



The
Carlsbad
Caverns
of New Mexico

Its History and Geology

CARLSBAD CAVERNS NATIONAL PARK IS OWNED AND OPERATED BY THE U.S. GOVERNMENT

CARLSBAD CAVERNS NATIONAL PARK

A Few Brief Facts

Carlsbad Cavern was made a National Monument by proclamation of President Coolidge, October 25, 1923.

It became a National Park, including a surrounding territory of ten thousand acres, by an act of Congress, May 15, 1930.

More than 21 miles have been officially surveyed and many more miles have been explored but not surveyed.

The main cavern is at a level of 750 and 765 feet under the surface, and the "lower cavern" is at the 900 foot level under the surface, while still deeper chambers have been discovered.

The Big Room is about 25 times larger than the largest room of any other cavern; it is 4,000 feet in length, 625 feet wide at the widest place with some ceilings 300 feet high.

The Iceberg, largest detached rock, weighs about 200,000 tons. The largest Giant Stalagmite in the Big Room is 62 feet high, 16 feet in diameter and is estimated to have been sixty million years in forming.

A system of lighting which includes huge searchlights to bring out distant formations and ceilings, and trail lights which make the trails always easy to see.

Credit for discovery and early exploration of Carlsbad Cavern is given to Jim White (who made his first entry trip in 1901). Further explorations grew out of guano mining operations during the years following. A survey was made by Robert A. Holley, of the U. S. General Land Office, in 1923.

Temperature of the main cavern is 56 degrees the year 'round. Air is fresh, pure and changes constantly. There is no stooping or crawling. Well lighted, safe trails are provided. Government rangers are in charge of every party entering the cavern.

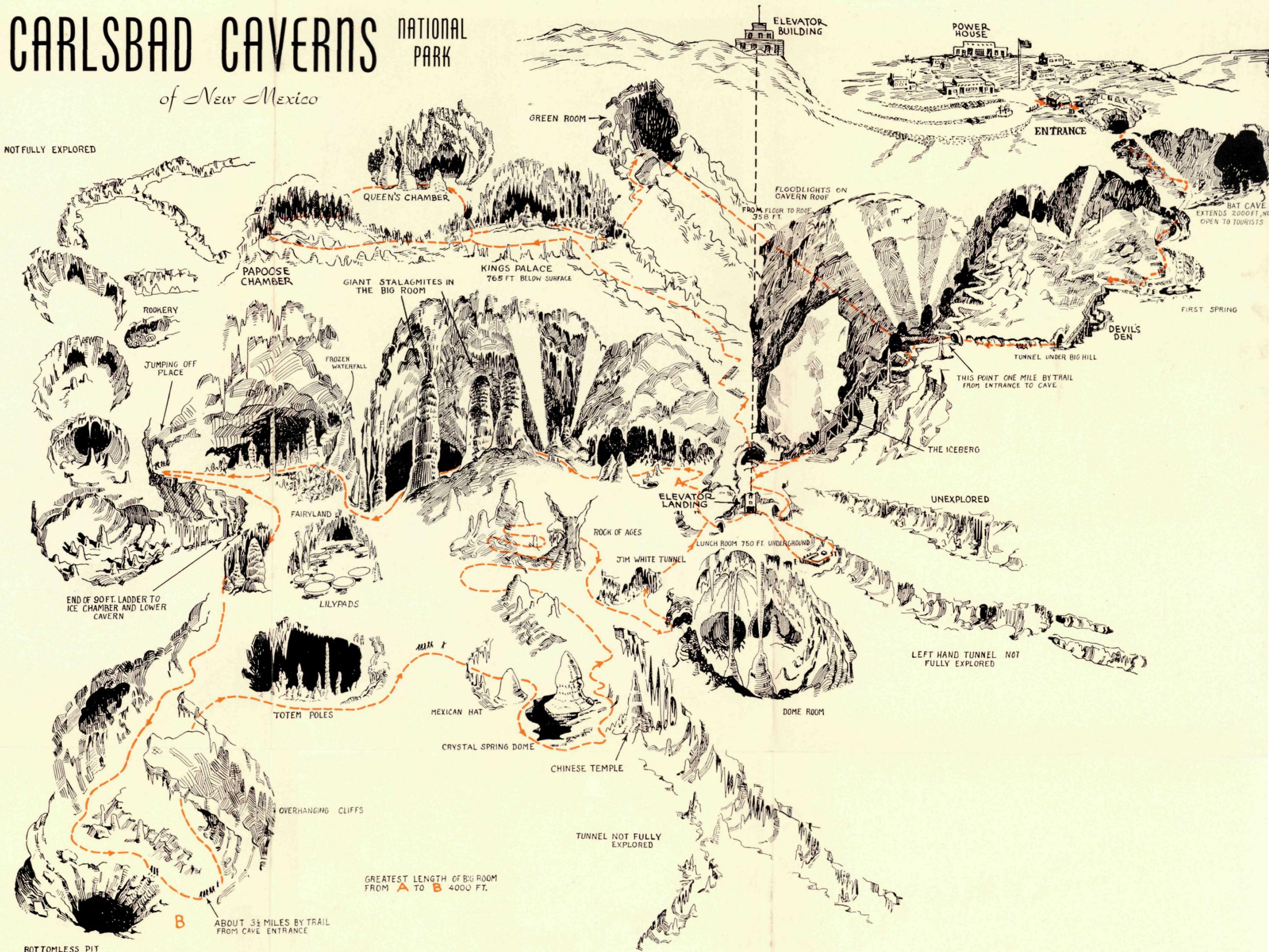
For convenience of the traveler, lunch room, drinking water and rest rooms are conveniently located.

Visitors are not allowed to handle formations or collect souvenirs.

CARLSBAD CAVERNS NATIONAL PARK

of New Mexico

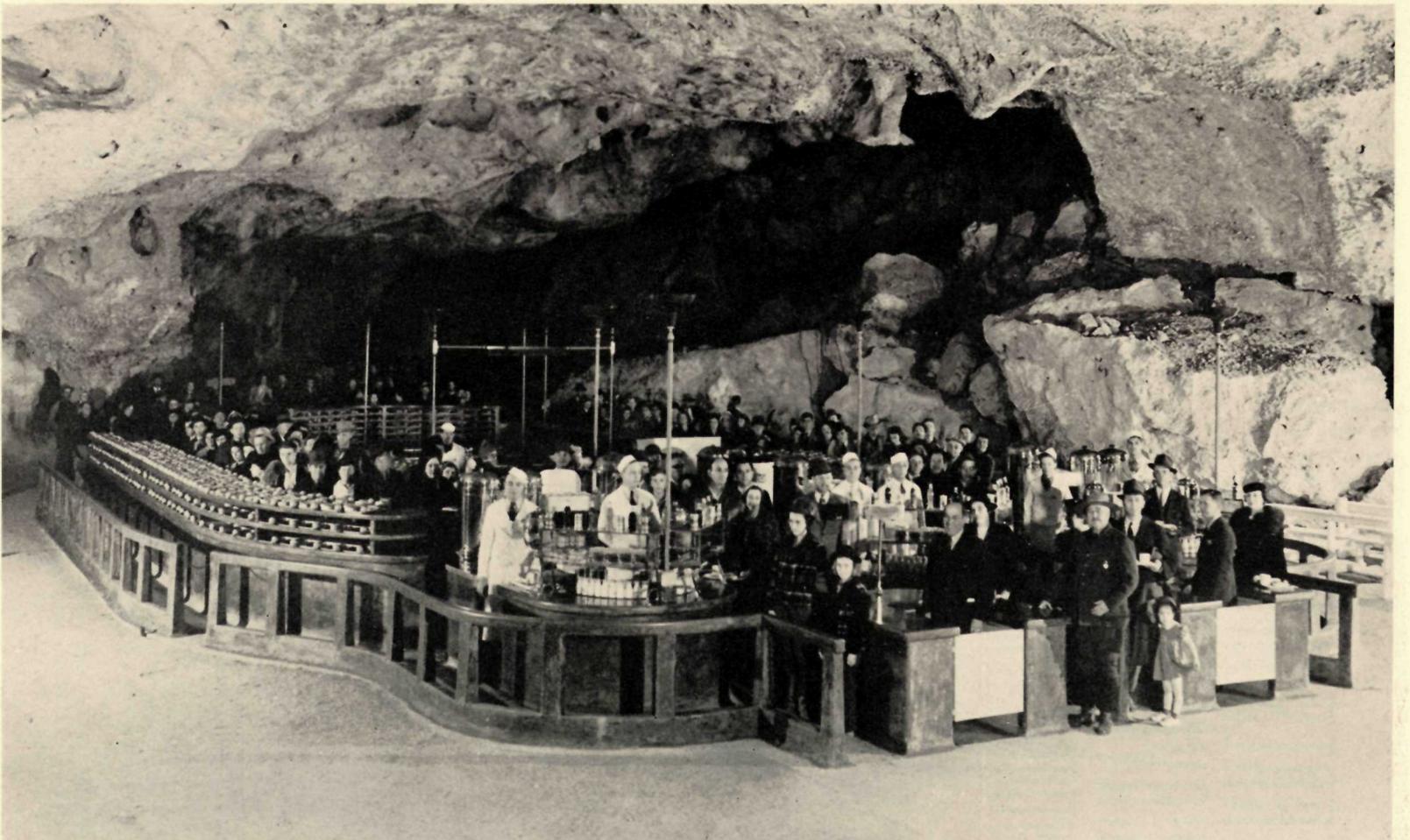
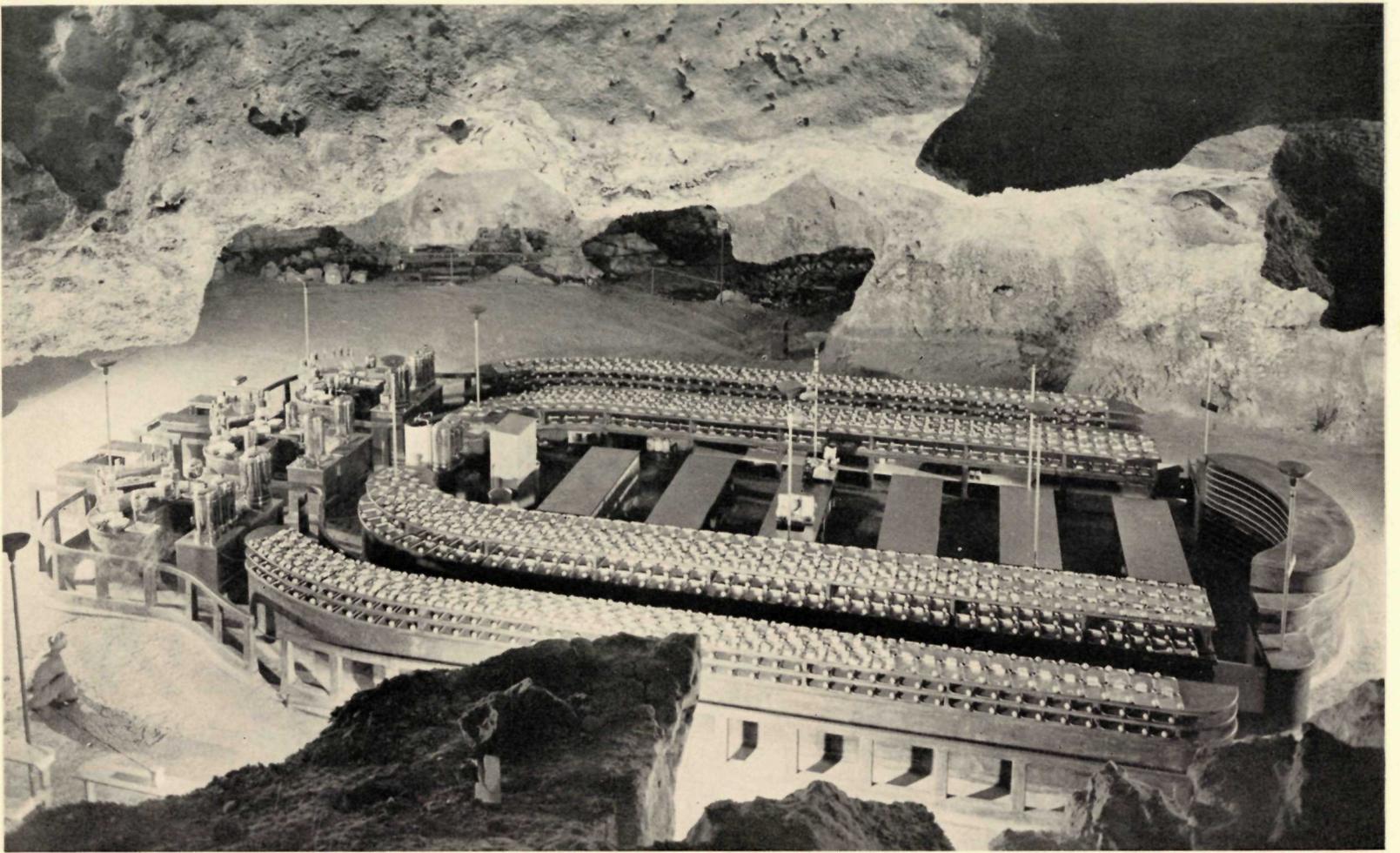
NOT FULLY EXPLORED



BOTTOMLESS PIT

GREATEST LENGTH OF BIG ROOM FROM A TO B 4000 FT.

ABOUT 3 1/2 MILES BY TRAIL FROM CAVE ENTRANCE



LUNCH ROOM IN CARLSBAD CAVERN
750 Feet Underground

The
Carlsbad Caverns
OF NEW MEXICO



Its History and Geology

FORMATIONS OF THE CAVERN
DISCOVERY AND EXPLORATION
BATS OF THE CAVERN
CAVERN GEOLOGY
ADMINISTRATION
THE LAND NOBODY KNOWS



WRITTEN BY A. W. ANDERSON, CARLSBAD, N. M.

Excepting Chapter "Cavern Geology"

"CAVERN GEOLOGY" WRITTEN BY JAS. S. WROTH

Geologist and Engineer, New York City; formerly of U. S. Bureau of Mines

ILLUSTRATIONS BY

JOE RYAN, FORT COLLINS, COLO.

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Printed by Bradford-Robinson Ptg. Co.

FIFTEENTH EDITION



COURTESY NATIONAL PARK SERVICE

THOMAS BOLES,
SUPT. CARLSBAD CAVERNS NATIONAL PARK

"Carlsbad Cavern

New Mexico

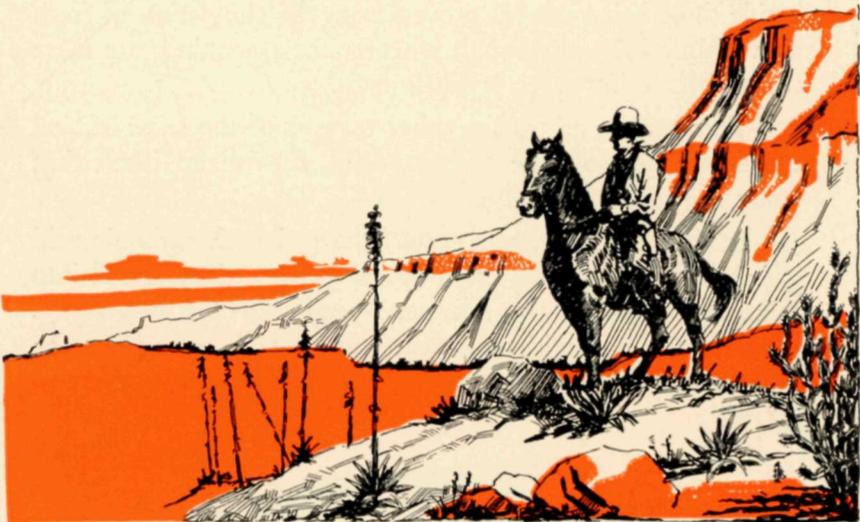
is the most spectacular of underground wonders; for spacious chambers, for variety and beauty of multitudinous natural decorations, and for general scenic quality, it is King of its kind."

DR. WILLIS T. LEE

in the

NATIONAL GEOGRAPHIC MAGAZINE

September, 1925



Formations of the Cavern

*I*t seems a paradox

to say that water, working drop by drop so slowly that progress could not be detected in the span of a human life, has hollowed out and built up and adorned, under the earth's surface several hundred feet, a cavern so vast and beautiful that man's mind cannot conceive of it. Yet that is eloquently true in Carlsbad Cavern. Limitless time of nature's work has made it; ages and eons the work has gone on without stop and still continues. While there are many other beautiful caverns in all parts of the world thousands of travelers who have visited other caverns declare they offer no comparison in vastness or beauty to Carlsbad Cavern. It is futile to attempt any adequate description of such a vast underworld fairyland, and only a few suggestions are presented, to give the reader some ideas of what the cavern is—not what it looks like.

There is no estimate as to its actual size, based on survey, although more than twenty-one miles of passages and chambers have been surveyed. That there are other outside openings beside those being used is proven from the circulation of fresh air within all rooms, though whether these openings are mere slits or even other caves, is not known.

This cavern, as well as other caverns of the same section which are not so large and beautiful, furnish an interesting study in "caveology."

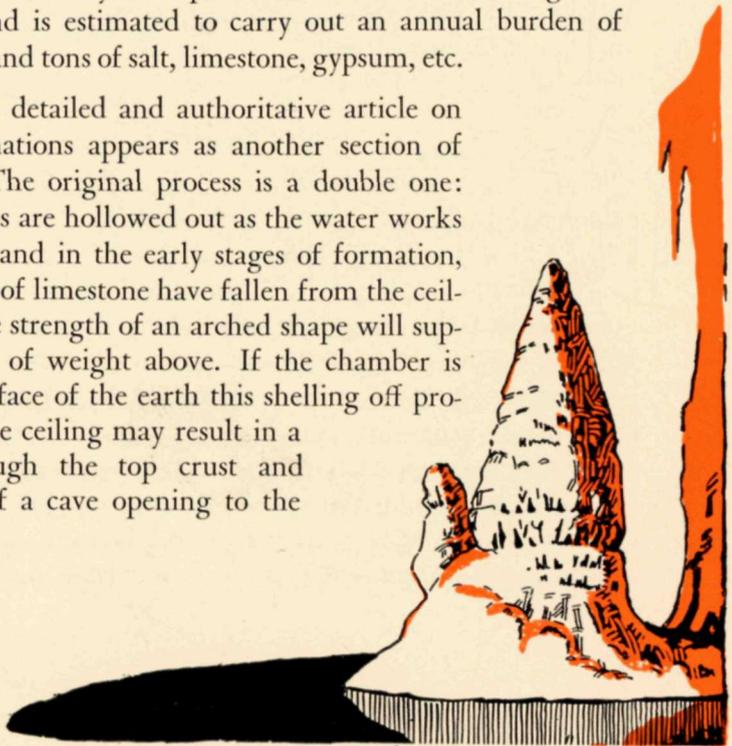
In the beginning, rain water, charged with carbonic acid gas absorbed principally from decaying vegetation, seeped into some tiny crack in the limestone—and the task was begun. Working from crevice to crack, and literally eating out the limestone itself, the work of the water leads downward, and

enlarged cavities make room for more water to start more work. As the seams and cracks in the limestone are far from uniform, the work is carried on at several levels, shown by the various levels of the cavern itself, and ends only as the water finds an outlet to the surface at some lower level and often flows away into a spring, or possibly an "underground river." The work is speeded when the water reaches softer deposits such as salt, potash, red beds or gypsum. That water stood for long periods in the cavern is shown by plain "water lines" on some of the walls where formations have not covered them.

Irregular action of the water in various kinds of deposits makes it impossible to find a basis for reckoning the hundreds and hundreds of thousands of years taken for this never-finished task. Geologists have estimated the age of some of the larger formations at from fifty to sixty million years.

Evidence that surface waters have done their "time" in cavern building is shown at Blue Springs, about ten miles northeast of the caverns, and near the cavern highway. This great spring carries approximately a teaspoonful of solid matter to a gallon of water, and is estimated to carry out an annual burden of thirty thousand tons of salt, limestone, gypsum, etc.

A more detailed and authoritative article on cavern formations appears as another section of this book. The original process is a double one: the chambers are hollowed out as the water works downward, and in the early stages of formation, huge blocks of limestone have fallen from the ceiling until the strength of an arched shape will support a mass of weight above. If the chamber is near the surface of the earth this shelling off process from the ceiling may result in a break through the top crust and formation of a cave opening to the outer air.



Evidence of such a process is ample in Carlsbad Cavern, where limestone blocks weighing thousands of tons, once a part of the ceiling, now stand as mountains of solid stone along the trails, fallen so long ago that these fallen "fragments" now have large stalagmites on them. The "Iceberg" is estimated to weigh two hundred thousand tons.

The process of decoration comes next, and while decorations are of unending variety as to shape, color and size, in this cavern a few general methods explain their formations.

"Stalactites" is the general term covering formations hanging from slanting wall and ceiling. They vary in size from a soda straw and smaller, to huge "chandeliers and icicles" weighing tons.

"Stalagmites," built from the floor, upon projections or limestone blocks, are built upward from their bases. From tiny match sticks to great pillars they are unending in variety. Among those of most interest are the slender totem poles, reaching heights of sixty to seventy feet, the giant stalagmite of a height of sixty feet and sixteen feet in diameter, the huge twin domes and many others. Often stalagmites and stalactites are joined, forming a "column" and in some cases they are slowly approaching each other, and after some thousands of years will be joined.

From stalactites are formed intricate, twisted and gnarled "patches" of vine-like formations, intertwined in every conceivable complexity and known as "helictites." These are seen at their best in the King's Palace and Queen's Chamber.

Curtains and draperies of "flowstone" of stalactitic explanation, result from water "running" along the roof before dropping.

Water falling from the ceiling too fast to make its building deposit in regular stalagmite form, spreads its burden like a crust over larger areas. This formation is noticeable where trails have cut through the crust, or where the crust has been broken.

Numerous "formations" have "popcorn" growths, like a stone moss growing out on them, caused by "sweating."

Water in pools becomes highly saturated with crystals of "building material" and these begin building near the pool edges. Evaporation being at a faster rate at the surface of water, the formations are naturally largest at the top and make "lily pads" and "toad stools" of onyx.

Especially in the "lower cavern" there were formed many nests of "pisolites," or as they are commonly known, "cave pearls." On a center grain of sand or limestone they are built layer by layer, mostly in perfect little spheres or marbles, though many take elongated capsule shapes. When water stops dripping into the "nests" in which these are formed, they generally settle and become attached, and roughened. In some cases, these are formed on centers of bat bones or other irregular forms and thus are irregularly shaped.

Every kind of formation has innumerable variations and is a creation of its own kind. Ready interest is always found in figures seemingly modeled after things of the world of sunshine and life. These include semblances of everyday articles, such as candlesticks, Statue of Liberty, stack of pancakes, walking canes, tomb stones, bacon-rind, cactus, pop-corn, chandeliers, flower pots, fried eggs, celery stalk, pipes, curtains and draperies, floor mop, oranges, apples, grape clusters, roses, and countless others, as well as forms from bird and animal life and architecture. Among bird and animal-like forms, most popular are moose head, a limestone erosion formation high upon the wall and a guardian of the main corridor, elephant ear, bull dog, screech owl, hippopotamus, lion, monkey, eagles, parrot, billing doves and others. There are many cathedral-like groups of Gothic architecture; many draperies unbelievably perfect in form and color in comparison with draperies of velvet, are seen. The totem poles need not be called by name to anyone who has seen the totem poles of the Alaskan Indians. Whether one is estimating the size of single formations or trying to judge the size of huge halls or vast chambers which give Carlsbad Cavern its world-wide distinction, it is very easy to misjudge sizes and distances. However, it is not hard to believe your guide when he tells you that your journey has covered over seven miles, for you

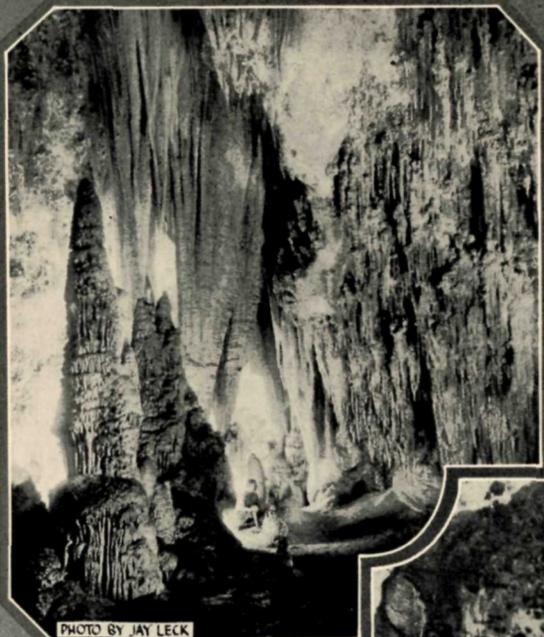
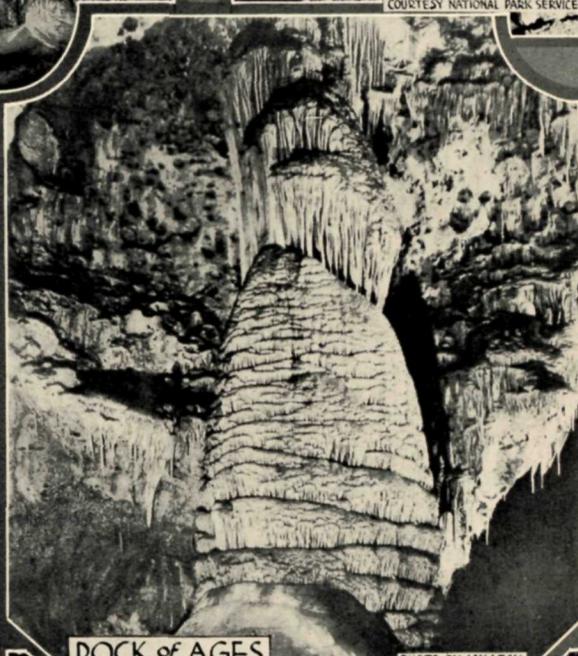


PHOTO BY JAY LECK

QUEEN'S ROOM



FROZEN NIAGARA
COURTESY NATIONAL PARK SERVICE



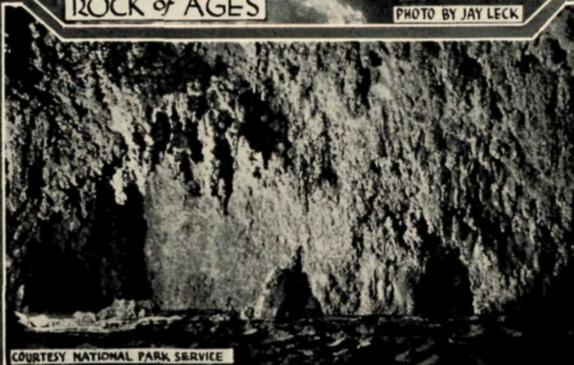
ROCK OF AGES

PHOTO BY JAY LECK



COURTESY NATIONAL PARK SERVICE

SHEET STALACTITES IN
PAROUSE ROOM



COURTESY NATIONAL PARK SERVICE

WISTERIA GARDEN and LILY PADS

have been lost in another world during the visit, and things of the every day life seem far away.

Outstanding in vast vaulted space is the Big Room, which is three-quarters of a mile long, as wide as 625 feet with maximum ceiling height of 348 feet, though at the "Bottomless Pit," with an inset ceiling dome, the height would be much greater, probably 500 feet or more. It has been estimated to be twenty-five times as large as the largest room of any known cavern. The Big Room is 750 feet under the surface.

At one point in the Big Room, known as the "Jump Off," one may look down into the magnificent halls of the lower cavern, where the depth is 900 feet under the surface. Here great buildings may be stacked one on another, or the national capitol building at Washington be set and there be left much space to spare about it even at the dome.

The left hand tunnel, near entrance of the Big Room, has been designated the lunch room, where keen appetites brought out by the journey are satisfied, and a rest is taken. Entrance to the lower cavern is in the fore part of this room. Opening from the Big Room are many tunnels, alcoves and other rooms. Of these, the Dome Room is particularly beautiful. Each hall and chamber of the entire cavern has distinguishing characteristics of formation, making each part of the journey a revelation in new wonders and delights. Every room of every cavern in this National Park area is different from every room of every other cavern.



Discovery and Exploration

Carlsbad Cavern . . .

greatest underground spectacle known to man, and located twenty-eight miles southwest of Carlsbad, New Mexico, was first explored in 1901 by James Larkin (Jim) White, a young cowboy who had come into the Carlsbad section from Texas, his native state.

The discovery was made while he was riding range across the rugged Guadalupe foothills. The adventurous spirit of youth led him to swing off by lasso rope into the yawning black abyss of the natural opening and gave him credit for bringing pleasure to thousands. Cattlemen who declared that they had, at an earlier date, seen that great opening into the earth's limestone crust, before Jim's time, perhaps were many, but no claims have

ever been made that anyone had risked deep entry into it before this young cowboy made his exploration trips. One had seen its wonders long before—but his story had passed with his life and only a crumbling skeleton was left to tell Jim that another had seen those great underground chambers before him. It was thought this skeleton was of an Indian; it laid on a little ledge near the trail under the “Iceberg,” during the earlier period of private expeditions, but was early taken out in parts until not a bit remains. It was never identified.

With the aid of a lantern which cast eerie figures of light into vaulted blackness, Jim’s first expedition carried him about a mile into the cavern, his path being marked by smoke marks on the walls, and cord unwound as he went along.

About a year following, the attention of others was attracted to the cavern by the flight of millions of bats from the opening, suggesting a valuable deposit of bat guano to be mined for its fertilizer value. Smaller caves of the section had produced this fertilizer. The natural entrance was a forbidding working entrance, and not on land controlled by the operators, so a shaft was sunk, about a quarter of a mile east of it, into the main section of the “Bat Cave” and various operators took from these deposits an estimated hundred thousand tons or more of guano before rising costs of operation and diminished supply brought the operations to an end, at the beginning of the World War.

Jim White was employed by the first operator, named Long, for a short time, and after an absence of a few years, returned in 1906, determined to make further exploration of that portion of the cave he had glimpsed years before, and which was still untouched and unexplored. Then, being accompanied by a Mexican boy, he spent three days and nights in amazed inspection of its wonders of formation.

Jim was foreman of the guano mining work when mining operations ceased, and following the World War began taking a few friends down into the cave, via the guano mining bucket which was hoisted by an old gas engine. This was a thrilling 180-foot drop which will be remembered by a number of people

who saw the cave while the bucket was still in use. Meanwhile, Jim had spent many weeks of spare time in making further explorations.

His story of the weird wonders of the cavern began to excite large local interest only after a few groups had been persuaded to make the trip with him. And when Ray V. Davis, a Carlsbad photographer, secured the first flashlight photographs of some of the most beautiful scenes, interest in the cavern's possibilities grew out of local bounds and began to attract scientists and explorers.

Meanwhile, Jim's visitor parties grew fast in number. At times as many as three hundred were taken down in two and threes by the mining bucket route, which was proven entirely too slow as well as risky; in 1925 the Carlsbad Chamber of Commerce, feeling the possibilities of increased travel, built a heavy stairway down through the natural entrance. Came the curious, the science-minded, the lecturers and writers, adventurers from the four corners of the globe, to see for themselves the new world wonder, heralded as "cavern such as never before known to man."

Their stories added to the weird maze of descriptive terms and attracted attention of the United States Geological Survey, for which, in 1923, Dr. Willis T. Lee came to make study and investigation. Dr. Lee, guided by Jim White, made even deeper exploration, and found that the "half had not been told," and his startling report, published in the National Geographic Magazine in January, 1924 aroused world-wide interest.

When authoritative news of the cavern's magnitude reached Washington, Robert A. Holley, of the General Land Office, was sent to make a survey of it for the Department of the Interior, this also being in 1923.

Mr. Holley's report aroused great interest, and contained such passages as the following: "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 under-

standing of the Divine Creator's work which presents to the human eye such a complex aggregate of natural wonders in such a limited space."

Following his report, on October 25, 1923, by proclamation of President Calvin Coolidge, 720 acres of land embracing the known cavern area, was declared a national monument. Investigation had brought out that the main cavern was not on privately owned land but on land belonging to the State of New Mexico. The state made transfer of this land at a later date to the federal government, it appearing that the development of the cavern was too huge a task for a state undertaking. It was officially named "Carlsbad Cave National Monument."

About the middle of March, 1924, the National Geographic Society sent a fully equipped expedition to continue exploration, study and survey of the cavern, Dr. Lee having been aptly selected to direct this expedition. Six months were spent in this work and proved that earlier estimates, seemingly exaggerated and imaginary, were yet too small as to sizes, too limited as to beauties suggested. This survey included twenty-one miles of chambers and hallways, the major part of them at the 750 and 900 foot levels below the earth's surface. Yet it did not find the cavern ends, nor are they known to this day, although many more miles have been explored. Every little alcove or opening in a wall, of which there are a great many, has possibilities of cavern extension and the work of discovery and exploration will go on through years to come as development funds are in sight.

The Nicholson expedition, early in 1930, found depths far below those of the lower cavern. They located large new rooms of weird beauty.

In January, 1928, a small opening in the ceiling of the Queen's Chamber, over the "Elephant's Ear," was found to lead through a series of small chambers into a huge room, second only to the Big Room, magnificently ornate, and on a higher level than the main cavern.

Carlsbad Cavern, as a national monument, developed very rapidly, taking its place among the larger national parks in

travel interest and laying a secure foundation for its own entry into the National Park Class, which occurred on May 15, 1930, when President Herbert Hoover signed the act creating Carlsbad Caverns National Park.

The growth of travel and appropriations of the caverns is indicated by the following figures:

<i>Year</i>	<i>Visitors</i>	<i>Appropriation</i>	<i>Year</i>	<i>Visitors</i>	<i>Appropriation</i>
1924	1,876		1933	56,002	\$135,000
1925	2,453	\$ 5,000	1934	92,397	308,000
1926	11,741	25,000	1935	116,457	168,000
1927	29,034	15,000	1936	155,357	223,000
1928	46,224	30,000	1937	207,041	60,000
1929	78,469	70,000	1938	200,617	100,300
1930	91,462	100,000	1939	218,382	145,000
1931	80,144	165,000	1940	241,590	101,000
1932	61,159	125,000	1941	250,000 est.	-----

Appropriations have been made in keeping with increase of travel and needs, so as to insure continued development to care for the great travel increases.

So far as trail or development are concerned, the cavern is always changing and those who view it and return the following year find it a very changed trip from their former visit.

Gone is the thrilling bucket ride and with it have passed the slippery, unsafe trails down rock-walled canyons, crawling or stooping. Chasms are bridged safely; tunnels have been cut through solid rock to eliminate many of the climbs; careful study has been made to find easiest traveling step-heights and trail grades. Stairways have banisters for greater comfort.

The famous old entrance stairway passed into history about the time the cavern came to its park status. Having served tens of thousands of people, it was as strong when taken out as when built, but the 216 steps were a climb remembered by most visitors.

Electric lights along these safe trails make the entire journey free from a feeling of caution. Hundreds of great search-lights pierce into the recesses of distant ceilings to bring out magnificent beauty of formations and give some adequate idea of the utter immensity of the chambers.

Three 240-horsepower Diesel engines in the power-house which stands at the top of "cave hill" furnish electric current for lighting. As much as ten thousand candlepower is used on a single formation to adequately light it. Room is provided in the power-house for two more engines to be added later, but these three engines furnish sufficient current to light properly all of the present known cavern.

The lighting effects achieved have been highly praised by experts in this field, and the illumination is regarded as the greatest effort of its kind ever undertaken. There is no direct lighting; the visitor does not see the lights themselves, which are carefully concealed by rocks and formations.

It is the policy of the National Park Service to make safety a major consideration in every park or monument, and in keeping with this idea, visitors are not shown, or allowed in, rooms which have not been prepared with proper trails, rail guards or other equipment to provide safety for the visitors and protection to the formations. Each year extensions and betterments to trails, lighting and all conveniences are made to better accommodate the increasing number of visitors.

During 1929 a telephone system from the cavern to Carlsbad was completed. A telephone from the surface at the cavern reaches the main chambers of the cave.

Two elevators have been installed from the surface to an alcove in the lunch room. This service is for the convenience of the visitors who do not care to make the walk out by the natural entrance. The elevator trip is made in one minute, travelling 750 feet.

A practical nurse accompanies the visitor crowds. Guides are also trained in first aid. Every special attention is provided for any who find themselves physically handicapped or exhausted, and at no time are visitors urged to travel faster than they can with comfort.

Pure, cool spring water is supplied at the lunch room in the left hand tunnel, being piped from a spring a mile northwest of the cave.

Complete lunches, with hot drinks, as well as sandwiches, drinks, tobaccos and chocolate bars are also sold in this lunch room, and avoid necessity of the visitor having to carry a lunch. Here postcards of the room may be mailed, marked as mailed 750 feet underground.

Rest rooms are provided near the lunch room.

The area about the cavern itself, now included in the park reserve, is unusually interesting. Early in 1924, an area of 80,000 acres was withdrawn from entry so it might be added to the monument if desired. Upon the change to park status, an area of ten thousand acres was included . . . a section of the rugged Guadalupe mountains which is yet only a partially explored wonderland of sky-high mesas and wondrous canyons, and literally honeycombed with caves about which very little is known. Some of these caves have never been entered, some are explored for but a small fraction of their probable size. And each of them holds its own magic charm, unlike any other.

The Guadalupes extend into Texas, and are the last link of the Rocky Mountain chain in the United States. Guadalupe Peak or "El Capitan" stands as the highest point in Texas, as 10,000 feet; a magnificent hewn landmark visible for many miles.

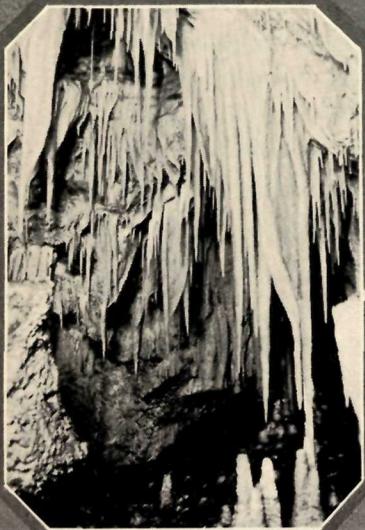


Cavern Geology

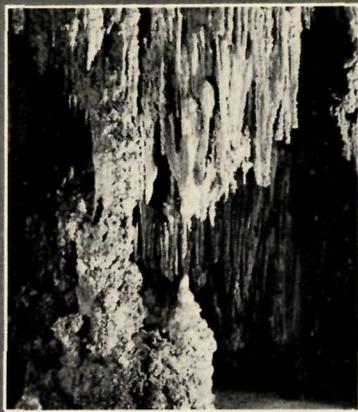
The features which give

Carlsbad Cavern its position of distinction among other beautiful caves of similar type are, first and most noteworthy, the unusual size of the open, unsupported cavities and chambers, and second, less unusual but none the less notable, the stalactitic display of curious, fantastic and beautiful formations with which some of the great chambers have been adorned.

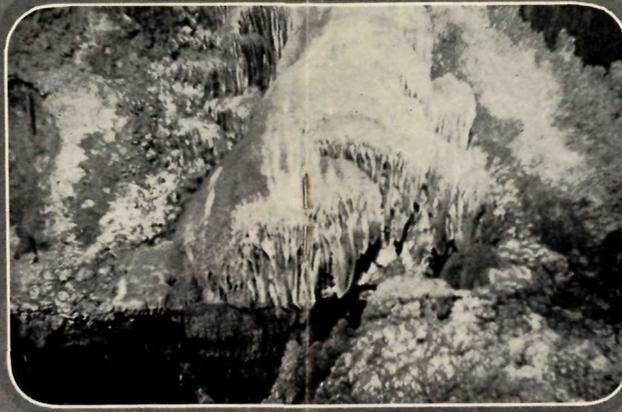
With respect to size of openings, the Carlsbad Cavern is most exceptional. The Big Room is the largest subterranean chamber in the world. Its dimensions are approximately: length, three-quarters of a mile; breadth, 625 feet; maximum height, floor to roof, 348 feet. That part of the cavern leading from the entrance towards the inner chambers is of very unusual breadth and height among open cavities.



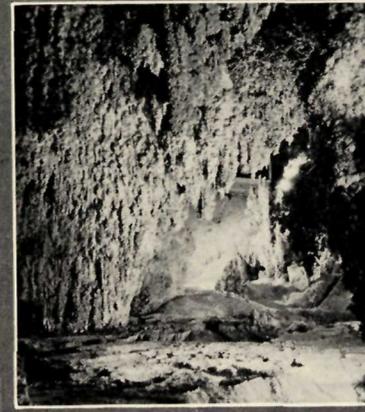
TYPICAL FORMATIONS in RECENTLY DISCOVERED ROOMS



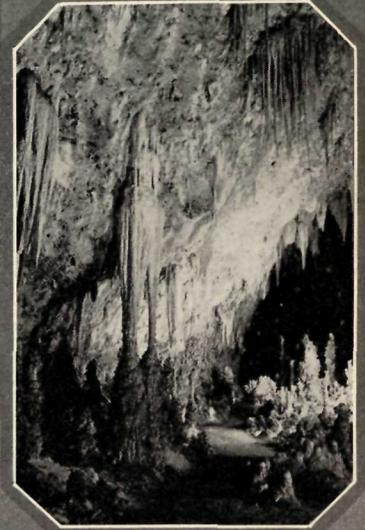
IN QUEEN'S CHAMBER



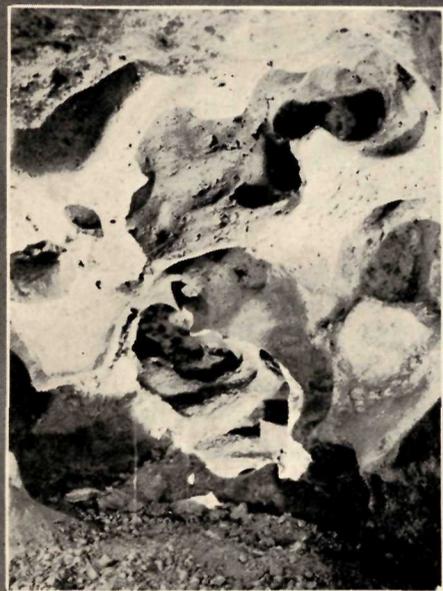
CRYSTAL SPRINGS



WISTERIA GARDEN



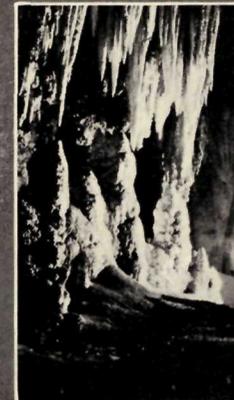
ALONG TEXAS TRAIL IN BIG ROOM



CAVERN STRUCTURE NEAR LOWER END OF ELEVATOR SHAFT



ENTRANCE TRAIL TO CARLSBAD CAVERNS.



STALAGMITES in KING'S PALACE



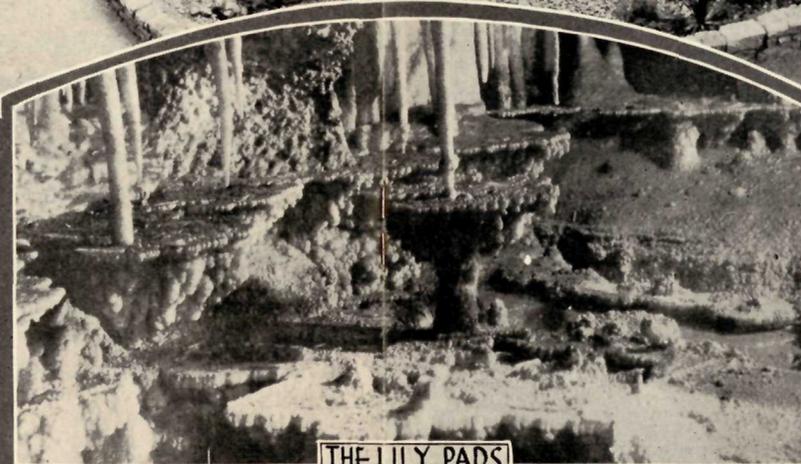
GIANT DOME IN BIG ROOM



MARBLE CASTLE in KING'S PALACE



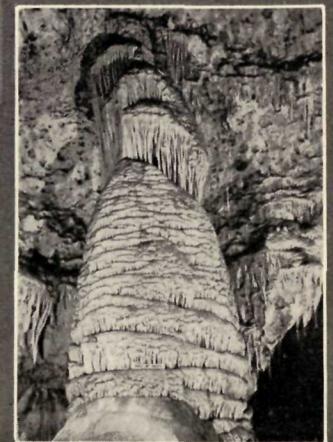
TERRACED STALAGMITE



THE LILY PADS
PHOTO BY JAY LECK - ALL OTHERS COURTESY NATIONAL PARK SERVICE



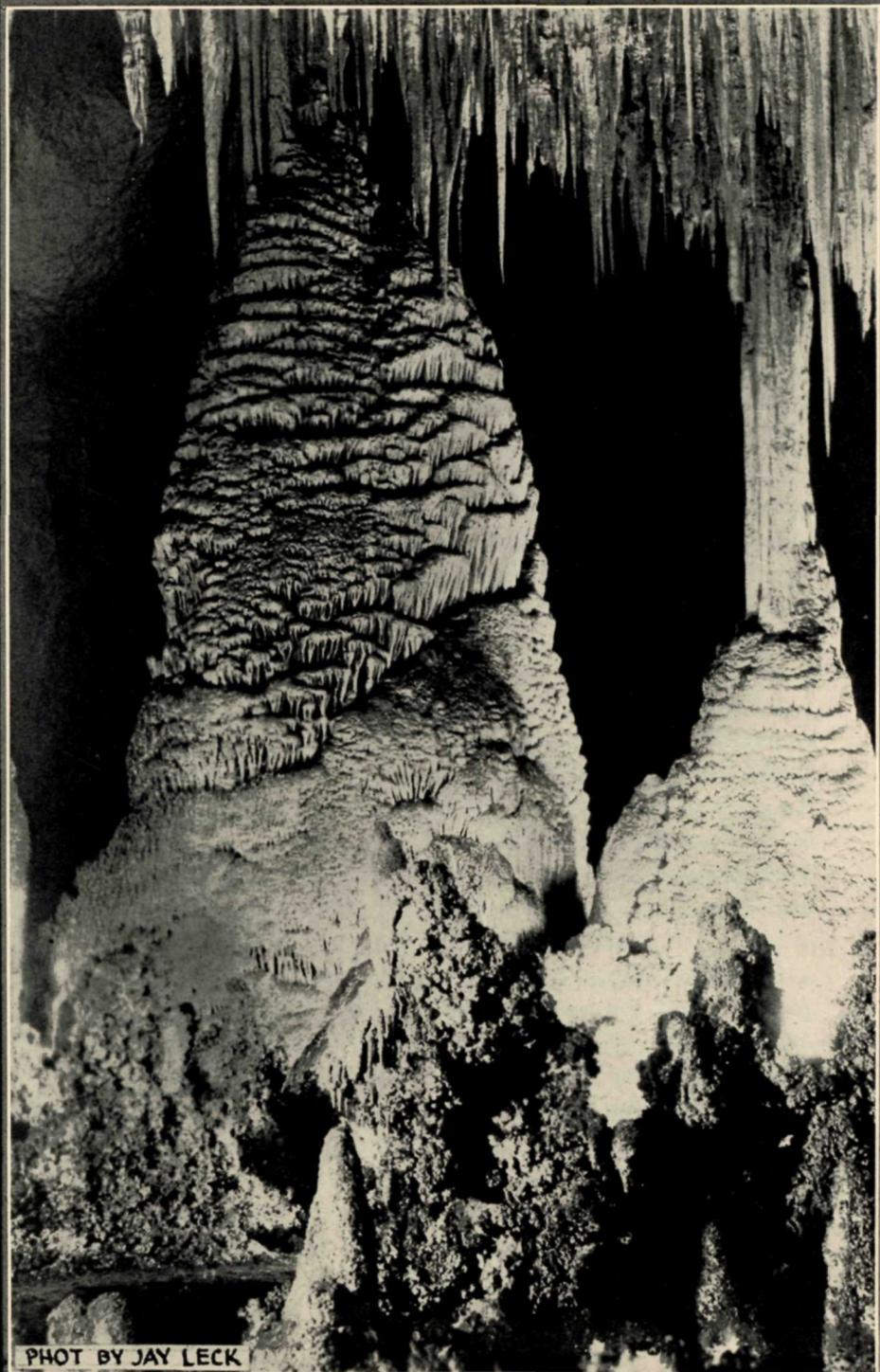
FROZEN FALL in GREEN ROOM



ROCK of AGES

Chambers of such size will only remain open where the rock formation in which they occur is exceptionally strong and solid. Otherwise the roof and walls would collapse, and evidences of the caving in of chambers too large to remain open are found in almost every district where caverns are known to occur. In fact, the surface evidence of such cave-ins in the form of sinks and local depressions, reveals a cavernous region where other indications are lacking. The Carlsbad Cavern is not without its cave-ins. The entrance passageway is partly filled with debris which has fallen there. Huge limestone blocks and broken stalactites, fallen from the roof, may be seen along the trail. In this particular case, the caving did not extend to the surface; it stopped when the roof was sufficiently arched to take the load of weight above it. This tendency of the roof to cave upwards until the "arch" is formed is characteristic of all underground openings in caves, in mines, and elsewhere, but when these arches are formed, they are absolutely safe and will hold up a load to the crushing strength of the rock. It is the arching tendency which stops the caving and makes such openings safe to enter.

The Carlsbad Cavern, therefore, owes its existence, first of all, to a rock formation strong enough to stand, unsupported, over large open areas. The Carlsbad limestone is such a rock. Now for the openings themselves, the Carlsbad limestone, in common with all limestones and massive rock formations, is traversed by a more or less regular system of cracks and fractures which are planes of weakness due to stress from various causes and are known as "joints." They vary in size from the finest seam, scarcely visible to the eye, to well marked fractures. It is because of these tiny cracks in the limestone that we have the chambers and passages of the present cavern. These enormous chambers and almost endless passages originated from the fractures in the limestone and are the result of the action of water attacking the limestone at its weakest points. How the water acts will be explained below: rain water, in falling through the air absorbs small amounts of carbonic acid gas which is present everywhere in the air above us. Water charged



PHOT BY JAY LECK

TEMPLE of the SUN

with carbonic gas has the property of attacking and dissolving small amounts of limestone. When the water strikes the ground it flows over the surface or seeps slowly through the soil and seeks out the weak spots, cracks and seams, in the underlying rocks. Here, in these cracks and seams, it attacks and dissolves the limestone with which it comes in contact. Soon regular channels are formed along these fractures and the openings formed in this way are gradually enlarged until what was originally a single crack or a network of cracks becomes a series of large openings and cavities literally "eaten" out of solid rock by the continued flow of water acting throughout long periods of time.

That the Carlsbad Cavern was developed along such a series of regular fractures is amply proven by a glance at the map of the cavern. In spite of the apparent irregularity of the openings, the map shows that they are not nearly as irregular as they seem. The main axis of the principal openings, the walls of many of the rooms, numerous small side openings and the passageways leading from one room to another show a striking parallelism. The original jointing of the limestone was a series of practically parallel cracks, and the cavern, opening from these cracks, shows about the same parallelism with, of course, many irregularities due to cross fractures and to the irregular action of the water in dissolving the limestone. When a continuous flow of water had been established through such a series of underground channels, the chemical process of solution is often aided by the mechanical process of erosion in which the sand and sediment borne by flood waters, together with fine rock particles from the caving of the roof lend their aid to wearing away the rock. These fine sand grains and rock particles carried along by the water are so many tiny chisels hammering at the rock and wearing it away.

During the period when the numerous rooms and passageways of the Carlsbad Cavern were being formed by the double process of solution and erosion described above, the whole cavern was undoubtedly completely filled with water which entered from the surface through cracks and other openings and

drained from some unknown outlet into the neighboring brooks and streams. At that time, the only surface indication of the cavern may have been one or more small pools or "sink-holes" into which surface water drained.

Water is continuously at work, both at the surface and underground, and when this subterranean stream found or made an outlet at a lower level, it drained the cavern and left it open and accessible. The level of the outlet of the water from the cavern has changed from time to time, for there is evidence within the cavern that water has stood at various levels for long periods of time. Except for seepage water the Carlsbad Cavern is practically dry, but streams probably flowed through it at different times as they now flow through other well known caverns. At any rate, the flow of water which formed the Carlsbad Cavern has practically ceased, having either found another outlet or having dried up as a result of climatic changes or diminished rainfall.

At the time the cavern was being formed it was full of water and there were no stalactites or stalagmites, no draperies or pillars. When the water receded it left nothing but bare openings and huge chambers into which surface water dripped from cracks and crevices. This water contained limestone in solution and when it emerged into the open air of the cavern, it gave off the carbonic acid which held the limestone in solution. As without the carbonic gas, the water could no longer hold the limestone, it deposited it immediately in the form of stalactitic formations and encrustations which we now see.

The same thing happens in a teakettle when water from a stream having its source in a limestone area is heated. The heat drives off the carbonic acid gas and the limestone is deposited, forming a crust or scale on the inside of the kettle. The stalactites in the cavern and the crust in the kettle are both the same substance — limestone — calcium carbonate. They are both formed in precisely the same way, from the evaporation of water containing limestone in solution. If one were to count the years of boiling, and measure the total amount of water which has been boiled to form the thin crust on the inside of the

teakettle, this would give a "yardstick" to measure the enormous periods of time and the enormous quantities of water required, first to dissolve out the rooms and chambers of the cavern, and second to build up the stalactites, stalagmites and encrustations with which the cavern is lined. Remember, however, that the action of the teakettle is many times faster than the action of nature in the cavern, because the water in the kettle is heated and the heat speeds up the process.

Pendant formations, hanging from the roof and sides of the cavern and growing downwards, are called stalactites. Every stalactite has its origin in a very slow trickle of water from the roof or sides. It starts as a small circle or ring of limestone, like an inverted crater, whose size is that of a drop of water about to fall. At the outer surface of the drop the carbonic acid gas is given off from the water and the dissolved limestone is deposited. At the center of the drop no evaporation and hence no deposition takes place. As the drop falls and another drop takes its place, this process is continued and a tube is formed which slowly lengthens. The rate of growth varies, of course, with the rate of flow, fast growing tubes have thin, delicate walls which gradually thicken. Water from the interior of the tube seeps through the walls and evaporates at the surface, leaving its dissolved limestone on the outer surface of the tube, evaporating as it goes and thus thickening the walls. Often the central tube becomes obstructed or completely closed and the escape of the water at points above the end of the tube forms peculiar nodular or cauliflower growths. In any event a second stage in the growth of a stalactite ultimately arrives, when the central tube is no longer the main source of supply but a general trickle from the roof bathes the whole outer surface of the stalactite and adds to its growth. Very large stalactites are usually formed by the joining together of many small ones.

The hollow, tubular stalactites often have small holes or openings through the walls which allow water from the central supply to escape at these points, and these openings become the starting points for new growths. These growths are also tubular, but their central tubes are very small, often mere capillaries.

Outgrowths from these capillary tubes curve and twist, give off branches, grow out horizontally and even upwards, and sometimes assume a corkscrew shape. They may resemble twigs, horns and intricate bramble patches. The material from which these peculiar growths, known as helictites, are formed is always derived from the hollow tube from which they grow and which, in turn, is connected with the main source of supply in the center of the stalactite of which they form a part.

A trickle of water which drops freely into the open space of the cavern will form stalactites resembling icicles. Where this trickle emerges near the side of the cavern so that it "runs" along the sloping arch of the roof instead of falling freely, curtain-like stalactites resembling delicate draperies are formed. These "curtains" have grown downwards along the path where the first drop of water trickled down the side of the cavern and the edges of these curtains are almost always parallel to the sloping roof from which they are suspended. The successive layer of limestone from which these curtains are developed can be seen in the banded structure which is revealed when a strong light is permitted to shine through the thin draperies.

Where water drops on the floor of the cave, evaporation still goes on and forms a crust which takes many forms, from slender spires to rounded domes and irregular sheets. Such formations, growing upwards and fed by water dripping from above, are called stalagmites.

If the air is still, the drops from a stalactite will always land in the same spot and a pillar will rise vertically, which may grow until it meets and joins the stalactite above it. The flow of water over the sides of a stalagmite with the consequent deposition of limestone thickens it. Sometimes the flow of water is so rapid that there is no time for evaporation at the roof and the formation of elaborate stalactites. When such a flow hits the floor it spreads out and evaporates and deposition takes place on the floor. Such conditions result in the formation of flat crusts or thick rounded domes of great size.

Stalactites grow from the water flowing down their sides and through their central tubes. Stalagmites, domes and crusts

grow from the water flowing over their outer surfaces; they have no central tubes. Stalactites which are "wet" or which have water dripping from their points are "alive and growing." Stalagmites which are "wet" by water dripping from above are also "alive" and growing. When the flow of water ceases and they become dry, growth has stopped and they are "dead." A new flow of water may revive these dead formations and add new growths, but when they have become thoroughly dried out the newer growths do not become tightly cemented to the old formations and may be lifted off.

The deposition of the lime goes on in the pools which occur in the cavern; feathery crystal growths line the sides of such pools. Evaporation and, consequently, the deposition of the limestone, is most at the surface of the water and a stalagmitic formation often forms at this surface and grows outwards from the sides of the pool. It may cover the pool completely with a solid, firm floor which will remain standing when water in the pool has drained away. Such formations at various former water levels are present in the cavern. The so-called "lily pads" are of this type.

Water dripping from the roof and landing on the floor often "splashes," sending tiny droplets in all directions. Where these land, they deposit lime and "splash" formations are seen on the floor and on the sides of the stalagmites, in what is known as "fairyland" in the Big Room.

Sometimes the drip from the roof, instead of building up a stalagmite, forms a small basin or crater on the floor, into which small particles may fall. These particles, a grain of limestone broken from a stalactite, a tiny grain of sand or a bit of crystal precipitated from the water, grow in size and are found varying in size from the tiniest spheres to rounded masses larger than a hen egg. The impact of the successive drops of water jars them enough to keep them from growing fast to the floor and rubs them against one another and the floor. In this way they become highly polished and are frequently of great beauty. They are known as "cave pearls."



Bats of the Cavern

*Q*ueerest of all things

that fly, associated in history with the underworld, and regions of darkness and evil, and unknown in character, to the average person, the bat has his place in the exploration and development of Carlsbad Cavern. Colonies of hundreds of thousands, or rather millions, of bats have made their abode for ages past in certain chambers of the Carlsbad Cavern, known as the Bat Cave, which is not included in sightseeing trips. The majority of the bats found in the Carlsbad Cavern are described by Vernon Bailey of the Biological Survey, U. S. Department of Agriculture, as the Mexican Free-Tailed (*Tadarida Mexicana*) the famous guano producing species native to the southern part of the United States and Mexico. A comparatively small number

of the two hundred fifty or more other species are also found among them. It is believed that these bats, during their season of activity, consume at least half their weight in insects each night, possibly more than this, and largely insects injurious to crops or forest growths.

During the cooler months of the year the bats hibernate, hanging as is their day by day custom, to the roof of their great cavern home in huge colony clusters. Hibernation begins about October 15th each year. About May 1st they begin to come out at dusk for insect food and by the end of May are coming out in sufficient numbers to make their flight of interest. Their number gradually increases until by midsummer their flights are a fascinating spectacle not easily forgotten. Estimates of the U. S. Biological Survey are that three million bats make their home in this section of Carlsbad Cavern.

As one waits, near the cavern entrance, for the evening flight of the bats, their approach may be recognized by a whirring sound deep in the cavern, which gradually grows as uncounted bats release their nestle-hold on the cavern ceiling and join in the swift and darting circle flights which are continued to the cavern entrance. Here they dart about at amazing speed until they reach the open, when they turn their course to the southwest in the search for insects. The Black River section, a few miles south, furnishes their most fertile hunting grounds.

Soon after the leaders have turned their course into the open, the column becomes so dense in numbers as to appear like a column of light smoke or cloud, sky-lining over the hills, and the flight continues for three hours or more, with hundreds upon hundreds of thousands, perhaps millions of the tiny mammals joining the great stream. Their return, near dawn, is none the less spectacular.

The bat roosts are remote and miles distant from the spectacular parts of the cavern, and are not seen at any time by the visitor on the usual journey. The only life seen in the cavern by the tourists are a few crickets sometimes seen along the trail near the entrance, or an occasional cave mouse.

Administration

The Carlsbad Caverns

National Park is owned and operated by the United States Government through the Department of the Interior and is administered by the National Park Service. The representative of the National Park Service in immediate charge of the Carlsbad Cavern is Thomas Boles, who maintains headquarters in the town of Carlsbad, New Mexico, 28 miles north of the cavern, but he may be usually found in the park area.

The first custodian of the Carlsbad Cavern, as a national monument, was Dr. Willis T. Lee of the United States Geological Survey, whose articles in the National Geographic Magazine had brought the cave its first national publicity. He was succeeded by W. F. McIlvain, who served until May 15, 1927.

On May 15, 1927, Thomas Boles, formerly in charge of Hawaii National Park, became superintendent of the cavern, and brought to its administration a practical experience of several years in the park service work.

An interesting group of cottages has been built on the "cave hill" for rangers and employees of the National Park Service. Other buildings include a power-house, an elevator building, an office building and a concession building, all of uniform architectural interest. A plan of uniformity in building and landscaping preserves the natural feeling.

Parking space is available for hundreds of automobiles on "cave hill," near the cavern entrance.

Any ordinary service accommodation or need is supplied readily, and employees of the Cavern Supply Company, as well as those of the National Park Service, offer courteous aid to the visitor in every way possible. Camping upon the government reservation is not permitted.

All complaints or suggestions for the improvement of the service, or information as to cavern trips, should be addressed in writing to the Superintendent, whose postoffice address is Carlsbad, New Mexico.



The Land Nobody Knows

The southeastern corner

of New Mexico is aptly described as "the land nobody knows." Besides the greatest caverns of the world, the Guadalupe hold scores of other caves, some known to be beautiful but not fully explored, some small and uninteresting, many never having been explored fully and few never entered. It contains cloud high mesas and rugged deep canyons which have been seldom trod by the foot of white men, and across but part of the more rugged and inaccessible rims has the redskin left his trail.

Seven flags have flown over this land: the insignia of the sun, of the Aztec Indians, was its banner until the coming of the

Spanish. The rule of Spain lasted through nine kings and fifty-three governors. The Republic of Mexico held this territory for a period of sixteen governors; later it passed as a part of the Louisiana purchase from France, and became a part of the Republic of Texas. It was annexed to New Mexico Territory when that included both New Mexico and Arizona, when Texas was admitted to the Union. It was held under the confederate flag until the battle of Old Pigeon Ranch on the Pecos. Its hectic history includes the flagless Lincoln County war and the history making activities of such desperadoes as Billy the Kid, Geronimo, the outlaw Indian chief, Black Jack and others.

In archaeology, in geology, in plant and animal life today and in the far distant past, the whole area is yet one of undetermined mystery. In history of the Old West, it had a very thrilling part, still practically unrecorded.

Fossilized remains of prehistoric animals have been discovered in the adjacent desert lands in such numbers as to arouse national interest. At one place a whole herd of mastodon fossils was found, along with the ancient horse and camel. At another, the cave bear was located in fossil form, harking back to days of the sabre tooth tiger.

And, as these animal races passed on, they interlinked with races of man. One skull, located recently, is believed to go back so many thousands of years ago that some scientists debate whether the cradle of man may not have been in this area of the now disappeared midcontinent ocean. Fragments of petrified wood arouse the question whether there was once forest here, or whether the old sea and streams carried the tree trunks from northward.

In Guadalupe canyon cliffs the Basket Makers, dating back four to five thousand years, buried their dead in caches of burial caves, and sealed them in. While in many cases entry of water has caused the remains and artifacts to be lost, in many others they are found perfectly preserved through these forty to fifty

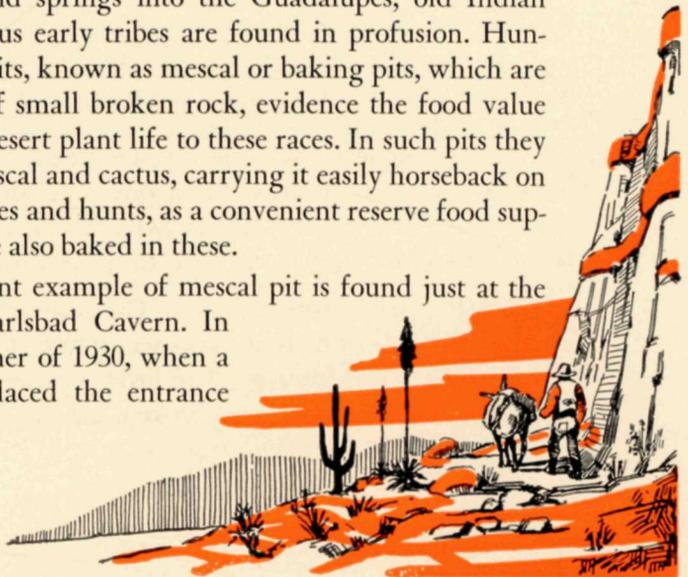


centuries because of the extreme dryness of the burial chambers. In a recent excavation, not only were perfectly preserved baskets and other weaving found, but in a section a hundred miles from water, there was proof that much of their weaving was of water grasses and that ages ago, that section was watered well. Along with such proof were remains of animals long ago extinct in this area.

A number of national and international authorities have taken interest in these archaeological discoveries and complete searching and study is promised, to try and learn some of the lost secrets. In many places, one race followed another in the Guadalupe fastness, shown by painted cliffs which bear the known marks of the Basket Maker, the crude designs of earliest hieroglyphics, as well as more modern Indian painting from everlasting rock paints.

Along stream courses and large springs are found seed grinding holes in which old civilizations ground meal for flour, and used, after they were too deep to grind in, as cisterns. Since some of such rocks have broken, geologists have tried to estimate the time of erosion on the broken rock parts, to be amazed at the ages which must have passed since these holes were drilled out by hand. Scattered through the great sand dunes which run northward and southward with the "Mescalero Ridge" or Caprock, thirty miles east of Carlsbad; following stream beds and springs into the Guadalupe, old Indian camps of various early tribes are found in profusion. Hundreds of rock pits, known as mescal or baking pits, which are circular piles of small broken rock, evidence the food value of cactus and desert plant life to these races. In such pits they baked their mescal and cactus, carrying it easily horseback on their pilgrimages and hunts, as a convenient reserve food supply. Meats were also baked in these.

An excellent example of mescal pit is found just at the entrance to Carlsbad Cavern. In the early summer of 1930, when a new trail displaced the entrance



stairs, evidences of the Basket Maker were found in the cave entrance. Flint work and other Indian evidences have been found in and about the entrance in considerable quantities. Flint pieces, such as arrow heads, scrapers and other utensils, as well as sandstone metates and pestles, are found in the old camps, and furnish an interesting treasure hunting expedition.

Indians finally left this area about fifty years ago, and old pioneers still may be found who aided in driving the last remnants of the redskin from this section.

The trail of the Spanish Conquistadors is believed to have come into the Guadalupe at Rattlesnake Springs, near the Carlsbad Cavern, and here it was crossed by the Butterfield Trail, the first express trail across the west. The Las Vegas trail to Mexico, and the path of a Spanish expedition from Florida, about 1527, are believed by students of these subjects to have passed through this part of the Pecos Valley.

Legends of many a hold-up of treasure caravans bringing gold from California cluster about the sentinel peaks at the end of the Guadalupe, near which the Forty-niners circled on their transcontinental pilgrimage. Even to this day, searching parties with treasure maps occasionally make expeditions into those forbidding canyons in the search of buried wealth, from Spanish expeditions, from the Forty-niners, from caches of robber gangs and believed lost mines.

The old Butterfield express trail is marked at a number of places, the most familiar being an old ruins near Pine Spring Camp, sixty-five miles southwest of Carlsbad.

One of the last representative settlements of the wild Old West was that of Phoenix, about one mile south of Carlsbad. Here blood ran free in many a brawl. A single crumbling adobe is the only remaining monument to those days of Phoenix.

About fourteen miles north of Carlsbad, a few almost vanished adobe wall ruins recall another frontier settlement of historical and pioneer interest. The little cemetery, with most of its headstones shot down and broken, bear dates back to '79—

with names of pioneer families inscribed. But there are other graves, still earlier, which bear no stone, and men who were not quick enough on the "draw" of the gun which was the law of that land, lie buried in them.

Two of the recognized life zones of North America meet and blend at Carlsbad Cavern, according to Vernon Bailey of the U. S. Biological Survey, who has written a book on "Animals of Carlsbad Cavern." These two zones, Lower Austral and Upper Austral, are supplemented by an area of the Transition zone on top of the Guadalupe, and in these canyons are variety of plant life beyond belief of anyone who has not closely studied the mysteries of the desert. "Of edible, uncultivated plants, few regions could be more bountiful," Mr. Bailey declares. The aboriginal tribes had not only the great herds of buffalo and antelope, as well as many other varieties of meats for selection, but they had an almost endless array of foods from plants, provided flour for cakes and bread, nuts and wild fruits.

As animal and plant life are interlinked, the variety of the latter provided unusual range, and the birds of the low reaches of the canyons are unlike those of the upper ends of the same canyons.

While the interest of scientists, geologists, botanists, zoologists, archaeologists, insures someday an unraveling of some of the Guadalupe country mysteries, any novice may hike at will and find evidence of facts that are yet unexplained, in the queer "land nobody knows."



The Blossoming Desert

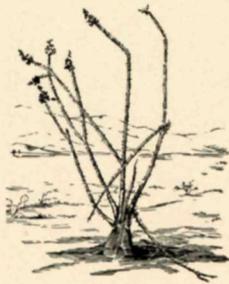
The desert begs nothing

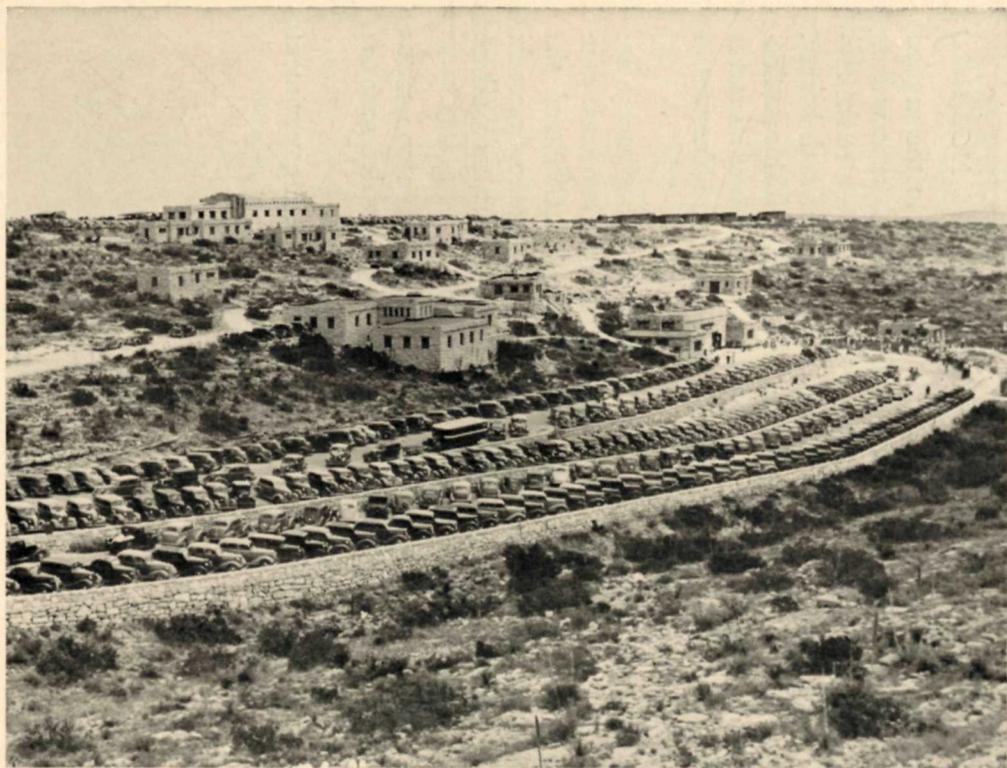
of the rose garden when blossom time comes to the myriad cactus plants which thrive on bleak limestone cliffs as well as in canyon beds. The drive through Walnut Canyon to the cavern entrance is one of keen pleasure to lovers of such beauty, and is especially interesting when it is known that this particular section is credited with being the most glorious of all cactus land in the variety of plants, scores of which have blossoms of extraordinary beauty.

Particularly plentiful about the highway to the cavern are the sotol, prickly pear, strawberry cactus, melon cactus, cane cactus, occotillo, Spanish Bayonet and "Yucca Glorioso," the appropriate state flower of New Mexico. Among the almost six hundred varieties of cactus known in New Mexico, most all are represented in the Guadalupe mountains.

Excellent specimens of some of the more common cactus varieties have been gathered in an interesting garden near the office at the cavern.

Gathering of cactus specimens on the reserved government lands is prohibited.





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