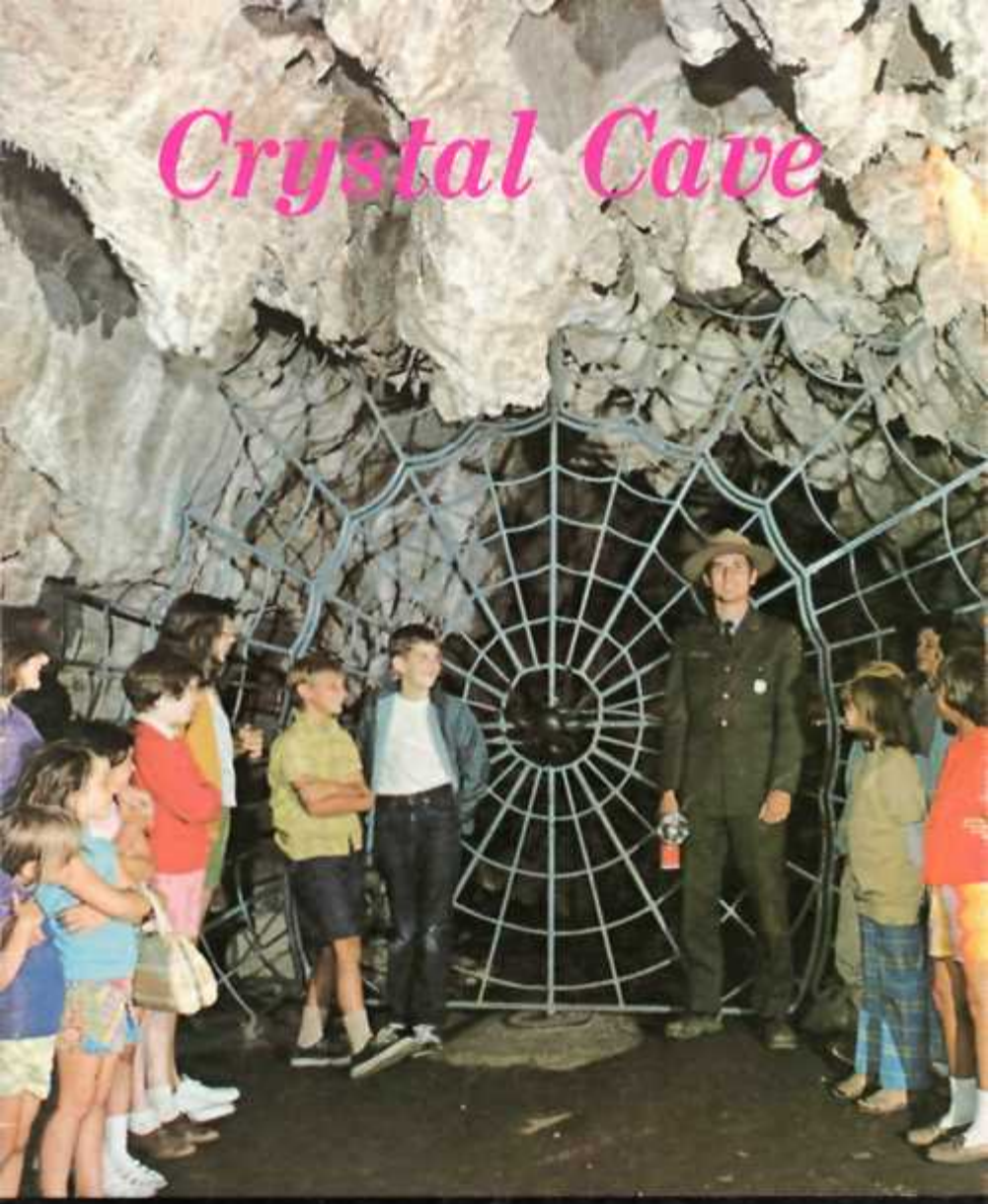
Crystal Cave



Sequoia National Park

CRYSTAL CAVE in Sequoia National Park is published by the Sequoia Natural History Association in cooperation with the National Park Service. This popular booklet is now in its fourteenth printing since first published in 1946. Revisions have been made in the text material originally prepared by Frank R. Oberhansley, who was Park Naturalist from 1939 to 1946.

The National Park System, of which Sequoia and Kings Canyon National Parks are units, is dedicated to the preservation of America's scenic, scientific, and historic heritage for the enjoyment and benefit of the people.

Color Photos—

Front: Party at Spiderweb entrance gate to Crystal Cave

Center: The Dome Room

Inside Back Cover—

Map of Crystal Cave

CRYSTAL CAVE

IN

SEQUOIA NATIONAL PARK

FRANK R. OBERHANSLEY

Caves traditionally belong to bats, ghosts and fierce wild animals. To the hardy explorers who squeeze through twisting passages and with a flickering candle, strain to identify shapes in gloomy chambers, there may be moments when indeed caves may seem to be peopled by creatures from another world.

Crystal Cave must have a "dual personality". The grotesque forms, the ghostly resemblances are here; but elsewhere delicate crystals, pastel translucent draperies and slender, fragile stalactites create a delightful fantasia.

In our enlightened era, feelings of terror are tempered with knowledge. The huge spider and its web that form the entrance gate are made of steel. The odd hanging pieces are mostly solution remnants of the marble bedrock. The glossy "pencils" suspended from the roof are redeposited calcium carbonate. But in this tempering knowledge is the essence of a new enjoyment—the satisfaction of man's endless curiosity.

To this new delight we invite you now. With your ranger-naturalist guide explore, feel needless pangs of fear, marvel at the infinite designs, and exult in your discovery of some secrets long kept inviolate by mother nature.

The rich variety of geological formations was probably unsuspected by those who labored to have Sequoia set aside as a national park. One such unusual feature, a band of ancient rock remnants on the west slope of the Sierra, contains many outcrops of gray and white crystalline marble. Most of these blocks of metamorphosed limestone contain caves, but Crystal Cave is probably the largest and most interesting.

While descending the trail into the narrow wooded ravine of Cascade Creek you may be curious to know who first scrambled over the rocks and through the brush to reach this beautiful glade. As might be expected, two trout fishermen, C. M. Webster and A. L. Medley, both employees of the National Park Service at the time, were the first to reach this spot and discover the entrance to Crystal Cave. This event occurred on April 28, 1918, almost 28 years after the area had been established as the nation's second national park.

Crystal Cave is one of several caves in Sequoia National Park located in narrow marble formations in the Sierra Foothills.

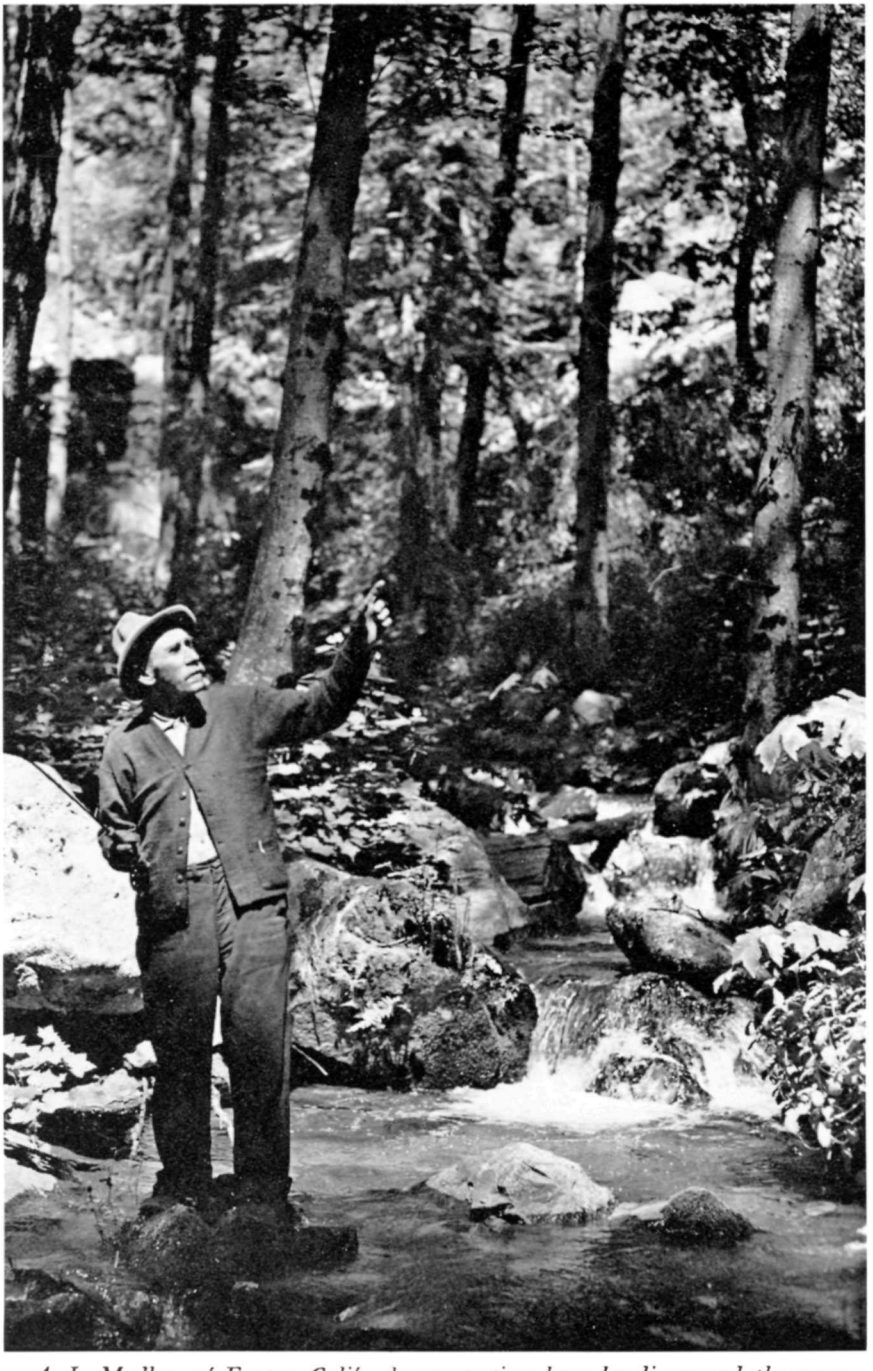
Walter Fry, then Superintendent, took immediate interest in this new discovery and assisted in the exploration of the cavern. Convinced of its scenic and scientific value, he ordered the construction of a log barricade across the entrance to protect its fragile beauty from vandals. Development for public use was delayed about 20 years until Congressman Albert E. Carter, who was born and reared in the Three Rivers community, made special provision for this project in the Department of the Interior appropriation bill. On May 29, 1940, after two years of work by the Civilian Conservation Corps, supplementing developments accomplished with regularly appropriated funds, Crystal Cave was opened to the public.

You will probably start your trip to Crystal Cave from Giant Forest, descending the main highway for 2 miles then branching right on the Crystal Cave Road. From here you will follow a winding course for 7 miles through virgin forest of mixed pines, firs, incense cedar, black oak and dogwood. Flowering plants and shrubs along the way will entreat you to stop and admire them. The changes in the trees and plants you notice as you descend to the parking area indicate a change in climatic conditions. You will have moved from a cooler level with more precipitation, to warmer and dryer surroundings. Giant Forest is typical of the Transition Life Zone but at the elevation of the cave parking area—4,860 feet—you will find yourself in the Upper Sonoran Life Zone. Here the stately yucca and lovely mariposa lily are found along with scores of interesting trees, shrubs and herbaceous plants.

From the parking area a self-guiding nature trail descends a half mile to the cave entrance in the bottom of the canyon of Cascade Creek. The altitude at the cave entrance is 4,540 feet, or 320 feet lower than the parking area. The trail crosses Cascade Creek over a rustic bridge. Above and below it is a beautiful series of waterfalls visible from the lower switchbacks on the trail. Fingers of vegetation representing the Upper Sonoran Zone extend upward along sunny slopes, while similar extensions from the Transition Zone cross the trail and descend into the canyon in more sheltered places resulting in a variety of plant and animal life. One of the interesting trees along the trail is the rare California nutmeg (Torreya californica). This tree is an evergreen with sharply pointed needles. It grows to a height of about 75 feet in cool canyons of the Upper Sonoran Zone, and its interesting seeds resemble nutmegs. This delightful natural trail is a fitting prelude to a trip through the cave. It also affords excellent views of the marble outcrops and associated rocks. The entrance to the cave is situated near the base of the lower waterfalls where a pleasant resting place has been provided in the shade of the alders. There are many caves that surpass Crystal Cave in size and beauty, but none has a more interesting approach.

A Trip Through the Cave

The entrance to the cave is a beautiful natural arch 30 feet wide and 16 feet high. A good trail 1,600 feet long provides access to the most scenic parts of the cavern. Since the first 500 feet are retraced on the return trip the total distance traveled underground is nearly one-half mile. Thirty feet inside the entrance, a wrought iron gate resembling a huge spider web forms an effective barricade. The cave is illuminated with indirect white light, and the wires and fixtures are so well concealed that they are not noticeable from the trail. There is good ventilation throughout, and the temperature never varies more than a few degrees from the normal of 50° F.



A. L. Medley, of Exeter, Calif., demonstrating how he discovered the cave while fishing on Cascade Creek with C. M. Webster in 1918.

The entrance leads directly into a large room some 20 feet wide and 160 feet long, with an average height of 9 feet. A flat ledge about 4 feet high projects from the east wall almost 10 feet into the room, and beneath it there is a shelf 2 feet high. The cave floor beneath this shelf is visible through small natural windows dissolved in the marble, and is seen to slope down toward the east wall where the cave stream is concealed in a deep marble trench. The ceiling is irregular in pattern with grotesque solution remnants of marble and massive deposits of dripstone pointing downward.

Cave Decorations

Some scenic features of the cave are the oddly-shaped remnants of undissolved bedrock extending from ceilings, walls and floors. These are called solution remnants. Another kind of rock is formed when percolating ground water reaches the cave openings. Here some of the water may evaporate and lose some of its dissolved carbon dioxide. In this process calcium carbonate dissolved from the marble is deposited. Some of the forms it may take are:

Stalactites: Icicle-like formations suspended from the ceilings and ledges, commonly having a small tube in the center.

Stalagmites: Formations built up from the cave floor or shelf by dripping water. They resemble stalactites but are usually thicker and blunt at the end.

Columns: Formed when the above-named features join.

Helictites: Irregular branching growths extending in various directions in apparent defiance of gravity.

Curtains or Draperies: Thin, blade-like deposits extending from walls, or cascading in folds from ledges as curved double-edge stalactites, terminating in single, sharp points.

Flowstone: Any calcareous formation deposited on the walls or floors of a cave by flowing water.

Rimstone: Coral-like dams of calcareous deposits enclosing basins often arranged in a cascading series.

Pistolites or cave pearls: Limestone concretions about the size of peas formed around particles of sand or other nucleus. They grow while agitation by water turns them over and around.

Unexplored Grotto

Ninety feet from the entrance, an interesting side chamber branches off to the west. This passage is about 3 feet wide and filled with quiet water from an unknown depth to within 3 feet of the ceiling. It is blocked from the main entrance room by a mound of clay covered with flowstone, and indicates that a different type of circulation formerly existed within the cave. The passage has never been explored, but as far as it is possible to see into it by flashlight there is a maze of weird marble projections both above and below water, and myriads of beautiful stalactites directly above the water.

The trail from the entrance room follows beside the stream through a high, narrow passageway beautifully adorned with a variety of stalactites. Here, also, are good examples of coral-like growths in the rimstone basins and stone nests containing calcite eggs, or pisolites. This passage narrows to a small opening about 3 feet wide and 10 feet high near the *Junction Room*. There is usually a breeze through this opening—blowing outward when the temperature outdoors

Horizontal solution cuts and shelves near the entrance. Water flowed or stood at various levels during formation of the cave.

is warmer than the cave. When air outside is cooler than 50 degrees the direction of ventilation is reversed. A moment of reflection will answer your question—"Why does this take place?"

The *Junction Room,* named because it is the junction of three trails, is about 30 feet wide, 75 feet long, and 20 feet high above the stream. It has an excellent display of cave decorations, containing many solution pits. Overhead there is a tortuous, winding passage incised through the marble. This passage connects with an interesting elevated chamber of complex design. In addition to many other interesting features, there is a series of rimstone dams about 18 inches high, enclosing basins up to 5 feet in diameter. These basins long ago lost the water which built them up. Also in the Junction Room, a great keystone pillar rises from floor to ceiling, and the remnants of undissolved marble hanging downward from the ceiling assume profiles that remind one of various animals and persons.

The Circle Trip

From the Junction Room a counter-clockwise course is followed, past many side and overhead openings, to the *Curtain Room.* Here delicately folded flowstone descends from the ceiling in the form of draperies. A few feet farther along, the narrow, sinuous trail opens into a sizeable chamber called the *Organ Room.* In this room a huge cascade of flowstone 20 feet long terminates in a magnificent bank of curving, double-edged stalactites which resemble a giant pipe organ. Leading from the chamber are several alcoves, partly separated by thin window-rock partitions. The alcoves are partly filled with clay and gravel, remnants of which are common in the main passage. Narrow, fissurelike openings and tubular passages radiate out in various directions from this section, some of which make complete loops. Huge blocks of fallen marble occupy much floor space in this and succeeding rooms.

A series of bladelike window rock separates the Organ Room from the *Dome Room.* The dome is a huge block of fallen marble capped by a thick layer of flowstone which resembles frosting poured over a mammoth cake. In general, the entire formation is shaped like a shoe, near the toe of which are several miniature lakes with delicately beaded shores. Here are some of the most fragile and attractive stalactites in the cave. On the instep of the Dome, there are several stalagmites resembling totem poles. The Dome is situated directly under a major crack in the marble ceiling from which water is constantly dripping to form a thin film of water over the Dome. Near the trail, thin strips of draperies resembling huge slices of bacon are forming beside curved, double-edged stalactites. The dripstone throughout the cave possesses various shades of ivory color. The ceiling in this room has a weird assortment of marble remnants and an intricate pattern of small, rounded channels incised upward into the marble. Some of these are filled tightly with stream deposited sand and gravel. A delicate slope of glittering, frostlike, white crystals is a major attraction in this room. The deep, inverted potholes in the ceiling are of special interest.

The trail from the Dome Room leads upward to a narrow passage called *Fat Man's Misery,* and from here descends into the largest room in the cave known as *Marble Hall.* There is a maze of connecting passages along this route. Some are complete circles and practically all connect with Marble Hall. This big room is roughly 54 feet wide, 43 feet high, and 141 feet long. The high point on the trail near this room is about 60 feet higher than the entrance. Huge blocks of collapsed marble partially fill this room. From high ledges massive

In the most constricted portion of the trail there is a thick covering of beaded flowstone.

banks of flowstone are terminated in a weird assortment of stalactites and draperies. Some of the ledges have broken off and lie inverted with the broken stalactites pointing upward. Other large blocks have slumped, as indicated by stalagmites pointing obliquely upward. There are also huge remnants of marble suspended from the ceiling by narrow necks or extending out from high alcoves and side chambers, that contribute to the gnome-like atmosphere. Here the lights usually are turned off to demonstrate the natural darkness of the cave. There are excellent deposits of bedded clays in the alcoves adjoining this room, and many remnants of the gravel on high levels, to suggest how completely the cave was filled in times past.

After traversing Marble Hall, the trail leads through a short, artificial tunnel to connect with a narrow fissure along a fault zone where the marble formation has parted and slumped along a deeply inclined plane to the right. One can see upward over this inclined slope more than 100 feet.

Near the lower end of the winding trail, a large overhead balcony of extreme beauty is viewed from a landing. The walls of this balcony are almost completely covered with a thick coating of cascading flowstone. This probably is the most scenic alcove in the cave. From this point it is about 100 feet to the junction, from which point the trail is retraced to the entrance.

It is impossible to describe more than a few features of the cave. The pattern is so complex and there are so many features that one can see only a few of the more outstanding ones in a single trip.

Living Things in Crystal Cave

In Crystal Cave, a small, brownish-black spider has been tentatively identified by experts as a new species of the genus *Pimoa,* family Linyphiidae. The spider spins its web in various parts of the cave where small flying insects, and occasionally cave crickets, become entangled frequently enough to furnish food for the spiders.

A type of cricket, sometimes called a cave cricket or camel cricket has been found inside the cave, but also occurs outide, under rocks, in deep bark crevices, in hollow trees, and in other similar dark places. Entomologists report that this cricket is a new species in the rare genus *Tropidischia.* It is similar in color to the spiders and has an antennae about three inches long upon which it seems to rely in moving about in the darkness. "This genus is practically unknown to science." (Cave spiders and crickets identified by Dr. Dwight Pierce, Los Angeles County Museum)

Large millipedes, sometimes referred to as thousand-legged worms, have been observed inside the cave many times. They are quite harmless, feed only on fungus and decaying organic matter, and roll themselves into a spiral when handled.

Several kinds of mammals have been recorded from the cave. A dusky shrew (Sorex obscurus) was once found on the trail just inside the entrance. Bats have been seen rarely. One specimen, a western lump-nosed bat (Corynorhinus rafinesquii), taken from a remote recess in December, 1945, proved to be a species previously unrecorded in the park. The long-eared bat (Myotis evotis), has been seen flying in and out of the mouth of the cave. Two deermouse species, the brush mouse (Peromyscus boylii) and the long-tailed mouse (Peromyscus maniculatus); and the dusky-footed woodrat (Neotoma fuscipes) find their way into the darkest recesses of the cave. Caches of acorns and other seeds brought in by these rodents

Columns, formed by merging stalactites and stalagmites, reach from roof to floor.

are common. Their droppings and tracks are abundantly distributed over surfaces of clay banks and silt deposits in alcoves adjoining the Organ and Dome Rooms.

Black bears (Ursus americanus) have been reported to den up in some of the outer openings of the cave in cold weather, and the skeletal remains of a raccoon (Procyon lotor) were once found in one of the openings. Bones of the mule deer (Odocoileus hemionus), and of other mammals, have been found in the cave, some of them being partially encased in flowstone.

Every summer since 1941, one or two pairs of canyon wrens (Catherpes mexicanus) have nested in small holes in the ceiling 15 feet or more inside the cave entrance. One summer a pair of robins (Turdus migratorius) nested there in a similar place. No reptiles or fish have been found in the cave but, on several occasions, specimens of an amphibian, the Ensatina salamander (Ensatina eschscholtzi croceator), has been found in damp places well within the mouth of the cave.

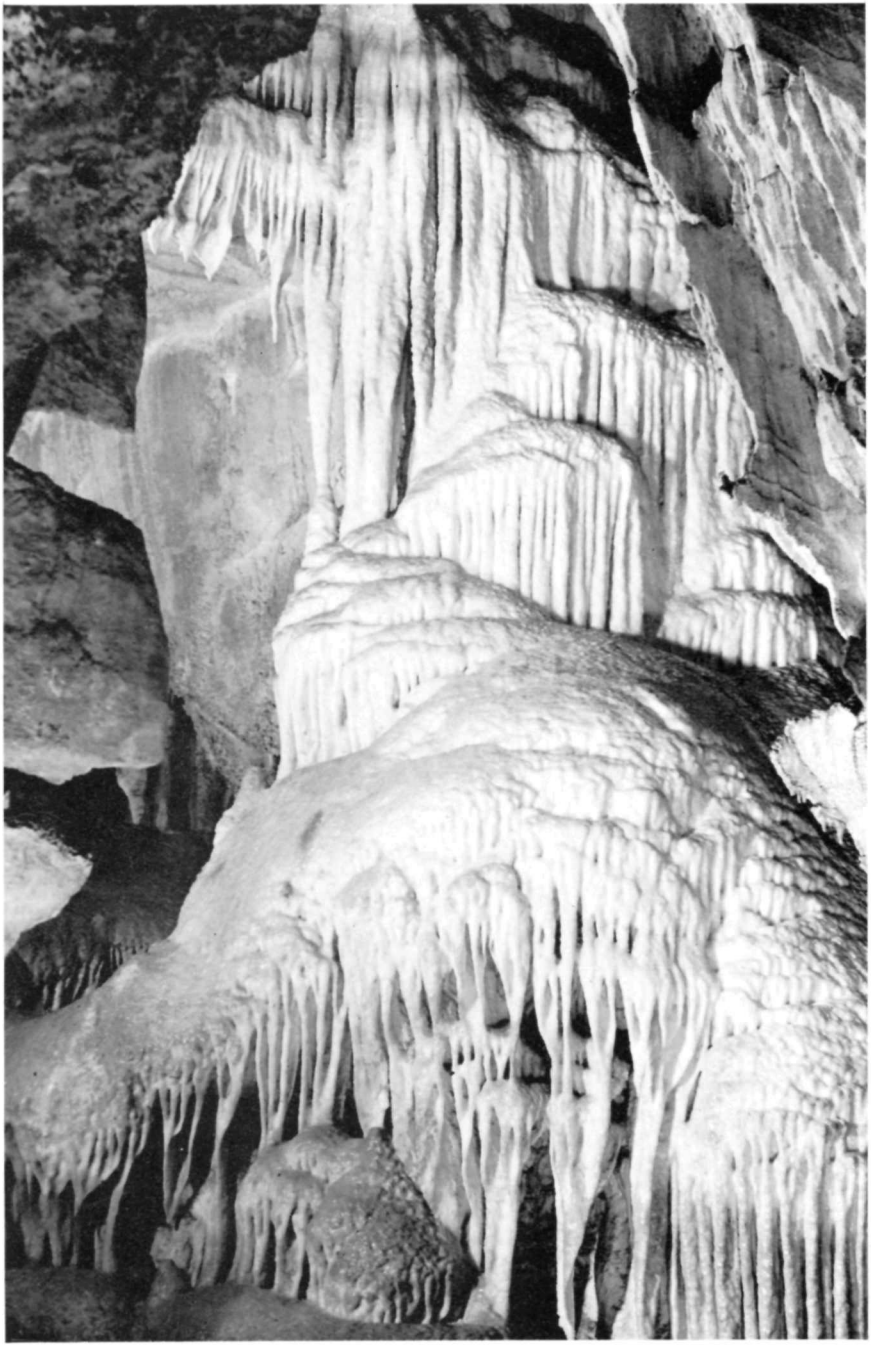
Very little plant life is known to exist in the cave. A few mushrooms, or toadstools, have been found growing in silt deposited in some of the rooms by ancient streams. Sometimes the dead body of a cricket or millipede is found with a growth of white fungus on it, and this is also true of some of the acorns left on rocky shelves by the rodents. In some places, 40 to 60 feet inside the entrance, where at least some daylight penetrates, several different colored types of algae grow on the ceiling and walls.

There is no evidence of occupation of Crystal Cave by either primitive man or Indians.

The Cave Marble

The marble represents an old limestone changed to a beautiful crystalline form by the intense heat and pressure experienced during mountain making movements in the earth's crust many millions of years ago. The limestone had its origin in the limy ooze deposited on the bottom of an ancient sea that covered this area in still more remote times. Since no fossils have been found in the marble, its geological age is unknown. Deposits of sand and finer materials were interbedded with the lime until the aggregate thickness amounted to several thousand feet. The resultant sandstones and shales also were altered or metamorphosed—the sandstone to quartzite, and the shale to schist. Outcrops of these rocks may be observed along the trail to Crystal Cave. These beds were compressed into a system of mountain folds beneath which a vast reservoir of molten rock material was forced. This molten rock cooled beneath the surface as granite. It baked and further compressed the rocks which were intruded by it. Subsequently, but long before the rise of the Sierra Nevada, this once lofty mountain system was worn down to a monotonous plain with low hills in which the granite core was exposed. Only the roots of this folded mountain system are preserved in the granite which surrounds them. They often are referred to as "roof pendants." (10).

Marble is composed of a calcite, one of the most soluble of common minerals. It can be dissolved to a slight extent by water. If the water is somewhat acid, as ground water usually is through contact with organic materials in soils, and because it usually contains carbon dioxide, its ability to dissolve is greatly increased. Consequently, all the marble outcrops contain cavities, some of which are sizeable cave systems.



Origin of Limestone Caverns

Water from rain and melting snow is disposed of in three ways. Part of it sinks into the ground, where it remains for an indefinite time before some of it reappears at the surface as springs. Some water runs off to join surface streams and lakes, and the rest is returned to the atmosphere by evaporation and plant transpiration. The amount that is absorbed into the ground depends upon soil depth and texture, steepness, type and quantity of vegetation, rate of downfall, cracks and fissures in the rocks, and several other factors. The character of the soil and plant cover in the drainage basin above Crystal Cave favors the retention of water in the soil despite steep slopes, consequently there is a steady source of underground water to feed clear mountain streams throughout the long, dry summers. The absence of grazing and logging in National Parks encourages delayed runoff and the conservation of water.

Ground water descends slowly under the influence of gravity until it reappears at the surface as springs or reaches a level below which all spaces are filled with water. This level is called the water table. Springs appear on valley sides at this level and deep wells become filled to a height even with the water table. The water table conforms roughly to the surface of the land, although it is much deeper beneath divides and comes closer to the surface in valleys to join streams and lakes. The water table rises following wet periods and drops after droughts, and as valleys are deepened it descends successively to lower levels. The movement of ground water is said to be principally downward until it joins the water table, when lateral movement is reported to be dominant. There is also abundant evidence that considerable movement occurs below the water table in sub-water table streams where passages have been dissolved out. Water is forced through such passages by hydrostatic pressure (2). Lateral movement is encouraged by the existence of caves which have openings and suitable grades near the level of surface streams. Such streams sometimes are called water table streams (4), and they are considered by some authorities to be the principal agents which excavate caves (16 and 17). Some geologists explain the origin of caves by simply stating that openings gradually are dissolved large enough to permit free flowing water, thus adding abrasion, or mechanical wear, to the work accomplished by solution (3), while others have contended that such caverns as the Mammoth Cave of Kentucky were entirely "worn out" by running water (8).

The term vadose is applied to ground water above the level of the water table, while phreatic, which in Greek means a well, applies to that below the water table.

After an exhaustive review of the literature on caves, William Morris Davis in 1930 wrote a masterly thesis on the "Origin of Limestone Caverns" (4), which had the effect of stimulating a renewed interest in caves. Some geologists supported and some opposed his theory that caves are first formed below the surface by phreatic water, and that due to a lowering of the water table, the caves were drained and air admitted for the first time, thus permitting the growth of stalactites and other deposits which decorate most limestone caves. His deductions are supported by the evidence found in the caves of Sequoia National Park. The outstanding field investigations and conclusions of J. Harland Bretz in 1942 largely confirmed the ideas of Davis. He concluded that most of the caverns he had seen were largely of phreatic origin, and that of 107 caves he studied only three simple ones were entirely vadose in origin (2). Many of the features he describes are applicable to Crystal Cave.

Fairy Pool in the Dome Room.

That sub-water table caverns may exist is suggested by huge, deep-seated springs or rivers that rise upward to the surface of valley bottoms in many parts of the country, as well as from the ocean floor off the coast of Florida (2 and 4). These streams must traverse large water-filled caverns. The Mammoth Hot Springs Terraces in Yellowstone National Park suggest another method of cave origin by solution at considerable depth. There, the hot rising water heavily charged with carbon dioxide has deposited a mountain of travertine about two miles long and one-half mile wide on the surface. This material was dissolved from a formation of limestone which has a thickness of about 1,600 feet. It is possible that caverns filled with hot water exist in this limestone in such proportions as to dwarf some of our best known caves. In 1941, Berlin C. Moneymaker described drilling operations and deep cut excavations in various parts of the Tennessee Valley which revealed the presence of hundreds of cavaties at depths exceeding 100 feet below the water table, some of which had the dimensions of large caverns (13). Similar drillings in other localities indicate such caverns are common geological features (2).

The Crystal Cave Stream And Its Work

Just inside Crystal Cave the stream is concealed under a ledge in a clean "U" shaped marble trench about 6½ feet deep and 2 feet wide, which gradually grades up to the level of the floor 160 feet from the entrance where it turns in adjusting itself from the west to the east side of the cave and follows beside the trail for an additional 75 feet, where it recrosses to the east side of the cave beneath another bridge. A short distance above this point, the stream disappears under a ledge and flows over a light gravel fill through a low chamber about two and a half feet high and 12 feet wide. Here again, a beautiful profusion of stalactites are forming directly above the sluggish stream, partly impounded on the level floor. The stream reappears in the Junction Room 500 feet from the entrance and finally disappears beneath the stone floor of the second level of the cave about 100 feet beyond the Junction Room.

The cave stream has special significance. Some think that it has been the principal agent in the excavation of the cave, while others contend that it is secondary and that it has only modified and enlarged selected parts of pre-existing chambers and passageways that are of suitable grade, which the stream could follow more easily.

The stream today is enlarging and modifying the cave in two ways. Near the entrance it is eating its way deeper into the marble trench in its attempt to maintain grade with the parent Cascade Creek on the outside. The trench is slowly migrating headward into the cave as the base-leveling process continues. A short distance above the trench where the stream flows sluggishly on grade over the almost level, gravel-covered floor, it cannot deepen its channel but is slowly dissolving the marble laterally. After many thousands of years, the stream will be rejuvenated in this section of the cave as the trench extended upstream, thus increasing its velocity and cutting power.

It has been noted that the cave became substantially filled with clay, sand and gravel by a larger depositing stream after the major galleries had been mostly dissolved out, and that subsequently this fill was removed as the stream load was reduced and its transporting power increased. Armed with particles of sand and gravel, the stream was able by abrasion to enlarge and modify those parts of the cave through which it flowed, as well as by dissolving the marble. Evidence of

Close-up of thin curtain formations.

stream work is preserved on the walls and ceilings in many parts of the main passageways. After most of the fill had been removed, the stream appears to have lost much of its volume and transporting power, until reduced to its present state in which its dissolving power is dominant over abrasion. Even in the steep marble trench where the stream flows rapidly, the principal process seems to be that of dissolving the marble rather than wearing it mechanically, as there are thin, blade-like dikes of insoluble material extending across the channel. Some of these are almost knife-edge sharp and could not have resisted much mechanical wear. They stand out from the marble because they are less soluble.

In no part of its known course is the present stream accomplishing work that could conceivably result in duplicating the major complex features of Crystal Cave. It appears to be following a pre-determined course which is modifying as noted previously, in the base-leveling process.

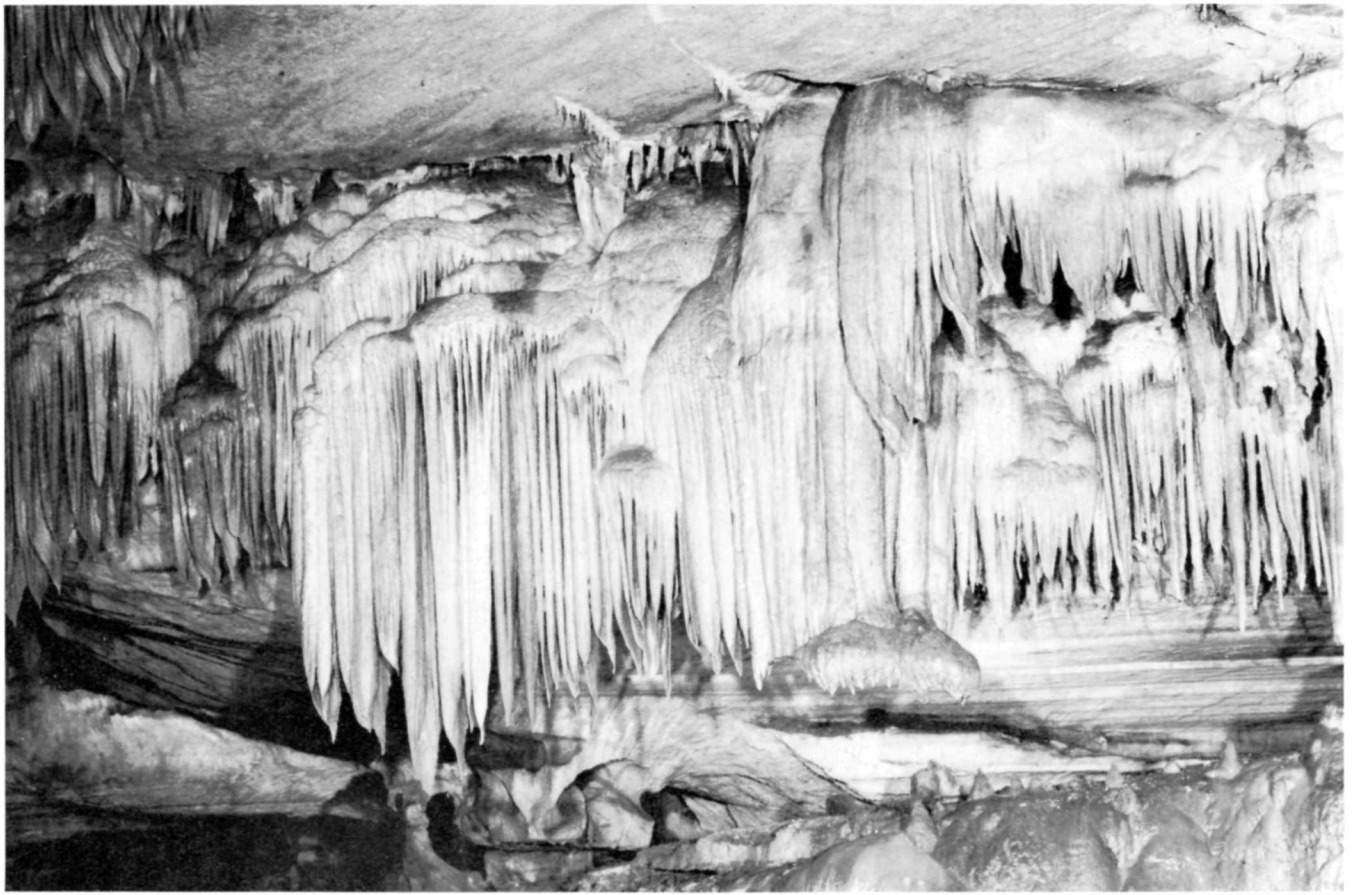
In addition to the difficulty of explaining the origin of many solution features in the cave and the amazing complexity of its intricate ground plan on the basis of stream wear, it seems reasonable to expect that the largest rooms would occur near the entrance where the volume of water would be greatest, and that the openings would become progressively smaller away from the entrance as the stream branched out, if the system had been excavated in this manner. Such is not the case, for the cave narrows down to 3 feet wide by ten feet high, with a communicating low chamber 2½ feet high and 12 feet wide, and 400 feet long. The largest room in the cave is most distant from the entrance and is known to have had a height of at least 75 feet before the collapse of marble occurred. Its average width of more than 50 feet, and a length of about 140 feet, dwarfs the dimensions of the entrance room which is separated from the major large rooms by the restricted portion of the main passage mentioned previously. This discrepancy in size can scarcely be explained on the basis of variable resistance in the rock structure.

Perhaps there are other caverns dissolved in marble beneath Crystal Cave waiting for surface streams to cut to their horizons and drain them, thus duplicating the higher features of the underground landscape, which in time will hasten the lowering of land as Crystal Cave is gradually reduced in the general base-leveling process.

The Origin of Crystal Cave

The small stream issuing from Crystal Cave as a spring, about 10 feet below and 15 feet east of the main entrance, joins Cascade Creek almost on grade a short distance below. A similar stream issues from the opposite side of the creek a short distance upstream on approximately the same level. This latter stream evidently is draining a cave system which probably was continuous with Crystal Cave in times past. However, due to slumps and collapse of the marble, it is not open to inspection. It is suggested that the major portions of this once continuous cave system were dissolved out and carried away before Cascade Creek Valley was lowered to this level, thus bisecting the cave system and giving rise to these water-table streams flowing from opposite directions. After the cave galleries were dissolved out, there is evidence that most of them became filled with clay, sand and gravel (2).

Most of this fill subsequently was washed out, but some of the side chambers still retain a compact, reddish clay reaching almost to the ceiling in some cases. Deposits of gravel contain stream worn boulders up to 10 inches in diameter.



Massive curtain formations in Marble Hall.

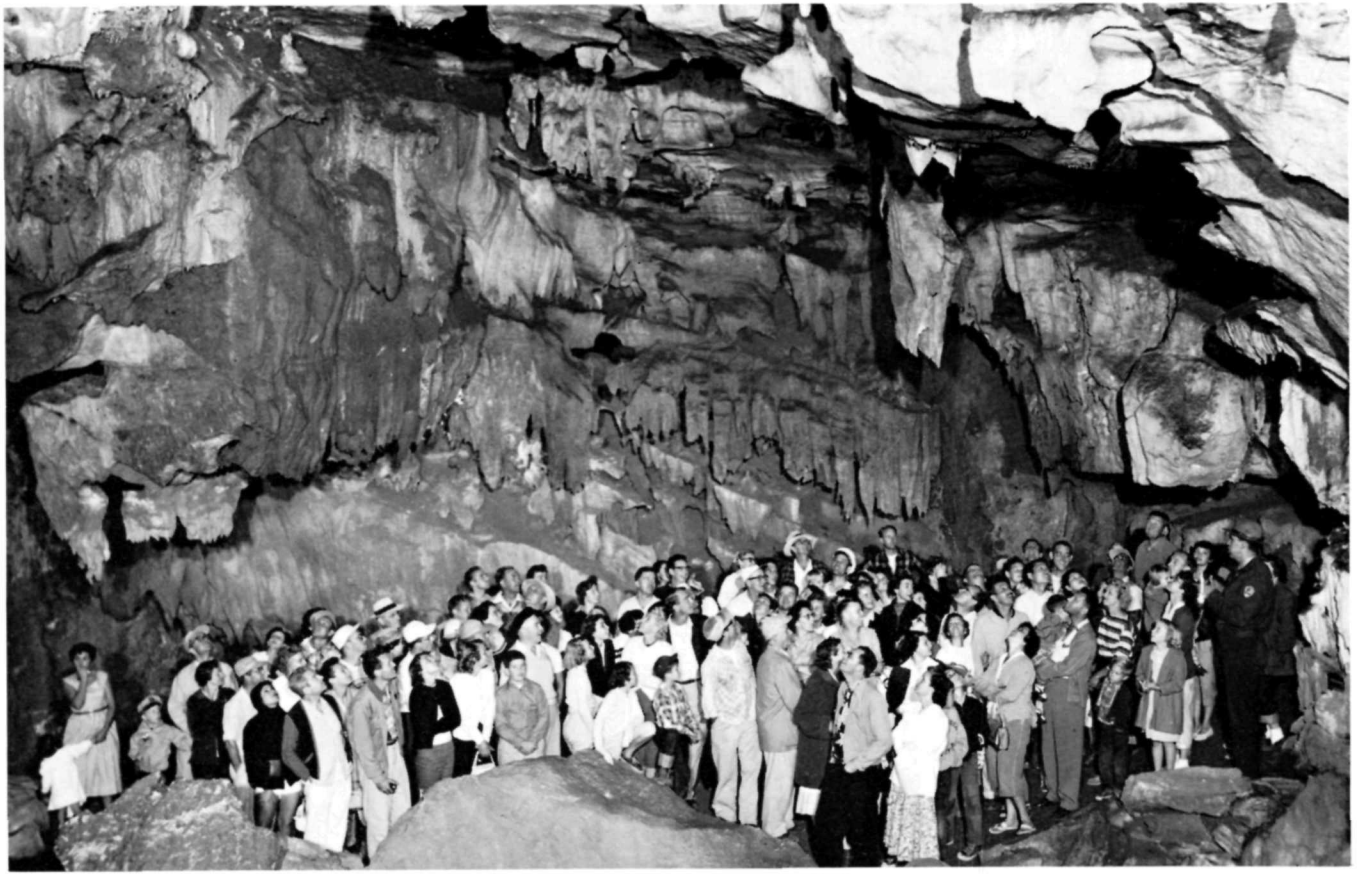
There are remnants of the fill on the highest shelves in the largest room in the cave, and some of the narrow passages are still tightly filled to unknown depths. These stream gravels are not in accord with the volume or plan of the present stream, and indicate that the larger depositing stream which the cave at one time contained, mainly followed two passages to the lower gallery through which the cave is entered. It is interesting to note that similar deposits were reported in sub-water table caverns in the Tennessee Valley (13). Most of the network of side chambers and passages were not filled with gravel, and their bedded clays indicate that relatively quiet water filled them when the clay was deposited. Some of the clay deposits are capped by a thick layer of flowstone. Perhaps a tight clay fill prevented the later aggrading stream from entering these recesses to leave coarser materials.

There are gravel deposits in the cave which are separated by at least three layers of flowstone, indicating that the stream which laid them down fluctuated considerably from time to time, since flowstone forms slowly, depending upon evaporation. The gravel was exposed successively for a considerable length of time before the stream returned repeatedly with new loads. In the Dome Room and other parts of the cave, there are intricate patterns on the otherwise flat ceilings. Remnants of marble hang down in great profusion and an interesting network of channels, many of which are filled tightly with stream-deposited wastes, have been incised upward into the ceiling. These have been interpreted as having been dissolved by water flowing against the ceiling on a rising fill (2).

Directly upon entering the Dome Room from the Organ Room, there are some interesting inverted potholes, or cone shaped extensions, in the ceiling. It is difficult to explain these features except on the assumption that water completely filled all spaces when they were formed, otherwise the presence of air would seem to have prevented their upward growth (2). Some of them are over 7 feet deep.

Streams normally have a branchwork of tributaries feeding into main channels, but the principal maze, or network, constituting Crystal Cave is so variable in grade and plan that it must have had a phreatic origin. It seems improbable that a stream could have produced this pattern(4). There are so many interconnecting passageways and loops with grades so inconsistent that no free flowing stream could follow them. Some channels resemble syphons and could have supported a stream only under pressure. In many parts of the cave there are patterns on the walls and ceilings which resemble ripple marks in sand. In 1925, Judge Walter Fry noted that the roof in Marble Cave was "heavily grooved and fluted" (7). It has been shown that these flutes record the direction of stream flow, and that they are elongated in the direction of flow (11). Since they commonly occur on ceilings, they probably were dissolved out by moving water. Some of them have an upgrade both on walls and ceilings, consequently sub-water table streams moving under hydrostatic pressure appear to be the best explanation for them (2). The same argument may be applied in the Junction Room and other places in Crystal Cave where the flutes change from a downward to an upward trend. A normal free flowing stream could not have made them.

In the Dome Room, as well as in several interconnecting passageways behind it, there are partitions and thin bladed extensions of marble such as the Elephant Head. Many of these have jagged holes dissolved through them. In several places multilegged pedestals with sharp, jagged edges rise from the marble floors. There



A guided party in Marble Hall.

are some passageways that terminate in blind ends. Natural bridges of rough marble across high, narrow passages are not uncommon. The marble literally is honeycombed in places which could not be explained on the basis of stream wear. They appear to have been eaten out when all spaces were completely filled with water.

There are many tubes in the cave, most of which are roughly circular. They extend from horizontal to vertical. One tube about three and a half feet in diameter terminates on the ceiling of Marble Hall, extending upward at a steep angle. On the outer side of the cave, about 100 feet above and east of the main entrance, there is a small opening in slumped marble. Behind the slump this becomes a rudely circular tube 6 feet wide and 5 feet 10 inches high above a partial filling of soil. The tube descends into the mountain at an angle of about 6°, and at 28 feet from the entrance it turns sharply to the left and narrows to 4 feet 11 inches in diameter, and 42 inches high above the fill. From this point on the fill rises almost to the ceiling. Flutes on walls and ceilings indicate a downward or inleading current of water formerly flowed through it. There is no possible way this tube could have originated under present conditions, terminating on the valley side and pointing upward about 100 feet above Cascade Creek. Like many other parts of the cave, it is much older than the valley of Cascade Creek and was exposed by the downward cutting of the stream. It has never drained into Cascade Creek. On the Cave Creek side of the ridge at about the same altitude, there is a jagged shaft descending straight down for a distance of 15 to 20 feet. There is no evidence that it ever supported a stream, although it communicates with the main cave system. It, too, is a pre-existing part of the cave.

Much additional evidence exists to support the supposition that Crystal Cave is largely phreatic in origin, and that it has been modified and enlarged by a variable stream.

It is hoped that this booklet has added to your enjoyment and understanding of Crystal Cave, and will have given you an even greater appreciation of Sequoia National Park.

All persons entering Crystal Cave must be accompanied by uniformed personnel of the National Park Service. Competent guide service is provided by the Government for which a fee of 50 cents, which includes Federal tax, is charged. No charge is made for children under 16 years of age, although it is recommended that younger ones be accompanied by an adult. All national park fees are deposited as revenue in the U. S. Treasury.

Allow an hour from Giant Forest to the cave. Wraps are recommended.

FOR FURTHER READING

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10. Sloane, Howard W. and Gurnec, Russell H. Visiting American Caves, 1966.

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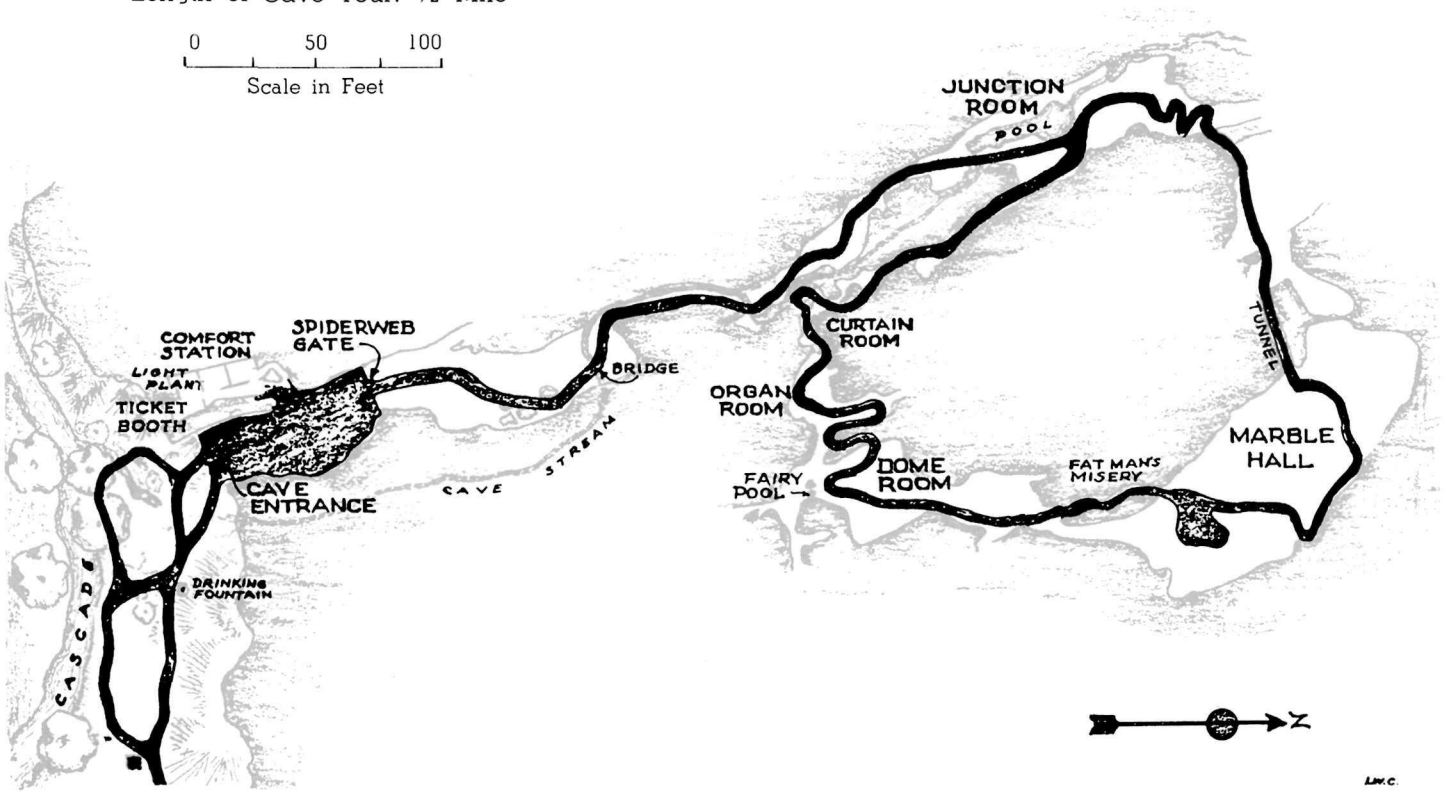
CRYSTAL CAVE

Length of Cave Tour: ½ Mile

0 50 100

Scale in Feet



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This Association was organized to cooperate with the National Park Service in securing and presenting authentic information on the natural features and history of Sequoia and Kings Canyon National Parks. It sponsors publications on pertinent subject material of interest in these parks including the plant and animal life, geology, and history.

Publications sponsored by the Association, and reference material from other sources, may be secured at the Lodgepole Visitor Center, Grant Grove Visitor Center and Cedar Grove, or by writing to Sequoia Natural History Association, Three Rivers, California 93271.

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