildings have had termite 'hits' at one or more stations! Each of the 28 pesticide-treated stations probably represents one destroyed termite colony. Once a colony has been removed and plain wood is restored in the bait stations, it usually takes three to four years for termites to re-colonize an area.



Reticulitermes sp., winged reproductive alate

[Drawings borrowed from:
http://www.desertmuseum.org/books/nhsd_termites.html]

Park buildings have been plagued with termites for decades probably since they were first constructed because that was before preventive construction techniques were developed to prevent termite access to the wood. The stone buildings were constructed on the escarpment near the entrance to Carlsbad Cavern beginning in the mid-1920s. In the Caverns Historic District, there are eight buildings with cut limestone construction, two adobe structures, and three maintenance buildings with stone and adobe construction that are of historical significance and individually eligible for the National Register of Historic Places. In the Rattlesnake Springs Historic District, the historic residence has been the frequent subject of termite 'attention.' Structural damage has occurred in most of these buildings. Termite foraging severely damaged floor joists, floors, ceilings, and walls.

In the world of Integrated Pest Management, we know that the best fixes to pest problems are usually not the quickest, easiest fixes. Any pest problem requires follow up monitoring and work. Our termite issues are no different. The bait station process is a long-term commitment the park has made in order to best protect its resources, both cultural (historic buildings) and natural (the cave ecosystem, and the termites).

CAVE ORIGIN BY SULFURIC ACID
A non-technical summary
Art Palmer

Introduction

Caves of the Guadalupe Mountains were formed in limestone by the dissolving action of underground water on limestone. The local limestone was formed by deposits of calcium carbonate on the former sea floor, about 250 million years ago, before the region was uplifted above sea level by the rise of the Guadalupe Mountains.

To dissolve much limestone, water must contain some kind of acid. Pure water can dissolve only a tiny amount of limestone, but with the addition of carbonic acid (from carbon dioxide in the air and soil) or other acids, the water can dissolve hundreds of times more. Most caves elsewhere in the world are formed by carbonic acid, because it is present in all groundwater and has a continuously renewed source – the water that infiltrates through the soil from the surface.

But the caves in the Guadalupe Mountains were formed by sulfuric acid. This is produced where water rises from deep beneath the ground. In the Guadalupes, this water came from the oilfields deep beneath the plains that stretch out to the southeast of Carlsbad. Some of the water also came upward from sources directly beneath the Guadalupes. The water rises into the limestone mountains because the water table is usually lower there than elsewhere.

Origin of sulfuric acid

1. There are gypsum beds (mainly calcium sulfate) deep beneath the surface in the region. These share the same origin as the limestone – they were deposited on the former sea floor – and are interbedded with other rock types.

2. There are also organic materials beneath the surface, mainly petroleum. Deep beneath the surface, where water contains little oxygen, the gypsum and petroleum can react together to produce hydrogen sulfide, the gas that smells like rotten eggs. This gas is very soluble, and in deep groundwater nearly all of it remains dissolved in the water.

3. As the groundwater rises toward the surface, carrying the dissolved hydrogen sulfide with it, it encounters water with dissolved oxygen. The oxygen reacts with the hydrogen sulfide to produce sulfuric acid. (If there is not enough oxygen, it will produce sulfur.) The sulfuric acid is a powerful cave-former and dissolves the limestone. The reactions are:

$CaSO_4 \cdot 2H_2O + H_2O$ + petroleum ➔ H_2S, etc.
(gypsum + water + petroleum ➔ hydrogen sulfide, etc.)

$H_2S + 2O_2 \rightarrow H_2SO_4$
(hydrogen sulfide + oxygen ➔ sulfuric acid)
The actual reactions can be a little more complex. They are also aided by a variety of bacteria, which can greatly increase the reaction rates.

Cave origin

The sulfuric acid dissolves the limestone most vigorously right where the acid is produced – where H2S-rich water mixes with oxygen-rich water. The dissolving reaction is

$H_2SO_4 + CaCO_3 \rightarrow Ca^{++} + SO_4^{=} + H_2CO_3$
(sulfuric acid + limestone ➔ dissolved calcium and sulfate + carbonic acid
Some of the carbonic acid can also contribute to dissolving the limestone)

The largest rooms, such as the Big Room of Carlsbad, were formed where deep groundwater rose upward to mix with

shallow oxygen-rich water. That is why the Big Room and Left Hand Tunnel have such a uniform elevation. The same process occurred at Lower Cave, which was formed later.

The various levels in the cave were formed at different times. In a general way, as the mountains rose, the water table stayed at about the same elevation, and the different levels represent different positions of the water table throughout this history. Dating of the cave levels shows that the highest levels are the oldest (about 12 million years old) and the lowest are youngest (about 4 million years old).

The cave levels are very distinct, because H_2S-rich water did not rise continuously or uniformly. Deep water seeps upward in short episodes whenever there's a geologic disturbance, such as periodic faulting (breaks) in the rock. In the meantime, the water seeps up only slowly. Today, for example, there is almost no H_2S-rich water rising into the Guadelupes. We understand most of these cave-forming processes by analyzing the by-products of the reactions that were left behind, as well as caves elsewhere that are still active.

Although the main levels in Guadalupe caves formed at the positions of old water tables, most of the actual cave volume was dissolved above the water table. Look at the Big Room – the flat floor represents the old water table, and the water may have entered through deep fissures such as Bottomless Pit and Nicholson's Pit – but most of the room's volume lies above this level. Much, or even most, of the solution by sulfuric acid took place above the water table, as described below:

Solution above the water table

When H_2S-rich water is exposed to air, some of the H_2S escapes into the air. Much of the H_2S is absorbed by moisture on the cave walls (which drips in from the surface, or condenses from water that evaporates from the pools below). This moisture also absorbs oxygen from the cave air. The combination of H_2S and oxygen produces sulfuric acid, which reacts with the limestone walls and ceiling, dissolving the surfaces and enlarging the cave.

As sulfuric acid dissolves the limestone, the build-up of calcium (from the limestone) and sulfate (from the sulfuric acid) can become great enough that gypsum is deposited as a rind on the cave wall:

$Ca^{++} + SO_4^{=} + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O$
(dissolved calcium and sulfate + water ➔ gypsum)

The gypsum flakes off the wall periodically and falls to the floor, where it can form thick deposits like those in the Big Room. Water that drips from the surface is able to dissolve this gypsum and carry it away in solution, which further increases the cave volume. (Note the drip holes in the gypsum blocks in the Big Room, and the fact that these blocks are mere remnants of what must have been more extensive layers in the past.)

In this way the cave enlarges by dissolving of the limestone directly by sulfuric acid, and any gypsum that is left as a byproduct tends to dissolve away later in fresh water.

The large ascending passages in the cave, such as the Main Corridor, were probably formed beneath the water table where oxygen-rich water converged with H_2S-rich water. But much of their enlargement, if not most, probably took place above the water table.

Strong acids

Sulfuric acid is used in batteries, and we automatically tend to think of it as very strong and corrosive. Actually, because the acid is produced right in contact with the bedrock, the reaction with the limestone tends to neutralize the acid almost immediately. Most streams in active H_2S-rich caves are nearly neutral. (Examples include Lower Kane Cave in Wyoming, Cueva de Villa Luz in Mexico, and the Frasassi Caves of Italy.) But if the acid is formed in drips that hang from gypsum, such as the gypsum that forms the rind on the cave wall, the drips are shielded from the limestone and retain their acidity. If the drips persist for a long enough time, they become more corrosive than battery acid (pH down to about zero!) These drips can eat holes in your clothing and burn your skin. Where they dripped in the past, the underlying limestone is deeply corroded into narrow channels. There are good examples high in the Big Room, between Appetite Hill and the Lunch Room, and also in side passages off the Left Hand Tunnel. Some of the sulfuric acid seeps through the gypsum rind and reacts with the limestone beneath, so the gypsum becomes thicker as the limestone wall retreats.

Evidence for sulfuric acid

Although the Guadalupe Caves are nearly inactive today, the evidence for a sulfuric acid origin is clear from the layout of passages, the secondary gypsum on the cave walls, and the deep rills that show evidence for highly corrosive acid. Other minerals were formed by the sulfuric acid attack of clay (which occurs mostly thin beds and pockets in the limestone). These alteration minerals (which few people have heard of, such as endellite and alunite) are stable only in highly acidic water that is rich in sulfate – in other words, sulfuric acid.

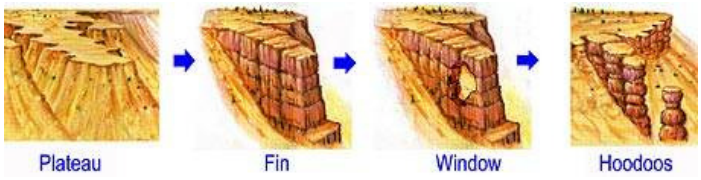
WHAT ARE CAVE HOODOOS?

Paul Burger

"Hoodoo" is a term frequently used to describe a range of tower-like landforms, particularly in the desert southwest. The most famous and most photographed of these are the ones that can be seen in Bryce Canyon National Park. These were formed by the erosion of highly-fractured bedrock by ice, water, and wind.

Generally, these hoodoos are formed where there is a hard, resistant caprock overlying softer rock. This phenomenon can also result in balanced rock formations, goblins, and desert spires, all of which have also been called hoodoos.

Bryce Canyon - Jon Sullivan Photo



NPS Illustration

Some of these processes are also active in caves, but do not result in the same types of landforms. The closest type of speleothem that resembles surface hoodoos is the coral pipe. Coral pipes form in sediment where dripping water erodes soft material while simultaneously depositing calcite. In some cases, pebbles or other, more resistant material sitting on top of the sediment protects the soft material from erosion and small towers (usually less than 10cm tall) can form.

Coral Pipes – Borrowed from Cave Minerals of the World
Photo © J. Ayrton Labegalini

The term "Hoodoo" as applied to speleothems refers to an array of calcite-cemented sediment deposits, usually silt, sand, or raft cones. The best examples in the park are found in Hoodoo Hall in Lechuguilla Cave where raft cones have been cemented, and in some cases, partially overgrown with aragonite.

Hoodoo Hall – Gavin Newman Photo

There are other speleothems that look like hoodoos, but are formed in different ways. The aragonite stalagmites found throughout the visitor trail in Carlsbad Cavern are a mix of aragonite-covered stalagmites and aragonite popcorn that likely formed as drip pit linings in gypsum where the gypsum has now been dissolved.

Some features, including the New York City Skyline in Carlsbad, and ironically, Bryce Canyon in Lechuguilla Cave, can also resemble hoodoos, but were formed by acidic water falling onto and dissolving limestone bedrock. The most common cave features formed in this manner are rillenkarren and spitzkarren and are more generally found on surface bedrock exposures.

Spitzkarren and Rillenkarren in Bryce Canyon, Lechuguilla Cave
Anmar Mirza Photo

While there are many tower-like speleothems, the term hoodoo generally applies only to those that consist of cemented piles of sediment and not those that were formed by these other mechanisms.

DID YOU KNOW?

Meredith Gosejohan

Beetles make up the scientific order Coleoptera and are the largest and most diverse group of insects on Earth, composing nearly 350,000 known species with new species being named by entomologists every day. They have economic importance to human beings and act as major decomposers and recyclers of organic nutrients. They are also predators of harmful insects (though some beetles can also be detrimental to agricultural crops).

The Calligraphy beetle (*Calligrapha serpentina*) – This fanciful beetle is from the family Chrysomelinae and is a leaf eating beetle which can be found here at CAVE eating globe mallow leaves (*Sphaeralcea* sp.). Emily Ficker, seasonal Interpretive Ranger spotted this Calligraphy beetle at CAVE near the Natural Entrance during the summer months. Thanks for passing this along Emily!

The leaf-eating beetle *Calligrapha serpentina*.
Photo © Emily Ficker