



### SHIVA TEMPLE

*This photograph of the model of Grand Canyon in the American Museum of Natural History shows the approximate path taken by Dr. Anthony and his party of scientific alpinists from the North Rim of Grand Canyon over the narrow ridge of rock to the summit of Shiva Temple.*

GEOGRAPHY

# Scientist Describes Visit To Unknown Island in the Sky

**Plateau in Grand Canyon Never Before Visited by White Man Contains Wild Life Isolated from Their Kind**

By DR. HAROLD E. ANTHONY

Leader, Shiva Temple "Lost World" Expedition.\*

See Front Cover

THE LAST man is down from Shiva Temple and today the Shiva Temple Expedition is another written chapter in the history of exploration and sciences. One of the few remaining blank spots on the biological map has disappeared.

More than 75 carefully prepared specimens from the top of the steep-sided mesa are on their way to the American Museum of Natural History in New York City for careful comparison and intensive study.

Near-tragedy and hilarious episodes both marked the expedition's course. We found convincing evidence also that someone else had tried to jump the

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gun and beat us to the summit of Shiva. Water was always a problem, even the first day when an unlucky accident lost us a large part of our supplies.

A final scientific report will be necessarily somewhat delayed but it is possible now to sum up the trials and tribulations of a party working in an almost inaccessible region where no naturalist has ever been before.

No scientist wishes to commit himself before he has studied his material carefully. Hence when I say now that many of the animals we found atop the lonely sky island seemed to me to be paler than their cousins on either rim of the canyon, it is but a tentative statement, made with the knowledge that a change of opinion may be necessary.

It seems hardly possible that such a country as the United States would have

a blank spot on its biological map, that there are areas where nature has been left severely alone. But there they are, inviting conquest.

Word of these two sky islands—Shiva Temple and Wotan's Throne—first reached the Museum upwards of two years ago. An inquiry addressed to the Park Naturalist stationed at the Grand Canyon disclosed the fact that such areas really existed, and had been set aside as research areas where nature pursued its own course, unworried by the inroads of men.

### Never Climbed

As far as was known to the park personnel, these had never been climbed by a white man, and certainly had never been visited and studied by a naturalist.

Such a state of affairs was an instant challenge to the American Museum of Natural History which has launched an aggressive campaign to build up a complete collection of North American mammals.

To make a long story short, after months of preparation, the Museum party assembled on the South Rim of the Grand Canyon on Sept. 11. In this undertaking, they had the full cooperation of the park authorities and the unexpected competition of certain adventurous individuals who, hearing about Shiva, attempted to beat us to our goal.

Either an autogyro or a dirigible was at first considered the logical means of placing the personnel of the expedition on the isolated plateaus, which are situated about a mile from the North Rim and are surrounded by a natural moat of 1,000 to 5,000 feet of cliff and precipitous slope.

However, that idea had to be abandoned. The forests were too dense for the autogyro and the swirling air currents rising from the heated floor of the canyon threatened disaster to the dirigible. An extensive aerial survey, which also provided the Museum with photographs for a detailed study of local conditions, disclosed the necessity for scaling the sky islands afoot.

### The Long Way

So we decided to take the long and hard way, which meant crossing from the rim afoot and climbing from the base.

Walter A. Wood of the American Geographical Society, who has had extensive mountaineering experience, was in charge of the climbing party whose job was to establish the route and bring personnel onto the summit. Elliott Hum-

phrey, who was injured in the assault on Shiva and had to drop out, was Wood's assistant. Mrs. Wood, who has accompanied her husband on previous expeditions, was also present.

The field party, the naturalists who were to do the collecting, were nineteen-year-old George B. Andrews, son of the director of the Museum, Dr. Roy Chapman Andrews, the famed discoverer of the world's oldest eggs, the dinosaur's eggs, and myself.

Miss Amy Andrews (no relative of Dr. Andrews) very generously volunteered her services as pilot and the use of her plane for expedition purposes. For even though we could not land members of the expedition from the air, we intended to use parachutes to drop food and water on the islands.

When we were discussing using the parachutes, little did I dream that we would be able to drop a dozen eggs on Shiva without breaking the shells or scrambling the yolks!

Photographer James B. Shackelford, because he was unable to bring his 275-pound colored motion picture equipment to the top, moved about from point to point on the North Rim and also used the plane extensively.

September 13 found our group one step nearer, on the North Rim, which thenceforth served as the central base. A hurried reconnaissance on the fourteenth took the mountain party almost to the summit of Shiva. Because of a late start, however, they returned, footsore and dead-tired, late at night. We had about concluded that they were bushed for the night somewhere out in the canyon.

First field camp was made on the North Rim on Sept. 15. The same day we pushed down onto the saddle of the ridge below Shiva. That night saw us prepared for a daybreak assault on the mesa.

### Signal Fire

With us that night were M. R. Tillotson, Park Superintendent; Edwin D. McKee, Park Naturalist; and Warren Hamilton, assistant superintendent.

We built a big bonfire the evening we spent on the saddle so that interested onlookers on the South Rim, eight or nine miles away in an airline, would know that we were knocking at the threshold of the canyon's mysteries.

Camp was astir at daybreak on the sixteenth, and we got to the top of Shiva Temple that day.

As we walked across the dark red sandstone of the Hermit Formation and

climbed up the steep slope of debris that has fallen from the cliffs above, we came upon a suggestive reminder of an attempt to beat us to our goal.

A neat coil of rope that apparently hadn't even been used for climbing, a small camera, and an alpenstock (hooked climbing staff used by mountaineers) lay in a pile on a rock—mute evidence that at this point the adventurer had lost his nerve. We even speculated whether we might discover more gruesome evidence as we clambered up the cliffs, but such was not the case.

We even appropriated this rope for our own use. We decided that it had been forfeited to the expedition.

A little further on we roped ourselves into two groups of four each. The forfeited rope came in handy as our own would have been enough for only one group, and we would have had to drop it down from the top to the second quartet.

The trip's only serious mishap happened to Humphrey, a member of the second group. The rope coiled around his middle knocked a rock off a ledge above him. The rock, although small, fell with sufficient force to cut through his hat and cut his scalp rather deeply.

### A Close Call

Almost stunned by the force of the blow, Humphrey had a close call. He almost fell off the cliff, with possible disastrous results to the other climbers roped to him.

Blood streamed down his face from the crown of his head when his hat was removed. Lack of water prevented us from making our first-aid measures a work of art. Humphrey did not finish the climb, remaining in the shade of a tree to rest up for the descent. All but the two who remained at the top returned that afternoon, taking Humphrey back with them. We needed no further warnings to keep a sharp eye out for rocks above. They are a constant menace on a cliff-side.

Soon after the accident we reached the end of the cliff pitch and the ropes were cast off as the climb was a bit easier. It was every man for himself up over the loose rock and occasional low cliff to the summit.

After a brief rest, we scattered about for a quick reconnaissance and eventually McKee and I picked as our settling point for the night a point on Shiva right opposite the ridge up which we had come. But we still had half of the day's surprises in store for us. We had less than a pint of water between



DR. HAROLD E. ANTHONY

*Leader of Shiva Temple Expedition*

us when we sat down to await the arrival of our packers with supplies from below.

As packers I had engaged six young men from Kanab, a Mormon community just over the state line in Utah. These men were all accustomed to climbing over the Grand Canyon and cliffs held no terrors for them.

They had started out in the morning with bedding, water and enough provisions to last us until the parachutes went into action. It was expected that when they arrived at the foot of the cliffs, our party at the top would let down ropes to haul the duffle up.

### Trouble Below

We waited. The shadows that fill the canyon at sunset were creeping higher and higher up the great gorge's walls. But still no sign of activity from below. We went to a point on the mesa directly above the cliff where the packers were supposed to be at work and called down to discover if there was trouble below.

Indeed there was, for George Andrews called back mournfully:

"We've been having an awful time to get things to the top of the cliff. The packers have quit and gone back. Only one of 'em is here with me now. You two will have to come down and spend the night here."

I got the wrong impression that the packers had quit en masse and gone back to Kanab, which would have placed us in a fine predicament indeed. I

wanted to spend the night atop Shiva for our program called for building a signal fire to tell watchers on the South Rim that Shiva had been conquered.

McKee and I put our heads together a moment. He decided to go below to learn what had happened and whether it was not still possible to bring up the few things we would need to stay the night on the top.

In the meantime we were getting more and more thirsty, and the knowledge that there was only one small drink between us and no water at all served only to make us thirstier.

McKee disappeared down the slope. Just before dark he and George Andrews clambered up laden with beds, part of a canteen of water and a few battered cans of food.

### Bouncing Cans

It was then that I learned the cause of our trouble and the story of the bouncing cans.

A fifty-pound sack of provisions had been started up from the base of the cliff, but when well up into the air had burst and everything in it had cascaded down over the crags. Bottles and stone jars were a total loss. But a number of cans of such stuff as beans, peas and corn were still intact, if somewhat dented.

The porters had spent precious time climbing around to retrieve the scattered tins and finally everyone became so tired that they had to call it a day. The

packers had not quit, but had merely gone back to the base camp for the night.

I had done them an injustice in supposing that they would quit under fire. They subsequently proved cheerful and willing under every circumstance. George Andrews himself, who had worked like a Trojan all afternoon, had become so exhausted that it seemed to him only logical that we should all spend the night on top of the Coconino rather than to use any of his remaining energy to stagger up to the top.

However, after he had rested, drunk a little and had something to eat, he recuperated rapidly, and the outlook was far more cheerful to all of us.

As soon as full darkness had set in we three—McKee, Andrews and I—followed the rim of Shiva around to the south face until we reached an open spot where we could see the lights of El Tovar, the lodge on the South Rim. Here we piled up dry juniper and pinyon pine and soon had a roaring signal fire.

Shiva Temple was at last on the scientific map.

### Life Changing Slowly

A picture of life changing slowly, very slowly, but changing none the less, will probably emerge from the ten days George Andrews and I spent as kings of all we surveyed atop a plateau that has, for many of the animals to be found on top, been to all intents and purposes cut off for some 20,000 years from the world outside.

Ten days of exploring its 300-acre plateau, trapping the small animals with which it is plentifully provided, shooting at its variety of chipmunk and cottontail rabbit, will serve as soon as we have had opportunity to study our specimens, to paint in detailed form the picture. But now we can draw the broad outlines of one of nature's canvases.

Twelve species of mammals which we noted either as resident throughout the year or as possible visitors may be listed as follows:

Chipmunk, cottontail rabbit, porcupine, two species of wood rats, rock squirrel, three and possibly a fourth species of white-footed or deer mice, black-tailed deer, coyote, ring-tailed cat and probably the cougar or mountain lion.

Some of these, such as the deer, more able climbers indeed than man, come up to the top only during the winter. Evidence of their visits was found in the form of antlers, which are known to

be cast only during January and February. But the smaller animals are there the year around and are effectively kept separated from their mainland cousins by the isolation of Shiva Temple and by the fact that any invaders would have to pass through a bitterly hostile environment to reach the mesa.

The world in which they live is warmer than the adjacent North Rim. It is drier. Although I did not take a series of thermometer readings and have only my personal reaction to guide me, I believe that Shiva is warmer. There was frost on the North Rim during our stay at Shiva, but none on the sky island.

### Semi-Desert Vegetation

Cactus is abundant on the mesa, much more abundant than on the adjacent North Rim. The pale coloring which we noted, marked for example on the Shiva chipmunk by the almost complete loss of all his stripes except for the black one down the middle of his back, is in keeping with the semi-desert character of the vegetation.

It can readily be shown that the darkest colored mammals are found in the regions of heavy rainfall, prolific vegetation and generally dark background. The paler colored ones are found in the deserts or open areas where there is a flood of sunlight and a generally light background. Consequently I was prepared to find a corresponding paleness in the coloring of Shiva mammals.

Pueblo Indians once were accustomed to visit Shiva but have probably not been atop the butte since the day when the Spanish Conquistadores reached Arizona. Ample evidence of their visits was found.

The Kaibab limestone which caps Shiva is the source of numerous flint nodules and these were the source of the Indians' weapons and tools. We found flint scrapers, arrowheads, spear points and numerous chips fashioned by Indian hands.

Remains of stone ovens set up by the Indians to bake or roast the starchy center of the century plant or "mescal," which grows abundantly here, were among our finds. Potsherds, broken bits of Indian pottery, were to be found about these "yant ovens," as they are known locally.

Weather throughout the year is probably generally fair. Except for the three days of intermittent thunder showers, which an oldtimer would term an equinoctial storm, the skies were bright and clear. We were fur- (Turn to page 252)



### PLENTIFUL

Such rodents as this little squirrel, found frequently on both rims of the canyon were also plentiful at Shiva Temple.

gest that the old theories of the cause of the condition do not correspond with the facts. Much new study will be necessary to finally determine the causes of otosclerosis, but when these are advanced, new methods of treatment and even of prevention may be hoped for.

Prof. Sourdille, who was awarded the Croix de Guerre for his four years' service with a surgical unit of the French Army during the World War, has labored for twelve years, in the face of great discouragement, to perfect his new surgical technic. He has changed the picture of hopelessness for many patients. No other medical or surgical treatment has given heretofore such a hopeful outlook.

*Science News Letter, October 16, 1937*

## From Page 247

ther blessed by the presence of a full moon, which enveloped the canyon in a pattern of silvery light and deep shadows and added greatly to its sense of awe and mystery.

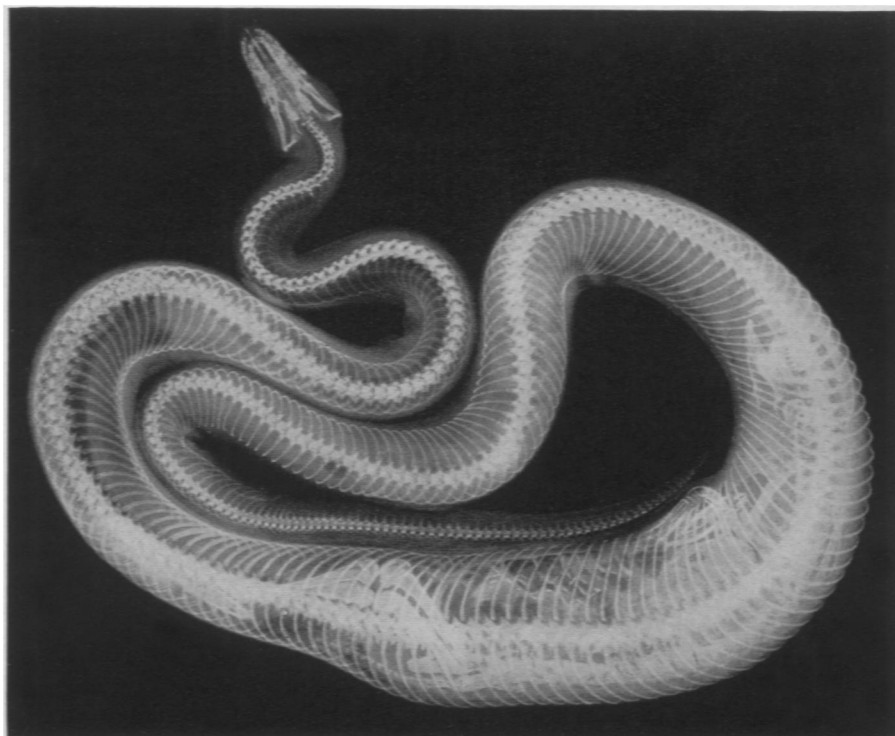
We had a visit from a coyote, which probably smelled our campfire, for shortly after the rainstorms we found a fresh track of the animal in the mud.

Yet in spite of the apparent comings and goings of animals such as the deer, Shiva Temple, carved out on its south side by the Colorado River and on the north side by rock falls and erosion, is a separate world to the small animals isolated from the mainland.

Physical separation from the canyon rim and environment obstacles between the top of Shiva and the rim of the canyon are the two types of barrier which can and do stop small animals like mice and other rodents from crossing to and fro. The physical inaccessibility of this sky island is sufficient to prevent the passage of many land animals.

Climbing rodents such as chipmunks can scale the cliffs with ease and they constitute no physical barrier to them, but the environmental obstacles are effective.

Any animal leaving Shiva to cross to



### BABY BOA BOLTS BUNNY

*This is no alliterative joke. Mexicans value young boa constrictors because the snakes eat insects and rodents. When this baby ate a rabbit intended for Mama Boa, its owner sent it to a doctor and X-ray apparatus in California to make sure the rabbit was following the proper pathway of digestion. This X-ray photo was the result.*

the North Rim by way of the saddle must drop down 1,100 feet into a distinctly different type of environment, which may be not only unattractive but actually hostile to it. As long as food and living conditions on Shiva are attractive to one of these small rodents capable of climbing up and down the physical barrier there is no incentive for it to leave, especially if the only highway open to it is less attractive than the place it is leaving.

Such a barrier as this environmental one is for many kinds of animals just as much a hurdle as a broad expanse of water is to an animal that cannot swim.

We rather expect therefore that the study of the mammals we have collected on Shiva will show that these two types of barriers have left their impress on the character of the animals found on the plateau.

### Mark of Isolation

The paleness is a mark of this isolation. If darker animals from the mainland could invade Shiva, by interbreeding they would dilute the tendency toward lighter coloration. But that ten-

dency toward paleness has apparently not been so diluted.

The beginning of our first day atop Shiva, Friday, Sept. 17, did not find us settled for our work by a long shot, but by sundown we were fairly well organized.

When we took stock after a rather meager breakfast out of cans, we found we had exhausted our water supply. Our greatest need was to see that some was started up to us at once from the camp on the saddle, where a water supply had been established the day before.

### Shouted from Pinnacle

It was on this morning that I shouted down from a pinnacle some fifteen hundred feet in an airline from the camp that we had not a drop left. Superintendent Tillotson was talking to the South Rim over his portable radio transmitter at the time.

And, I am told, the two-way conversation between us was picked up by the microphone. I do know that press reports for that day declared that Dr. Anthony had sent down from the cliffs above "plaintive calls" for more water.

This day saw the termination of most

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of our transportation difficulties, for Wood, who had led the climbing party, was on his way out to start the parachute as a vehicle for supplying us with food and water.

The first parachute was landed on Shiva shortly before six o'clock that evening. It arrived while we were all at camp and caused some confusion because the packers had just arrived with their last loads for the day.

George Andrews and I dropped everything to run for the open spot which we had picked as the landing place for the 'chutes and which we had nicknamed the "Shiva Airport."

### Successful Landing

We had a pile of dry brush ready to fire as soon as the plane, whose motors we could hear, came into sight. Green pine boughs were to be thrown on this and the dense smoke would tell the pilot the direction of the ground wind. But before we could get this fire more than started, the bright red plane of Miss Andrews flashed over the rim, crossed Shiva once, wheeled to return, and on the second crossing, let go the first 'chute.

We saw the package drop through the trapdoor in the fuselage and then in a second the white billowy folds of the parachute puffing out as it caught the wind. The first parachute landing of "freight" on Shiva was one hundred per cent. successful. We had no trouble retrieving the cargo of food.

The white silk 'chute was hung in a

low juniper, but was not torn and with a little care we succeeded in getting it to the ground and safely stowed into a small bundle for return to the outside world and possible use once more in the future.

By a coincidence, the juniper limb I pulled down to free the 'chute dislodged a headless mouse which fell into my hand. Perhaps the remnant of a hawk's or owl's repast was an omen of the dozens of mice we were to catch.

While we were disposing of this first 'chute and bringing the provisions back to camp, Miss Andrews and Wood flew back to the Grand Canyon Airport on the South Rim to take on a second load—water—for Shiva.

Before we were ready for them, however, back came the drone of the motor and this time the package which was dropped did not check its flight, but hit Shiva like a bomb, while a partially opened 'chute fluttered down out of sight behind the trees like a wounded bird. A knot had slipped and 'chute and water can had parted company.

### Lost for Week

We didn't locate the ten gallon dairy can until the next day; it was a week before we found the parachute itself.

In the first 'chute load were the dozen eggs, packed just as they came from the grocer.

In case anyone is interested in what the well-equipped expedition will land from the air, we had items ranging all the way from substantial and necessary tinned meat, milk and vegetables to the unexpectedly luxurious features such as eggs, tobacco and a package of cheeses in individual portions.

These last were a last-minute thought by Wood, who can probably recall many a mountain-climbing expedition when he would have liked some of the little things in life and intended to surprise us when we first peeked under the lid of the packing case. I admit, we were surprised.

The pipe tobacco went begging, however, because the one pipe smoker in the camp, admittedly a slave of habit, didn't like the brand, despite the fact that Shiva shoppers couldn't be choosy.

Three more 'chute loads were landed the next Sunday and since they included a second full carton of provisions and twenty gallons of water, we were assured of adequate supplies for the rest of our stay.

Just to be on the safe side, however, the packers brought with them each day a two-gallon container of water. Even

so we didn't have enough to wash our camp dishes or our hands and faces. Fortunately for our senses of decency (skinning animals and handling traps is not the cleanest operation in the world) the three-day period of rainy weather set in on Sept. 20 and we gathered five gallons of water from shallow rock pools in collapsible canvas buckets we had brought with us for water storage.

### Mosquitoes

Insect life on Shiva had its interesting as well as annoying features. I was very much surprised the first night in our camp to hear high-powered mosquitoes flying about my ears. There were only two of them but they sounded large and as though they meant business.

Apparently, however, they were out of practice in biting humans, for not only was I not bitten, so far as I can discover, but I caught one landing on me only once. I finally fell asleep waiting to see if one would settle down on my face that evening.

Later I saw one of these at daytime in the tent and although it escaped before I could catch it I saw that it was much larger than the ordinary mosquito and very dark in color. It might seem strange to find mosquitoes in a region without water, but it must be remembered that these insects may fly or be blown a considerable distance from the water which hatches them.

Another bedtime visitor was a large black ant which every night (I was sleeping on the ground) persisted in coming into my sleeping bag.

There were never more than one or



### HOW HE REALLY LOOKS

Without the aid of X-ray eyes the baby boa would look like this 6-month-old specimen at the National Zoological park.

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two at a time, but they seemed unable to find a spot that satisfied them, and kept wandering up and down the length of my bed. I came to appreciate the significance of the saying, "I have ants in my pants."

A typical day for us began the afternoon before, when we set out a string of traps, usually fifty to seventy in number. These were baited with a bait made up of rolled oats, bacon, peanut butter and raisins, a banquet certain to suit the most fastidious rodent appetite and good enough for humans if we ever ran out of food.

While plain rolled oats would undoubtedly have attracted many rodents to the traps, and during these days of the rising cost of living the ingredients of our special bait would seldom appear on the average mouse menu, we felt that special circumstances justified the best for Shiva. We wanted to be more certain of catching rodents, mice among them, than the average housewife is.

Incidentally, this bait was very attractive to ants and this meant that fresh bait could be put out only well on in the afternoon.

Our traps were placed in all the different types of environment atop Shiva—under the edge of the rim, among the rocks, along fallen logs, under the yellow pine, and in clumps of brush scattered through the grassy areas in the more open portions of the plateau.

### Plentiful Rodents

Although a museum expedition usually runs from 100 to 200 traps a night and I had almost the latter number with me, it was not necessary to use such a large number because of the plentiful numbers of rodents atop the plateau. By constantly shifting the traps in order to test out each habitat we have good grounds for believing that we secured a representative sample of the mesa's animal life.

At daybreak George Andrews and I

made the rounds of our trap lines, removing specimens before the ants had mutilated them too badly. There is a variety of large black ant on Shiva which will very soon ruin as a specimen any small rodent left long in a trap.

Breakfast and a day of skinning followed.

As soon as we had gotten a large enough number of the common things and could let up on the daily routine of skinning and thus have a little leisure, we started to hunt with a shotgun, take photographs, turn over rocks and stones looking for any animal life that might be under them, and otherwise explore the possibilities of the plateau.

Hunting with the shotgun was not as productive of specimens as might be imagined. Chipmunks are very abundant on the mesa, but also very shy. They were usually in full flight when we saw them.

### Mammals Timid

In fact, this timidity and wildness was characteristic of all the mammals. Cottontail rabbits (which we went after without much success to add to our food supply toward the end when we ran low on meat) and rock squirrels were very seldom in view long enough to catch through the gun sights. Usually the animals made at once for the rim and disappeared down the slope where there was an abundance of cover amid the fallen rocks.

It may seem strange that animals which had never seen man as must be the case on Shiva would be so fearful of him. Very often where animals have not known man, such as on certain oceanic islands, the visiting naturalists have found their tameness so striking as to deserve notice.

I can offer as an explanation of the timidity of the Shiva animals only the fact that Shiva is the happy hunting ground for several kinds of hawks and probably the mammals have learned to fear anything that is moving.

Some of the chipmunks, however, were a little tamer. If one had the patience to sit quietly near the rim of the mesa soon the chipmunks would come out and go about their various ways. One of those ways was toward one variety of cactus which had a large red fruit. The chipmunks' cheek pouches were full of the hard seeds of this desert plant.

During the first day, McKee and I, troubled with thirst, had tried them. They are quite palatable, but are a tremendous amount of work to prepare,

removing the spines. One has to practically peel the entire fruit, which is about as large as a man's thumb. It was a lot of work for each mouthful of the red sweet pulp.

While we were completing the survey of Shiva the climbing party was organizing and preparing to climb Wotan's Throne, a detached mesa similar to Shiva. Wotan's Throne lies just off Cape Royal on the North Rim. We expected a much more difficult climb because the ridge which connects its base to the mainland is cut by several deep fissures too wide for man to cross. (See front cover. This picture and that on page 247 are official Park Service photographs.)

The climbing party reached the top of Wotan but it was away three days in accomplishing the task. Wood reported that they had met such difficulties over the cliffs that he believed it would be inadvisable to try to get water, provisions and collecting equipment onto Wotan by way of packers.

So when we came down from Shiva we decided that more was to be gained from coming back to the Museum immediately to check the work already finished rather than try an immediate ascent of Wotan's Throne.

Wotan's Throne should be and doubtless will be studied some day, whether by me or someone else makes no scientific difference. Such a study may well find that not only is Wotan's Throne different from the North and South Rims of the Grand Canyon, but that it is different from Shiva Temple as well.

Gained as a result of the expedition is the knowledge that there is one less blank spot on the scientific map of the world. Gained, too, are possibly some new varieties of mammals and some further idea of how much evolution has taken place during the 20,000 or so years that Shiva Temple has stood apart in lonely grandeur from the North Rim of the world's mightiest and most awe-inspiring hole—the eight-million year-old Grand Canyon of the Colorado River.

*Science News Letter, October 16, 1937*

Bulgaria plans to build 250 maternity hospitals during the next few years, in an effort to eliminate heavy mortality among newborn infants due to present lack of sanitary facilities.

Germany's compulsory health insurance system has a set-up including more clerks and officials than physicians.

A great, unbroken forest once covered Africa, so a bird specialist deduces from the distribution of birds there.

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