A Guide To Accompany the Tour

This document was created to assist you in preparing your students for a trip to Natural Bridge Caverns. The information contained within *The Guide to Accompany a Tour* is the total amount of information we expect our guides to know. *We do not expect our guides to give all of this information to our guests!* Other hints or extra information is given within the body of the text and in an *italicized typeface*.

INTRODUCTION

Welcome to Natural Bridge Caverns! Your tour through Texas' largest and most spectacular underground attraction will be leaving from the patio. The trip through the cavern will take approximately 75 minutes. The temperature inside the caverns is 70 degrees, however, it may feel as warm as 80 degrees due to a 99% relative humidity. Please wear good, comfortable walking shoes which provide good traction on steep, wet surfaces. You will be walking three-fourths of a mile, and you will walk down 180 feet below the surface (as well as back up). Those with any physically limiting conditions may want to consider all of these factors before choosing to go on the tour.

The caverns you will see today are still forming. To protect the caverns for future generations, we do ask that you follow some simple rules. First, we ask that you not touch any of the rock formations along the trail. By touching the formations, you leave behind oils, acids, and dirt, all of which are permanently destructive to the cavern. The oils on your skin will stop the formations' growth, while the acids and dirt will turn the formations a dirty gray color. There is also no food or drinks permitted in the cavern, and please stay on the trail at all times. Please deposit any trash in the trashcans located in the larger rooms. Again, these rules are designed to protect the natural beauty of the caverns for the enjoyment of future guests.

SINKHOLE

Geologists refer to the depression you are standing in as a sinkhole. We theorize that this area was once the uppermost room in the cavern until

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THE DISCOVERERS

Orion Knox, discoverer/ developer

Al Brandt, discoverer

Preston Knodell, discoverer

Not pictured, Joe Cantu

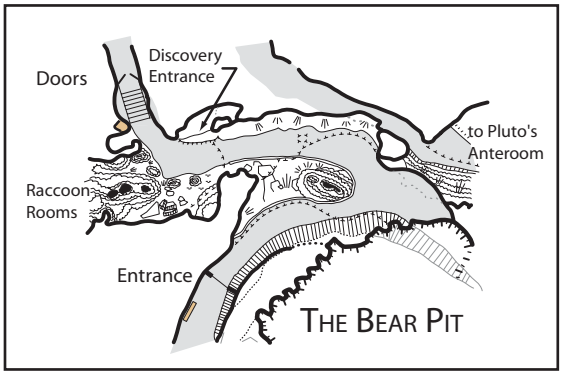
roughly 5,000 years ago. At that time, erosion from both above and below the surface weakened the ceiling to the point of collapse, leaving behind the Natural Bridge. The bridge itself is composed of Edwards Limestone, one of the younger rocks exposed in the immediate area.

Local farmers and ranchers have known about the Natural Bridge, sinkhole, and some small passages since the early 1900's. The full extent of Natural Bridge Caverns was not known until four college students from St. Mary's University (Orion Knox, Jr., Al Brandt, Preston Knodell, and Joe Cantu) obtained landowner permission to enter the small passages and look for unexplored sections. The four cavers were on their fourth trip to the cave on March 27, 1960, when Orion Knox examined a low, rubble-filled crawl and felt a cool draft of air blowing from its entrance. To an experienced caver, a draft of air such as the one felt by the students indicates the possibility of additional passages. The four men started to clear away the debris and eventually uncovered a 60-foot long, 22-inch wide crawlspace, which they later named Discovery Crawlway. This small passage led the men into another two miles of unexplored cavern.

The developers of Natural Bridge Caverns included Mrs. Clara Wuest-Heidemann, Reggie Wuest, Harry Heidemann, Jack Burch and Orion Knox. Mr. Burch has developed many caves, including the Caverns of Sonora.

By 1963, the landowners had a good idea of what lay beneath their land. After touring other commercial caverns in the country, the landowners formed plans to develop Natural Bridge Caverns. Work started in 1963 and continued until opening day, July 3, 1964. On August 5th of that same year, John Connally (then Governor of Texas) officially dedicated the caverns.

BEAR PIT



The first room you enter is the Bear Pit. During excavation, explorers found an 8,000 year-old jawbone of a black bear. Also found were the remains from 45 other vertebrates including a human thighbone and numerous artifacts left behind by Native Americans approximately 5,000 years ago.

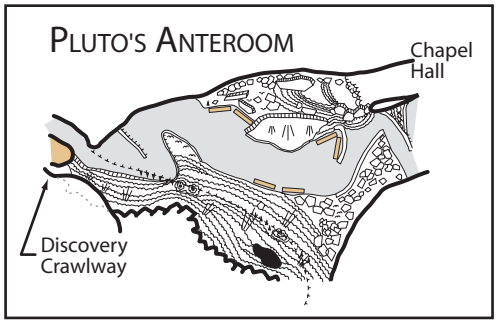
Continuing further down the trail, Discovery Entrance may be seen below the handrail on the right. This narrow crevice was once the only entrance or exit to the lower portions of Natural Bridge Caverns. This crevice and a series of crawlways and pits extends downward into Pluto's Anteroom, the next room on the tour. Above the trail and to the left lie the Raccoon Rooms. Named after a family of raccoons found living in the cave, the rooms continue for nearly 200 feet before coming to an end. With the exception of an occaisional bat, no other large animals are found living in the cavern today.

The trail takes a right turn and passes through two glass doors. These doors act as a "humidity barrier" and keep the caverns' environment much as it was found in the 1960's. The tunnel beyond the doors is one of three man-made passages along the tour. Developers blasted out the rock to create the tunnels which connect portions of the cavern. The tunnel will take you into St. Mary's Hall.

ST. MARY'S HALL

St. Mary's Hall gets its name from the university some of the discovers attended in San Antonio. Although the trail forks to the left, it comes to an end just around the corner with some nice formations. The tour continues along the trail to your right and through the narrowest portion of the trail. Please watch your head while walking through this section – the ceiling is low in places. Look for the exit of Discovery Crawlway just after the handrail reappears on the right side of the trail. The room ahead is Pluto's Anteroom.

PLUTO'S ANTEROOM



Pluto's Anteroom was the first large room found associated with Natural Bridge Caverns. Pluto was the Roman god of the underworld, and "anteroom" is a small meeting room before a larger chamber. The room is 108 feet (33 meters) below the surface. As you enter this room, note the upper level called Chapel Hall. The explorers named this passage Chapel Hall after the formation which resembles a Madonna statuette found in some churches.

Pluto's Anteroom contains many of the different calcite formations we will see today. The formations, as a whole, are called speleothems and are divided into two groups: dripstones and flowstones. The dripstones form from dripping water and include stalactites, stalagmites, and columns. The stalactites grow downward from the ceiling towards the floor, while the stalagmites reach from the floor to the ceiling. A specific type of stalactite is the soda straw. Soda straws are hollow, like a drinking straw, and the calcite crystals grow in a ring at the tip. Whenever a formation touches both the floor and ceiling it forms a column.

The other type of formation, flowstone, forms from water flowing along the cavern's walls or floors. Often flowstone is smooth; however, some flowstone may also have a rough, textured appearance similar to corals found in the sea. Flowstones along the walls or ceilings of rooms form cave ribbons. The longer ribbons are sometimes called cave curtains or draperies.

Again, both dripstone and flowstone form as water passes through the cavern. All of the water seen in the cave was at one time rain. As rain passes through soil layers near the surface, it mixes with carbon dioxide gas to form carbonic acid. As the acid solution continues moving through the limestone layers it dissolves some of the calcium carbonate (limestone) contained in the rock. This dissolved calcium carbonate is transported in the water as calcium bicarbonate. Upon reaching the cavern, the water releases carbon dioxide to the atmosphere in the cave. As the carbon dioxide content of the water decreases, the calcium bicarbonate precipitates as calcium carbonate or calcite crystals and forms the various speleothems or cave formations seen on tour. The calcite crystals accumulate layer by layer to form the formations you now see. It is believed the formations grow at the rate of a cubic inch every 100 to 1000 years, depending on rainfall.

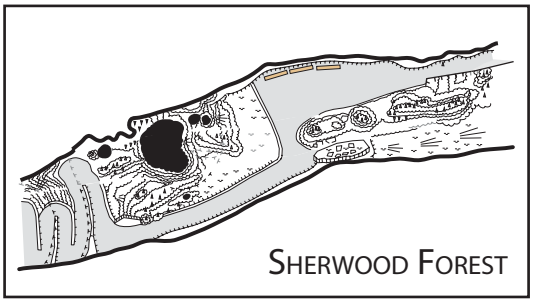
Soft drinks contain carbonic acid!

Finally, people sometimes associate caves with bats, and visitors often ask whether the caverns contains any bat colonies. Although bats no longer live here, they once did, and the bats left behind clues telling us where they lived in the cavern. One clue is the black stain seen on the ceiling of Pluto's Anteroom. The stain was left by the bats whose skin oils darkened the rock wherever they would hang. These stains may be found on the ceiling of virtually every room along the tour. You can also sometimes see a black, dirt-like deposit on the floor beneath the stains. These deposits on the floor are collections of bat guano, or bat droppings.

The bats which once lived in Natural Bridge Caverns were most likely Mexican Freetails.

Three of the explorers started down Chapel Hall thinking it was the main route. Al Brandt made his way to the lower end of the room and yelled to the others that the main cave continued down. The group reassembled in Pluto's and proceeded to explore the deeper sections of the cavern. To reach these sections, you will be following the same path the explorers used, a 72-foot drop to the next room, Sherwood Forest. While walking down the switchbacks, please use the handrail and take small steps. The path is steepest on the inside corners, so please take the turns wide.

SHERWOOD FOREST


SHERWOOD FOREST

You are now 180 feet (55 m) below the surface and standing in Sherwood Forest. The room gets its name after the tall, slender stalagmites to your left, which the explorers said resembled tree trunks. The explorers also claimed to see the tops of trees in some of the flowstones to the right. Perhaps most astounding are the slender stalagmites found in this room. Some of these formations are only a few inches in diameter. It is rare for stalagmites to maintain such a small diameter throughout their

length, and we speculate that these formations grew as water dripped at a slow, steady rate.

While in Sherwood Forest, you can find clues that tell something about how the caverns formed. First, notice where stalactites grow in a straight line along the ceiling. These formations mark the presence of a joint, or crack – the so-called "life-line" of the cavern.

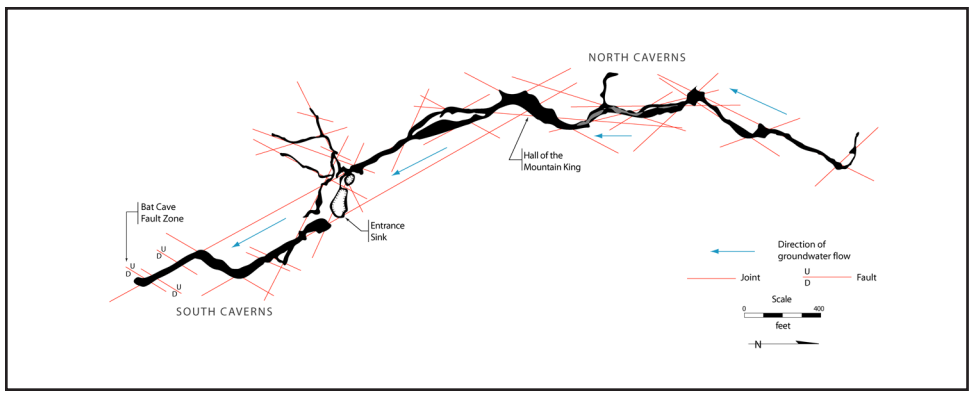
BACKGROUND GEOLOGY

Geologists theorize that around 140 million years ago, during the Cretaceous Period, a warm, shallow sea covered much of what is now Texas. Sediments and dead marine organisms collected on the ocean floor, compacted, and formed the different limestone layers. Geologists give different names to the various layers, and here at Natural Bridge Caverns you will see the Glen Rose and the Edwards layers. The Glen Rose, the oldest rock layer exposed in Natural Bridge Caverns, forms the lowermost chambers, while the Edwards layer forms the Natural Bridge.

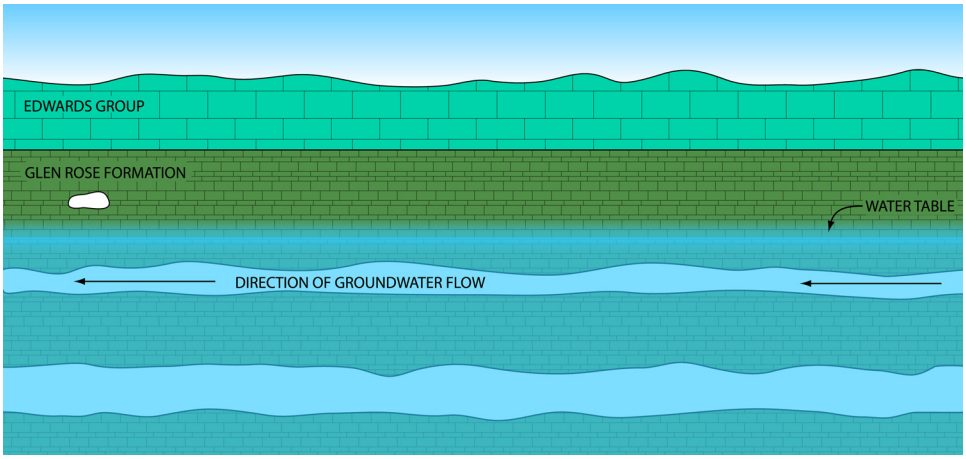
Perhaps around 20 million years ago, a number of earthquakes shook Texas and created the Balcones Fault Zone. The Fault Zone starts near Del Rio, then heads east to San Antonio and then north towards Dallas. In addition to forming a large number of faults, the earthquakes also may have placed cracks in the rock, or what geologists call "joints."

Before the caverns formed, water passed through joints and slowly began dissolving the surrounding limestone. The first level carved from the rock may have been the Bear Pit and the Raccoon Rooms. Sometime after these upper passages formed, the water table lowered and started carving another level, St. Mary's and Chapel Hall. The water dropped once more and carved out the deeper passages such as Sherwood Forest and Purgatory Creek. Finally, the water dropped again and left all of these passages dry. Air replaced the falling water and the formations started to grow.

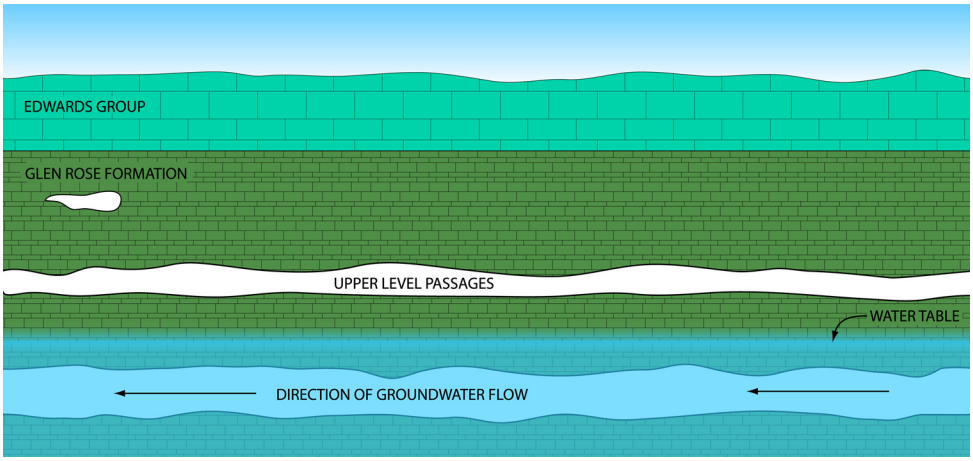
Each time the water dropped to a new level, the water-formed passages were often modified by collapse. This process will be discussed later, but in many areas we can see the effects of collapse modification. Large boulders



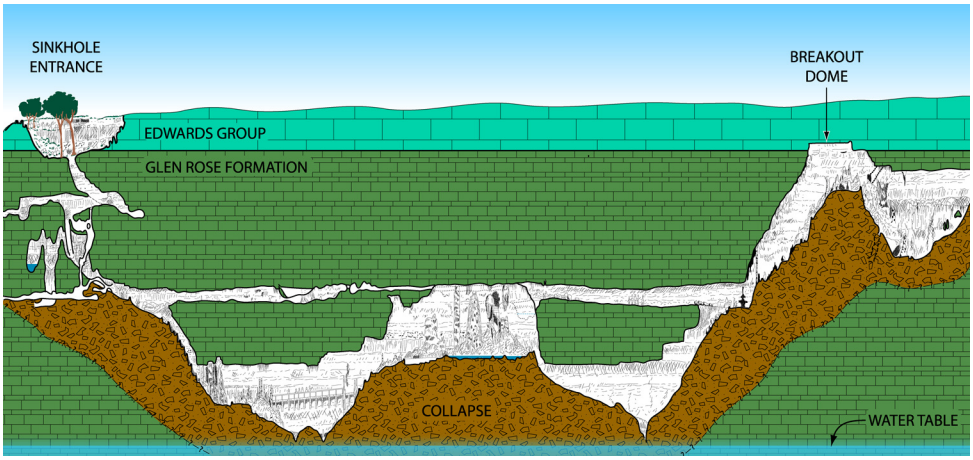
Joints or fractures control the direction or orientation of passages. Here at NBC, the passages formed either to the northeast or to the northwest. The overall direction of passages is north-south.



Stage One: The Birth of a Cavern.
Water tables are significantly higher than today. Water passes through joints and carves out the initial passages.



Stage Two: A new level.
Possibly due to changes in climate, the water table drops to a lower level. Passages such as the Raccoon Rooms are exposed to air.



Stage Three: Collapse Modification.
When the watertable drops completely out of the cavern, support is removed from rock layers. This process likely led to the creation of large passages.

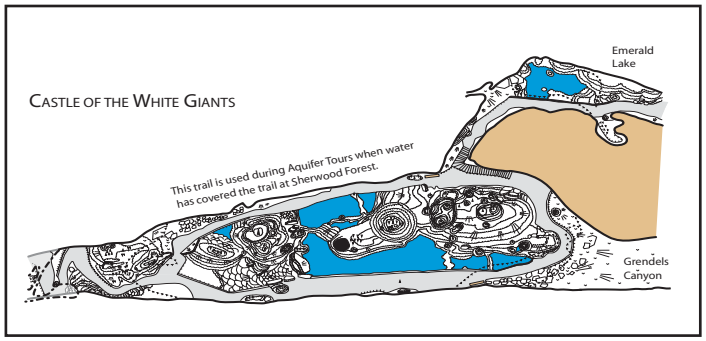
or "breakdown" can be seen on the floor. With many of these instances, however, formations have grown over the breakdown thus showing how stable the caverns are today.

Whereas Sherwood Forest is as deep as you walk in the cavern, you will see two deeper sections on your tour. As you walk across the bridge to Castle of the White Giants, you will be 30 feet above the floor. The area you are above is called Purgatory Creek. It is the deepest point in the caverns at 211 feet (64 m) below the Natural Bridge. The explorers walked down through the mud and then climbed up the far slope into Castle of the White Giants. You will use a 152-foot long bridge. Developers constructed the bridge as

Do we still have earthquakes in Texas? Yes, in some areas, but not in this portion of Texas. There are earthquakes in far west Texas and along the coast. The Hill Country, however, is relatively free of such events.

one continuous piece to avoid using any joints or gaps which could shift or weaken over time.

CASTLE OF THE WHITE GIANTS



The Castle of the White Giants is the second largest room on your tour. The room is 50 feet wide, 50 feet high, and about 250 feet long. This room is 150 feet (46 m) below the surface. Although the Castle is not the largest room you'll see, it does contain some of the biggest formations found anywhere in Natural Bridge Caverns.

One of the first large formations seen in this room is the Bomb Burst. The explorers said this large stalagmite looked like a collection of atomic blasts or mushroom clouds. On the floor to the right of the Bomb Burst are a series of depressions called rimstone pools or travertine dams. These flowstones form as water fills the pools and spills over the dam, depositing calcite in a thin layer.

Beyond both the Bomb Burst and the dams is the Watchtower. The Watchtower is over 50 feet high and is the largest column in the cavern. On the ceiling to the right of the Watchtower are examples of draperies known as cave bacon. At one time, the orange discoloration in the bacon was thought to be the result of iron oxide, but current theories suggest that the orange colors are the result of humic and fulvic acids. These acids are formed in soil by the decomposition of plant material. Darker layers indicate higher amounts of humic acid, while lighter or white layers show lesser amounts. The different color bands could be an indicator of how the climate has changed on the surface.

Continuing further up the right-hand trail will allow you to view the most massive stalagmite in the cavern, Mount of the Landlord. The explorers said the smaller stalagmites on the sides of the Mount resembled castles of the landlords who could look out over their surrounding lands. Another interpretation holds that the holes along the Mount's surface resemble apartments, and you can even pick out the Landlord sitting on the edge. To the right of Mount of the Landlord lies another massive stalagmite, the King's Throne. Finally, you can see the Cavern Chandeliers on the ceiling at the far end of the room.

While standing before the Mount of the Landlord, you may want to reach down and touch the black stalagmite in the center of the trail. This

discolored formation is called the Touchstone, and it is the only formation you may touch in the cavern. Dirt and acid from people's hands cause the dark color. Also, the oils from our skin have "waterproofed" the stalagmite, and it will no longer grow. Keep in mind that this damage is done to any rock formation your skin touches.

The highest recorded water level in Natural Bridge Caverns occurred on Dec. 23, 1991. A strong weather system dropped almost 14 inches of rain over a 4-day period of time. The water in the caverns rose to cover the 31st step.

Making your way along the trail will take you past the entrance to Grendel's Canyon, the dark passage to your right at the far end of the Castle. Named after the monster in the epic poem *Beowulf*, Grendel's Canyon is the second deepest point on the tour at 207 feet (63 m) below the Natural Bridge. The room is similar to Purgatory Creek in that mud also covers the floor of the room, however, there are no formations to be seen in Grendel's Canyon. The lack of formations could be the result of clay beds above this section of the cavern. The clay would prevent water from flowing through the layers and into the room below.

EMERALD LAKE PASSAGE

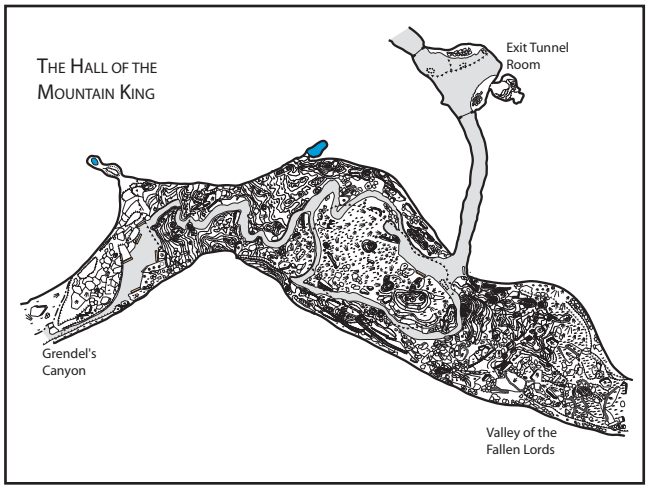
The original explorers did not have stairs, so they continued through Grendel's Canyon. To get around Grendel's Canyon, we will use an upper level known as Emerald Lake Passage. You will be climbing a flight of stairs to reach this upper level, and once off the stairs look for Emerald Lake to your left. The water in the Lake possesses a dark green color resulting from the refraction or bending of light passing through the pool. The deeper the water, the darker the color. The passageway beyond Emerald Lake is completely natural, with the exception of the walkway.

HALL OF THE MOUNTAIN KING

The Hall of the Mountain King is the largest room in Natural Bridge Caverns and one of the largest cavern chambers for the entire state of Texas. Nearly the size of a football field, the Hall is over 100 feet wide and 350 feet in length. The room was named after a formation which resembles the profile of a king when viewed from one side. This formation is at the top of the room. In places the ceiling rises over 100 feet above the floor. As you enter this room, you can also look down into the other side of Grendel's Canyon.

While other rooms formed from water dissolving limestone along joints or cracks, Hall of the Mountain King formed from the collapse of limestone layers. In this room there are at least five joints or cracks which intersect near the center of the Hall. These joints weakened the surrounding layers and also allowed water to flow in many different directions. The water then separated the rocks into distinct layers, and you can see some of these layers in the ceiling above Grendel's Canyon. The caverns' water levels dropped, removing the support for the weakened rock. The rock then fell, layer by

layer, until the collapse was just 55 feet (16 m) below the surface. The collapse stopped at that point, and no additional movement is expected in the foreseeable future.



When you begin your climb up this room, keep an eye out for Fried Egg Stalagmites. The upper surface of these stalagmites resembles a fried egg. In this instance, water drips very slowly and deposits most of its calcite content in the center of the formation to form a dense, dark yellow calcite crystal. Any calcite not deposited in the center goes to the outside of the formation to form the outer white ring.

Grendel's Canyon was originally the only route through the Caverns. Emerald Lake Passage was accessed by crossing a steep, muddy ledge on the Hall of the Mountain Kings end. The drop at the Castle end kept the explorers from using it to access the back part of the cavern. According to Orion Knox, he and another caver noticed an opening above Grendel's, and they climbed out along a ledge and entered the unknown passage. When they got to the point where the stairs are today, Orion thought he had just found another huge room. When he saw the headlamps from some other cavers, he then realized that he was actually looking at the backside of the White Giants. Not a new discovery, but it turned out to be a way to eventually get the tour from the Castle to the Hall without another bridge!

"Is that water down there?" – a common question as guests look into Grendel's Canyon. There typically is no water in Grendel's Canyon. After heavy rains, you may hear and see running water along the side.

TOP OF THE HALL

As you make your way to the top of the Hall, you will see a large black deposit to the left of the trail. This is a large mound of bat guano, or bat manure. Looking up at the ceiling, you can see two remaining black stains left by the bats. Visitors often ask why there is so much guano on the floor but only two small stains on the ceiling. It is possible that the stains once covered a larger area of the ceiling, but perhaps water has since removed or washed away some of the stains.

Continuing beyond the bat guano, you will see a red light in the distance. This light shows where another mile-and-a-half of cavern passages continue beyond the present tour. These passages have been explored and mapped, and we do have plans for limited development in the future.

Finally, as you make your way beyond Valley of the Fallen Lords, you can take a drink of cavern water from the fountains to the right. The water used in the fountain comes from an underground river located at the end of the cavern beyond the red light. Further to your left is an observation platform from which you can look back down to the bottom of the Hall of the Mountain

King. When you are ready to leave this room, walk up the exit tunnel near the drinking fountains and continue into the last room on the tour.

EXIT TUNNEL ROOM

You will be using a man-made tunnel to exit this section of the cavern. Developers started blasting the tunnel in 1965 and finished their work about six months later. While blasting, the developers discovered a small room. The "Exit Tunnel" room is not considered to be part of Natural Bridge Caverns as there are no known passages which connect the room to the rest of the cavern system.

This concludes your trip through Natural Bridge Caverns. We would like to thank you for visiting the cavern today and hope you enjoyed your tour. Upon exiting the tunnel you will use a covered walkway to return to the Visitors' Center. Again, thank you for visiting Natural Bridge Caverns.

GLOSSARY

Calcite: mineral which forms all of the formations in Natural Bridge Caverns. A crystalline form of calcium carbonate.

Cave Bacon: drapery speleothem possessing alternating light and dark color bands, thus resembling bacon. The color bands are the result of differing amounts of humic or fulvic acids.

Cave Curtain: see Drapery.

Column: a speleothem created by the joining of a stalactite and a stalagmite into one, continuous formation touching both the floor and ceiling.

Drapery: a curtain-like speleothem which hangs down from inclined cave ceilings or walls.

Dripstone: type of speleothem formed by dripping water.

Flowstone: type of speleothem formed by flowing or running water.

Fried Egg: a stalagmite which has a yellow-colored center surrounded by white calcite.

Fulvic Acid: see humic acid.

Helictites: a contorted speleothem which twists in any direction ("defy gravity"). Helictites typically grow on cave ceilings, walls, or other speleothems. All helictites form as water is pushed through a tiny capilary or tube in the center of the formation. The orientation of the tube is what determines the direction of a helictites' growth.

Humic Acid: formed in soil by the breakdown of plant material. Neither humic or fulvic acids are specific molecular compounds. Instead, they are mixtures of chemically similar organic molecules of varying molecular weight.

Karst: a type of landscape created by solution and dominated by caves, sinkholes, and predominately underground drainage.

Limestone: a sedimentary rock typically formed at the bottom of oceans or lakes. The primary makeup of limestone is calcium carbonate, with varying amounts of other minerals.

Rimstone Dams: barriers of calcite that obstruct cave streams or pools.

Sinkhole: a natural depression in a land surface communicating with a subterranean passage, generally occurring in limestone regions and formed by solution or by collapse of a cavern roof.

Soda straw: hollow, tubular stalactites.

Stalactite: dripstone deposit found on the ceiling of caverns. Stalactites (and stalagmites) are some of the oldest recognized speleothem type. Earliest report is that of the Roman scholar Pliny (77 A.D.) who wrote about stalactites and stalagmites in caves around Italy and Greece.

Stalagmite: conical floor deposits built up by water dripping from overhead.