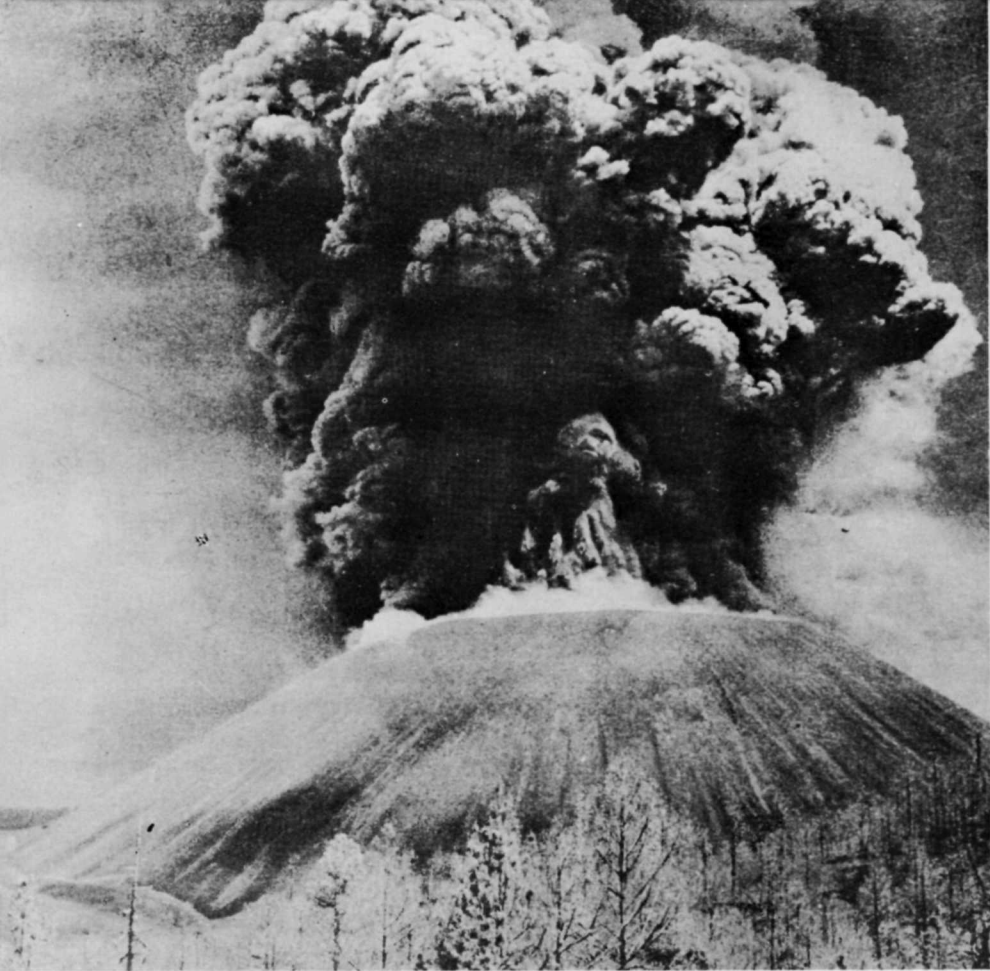


LAVA FLOW NATURE TRAIL



SUNSET CRATER NATIONAL MONUMENT
ARIZONA

10 CENTS IF YOU TAKE THIS BOOKLET HOME



Paracutin Volcano in Mexico. Sunset Crater looked like this when it erupted about 900 years ago.

NATIONAL PARKS AND MONUMENTS

Sunset Crater National Monument is one of 180 areas administered by the National Park Service, U. S. Department of the Interior. These include such magnificent scenic areas as Grand Canyon and Yosemite National Parks and other Parks and Monuments set aside for their scenic, scientific and historical values.

In order to preserve the Parks and Monuments for the enjoyment and inspiration of future generations it has been necessary to prohibit hunting, grazing, mining, woodcutting, and other such activities which would destroy the handiwork of nature. We hope you will join with us in protecting Sunset Crater National Monument by taking only pictures and inspiration and leaving only footprints and goodwill.

INTRODUCTION

The 1,000 foot high Sunset Crater erupted in A. D. 1064, the last crater to erupt in this volcanic field. The ash fall of this eruption forced scattered Indians to flee their homes, but at the same time built up a beneficial moisture-retaining layer which made dry farming possible. This change in soil moisture conditions caused a prehistoric land rush that drew an estimated 8,000 people into a region of 800 square miles.

As a purely geological attraction, Sunset Crater exhibits an extremely wide range of volcanic phenomena, with all kinds of lava and an immense variety of spatter cones and fissures, as well as squeeze-ups. The latter are extremely rare.

The trail beginning just behind this register desk is about one-half mile in length and will take you to some of the more interesting features of Sunset Crater National Monument. It is a loop trail and in about 45 minutes of easy walking you will return to this point.

The numbered posts along the trail correspond to the numbered paragraphs in this booklet.

LAVA FLOW NATURE TRAIL

Station No. 1. Fumarole or "spatter cone." This fumarole is, in reality, a miniature volcano. Since no great force was present when it erupted, the molten lava was ejected only a short distance in building up the small cone you see. The bottom of this spatter cone has been oxidized by steam and gas; hence the red color.

Station No. 2. Line of fumaroles. Around you, you will notice a line of fumaroles. These erupted along a small crack or crater.

From cracks at this base, to your left, also came the bulk of the molten lava that comprised Bonito Lava Flow. Contrary to general opinion, most volcanoes issue their lava in this way rather than from over the top of their craters.

Station No. 3. Lava tube. Even after a thick crust formed on the surface of the lava, the molten mass underneath continued to flow. In this case the mass drained away and left a tunnel or tube. Under some conditions ice may accumulate in these tubes and they may be called ice caves; such is the case with this tube.

Station No. 4. Ponderosa pine (*Pinus ponderosa*) This stunted, twisted tree is a ponderosa or western yellow pine, the same tree which in better soil makes the pine forests of northern Arizona the largest standing yellow pine forest in the United States. A large

number of these trees in the vicinity of Sunset Crater are stunted and strangely spiraled like a barber's pole. This odd type of growth may be partly due to the lack of rich soil in this lava and cinder area.

Young ponderosa pines do not have the characteristic orange-yellow bark of the mature trees. Instead their bark is rough and blackish and because of this the young trees are sometimes called blackjack pine.

Station No. 5. Small fumarole (possibly a blister or bubble). On your right you will notice an excellent example of a small fumarole which built up from the lava flow itself. Walk over and examine it, but be careful of the rough, sharp lava.

Station No. 6. Apache-plume (*Fallugia paradoxa*) This shrub derives its name from the plumelike seed clusters which appear in the fall of the year. It provides browse for deer and sheep. By the Hopi (HOH-pee) it is used for arrowshafts and, with duck grease, as hair dressing. Whatever its merits, one seldom, if ever, sees a Hopi who is bald.

Station No. 7. Pinyon (*Pinus edulis*) This small tree is a pinyon, a common small pine of the Upper Sonoran Life Zone that extends from the Sonoran plains of Mexico, after which the zone is named, northward into Colorado and Utah. The pinyon nuts you see in the local stores are the seeds of the pinyon and are quite delicious. These nuts have recently become commercially important and provide a source of income to many Indians in northern Arizona.

View from top of Sunset Crater looking east



In the distance you see the San Francisco Peaks which reach an elevation of 12,611 feet, the highest point in Arizona. On the cool moist slopes of the peaks, which incidentally are extinct volcanoes, are found dense forests of pine, quaking aspen, spruce, and fir. The higher parts of the peaks are above timberline and the small plants growing there are similar to the vegetation of the Arctic regions.

Thus in the very few miles from Sunset Crater to the top of the San Francisco Peaks you can go from the Upper Sonoran Life Zone with its pinyon through the ponderosa forest of the Transition Zone, the quaking aspen of the Canadian Zone, the Hudsonian Zone with its spruce and fir forests and finally the Arctic-Alpine Zone where the climate is too severe for trees to grow at all. To do this at sea level it would be necessary for you to travel from Mexico to the Arctic.

Station No. 8. Lava flows. Looking down and to your right, notice two different lava flows. The older one, in the bottom of this basin, came out from the base of Sunset Crater, flowed out beyond the present parking area, and then turned back into this depression. The more recent flow, which probably occurred within a few months or a year after the first, advanced over the lower flow and finally stopped, forming the jagged cliff to your right front.

Station No. 9. Wax currant. (*Ribes cereum*) The berries of wild currants are an important source of food for wildlife and are sometimes used for making jelly. A preparation of the wax currant has been used by the Hopi Indians in the treatment of stomachache.

Currants and gooseberries harbor one stage of the white pine blister rust and are being killed out where commercially important stands of white pines occur. Control of these shrubs has not been found necessary in Arizona.

Station No. 10. Forest fire. A forest fire once burned through here. **Prevent This From Happening Again!** Please be very cautious with matches and cigarettes!

Station No. 11. A'A' lava and plant succession. The lava in the flow that you are walking along is known as a'a' lava, an Hawaiian term describing this type of rough, jagged material. The roughness of this type of lava is due to the fact that contact with the air formed a crust on the surface of the molten mass as it flowed slowly along. Further movement of the flow has caused the crust to break into



Sunset Crater and Bonita Lava Flow

“clinkers” which were piled into the tumbled mass you now see.

Along this trail you are seeing the story of the plant world unfold as it has been unfolding since earth's history began. This plant story is a systematic process known as plant succession which proceeds in this arid climate from bare rock to the beautiful ponderosa pine forests of the region.

Before you on the bare rocks of the lava flow you will notice splotches of gray and green. These splotches are in reality tiny plants known as lichens. Due to a very specialized system they can exist upon the bare rock, obtaining their food from the air and rain water, and from the rock itself. Slowly they wear away at the rock with their tiny roots, and with weak acids which they produce, until some soil is formed.

As soon as some small amount of soil is formed, mosses move in and crowd out the lichens, just as dandelions move into your lawn at home. The mosses, being even more powerful, break down more rock to form more soil and are in turn driven out by grasses and annual flowers such as these along the trail.

These annuals, in turn, break down the rocks further with their roots until shrubs such as the squawbush and Apache-plume can survive, and, finally, enough soil collects to support a tree.

In this particular area most of the soil which supports the vegetation has been carried in by the wind. However, the lichens before you are slowly breaking down the solid rock to form new soil, which will in turn nourish the mosses, and so through the full cycle of plant succession.

Station No. 12. Drag marks. These are caused when the edges of the molten lava begin to cool somewhat and become puttylike. The material over which the still-advancing lava scraped and dragged has left these marks. The observant visitor will also notice these in the "squeeze-ups" to be seen farther along the trail.

Station No. 13. Rabbitbrush. (*Chrysothamnus sp.*) These shrubs are quite abundant throughout the Southwest. They are looked upon in disfavor by stockmen as they have only slight forage value and tend to increase on overgrazed land at the expense of more useful plants. The sap of some species contains rubber of fair quality, but has not yet been used on a large scale.

The Hopi use the stems in great quantity in the manufacture of wicker plaques. The Navajo make yellow dye from the flowers and green dye from the stems. Being one of the common desert shrubs, rabbitbrush is widely used in making windbreaks and for other construction where brush is needed.

Station No. 14. A'A' lava flow. Here the trail moves across a typical a'a' lava flow which is described at Station 11. The lava looks almost as fresh as if it flowed yesterday, doesn't it? Actually, it is very recent, geologically, for Sunset Crater's eruption can be dated accurately by archeological and tree ring methods at A.D. 1064, in the fall of the year.

Station No. 15. Squeeze-ups. In case you don't quite know what you are looking for at this station, the squeeze-up is the standing section of lava ahead of you marked by the white arrow. The picture on page 7 shows a view of a squeeze-up.

After the surface of the lava cooled and hardened, a crack occurred, and through this crack lava with a consistency of modeling clay was forced up from below. In some cases thin sheets of lava have been pushed several feet above the surface of the flow until they have arched and broken under their own weight. Squeeze-ups are common at Sunset Crater but are rarely found in other volcanic regions of the world. As this lava flow was dammed up in the valley, it created tremendous pressures and tended to push the viscous lava up through surface cracks to create these odd forms.

Station No. 16. Root systems. Note the manner in which the roots of the ponderosa pine are exposed along the surface of the ground. This is unusual, as ponderosa pine develops a much deeper root system on better soils. It is believed that in this area any water which

passes through the first few feet of the soil sinks so deep into the loose cinder underneath that the tree roots cannot reach it. Hence the roots stay near the surface and take up the moisture absorbed by the decayed needles and soil on or very near the surface of the ground.

Station No. 17. One-seed juniper. (*Juniperus monosperma*) This tree is commonly miscalled cedar, due to the aromatic wood. In association with the pinyon it makes up the scrub forests of the South west. Locally it is extensively used for fence posts and firewood. The Indian has many uses for the tree and its berries in the preparation of medicine. Perhaps due to the clean aromatic fragrance, extracts of the berries and twigs are widely used in "cleansing" ceremonies.

Station No. 18. Volcanic blister. To your right you see a volcanic blister which is indicated by the white arrow. Visualize a pan of fudge boiling on the stove and you get the idea of how these blisters formed. In this case the lava cooled before the blister burst. There are several other examples of blisters in this vicinity.

Station No. 19. **We hope you have enjoyed this trail. Please return this booklet before you leave, or you may purchase it by dropping 10 cents in the coin slot in the register desk.**

GENERAL INFORMATION

If you want to see more of Sunset Crater, and have an hour or so to spend, climb to the crater's rim. The trail starts 150 yards east of the register desk where you obtained this booklet, and is marked by a sign. The climb is a distinctly "stiff" one.

Be sure to wear old shoes; and ladies. *not* the toeless variety. The first part of the trail is steep and may seem discouraging, but after a bit it becomes easier. Once on the crater's rim, and after catching your breath, walk to the highest point on the rim for a wonderful view eastward towards the Painted Desert and the Navajo and Hopi Reservation.

Take nothing but pictures —

Leave nothing but footprints



Squeeze-ups at northwestern foot of Sunset Crater's cone



Distant view of Sunset Crater through ponderosa pines.

MISSION 66

Mission 66 is a 10 year development program, now in progress, to enable the National Park Service to help you enjoy and understand the Parks and Monuments, and at the same time, to preserve their scenic and scientific values for your children and for future generations.

CONSERVATION—YOU CAN HELP

If you are interested in the work of the National Park Service and in the cause of conservation in general, you can give active expression of this interest, and lend support by alining yourself with one of the numerous conservation organizations, which act as spokesmen for those who wish our scenic heritage to be kept unimpaired for the enjoyment of future generations.

Names and addresses of conservation organizations may be obtained from the ranger.

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ADDITIONAL POINTS OF INTEREST

This region is one of the most interesting archeological and scenic localities in the United States. Wupatki National Monument, 18 miles north by secondary road through lava flow and cinders (a few miles farther by paved highway), and Walnut Canyon National Monument, 21 miles by paved highway to the south, are manifestations of the effect of the Sunset Crater eruption. Noted as Great Drought refugee areas are Tuzigoot and Montezuma Castle National Monuments, in the Verde Valley.

While in the Flagstaff area you would find the Museum of Northern Arizona, 3 miles north of town on the Ft. Valley Road, very worth visiting. It is open to the public from March 1 to December 1 annually, and during these months is open daily. Open hours on Sunday are 1:30 to 5 P. M. Open hours on week days are 9 to 12 A. M. and 1 to 5 P.M., save for June, July and August, when it is also open during the noon hour.

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which is a non-profit distributing organization pledged to aid in the preservation and interpretation of Southwestern features of outstanding national interest.

The Association lists for sale interesting and excellent publications for adults and children and very many color slides on Southwestern subjects. These make fine gifts for birthdays, parties, and special occasions, and many prove to be of value to children in their school work and hobbies.

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- **107. **TUMACACORI'S YESTERDAYS.** Jackson. The interestingly written story of 18th and early 19th century Indian and Spanish life in southern Arizona and Sonora as reflected in the history of the mission of San Jose de Tumacacori, now Tumacacori National Monument. 96 pp., color paper cover, 53 excellent illustrations.\$0.75
- **131. **NALAKIHU.** King. Thorough and concise report on an interesting pueblo in Wupatki National Monument. Technical but has interesting summaries and discussions. 183 pp., 81 plates, 17 tables.\$4.00
- **650. **FOR THE DEAN.** Reed and King, eds. Handsome volume of anthropological essays by 23 of his former students in honor of the late Dr. Byron Cummings of the U. of Arizona. Valuable contribution to science, consisting mostly of Southwestern subjects. Authors include Haurly, Hawley, Wedel, Willey, Spicer, etc., and subjects cover wide field: Pueblo witchcraft, Cocopah history, Papago physical status, Great Kivas, etc. 319 pp., illus., cloth.\$6.00
- **652. **MONTEZUMA CASTLE ARCHEOLOGY, Part 1: EXCAVATIONS.** Jackson and Van Valkenburgh. Technical but understandable report of excavation of Castle A. Appendix on skeletal specimens by Bartlett. Technical Series, Vol. 3, Part 1, 1954. 96 pp., illus.\$3.00
- **653. **MONTEZUMA CASTLE ARCHEOLOGY, Part 2: TEXTILES.** Kent. Technical study of 60 textiles, fully described and illustrated. Invaluable for archeologists, ethnobotanists and students of textiles. Technical Series, Vol. 3, Part 2, 1954. 110 pp.\$2.00
- **654. **EXCAVATIONS, 1940, AT UNIVERSITY INDIAN RUIN.** Hayden. Technical, but readable, report on the excavation of this interesting site near Tucson, Arizona. A must for students of Southwestern archeology. Special appendices by Danson and Wallace. Technical Series, Vol. 5, 1958. 6 fold-out maps, 52 plates, 234 pp.\$4.00

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