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OREGON CAVES NATIONAL MONUMENT

PROVISIONAL MANUAL OF INFORMATION

Eighth Edition

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I. FOREWORD

There is one important thought I want to impress upon each and every employee at Oregon Caves, whether he is a Company employee or works for the Federal Government, and that is: You're here because you can provide some service to the public. Remember that -- appreciate it -- and the underlying purpose of your work will be clear to you: The need to be pleasant to visitors, to display good manners in your dealings with them and to offer those services that they have every right to expect as visitors to a National Monument.

In serving visitors to the monument, do not forget those who will be visiting next year and the centuries to come. It is of the greatest importance that we each endeavor to assure that the natural features of Oregon Caves National Monument remain unspoiled for the benefit of future generations.

Of major importance in your effort to help visitors enjoy their stay at Oregon Caves is your ability to explain the interesting features of the area accurately. It is for that purpose that this booklet has been prepared and presented to you. It reflects the best knowledge acquired to date about the caves. Study it. Use it. You'll do a better job and enjoy your own stay here the more by contributing to others' enjoyment.

Good Luck - - -

W. Ward Yeager

W. Ward Yeager
Superintendent
Crater Lake National Park
Oregon Caves National Monument

April 1, 1961

II. INTRODUCTION

This manual has been prepared to give a broader understanding of Oregon Caves National Monument, its history, purpose, place in the national scene, administration and natural features. It is believed that this will enable all concerned with the operation of the monument, whatever their affiliation, to do a better job through being more fully informed.

In the preparation of the material presented, the rangers and guides have been especially kept in mind, because protection hinges on understanding, and a conducted cave trip can be no better than the interpretation furnished by the guide. However, every person working at the monument is basically there for one purpose - to serve the public.

Only the most salient features of the story of Oregon Caves appear here, partly because much still remains to be learned about this cave. This is a provisional manual and, therefore, should be considered quite tentative. The next edition will contain additional material. It may also be changed in some respects due to more extensive information having been uncovered. The story is not static. There can be no final word. It is our duty to keep abreast of changes brought to light by fuller knowledge. Suggestions and questions are very much in order and should be submitted in writing to the Management Assistant in charge.

Thanks are due members of the staffs of the Departments of Biology, Geography and Geology, University of Oregon; Departments of Geography, Geology and Natural Resources, Oregon State College; Dr. William R. Halliday, Director, Western Speleological Survey, and Chairman, Medical Committee, National Speleological Society, who has twice carefully reviewed the text, for encouragement, advice, and suggestions; and to the State Library, together with that at Oregon State College, for valuable aid with references and the loan of books. Several persons with experience at Oregon Caves as ranger or guide, or both, have been most helpful, as has the management of the Oregon Caves Co., especially Mr. Richard L. Sabin and "Old Dick" Rowley. However, none of these persons or institutions is responsible for any errors which may appear in the material presented here.

III. HISTORY AND POLICY

The Oregon Caves have been known since a day, probably in 1874 (Watson, 1909), when Elijah J. Davidson, then living in the Williams Valley, went hunting in the Siskiyou Mountains (Davidson, 1922). The story goes that, after killing a deer, he followed his dog to a large hole in the mountain. Here he heard sounds of fighting coming from within. Being undecided as to what to do, he stood waiting--until his dop gave vent to a weird howl, as if in great pain. Hesitating no longer, Davidson rushed into the opening. He soon found the chase difficult to pursue without a light, whereupon he resorted to a few matches that he had in his shot-pouch. Striking match after match, he expected that he would soon be at the scene of the struggle. Before arriving there, however, his supply of matches gave out, leaving him in the dark. Davidson finally found his way back to a running stream of water and, following it, came to the mouth of the cave. Soon after, the dog came splashing down the creek and, but for a few scratches, was unhurt. As it was then well on in the evening, Davidson decided to go back to camp and return the next day. Before leaving, however, he placed near the entrance to the cave the buck that he had recently killed. He anticipated that a bear would come out for food, eat all he could, and then lie down by the remaining part. Returning to the scene early the next morning, Davidson found a monstrous black bear lying near the carcass of the deer.

Davidson told others of his discovery, and the cave soon became an attraction for the adventurous, portions of it being explored and opened. Explorations by three different parties are reported for 1877. One of these included Davidson, his brother, Carter Davidson, and James Nail (Fidler, 1922). Another consisted of nine persons, among these being three women and Davidson (Fidler, 1922). The third was composed of John H. Kincaid, Frank M. Nickerson, John M. Chapman, and Davidson (Watson, 1909).

In 1880, Homer and Ernest Harkness, brothers, took a squatter's claim at the lower entrance (Watson, 1909). They were unable to acquire title because the land was unsurveyed. During the next two years they spent about a thousand dollars in enlarging passages between the known chambers. They also built the first trail into the area. However, too few visitors could be attracted from the sparsely settled surrounding country and from the nearest railroad some 200 miles away, so the enterprise became a financial failure. This discouraging situation led the brothers to abandon their claim.

In 1887, Frank M. Nickerson and A. J. Henderson took possession of the cave and incorporated a company for its further exploitation (Watson, 1909). Their work attracted the attention of one "Captain" A. J. Smith, who secured a bond from Nickerson and his partners, employed surveyors to lay out roads and trails, hired men to explore and develop the cavern further, bought provisions and supplies, erected cabins, and put gates at the entrances. Much work was accomplished within the cave during succeeding months, especially by John H. Kincaid and Frank M. Nickerson. At the same time, the

liabilities assumed by the "Captain" grew to an amount of several thousand dollars--whereupon he one day suddenly and permanently disappeared. Kincaid and Nickerson continued to be associated with the cave for many years, acting as guides.

In April, 1903, a large area in this part of Oregon and California--including the cave--was withdrawn from entry as the Siskiyou National Forest.

In August, 1907, two years before the establishment of Oregon Caves National Monument, the cave was visited by a party that included Joaquin Miller, the Poet of the Sierra; C. B. Watson (1909), author of Prehistoric Siskiyou Island and the Marble Halls of Oregon; and the Honorable Jefferson Myers of Portland. Their guides were John Kincaid and Frank Nickerson. These visitors were deeply impressed, and Miller did much to attract public attention to the area by his many references to the cave as "The Marble Halls of Oregon."

President William H. Taft, on July 12, 1909, proclaimed the Oregon Caves, including a tract of approximately 480 acres, as a National Monument, stating that "the public interests will be promoted by reserving these caves . . ." Because there was no National Park Service at the time, the monument was administered by the United States Forest Service. In 1934, it was turned over to the National Park Service, and administration was delegated to the Superintendent of Crater Lake National Park.

"Old Dick" Rowley was a close personal friend of discoverer Davidson, having lived as a neighbor to him in the Williams Valley for years. He made his first trip through the cave in 1908 with Davidson. He was intensely interested and made several trips later by himself. The place could still be reached only by trail at that time.

In 1910, Dick accepted the job as ranger-in-charge for the Forest Service, acting as fire guard, forest ranger, and guide until 1923. During this period, he did all the development in the cave. With the formation of the present concession company in 1923, Dick was retained as chief guide until his retirement a few years ago. Though now past 80 years old, he still comes to the monument on special occasions. Until recently, he continued to help orient new guides at the beginning of each season.

In 1923, the Forest Service granted a concession to the Oregon Caves Co., which built the old Chalet and took over the guide service that same year. In 1934, the Chateau was opened to the public.

In the years following 1934, the National Park Service made a number of physical improvements in the facilities within the monument. Oregon Caves National Monument is one of about 185 National Parks, Monuments, and allied areas comprising a system that originally was unique in the annals of civilization--wherein a national government sets aside priceless parts of its national heritage to be conserved for all the people for all time (See Appendix D).

Our National Park System, the world's first, got its start in 1872 when a group of Americans voluntarily relinquished their legal and moral rights to profit through private ownership of what is now Yellowstone National Park. They decided to work for the reservation of the area as a park for all the people.

The law requires that National Parks and Monuments be administered to provide for public enjoyment "in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." They are, thus, great outdoor museums, and this is why it is against the law to molest wildlife, plant life, cave formations, and similar natural features that they contain.

It is the responsibility of the Secretary of the Interior, the Director of the National Park Service, and the administrative officers of the various areas to preserve, develop, and regulate the use of these areas. The Management Assistant is the Superintendent's representative in Oregon Caves National Monument and, as such, is in immediate charge of this area.

With as many as 101,000 visitors a year coming to the monument, certain services and accommodations are needed for public convenience. The Oregon Caves Co. operates under a contract with the Secretary of the Interior to serve the needs of these people. This company provides a hotel (Chateau), cabins, souvenir and refreshment store (Chalet), food, and nursery service (for children under 6, who are not permitted in the cave).

In addition, the company is authorized to provide competent guides for conducting visitors through the cavern. In this respect, the contract is unique: this National Park concession being the only private organization which is authorized to provide cavern guide service within the National Park System. This service is performed by uniformed personnel of the National Park Service in other National Parks and Monuments having caves open to the public. The informational and guide service performed by National Park Service employees is internationally known for its excellence and the high quality of the information given out.

It is apparent, then, that you, as guides at Oregon Caves, have a high standard to measure up to. You work in one of the units of a system which has set a pattern for nature protection and interpretation eventually followed by other countries throughout the world. It is imperative that dignity be maintained and that accurate information be given out. If you grasp the true significance of the National Park idea, your work will mean far more to you than merely being a job. You will be proud to share in the responsibility of assisting the public to appreciate the natural values in Oregon Caves and, consequently, to contribute to the preservation of the monument so as to leave it unimpaired for others to enjoy.

IV. GEOLOGIC STORY IN BRIEF

The Mountains

In the heart of the Siskiyou Mountains is Mt. Elijah, elevation nearly 6400 ft., where we find the Oregon Caves (Entrance 4,000 ft.). The Siskiyous lie between the Rogue and Klamath Rivers and extend west of the Cascades to the Pacific; they are part of the Klamath Mountain system.

Over a period of time, possibly between 180 and 150 million years ago, or in the Triassic Period, a shallow arm of the sea covered this area, where there were accumulated masses of volcanic rock. These contained smaller bodies of limestone, sandstone, shales and similar rocks derived from sediments that had been deposited on the sea bottom.

Later came a period of mountain making, involving folding and uplifting of the rocks due to stresses in the earth's crust and other forces. As a result of these processes, the limestone was changed by intense pressure and heat into marble. An example is the narrow, tilted belt running through Mt. Elikah.

Soon after being formed, the marble was profoundly fractured, and it is quite likely that this fracturing continued until a later period. Some of the more prominent fractures revealed in Oregon Caves are vertical, but in addition, there are many minor cross fractures of varying angles. Next, for a long period, the mountains were slowly worn away by erosion until this was an area of low relief, near sea level.

Then followed a period of uplifting, in various stages, giving us the Siskiyous of today. Indications are that this was mainly accomplished before the Ice Age, during which glaciers were formed locally in the higher mountains.

The Cave

The study of caves has been given the name speleology, and those who make such studies are known as speleologists. In recent years, devotees of cave exploration as a hobby have called themselves "spelunkers."

Caves are in general classified according to the rock in which they developed. They may be formed in limestone, sandstone, or igneous rocks, such as volcanics. Of these, limestone caves are the most important and most frequently attain great size.

In order to have a large cave or cavern it is necessary that there be a mass of limestone or other soluble rock to contain it and underground water to fashion it. Limestones are more extensive and widely distributed than other water soluble rocks and, in consequence, most caves are found in limestone regions. Gypsum and rock salt are extremely soluble materials and they, too, cover large areas but they seldom possess the inherent strength necessary to support a large underground solution system. Caves can also be formed in less soluble rocks through processes other than ground water solution; for example,

by the continued flowing of molten rock from within the periphery of lava tubes with already solidified exteriors. The vast and spectacular caves, however, do have an underground origin and are the products of subsurface water sculpturing.

Oregon Caves represent a type found in limestone formations throughout the world, but is of special interest in that it has been formed in tilted strata of marble (a recrystallized limestone). There can be little question that the cavities were produced by the action of underground water dissolving the marble and carrying it away.

This solution was initiated along cracks and joints until pockets were finally formed and these in turn enlarged to what are now galleries or rooms. It would seem that the cavern at some time was completely filled with water and the level of this water would have varied with that of the adjacent surface streams. As the streams deepened their valleys, this level would have been lowered, through drainage. As the water level dropped, the galleries above were emptied.

These galleries appear to have been only slightly altered by streams flowing through them afterward. That stream work does appear has not greatly modified the spongelike cave pattern produced by the earlier solution. Further, this general pattern of several-storied, honeycomb chambers does not conform to the branchwork that might be produced by free-running subterranean streams. Some of the points mentioned here will be referred to under "Progressive Cave Trip Comments" (Section VI).

Areas containing subsurface water can be conveniently divided into two distinct zones. The upper zone, called the zone of aeration or vadose zone, is characterized by rocks that are cracked or porous, the openings being filled with air most of the time. Water within this zone moves from the surface to a deeper zone of saturation by gravitational pull. The lower or phreatic zone also contains porous and fissured rock but, in this case, the openings are filled with water. Ground water within the saturated zone may circulate because of gravity or as a result of hydrostatic pressures. This may be a very slow circulation, but, normally, the movement is intensified near the water-table, the fluctuating and irregular horizon or division between the vadose and phreatic zones.

Recognition of this division of ground water into separate zones is important in explaining cave formation for most caves have experienced a two-phase or two-stage method of development, one phase taking place in each zone. The first phase is that of excavation, performed by ground water solution when the rocks which enclose the cave lie beneath the water-table of the area. This is a deep-seated, phreatic dissolving in the zone of water saturation and is most effective, for the process of solution proceeds on all exposed surfaces. The first stage is followed by the depositional replenishment of the cave. This second stage is brought about when the water-table is lowered, usually as a result of regional uplift. With the lowering of the water-table, air enters the once water-filled chambers and, instead of further solution, flow of water from the surface to the water-table may bring mineral matter to the rooms and galleries where it is deposited as flowstone and dripstone.

During the first or phreatic stage, the cavern system is hollowed out; during the second or vadose stage, the cave is at least partially refilled or destroyed.

Marble is said to be 93% calcium carbonate ($CaCO_3$), which is but slightly soluble in plain water. However, if water picks up carbon dioxide, the carbonic acid solution thus produced makes the calcium carbonate many times easier to dissolve through a change to calcium bicarbonate. Rain water, as it percolates down through the soil, becomes charged with carbonic and other acids, derived from decaying vegetation and other sources. It finds its way along small fracture planes in the marble, altering the calcium carbonate to calcium bicarbonate and dissolving it out.

The carbonate thus removed from one place is redeposited wherever the water is subjected to evaporation or agitation. This occurred in the various cavities as the underground water in them was drained away and they became air filled. Particularly, where the water dripped slowly from the ceiling of a cavern, each drop, as it clung to the rock, lost some of its water to the air, and the calcite which it carried was left as a deposit on the rock. Each successive drop added its increment to the previous one, and gradually an icicle-like stalactite was formed.

Where the drops of water fell to the floor and there evaporated, a pillar known as a stalagmite was made. In some places a stalactite and stalagmite eventually joined, forming a column that extends from floor to ceiling.

By alteration of the volume and path of the water, drapery-like blades and fluting were produced. On the sides, where water ran down the walls, are layered deposits, sometimes known as travertine or flowstone. There are many forms taken by these deposits in Oregon Caves. The process of deposition is still going on at varying rates, so that we can ascribe no time for deposition that will apply equally to all the formations.

The rate of growth of cavern deposits is subject to many variable factors, including the amount of seepage water, the availability of carbon dioxide in that water, the quantity of carbonates in solution, and the rate of evaporation and degree of agitation. The often expressed thought of a cubic inch per century as the average rate of growth of cavern formations is not tenable. Measurements of still active structures show that those formed under a very slow seepage of water do so at a much faster pace; however, changes in rate of growth occur almost daily, so present rate of growth cannot be used in estimating the age of any given formation.

It should be borne in mind that marble is merely recrystallized (metamorphosed) limestone and that both marble and limestone, together with the above cave deposits, are composed primarily of a mineral known as calcite, which has the chemical composition, $CaCO_3$. It is also found in caves as free calcite crystals. However, since there are differences between all these, it is inaccurate to say that they

are all the same and use the terms interchangeably. The term "lime" is best abandoned in the cave story for, while it is thus used freely by mining men, in the minds of visitors "lime" means the commercial products known by that name, which have different chemical compositions and different properties.

This geologic account should have indicated that a great many variable factors enter into the making of caves in limestone, and, therefore, specific comparisons cannot always be made between caves. This should be a guide in answering questions from visitors such as "In Blank Cave they told us the stalactites grew one cubic inch a century. Why don't these all grow at the same rate?" Or, "Why aren't Oregon Caves as large as Blank Caverns?" In reply to this second question, the limestone in Blank Caverns is perhaps more easily dissolved and/or may have been subjected longer to solution; or it may not be severely tilted and metamorphosed; or perhaps it has a more well defined system of joints which would make it easier for the solution formation of chambers.

The general processes of development of solution caves, however, are becoming better understood and made more widely applicable as more and more caves are studied critically by geologists. That is why we can infer certain things about the history of Oregon Caves, because of certain recognizable signs that match those found in other caves where the story is more completely told in the rocks. The chief general principle to remember is that solution comes early in the history of a cave, while the deposits (speleothems) or "formations" come later. This may be a continuous process: while the upper ("older") chambers are receiving deposits, the process of solution is still going on at a lower level.

V. YOU AS A GUIDE

Manners and Appearance

During your service at Oregon Caves, you will guide many hundreds of visitors. The degree to which they enjoy their tour rests directly upon your total performance. This begins with neat appearance and good manners. Obviously, you must shave daily, wear clean clothing, and keep your hair cut regularly. Sloppy appearance, uncombed hair, shirt-tails sticking out under your jacket, etc., cannot be tolerated.

Courteous, friendly manners and a sincere regard for the needs of your party do more than comfort the visitors. They help you, as a guide, maintain the respect of your audience and thus keep the party organized and attentive, resulting in an informative and enjoyable tour. There is no place inside the cave for horseplay or impertinence.

Many people visiting a cave for the first time anticipate mystery and adventure. This attitude might tempt you to exaggerate or tell "tall tales." Such exploitation of the visitors' attitude is still a practice in many privately owned caves, but is definitely not permitted by the National Park Service. The real story of Oregon Caves is impressive enough if the guide does a good job.

The Mission

Basically, your mission is two-fold: The first part is to help the visitors see the cave in safety and comfort. Secondly, you must help them understand what they see, through careful explanations.

Your duties in the first sense will follow a rather set routine. Without fail, you must warn every person of all the "low bridges" (asking them to pass the warning on down the line), projecting rocks, steep stairways and proper use of the ladders. At the 110' exit and the Ghost Room, you must always give the visitor a gracious opportunity to leave the cave or forego the climb to Paradise Lost without embarrassment. Another important consideration often abused is your walking speed. It is easy for a guide, in his enthusiasm, to rush his party from one feature to another, causing some to get out of breath, stumble, or bump their heads in an unconscious effort to keep up. Remember you are young, strong and familiar with the cave. They are not. Watch each member of the party for signs of being rushed. Failure to do this could aggravate heart trouble, strokes and other medical problems among older persons.

The second part of your mission-- explaining the features-- is an even greater challenge, in many respects. Obviously, the first requirement is to learn as much as possible about the caves, and to

keep learning as you guide. Carry a note pad so you can jot down questions as they arise, then ask a ranger about them later. Be prepared for the alert visitor who wants to know more about the cave. At the same time, be willing to say "I don't know," if that is the case. You are not expected to become a geologist in a few weeks. To mislead your audience, lie or bluff is a betrayal of trust.

Stay out of the Guiding Rut!

Once you have acquired the basic knowledge of the cave story, you are ready to concentrate on the hardest part of guiding. This is the development of a friendly, flexible approach to each party, sizing-up their level of interests through conversation, and adjusting your "talk" in a way that will make the trip most understandable to them. In this way you talk with them rather than at them. To some guides this ability comes naturally. Others fall into a rut of giving the same "canned," memorized spiel to all parties. They lose contact with the party as they stare at the floor and talk as if they were reading a book. Half the party may be confused, the other half will be yawning in boredom. Worst of all, the guide himself begins to dislike his task. When that happens he should stop guiding.

Your party has paid to be shown the cave and learn something about it. Not all of them are well educated, but they can all understand how it was formed if you explain it clearly, in terms they are familiar with. Their questions and reactions will tell you how well you are doing.

There is one tool that will do more for you and your party than anything else. This is simply an occasional question, asked not by them, but by you. An example is, "why do you think the green plants grow only near the lights?". Be careful not to embarrass them when an incorrect answer is offered; compliment their reasoning and carefully steer them toward the proper answer. This invites group participation and injects variety into each tour you lead. It will keep you on your toes as a guide and assure the party of a stimulating tour. Caution: it consumes more time. Use it with judgment.

A touch of humor along the way is equally valuable, if not overdone. Remember not to confuse it with factual information.

Emergencies

Know what to do if and when emergencies occur. Always keep good batteries in your flashlight. If a power failure occurs, keep your party in place until help arrives with gasoline lanterns. Never separate your party or leave it unattended. If someone is injured or becomes ill, calmly get them in a comfortable resting position, then find out as much as you possibly can before sending for help. If a stretcher or ambulance will definitely be needed, ask one of the adults in the party to take charge and keep everyone in place

until you can reach a telephone, give the message, and return to the party. If an obviously ill person insists on going ahead, it is your responsibility to encourage him to accept aid, although we cannot legally force first aid upon anyone. You are in charge of the party. You, your employer and the Government can be held liable if injuries result from your negligence.

Other Problems

In spite of your efforts to keep your party in a dignified mood, you may someday encounter unruly individuals who deliberately cause trouble in one form or another. Politely warn them that they can be fined for disorderly conduct, disturbing natural features, etc. As a last resort, proceed to a telephone and call a ranger. Any damage to the cave formations should also be reported immediately.

Of less serious nature, visitors who have previously toured the cave may say, "that's a different story than they told last time." It is futile and impolite to question their memory, or cast reflections on earlier guides. Simply explain that the information you are required to give is sometimes changed from year to year to keep abreast of the latest information we have available. If they remember certain items no longer included in the tour (such as Petrified Forest or Dante's Inferno), similarly explain that alterations have been made in the tour to avoid congestion from increasing numbers of visitors.

If a visitor is dissatisfied with any part of the tour, or anything else encountered in the National Monument, encourage him to contact the Management Assistant.

VI PROGRESSIVE CAVE TRIP COMMENTS

These are based on portions of the talk given by "Old Dick" Rowley, who expertly guided thousands of visitors through the cave for nearly half a century. The salient features to be discussed at each location are parenthesized at each heading. You are required to give the information listed in the full paragraphs, although you may alter the wording to suit your manner of speech. Information in the indented paragraphs is for your benefit or optional use.

Cave Entrance (take tickets, general information)

"May I have your tickets please. * * * Before we enter the cave, I want to welcome you all to Oregon Caves National Monument. My name is _____, and I will be with you for the next hour and a half. I'm sure you will enjoy the tour, but I would like to warn you to be careful not to step off the trail or bump your head. Since 1923 we have guided over a million and a half visitors through the cave with no serious injuries. Let's try not to break that record."

> This is your opportunity to establish a calm, receptive mood. Do not appear rushed. The success of the rest of your trip depends on a dignified beginning.

"Feel free to smoke or take pictures inside the cave. We only ask that you use the refuse cans along the trail to dispose of cigarettes, flashbulbs, etc. Also, National Park Service regulations prohibit the injury of natural features, so please do not touch the cave formations except when necessary to keep yourbalance.

"Now, if this gentleman will be our tail-light, we can enter the cave. Keep in single file between myself and the tail-light. LOW BRIDGE."

Watson's Grotto (rooms dissolved from marble by ground water)

"How many of you have never been in a cave before? * * Soon your eyes will dialate and it won't seem so dark in here. And don't be afraid of the ceilings; the cave is quite solid.

"This is Watson's Grotto, named after Chandler B. WAtson, an early geologist who visited the cave in 1907 and helped in getting it established as a National Monument in 1909. There are now approximately 187 such areas preserved by the National Park Service for public benefit.

"About 180 million years ago, this area was the limestone floor of a shallow sea. Later, when the Siskyou Mountains were formed by a great geologic uplift, the limestone was changed by heat and pressure into marble. In the process, the marble was cracked in many places. You are standing within a layer of marble. This room was formed by the water table (the same thing as well water) seeping slowly along a crack, gradually dissolving the marble from the walls until the room was formed. As the streams outside the cave cut deeper into the mountain, the water table was gradually lowered, leaving the room empty. Notice how pitted the walls are, indicating they were slowly dissolved, rather than washed out by running water. The stream behind you is at the top of the water table. Below us, there may be many water-filled rooms in the process of dissolving."

Petrified Gardens (cave deposits in emptied rooms)

"At our first stop we saw how caves are formed within the saturated zone of the water table. Now we can see how nature adds beauty to rooms after they are drained. Rainwater trickles through the ground to join the water table below us. From decayed plants on top of the ground, it absorbs carbon dioxide. This turns water into a weak solution of carbonic acid, so it dissolves part of the marble above us on its way down. Reaching this room, some of the water evaporates, leaving the dissolved mineral in thin layers of re-crystalized limestone, or calcium carbonate. If the formation is made from water dripping from the ceiling, we call it a stalactite. Or it can drip to the floor and form a stalagmite. If it flows along the wall or floor, it is called flowstone. It is all made of the same material, limestone, and is deposited in the same way as the mineral crust that forms in your steam iron or teakettle."

It is best to avoid explaining the green plant life at this point, since the story of cave formation should be fully clarified before other factors are introduced. If the question comes up, briefly explain it, and add, "I'll show you more about the plants later on."

Tree Root (plant penetration into the cave)

"The roots you see here are those of a Douglas-fir that is growing on the surface 40 ft. above us. They did not penetrate the solid marble to get here. They found little crevices previously filled with clay and followed them down, then extended for some 25 ft. along this passageway."

Cave Discovery

"Maybe some of you have wondered how the cave was discovered. As far as we know, it wasn't by Indians, for we have no evidence that they even knew of the cave. It was discovered in 1874 by Elijah Davidson, who found it while he was hunting in this area. There are several conflicting versions of the story, involving a bear which led him and his dog into the cave. At any rate, this cave was discovered in 1874, and by Elijah Davidson."

You may relate the version found in the history section of this manual, if you wish. It is from Davidson's own account (1922). Do not make a big issue of it.

River Styx (relationship to cave)

"We passed this stream when we entered the cave. It is called the River Styx after the underworld stream in Greek mythology. Outside it is called Cave Creek. It represents the top of the water table, and runs faster because the caverns have provided unobstructed drainage. In other words, the stream did not produce the cave. Its cutting action has had only slight affect on the cave. The real work was done deeper in the water table, where the water moves very slowly.

"There are no blind fish or crayfish in this stream, as are sometimes found in caves in other parts of the United States."

Passageway of the Whale (fine example of enlarged crevice)

"Look above you and see the crevice, or crack, that runs along the ceiling. This room was formed by water first seeping slowly along the fracture, eventually enlarging it so that more acid-charged water could enter and dissolve out the passageway. The smoother walls here would indicate that the River Styx may have once used this room for a while before it found another route. Now, if you can imagine that you are inside a whale, with the ceiling as the backbone and the sides as ribs, you can see why this is called the Passageway of the Whale."

You should stop at the far end of this room so most of your party can stand inside the "whale" before you begin talking.

Tunnel (freshly exposed marble)

"We are entering a man-made tunnel built before World War II to avoid 80-feet of ladder-climbing. Do you notice the echoes? This is due to the smooth walls of the tunnel. Natural caverns have an irregular surface which absorbs sounds. Here you can see the marble from which the cave was formed. It and its derivatives are the only important minerals found in the cave. Overhead, there are some impurities, indicating we may be near the edge of the marble belt which contains the cave."

Stop at the top of the 5th set of steps. Most of your party will be in a position to see the marble as well as the overlying impurities as you speak.

Adam's Tomb (drapery)

"In this room we have a very good example of flowstone. Above you on the right is a rather verticle flowstone deposit. Across from it, you can see another type of flowstone which forms graceful ridges. We call this drapery. It results from back-sloping walls and channeled streams of water. There on the floor is a fallen stalactite that has been sealed permanently by many layers of flowstone."

Dry Room (sealing of crevices, plants)

"We are now 18 feet above the trail we just left, and 80 feet higher than the cave entrance. This is the Dry Room. Overhead the crevices in the rock have been completely filled with the same limestone deposit that forms flowstone and stalactites. So the rainwater trickling down is directed elsewhere, instead of dripping into this room.

"Near the two lights is one of the three types of plants living in the cave. This is moss. Its spores are carried into the cave by air currents. Why do you suppose it grows only near the lights? * * That is correct, before lights were installed in 1932, there were no living green plants in the cave. They require the energy of light to live and grow. In the rooms ahead we will see examples of the other two kinds of green plants, the algae and ferns."

Wigwam (water levels)

"Now you can see part of the 80 feet of ladder-climbing we avoided by using the man-made tunnel. * * * In this room, you can see grooved evidence of several fairly stable levels of water that occurred during the formation of the cave. (Point out) At various intervals the water apparently dissolved new channels of drainage and dropped quickly to the next level. Eventually the water dropped further and left the room empty.

"This is called the Wigwam Room, because of this fellow, 'Chief-Rain-in-the-Face.' We also have a 'heart,' and a 'gopher hole turned inside out.' All of these are natural formations left here by rain water on its way to the water table. And here is a three-humped camel. Notice how flat its side is. It was probably once a horizontal layer of the ocean floor, but has been tilted during the mountain uplift.

"At the top of this ladder is a narrow place we call the squeeze. You may wish to turn sideways or duck under it."

Do not say the heart was "cut out" of anybody, or use any other such macabre stories. Though they may bluff courage, many women and children are already frightened somewhat by the cave. Crude talk only upsets them more.

Also, no cracks about the physical proportions of the visitors in relation to the squeeze. It is not the "fat man's squeeze."

Beehive Room (popcorn, types of stalactites)

"If you step up here you can see the Beehive, a pendant type of stalactite resembling a bees' nest. On its surface is a bumpy covering called popcorn. Popcorn is still a bit of a mystery to geologists. It can form under water, but also can form on one side of a room where air currents contact moist walls. We will see more popcorn in the next room.

"On the ceiling is a variety of stalactites. These are pendant-shaped. The more common type is the icicle shape. This is a soda straw stalactite. It is hollow and its diameter remains the same as it grows. The water comes down the center, so growth takes place only on the ends. Some soda straws may receive only a few drops of water a year. If they get a sudden increase in water from the outside, they become icicle stalactites. In a cave in Western Australia there is a soda straw stalactite no larger in diameter than this one, but it is 20 feet, six inches long."

110' Exit (opportunity to leave the cave)

"We can rest here a bit at the old exit. This, and the entrance you came in, are the two natural openings into the cave. We have climbed 110 feet in getting here. We will go out a man-made tunnel farther on. Before it was built, all parties had to return here to leave the cave.

"If anyone would like to leave the cave for any reason, I will be glad to let you out this gate. It is only a short walk back to the Chalet. (Make phone call now.)

"Ahead of us lies the older and more interesting part of the cave."

Let the offer to leave the cave be a courteous gesture. No remarks about "sissies." Nor is it necessary to try to convince them of the beauties ahead. Most people will go on if they feel alright.

Tall Man's Misery (warn of extended length)

"WE'll all have to duck down now for tall man's misery. It is a very low bridge, three feet high and sixteen feet long. Be careful not to straighten up too soon."

Banana Grove and Potato Patch (algae)

"Here we have the caveman's own Banana Grove. These formations get their color from the second kind of green plants growing in the cave--algae. Algae has no true roots, stems or leaves. It is a very low and simple plant. Yet it grows in every part of the earth, from the deep oceans to the highest mountains.

"Over here is a group of stalagmites we call the potato patch. Can you see the 'eyes' in the potatoes?"

Whitehouse (Flowstone and columns)

"On the left, the flowstone suggests 18th century colonial architecture--hence the name, White house."

Jailhouse

"This is a solution cavity that was lined with flowstone. Later the distribution of seepage water may have changed so that columns were formed in front, making the 'bars.' Here also is an example of plant growth made possible by the artificial light."

Niagara Falls (large active flowstone; vandalism)

"What does this formation remind you of? * * * Those are good suggestions. Long ago it was named Niagara Falls. It is a fine example of cascading flowstone. Notice the broken columns and stalactites? Thoughtless vandalism such as this occurred for many years before the National Monument was established, destroying many formations. This is why the National Park Service carefully protects the features of the parks and monuments--so that they will be preserved for the enjoyment of Americans for hundreds of years to come. Just imagine what the cave would look like if each of the million and a half visitors had taken just one stalactite."

If the question of the age of this formation comes up, explain that we have no accurate gauge upon which to base an estimate. Too many variables have occured in the past to make any estimate reliable. Of course the cave is many thousands of years old. That much is certain. In the exit tunnel we will give them a chance to guess the age of the cave for themselves.

Flowstone Layers (cross section of flowstone)

"As you pass this ledge, notice the crystaline layers of flowstone that were exposed when this trail was broken out. You can see the layers were formed at an irregular rate."

King's Throne (clay worms)

"Here in the King's Throne Room and the Hanging Gardens of Babylon we see a variety of forms taken by the deposits. You will recall the soda straws we saw in The Beehive room. Notice the holes in these soda straws and in some of the larger formations that were broken off during the early days of exploration. See how the clay has grouped into small brown blotches. (This may be due to the great cohesive force between particles of clay.) Also, observe that algae are well established here."

Neptune's Grotto (third plant--fern)

"Caves are not only found in marble as here, but in limestone, sandstone, and in volcanic rocks. Most caves, however, occur in limestone regions. It is estimated that there are between 5,000 and 10,000 caves known in the United States, some in nearly every state of the Union. There are approximately 150 commercial caves in the nation.

"Now we are going down two ladders for about 25 feet. The safest way to go down steep ladders is to face the ladder and to hold on to the rails with both hands as we go down. Would you all do that, please?

"As you change from the first ladder to the second, look closely under the light and you will see a tiny leafy plant growing in the moss. This is the third and highest type of plant in the cave, the Christmas tree fern."

Petrified Forest (optional)

"If you will split up into groups of four or five people, you may walk up the stairway and look at the Petrified Forest. It is a good example of stalagmite formation. When the first group has seen it, return here so the next group can have a look."

The side trip to the Petrified Forest can be eliminated on busy days. If you are overtaking the next party, it may be a useful point of delay. If you do not intend to use it, pass by without comment. If questioned, explain simply that it is a minor side trip not used on busy days.

Grand Column (union of stalactite and stalagmite)

"A stalactite has grown down from the ceiling to within about two feet of the floor and has joined with a stalagmite that has grown up from beneath. The column is about 7 feet in height and a foot through at the narrowest place. (Don't try to give an estimate of its age.) One feature of interest here is the dark stain, which is not plant growth. It is believed to have come from countless people putting their hands on the same spot. The oil and dirt from the skin have made the stain." (CAUTION THE PEOPLE NOT TO TOUCH IT.)

If it has not come up before, this is a good place to mention the "wind" that is nearly always flowing through parts of the cave. There is no simple answer that can be given to questions about the cause of this wind. Since temperature in here fluctuates only a few degrees, there is likely to be an exchange between the air inside the cave and that outside. Cold air, being heavier than

warm air, tends to flow to lower levels; while warm air, in contrast, tends to rise. Air currents through the cave occur when inside air and outside air are at different temperatures. When outside air is colder, as is usual in winter, it moves in at the entrance, while the warmer, lighter inside air goes out the exit. The reverse usually obtains in summer. If asked why the temperature in the cave stays comparatively even, it may be stated that the area underground is insulated from big temperature changes that come from heating by the sun, and the radiation of such heat at night. Further, the great masses of exposed marble tend to stabilize air temperature at about 48 degrees. Cold air flowing into the cave is warmed by contact with the rocks; warm inflowing air is cooled by contact. Also, the moisture in the cave tends to reduce the rate of temperature change. Caution about low ceilings.

Wishing Post (alabaster)

"Here is one formation we encourage you to touch. It is the wishing post. You may make a wish and rub the top. Also notice the rings of calcium carbonate, which in this form are sometimes called alabaster."

Joaquin Miller's Chapel (lights out)

"Some of you folks may have heard of Joaquin Miller, known as the Poet of the Sierra. When he and a party of friends were here in 1907, he became very enthusiastic about the cave, referring to it as the 'Marble Halls of Oregon.' In 1909, when the National Monument was created, this room was dedicated as Joaquin Miller's Chapel, in recognition of what he had done to bring public attention to the cave and to other features of the Coast States.

"Here we have a completed column and one in the process of growing. If this stalactite and this stalagmite were to join, we would have a gateway. Behind it is one of the best stalagmites in the cave. It is known as the Washington Monument. On the bench immediately above is the Garden of the Gods.

"Now if you will all get a firm stance, I'm going to turn the lights out for a moment and let you experience total darkness. Please put out your cigarettes in this can. (signal with both switches) * * *

* * Now pass your hands in front of your face. This is truly the natural condition of a cave, where light is unknown except near the entrances. Possibly some of you have never experienced total darkness before; Outside a cave there is nearly always some light from the stars or moon. Now I will light a match to show you how well your eyes have adjusted to the dark. Try to look away from the match, so it won't spoil the effect."

Be careful not to make this too lengthy. About 1 minute is sufficient time in the dark for the purpose of this demonstration. When you light the match, shield the glare by placing your other hand between the match and the audience.

Unless you have a small party of six or less, omit taking the visitors back into "Lake Michigan." Too much vandalism has occured in the Chapel and Trophy room while the guide was in the back room with a small portion of the party.

Head Hunter's Trophy Room (skulls and squirrel)

Caution about 13 steps. You may briefly call attention to the formations which resemble three skulls--no comments about what might happen to any members of your party--and a ground squirrel.

Atlantic Ocean (rimstone)

"Crouch down and look across. Under the red light, we have the Devil;s Washboard; on the other side is the Atlantic Ocean. This type of formation is called rimstone. It is formed in pools of mineral-laden water which are agitated in one way or another. Probably the pool which once stood here was agitated by dripping water, forcing carbon dioxide from the water as a gas. This weakens the strength of the carbonic acid solution and causes the water to deposit some of the dissolved mineral. Slowly, ridges of cave deposits are built up in response to the wave pattern in the pool.

"There are two ways, then, in which calcium carbonate is deposited by water. One is evaporation; the other is agitation."

Transluscent Flowstone

"Here in front of this light is another example of the crystaline structure of flowstone. If you look closely, you will see the many six-sided calcite crystals. Calcite is a well known crystal formed from calcium carbonate. It occurs in most limestone or marble regions, and takes on many different sizes and shapes."

Ghost Room Terrace (size of room, dike)

"This is the largest room in the cave, the Ghost Room. It is 40 feet high, 50 feet wide, and over 300 feet long. It was formed in basically the same way as the other chambers in the cave. Overhead is an interesting formation called a clastic dike. This was caused by eroded foreign minerals above the cave being deposited in a crack in the marble--you might say it was mud. Later on, the mud was hardened into rock by compaction. Unlike the marble, this new rock was not soluble in carbonic acid. So, as the marble was eaten away, the dike was left to jut out into the room. You can see it has been broken off by some ancient disturbance, rather than dissolved.

"Here are some small stalagmites that are being eroded by dripping water almost as fast as they are being built. So the same agent--water--can both build and destroy cave formations.

(At bottom of steps) "From here we will climb up 40 feet of ladder to Paradise Lost, the most popular feature in the cave. Then we will come back to this point. If any of you would rather not climb up and back, you may wait here on the Ghost Room floor."

Paradise Lost

"Before starting the climb up the stairs, look at the mother owl and the two little owls. Here is the Jaws of Death, and overhead, the Dinosaur. As we go up, watch out for Headache Rock at the 13th step.

"Now I am going to put on some colored lights for a moment,..... then the white lights.

"Note the five great cones in line; on the right, see how everything has taken the form of a fungus; and to the left, everything is rounded on top. All three of the formations have extended from the floor to the ceiling. This is considered the most beautiful room in the cave. On the floor, a formation similar to the Atlantic Ocean and the Devil's Washboard seems to be building up. Those dark stains over there are places where people tend to put their hands. Please, refrain from doing so."

Ghost Room Floor (pure white calcium carbonate)

"From this point, we start going back out of the cave. We have now come 3,300 feet into the cave, and are 186 feet below the surface of the ground.

"In this room we have several examples of pure white flowstone, which is almost free of all impurities. Here is George and Martha Washington--George on the left, in his tight pants; Martha is on the right in her hoop skirt. I'll show you some more from this next landing."

Dante's Inferno (optional)

"Now, we go up that ladder where you see the light. Here we get a view that suggests what Dante may have had in mind when he wrote his great poem, 'The Divine Comedy.' It tells how, in a dream, he saw the lost souls in Hades being punished in a river of fire which was converted, for further punishment, into a frigid mass, and then back to Inferno again.

This presentation should be deleted when it conflicts with other parties in the Ghost Room or when you are behind schedule. Turn on the red lights to represent the inferno and change to blue lights to show the frigid stage.

Spotlight (soda straws, waterfalls, etc.)

"Across the ceiling are hundreds of soda straws. Here are two pure white icicle stalactites. This is Oscar the trained seal, balancing a rock on his nose. Behind is another example of drapery, or bacon. The darker strip is from other minerals imbedded in the flowstone. And finally, here are two white flowstone waterfalls.

"As you go up the second ladder, look in front of the light and see the Bird of Paradise. He is waiting for the little 'worm' hanging over his head. This is a case of a stalagmite which sits above a stalactite, reversing the usual procedure."

Wedding Cake (tunnel story)

"Years ago, it was necessary to go back from here to the 110' exit. Then in 1931-32-33, the exit tunnel was constructed to allow a one-way tour of the cave. It is 512 feet long and climbs at a 16% grade. We will stop to rest along the way."

Clay Pocket (bats)

"This is the largest of the clay pockets discovered when the tunnel was drilled. Sometimes bats roost here. We have eight different species of bats that occasionally use the cave, although this is not a true 'bat cave' as are others in the United States. An interesting ability of bats is their means of flying in the total darkness of caves. This puzzled scientists for many years until it was learned that bats navigate by echo-location, a system similar to the Navy's sonar. They emit ultra-sonic squeaks from their mouth (too high for human ears to detect), then listen for the echo to bounce off the cave walls back to their ears. They are thus able to interpret the shape of objects near them. A rather amazing ability."

Questions may arise about bats. Here are some answers: They feed mostly at night, primarily on insects. They use the cave as a roosting place, and a few hibernate in Oregon Caves during the winter. We have no "guano" deposits here. Bats are not blind; they have normal vision in light. They are beneficial to mankind with one exceptinn: the vampire bat of central America and Mexico. No vampire bats occur in the United States.

Exit Tunnel Near Exit (stalactite and flowstone growth)

"Notice the thin white deposits of calcium carbonate along the walls, and tiny stalactites on the ceiling at this point. These have grown since 1933 when the tunnel was built. Of course this may be an unnaturally rapid growth due to the swift passage of dry air through the tunnel. The evaporation rate is certainly more rapid here than deep in the cave. Still this is a rough index of the rate of cave growth. If this tiny crust took 30 years to form, imagine for yourself the great age of the larger formations inside the cave."

Conclusion (at the exit)

"This concludes our trip. We have attempted to tell you why the National Park Service administers this area, something of its history, and of the geological story. We hope that you have enjoyed your trip. We are 218 feet above the entrance. You can return to the starting point, a quarter of a mile down the trail; or, if you wish, you may sit here and smoke or rest a while and look out over the Siskiyous.

"Perhaps you would prefer to take the left fork of the trail, returning to the starting point by way of the Cliff Nature Trail. An uphill climb at the first will lead you to an excellent viewpoint, from which the trail then continues downward to the cave entrance. No smoking is allowed while you are traveling on the trail. Thank you for your attention throughout the trip."

Note: If you conduct the party, or members of it, down the trail, you will have the same obligations toward their safety as you had within the cave. Remember to collect the flashlight from the "tail light."

VII. OTHER SIGNIFICANT FEATURES OF THE MONUMENT

In addition to the cave, the area has other outstanding scientific values, particularly in the botanical field, where we find certain rare species. Most famous of these are the Brewer spruce, the MacNab cypress, kalmiopsis, Hupa gooseberry, and Sadler oak. None of these has as yet actually been found within the monument; the last two species are the ones most likely to occur here.

The discovery of certain plants in this area is a source of interest to scientists who deal with plant distribution. The composition of the associated species of the area is so singular that it attracts the attention of authorities, since many species find in this cave area the southern limit of their range, while species otherwise limited to California find here the northern limit of their range.

Natural stands of Port-Orford-cedar, one of our most graceful native trees, are important features. Other plants include the snow-plant; Sierra wildginger, with beautifully mottled leaves; the Lee lewisia; and the phantom-orchid. Labels are placed on many of the plants along the trails that lead out of the central area.

Last, but not least in interest, are the little plant colonies, mostly of simple types like algae (similar to green pond scum) and mosses, growing in the depths of the cave under electric lights, that receive from this source certain rays needed for growth. The colors of the lights at various parts of the cave doubtless affect the growth rates of the plants, but probably none precludes growth entirely, since the food manufacturing process in plants makes use of any part of the entire range of visible light. It is likely that some other factor--for example, length of time the lights are on--is responsible for their not becoming established at some places.

The large white and gray birds that come so readily to be fed at the Chalet are the gray jays. The jays with the black topknot are Steller's jays. It is incorrect to call them "blue jays."

At the same place, vying for peanuts, are the golden-mantled ground squirrels, often mistakenly thought to be chipmunks. However, these ground squirrels are much larger than chipmunks and do not have stripes on the face. The Townsend's chipmunks also occur here, and it will be readily noted that they are smaller, have smaller feet, more pointed noses, and stripes running along the sides of the face. The large, gray squirrels with a blackish patch between the shoulders are California ground squirrels.

At least eight kinds of bats have been observed in the cave. There are no large colonies that pour out of the entrance like smoke, as at Carlsbad Caverns. No blind animals are known from the cave.

The rugged, forested, wild beauty of this spot--where there is no logging, hunting, trapping, or grazing--presents a charm that is of the utmost attractiveness to those who visit from places not so well endowed with wild land as Oregon.

VIII GLOSSARY

Aragonite--a crystalline form(rhombic)of calcium carbonate. (See also calcite.)

Bacon--a thin sheet of calcite having alternating dark and light bands which give it the appearance of a strip of bacon. The dark bands are usually caused by an iron oxide stain.

Bedding plane--the stratification or meeting place of two different layers of sedimentary rock.

Botryoid--a descriptive term for mineral deposits formed in such a way as to resemble a bunch of grapes.

Boxwork--a calcium carbonate deposit resembling a honeycomb due to a closely intersecting network of joints.

Breakdown--heaps of rubble on a cavern floor caused by the collapse of walls or ceiling.

Calcium bicarbonate--an ustable compound occurring in solution when carbonic acid comes into contact with calcium carbonate.

$(CaCO_3 + H_2CO_3 = Ca^{++} + 2HCO_3^-)$.

Calcium carbonate--a mineral with the chemical formula, $CaCO_3$. It crystallizes in two forms, calcite or aragonite.

Calcite--a crystalline form (rhomobohedral) of calcium carbonate ($CaCO_3$). It is the chief mineral making up limestone, chalk, cave formations and marble. (See also, aragonite.)

Carbonic acid--a weak acid occurring only in solution, having the chemical formula H_2CO_3.

Cave--a hollowed out chamber in the earth - a cavern.

Cavern--(see cave.)

Cave pearl--a roundish unattached mass (concretion) of calcium carbonate formed in cave pools.

Chamber--a natural cavity or room.

Cohesive force--a force causing pieces or particles to stick together.

Chimney--a narrow vertical shaft in rock. It may be a rough tube resembling the chimney of a house, or it may simply be a narrow cleft between two more or less parallel walls of rock.

Clastic dike--a dike made up of fragments of pre-existing rocks. (See text.)

Column-a speleothem formed by the growing together of a stalacitite & a stalagmite.

Deposit--a natural occurrence or accumulation of mineral material, such as an iron ore deposit; or in the vocabulary of the speleologist, any cave formation originating from deposition.

Deposition--act or process of depositing.

Drapery--hanging speleothem which takes the form of a curtain or drape.

Dripstone--a calcite deposit left by dripping water.

Flowstone--calcite deposited by water running down a cave wall or over a cave floor.

Formation--a term geologists use to describe a body of rock, but it is also applied to cave deposits such as stalactites. (Speleothem is a better term for the latter.)

Fracture--a break in rock.

Gallery--an underground passage.

Grape formation--see botryoid.

Ground water--water within the earth, such as supplies wells and springs.

Helictite--a variant form of stalactite which does not hang vertically or which has side growths resembling branches or twisted roots of plants.

Hydrology--the science that deals with surface water and underground water.

Hydraulic pressure--a force caused by water pressure.

Igneous (rock)--pertaining to rocks formed from molten matter (magma). Igneous rocks include granite formations, cooled deep within the earth and volcanic rocks.

Joint--a crack, which in limestone forms at an angle to a bedding plane. A series of joints often intersect each other in a four-sided pattern.

Lime--may be any of several caustic compounds containg calcium.

Limestone--a rock consisting chiefly of calcium carbonate, usually an accumulation of organic remains such as shells.

Marble--(proper) differs from limestone in being more or less crystallized by metamorphism.

Metamorphose--to change into a different form, such as to change sedimentary rock (limestone) into a metamorphic rock (marble).

Nodule--a rounded mass of irregular shape; a little lump.

Moon milk--a rare form of calcium carbonate which is semi-liquid.

One-stage theory--an explanation of the origin of caves which holds that they were created by acid-bearing vadose water at or above the water table.

Phreatic stage--according to the two-stage theory, this is the period during which caves originate by solution in the phreatic zone.

Phreatic water--see phreatic zone.

Phreatic zone--the region, below the water table, in which rock is saturated with water. The water in this zone is called phreatic, from the Greek work meaning "well."

Popcorn--(see botryoid).

Recrystalize--to crystalize again or repeatedly.

Room--a chamber.

Rimstone--a calcium carbonate deposit around the edge of a pool of water.

Sandstone--a sedimentary rock consisting of sand, usually quartz, united by some cement, as silica, iron oxide, etc.

Sedimentary rock--formed from deposits of sediments, particularly fragments of other rocks transported from their sources and deposited in water.

Shale--a sedimentary rock formed by the consolidation of clay, mud, or silt, and having a finely laminated structure.

Sink--a depression in the landscape caused by collapse of the roof of a cavity beneath the surface.

Sinkhole--an opening that leads steeply downward from the surface to a cavernous area. Such holes may appear in the bottoms of sinks or their mouths may be flush with the surface of the surrounding terrain.

Solution--the process by which a substance is homogeneously mixed with a liquid. Also, the state of being so mixed.

Solution cavity--a cavity produced by the process of solution.

Soda straw--a small, hollow stalactite inside which drops of water descend.

Speleologist--one who makes a scientific study of caves.

Speleology--the scientific study of caves in all their aspects.

Speleothem--a general term used to describe the deposits in caves, of calcite, aragonite and gypsum. The word is more and more frequently used instead of the word "formation" which geologists use to describe large bodies of rock. Thus, a cave may be said to be in a certain limestone formation.

Spelunker--one who explores caves as a sportsman or as an amateur speleologist.

Squeeze--a passageway in a cave that is very tight from a human point of view.

Stalactite--a calcium carbonate speleothem which grows downward, icicle-fashion, as a result of deposits left by dripping water.

Stalagmite--a deposit of calcium carbonate which is built upward from a cave floor by dripping water.

Travertine--a term loosely applied to several forms of calcium carbonate deposits.

Two-stage theory--an explanation of the origin of caves which holds that they were created by acid-bearing phreatic water below the water table; and that then, in a later stage, when the cave was drained of water and lay above the water table, a calcium-bearing vadose water deposited the speleothems.

Vadose stage--according to the two-stage theory, this is the second stage or cycle in which caves become partially or completely filled with formations deposited there by vadose water.

Vadose water--see vadose zone.

Vadose zone--the region lying between the surface of the earth and the water table. Water which seeps or flows through this region under the pull of gravity is called vadose water.

Volcanic (rock)--rock formed by solidification of a magma (molten rock) poured out over the earth's surface from a volcano or other surface eruption.

Water table--the meeting place of the phreatic and the vadose zones. Below it, the rock is saturated with water; above it, water under the pull of gravity is continuously flowing downward.

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X. APPENDIX A - WHO'S WHO - 1961

Superintendent - - - - - - - - - - - - - - - - - W. Ward Yeager

Assistant Superintendent - - - - - - - - - - -

Chief Park Naturalist - - - - - - - - - - - - - Bruce W. Black

Assistant Park Naturalist - - - - - - - - - - Vernon D. Dame

Chief Ranger - - - - - - - - - - - - - - - - - - Marshall B. Evans

Management Assistant, Oregon Cave NM - - - - Roger J. Contor

Manager, Oregon Caves Company - - - - - - - - Richard L. Sabin

XI APPENDIX B - REGULATIONS IN BRIEF

It is unlawful to disturb, mar, mark or remove any formation, stalactite, stalagmite, or other mineral from the confines of the monument.

Plant and animal life are absolutely protected. It is unlawful to tease, disturb or molest the animals. Hunting and trapping are forbidden. Living and standing plant life are protected and may not be disturbed.

No one may enter the cave without a gegular guide. Children under six years old are not allowed to take the trips. Guides can enter only in line of duty connected with guiding parties. Cave exploration is not allowed. (This means No "wiggle" parties, whether with guides or not.)

Dogs, cats and other pets must be kept under positive physical restraint at all times and then only in certain areas (ask a Ranger). They may not be taken into the cave, on trails, or into the chateau and other public buildings.

Unsealed firearms are not allowed on the monument.

There is no camping overnight on the monument.

Fires are permissible in the picnic area only.

No smoking is allowed on trails outside the cave during the fire season.

Violation of these regulations constitutes a misdemeanor punishable by a maximum fine of $500.00 and/or a maximum of six months in jail.

XII. APPENDIX C - ROADS AND TRAILS

Roads Mileages

Cave Junction	20 miles	
Crater Lake National Park	150 miles	(via US 199, 99, Oregon 234, & 62)
Crescent City	77 miles	(via US 199)
Grants Pass	50 miles	(via US 199)
Lava Beds National Monument	198 miles	(via US.199, 99, Oregon 66, &39)
Medford	80 miles	(via US 199, 99)
Portland	330 miles	(via US 199, 99)
Roseburg	130 miles	(via US 199, 99)
San Francisco	451 miles	(via US 199, 99)
	470 miles	(via Medford, US 199, 99)

Trails

Big Tree	1½ miles	(to Big Tree)
	3½ miles	(Loop on Lake Mtn. Trail to Chalet)
Cliff Nature	1 mile	
Lake Mountain	5 miles	

Ask a Ranger for further information, expecially about other trails.

XIII. APPENDIX D - NATIONAL PARK SYSTEM IN BRIEF

The Act of Congress, August 25, 1916, to establish the National Park Service, defines the fundamental purpose of the Service to be as follows: "The Service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments and reservations*** by such means***as confirm to the fundamental purpose***which***is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner*** as will leave them unimpaired for the enjoyment of future generations."

Types of Areas Administered by the National Park Service

Type	Number	Example
National Parks	29	Crater Lake National Park, Oregon
National Historical Parks	8	Colonial and Yorktown, Virginia
National Monuments	84	Oregon Caves, Oregon
National Military Parks	12	Gettysburg, Pennsylvania
National Memorial Parks	1	Theodore Roosevelt, N. D.
National Battlefield Parks	3	Richmond, Virginia
National Battlefield Sites	5	Fort Necessity, Pa.
National Historic Sites	12	Home of F. D. R., New York
National Memorials	14	House where Lincoln Died, Wn., D. C.
National Cemeteries	10	Vicksburg, Mississippi
National Parkways	3	Blue Ridge, Va., N. C.
National Capital Park System	1	Washington Monument, Wn., D. C.

Total National Park System, March 15, 1961 - 186. Also, 4 National Recreation Areas, such as at Coulee Dam, Washington.