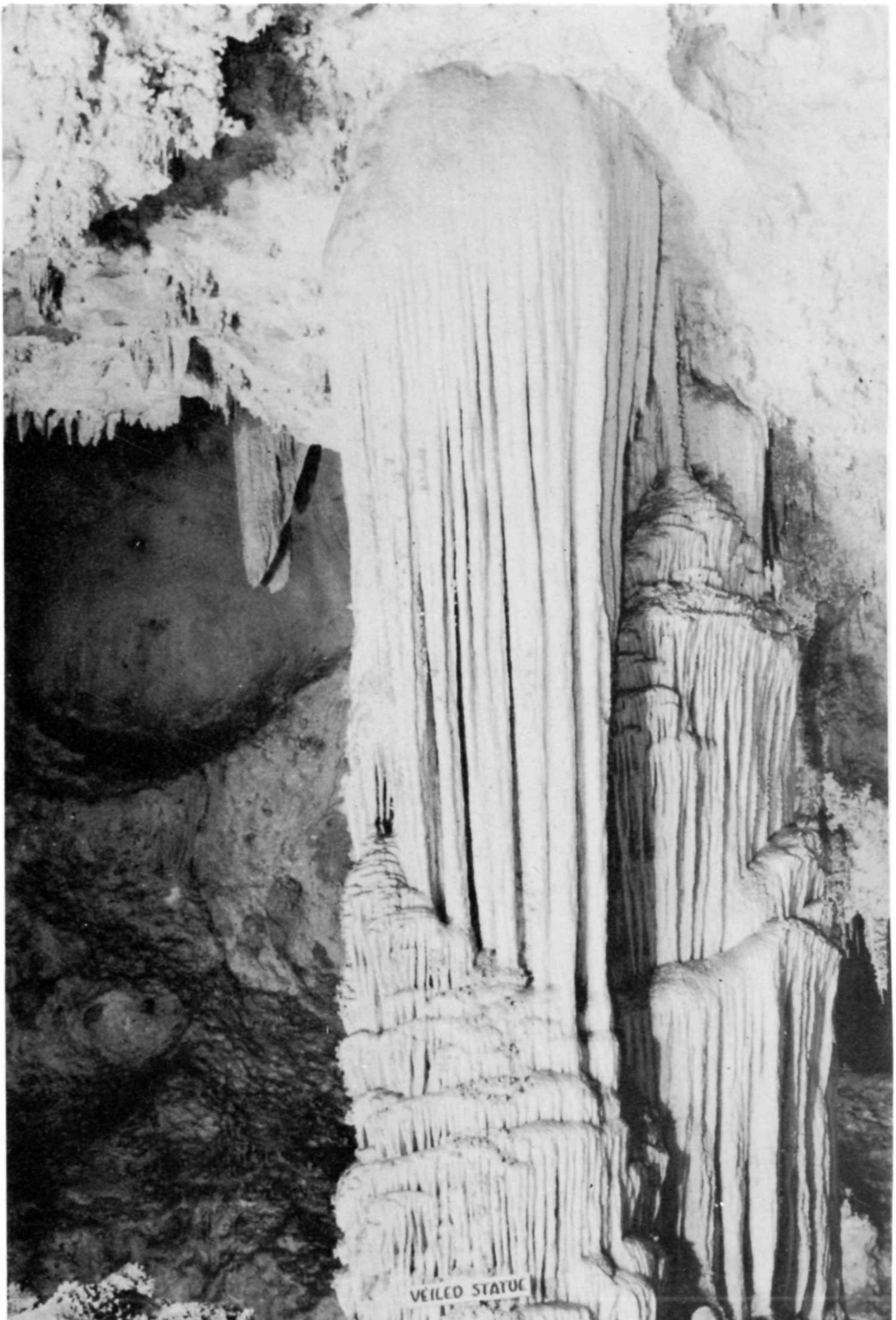
GUIDE BOOK

To Carlsbad Caverns National Park

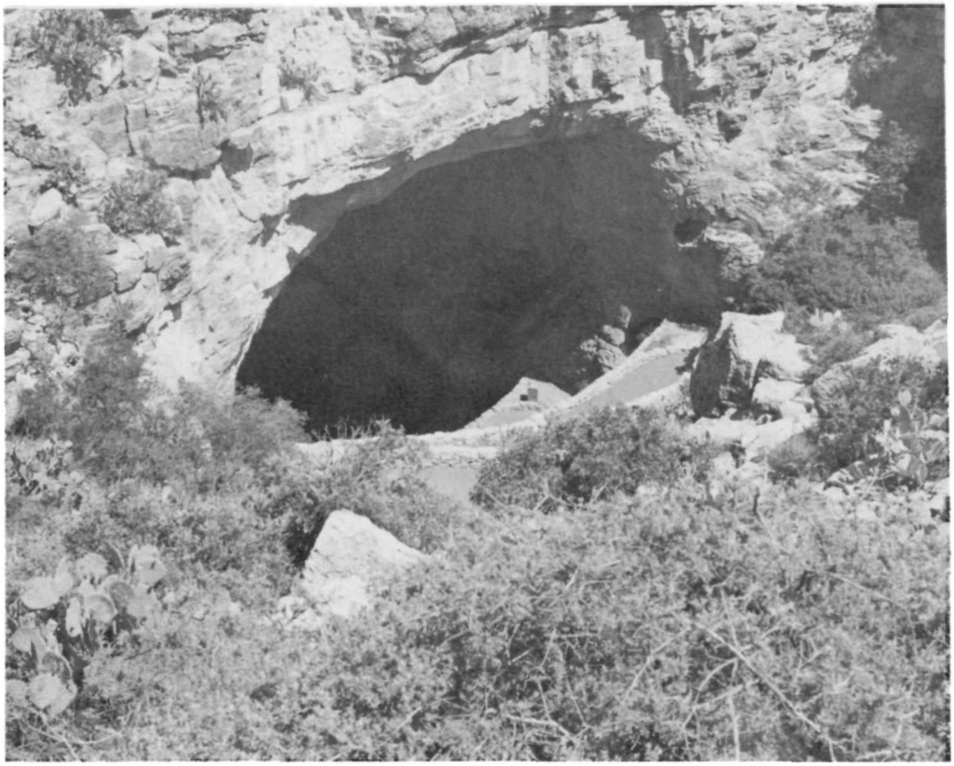


The Veiled Statue

A GUIDE BOOK

TO

CARLSBAD CAVERNS NATIONAL PARK



Natural Entrance to Carlsbad Caverns

THE NATIONAL SPELEOLOGICAL SOCIETY
WASHINGTON 25, D. C.

GUIDE BOOK SERIES NO. 1
1960

EDITOR: PAUL F. SPANGLE

Printed by Beedle Publishing Company, Carlsbad, New Mexico

The National Speleological Society was organized in 1940. It has members throughout the United States and many members in other countries. The Society is associated with the American Association for the Advancement of Science.

The Society is a non-profit organization of men and women interested in the study of caves, karsts, and allied phenomena. It is chartered under the laws of the District of Columbia.

The Society serves as a central agency for the collection, preservation, and dissemination of information relating to speleology. It also seeks the preservation of the fauna, minerals, and natural beauty of all caverns through proper conservation practices.

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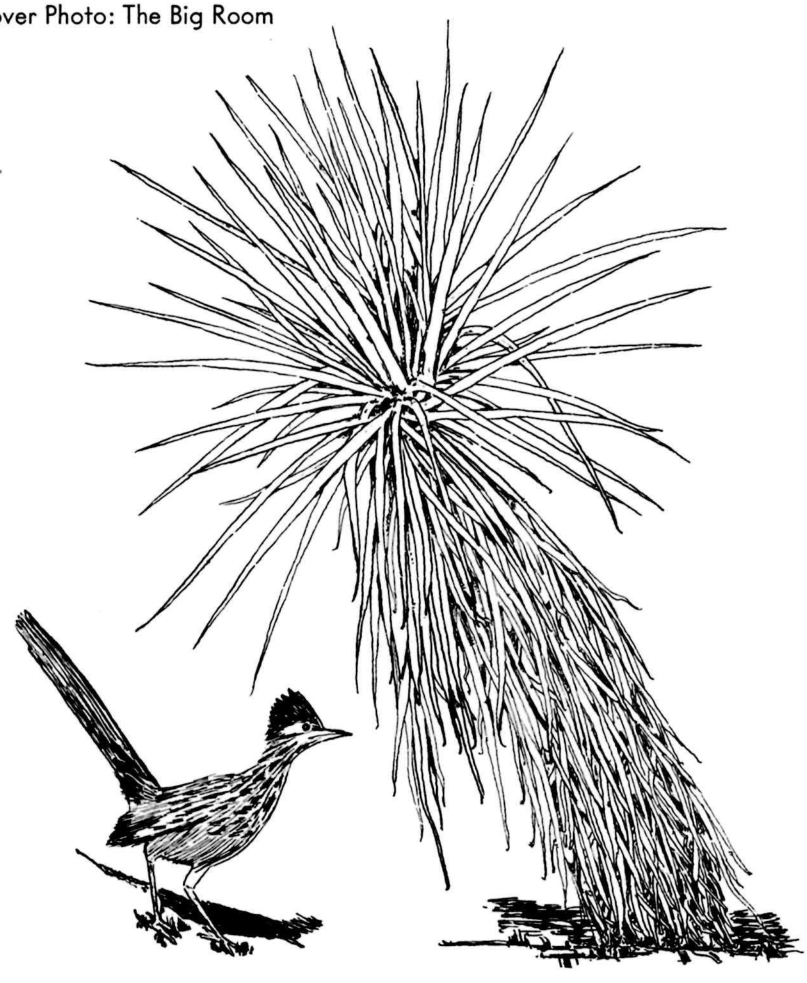


Road Runner — Soaptree Yucca: State Bird and Flower of New Mexico

GEOLOGIC ROAD LOG
Carlsbad to Carlsbad Caverns

George W. Moore

29.0	0.0	Eddy County Court House, corner of Canal and Mermod streets. Carlsbad was founded in 1889 by Charles B. Eddy and was originally named Eddy. Later the name was changed to Carlsbad because of the similarity between the chemical composition of water in Carlsbad Spring and that at the Karlsbad Spa in Czechoslovakia.
0.2		
28.8	0.2	La Caverna Hotel.
0.9		
27.9	1.1	Dark Canyon arroyo. This innocent-looking wash has a drainage basin of more than 400 square miles and has been the cause of several serious floods.
1.3		
26.6	2.4	Junction with U. S. Highway 285. Continue southwest.
0.8		
25.8	3.2	Carlsbad city limits.
1.1		
24.7	4.3	The Hackberry Hills to the west are underlain by rocks of the Carlsbad group.
1.9		
22.8	6.2	Entrance to Carlsbad airport.
0.4		
22.4	6.6	Caliche pit to east. Caliche is a calcite-impregnated soil formed in arid regions where water containing calcium ions rises to the surface and combines with carbon dioxide produced in the soil. Below a thin surface crust the caliche is earthy, and it is extensively mined in this area for use on road surfaces where it hardens on exposure. An 8-foot thickness is exposed in this pit.
4.4		
18.0	11.0	Pump of the one-well Dark Canyon oil field one fourth mile to the west. This well produces from sandstone at the top of the Delaware Mountain group at a depth of 1,900 feet.
1.4		
16.6	12.4	The pink and white hills to the west are underlain by the Rustler formation of Permian age, youngest bedrock formation to be seen along the route of the road log. The Rustler consists of dolomite rock, sandstone, gypsum rock, and rock salt; but the salt does not appear at the surface because it has been dissolved by ground water.
1.1		
15.5	13.5	Roadcut. Culebra dolomite member of the Rustler formation. The Culebra is distinguished by one fourth inch pock marks on weathered surfaces. Irregular solution of salt below the outcrop has caused contortion and fissuring of the beds.
0.7		
14.8	14.2	STOP 1. Good view to the northwet of the relationship between the Rustler formation and underlying rocks. The Culebra dolomite member caps the Frontier Hills to the right and the red rocks below are the lower part of the Rustler formation. The valley is underlain by residue from rock salt of the underlying Salado formation which is largely covered by alluvium. The hills to the left are underlain by the still lower Carlsbad group except for a narrow wedge at the base
1.7		

of the scarp where the Capitan limestone appears. The dip of the Rustler formation here of about 25° east did not result from mountain-building forces but from draping of the Rustler over the Capitan limestone when salt and gypsum present to the right were removed by ground water.

13.1 15.9 Road to east to Black River. Continue straight.
0.2

12.9 16.1 The reddish bluffs in the stream bank about one fourth mile to the
1.5 east is an outcrop of residue from the salt-bearing Salado formation.

11.4 17.6 The escarpment to the west is capped by the Tansill formation, upper
formation of the Carlsbad group. The Capitan limestone crops out
2.0 on the lower slopes.

9.4 19.6 The white rock on the shoulders of the road is gypsum rock or ala-
baster in the Castile formation. The Castile directly underlies the
1.5 Salado formation and terminates abruptly against the Capitan lime-
stone.

7.9 21.1 Turn west on state road 7 toward Carlsbad Caverns. A good view in
the distance of El Capitan and the escarpment of the Guadalupe
Mountains. (South of this point 14 miles is a remarkable exposure
of gypsum rock of the Castile formation in a highway roadcut. The
0.2 rock contains thin laminae of calcite, and each calcite-gypsum pair
is thought to represent the deposit of one year.)

7.7 21.3 White's City, owned by Charlie White who homesteaded 140 acres
here about the time the caverns were opened by the government.
0.4 Charlie is no relation to Jim White, explorer of the caverns.

7.3 21.7 Park entrance. Massive rock at the base of the cliff to the south is the
0.5 Capitan limestone, the formation containing the main part of Carls-
bad Caverns.

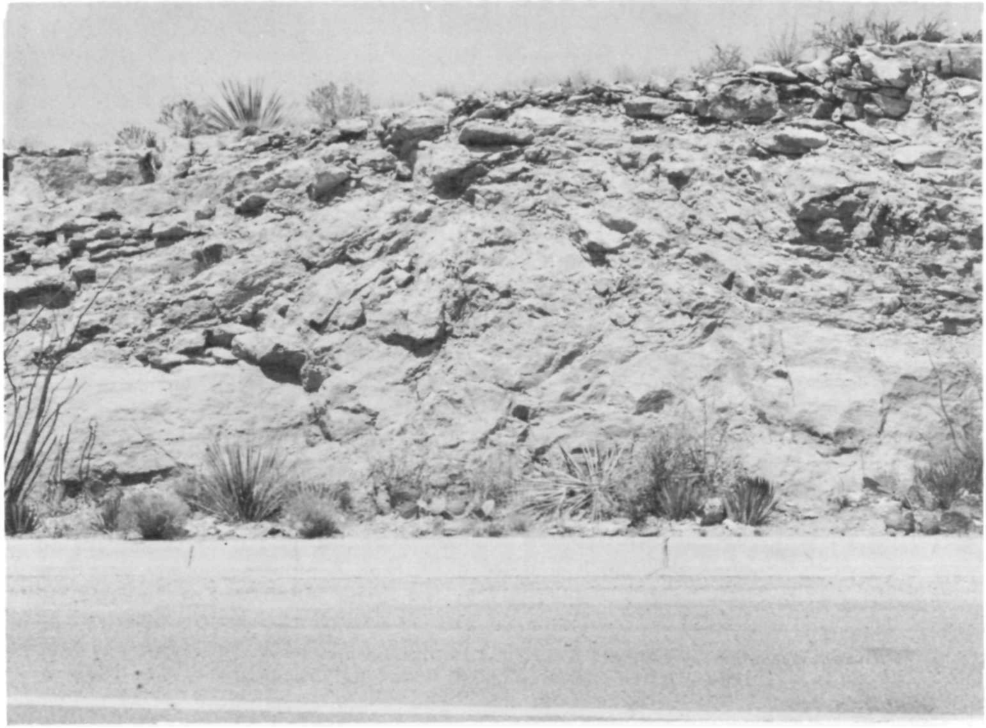
6.8 22.2 STOP 2. Turnout to south. Looking to the east toward White's City,
the lateral change from the Carlsbad group to the Capitan limestone
can be seen. A sandstone bed in the Carlsbad group follows the line
of green shrubs halfway up the slope. It ends abruptly at a cluster of
0.2 bushes. Beyond this point the thin-bedded dolomite rock and quartz
sandstone of the Carlsbad group is changed into massive limestone
of the Capitan. The contact cuts diagonally across the bedding.

6.6 22.4 STOP 3. Turnout to south. Excellent exposure of a fault in the road-
cut to the north. Orange sandstone of the Yates formation is faulted
down against dolomite rock lower in the Yates formation. The Yates
0.3 is the middle formation of the Carlsbad group. The upper is the
Tansill formation and the lower, the Seven Rivers formation. Each is
equivalent in age to a different part of the Capitan limestone with
which they all interfinger.

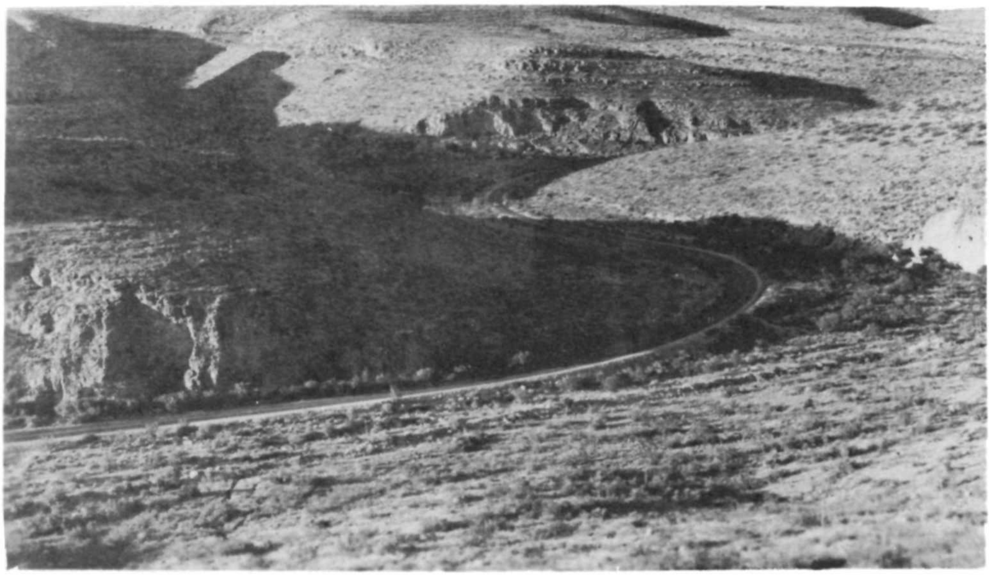
This fault passes 100 feet to the right of the gully on the other side of the canyon. Another fault of opposite displacement cuts the rocks 300 feet to the left of the gully. The gully and prominent buttress to the left have been displaced downward 50 feet as parts of a keystone block or graben.

The dolomite rock in the roadcut contains many pisolites — small spherical bodies one half inch in diameter. On close inspection, their concentric internal structure can be seen. The pisolites were

			formed as algal or bacterial colonies in a saline lagoon.
6.3		22.7	Yates formation showing distortions of bedding. These distortions were probably caused by daily thermal expansion and contraction of the thin beds during their deposition in shallow water. The cracks that formed during contraction became filled so that later expansion caused buckling.
	1.2		
5.1		23.9	A sandstone bed low in the Yates formation. These are the oldest rocks that will be seen on the route of the road log. They are Permian. The Seven Rivers formation lies below the floor of the canyon.
	0.2		
4.9		24.1	Tent-shaped distortion of bedding to south.
	2.0		
2.9		26.1	More good exposures of tent structures in cliff face.
	0.5		
2.4		26.6	Excellent section of the Yates formation to the north. The contact *with the overlying Tansill formation is at the top of the two sand*stone beds marked by the line of shrubs just below the steep cliff at the summit.
	0.3		
2.1		26.9	STOP 4. The sandstone bed in the roadcut marks the top of the Yates formation. Another bed is just below road level. Note the water coming from the sandstone. Sandstone beds are the principal aquifers in this area, and all the springs issue from them. In the cliff beyond the horseshoe bend in the road, the two sandstone beds can be seen at the top of the Yates. Note that when the sandstone beds are traced in this direction they sag, reach a low point several hundred yards north of us, then rise to our position. This sag is the Walnut Canyon syncline. It may have resulted from leaching of rock salt or gypsum at depth.
	0.9		
1.2		27.8	Typical dolomite of the Tansill formation in the roadcut. The Bat Cave part of the caverns is in this formation where the rock has changed to limestone.
	0.2		
1.0		28.0	Road to south. Continue straight. Steep dips into Walnut Canyon syncline can be seen to north.
	0.4		
0.6		28.4	Road to south. Continue straight.
	0.2		
0.4		28.6	The sandstone bed in the roadcut is the uppermost of two thin beds in the Tansill formation. The other crops out near the mouth of the caverns.
	0.4		
0.0		29.0	Flagpole at visitor's center, Carlsbad Caverns. The low plain to the south is underlain by soft gypsum rock of the Castile formation which has been etched out by erosion. Guadalupe Peak on the skyline to the southwest, the highest point in Texas, is capped by rocks of the Carlsbad group. El Capitan, the scarp below Guadalupe Peak, is the type locality for the Capitan limestone.



Teepee structure or tent-shaped distortion in Tansill formation



Walnut Canyon

GEOLOGY OF CARLSBAD CAVERNS, NEW MEXICO

George W. Moore

Two features of Carlsbad Caverns, which taken together distinguish them from other caves, are the relatively great depth and immense size of rooms, especially the Big Room (fig. 1). The total depth of the caverns extending from the visitors' center on the surface to the level of Lake of the Clouds in the Left Hand Tunnel is 1,092 feet (Slemaker, 1958). From the ceiling of the natural entrance to the surface of the lake, the depth is 1,011 feet. The Big Room is T-shaped with a 1,100-foot cross arm and a 1,800-foot pedestal; at its widest point the room could contain a circle 300 feet in diameter.

GEOLOGIC SETTING

The enormous size of Carlsbad Caverns has resulted from geologic processes operating in an unusual setting - - perhaps one that is unique. Most caves lie in beds of limestone that are relatively thin but extend as flat or folded layers for hundreds of miles. The Capitan limestone, which contains the main part of Carlsbad Caverns, although over a thousand feet thick, is only a little wider than the caverns themselves. The limestone is about three miles wide and is exposed in a belt from El Capitan, a mountain escarpment 30 miles southwest of the caverns, to a point 10 miles northeast of the caverns where it dips beneath younger rocks (fig. 2). Wells drilled for oil have shown that it continues underground for more than 200 miles, still less than five miles wide, until it again rises to the surface in the Glass Mountains of Texas. The linear shape of the Capitan limestone is not due to erosion but is its original form. The limestone is a massive rock wth indistinct bedding and hence was especially favorable for the development of a cave of such majestic proportion. The Capitan limestone was deposited in Permian time, about 200 million years ago.

North of the narrow outcrop belt of the Capitan limestone lie the Carlsbad group and underlying Queen and Grayburg formations (Hayes, 1957; Hayes and Koogle, 1958). The Carlsbad group consists of interbedded sandstone and dolomite rock and was formed at the same time as the Capitan limestone with which it interfingers. The Queen and Grayburg formations also are composed of sandstone and dolomite but are slightly older than the Capitan. The interfingering relationship between the Carlsbad group and the Capitan limestone is illustrated in figure 3. Toward the Capitan the beds of dolomite rock grade into thin-bedded limestone which gradually is replaced by massive limestone of typical Capitan lithology. Thin beds of quartz sandstone within the Carlsbad group thicken slightly near the Capitan limestone and then pinch out abruptly as they pass into it.

South of the narrow belt of the Capitan limestone, the massive limestone interfingers with sandstone and fossiliferous limestone of the Delaware Mountain group. The transition between the Capitan limestone and the Delaware Mountain group on the south is much the same as the change to the Carlsbad group on the north side of the Capitan belt.

Overlying the Delaware Mountain group south of the caverns is the Castile formation, which consists of more than a thousand feet of gypsum rock and includes some beds of rock salt. The gypsum of the Castile formation is much less resistant to erosion than the limestone of the Capitan so it has been stripped away leaving the steep escarpment south of the caverns.

The unusual shape of the Capitan limestone, only a few miles wide but hundreds of miles long, has been considered by many investigators as evidence that the Capitan was deposited as a barrier reef similar to the Great Barrier Reef on the east coast of Australia (Lloyd, 1929; King, 1948; Newell and others, 1953). The barrier-reef concept is illustrated in an excellent exhibit in the museum at the cavern headquarters. According to this hypothesis, rocks of the Delaware Mountain group were laid down in relatively deep water on the seaward side of the reef and rocks of the Carlsbad group were deposited in a shallow lagoon. At the close of deposition of these formations, the water on the seaward side of the barrier reef became isolated from the remainder of the ocean and evaporation caused it to become highly saline so that the gypsum and salt of the Castile formation were deposited. This increase in salinity also killed the the organisms living on the reef and further growth of the reef was arrested.

After deposition of the Castile formation, a highly saline sea inundated the entire area, and 1,500 feet of rock salt and gypsum of the Salado formation were deposited directly over the present position of Carlsbad Caverns. This material is very easily eroded and has now been removed from the caverns area, but it still lies east of White's City (fig.2) and at depth contains valuable deposits of potassium minerals which are mined east of Carlsbad (Jones, 1959). Even in this semi-arid climate the salt does not crop out; ground water has dissolved the salt to an average depth of 300 feet and the Salado formation crops out as a leached residue with a thickness of only about 200 feet. The residue consists of a brecciated mixture of orange and white gypsum blocks and silt impurities remaining from the solution of the salt.

Overlying the Salado formation to the east and appearing at the right border of the geologic map (fig. 2) is the Rustler formation. It contains some rock salt as well as dolomite rock, yellow standstone, gypsum rock, and redbeds.

This then is the geologic setting of the raw material from which, at a much later time, Carlsbad Caverns were carved.

ORIGIN OF THE CAVERNS

Although limestone is a strong rock, it is soluble in acid, and even very dilute acid operating over a long period of time will dissolve it. Ordinary ground water may possess such acidity. This unique property of limestone solubility explains why caves are present in this type of rock the world over.

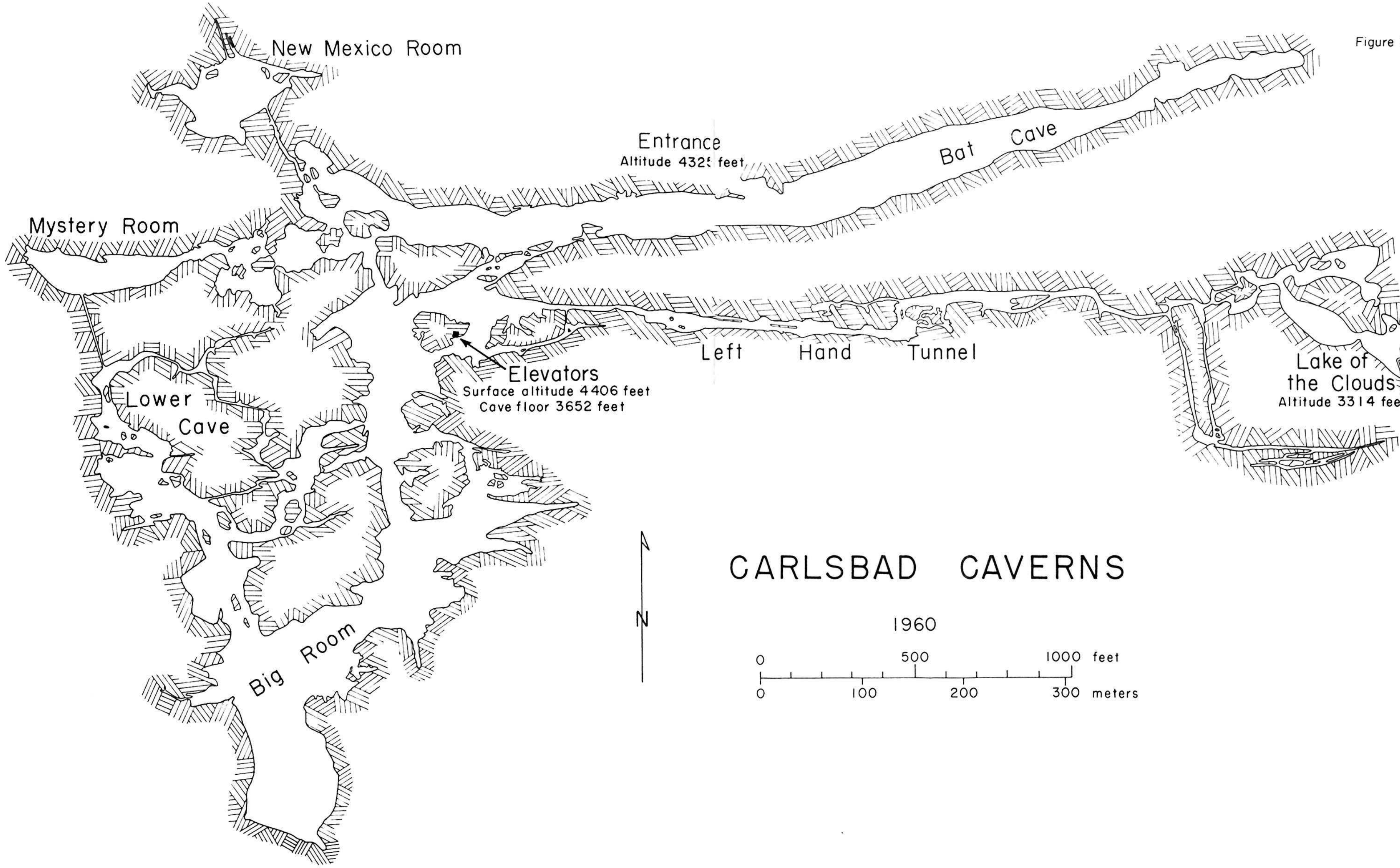
Until fairly recently it was generally supposed that caves were formed when limestone was dissolved by water descending from the surface. As detailed maps of caves were prepared, however, certain characteristics of cave patterns became evident which suggested that caves are not enlarged by downward-moving water but are formed below the top of a zone that is saturated (Davis, 1930). This is the zone to which wells are drilled to obtain a continuous supply of water. If caves were formed by water flowing downward in the near-surface zone of percolation, the passages ought to have patterns like surface streams where tributaries join and rejoin into larger and larger trunk channels. But most cave passages tend instead to have irregular or network patterns in which passages divide and come together again to form a labyrinth of interconnected passages.

The formation of Carlsbad Caverns in the zone of saturation is strongly suggested by the irregular interconnected passages, by sponge-like solution pockets in areas such as the Boneyard, and by openings along long straight fractures or joints as in Bat Cave and the Left Hand Tunnel.

When it was first realized that caves are formed chiefly in the zone of saturation rather than by percolating water or underground rivers, the solution was assumed to take place at random depth in the zone of saturation. Later studies showed, however, that most caves form along definite horizontal zones or cave levels about 50 feet thick where the greatest solution takes place (Davies, 1953). These cave levels are directly below the nearly horizontal surface of the zone of saturation. At least three such cave levels, each one indicating a different position of the zone of greatest solution at a different time, are represented in Carlsbad Caverns.

Where caves are in flat-lying beds of limestone, it is not always possible to be certain that solution has taken place in a horizontal layer at the top of the zone of saturation because differences in the solubility of different limestone beds would also give a horizontal character to the passages. But in caves in folded limestone (or in caves such as Carlsbad Caverns) where there is an abrupt lateral change to rock of different character and solubility, horizontal solution along former surfaces of the zone of saturation is easily proved. Figure 3 illustrates the way a horizontal level extending from the New Mexico Room to the Big Room transects different layers of

Figure 1



rock. This is the main cave level lying about 750 feet below the surface. Lower Cave and part of the Left Hand Tunnel have been developed along a zone below this Big Room level, and Bat Cave has been developed along another level much nearer the present surface of the ground.

The principal formation of Carlsbad Caverns by dissolving of limestone began at a time when the rock was saturated with water to a level at least as high as the ceiling of Bat Cave, approximately 50 feet below the present ground surface. Through the course of a long history, the surface of the zone of saturation moved generally downward — not uniformly but in successive steps with long periods of stability during which the main parts of the cave were hollowed out directly below the top of the zone of saturation. The water surface was stable for an especially long time at the Big Room level during the period when the large rooms on that level were made.

Limestone caves are formed as one phase of the destruction of a landscape by erosion, hence they themselves tend to be ephemeral and do not have a long geologic history. Evidence from fossils does not closely define the age of Carlsbad Caverns. The caverns cannot exceed an age of 200 million years (Permian), the age of the enclosing limestone, or have an age of less than a few thousand years (Pleistocene), the age of a ground sloth whose bones were found in the cave. The structural history of the region, however, allows a closer estimate of the age of the caverns. The Guadalupe Mountains, including the area of Carlsbad Caverns, were uplifted in late Pliocene or early Pleistocene time (King, 1948). Prior to the uplift of the mountains, when thick layers of Salado, Rustler, and overlying formations extended across the area of the caverns, the top of the zone of saturation would have been far above the level of the caverns. It was only following uplift and denudation of the area that the top of the zone of saturation was lowered to the level of the caverns and extensive cave devlopment could take place.

In some parts of the world it is possible to correlate cave levels with the levels of terraces cut by rivers on the surface which controlled the water level in caves. In this area, however, the terraces and deposits of the Pecos River have been so disrupted by collapse caused by solution of salt at depth that it has not been possible to use this technique. The evidence available from the structural history, however, suggests that Carlsbad Caverns were formed in late Pliocene or early Pleistocene time, about 1-5 million years ago.

After the development of the caverns, the soft gypsum rock was eroded from the escarpment, and Bat Cave Canyon was deepened to partly expose the caverns. While the lower levels of the caverns were being formed, the upper levels were drained of water. Even today new caves are probably developing east of Carlsbad Caverns where the Capitan limestone dips down and intersects the present zone of saturation.

CAVERN SEDIMENTS

Deposits of sand and silt lie on the floor of the cave in many places (Bretz, 1949; Good, 1957). These deposits are associated with blocks of limestone which collapsed from the ceiling as solution of adjacent rock removed their support. The sand shows cut-and-fill structures suggesting it was deposited from fairly rapidly moving water, and the silt and clay may have been deposited in pools or in slowly moving water. These deposits are more than six feet thick in the middle of the Big Room. The material probably consists partly of insoluble residue from the limestone and partly of surface residuum carried into the cave during the period when the rooms were changing from water-filled to air-filled conditions.

In the Lower Cave there is an abandoned channel of a former cave stream which cut a trough in earlier deposits of cavern sediment. Pebbles and cobbles in the channel indicate that the stream was rather swift. But where the stream channel impinges against limestone, the rock is little cut suggesting that the stream flowed at a relatively late time in the history of the cave and was short lived.

In the Bat Cave part of the caverns, extensive beds of guano were mined before the caverns became a national park. The dark brown deposits of bat droppings are interbedded with layers of silt and flowstone. One typical section consists of 6 feet of guano, overlain by 9 feet of silt, overlain in turn by 4 feet of interbedded silt, flowstone, and guano. The guano has been chemically changed during thousands of years of burial and this alteration makes it especially valuable as a domestic fertilizer. Between 1903 and 1923, 100,000 tons were taken from the caverns, and mining of similar deposits continued in New Cave until 1957.

SPELEOTHEMS

Carlsbad Caverns exhibit a remarkable variety of stalactites, stalagmites, and other speleothems deposited from water entering the cave. Because of the high humidity of cave air, the rate of evaporation is low, and stalactites and stalagmites are formed, not principally by the evaportion of dripping water, but by chemical change which occurs as carbon dioxide gas is released from the water. Water descending from the ground surface becomes charged in the soil with carbon dioxide produced by the decay of plant material. Soil air may contain 10 percent carbon dioxide - - 300 times the amount in the atmosphere. The dissolved carbon dioxide combines with water to form carbonic acid, which has the ability to dissolve limestone and carry it in solution. When water containing dissolved limestone enters the cave, the carbon dioxide in the water escapes because of the lesser amount of carbon dioxide in the cave air, just as it does from an uncapped bottle of soda water. This escape causes redeposition of

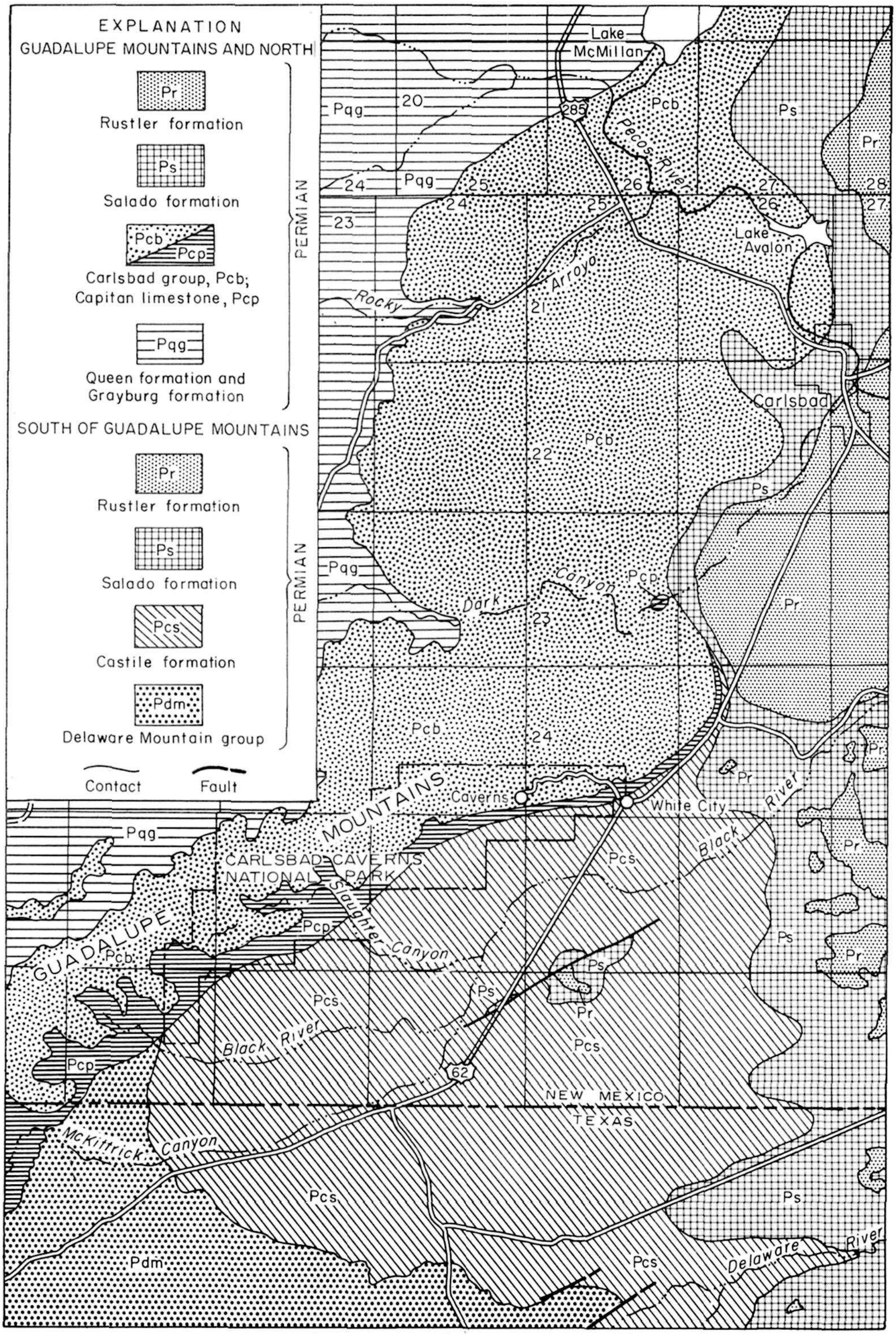


Fig. 2. Bedrock geology of the Carlsbad Caverns Area, New Mexico

the dissolved limestone and formation of a stalactite usually composed of calcite ($CaCO_3$).

When the water first enters the cave it is rather strongly charged with carbon dioxide, and deposition after spontaneous loss of the gas is rapid. At this stage a a small ring of calcite with the diameter of a water drop is formed on the ceiling. This ring has the unusual property of being part of a single crystal. As a result of the continual flow of water, the rings grow into tubes about the size of straws and in places more than a yard long, yet they have the same crystal structure as if they were cut from a large vertical crystal of calcite.

Stalagmites, flowstone, and outer parts of conical stalactites, however, have a different arrangement of crystals. Their crystals radiate outward and are everywhere perpendicular to the surface of growth. This change in crystal form is related to a change in the mechanism of deposition. Carbon dioxide commonly can maintain a supersaturated solution in water for long periods. The deposition of the tubular stalactite takes place from an extremely supersaturated solution, but after this initial deposition has occurred, if chemical processes were to operate alone, sustained supersaturation would hold the remaining mineral matter in solution and prevent subsequent deposition. The abrupt change in the character of the crystals may reflect deposition as a result of biochemical processes in the cave. Bacteria are abundant in Carlsbad Caverns (Gerundo and Schwartz, 1949), and the activity of bacteria is suggested as a possible cause of deposition of these radiating crystals either as an incidental or an essential part of their life processes.

The rate of growth of stalactites and stalagmites has long attracted interest. The rate is variable, however, and is dependent on the rate of water flow, the concentration of mineral matter in solution, and other factors. The most precise information on rate of growth available at present was obtained at Moaning Cave, California (Broecker and others, 1960). The rate of growth of stalagmitic material in that cave, based on the radiocarbon method of dating, is one inch of thickness in 400 years. Probably this value is near the rate that existed in Carlsbad Caverns when the deposits were actively forming, but at the present time most speleothems in the caverns are dry and dormant; therefore their age must be even greater than implied by this slow rate of growth.

In the New Mexico Room, in contrast to most parts of the caverns, deposition is still continuing at a fairly rapid rate. A steeply dipping bed of sandstone crops out in the walls of the room, and this sandstone bed serves as a aquifer which carries water to the speleothems (dotted line on figure 3). Many of the beds of sandstone in the Carlsbad group are water bearing, and Oak Spring, a former water supply for the park about a quarter of a mile northwest of the cavern entrance, derives its water from one of these sandstone beds.

Remnants of an extensive bed of gypsum that originally was more than 10 feet thick cover part of the floor of the Big Room. The top of the gypsum layer is at approximately the same altitude as a horizontal line marking a former water level on the wall of the room. The gypsum covers some calcite speleothems but it is in turn overlain by large stalagmites indicating that it is fairly ancient. The gypsum crystals grew in a cave pool possibly by reaction between calcium carbonate and a solution of sodium or magnesium sulfate. In places cylindrical holes have been dissolved through the gypsum by the solvent action of dripping water.

Helictites, or twisted stalactites, are especially well developed in the Queens Chamber where they curve at random on the ceiling. Each helictite has an almost microscopic central conduit passing along its axis. Water moves under pressure through this conduit, and deposition takes place at the tip. The flow of water is so slow that drops never form and gravity therefore has no effect on the direction of helictite growth. Each small addition is in the form of a cone on the tip, and a helictite may be visualized as a nested stack of ice-cream cones. Each cone is part of a separate crystal of calcite, and the individual cones are distorted by the tendency to form crystal faces. The distortion of the cones causes the nested stack to be curved and is the cause of the curvature of the helictites.

One of the most interesting mineral deposits in Carlsbad Caverns is moon milk, which occurs in damp parts of the cave. Moon milk is a white plastic mixture of very fine crystals of hydromagnesite ($Mg_4 (OH)_2 (CO_3)_3$) and water (Davies and Moore, 1957). It has somewhat the texture of soft clay, but the water is expelled when it is squeezed. The name moon milk comes from 15th century mountain people in Switzerland who worshipped gnomes that were thought to live in caves. They called this substance from Swiss caves **Mannlimilch** or **Monmilch** (gnomes' milk). In 1555 Gessner used the form **Moonmilch,** which ultimately led to the present name. The ancients considered moon milk to have magic medicinal properties, and in the 16th and 17th centuries the dried powder was used by physicians to stop bleeding and as a dehydrating agent. When moon milk is disolved in weak acid, a residue of microorganisms remains (Hoeg, 1946). It is therefore thought that the substance is produced by bacteria or other microorganisms living in the cave.

The geologic development of the different phenomena found at Carlsbad Caverns began 200 million years ago when the rocks were laid down and required the interaction of many processes. In interpreting the phenomena we are reading a complicated history recorded only here and there by characteristic elements of erosion and deposition. Much evidence is missing, so the history can never be entirely known, but this uncertainty adds to the mystery of the caverns and challenges further inquiry.

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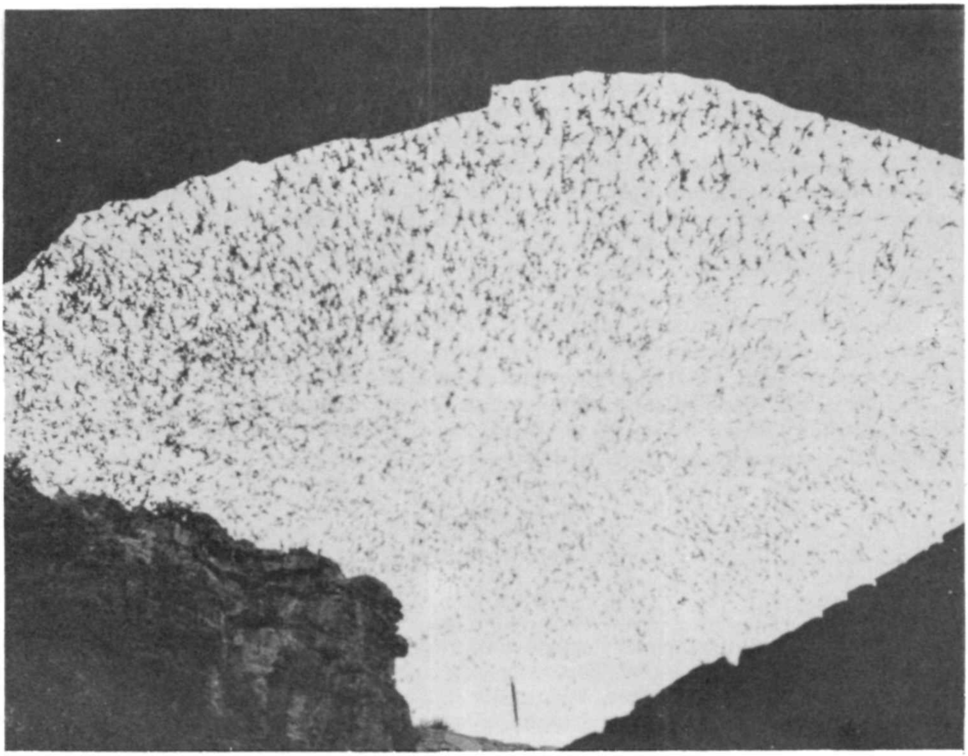


Bat Flight as seen from natural entrance to Carlsbad Caverns

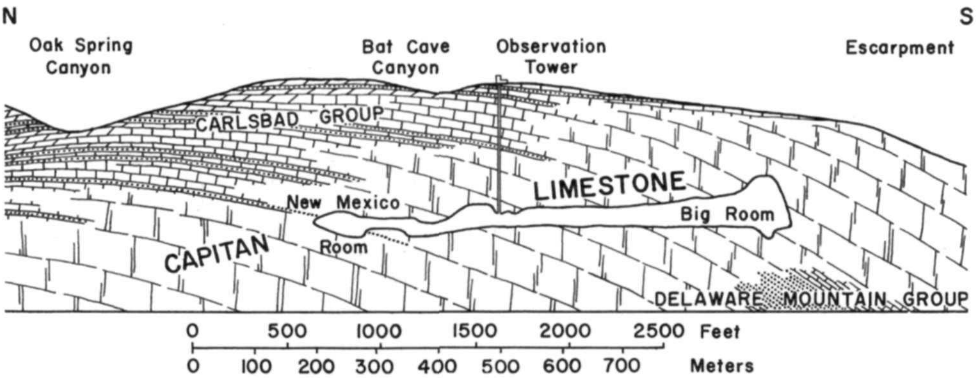


Fig. 3. Partly Hypothetical Cross Section through Carlsbad Caverns

THE FIRST HUMAN INHABITANTS OF THE REGION

Paul F. Spangle

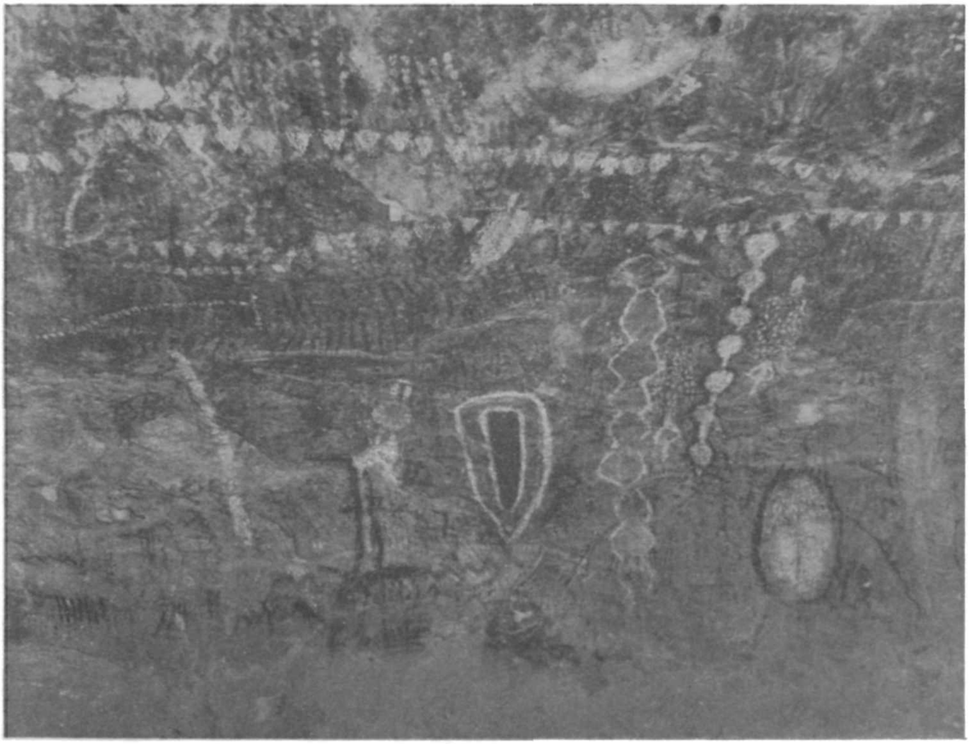
Southeast New Mexico has long interested students of archeology because of the complex story of the early Americans. As the first Spanish explorers journeyed from Mexico up the Pecos River and the Rio Grande River in search of the fabled Seven Cities of Cibola, they encountered the plains-dwelling Lipan Apaches east of the Pecos. To the West of the slow-moving explorers, along the slopes of the Guadalupe and Sacramento mountains, small bands of fierce Mescalero Apaches watched their progress. To the north, these first European explorers encountered another group of people, the Pueblo Indians.

Later explorations throughout the Southwest brought to light the fabulous remains of extensive cultures that flourished in the 12th and 13th centuries. Study of these long-vanished people led to the discovery of a much earlier group called the Basketmakers, named in tribute to their excellent basketry. Even later discoveries scattered in caves and open sites throughout the Southwest pushed the appearance of man in the new world back at least 20,000 years.

With the influx of settlers in the foothills of the Guadalupes, shortly after the Civil War, there came the discovery of use of the region by people before the then-reigning Apaches. Discovery of the entrance to Carlsbad Caverns in the early 1880's proved to be only a re-discovery — paintings on the walls of the entrance, rings of fire-broken stones, and mortars ground in ledges pointed to intensive use of the area by a tribe of people existing by hunting and gathering wild plants. Who were these people? How long ago did they occupy these mountains; when and where did they go? These questions and many others have been under study since the 1930's and we still know very little about these people. The sketchy evidence now at hand indicates that there may have been two or more distinct groups — the earliest dating back at least 10,000 years and the second group occupying the Guadalupes until the late 1200's. By the 1300's, Apaches seemed to have moved into the southern Guadalupes and at that time we lose contact with the early people. The generally accepted theory is that the pressure of the nomadic Apaches forced these people to move southward to join similar groups in West Texas and Mexico.

In 1957 a study was instituted in the park to provide answers to the many questions originating from earlier sporadic archeological studies. This study is still under way, with a number of significant discoveries coming to light. During the study, all available publications dealing with the archeology of the region were examined to provide background information. Early work by E. B. Howard in 1932 turned up an association of extinct animals such as the horse, 4-horned antelope, and musk-ox with early man remains. In 1958 this apparent association was further verified by the use of Carbon-14 dates from another site dug by Edwin Ferdon. Three samples provided dates of 11,850 to 12,900 years! This same site dug by Ferdon, Hermit Cave, provided stratigraphic evidence of three distinct cultural levels or times of occupancy of this one cave. The earliest, those people living there 12,000 years ago in association with now-extinct animals. The second occupancy was typical of the West Texas- Hueco Basketmakers, a group associated with the so-called Archaic Desert Culture which is inadequately dated, but probably flourished 2-4,000 years ago. The third or uppermost level told of influence of the great Pueblo Period of 1250 - 1300 A. D. because of the pottery fragments recovered. Here the story of Hermit Cave ends until the arrival of James Picket, the hermit inhabiting the cave at the time of the excavation.

Results of the local study within the park show that the early inhabitants of the region lived in caves, natural rock shelters, and probably open campsites in warmer weather. There is very little evidence of cultivation, but rather a livelihood of hunting and the gathering of plant food. The so-called "Cooking Pits" may have been mescal pits, commonly used by the Apaches. Primitive people though they were, they left examples of their fine basketry and artistic paintings on the walls of many rock shelters. Thus, little by little, we are learning about the people first to see the entrance to Carlsbad Caverns.



Early Indians left Pictographs on Rock Shelters and Canyon Walls.

Typical Cooking Pit

EARLY HISTORIC EVENTS

Dale Giese

In 1912 New Mexico was admitted to the Union. The story begins a long time before this with the entry of man into the New World about fifteen to twenty-five thousand years ago. We believe that they moved toward the Southwest and eventually into the southeastern part of what is now New Mexico and into western and northern Texas. Here they stayed many thousands of years dividing into many Indian groups.

In the year fifteen hundred and forty, Coronado marched north from Mexico into the unexplored Southwest. Many wars resulted in the Spaniards' search for gold and their desire to spread Christianity. The country which they found was quite unlike the country in which we live today. The grasslands must have been of a fine quality. Alvarado, Coronado's captain, spoke of the many buffalo that he saw by saying, "There are such multitudes of them that I do not know what to compare them with unless it be the fish of the sea."

Actually there were three factors which brought the Spanish into this part of the country. The Spanish were after gold of which they had heard many tales. Upon learning this, the Indians started to obliterate all traces of their mine workings. Many chapters could be written about white man's search for these mines in later years. The Spanish rancheros also needed more land for their stock. One Texas historian noted that cattle were grazing north of the Rio Grande in what is now Texas in the fall of fifteen hundred and eighty-three. The third factor centered around the Priesthood and the Catholic Church. Many expeditions which were sent out to rob, murder, and enslave the Indians had the blessings from their holy padres. Therefore, many things could be done under the guise of the Mother Church. In time, missions were set up on the frontier for military reasons and also to convert the heathen.

One group of Indians that gave the Spanish a lot of trouble was the Apache. The Spanish named them, "enemy." When the Spanish entered this area, they stayed in the valley near the Pecos River knowing that the fierce Apaches were in the Guadalupe Mountains area.

Many military expeditions came into this part of the country in the following years. One of these was headed by a Captain Pope in January 1855. Pope came to the Pecos Valley to establish a permanent garrison near the mouth of Delaware Creek. An adequate water supply could not be obtained and they had to give up in July 1858. A month later the site was re-occupied as a Butterfield Stage Station. The Butterfield Trail passed south of Carlsbad Caverns going from St. Louis to San Francisco.

In the eighteen hundred and eighties homesteaders moved into this area and set up ranches. After the Civil War there was a need for cattle and cattle range. During the war an industrial revolution had taken place and many people moved from the farms to help in manufacturing brought about by government contracts. Also at this time the government was offering assistance to railroads and now the ranchers had a form of transportation for their cattle.

The Eddy brothers came into this part of the country as cattlemen and the county of Eddy was formed from Lincoln County in eighteen hundred and eighty-nine. Here they found a paradise for cattlemen. Rich grass was abundant. In the eighteen seventies the "Buffalo War" was in full force. The buffalo hide was sold commercially and a good hunter could average between a hundred and fifty to two hundred buffalo a day.

At this time, many "characters" dispensed justice in this part of the country. Here was a sign one could have read in Langtry, Texas.

Judge Roy Bean, Notary Public - Justice of the Peace - Law West of the Pecos -
Ice Beer

Many disputes took place between cattlemen. One of these took place just to our north between John Chisum and Major L. G. Murphy. It was known as the Lincoln County War and one famous outlaw who took the side of Chisum was William Bonney otherwise known as Billy the Kid. At this time our territorial governor, General Lew Wallace, was then writing his famous novel **Ben Hur.**

The Southwest had been under the Spanish flag from the time of the Conquistadores until it was made part of independent Mexico in 1821. Under the provisions of the treaty of Guadalupe Hidalgo, this part of the country along with a great part of the Southwest was granted to the United States. An act of Congress established the territory of New Mexico in 1850 and it became the forty-seventh state in 1912.

We believe that it was in the 1870's or 1880's that the cavern entrance was rediscovered by some of the early settlers who came into this area. Many of them came to homestead and raise cattle, sheep, and goats. Some of these ranch headquarters were not very far from the cavern entrance.

One of the earliest visits into the cave was made by Rolth Sublett in 1883. Here is part of his certification:

> This is to certify that I, Rolth Sublett, of Artesia, New Mexico, Route No. 1, first visited what is now known as Carlsbad Caverns in 1883 when I was twelve years of age. I went down the natural entrance about sixty to sixty-five feet and then in the part where the bats stayed. The cave was known as Bat Cave. My father, William Caldwell Sublett was with me.

Another one of the early homesteaders who saw the entrance was Ned Shattuck. Ned and his father were searching for a cow that had strayed from the herd. To the best of his knowledge this was on August 2, 1885. Shortly after finding the cow, they saw many bats flying from the cave entrance and Ned described the bats as sounding like a "whirlwind."

In later years quite a few people entered the cave and found in the Bat Cave section a large quantiity of bat guano, or bat droppings, had been deposited. A placer claim was filed by Abijah Long on June 16, 1903, on 40 acres around the entrance of Carlsbad Caverns for guano and other mineral rights. The claim used the name, "Big Cave." Other claims were filed in 1908, 1910, 1912, and later.

A number of companies came into the cave with the idea of making a large profit in mining and selling this bat guano. Because of the rising cost of labor and transportation in the later years of mining, this operation was not quite as profitable as many had anticipated. There were as many as six companies engaged in the mining of bat guano at Carlsbad Caverns. Why did they mine this bat guano? Much of it was used as fertilizer and shipped to Southern California to be used in the orange and lemon groves. Quite a lot of it went to Redlands, California.

There was a man named James Larkin White who worked for all but one of these mining firms. Jim was a very interesting man who was well liked by all who knew him. He was very interested in the cave and wanted to see all of it that he could. At the same time he wanted as many of his friends to see it as possible. So Jim White started to explore with the help of his friends. He explored most of the cave and we give him credit for extensive exploration of Carlsbad Caverns. Jim White died in April, 1946.

Many stories began to spread about the size and beauty of the cave. In 1922 a party of thirteen men from Carlsbad and one from Loving came out to check on the validity of the stories. Needless to say, they were greatly impressed with what they saw. Shortly after this trip, a state legislator interested Commissioner William Spry of the General Land Office in the cave. Because of this he initiated a government investigation to ascertain if it would be suitable to be made a national monument. Mr. Robert A . Holley, a mineral examiner of that bureau, was given the responsibility for this investigation. The report that Mr. Holley made was very favorable indeed.

Here is part of his report:

> I enter upon this task with a feeling of temerity as I am wholly conscious of the feebleness of my efforts to convey in words the deep conflicting emotions, the feelings of fear and awe, and the desire for an inspired understanding of the Divine Creator's work presents to the human eye such a complex aggregate of natural wonders in such a limited space.

Mr. Holley's report was eventually studied carefully by Major Richard F. Burgess from El Paso and Vernon L. Sullivan and George Neal of New Mexico. Major Burgess, in particuar, was very anxious to have the cave developed and he influenced governmental agencies, members of Congress, National Geographic Society, and other organizations to make the cave better known and more accessable for visitation.

Major Burgess was instrumental in having a geologist, Dr. Willis T. Lee, visit the cave. The result was that Dr. Lee became very interested in the cavern and recommended that it be made a national monument.

The efforts of all of these men were not in vain for on the 25th of October, 1923, President Calvin Coolidge signed the proclamation creating Carlsbad Cave National Monument.

A National Geographic Society party, headed by Dr. Lee, started detailed explorations in March, 1924. The survey lasted some six months and in the findings appearing in the September, 1925 issue of the "National Geographic Magazine," Dr. Lee began his article by saying:

> Carlsbad Caverns, New Mexico, is the most spectacular of underground wonders in America. For spacious chambers, for variety and beauty of multitudinous natural decorations, and for general scenic quality, it is king of its kind.

In 1926, lights were installed in the King's Palace, and then placed in the Big Room in 1927. It was also in 1926 that the first telephones were installed in the cave. In the same year, the ticket office and the power house became the first permanent buildings. The Cavern Supply Company was organized in 1927 and given a concession to include the sale of lunches to visitors in the cave. During the period of Monument status, cavern exploration continued with the examination of the side chambers of the Left Hand Tunnel, the Mystery Room, and the New Mexico Room.

Many men were responsible for bringing about National Park status for the cavern. One of the foremost was Victor L. Minter, a former United States Bureau of Reclamation employee, part time clerk for the Monument, and later Secretary of the Carlsbad Chamber of Commerce. When United States Representative Simms of Albuquerque was in Carlsbad on business concerning the Avalon Reservoir, Mr. Minter asked him to initiate action to make the area into a park. Congressman Simms introduced the bill in the House where it passed and then it was passed by the Senate. The Carlsbad Caverns National Park Establishment Act was approved by President Herbert Hoover on May 14, 1930.

In 1931, an elevator shaft was cut from the surface to the underground lunchroom and two elevators were put into operation. In 1955, the second elevator shaft was cut and two additional elevators were installed. The visitor center was completed in May of 1957.

Today the park contains fifty-five thousand acres of land and the yearly visitation averages nearly five hundred thousand.

THE CHIHUAHUAN DESERT:
Its Trees and Flowers

Paul F. Spangle

What is a desert? Immediately you think of the shifting sand dunes of the Sahara; a winding column of camels making their way to a palm-fringed oasis. Perhaps the depths of Death Valley with its poisonous waters and furnace-like winds better fits your idea of a desert. Actually there are four desert areas in the Southwestern United States, each of them a distinct type, yet not fitting the popular idea of what a desert should be. First is the Sonoran Desert stretching from the arid west coast of Mexico and Baja California into Southwestern Arizona and Southeastern California; the Mojave Desert east of the Sierras of California; the Great Basin Desert covering most of Nevada and Utah and extending northward into Oregon and Idaho; and the Chihuahuan Desert extending from central Mexico into Southwestern Texas and Southern New Mexico. All of these deserts exhibit the same general features to some degree; light rainfall, and high summer temperatures.

Carlsbad Caverns National Park lies on the northern fringes of The Chihuahuan Desert zone, exhibiting many of the plants that are considered to be 'indicators' of this desert. Entering the park at the foot of the massive reef front these plants; creosote bush, catclaw, mesquite, yucca, and lechuguilla agave, are quite abundant. Driving through the reef front into Walnut Canyon, these same plants are evident, but a subtle change takes place in the plant life — the vegetation becomes thicker and more varied — Texas walnut, juniper, hackberry, Mexican buckeye, desert willow, goat bean, and many cacti appear. Why is this? Aren't we still in the desert? Yes, we are still within the range of the Chihuahuan Desert but as we enter Walnut canyon we begin to gain altitude slowly, thus changing life zones.

The United States has been divided into seven life zones ranging from the true tropics to the arctic zones. Generally the zones are controlled by altitude and temperature. In northern areas the arctic zone appears at a lower altitude than near the equator, ie; the arctic zone in northern Canada is near sea-level, and the arctic zone in New Mexico will be found between 11,000 and 12,000 feet above sea-level. Each of these life zones exhibit a certain group of plants as zone indicators. Here, within the park, are three life zones from the Lower Sonoran, up to the Transition zone in the northwest portions of the park.

Actually the Lower Sonoran zone is the only portion of the park that can be properly classified as being a part of the Chihuahuan Desert. They both contain the same general plants such as: creosotebush, catclaw, senna, goatbean, walnut, ocotillo, soapberry, barberry, Mexican buckeye, lechuguilla, sotol, yucca, and a variety of cacti.

As you reach the vicinity of the cavern entrance you have reached the second life zone, the Upper Sonoran Zone. Plants that indicate this zone most commonly are the one-seed juniper, gray oak, walnut, hackberry, apache-plume, sumac, saltbush, mimosa, bear-grass, century-plant, yucca, and cacti of many types. Many of the Lower Sonoran Zone plants of the Chihuahuan Desert may still be seen here.

The third or Transition Zone is found only high in shaded canyons and in the northwest corner of the park. Plants that exemplify ths zone are: ponderosa pine, Douglas fir, white oak, maple, New Mexico locust, choke-cherry, roses, and snow-berry. Here again plants of different zones will intergrade according to shade and moisture conditions.

Plants which are characteristic of a desert environment, like man, must adapt to its harsh demands; extreme heat will scorch or dry out many plants; lack of adequate moisture will prevent or retard plant growth. To exist under these conditions, many plants have had to adjust their normal way of life.

1. **A Short Life:** Many desert plants germinate, grow to maturity, flower, produce

Map of Southwestern Deserts

seeds, and then die in a matter of weeks or even days. In this way, spring rains and relatively cool weather allow the plants to carry out their normal life processes, but at a greatly accelerated pace. Various mustards, evening-primroses, and some grasses exhibit this process.

2. **Leaf and stem adaptions:** Normally, leaves of plants play a large part in the production of food. To do this, water and carbon dioxide are needed. To prevent the loss of water through extreme evaporation, leaves of desert plants may be coated by a heavy wax or resin to reduce water loss, as does the creosotebush. Another plant may put out leaves only when moisture is plentiful and then shed them when a dry period exists, as does the ocotillo. Many plants have even learned to do without leaves and have transferred their duties to stems, as do most cactuses.

3. **Other adaptions:** Those plants that live for years under arid conditions have further adaptions to tide them over. Many will develop two-fold root systems, long taproots to dig deep for permanent moisture, and a network of wide shallow roots to gather every available drop of rainfall. Other plants spring from bulbs or seeds capable of lying dormant for many years until favorable conditions stir them to life.

Plants have learned that life in the desert is possible!

ANIMALS OF THE PAST

James K. Baker

To learn of those animals of the past, we can only draw our conclusions as to what they were and when they were here by the often painstaking and time consuming tasks of searching for and determining as to classification and their position in the earth's crust the asemblages of fossilized remains they left behind. But only a few of the countless millions of animals that must have existed here in the past were preserved, and it was, perhaps, an exception, but fortunate that an animal was in such a position that its soft parts quickly rotted but the skeleton preserved in a gradually hardening matrix. In the area of the Carlsbad Caverns we find but two fossil assemblages representing two periods of our earth's history; an invertebrate fauna of the middle Permian and a vertebrate fauna of the late Tertiary. A study of these is but a means toward an end in achieving the complete interpretive story which is needed for the Park's past and present.

There is lithified in with the rock itself and a major constituent of it an invertebrate fauna and flora characteristic of the various facies of an organic reef. It is in this reef that the Caverns have since been hollowed. On its basin side the rocks are predominantly fine-grained and contain siliceous sponge spicules and certain of the pelecypods, brachiopods, and gastropods. Ammonoids are especially abundant in the deeper areas. Grading into the shallower edges of the basin is the detrital material from the reef front and crest that had accumulated as talus slopes. Great quantities of worn and broken brachiopods, bryozoans, and fusilinids, rolled down the reef front and were imbedded. Some were remarkedly preserved, however, and silicified. The Glass Mountains, a part of the reef in western Texas, are famous the world over for their whole, silicified fossils which can be extracted from the limestone matrix by acid. The Lamar limestones near McKittrick Canyon were the burying grounds for many millions of similar silicified fossils.

The reef itself is composed of a light-colored, grayish limestone. It has no stratification and was deposited as carbonates secreted through the life processes of the infinite number of marine organisms that lived upon it. Perhaps the largest contributors were the lime-secreting algae. Fusilinids, brachiopods, crinoids, nautiloids, trilobites, pelecypods, scaphopods, bryozoans, gastropods, and others occupied the reef in great profusion and added their skeletons to the calcareous deposits.

The lagoonal facies, or shelf province, contains relatively few and poorly preserved fossils. Some of the fusilinids, brachiopods, and gastropods, existed in water which must have exerted a broad range of environmental influences. Abundant pisolitic limestones, probably algal in origin, comprise large portions of the lagoonal deposits.

Along the surface areas of the Park many of the reef dwellers are exposed, etched out of the rocks by weathering processes and especially prominent are many of the silicified forms which stand out in great relief. Within the caverns, rock which is exposed and not covered by secondary formations often shows the reef organisms.

Subsequent periods of our earth's history covered the reef even though it is now exposed. Late Permian and Cretaceous seas deposited sediments which have since been eroded away. Only one small area of the Cretaceous still outcrops in the vicinity of the Park with fossilized remains of that period. Tertiary sediments are more abundant and the Pleistocene deposits of silt and sand are found in many of the caves. Along the canyon walls and entrance areas to several of the caves are brecciated deposits of Pleistocene debris.

In the silt and sand, many vertebrate remains are preserved and on occasion in great abundance. By correlating the genera and species they represent with the living forms of today we can assume the climatic conditions that existed in the past. Pollen grain analyses aid cosiderably.

As recent as 25,000 years ago a cool and very moist climate prevailed in the Carlsbad area which supported the growth of such trees as pine, fir, and spruce. It may have been at this time that excessive amounts of rainfall drained into the Cavern to flood the Big Room and help build the myriads of secondary formations. But it did support a fauna usually associated with a cool, moist, climate. Pollen that was contained in association with bone material in a cave north of the Park showed an arboreal-shrub component of pine, oak, walnut, and elm; indicative of a more recent mild temperate climate which still contained more moisture than today.

The cave remains of animals such as tree squirrels and mountain wood rat forms indicate a cooler, moister, climate with arboreal vegetation. Numerous red bats are mummified in the main caverns indicating they were once more common than today. The red bat is normally a tree-inhabitant.

The most numerous of the fossilized forms is an extinct freetail bat whose bones are preserved by the thousands in the silt and ancient guano deposits of New Cave and the main Caverns. Carbon-14 datings place the age of this bat to at least 17,800 years ago. But not only is the age of the bats an interesting find, the dating also helps to age the entrances to these caverns.

Contemporary inhabitants with the freetail bats were a now extinct species of jaguar and a giant ground sloth. The fierce jaguar had a den a short distance inside the Caverns and the huge cat was crushed when a rockfall pinned it between two large slabs of limestone. The ground sloth was a large vegetarian with a length of about eight feet and persisted to a very late date in the southwestern United States. It appears that this form was a contemporary also of early man. When the specimen in the Carlsbad Caverns died its bones were washed deep inside by a stream and deposited in a silt bank. The stream entered through the Cavern entrance and could have flowed only with a good supply of rainfall.

Bone material retrieved from other cave deposits in the Park and nearby vicinities contained remains of camel, musk-ox, 4-horned antelope, giant bear, large and small species of horse, caribou, bison, deer, and numerous rodents and birds. Today, the caribou and musk-ox are restricted to the arctic areas. Although they were of a different species, these forms inhabiting the Carlsbad area were indicative again of a a colder climate perhaps some 25,000 years ago.

A mild, temperate climate ensued and the pine, fir, and spruce retreated to the higher elevations and were replaced by such vegetation as oak, elm, and walnut. It may have been then the tree squirrels moved in for their period of existence. Grasslands followed and the great herds of bison, horse, camel, and 4-horned antelope had their stay. The horse and camel then met with extinction as did the jaguar and ground sloth but the bison and antelope, which was really not true antelope, gave rise to the bison that we know of today and the pronghorn which still inhabits the Park. Even into modern times, these animals ranged in great numbers and the bison were so numerous across the grasslands in the 1500's that the Spaniards likened them as to the fishes in the sea. Today, however, only a few small herds still exist.

The mild, temperate climate gave way to the semi-arid. No longer do we have the elm, and the oak is just a shrub. The walnuts have dwindled to occuy only the moister stream bed areas of the canyons. A desert vegetation of cactus, yucca, juniper, and others now prevail. Little of the grasslands remain and man himself with all his destructive forces has had much to do with this.

The animals of the past contrast sharply to the animals of today. The complete story of this change may never be known but with the few fossil remains we are able to find and identify we can add just that much more to the interpretive story of the Carlsbad area.

ANIMALS OF TODAY

James K. Baker

The Carlsbad area is situated upon an indefinite division line between the Upper and Lower Sonoran Life Zones. Near the city and along the Pecos River Valley is the Lower Sonoran, and grading through the Park area, into the Transition Life Zone of the higher Guadalupe Mountains, is the Upper Sonoran. Over much of this area the Chihuahuan Desert exerts its environmental influence and manifests itself upon the animal life of this arid region. The animals are not limited by any definite boundaries between the life zones and they may intergrade back and forth and sometimes for long distances into them. This overlap area falls upon the Carlsbad region and consquently a wide variety of animal forms are found.

The Chihuahuan Desert surrounds Carlsbad, and this open country is sunny and windy, and it often fluctuates sharply in its temperature; particularly from day to night and from summer to winter. Little vegetational cover is available to shelter its inhabitants from the direct rays of the sun. Air currents have a free sweep over this open desert and wind storms are seasonally frequent, driving dust and sand with terrific force.

As a desert, it comprises one of the major types of terrestrial environments and the extremes of temperature, wind, and visibility, help explain why many of its inhabitants have adapted themselves the way they are. The burrowing habit is quite widespread. Within a depth of several inches the damp soil temperatures approach the average annual temperature for the region. By burrowing, animals find protection from the heat of summer and the cold of winter and all classes of the vertebrates and many of the invertebrates have adapted themselves to this mode of living.

Of the mammals, desert rodents are the most numerous of the burrowing forms. In suitable areas they may dwell side by side and undermine wide stretches of the land. Kangaroo rats, pocket mice, grasshopper mice, rock squirrels, ground squirrels, and pocket gophers are examples of those which burrow in the Carlsbad area. But animals other than rodents are not excluded from this list for the badger, fox, skunk, and rabbit, and numerous species of the reptiles and invertebrates are also known to burrow or occupy the burrows of others. Those which do not burrow may accomplish the same effect by inhabiting spaces beneath piles of rocks.

But in the heat of the desert, animals will not only burrow but will seek any shelter to escape the sun. Temperature differences from day to night are often great and in the desert may be as much as 50°. Humidity will increase at night, as is evidenced by dew, and desert life becomes largely nocturnal and active only at night. Casual observations will seldom reveal desert mammals during daytime and for this reason they are often thought to be scarce. But they are common and numerous in their distribution. The animals, however, are not all nocturnal. Those that feed largely by sight, as many birds and lizards, and insects such a dragonflies and mantids, need daylight to hunt their food. But even these may be active only in the early mornings or early evenings. Those which can rely upon smell or other senses to search for food and which can be independent of the sunlight prefer the night.

Numerous of the desert species adapt themselves to the cursorial or running habit and/or the jumping habit for in the open desert speed in running and jumping is often necessary to escape predation. The pronghorn, mule deer, jackrabbit, and the kangaroo rats are examples of those mammals which will run or jump. Probably the swiftest mammal in North America is the pronghorn, common around the Caverns area. Of the birds, the roadrunner and the quail are able to run for long distances and it is often difficult for even a man to keep up with them. The Iguanid lizards run swiftly on their long powerful hind legs, keeping upright in dinosaur fashion. In the insect world, jumping or hopping is a very well developed mode of transportation in many species.

A keen eyesight, and sensitivity to smell and sound are also important assets.

Prairie dogs and the other ground squirrels sit upon their haunches beside their burrows and scan the countryside watching for predators. Rabbits which must depend upon flight for escape must be able to see for long distances. The golden eagle and other raptors, are birds of prey, hunt by sight and can see movements of small animals from hundreds of feet above the ground. The pronghorn is capable of seeing a moving coyote at several miles. As danger nears, the grid-iron lizard lifts its tail and waves it back and forth. The black and white bands on the tail stands out in sharp contrast and flash warnings easily seen by others.

Smell for many is extremely important to locate food or enemies. Sensitivity to sound is of lesser importance and is seldom used but in the open desert sound can be audible at great distance. Animals of the desert tend toward quietness and rely largely upon keen eyesight to keep together. As a matter of contrast, in forests, where individuals may be hidden from one another by dense vegetation, noisy groups like monkeys and parrots frequently use loud, shrill warning calls and whistles.

In the open areas of grasslands and deserts, mammals often pack or flock together. Pronghorn and often deer will travel as herds and large communities of ground squirrels (the famous prairie dog towns) and mammals such as the kangaroo rats often live in large numbers in close association. Coyotes will pack to hunt, taking turns to run a deer or pronghorn in wide circles, relieving each other in the chase until the hapless victim collapses from exhaustion. Then all move in to feast.

A chief problem for the desert animal is a source of water, for the desert is, of course, arid and watering holes are few and far between. Animals may inhabit the areas immediately surrounding water and seldom leave the vicinity. Of the larger mammals, the deer and pronghorns will range great distances from water. But what of the smallest mammals, the rodents, which are too small to travel great distances but yet are common throughout the desert. Many never drink, as such, and obtain their water from other sources. This group is best represented by the Heteromyid rodents. The moist earth of their burrows increases the humidity of the air inside and lessens the degree of body water lost through respiration from their lungs. Being nocturnal they are exposed to lower temperatures and relative humidities of night time air and this tends to reduce the rate of water loss also. They are able to exist primarily on moisture obtained from food plants. Their excrement is relatively dry waste material, and concentrating their urine enables them to re-use some of the water in their metabolism. Carnivores can utilize water from the blood of their victims. As a result of combinations of these different water producing and water saving adaptations, desert mammals may exist for months without drinking.

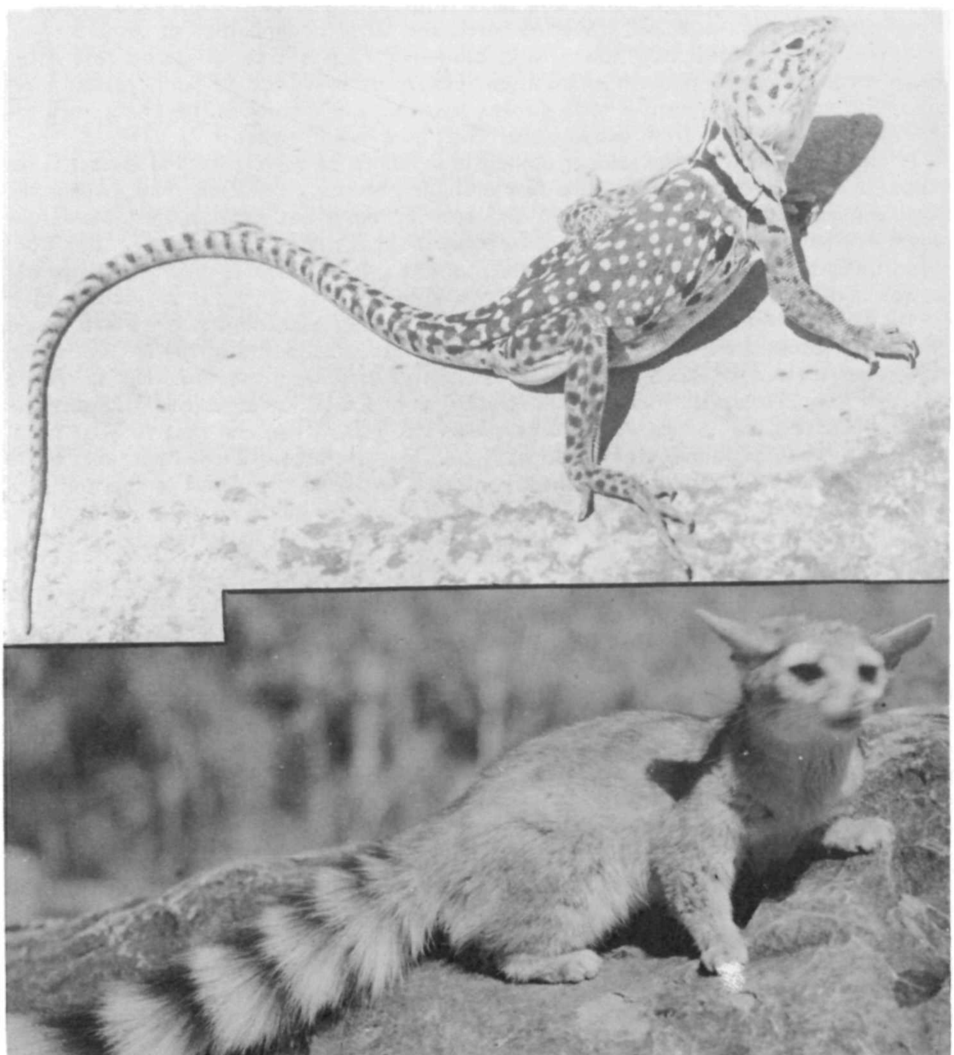
On a scale much larger than a burrow but with similar micro-climatic conditions of cool temperatures and high humidities, the cave environment is an important factor to the animal forms in the Carlsbad area. Many caves are to be found and a large percentage of desert life of all classes and sizes will inhabit the entrance areas and twilight zones for the cool temperatures and dampness they afford.

Bats are the animals generally thought in association with the cave environment and the bats, like most of the other animals, are nocturnal. They can inhabit damp caves and reduce the high rate of water loss which occurs through the thin membranes of their wings and tails. It is a bat, the Mexican Freetail, that is probably the most abundant mammal in the Carlsbad region.

Many, many, millions of these bats inhabit caves and buildings in the southwest. Their exit flights in the early evenings for a nighttime of foraging are a spectacle many have witnessed and remember for a long time. This mammal is the one most discussed and most often seen during the warmer months. At night they often flit down city streets around lights, and it is fascinating to watch them twist and turn in silent flight as they pursue the insects attracted to the lights. Other than the freetails, about 14 bat species occur in the Carlsbad area.

Desert animals often show a remarkable degree of protective coloration. The pale grayish, yellowish, or reddish colors of the desert soil and rock occur in many forms. Some of the masters of protective coloration are the locusts. They are as of the soil or the pebbles themselves. Almost impossible to see until they fly and flash the brilliant red and yellow colors of their wings, they alight and fold their wings and "disappear" with the blending of their background. But it is not only the locusts and numerous other invertebrates, but most of the snakes and lizards, and many of the birds, and numerous species of the mammals, also, that adopt the colors of the soils. *On the dark soils they are dark. On light soils they are light. Their very existence* depends upon this to hide from their predators and be hidden from their prey.

Animals in the Chihuahuan Desert, then, are not uncommon or scarce but are, for the most part nocturnal and burrowing in habit and therefore seldom seen. They can run and jump and they can see or hear or smell exceptionally well. They blend in colors with the soils and adapted as they are to the arid climate, may go for long periods with little or no water. The desert, as with any environment, does manifest itself upon its animal populations.



Collared Lizard **Ringtail Cat**

OTHER CAVES IN THE VICINITY

Bobby L. Crisman

The Guadalupe Mountains of southeastern New Mexico contain numerous caves. Little is known about many of these caves and there are probably dozens or perhaps hundreds more yet to be found in this region. The area is a relatively new caving region and little work has been done because of the extremely rugged terrain and the relative inaccessibility of its caves. Only a few jeep and horse trails lead into the rugged mountains west of Carlsbad Caverns National Park where the largest and best caves probably lie, and the difficulty of crossing canyons up to 1800 feet deep and slopes covered with thick stands of cacti makes travel in the area slow and tedious, especially when burdened with gear. Successful and profitable field work in this area will require numerous and extended overnight pack trips.

This article contains a brief report on some of the better known and most frequently visited caves in this area and a list of other rumored and reported caves that need additional investigation. It is hoped that this report will aid spelunkers interested in making additional field trips in this area. Informaton gained from such trips not included in this article should be reported to the Park Naturalist, Carlsbad Caverns National Park, for incorporation into the cave file for this area. Written reports will be appreciated greatly.

Within the confines of Carlsbad Caverns National Park there exist additional caves which are restricted to entry to qualified groups in pursuit of scientific study. Permission must be obtained from the Park Superintendent before entrv into these caves, and the group must be accompanied bv a member of the park staff.

COTTONWOOD CAVE

Cottonwood Cave is located in Lincoln National Forest about three eighths of a mile from the Dark Canyon Fire Lookout. Before entering this cave, or others in the National Forest, permission should be obtained from the District Forest Ranger at 109 North Canal Street in Carlsbad. The Dark Canyon Lookout can be reached with a jeep or pickup only. Without a jeep or pickup the walk to the cave is approximately three miles.

The entrance, which is rather large and impressive, lies about 100 feet below the ridge crest which is 6,850 feet in elevation. The exact location is marked on the U. S. Geological Survey **Carlsbad Caverns West** Quadrangle Topographic map.

The main chamber of Cottonwood Cave is about 700 feet in length, 50 to 100 feet wide, and the ceiling in places is almost 100 feet high. The joint along which this main chamber is formed, strikes North, 15° West. At the end of the main chamber a sharp slope drops another 100 feet to a dead end. Just above the top of this slope along the left wall several small crawlways lead to a small balcony about 60 to 70 feet above the floor of the cave.

Cottonwood's primary attraction lies near the center of the main chamber about 350 feet from the entrance, and consists of an impressive group of very large, massive stalagmites, some of which are more than 40 feet tall and 15 feet in diameter. There is also a very nice group of stalagmites within reach of sunlight just inside the entrance.

As large as these stalagmites are and as thin as the cave roof over them is, it is obvious that this cave was formed long before the present canyons were cut. The thickness of the roof at the midway point above the giant stalagmites is only about 30 feet, and the ridge above slopes steeply which shows this is true.*

No known studies have been made of the flora and fauna of this cave, but bat guano and dry goat dung and cave crickets have been observed as well as algae.

* Bretz, J Harlen, "Carlsbad Caverns and Other Caves of the Guadalupe Block, N. M.", p. 457

There has been some vandalism in the cave and it is dirty, but is still beautiful.

HIDDEN CAVE

Hidden Cave is also located in Lincoln National Forest near the Dark Canyon Lookout. The exact location is shown on the **Carlsbad Caverns West** Topographic map. The closest driving distance without a jeep or truck is about a mile and a quarter from the entrance.

The cave has two actual openings which are very close together. One requires a rope to enter, the other does not.

The main room is reported to be 700 to 800 feet in length, with the width ranging up to 50 feet and the ceiling up to 60 feet in places. There are two other rooms slightly smaller, and numerous small tunnels and crawlways.

This cave has been badly vandalized. Many formations have apparently been broken just to see them fall and have been left covering the floor. Names and initials cover many of the formations. A few stalagmites 12 to 15 feet high and 8 to 10 feet in diameter remain as well as a few that are more slender and delicate. It is considered one of the best caves of the area to visit.

BLACK CAVE

Black Cave lies in Cave Canyon about two miles NE of the Dark Canyon Lookout and about one mile from Hidden Cave. (See USGS Topo map for directions). A jeep or truck is also required to get within reasonable walking distance of this cave. The entrance is about 250 feet below the ridge and about 100 feet below the top of the "saddle" just above the entrance.

The name **Black** comes from the fact that most of the formations in the cave are a very dark color. The staining is deeply imbedded rather than superficial.

The Cave is reported to be made up of three main chambers and several side passages that have been blocked by secondary deposits. Walking passages total about 500 feet. The shallowness of the cave indicates that it was formed long before the present canyons were cut as most of the other caves in this area.

MUDGETTS CAVE

Mudgetts Cave is located in the "Serpentine Bends" area of Dark Canyon. The entrance is about half way up a rock bluff and about 300 feet above the stream bed in the last of the big"bends." (See USGS **Carlsbad Caverns West** Topo Map.)

The main passage is reported to be about 750 feet in length, extending N75°E from the entrance. It is also reported that guano was mined from this cave in the early 1900's.

Mudgetts Cave may be reached by the Dark Canyon road through the Smith Ranch, or by the Juniper Spring and Baldridge Canyon roads just north of the Carlsbad Caverns National Park boundary. A jeep or truck is required for the Juniper Spring and Baldridge Canyon "roads."

MANHOLE CAVE

This cave is located about a half mile north of the boundary of Carlsbad Caverns National Park and just south of the center of Section 22, T. 24 S, R 24 E. (See USGS **Carlsbad Caverns East** Quandrangle map). The Juniper Spring-Baldridge Canyon road passes within 20 feet of the opening. (The entrance is right in front of the "G" in Guadalupe or the Topo map.) This road, however, should not be attempted without a jeep or truck.

The entrance is a rectangular slot in the rock about 2 feet wide and 6 feet long. A 40 foot ladder is required for the first drop directly below the entrance.

The main chamber is a circular room about 100 feet in diameter and about 65 feet high at the highest point. In the center is a pile of breakdown that reaches up almost halfway from the floor of the room to the ceiling. Around the edge are several small crawlways and rooms.

The cave contains a number of small stalactites (up to 2 feet long) and stalagmites and cave coral or popcorn. Some of the cave coral is reported to be in an unusual form that appears to have been twisted and folded.*

McKITTRICK CAVE

The location of this cave is northwest of Carlsbad near McKittrick Hill. It is reached best by the old Rocky Arroyo Road about 9 miles north of Carlsbad on the Artesia highway. A car can be driven over this road within a half mile of the entrance. (See USGS **West Carlsbad** Quadrangle map for exact location).

McKittrick Cave is in the Yates formation and drops only about 100 feet below the surface. There are three known entrances, all fairly close together. Two of them are within a sink about half way up the east side of a hill 250 to 300 feet high. The third entrance is higher up on the same hill. The cave is in an intermediate state of development and might best be describd as a giant "boneyard", or sponge. In the lower section of the cave some collapse has occurred, but in the upper section most of the separating walls and partitions remain, leaving an intricate and confusing maze of tunnels and corridors.

Vandalism has virtually obliterated the scenic features this cave once contained. It has been mined extensively for specimens to polish and sell as souvenirs in local curio shops. It is also badly marked with names and other smoke writing, and littered badly with cans, paper and flashbulbs. Some gypsum deposits remain, however, some which were laid down as flowstone.**

Bats, crickets, beetles, and spiders have been observed in the cave.

ENDLESS CAVE

Endless Cave is an extensive cave of three levels and very similar to McKittrick Cave in development. It is located about a half mile north of McKittrick Cave and is reached by the same road as McKittrick. (See USGS **West Carlsbad** Topo map).

Photographs taken by early settlers show that this cave was once one of the most beautiful in the area. It has now been heavily damaged by vandals. There are a few rooms that have not been reached by vandals, however, that are still beautiful and which make the trip through the cave very rewarding. A car can easily be driven to within a hundred yards of the entrance.

SAND CAVE

Sand Cave is located between McKittrick and Endless caves (See USGS **West Carlsbad** Topo Map). Damage to Sand Cave has been even more severe than to McKittrick and Endless. In fact, it is now almost completely bare of any secondary deposits of any type. For many years Sand Cave was the primary source of supply for local rock polishers who sell polished cave formation to curio shops in the Carlsbad Caverns area. Dynamite was even used in the formations "mining" and wire and blasting caps are still observed in the cave.

BORDER CAVE

The name "Border" comes from the fact that this cave is located near the New Mexico-Texas line just off highway 62-180. At the state line, 16 miles southwest of White's City on the El Paso highway, take FM Road 1108 (to the left) two miles to a draw or gully. A water tank and windmill will be visible on the left. Continue up the hill past this gully and water tank on the main FM road until coming to a bare spot of "gyp" soil on the right (west) side of the road. Another windmill will be seen near

* Thrailkill, John V., "Report on Manhole Cave", pages 1-4.

** Bretz, J Harlen "Carlsbad Caverns and Other Caves of the Guadalupe Block, N. M.", p. 460.

the south end of this bare spot. The cave entrance is located in a gully on the other side of this bare spot, and is a very short walk from the road.

Border Cave has been formed in gypsum. It is reported to contain about 500 feet of "walk through" passages, and to contain a rather large lake, the depth of which varies tremendously with rainfall in the area. It is considered dangerous in extremely wet weather due to the drainage into the cave.

Bats have been observed in the cave.

SITTING BULL FALLS CAVE

A small, but frequently visited cave is located behind the Sitting Bull Falls in Lincoln National Forest Sitting Bull Falls Recreational area. (See USGS **Carlsbad Caverns West** Topo map). It has little of major or special interest, but is one of the few active caves in the area and contains several nice formations.

OTHER CAVES

There are many other lesser known and lesser visited caves in the area. Many of these were entered and explored by early ranchers and settlers who left little or no record of their findings. Others have had little or no work done in them at all either in the way of exploration or study. The following are among the lesser known caves reported to the writer and more specific information could not be obtained prior to the writing of this article. These leads are presented as a challenge to those desiring to find something new. Information gained concerning these caves would be appreciated.

WIGGLEY CAVE A small cave in the gypsum formation near Border Cave. Reported to be across the road from Border Cave in a large sink.

DOW'S PASTURE CAVE Reported to be four miles southwest of Carlsbad and a half mile northwest of the Santa Fe Railroad water tower on top of a limestone ridge.

BOYD'S CAVE Near Boyd's waterhole at the head of Boyd's Canyon on the road to Rain Spring Ranch and McKittrick Hill. (USGS **West Carlsbad** Topo Map).

RATTLESNAKE CAVE About four miles west of the Carlsbad Air Field and three quarters of a mile south of the Windham Ranch on the Little McKittrick Draw Road. (USGS **West Carlsbad** Topo Map).

THAYER CAVERN A cave is reported to be on the old Thayer Ranch near Queen, N. M. (USGS **El Paso Gap** Topo Map).

GYPSUM CAVES Several gypsum caves are reported just off the Van Horn Road (Texas 54) south of US 62-180.

BIG MANHOLE CAVE ..Located about a quarter of a mile ESE of Manhole Cave on the Juniper Spring - Dark Canyon Overlook Road just north of the Park. After going through a gate at BM 4699 on the Park Boundary, go a quarter of a mile NW to a fork in the road which makes a loop around a hill and then rejoins near the entrance of Manhole Cave. The cave is about 100 yards south of the road in line with the center of this hill and between two small canyons. The entrance is reported to be a vertical shaft about four feet in diameter.

RADIER CAVE A deep cave is reported on Radier Ridge between Smith Canyon and Bell Canyon near Guadalupe Peak.

BIG CANYON CAVE Near the mouth of Big Canyon on the right near the three gaps or sawtooth peaks in the ridge (USGS Carlsbad Caverns West Topo map).

FRANKS CAVE In Franks Canyon or Black Canyon near the peak opposite Franks Spring.

DEVIL'S DEN CAVE A sinkhole eight feet in diameter is reported in Devil's Den Canyon south of El Paso Gap. (See **El Paso Gap** Quadrangle).

HELLS BELOW A 90 foot sinkhole of this name is reported in the area of Black and Hidden Caves. It is said to be very active and thought to contain a small stream.

2000 FOOT CAVE An extremely deep pit is reported at the head of North Double Canyon. The entrance is said to be a funnel about four feet in diameter and located near the top of the ridge about 100 yards off the Double Trail about 2 miles east of the Dark Canyon Fire Lookout.

Numerous other cave openings have been observed in Double Canyon, Gunsight Canyon, Black Canyon, Big Canyon, Cottonwood Canyon, Dark Canyon, and many of the other canyons which "head" southwest of the Park. Also, there are no doubt many others yet to be found not mentioned in this report. It is believed that this is a very challenging area and that prospects are very good for finding other outstanding caves.

It is hoped that this report will be of value to you in planning your field trips and in getting started on a safe, enjoyable and profitable spelunking adventure in this area.

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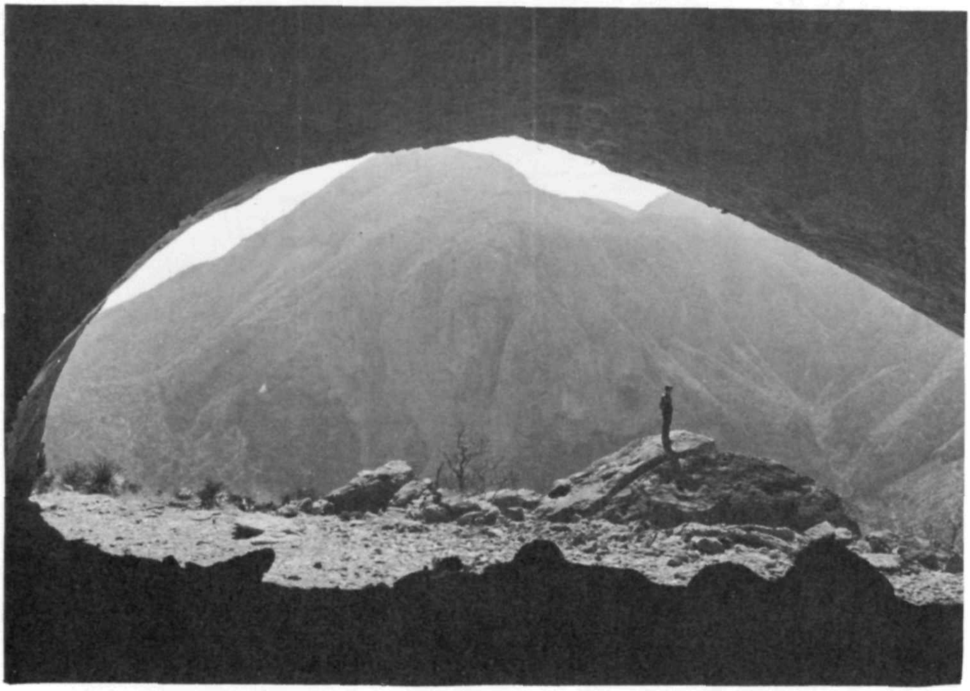
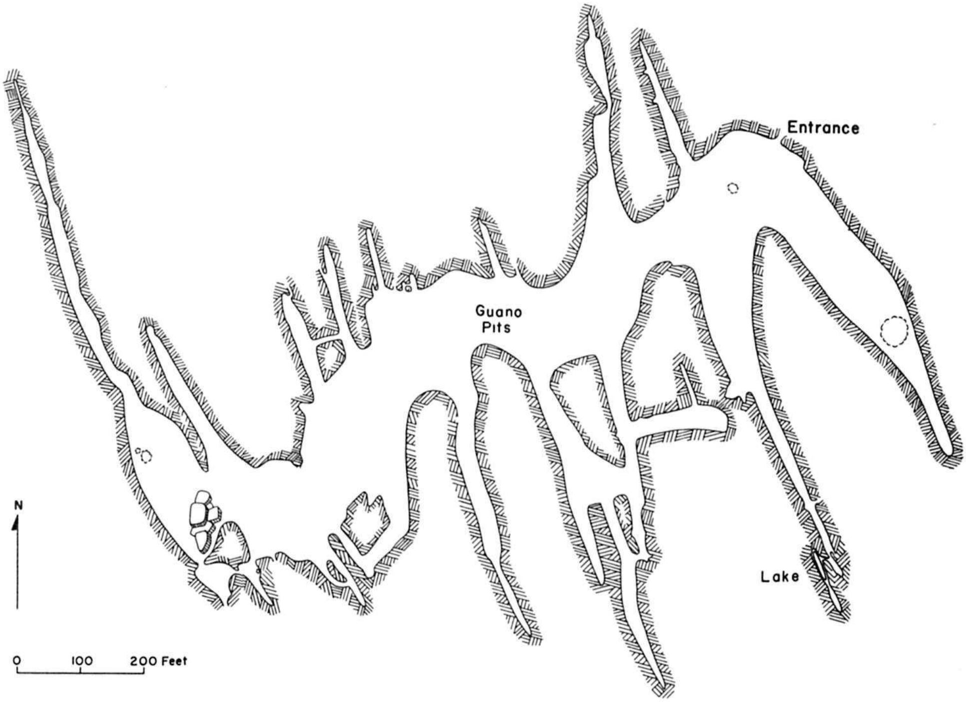


A Cave high in a ridge overlooking a canyon in the Guadalupes



MAP OF NEW CAVE, CARLSBAD CAVERNS NATIONAL PARK, NEW MEXICO

by G.W.Moore, A.F.Hewitt, P.T.Hayes, and R.P.Hayes

1957

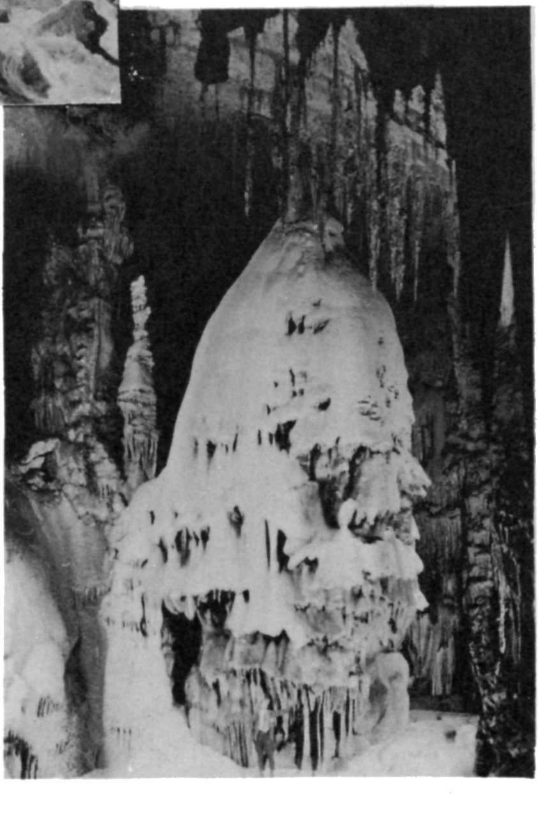
New Cave, located near the mouth of Slaughter Canyon is the second largest known cave found within Carlsbad Caverns National Park. The shape of the cave, as shown on the accompanying map, is one long corridor 1140 feet long and numerous side corridors totalling over one mile of secondary passageways. The total extent of the cave is one and one quarter miles. The lowest point below the entrance is approximately 250 feet.

New Cave, like so many others, was discovered by goat herders searching for lost flocks of goats in the early 1930's. Later the cave was subject to mining claims by guano miners. Mining continued until 1957 when the claim was purchased by the government thus ending guano mining within the park boundaries.

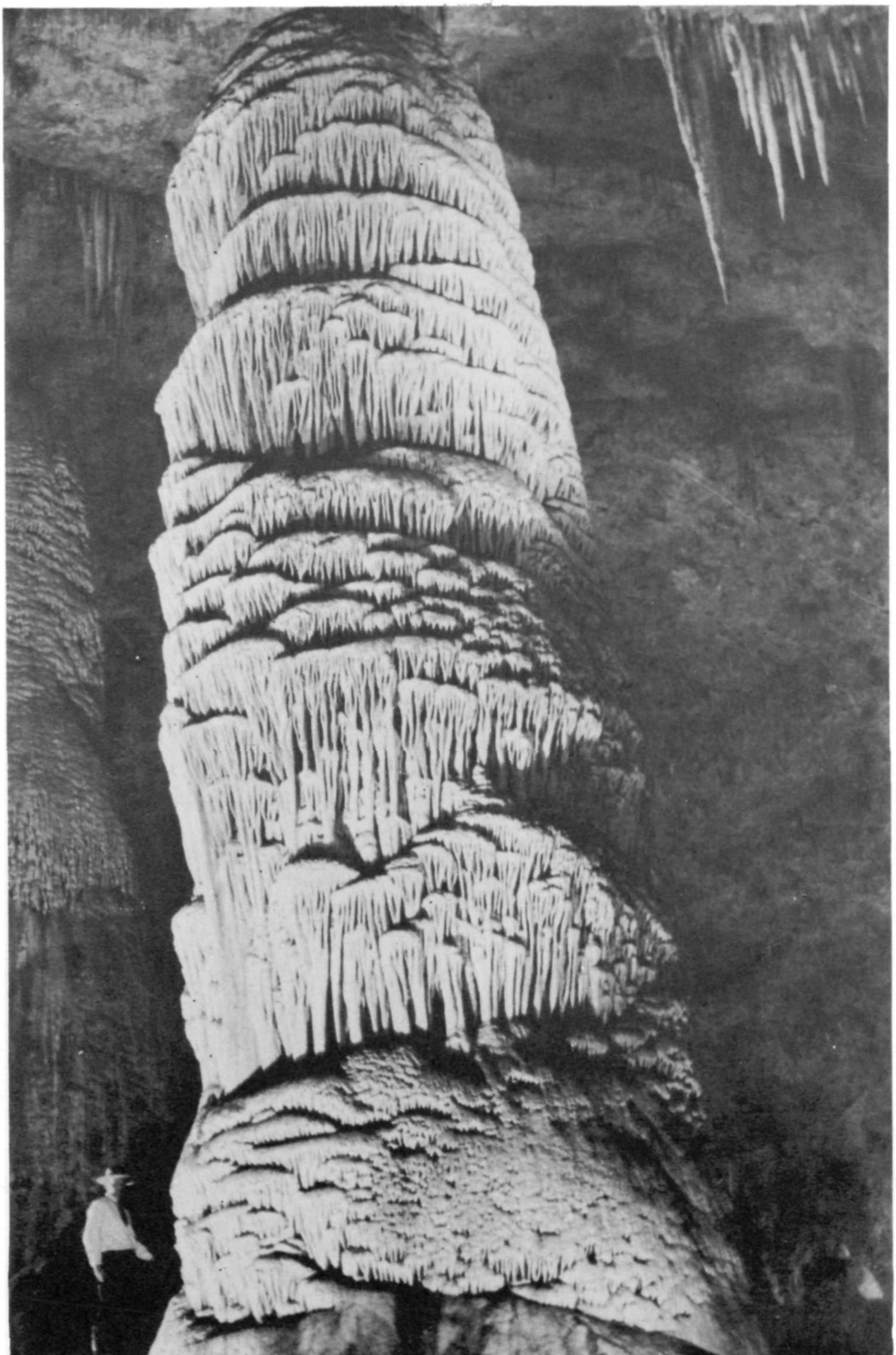
Although smaller than Carlsbad Caverns, New Cave contains a wealth of spectacular formations, large guano deposits left by an extinct form of Freetail bat, prehistoric animal remains, and evidence of use of the cave by early man.

At present New Cave is not open to the public, but further planning may provide trips through this excellent cave.

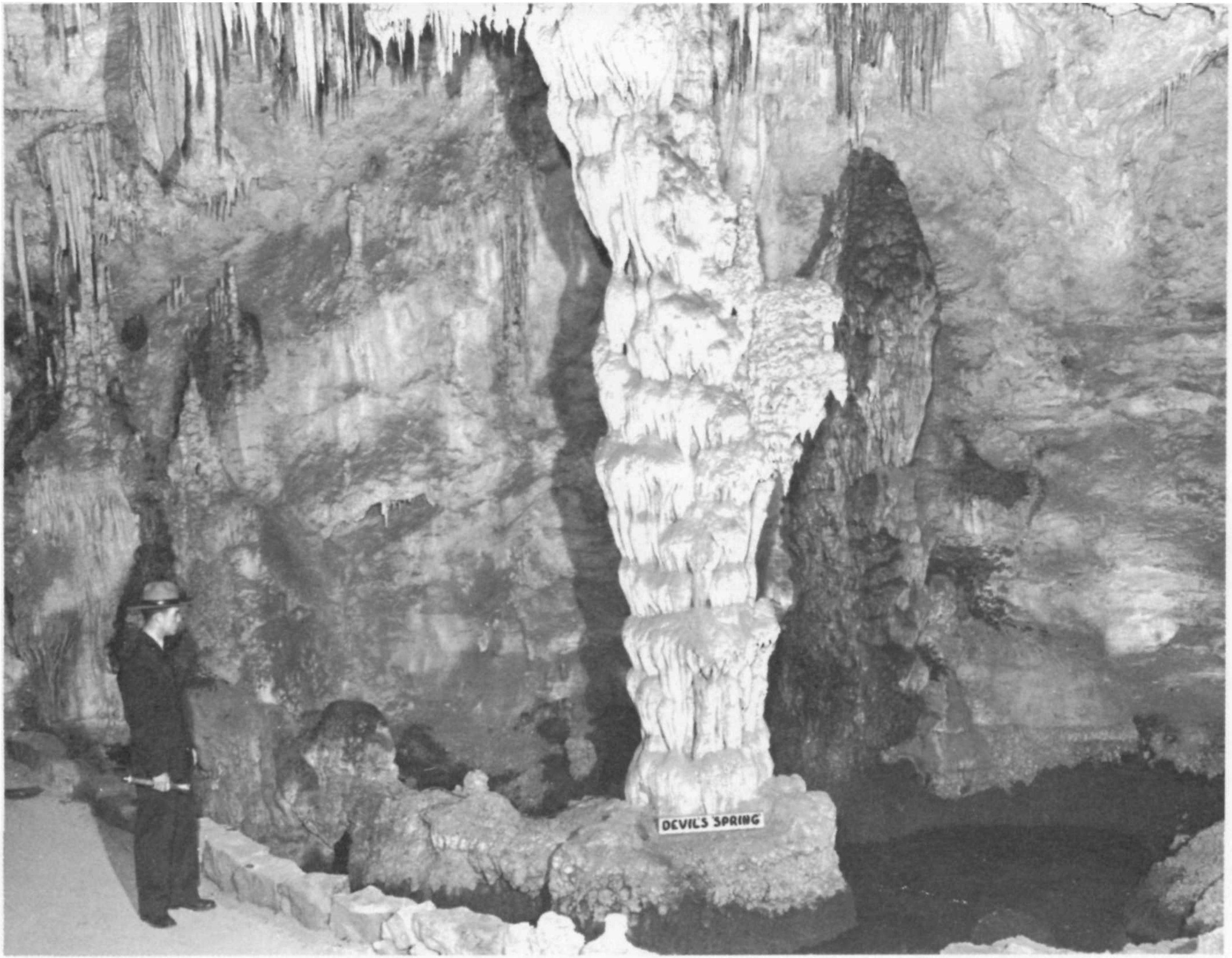
The Klansman of New Cave

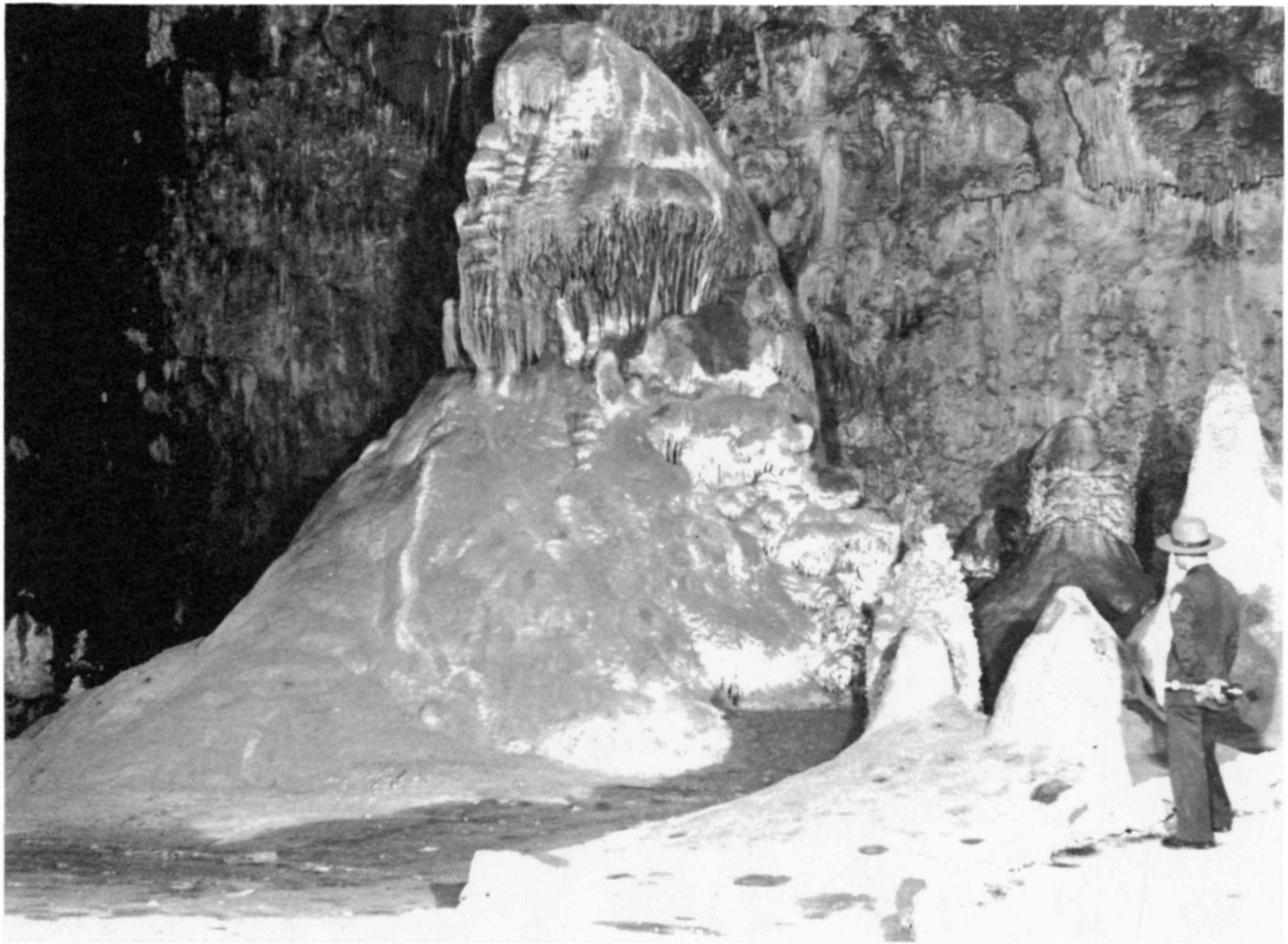


The Christmas Tree in New Cave

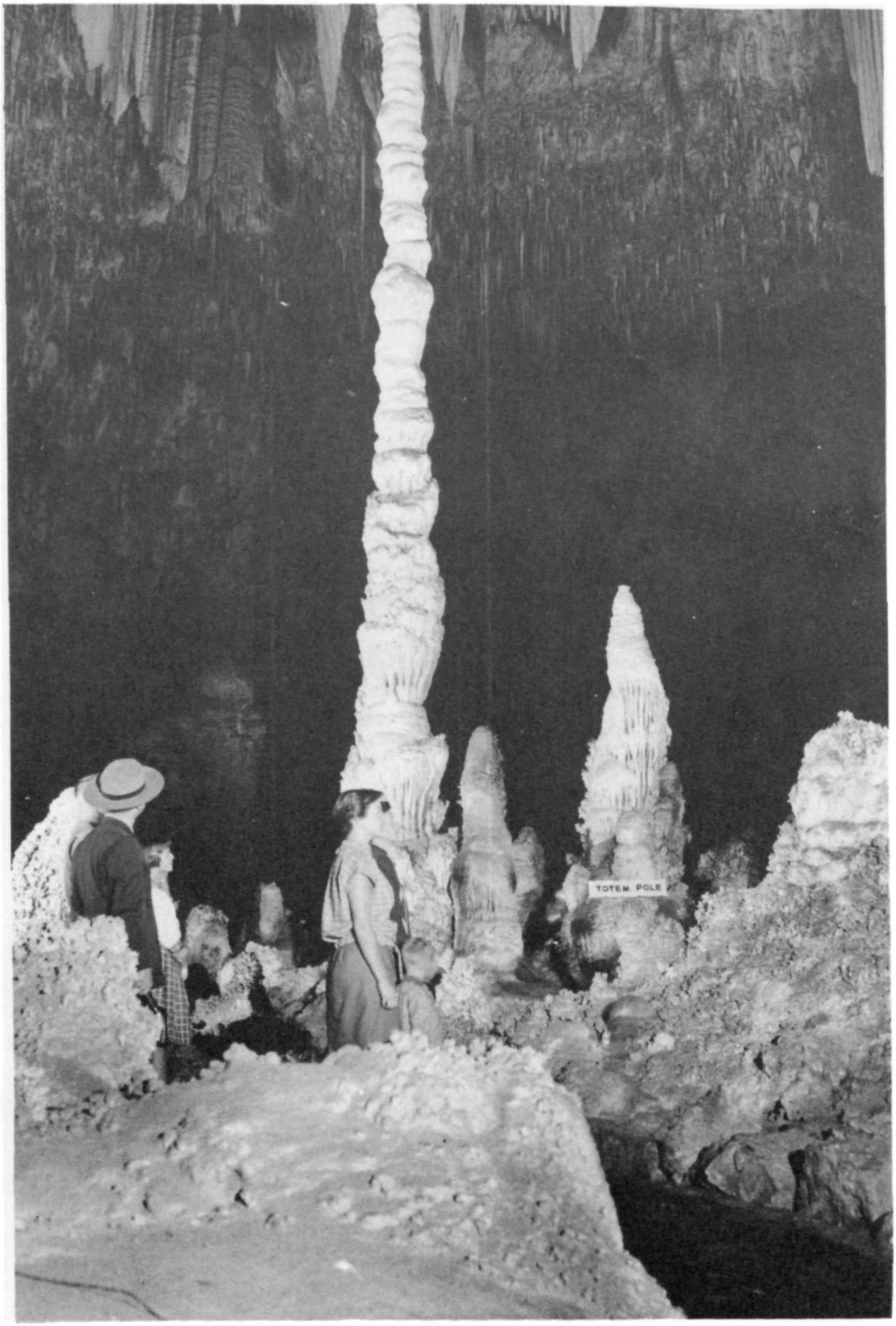


Giant Dome


DEVIL'S SPRING

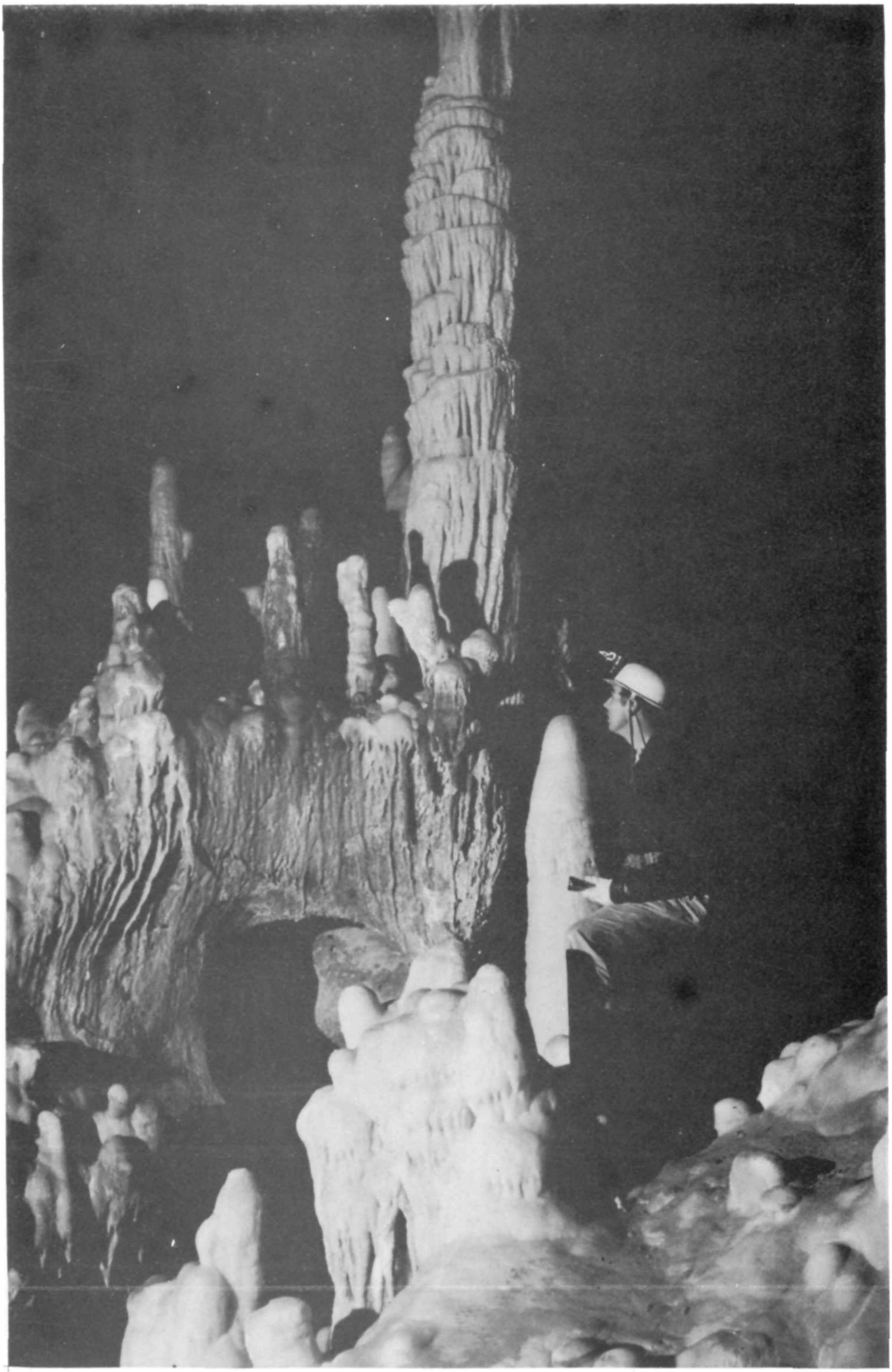


Cave Man



Totem Pole

Rock of Ages



The New Mexico Room