

# REGION THREE QUARTERLY



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New Mexico

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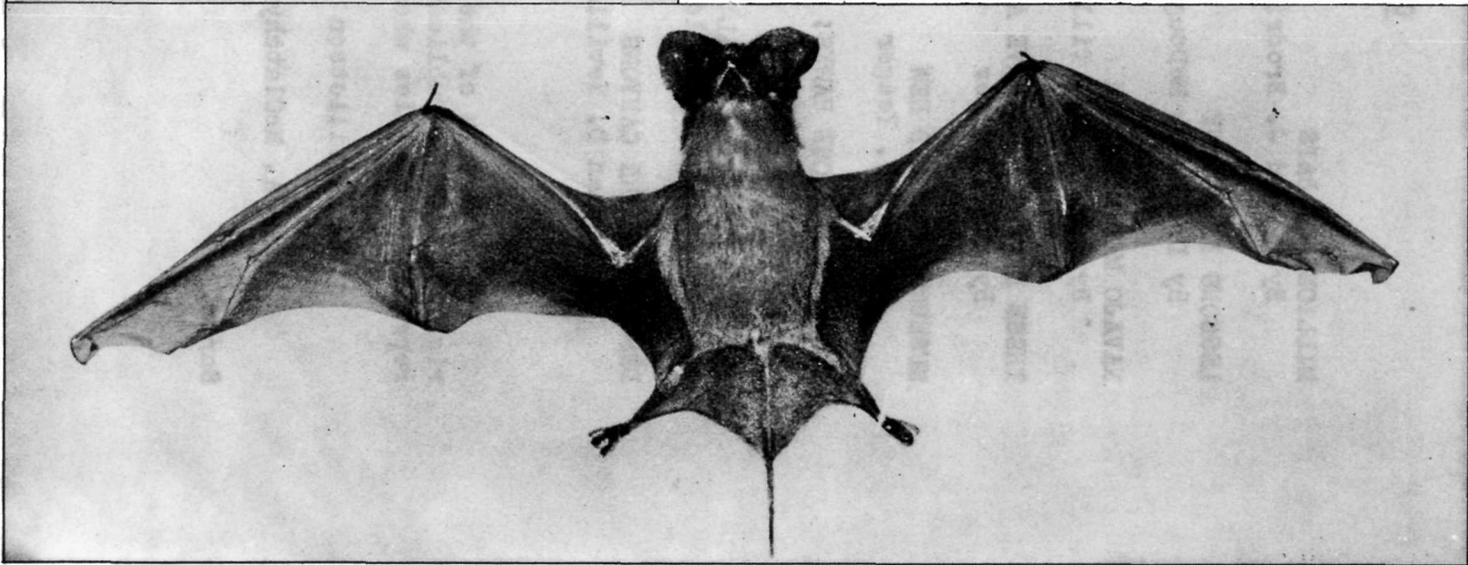
R E G I O N T H R E E

ARIZONA - ARKANSAS - NEW MEXICO - OKLAHOMA  
TEXAS - UTAH - AND SOUTHERN PARTS  
OF COLORADO AND NEVADA



Bats are mammals, not birds. They are clothed in fur instead of feathers, and they have a mysterious sense that enables them, in swift flight, to avoid obstacles they can't see. The photograph at the left is of a live specimen; below, a mounted specimen.

Kennicott Photos



## MILLIONS OF BATS

By Harold J. Brodrick,  
Assistant Chief Ranger,  
Carlsbad Caverns National Park.

Bats, mysterious little creatures of the darkness, have been associated through the ages, in art and story, with Satan and the infernal regions, and as emblems of evil and darkness. It is little wonder that they are still the basis of several erroneous superstitions. The mere mention of the name still makes some people shudder. These flying mammals are of a very old and highly specialized group. They were hanging upside down in caves long before the cave man came to join them, and they have special senses of which man still has little knowledge.

Bats are clothed in fur instead of feathers. Their arms and fingers are greatly elongated to sustain a thin leathery membrane used as a wing. The thumb is free, and is armed with a strong claw, enabling the bat to climb walls and to run upon a rough surface. In this case the wings are folded and are used rather awkwardly as front legs. The hind legs and tail are connected with this same membrane. The bat suspends itself when at rest, with its hind feet, and hangs head down.

Their eyes are small, the vision is apparently short in range, but a bat can see in daylight as well as in darkness. The old saying, "blind as a bat", probably arose from the fact that they habitually fly in dusk or darkness. I have frequently had a captive bat follow me with his eyes, as I moved about him, or moved my hand toward him. The bats depend upon a mysterious sense that enables them to avoid objects, and to capture food, without the need of sight. Recent experiments indicate that they utter high-pitched staccato squeaks - too high a frequency for the human ear to hear - and by the rebound of these sounds they are able to avoid, while in swift flight, objects which they are not able to see. The bat's many sharp-pointed teeth enable it to capture and crush insect food, which it must catch while on the wing. Bats drink by swooping low over the surface of a pond or stream, scooping up a mouthful of water at each dip, until satisfied.

Approximately 230 species of bats have been classified as inhabiting North America. All of them are insectivorous. The fruit-eating bats and fabled vampires are tropical forms. The bats feed on, and help control, the night flying insects, just as birds do the daylight species. They feed rapidly and consume great numbers of insects. It has been estimated that if they were able to secure a full meal they would consume half their weight of insects every 24 hours. So far as we know the insects which are eaten are mainly injurious, so the

economic advantage of a colony of bats is readily apparent. It has been estimated that the bat colony in an isolated cave in Carlsbad Caverns National Park, New Mexico, would consume several tons of insects in a night, based on the largest estimates for size of colony and the assumption that they all secured a full meal on the night's foray.

"Oh Ranger, am I too close?" "Will the bats get in my hair?" These are frequent questions from the feminine contingent of visitors as they are grouped around the entrance to Carlsbad Caverns, to watch the nightly bat flight. Well, there is nothing farther from a bat's habits or inclinations than to become entangled in a person's hair. No records are available here to show that this ever occurred. Bats will bite and fight viciously, if captured and held against their will, but if handled gently they are quiet and interesting little animals.

There are eighteen species of bats known in New Mexico. About twelve of these have been recognized in the vicinity of Carlsbad Caverns and the nearby canyons and caves. However, practically the entire colony that lives in the Carlsbad Caverns bat cave is the Mexican Free-tailed Bat (*Tadarida mexicana*). This is the famous guano producing bat of Mexico and southern United States. It roosts in enormous colonies, and gets its name from the fact that the tail projects nearly an inch beyond the attached membranes. They are rather small animals, with a wing spread of about  $9\frac{1}{2}$  inches. They are dark brown in color, have short close fur, short wide ears, and a strong musky odor.

The free-tailed bat, like most other North American species, has only one young a year, born in May or June. The infant is carried about by the mother, clinging to the underside of her body, even while the parent is in flight. This continues until the baby is strong enough to shift for itself. Rather remarkable is the fact that the young bat weighs, at birth, approximately one-quarter the weight of its mother. The adult weighs one-half ounce, or slightly over. The same comparative weight in humans would mean a baby weighing about 30 to 35 pounds at birth. Mating apparently takes place in the early fall, before hibernation, but the embryo does not develop until spring.

Nearly every little cave in the vicinity of Carlsbad has its own colony of bats. Some of the smaller colonies are of different species than the free-tailed bat. However, the Carlsbad Caverns have the largest opening and the largest passages, thus providing a home for the largest colonies. This species is naturally gregarious and congregates in larger numbers than most other kinds. The immense deposits of guano that were found in the bat cave end of the caverns indicated that this cave had been in use for centuries. Guano has been removed over the period of years since 1900, and well over 100,000 tons is said to have been mined. It has been shipped chiefly to the citrus regions of California. The market price originally was from \$60 to

\$90 a ton. The price now is a great deal lower though this particular supply is nearly exhausted. That portion of Carlsbad Caverns has been in private ownership since 1900. The public does not have access to that particular cave, and the bats are not seen by visitors to the caverns, except during the evening flights. Originally this colony was estimated to number from 3,000,000 to 5,000,000 individuals, at the time the first studies of the caverns were made. The size of the colony varies considerably from time to time, and during the past few years it has been much smaller, with the best flights estimated to be in the hundreds of thousands, rather than in the millions.

The caverns were first thought to be the winter home from which the bats spread to surrounding territory for the summer. Recent observations and reports by owners of the bat cave indicate that most of the colony migrates southward while a comparatively small number hibernate over winter. During hibernation their respiration and other functions are reduced to the lowest stage that will support life. They appear at such time to be lifeless, as they hang singly or in clusters from the cave ceiling. The body temperature becomes approximately that of the air. Occasionally after warm spells in the winter a few bats may stir around and appear in the caverns entrance in the evening, but they seldom fly far from the entrance.

The flights start in the late spring, gradually increase through June, reach their peak at intervals between late June and late August, then dwindle in the fall until they finally stop in late October. These flights fluctuate considerably throughout the summer. The controlling factor apparently is the available food supply, which in turn is governed by weather conditions. Observations over several years have shown that flights become smaller during continued hot, dry spells, and increase immediately after rainy periods. When their food supply is not adequate, due to adverse weather conditions, they fly off elsewhere for a short time.

The bats are strong and excellent fliers, and apparently range quite a distance on their nightly flights. Their first objective, as they fly from the caverns, is water, as they ordinarily fly in a long smoke-like column toward Black River, 6 miles from the caverns entrance. After satisfying their thirst they spread along the river valley and throughout the surrounding country. It is difficult to estimate how far they range, but the bulk of the colony probably feed over an area within a radius of 30 to 50 miles.

The nightly flights usually start from 30 to 40 minutes before dark, although frequently not until it is too dark to see them. These flights may be over in a few minutes or they may last for one or more hours, depending upon the season. Frequently the colony returns about daybreak, coming in from all directions and quite high above the entrance, where they circle a time or two, partially fold their wings,

and glide through the entrance at considerable speed. The velocity of their descent creates a vibration in their wings which, in a large inbound flight, sounds much like the murmur of a distant waterfall. This sound is frequently sufficient to waken the occupants of the government residential area nearby.

Bats fortunately have very few enemies. Their habit of flying at night, and spending the days in caves, crevices or old buildings, puts them out of reach of most predacious animals or birds. Horned owls have been seen swooping out into the bat column as it pours out of the caverns entrance. On some occasions they have been successful in capturing a bat. Occasionally the Ringtail or Cave Cat might be able to reach an accessible bat that is hanging too near a ledge. Wind has been known to cause bats to strike obstructions that ordinarily they are able to avoid. The bats may have an average life of about 10 years. Very few dead are found under areas where the bats usually roost. However, in remote passages and in half hidden corners considerable deposits of bat bones, skeletons and mummies have been found. Apparently, like the fabled elephants' graveyards, the older bats, weakening with age, or others that may feel death approaching, seek these remote passages in which to die.

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Inscription Rock, in El Morro National Monument, New Mexico, is the nation's largest autograph album. It is a one-page "book", over 200 feet high. No one has read the full page. Some of the signatures, symbols, and messages are so old that modern man has not been able to decipher them. Code experts have puzzled over them - and are still puzzled. Don Juan de Onate, founder of New Mexico, wrote a message in Spanish on Inscription Rock in 1604, two years before Jamestown, Virginia, was founded. Indian petroglyphs were placed there earlier. The last Spanish inscription is dated 1774, two years before the signing of the Declaration of Independence. The book has been closed to further writing, under a federal law which also provides penalties for persons who damage existing inscriptions.

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## LESSONS IN BOTANY

By Dr. W. B. McDougall,  
Regional Biologist.

(This is the first in a series of  
LESSONS IN BOTANY, by Dr. McDougall.)



The beauty of the surface of the earth depends very largely upon the plants that grow upon it. One can scarcely imagine what a drab and uninteresting place this world would be, without the trees, the shrubs, the grass, and the flowers. When we go on a hike or an automobile ride, the amount of pleasure that we derive from the outing is measured to a large extent by the character and luxuriance of the plant life that we encounter, and especially upon the numbers of wild flowers that we see. Since we derive so much enjoyment from plants, we like to have a speaking acquaintance with at least some of those that we come upon. There are so many different kinds that no one person can know all of them well enough to call them by name, but it is a simple matter to become acquainted with a few of the common ones in our immediate vicinity, and to increase our knowledge, on each of our outings.

The fundamental parts of a seed plant are roots, stems and leaves. Sometimes these parts may be so modified that they do not look much like roots, stems or leaves. In order that a seed plant may perpetuate itself through the production of seeds, it must produce flowers. But a flower is merely a modified stem bearing modified leaves. In a typical flower there are four sorts of modified leaves attached to the modified stem. The outermost set is made up of modified leaves called sepals. They are usually green, and look very much like little leaves. Collectively they make up what is called the calyx of the flower. Within the calyx is another set of modified leaves called the petals. These look like little leaves but they usually are not green. They may be white, red, yellow or blue, or almost any other color except green. The petals, collectively, make up the corolla of the flower.

In the third set of modified leaves, within the corolla, are the stamens. They do not look like leaves at all. Usually a stamen consists of a stalk, called the filament, on the upper end of which is a sac-like or box-like structure called the anther. Within the anther

are the little pollen grains which contain the male elements of the flower. Finally, in the center of the flower, we find one or more modified leaves called pistils. These, like the stamens, do not look like leaves. A pistil usually consists of three parts: an enlarged lower portion called the ovary, within which are found the ovules that contain the female elements of the flower, and that later may develop into seeds; a slender portion called the style; and a slightly enlarged upper end called the stigma.

Sepals, petals, stamens, and pistils, then, are the four kinds of floral parts that we need to know about in order to identify different kinds of flowers. Suppose, for example, that we were to look at a buttercup flower. It usually has five green sepals, five or more yellow petals, many stamens, and several pistils. Suppose we remove one of the sepals so as to leave only four; remove one of the petals so as to leave only four; remove all of the stamens except six, and shorten two of the six; and remove all of the pistils except one. We would then have left the correct materials for making a mustard flower. Again, suppose we were to take the same buttercup flower and leave the five sepals just as they are; leave five petals but fasten them together to make a tube-shaped corolla; take off all of the stamens except five and fasten these five to the corolla; and remove all of the pistils except one. We would then have a primrose flower.

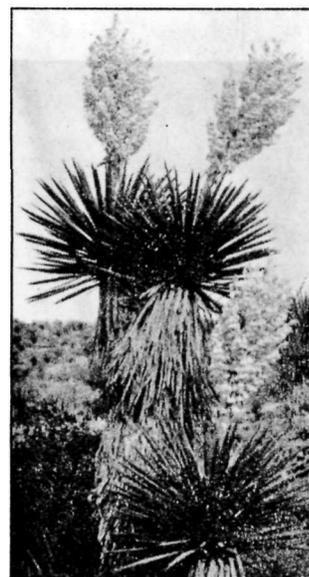
Thus we might continue, making all of the many different kinds of flowers without adding anything new, but by simply changing the number, size, shape, color, and arrangement of the four kinds of organs that we found in the buttercup. That is exactly what Nature has done. And that is why it is so important that we understand these four kinds of organs: the sepals, petals, stamens, and pistils.

Before a plant can produce seeds it is necessary that pollen grains be transferred from the anthers of the stamens to the stigmas of the pistils. This transfer is called pollination, and is a necessary prelude to fertilization which enables the ovules to develop into seeds. In the great majority of plants pollination is brought about through the agency of wind or insects. The wind will blow, whether flowers are attractive or not; but insects must be attracted if they are to perform their function. Therefore, beautiful flowers are simply devices to attract insects.

With the above brief introduction as a basis for beginning our study of flowers, suppose we start by learning something of the Yucca, often called Spanish Bayonet, because of the shape of the leaves. The Yucca is the state flower of New Mexico, but it is by no means limited to that state. When this story is published, in July, there will be one or more kinds of Yuccas blooming somewhere in more than half of the United States. These various kinds of Yuccas vary much in their general appearance and habit of growth, from the Spanish Bayonet of the east which has such a short stem that the cluster of leaves is

right at the ground; to the Giant Yucca of southwestern Texas, and the Joshua Tree of Arizona and California. Some of the latter are over 25 feet tall. Plants are classified, however, primarily on the basis of their flowers and fruits, and we find that the flowers of the various kinds of Yucca are all very similar.

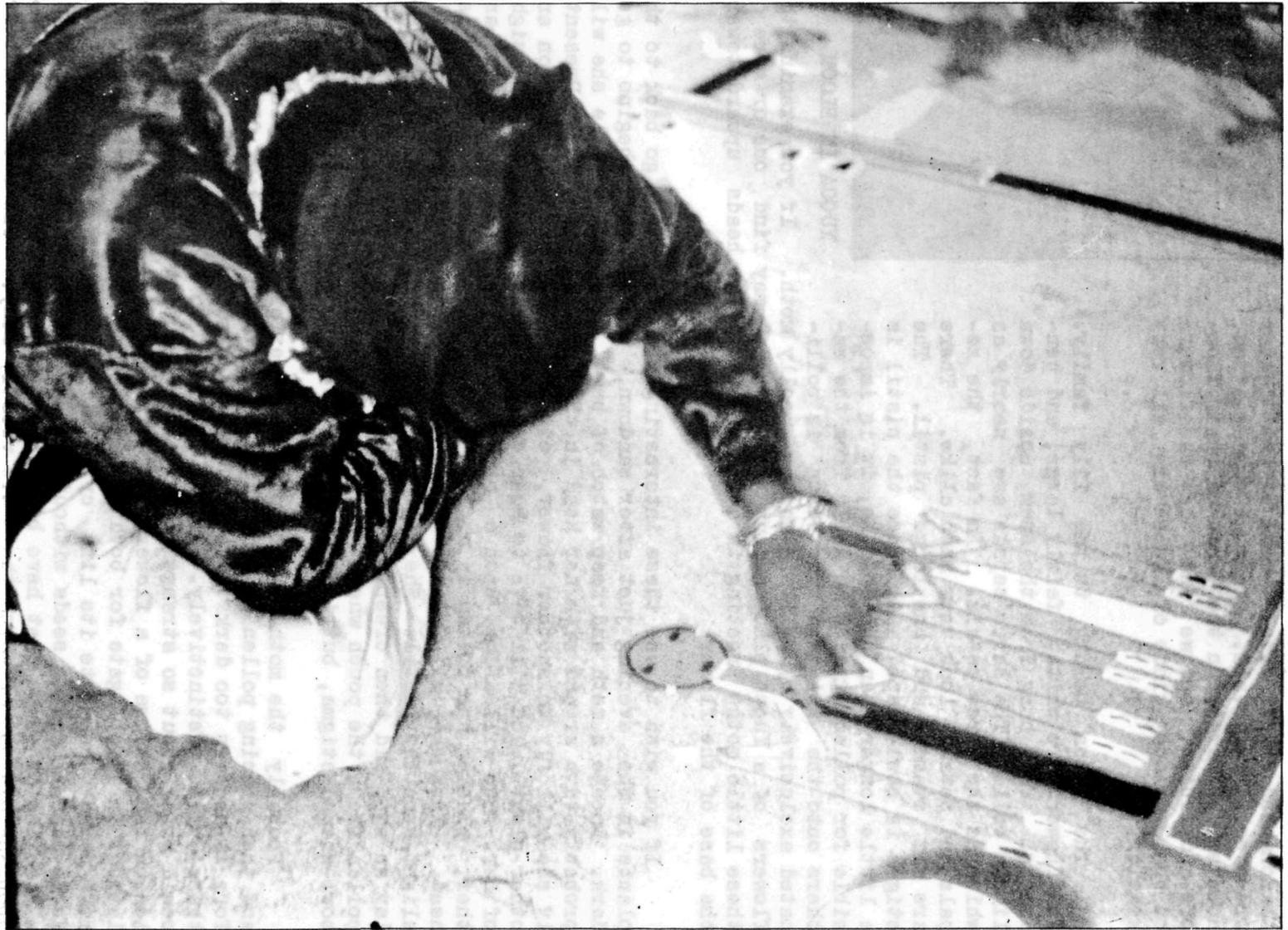
The Yucca belong to the lily family. The flowers are white, fairly large, and pendulous. They hang from the stem, upside down like a bell. The three sepals are nearly as white as the three petals. In fact, the sepals and petals look very much alike. There are six stamens and one large pistil. The stigma is bowl-shaped and, since the pistil is a little longer than the stamens, it is impossible for pollen grains to fall from the anthers onto the stigma. The Yucca is pollinated exclusively by a little white, woolly moth. If you examine the flowers of a Yucca plant during the day, you may find one or more of these little moths resting in a flower with their heads upward toward the base of the flower.



YUCCA IN BLOOM

If you wish to see these interesting insects work, go back to the plants in the evening just after sundown, but before it begins to get dark. Locate a moth and keep watch of her. In a little while she will probably turn around with her head in the opposite direction. Presently she will fly to another flower, either on the same plant or on another plant. You will have to keep close watch so as not to lose sight of her. She will alight upon a stamen and collect pollen from the anther, placing the pollen in a little pouch on the under side of her head. Then she will fly to another flower, but this time she will alight upon the pistil. She will pierce the ovary with her ovipositor, lay an egg, and then creep down to the end of the pistil, take a bit of pollen from the pouch where she has it stored, and stuff it into the bowl-shaped stigma, butting it with her head to make it stick.

Probably the moth will repeat this performance of laying an egg and then placing pollen on the stigma in several different flowers before it becomes too dark to watch her. The moth, of course, performs these duties instinctively. It is difficult to imagine how evolution could bring about so strange an instinct, causing a moth to place pollen on the stigma of a flower every time she lays an egg, but the relationship is obligate for both the plant and the insect; that is, the moth cannot complete its life cycle without the Yucca plant, and the Yucca cannot produce seeds without the help of the moth. When there is a hatching of eggs that have been laid in the ovary, the larvae feed upon the ovules, of which there are usually many. The ovules that are not eaten develop into seeds.



NAVAJO WORKING ON SAND PAINTING

## NAVAJO MEDICINE MEN

By Winifred S. Tillotson.

Little Natah-lee-has-pah was ill. Her big sister, Has-Pah, came running to me, tears rolling down her brown cheeks. "Oh, Mrs. Tillotson, my little sister is worse."

"Do you want me to go over?" I asked. "Yes, please", was the response. So we went to the near-by hogan, the home of Hosteen Tah-ya, the Navajo pesh-le-kai, or silversmith.

To those unfamiliar with the Navajo Indian my question might seem strange, since Has-pah's cry would surely be interpreted as an appeal for help. In the case of a white neighbor one would go immediately to the home of illness, asking no questions. But the Navajo is dignified and reticent. Furthermore, he has been subjected so frequently to the curiosity of the inquisitive tourist that he has wrapped his mantle of dignity and reticence even more closely about him, and he resents visitors entering his hogan, or home, uninvited.

Has-pah is my housemaid and very dear friend, and her family has also accepted me as a friend and adviser. Even so, knowing the Indians as I do, I never visit them without a special invitation.

When we entered the hogan the three months' old Natah-lee-has-pah lay on a mattress on the floor. She had a severe case of bronchitis, and she was whimpering. Her eyes rolled until nothing could be seen but the whites. She was breathing very heavily and coughing frequently. The mother sat on the floor. She had the most heartbroken expression I have ever seen. She had been sitting up with the child for three nights, and she was weary from anxiety and loss of sleep. In the hogan also were the father, the aunt and two older children, Kay-ah and Kadi-ash, aged 7 and 3 years, respectively. These brothers had bronchial colds.

A Navajo hogan is shaped like a large beehive. It is made of brush and logs thickly plastered with mud. The door always faces the east. The fire occupies the center of the one room, which is circular. The smoke floats around and finally drifts out of the large hole in the center of the roof.

In Tah-ya's home there were two blanket-covered mattresses on the dirt floor. There was also a cot and a bench. On the walls were boxes containing food supplies. A haunch of mutton hung from one of the posts. Near the fire were some cooking pans and a bucket. All the cooking is done over the open fire, and the meals are eaten from the cooking pans, the family sitting on the floor in a circle with the food in the center.

While Tah-ya was telling me how sick his baby was - his older daughter, Has-pah, interpreting- the mother sat motionless, never taking her eyes from little Natah-lee-has-pah. Presently there came a knock at the door, and the white doctor was admitted. He had been attending the baby for several days, and seemingly the child was no better. On this visit he tried to tell the worried mother that in time the baby would get well. He had brought some medicine which he gave to Has-pah, with directions for caring for the child. While Has-pah and I were carrying out the doctor's orders the father paced the floor. He stopped finally beside the baby and uttered a few guttural Navajo words. He then turned and abruptly left the hogan. Has-pah looked at me somberly and said, "He has gone for the Navajo medicine men. He thinks my little sister will die unless the medicine men come to save her."

The father, fear and hope his companions, hastened out upon the Painted Desert, that weird colorful land of painted steppes. Meanwhile in the hogan we watched, and tried to ease the little sufferer. The nearly exhausted mother was finally persuaded to rest.

Just before sundown Tah-ya arrived with two medicine men, one an old man; the other, much younger. He had traveled miles over the sandy wastes and had arrived at the camp of the medicine men just as they were ready to move in search of fresh pasture for their sheep. The Navajo is a nomad, and he roams over his large reservation seeking the best feed for his flocks of sheep and goats.

At the sound of their arrival the mother roused, and she and Has-pah quickly turned over one of the mattresses. I couldn't see how any improvement was made by turning over a mattress already lying on a dirt floor. Yet that was the preparation for the coming of the sha-men. The medicine men entered the hogan and squatted cross-legged on the freshly turned mattress. There was not a word of greeting; only stoical silence. Nor was there a glance at the sick child. Sensing that I was considered an intruder, and that they would not begin their ceremonies in the presence of a white stranger, I slipped away.

Has-pah later told me that the younger of the two medicine men was the one who could tell what was the matter with the sick child; he was the diagnostician. The Navajo believes that when a person is stricken with illness he is possessed by an evil spirit, and will not become well until that evil spirit is driven out. Has-pah told me that, according to the younger medicine man, her little sister's illness was caused by the mother's attendance at a sand painting ceremony two or three months before the child was born. The mother had attended that ceremony alone. Had her husband been with her no ill effects would have resulted. This explanation was accepted by the family.

That night the sha-men had a "sing" over Natah-lee-has-pah. Sitting by my own fireside, far into the night, I could hear the beating of the tom-toms, and fragments of the weird chant in the neighboring hogan. Shortly after sunrise Has-pah knocked at my bedroom door to inform me that as a special favor, and because I was a particular friend of the family, the sha-men had consented to allow me to witness the making of the ceremonial sand painting. Knowing the Navajo beliefs and the reverence with which this religious ceremony is regarded; and knowing also that few members of the white race are so favored, I realized that this was indeed an expression of friendship and trust.

The door of the hogan was closed. Has-pah tapped lightly, and the child, Kay-ah, let us in. The mother, in her picturesque garb of velvetreen blouse, full calico skirt, buckskin moccasins and strings of turquoise and silver, sat on the floor as usual. Now, however, she was holding little Natah-lee-has-pah in her arms. There seemed no change in the condition of the patient, but the mother had lost her look of hopelessness, and her expression seemed to say, "all will be well now." The two medicine men and the father were kneeling on the floor. In front of them was a large rectangle of dry sand, about 3 feet wide, 5 feet long, and 3 inches deep. This had been smoothed by the broad battens that the mother used in weaving. At the sides of the sand oblong were little piles of colored sands, white, yellow, red, black, and a bluish grey. These pigments represent the five sacred colors of Navajo mythology. The white, yellow and red were of finely powdered sandstone; the black, of powdered charcoal mixed with sandstone; and the blue-grey, of black and white mixed.

The younger medicine man and the father were making the sand painting. The older sha-man seemed to be directing the work. They would pick up a small quantity of sand between their first and second fingers and thumb, and allow it to flow slowly as they moved their hands. As each took up his pinch of powder, he blew on his fingers to prevent adhering particles from falling on the painting. Tah-ya, the father, looked up at me, and I seemed to see a twinkle in his eye. He spoke in Navajo to Has-pah who laughed and, turning to me, said, "My father wants to know if Mrs. Tillotson thinks he is eating the sand." The Navajo is reserved and dignified, but upon acquaintance he is often gay and even humorous.

They began their drawing near the center. They drew two gods, first the bodies, then the clothes. When they made a mistake they did not brush away the colored powder, but obliterated it by pouring white sand upon it, then making the design anew. At the bottom of the painting there was a black border which they told me represented their sacred home of the gods, Navajo Mountain. The two gods, male and female, were represented as standing on this mountain. The zig-zag lines bordering the two sides and extending across the bottom above the black border represented lightning.

This explanation was given to me: Long ago before human beings were created, the gods roamed over the earth, living where we now live. Later when we were created the gods retired to Navajo Mountain, where they now reside. From this mountain they watch over us and guard us from danger, and when the evil spirits take possession of our bodies and minds, if we show the gods that we need their help, and pray to them, they drive out the evil spirits and make us whole again. Navajo Mountain is therefore the Navajo Mt. Olympus, the home of the gods. To all Navajos disease means the presence of an evil spirit. Practically all their religious ceremonies are for healing the sick.

The drawing and coloring was done by spreading handfuls of colored sands, and outlining the figures with delicate lines. Many helpers are needed on an important subject, since it must be started after sunrise and completed and destroyed before sunset. This art, symbolical rather than pictorial, has been handed down from one generation of medicine men to another. No material record is kept of the paintings or chants, the memory of the sha-men being the sole medium of perpetuation.

The sand painting made in Tah-ya's hogan was a small one and was completed in about two hours. Then the mother with the sick babe in her arms was seated in the center of the sand painting. The two medicine men, with rattles made of brilliantly painted gourds, danced around her, chanting. The chant was a prayer to the gods that the evil spirit be driven out and the sick child healed. They kept up the chant for two hours. Then, gathering the sands of the painting in a blanket, they carried them to the door of the hogan and scattered them to the four winds.

Thus was completed the ceremonial which in the minds of Tah-ya and his family saved the baby. Natah-lee-has-pah improved immediately. Her eyes cleared, her cough disappeared, and in a very few days she was a smiling happy baby. Today she is the picture of health, bright shining eyes, fat rosy cheeks, and sturdy body. Whether she would have recovered without the aid of the sha-men no one can tell. But her father and mother know that it was only through the medicine men with their sand painting, chants, and prayers that their baby was saved.

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## THESE LITTLE PIGS HAVE A WAY

By M. V. Walker,  
Associate Park Naturalist,  
Crater Lake National Park.

The peccary, a species of wild pig, is only a little fellow, but he can defend himself against all comers by polluting the air with such an offensive odor of musk that other animals will clear out in a hurry. He can, at will, launch such a terribly nauseating attack that only he and his kind can withstand it. The barrage not only is olfactorily devastating; it produces effects similar to those resulting from the modern tear-gas bomb. It all comes from the secretion in a musk gland in the animal's back - a combined defense-offense mechanism that enables him to conquer and hold territory without even fighting for it. His mere presence, or the scent of his nearness, often causes other animals to flee.

This little piggie, also known as the javelina, or musk hog, was the only species of pig in North America, when white men first came to this continent. Fossil bones reveal his presence in this country for many millions of years. His kind is comparatively scarce now, due to man's hunting. He is confined mainly to isolated regions in Texas, New Mexico, and Arizona, including the Organ Pipe Cactus, Tonto, and Saguaro National Monuments, in Arizona; and the proposed Big Bend National Park, in Texas. He is protected in those areas. There is only the single species in this country, the collared peccary. Other forms are found in Mexico and Central America.

The musk gland is situated mid-dorsally, slightly above and forward of the tail. Its stifling discharge is the animal's first line



of defense, for the musk discourages attack while the little pig is making a dash for the shelter and safety of a dense thicket or a hollow log. Should the pursuer be so ravenously hungry that burning eyes and choking throat are not enough to persuade him to give up the chase, he may overtake the fleeing pig, bring him down, and after a desperate struggle, claim the victim for his own. The conqueror has not reckoned too well, however, for the flesh of the pig has now been made so fetid by the excessive discharge of musk that the killer can stomach only a few bites. Then he slinks away through the brush in the general direction of a pond of water.

If the peccary has escaped, he may dodge into a dense thicket that is infested with flies and mosquitoes. His first impulse would be to switch the small tail and drive the pests away. But the movement of that flipping tail might attract attention, and lead an enemy to the hiding place. So the pig keeps his tail very quiet, and discharges more musk, as an insect repellent. Thus the flies and mosquitoes are driven away, yet the pig has made no movement to attract the enemy. The use of musk, down through the years, resulted in less use of the tail. Disuse led to retarded growth and finally atrophy, and so the peccary now has only the remnant of a tail.

The peccaries are sociable only to the extent that they prefer to be with others of their kind. They know, too, that there is power in numbers, so they usually travel in bands, for the common good of the herd. They have a leader in their excursions through the brush; also a watchman, when they retire to a wallow or shelter. The band will scatter, to lose an enemy, but the individuals are adept at reassembling. The jungle is too thick to see through; a call or a squeal would attract enemies, so the peccary again resorts to that musk gland for guidance. He sniffs the wind, searching for that characteristic odor, and at the same time rubs gently against the brush along the trail, leaving a signal that he has passed that way. With all members of the band cooperating, it is not long until family and friends are reunited.

We have been calling the peccary a pig; he does belong to that group of mammals, but he is quite different from his European cousin. If we look at his head we see a very definite pig-like resemblance, but we note one thing that is different from the domesticated hog or even his European wild ancestor. The European wild boar developed an efficient fighting weapon when he managed to get his big upper canine teeth to grow out and up, instead of down. With these tusks he fought his enemies. In the peccary the canine teeth grow down instead of turning up, and are probably far less efficient as fighting tools. The teeth of the peccary are interesting, however, for they tell us that he could never make up his mind what he wanted to eat. His teeth are in no way specialized for any type of food. He can eat roots, plants, berries, acorns, carrion, or flesh, pretty much as the notion strikes him.

The peccary has a slightly complex stomach. There must have been a time long ago when he decided that his food was to be largely bulky and fibrous plant material; that he would have to spend so much time gathering it that he would not have time to chew it on the "spot", but would gather it, store it, and then chew it at his leisure, a characteristic which we find among the ruminants. In other words the peccary had all good intentions of becoming a "cud-chewing pig", but apparently he was not quite persistent enough, for although the stomach is somewhat partitioned off and complex, the idea was not carried out to completion.

Now let us return to external characteristics. If we look at his feet and toes we see that here was another situation that had his mind in a whirl. He was so perplexed by this problem that he chose differently fore and aft, for there are four toes on his front feet but only three for his hind feet. There is little doubt but that his early ancestors had the original five digits, and that those ancestors had all intentions of becoming and remaining even-toed ungulates. Just what quirk of nature caused them to discard one on each hind foot is another one of the interesting facts in the story of this little pig.

North America is often referred to as the cradle of mammalian development, and it seems that the peccaries also got their start here in the new world. The first forms we know anything about were small, probably not much larger than a small dog. This primitive peccary lived in competition with the 5-toed horse, the primitive rhinoceros, and the huge carrion-eater of the early Eocene. Their fossil bones are found associated in the badlands (Eocene) in Wyoming and northern Utah. Next, the peccary lived in competition with the 3-toed horse, the small active camel, the primitive dog, and early sabre-toothed cat of the Oligocene. Their bones are found associated with such forms in the Oligocene badlands of Nebraska, Wyoming, and South Dakota.

One can imagine the early sabre-toothed cats chasing the early pigs, but having to give up the chase when overcome with the stifling musk. Down through the Miocene, Pliocene, and Pleistocene the peccary in turn competed with the rhinoceros, camel, dog, sabre-toothed cat, elephant, and other like forms. When we get to the most recent time, the very present, we find that only the peccary remains of this vast assemblage of varied mammalian forms.

We are struck with the fact that our little native wild pig has come down through the ages and survived, while most of his competitors have fallen by the wayside. Mother Nature certainly did quite well with her problem child, but the road was not easy nor were the problems solved without a struggle. Today, however, our little wild pig is facing his greatest struggle. The most baffling competitor of all time has put in his appearance. That competitor is man. Mother Nature

works too slowly to compete with man, so unless something is done very quickly, the little pig will soon cease to exist, except in the Texas Big Bend and the National Park Service areas, where he is protected.

If man killed solely for the purpose of securing food, perhaps that dorsal musk gland would solve the problem. If the flesh was of no value for food, there would be less desire for the kill, but many men kill wantonly. Man also kills quickly, and some have learned to remove the gland immediately after the kill to prevent the flesh from becoming undesirable as food. Man also has introduced other forms of animal life which are actively competing for food, and as a result, the little native wild pig is forced to retreat to the most inaccessible places. According to a recent wildlife survey there still exists in Arizona some 14,000 individuals but these are scattered in five small isolated regions. One area in New Mexico contains some 400 of these animals. Texas has the largest number, some 35,000 individuals divided between two areas.

In food and range habits the existing peccaries are quite adaptable, being found not only in some marshy swamp thickets of Texas but also in the rocky and cavernous canyons of New Mexico, and in the dense cactus and chaparral of southern Arizona. In the matter of young they differ from other members of the pig family for they produce but two, sometimes only one, each year.

Many are the stories about the fighting abilities of these little pigs. Perhaps in the early days of the white man in this country, and before the peccaries had been so reduced in numbers, a large band might have turned upon a suspected enemy and either "ripped him to pieces" or forced him up a tree. But with the advent of the gun, even these little wild pigs were intelligent enough to associate the crack of the rifle and the impact of the bullet. As a result they have become more shy and retreating. Their size surely would not make them a very formidable enemy, for they range from 35 to 40 inches in length, and do not weigh more than 40 to 60 pounds.

Mother Nature did quite well by her little pig. Her experiments on his anatomy, in stomach, teeth, tail, toes, and musk gland, were all valiant attempts to maintain his race. In this matter we have no such powers. We can not get him to grow a bullet-proof armor, to change his color so as to be less conspicuous, to take a new trail each time he forages through the brush, or to become solitary instead of social. Our problem is to make every effort to eliminate those factors which are rapidly putting these little pigs in the class of vanishing first Americans.

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## MUSEUMS, OLD AND NEW

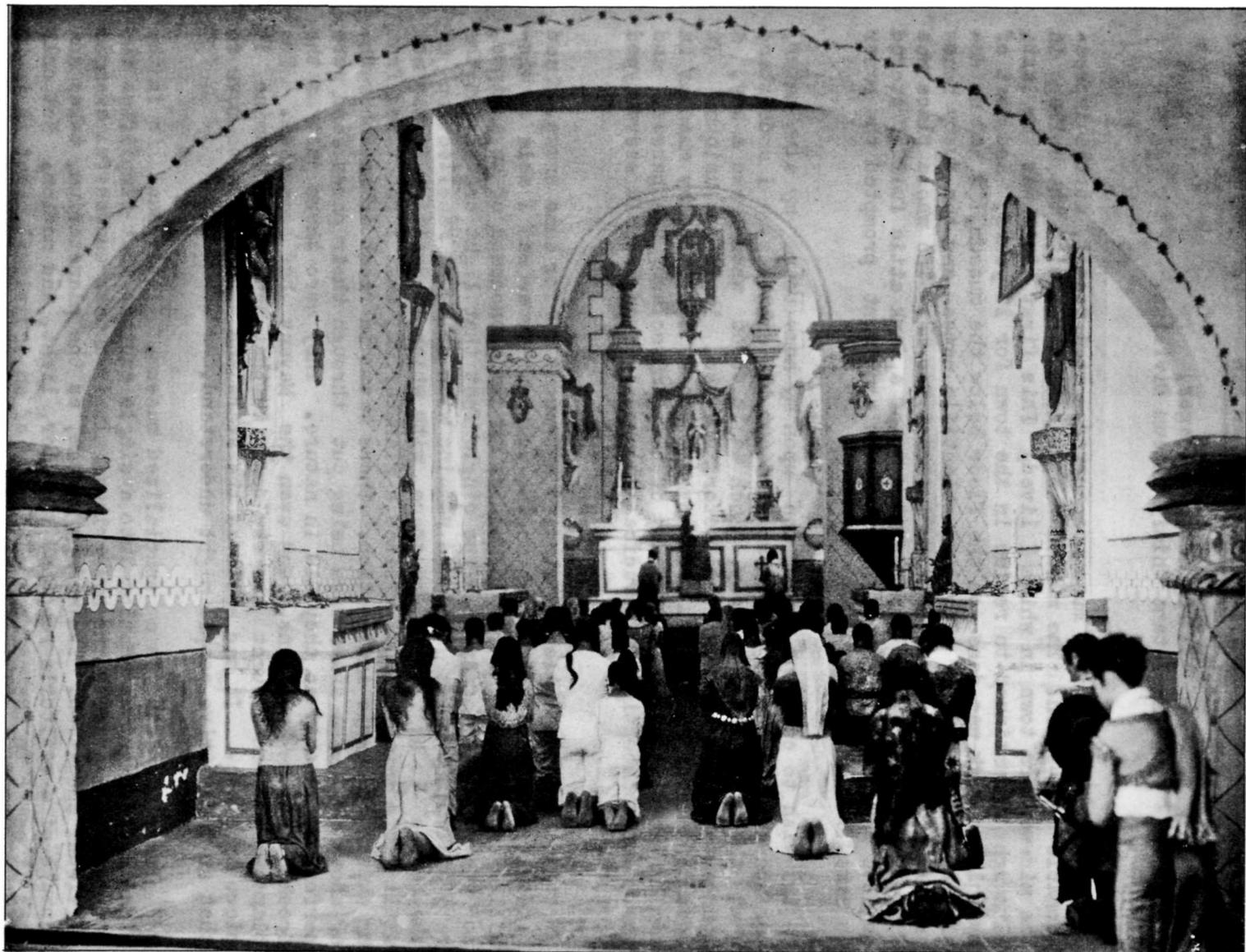
By Dorr G. Yeager,  
Assistant Chief, Museum Division.

My first visit to a museum occurred, as I recall, at the impressionable age of ten. The museum was in connection with the college in the mid-western town in which I lived. This first visit was the last. Although I continued to reside in the town for 15 years, and most of my college work was done on the floor below the museum, I had no desire to see it again. The long scientific names and the dusty bones and the moth-eaten birds held no interest for me. The whole place was dingy and ill-lighted, and reminded me of a dark attic full of stored objects which were of no use, but which sentiment prompted the owner to save.

I wish to cast no reflection upon my home town, my alma mater, nor upon the good man who first laid out the exhibits. I understand that the museum stands today, much as it stood when I was a boy, a monument to one who was a collector. If so, it is not unique. It does not differ radically from so many other contemporary museums in similar localities. But the day of the "museoleum" has passed, and the modern conception is a radical departure from the old stereotyped product.

In that same college I studied astronomy and for some unexplained reason, received a "B" credit in the course. Never was I able to visualize the movement of stellar bodies nor the phenomenon of an eclipse, nor the magnitude of space. The single fact that light travels at the rate of 186,000 miles a second remains with me. My recollection of the course is as void as the space with which it dealt. It was not until years later, when I visited a planetarium, that I recovered from my attack of cosmic indigestion. There it was in front of me, or rather above me. The stars were being put through their paces and were performing exactly as they did in nature. They were there just as the Greeks and the Egyptians, and even the Mayans had seen them. The planetarium had brought the sky down so that man could examine it piece by piece. It had enslaved the stars and forced them to move so that an inquisitive people might understand.

The planetarium is a specialized museum. Its appeal is in the blending of light and motion into a single exhibit that simplifies the complex and clarifies the mysterious. It is a most successful example of visual education. The modern museum, as the planetarium, takes advantage of a visitor's response to color, light, and motion. Not only does it cater to the natural curiosity of an individual, but it is in



**DIORAMA OF THE MASS  
TUMACACORI NATIONAL MONUMENT, ARIZONA**

itself the result of painstaking psychological study. Will the visitor be attracted to this or that; will he go here or there; which label will he read first? These and a hundred other questions must be answered by museum technicians if the displays are to function properly. The modern museum beats the visitor to the "punch" at every turn. It directs him through the rooms in a preconceived and carefully planned manner by the subtle use of light, color, and motion. Even in the matter of labels, his thoughts must be anticipated and his questions answered before he asks them. This is the museum functioning at its greatest efficiency.

Prior to 1934, the national parks' museum program had received scant financial support, with the exception of the Yosemite and Yellowstone projects which were sponsored by the Laura Spellman Rockefeller Memorial. Most of the museums were the result of the initiative and perseverance of park naturalists or a few interested superintendents. Usually, the exhibits were home-made, and the buildings were structures which had been outgrown or discarded by some department in the area.

The picture has changed since 1934. Through emergency projects and funds, the program has made rapid strides during those 7 years. So active and important has this work become that the Museum Division was established in the Branch of Research and Education to care for the increasing needs along museum lines. Not only have new museums been built and old exhibits augmented, but what is even more important, a fuller understanding of museum possibilities and needs has been recognized among national park administrators. More and more park superintendents are realizing that a museum is a vital adjunct to the interpretive program--the hub around which all such activities radiate. The Santa Fe Conference of Superintendents recommended that "the importance of park museums in presenting the results of research, aiding in interpretation, and providing laboratory and library facilities be recognized", and the last Washington Conference again recommended that "the paramount importance of museums to preserve and interpret, through material objects, be stressed." These recommendations and the friendly rivalry which exists between certain areas over the effectiveness of their museums are most encouraging.

Few sections are more museum conscious than the Southwest. Most of the Southwestern National Monuments staff are interpreters, and rightly so. No areas within the National Park Service lend themselves better to interpretation. It seems to me that here there is a minimum of recreational activity, in the sense that recreation is organized play. There are admittedly exceptions, but in most of these areas, the visitors come not to dance or ski, to fish or to relax in scenic beauty. Primarily, they come through an interest or a curiosity in history, in archaeology or natural phenomena.

It is significant, therefore, that so many museums both large and small are located in these parks and monuments scattered over the Southwest. The museum plays a vital part in the interpretive work. One cannot imagine Casa Grande, or Tumacacori, in Arizona; White Sands, or Bandelier, in New Mexico; or Mesa Verde, Colorado, without their museums, now that they are established and functioning. Before there were museums in those areas, the work of interpretation must not only have been difficult, but somewhat superficial as well. Personal contact with a guide who conducts a group through a ruin is excellent, but it is not enough. He cannot hope to impart the information which can be obtained in a museum within the limited time at his disposal. No matter how interested or how hard he tries, a guide must in time give a "canned" recitation. Few, if any, can sparkle with originality after giving the same talk a thousand times. A museum, on the other hand, continues to serve its visitors day after day, and the exhibits, if adequate, do not cease to sparkle, no matter how many persons use them.

When one enters such museums as those in Mesa Verde or Tumacacori, he cannot fail to sense the difference between these and the "museum." There is a predominance of harmonious color, there is light, and there is animation. In Tumacacori National Monument, an outstanding example of modern museum practise is a diorama depicting the interior of that old mission during mass. Candles flicker realistically on the altars, sunshine streams through the miniature windows, and a background chant of choir music makes the picture live. Is it effective? Were it not, Mexicans would not drop to their knees and cross themselves, upon viewing it for the first time.

Two other dioramas, "Father Kino on the Trail", and "The Attack on Tubutama", find a place in the Tumacacori Museum, and are the subject of much comment. Eventually, three more will be installed--"The Expulsion of the Jesuits", "The Departure of Anza from Tubac", and "The Storming of Hauikaua." When these are completed, the museum in this monument will strengthen even more its claim of being one of the outstanding in the Southwest.

The White Sands National Monument Museum is another of the more recent acquisitions. Although smaller than Tumacacori, the two rooms of exhibits tell a graphic story not only of the sands, but of the intriguing local history. With the installation of an adequate light plant, these exhibits will become better and better known, for nowhere in the world can a more detailed story of sand dunes be found. Here too, animation plays its part in making the exhibit a success. Case No. 3, "Nature Mines and Refines Gypsum", illustrates the action by which dunes are formed. Moving shadows are thrown upon a ground glass

in such a manner as to give the illusion of sand being blown by wind to build up the great white hills.

One of the older of our Southwestern museums, the Yavapai Observation Station in Grand Canyon National Park, Arizona, plays a highly important part in the interpretive program at that point. Situated on the very brink of the canyon, it is so designed that it indicates to the visitor the various key points within the canyon - points which are chapter headings in the book of geology that is the canyon. These important features are brought to the visitor by means of powerful telescopes mounted on the parapet. The view as seen through these telescopes is duplicated by colored transparencies, adequately labeled, so that the visitor with a desire to learn can leave the museum with a clear picture of how the Colorado River cut through the sedimentary deposits like a great file, to form the world-famous gorge.

Mesa Verde National Park, Colorado, claims the oldest and the largest, and in many ways the best museum in the National Park Service. The pioneering here is to be credited to Senior Archaeologist Jesse L. Nusbaum. Its high spot is the series of dioramas, some made in our Western Museum Laboratories, and some made in the park, dealing with the cliff dwellers of Mesa Verde. These dioramas are acknowledged to be among the best in the United States. The exhibits of archaeology and ethnology are housed in good metal and plate glass cases, situated in large, well-lighted rooms. The whole atmosphere of the museum is expansive, and one has the feeling of not being crowded.

The Museum Division is on the alert for new methods of presentation. Some are initiated in the National Park Service laboratories, and others are borrowed from recent developments in museums over the country. Some of the first exhibits executed by the Museum Division were admittedly flat in design. Pictures, photographs, and maps were mounted on the monkscloth background of the case. An advancement in our technique came with the introduction of the display panel, which was shoved into a case and constituted the background. This came about more or less through necessity. Many areas already had museum cases, purchased from a manufacturer, which were designed wholly for the display of specimens. Some satisfactory means of displaying flatwork as well as three-dimensional objects were needed, and this panel answered admirably since it gave a wider latitude to methods of presentation. The type now being used evolved from the flat panel background; that is, a background whose flat expanse is broken by shelves, pedestals, and sloping surfaces. With the construction of many of our own museum cases, we are able to design the background panel and the case together, which is a happy solution and permits a more natural use of three-dimensional objects with the art work, as well as relieving the flat appearance of the exhibit.

As far as is known, the use of plastics in casting letters for museum case titles was first done by the Museum Division. Heretofore, painted plaster letters were employed, but the use of plastics gives a letter which is unbreakable, and is water and even acid-proof.

In the White Sands Museum, we were faced with the problem of telling two stories which would have taken considerable space or lengthy labels. These were the life story of Billy the Kid, and the fight between Indians and United States troops in Dog Canyon. Here a tip was taken from the popularity of the comic sheets in the newspapers. The stories were successfully told by a series of small, intimate sketches of incidents, following one after the other in chronological sequence.

Many visitors have expressed curiosity over the flickering candles in the mass diorama in Tumacacori, and the simulated movement of sand in White Sands. "How is it done?" they ask. The basis is the same principle as that employed in ornamental table lamps showing forest fires, ocean movement, etc. Heat rising from an ordinary electric lamp turns a delicately balanced cylinder in the same manner as wind turns the blades of a windmill. In the case of the candles, the flickering light travels up a lucite rod whose end is tapered and painted to represent a candle. In the case of the moving sand, intricate motting on the celluloid cylinder casts the desired shadow effects.

There are many creditable exhibits in National Park Service areas scattered through the great Southwest; more exhibits than in any of the other western regions. Many of these will stand as an everlasting monument to the foresight of the late Frank Pinkley, Superintendent of Southwestern National Monuments. He was a master at the art of public contact, and he knew the value of visual objects and graphic devices in putting across a story. If money was available, he used it; and museums like White Sands, Bandelier, Casa Grande, Aztec, and Tumacacori were the result. If money could not be had, a display of pots on wooden shelves was substituted for an elaborate exhibit.

The museum program of the National Park Service is in its infancy. Year after year sees our horizons widen and our possibilities increase. The museum work will go steadily forward - slowly at times, more rapidly at others, according to appropriations. Ours is the world's outstanding system of parks, and in these parks some day we may have the most outstanding museum system ever known.

## DON'T KILL THOSE HAWKS!

By Earl Jackson,  
Custodian,  
Montezuma Castle National Monument.

Scientists have demonstrated conclusively, with studies made over many years, that preservation of our hawk population as a whole is a strong economic need; and that indiscriminate slaughter of these birds is a nice figurative way of slitting our own throats. A national asset which has suffered terrible misuse through gross ignorance, is



HAWK WITH WEASEL

worth knowing about. Hawks, like humans, include good, "ornery", and just plain indifferent specimens. Broadly speaking, hawks are any members of the order of birds which ornithologists call Falconiformes, or the diurnal birds of prey. This includes, as of check lists of 1931, about 290 species, and many sub-species, distributed over the entire land area of the earth except the extremes of the polar regions and a few isolated oceanic islands. The American Ornithologists' Union in 1931 listed thirty-seven living species and one extinct species (the Guadalupe Caracara) in North America north of Mexico, including Lower California. Some of these are divided into numerous sub-species, but for general purposes we don't need to worry about them. Moreover, we don't have to memorize thirty-seven different bird types, either, as will appear presently.

This sizable grouping of feathered flyers includes such regal characters as the Bald Eagle, our national bird; and such plebian souls as the Turkey and Black Vultures; also the Falcons, the Buteos, or Buzzard Hawks; the Kites, and the true Hawks, or Accipiters. If you like superlatives, it can be said that this order includes the Duck Hawk, or Peregrine Falcon, the fastest of all birds; the vulture, the finest gliders in the bird world; and the California Condor, the largest North American land bird, which is also the largest bird on earth capable of soaring flight. He is probably equalled in size by the South American Condor.

The role of the Falconiformes in our biotic scheme has been so completely misunderstood by farmers, hunters and sportsmen that most species have suffered complete and relentless persecution. The result is that as a group these birds are progressively diminishing in numbers, with some varieties on the verge of extinction. Ironically enough, the beneficial species suffer more from man's misguided zeal than the few highly destructive ones. To figure out in brief fashion who the problem children of the Hawk world are, we have to do a bit of sifting and sorting. We can readily eliminate the vultures. There are only three kinds in the United States, the Turkey Vulture, the Black Vulture, and the California Condor. The first two are so well known and are so universally recognized as completely harmless and very beneficial scavengers, that they are protected by law in most states, and are effectively holding their own. They simply are not adapted to the capture of live prey, for their talons are dull and only slightly curved, and the feet are clumsily formed. Their feet leave tracks of ground walking birds, rather than clutching birds.

The California Condor is not so fortunate as his near relatives. While his principal food is carrion, he occasionally captures living prey, and has been accused by shepherds of killing young lambs and even sickly sheep. John B. Mays points out in his "Hawks of North America" that the reports are probably exaggerated, and that sickly sheep seldom survive on the open range, so that their destruction and conversion into food for vultures may eliminate them as sources of contagion for other sheep. At any rate the bird is so rare today that he is not an economic factor. Some observers estimate that not over a couple of dozen are left. One reason for their phenomenal decline, years ago, was the use by cattle and sheep men of poison for predator control. The poisoned flesh of the dead animals meant death to the scavengers as well.

The Kites, of which there are four kinds in the United States, are among the most beautiful birds in North America, and their morals are above reproach. Birds are practically unknown in their diet. The White-tailed Kite eats great numbers of small rodents and insects; the Swallow-tailed Kite is an enthusiastic consumer of insects, small snakes, and lizards; and the Mississippi Kite, while too rare to be of economic consequence, eats similarly on insects, lizards, snakes, and frogs. The Everglade Kite is a peculiar epicure who apparently feeds entirely on a single variety of large snail, which seems of no harm or value to mankind. All of the Kites are in danger of extermination, and should be rigidly protected.

The Marsh Hawk, the only North American Harrier, stands near the dividing line between virtue and iniquity. He certainly eats birds, but he also eats a lot of harmful rodents. He prefers to do his

hunting over marshes and swampy areas, and is harmful or moderately beneficial according to locality and available food supply. Experts agree that in general he is worth protecting, except in individual cases where he shows a weakness for the poultry yard population or the game birds.

The American Osprey, or Fish Hawk, is a highly specialized fish-eater. He is a long legged fellow, for a hawk, with large strong toes to hold his slippery prey, and a reversible outer toe so that when he holds a fish the talons are paired for the best possible grip. Most of the fish he eats are of little commercial or sporting value, although at times he is a bit of a problem around fish rearing ponds, and in such cases he may require control measures. In general, he is definitely deserving of protection.

Ordinarily when an ardent fisherman encounters a fish-eating bird he conjures up wrathful pictures of all the fine trout, bass, and other game fish the feathered Walton is taking. Actually, it is a rare day when a fishing bird makes a noticeable inroad on desirable fish. Put yourself in the bird's place. Lacking man's highly discriminatory taste, if you found your fishing grounds abounding in carp, suckers, and other slow-moving, sluggish fish, would you run yourself ragged trying to catch the more elusive gamesters? Fish-eating birds really do the sportsman a service, for they catch mostly the slower, weaker, or sickly fish. Such selective elimination of unfit specimens leaves a healthier average breeding stock, thus working toward a sturdier breed of game.

The Caracaras, while anatomically similar to the related falcons, are much like the vultures in their habits, and are largely carrion-eaters also. Unlike most hawks, the Caracara walks, instead of hopping, and can run freely and with considerable speed. He deserves complete protection, for the occasional bird or beneficial small animal or frog he takes is more than offset by the scavenging habits and the great numbers of injurious rodents and snakes he destroys.

The Falcons represent a subfamily which is characterized by vigorous, powerful birds, with long narrow pointed wings, rather large heads, fairly long tails, and a dashing flight. The group ranges from the fastest living bird, the Duck Hawk, a large and very powerful species, to the dapper little Sparrow Hawk, the smallest and most brightly colored North American Hawk. The latter is one of the most valuable of all our birds of prey, for his food is very largely composed of injurious insects, especially grasshoppers. He also eats some destructive rodents, and a few birds. Unlike most other Falcons, his bird food is of little consequence. He eats them mainly when there is a shortage of grasshoppers, field mice, or other natural food. He

is something like a human. If a man can't get beef steak or pork chops for a long period of time, he has been known to compromise on horse meat.

The Duck Hawk is the American representative of the Peregrine Falcons, which were much used in medieval Europe in the practice of falconry. Only high ranking persons were allowed to fly the birds. G. H. Thayer, in 1904, stated the Duck Hawk "is, perhaps, the most highly specialized and superlatively well-developed flying organism on our planet today, combining in a marvelous degree the highest powers of speed and aerial adroitness with massive, warlike strength."

This hawk is so fast and powerful, and so predacious by nature, that he easily overtakes and kills pigeons, ducks, gulls, sand pipers, and many other game birds. When not hungry he becomes so playful he will at times herd other birds along the river channels, humiliating them to the extent of forcing swimming or diving birds to enter and go under the water to escape him. Then, on their attempted emergence, he darts at them until they lose the last shred of dignity and have to come up under protection of reeds or trees. He would be a real menace if he was common, but oddly enough he is comparatively rare. He is such a truly magnificent bird that it would be unfortunate indeed if he were to become extinct. It can be said of the bird-eating Falcons in general that they are not common enough to call for control measures except in cases of individual raiders on poultry or game farms.

The Accipiters, or true Bird Hawks, contain the most destructive hawk in the United States, the Cooper Hawk, often called the Big Blue Darter or Chicken Hawk. He has the typical short rounded wing and long tail of his group, and that length of tail guides him in remarkably quick and accurate maneuverings after his intended victim, a chase which often leads him into the heart of bushy clusters of leaves and branches. As an individual he isn't as destructive to larger game birds as his fierce relative, the Goshawk, but he is more numerous than the latter. He is no weakling himself, however, and can carry away a good sized chicken, grouse, or cottontail rabbit. He eats principally birds, but also likes squirrels and chipmunks. The slightly smaller Sharp-shinned Hawk has an equal ferocity and craving for bird meat, from quail, flickers, and robins on down.

All of the Accipiters are common enough today that there is little immediate likelihood of extinction. Their habits are wonderful insurance, for they usually dart suddenly after their prey from sheltered wooded spots, and perch in inconspicuous nooks, frequently under leafy cover, and hence are hard to shoot.

The large subfamily of Buteonine Hawks is essentially as different

to the Accipiters as a professor of philosophy is to a blitzkrieg general. They are principally eaters of insects, mice, and other harmful rodents, and are more buzzard-like in habit and looks. They seem heavy and sluggish in appearance, and have short tails, with fairly long rounded wings. Being expert soarers, and too clumsy and slow to chase an incipient meal over a darting, winding course, they prefer to pounce suddenly on a victim. Their habits of perching in open, often conspicuous spots, the better to survey the feeding range, have caused them no end of trouble from farmers and hunters. While several varieties eat some birds and poultry, in no case are they important destroyers of our avian fauna. Almost without exception they merit general protection as valuable friends to our economy.

The Red-tailed Hawk is a very good and common example of a Buteo. He is a large fellow, and almost always well marked in flight by his reddish tail. On the whole he is quite beneficial, but once in a while he wanders off the straight and narrow path to eat a chicken. In fact, some individuals develop an affectionate regard for the taste of chicken meat, and have to be controlled. But because one person may go wrong is no reason to condemn a group. We can't condemn our human species because an occasional sinner carves his neighbor with a butcher knife. Under the law a man is declared innocent until proven guilty, and if we applied that principle to control of hawks a lot more justice would be done to beneficial birds.

To show how circumstantial evidence, even to production of the corpus delicti, may frame an innocent Red-tail of murder, let's look at an illustration or two. The farmer catches the hawk in his field, eating on a dead chicken. It seems an open and shut case of the audacious killer caught while profiting from a foray. The farmer doesn't realize that the Red-tail, like most other buzzard hawks, sometimes eats carrion, and that the chicken may have died of old age, disease, or attack from an Accipiter which may have been frightened away.

Suppose the farmer has set a trap by a dead bird. He catches a Red-tail, and thus convinces himself this hawk is a real chicken killer. A little study of hawks would teach him that the real killers, the Accipiters, seldom eat dead food and seldom return to a kill. Perhaps a poultry raiser sees a daring hawk steal a pullet out of his yard and make off. By the time he gets his gun in his hand, the only hawk he sees is a big fellow calmly perched on the top of a dead tree a short distance away. He shoots, and kills an innocent Red-tail, while the real culprit is filling his stomach under cover of the foliage of another tree. The man picks up the dead target and cuts it open to examine the stomach contents. Here he finds chicken fragments, and thus completely convinces himself he was correct. Yet the Red-tail may have been scavenging.

The other Buteonine Hawks, to a person who has recognized one, can usually be distinguished from the Bird Hawks by the short tail. They range from mildly beneficial species to saintly characters who never touch a bird or chicken, with only scattered individuals who are lacking in the approved moral code.

We can't be quite as charitable toward the Eagles, not even toward our national bird, the Bald Eagle. They slip from grace, but on the whole they are not destructive. Because of lack of economic importance and because of rarity they should be protected at all times except where individuals become predatory on domesticated animals. The Bald Eagle is not above eating a good supply of carrion. He spends most of his time along the sea coasts, lakes, and rivers, where he lives almost entirely on fish. He eats principally dead fish picked up on the surface of the water, although sometimes he robs an Osprey. Once in a while he fishes for himself, at which job he couldn't possibly pass an aptitude test. When he attacks a waterfowl it usually escapes by diving. He sometimes kills many rabbits, squirrels, mice and snakes.

Having completed a birdseye view of our hawk population, it is well to stress a point or two which cover most of the regular and occasional bird eaters. A. K. Fisher, in "The Food of Hawks and Owls", from Birds of America, states a vital principle in maintenance of healthy game: "It is well known to poulterers and owners of game preserves that killing off the diseased and enfeebled birds, and so preventing their inter-breeding with the sound stock, keeps the yard and coveys in good condition and hinders the spread of fatal epidemics. It seems, therefore, that the birds of prey which catch aged, frost-bitten, and diseased poultry, together with wounded and crippled game, are serving both farmer and sportsman."

Birds of prey, along with other predators, are a vitally necessary part in Nature's control of over production. Rabbits and quail, for instance, are very prolific. They form important food for several varieties of hawks. Reduce the hawks, as well as owls, and other natural birds of prey, and you would have such over abundance of rabbits and quail that they would literally starve to death. Many graphic instances of what happens when predator control is carried to the extreme are matters of record, and they all reflect unhappiness to the farmers and sportsmen who initiated such elimination.

It is significant that a great many of the depredations committed in poultry yards by the essentially beneficial hawks are the raids of youngsters less than a year old. Naturally a fast growing adolescent boy, with his cavernous tummy and his clumsy feet, isn't the graceful athlete he may be at young maturity; and likewise the young hawk is clumsier than the adult in capturing his food. The result is, he

sometimes takes what is easiest to get, the domestic fowl, and if he survives to adulthood he then takes after the insect or rodent food which is the more elusive but more natural food for him.

Some of the hawks whose normal diets include few birds have bad reputations because of their actions during nesting season, after the babies have come around to spend their daylight hours clamoring for food. A man will steal without compunction, if necessary to provide food for his children, where otherwise he wouldn't think of such a thing. So with hawks. They will take birds in far greater numbers with the echoes of posterity's ravenous demands in their ears than at any other season.

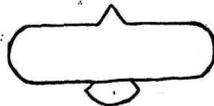
All in all, hawks are a mighty useful adjunct to civilization. If you think of them as somewhat like humans, with their mixture of good and bad well distributed, but with the good usually predominant, you can have a much more sympathetic comprehension of the frailties which occasionally show up. We should have great admiration for their grace and complete mastery of the air; regard for their beauty, and respect for their prowess.



Sparrow Hawk



Cooper Hawk



Red-tailed Hawk

*Norman Jackson*

The above sketches give exaggerated and actual impressions from below of representative hawks of the three principal groups—the Falcons, the Accipiters, and the Buteos.

## THE ORIGIN OF THE ROYAL GORGE

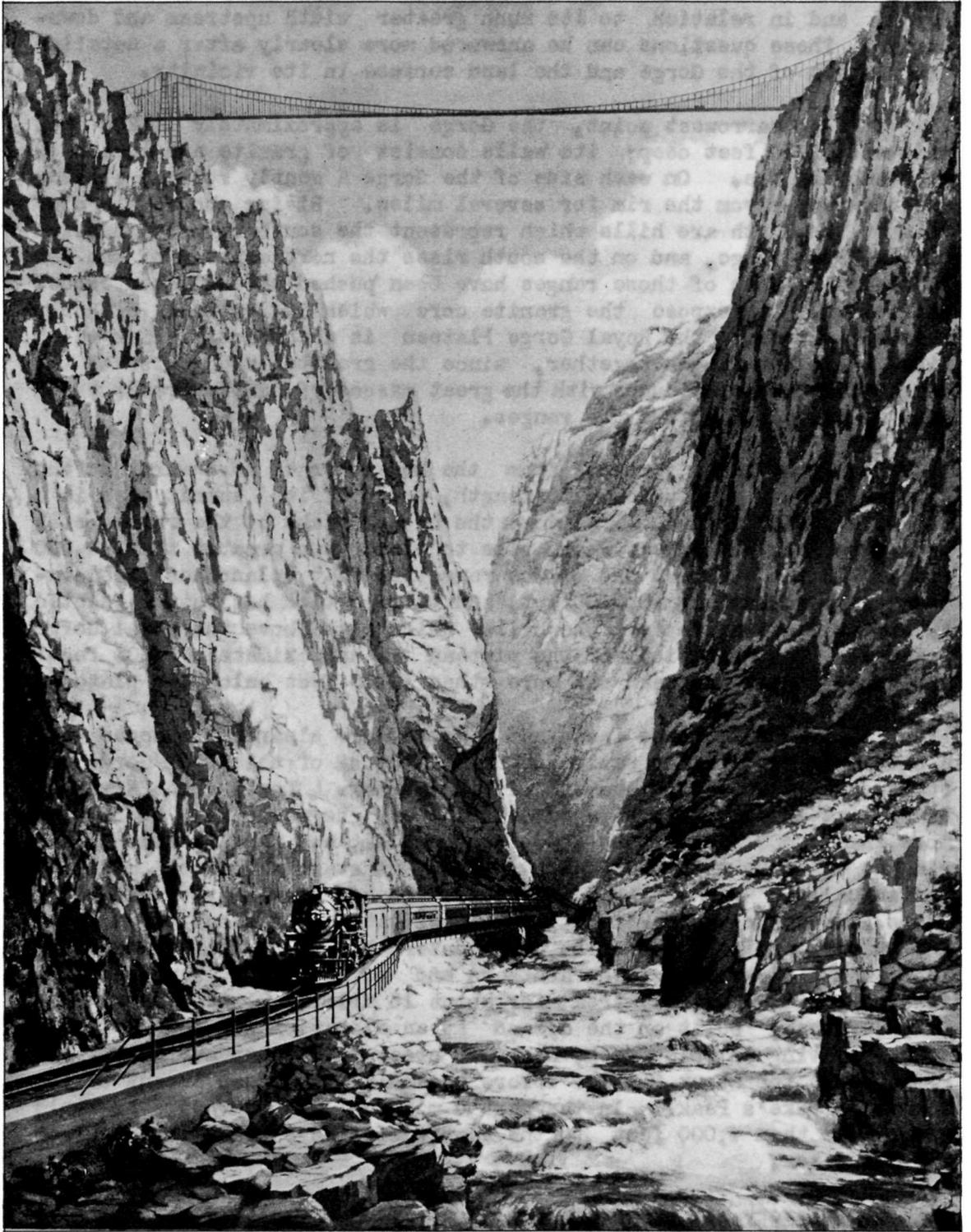
By Dr. Don B. Gould,  
Assistant Professor of Geology,  
Colorado College.

The Royal Gorge of the Arkansas River, in Colorado, is a bottleneck for the upper Arkansas Valley; it is a deep and unusually narrow canyon which cuts across the grain of the Rocky Mountains. The Rocky Mountains have a grain, something like a piece of wood. This is shown by the northwest-southeast trend of the main ranges. Between the ranges are lower areas, in which several major rivers have their source. The Arkansas River heads in one of these linear depressions in central Colorado, being fed by the melting snows of the Sawatch Range on the west, and the Mosquito Range on the east. The crests of these parallel ranges are about 15 miles apart, and their peaks rise more than a mile above the valley to elevations greater than 14,000 feet.

The upper Arkansas Valley is relatively open and conforms perfectly to the grain of the Rockies. From Tennessee Pass, at the north end of the Sawatch Range, the river flows southeastward for about 75 miles to a point below Salida, following the "straight and narrow path." But here, in spite of topographic and geologic arguments that the river should continue to follow the grain of the Rockies, it makes a sharp right angle turn to the northeast and flows "cross-grained" for about 30 miles through a granite-walled canyon which gets narrower and deeper downstream. The narrowest and deepest part of this canyon is known as the Royal Gorge. The Gorge opens abruptly onto the flat lowlands surrounding Canon City, where the Arkansas River begins its long journey eastward across the plains.

To visitors who look down into the Royal Gorge from its rim, the Arkansas River far below looks so small and insignificant that it seems incapable of cutting such a deep gash into the earth's surface. It is not surprising that these visitors occasionally suggest that the gash must have been opened by a mighty earthquake. To passengers on the railroad, which follows the bottom of the Gorge, the river is much more impressive as it rushes turbulently through the narrow passage. Those who realize the cutting power of sand-laden water are willing to concede the ability of the Arkansas River to saw its way down through the hard rocks of the canyon walls.

Several phases of the history of the Royal Gorge and the upper Arkansas Valley are not fully known, but geologists agree that the Gorge has been formed by the incessant grinding of pebbles and sand grains against the river bed as they are carried along by the stream. But why is the Gorge so deep, and why so narrow in relation to its



THE ROYAL GORGE, COLORADO

depth, and in relation to its much greater width upstream and downstream? These questions can be answered more clearly after a detailed examination of the Gorge and the land surface in its vicinity.

At its narrowest point, the Gorge is approximately 1,250 feet wide and 1,050 feet deep; its walls consist of granite and gneiss of pre-Cambrian age. On each side of the Gorge a gently rolling plateau extends away from the rim for several miles. Rising above this plateau on the north are hills which represent the southernmost extension of the Front Range, and on the south rises the northern end of the Wet Mountains. Both of these ranges have been pushed up and later eroded sufficiently to expose the granite core which is typical of Rocky Mountain ranges. The Royal Gorge Plateau is a connecting link which ties these two ranges together, since the granite and gneiss of the Gorge walls are continuous with the great masses of similar rocks which make up the cores of the two ranges.

The Front Range extends from the Royal Gorge northward to the Wyoming line. Throughout its length, most of its summit area is a relatively flat upland, above which the higher peaks of the range, such as Long's Peak and Pike's Peak, rise to elevations greater than 14,000 feet. At the southern end of the range the flat upland has an elevation of approximately 10,000 feet, and this portion has been dissected by stream erosion to form the hills which rise above the Royal Gorge Plateau. The elevation of the plateau is approximately 6,600 feet; the Gorge itself has been cut more than 1,000 feet below the plateau.

To illustrate these facts and figures more clearly, suppose that a passenger got off the railroad at the bottom of the Royal Gorge and started to walk to the summit of Pike's Peak. Leaving the Arkansas River, at an elevation of about 5,550 feet, he would have to clamber more than 1,000 feet up the steep canyon wall, and when he reached the rim he would be only 600 feet away from his starting point, measured horizontally. From the rim he would take off across the flat Royal Gorge Plateau to the northeast, at an elevation of about 6,600 feet, for nearly 3 miles, where he would enter the hilly tract resulting from the dissection of the southern end of the Front Range upland. After crossing the hilly area for about 15 miles, he would arrive at Cripple Creek, built on the upland at an elevation of nearly 10,000 feet. Leaving Cripple Creek, he would cross the upland surface of the Front Range for about 5 miles before beginning the steep ascent to the summit of Pike's Peak. In the next 4 miles of his journey, he would climb more than 4,000 feet to the summit of Pike's Peak at 14,110 feet above the sea.

The history of the Front Range has been investigated more thoroughly than that of any other range in the Rockies. Details have been added to this history by many workers since the masterly study by

Davis 30 years ago, but the sequence of events is still recognized to be as he described them. Davis used the Front Range as an example of a two-cycle mountain range; this means that it has passed through one complete cycle of uplift and erosion, and is now in its second cycle, having been reelevated so as to revive the streams and put them back to work cutting canyons into the uplifted mass. The second cycle is sometimes called the canyon cycle.

The first uplift occurred during the folding of the Rockies, at the end of the Cretaceous period about 60,000,000 years ago. Streams carved the uplifted area into rugged ridges and valleys, and aided by weathering, eventually removed most of the land above the level of the streams, leaving a gently rolling surface. A few hills stood above this flat surface as much as 4,000 feet. Then a second uplift raised this surface to its present elevation of 10,000 feet, probably during the Pliocene period about 10,000,000 years ago. Since that time, streams have been working away at their appointed task of removing everything above stream level, although most of them have not progressed beyond the initial stage, which is the cutting of canyons. The foregoing summary of the history of the Front Range provides a background for the history of the Arkansas River and the Royal Gorge.

Prior to the second uplift, the Arkansas River was a major stream flowing in approximately its present location across the old erosion surface worn flat during the first cycle. It carried a large amount of water received from numerous tributaries. After the second uplift, which revived the drainage of the Rocky Mountain region, this large volume of water enabled the ancient Arkansas River to transport a heavy load of sand and gravel. Then, due to this combination of large volume and heavy load, it cut into its bed more effectively than did its tributaries, and rapidly passed through the canyon-cutting stage, after which it began to widen its valley. That is, it soon sawed its channel downward to the lowest point and the gentlest gradient at which a stream of that size could carry such a load, and then, by undercutting its banks as it swung from side to side in wide bends, it slowly ate away the walls of the canyon until a wide valley floor was established. This process continued until the valley floor, consisting of granite and gneiss and veneered with alluvium, was 5 or 6 miles wide. Upstream from the area of hard rocks, the valley was wider, and downstream in the soft rocks of the Great Plains, it was wider still.

This broad-valley, gentle-gradient condition would characterize the valley of the Arkansas River today, were it not for the occurrence of one more event of great importance - another uplift. This uplift began just before the Glacial period, possibly 1,000,000 years ago. Its effect was apparently local, since the entire Rocky Mountain region was not involved, as in the first and second uplifts. This third movement raised the area now occupied by the Royal Gorge Plateau along

an axis which lay directly athwart the course of the Arkansas River. The adjoining ranges to the north and south may have participated, but this is not certain. The rise of the old valley floor was probably intermittent, and fairly rapid, but slow enough for the downcutting of the river to keep pace with the uplift. By grinding away its bed, with the sand and gravel it carried, the river sawed a deep trench into the rising mass of granite. Slow as this process must have been according to human standards, it was much faster than the action of weathering by which canyons are normally widened. This trench is the Royal Gorge.

In short, the Royal Gorge was caused by the deep intrenchment of the Arkansas River into its rising valley floor so recently that weathering has not had time to widen the trench to normal canyon proportions. The complete history of the Arkansas River may be summarized into three stages:

1. Uplift of the Rockies at the end of the Cretaceous period, followed by stream erosion to a flat surface during the early Tertiary. The course of the Arkansas River was established at this time.

2. Relevation of the Rocky Mountain region during the Pliocene period, followed by canyon-cutting. The Arkansas River passed through the canyon-cutting stage and developed a valley floor several miles wide.

3. Local uplift of the old valley floor in the Royal Gorge area began just before the Glacial period. Intrenchment of the Arkansas River into the rising mass to form the Royal Gorge.

Most of the many people who see the Royal Gorge each year probably do not realize that it has had a complex history, but all are impressed by its depth and scenic grandeur. The construction in recent years of a suspension bridge across the Gorge from rim to rim, and an inclined railway from the rim to the railroad platform at the bottom has increased the feasibility of seeing and appreciating the Gorge from all possible angles.

Many of the visitors have been passengers on the Denver and Rio Grande Western Railroad. This railroad, after overcoming many knotty engineering problems and legal difficulties, finally completed the water level railway route through the Rockies in 1880, by following the Arkansas River through the Royal Gorge. Officials of the railroad estimate that 7,800,000 people have passed through the Gorge during the 60-year period since trains started operating over this route. A large number of people visit the rim of the Gorge by automobile, as a side trip from U. S. Highway 50, about 10 miles from Canon City.

## DESCENT OF THE CANYONS

By Norman D. Nevills.

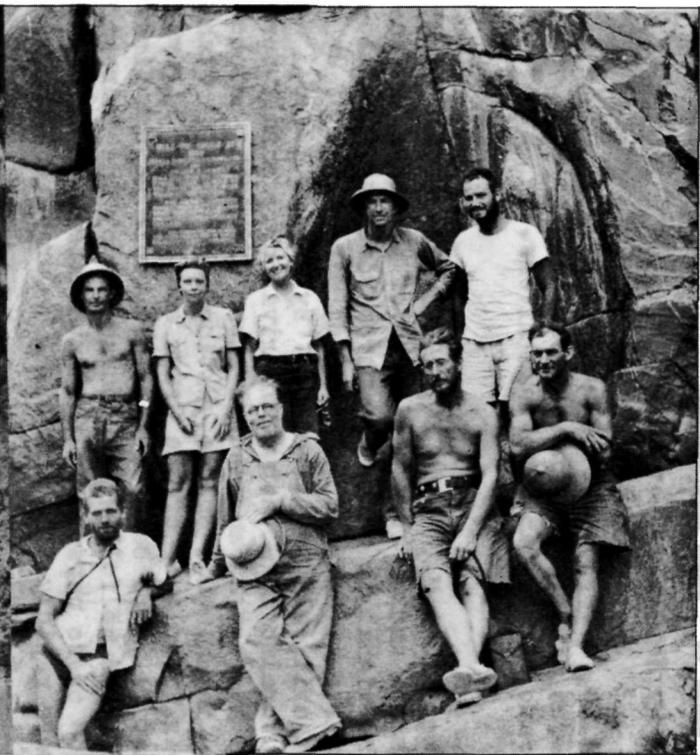
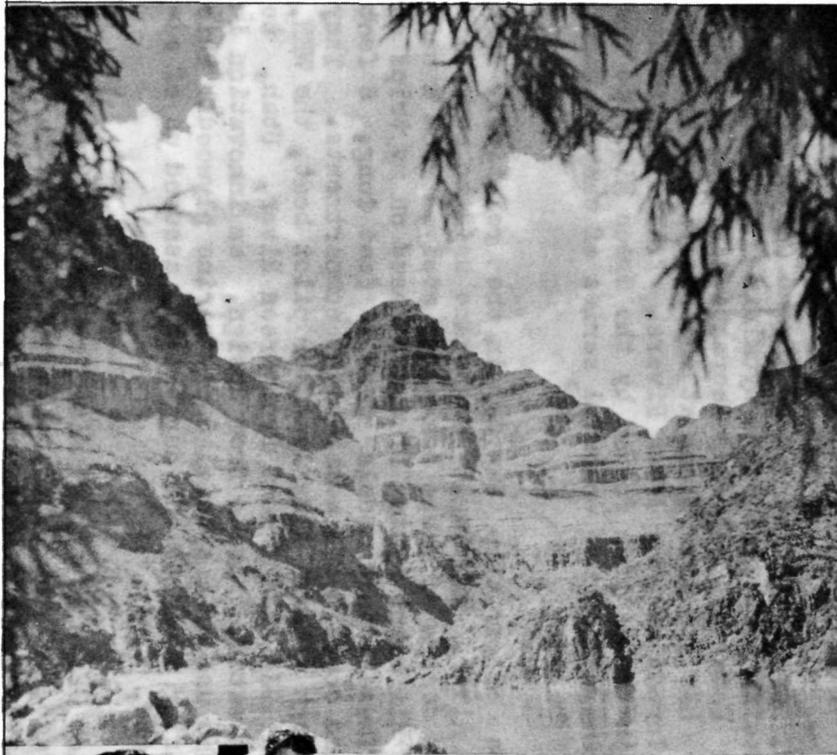
(Mr. Nevills, a resident of Bluff, Utah, is a veteran explorer of the canyons of the Colorado, Green, and San Juan Rivers.)

Green River, Wyoming, 10 A.M., June 20, 1940 - There were eight of us, including two women, and we breathed sighs of pleasure and anticipation as I gave the signal to push the three rowboats into mid-stream. Nearly 1,200 miles of canyons and rapids were ahead of us - scenery to hold the most critical, spellbound. By use of a map, we hoped to find a great natural bridge that would rival or possibly surpass in size the world's largest known natural stone arch, the Rainbow Bridge, 309 feet high, in Rainbow Bridge National Monument, Utah. Major John W. Powell, early explorer of the Green and Colorado Rivers, left this same place just 71 years before us. This would be the first time that women had attempted to follow the course set by the intrepid Major in 1869. The 200 or so persons in the interested and friendly town of Green River were rapidly lost to view. Our adventure was started.

The Colorado River, as we know it in the Grand Canyon, has its source in the high mountains of Colorado and Wyoming. Near the upper reaches of the proposed Escalante National Recreational Area in Utah, the main Colorado River has its inception at the Junction - the confluence of the Upper Colorado and the Green Rivers. Tradition and interest are established in the canyons formed by the Green River to the Junction, and a more remarkable and colorful series of canyons would be hard to find.

The first few days of our trip saw us in the relatively open country south of Green River, Wyoming. We became used to our boats and their handling. The design of these boats was evolved from a number of years' study of different types of craft used on my trips on the San Juan River. These latest models were 16 feet long, 6 feet wide, one-third open, and contained 7 water-tight compartments. They were well adapted for rough water. My lead, or pilot boat, the WEN, was also my lead boat in 1938 when I went from Green River, Utah, to Boulder Dam during high water. Aside from design, an innovation in boat construction was the use of a special 5-ply marine plywood. This material, with its amazing strength and durability, assured us of almost indestructible crafts.

About 68 miles below Green River, Wyoming, we entered the portals of Flaming Gorge, Colorado, in the Dinosaur National Monument. This was the first of the sixteen canyons we would pass through to Boulder



Near the end of the trail, the explorers were photographed in Separation Canyon, at the plaque commemorating Major Powell's expedition of 1869, when two men who climbed the canyon wall were killed by Indians. Mr. and Mrs. Nevills are at extreme left, in top row. Photo at upper left is of the lower Granite Gorge, in Grand Canyon.

Dam. Sundown lights accentuated the red cast of the deep canyon, and it was a real flaming gorge in which we made Camp No. 3. Our large load capacity simplified the camping problems. Two compact nested cooking sets were ample for all meals. We used canned goods almost without exception, and the menus were prepared in advance of our starting, by my wife, Doris. Her unflinching good nature and cheerfulness in trying situations throughout the trip contributed much to our success. Her past river experience proved in good stead in preparing the menus. This system conserved supplies, as we at all time knew exactly what to open. Doris prepared all the meals, assisted by the other woman voyager, Miss Mildred Baker of Buffalo, New York.

The day following our entrance into Flaming Gorge, we passed through Horseshoe and Kingfisher Canyons, on down into our first real rapids, in Red Canyon. It was a welcome change to be in the depths of these beautiful canyons; our progress was faster, the water was more interesting, and the scenery was of incomparable beauty.

Early each morning, Doris would write a resume of our previous day's events and send the message to the Salt Lake City newspapers, by carrier pigeon. It was a thrilling sight to see the birds swoop up and strike an unerring course. On a few occasions film was sent out this way, and a few hours later the pictures were printed in the newspapers.

Each succeeding mile brought us into deeper canyons, and into rapids that increased in their fury. Our passage through Lodore Canyon was marked by a near accident when one of the boats was tossed up on a rock in Disaster Falls. Triplet Falls and Hell's Half Mile were run successfully, and that saw us through the steepest part of the Green River. There is a drop of 25 feet in Hell's Half Mile. Just above Jensen, Utah, we landed the boats and walked one mile to see the dinosaur quarry and the museum, in Dinosaur National Monument. Part of the monument is in Utah, and part in Colorado. Nowhere else in the world have dinosaur remains been found in such abundance and concentration as in this quarry.

Day by day the miles were put behind us. There was never a tiresome moment; always something new and different to interest us. Time and distance passed quickly, and almost before we could realize it we were down to Green River, Utah, one-third of our journey completed. Here we stayed a couple of days to take on more supplies, get out letters, and visit with friends and relatives who came to see us. Here B. W. Deason, Salt Lake City assayer, left us, to rejoin the party at Bright Angel, in Grand Canyon National Park. His place was taken by Miss Anne Rosner, Chicago school teacher. Also to join the party was Barry Goldwater, Phoenix merchant, and Arizona historian. For the next  $117\frac{1}{2}$  miles through the Labyrinth and Stillwater Canyons to the junction with the Colorado River, we would have smooth water unbroken by any rapids. For this stretch we used outboard motors to relieve

the monotony and tiresomeness of rowing. And then would come Cataract Canyon, the "Graveyard of the Colorado." The rapids to be encountered there would pale to insignificance the rapids of the Green River. We all felt undaunted, as our equipment and personnel were believed to be adequate for the task.

Handling my other two boats, the JOAN, named after our 3-year-old daughter; and the MEXICAN HAT II, were two men whom I had trained on previous trips. Dr. Hugh Cutler, botanist of the Missouri Botanical Gardens, handled the Mexican Hat II, and he also spent all possible time in gathering flora and making a study of plant life. Dell Reid, a prospector, and member of my 1938 expedition, guided the Joan. Our photographer was C. W. Larabee, of Kansas, genial and excellent all round man. Larabee's pictures were supplemented by the excellent photography of Barry Goldwater, known for his photographs of Arizona. Mining Engineer J. S. Southworth of California, rounded out our crew. The unexpected abilities of Mr. Southworth were a real asset.

On July 10th, we were proceeding down the river. The water was low, and sandbars were troublesome. Overnight camp was made at a geyser that was developed during oil prospecting operations. Passing the San Rafael River we entered Labyrinth Canyon, and crossed the northernmost boundary of the proposed Escalante National Recreational Area. We were here in the lovely orange tinted sandstones, and abounding on each side were monuments of many types and descriptions. Major Powell called this the "Land of Standing Rocks." I hope that this little known and exceedingly beautiful section will soon be made more accessible so that thousands of people can see and enjoy its weird and magnificent grandeur. The canyon rapidly gets deeper; soon we were between two almost polished walls, and only occasional views of the tops were possible. Each of the many interesting side canyons, with cliff ruins and surface sites of prehistoric dwellers, was a trip and adventure in itself. The miles passed rapidly amidst all this charming and interesting display. Nature must have been in an extra benevolent mood for spreading beauty, when moulding this canyon.

July 14th - Junction of the Green and Colorado Rivers! The confluence of the Green and Upper Colorado forms a mighty and impressive river. The formation here gives way to immensely high cragbound cliffs that would be formidable obstacles to anyone trying to gain access to the rim. Bishop and Wayne McConkie of Moab, were here to meet us, and to see us run the first little rapids of Cataract Canyon. We had planned to stay here at least half a day, but impatience to start the task of navigating Cataract Canyon was too much, and after hurriedly writing letters for the McConkies to take out, we embarked again. Cataract Canyon is only 41 miles long, but it is filled with innumerable rapids, many of them very dangerous unless every precaution is observed. This section, owing to the number of fatalities occurring to earlier parties, was well named the "Graveyard of the Colorado." Our good fortune held through here, and our passage was marked with but

one serious mishap. In rapid 24, Dell Reed, boatman involved in the Disaster Falls experience, this time had a close call when he got off the channel. It took us several hours of hard work to extricate Reed and the Joan, and we were glad to crawl into our sleeping bags that night.

There are mountain sheep in this area, but very little else except rabbits and rattlesnakes. Towards the foot of Cataract Canyon is the lateral tributary, Dark Canyon. Fabulous tales are told of great prehistoric ruins in this canyon, so we spent several days here in an effort to penetrate up from the river as far as possible. Much work resulted in only getting 7 or 8 miles into the canyon. Waterfalls are a great problem, and I am convinced that the Cliffdwellers never used the lower end of the canyon to reach the river, as there are no pictographs or other indications. It would be worthwhile entering from the head and working down, as the upper reaches were no doubt occupied in the past.

Mille Crag Bend marked the terminus of Cataract Canyon, and now for the next 184½ miles of Narrow and Glen Canyons we would relax on the relatively smooth water, and give ourselves up to the fascinating and charming beauty of Glen Canyon. The rest would prove welcome in preparation for the rough, heavy rapids of Marble and Grand Canyons. To this point every rapid had been run, but I doubted if this record would maintain, as the constantly lowering river was making for extremely rocky channels.

Upon entering Narrow Canyon we again put on our outboard motors, and the 9 miles were quickly put behind. We were impatient for a sight of the Dirty Devil, or Fremont River, marking the head of Glen Canyon. In 1869 Major Powell, upon reaching this point, called to Jack Sumner: "Is it good water, Jack?" "No, she's a dirty devil," replied Sumner. And truly apt is the name, as at all times the stream seems to have a dirty, unpalatable flow of water.

Eight miles from here we stopped at Trachyte Creek, or Hite, to visit the Chaffins. They have a ranch and do a little mining. A pleasant visit was made here, but we all felt the urge to be on our way and explore the canyon in which the bridge should be found. Upon leaving Hite I divulged for the first time where I expected to find the bridge. About 90 miles below, in a side canyon of the Escalante, we would prove or disprove our information of the tremendous big natural bridge. With the motor, and a smooth river we made good progress. But the second night out from Hite, Doris injured her leg at the point of an old break, and it looked to be broken again. This was a serious mishap. We decided to wait until morning; then, if the leg wasn't better and showed a break, we would get her to Lee's Ferry, 90 miles distant. The next morning showed an improvement, and another day's rest saw my wife able to hobble around, with the use of an improvised crutch.

We reached the Escalante River at noon, and after lunch most of us started hiking up the canyon. A small stream of not too brackish water had to be crossed and recrossed, but it proved a blessing in the extreme heat. My information indicated that we must go up to a lateral canyon coming in from the south, and known as Forty Mile Creek. It lay some 8 miles from the Colorado River. A walk of a mile up Forty Mile Creek would find the bridge, we hoped! By sundown we reached Forty Mile Creek, and it was decided to spend the night at the mouth of the creek. We ate dinner, then rolled out on the sand to enjoy a night's sleep.

Next morning, after a hastily consumed breakfast, we were again on our way. A 15-minute walk brought us to the bridge. And such a bridge! As we gazed at it its enormity began to be appreciated and we soon realized that here was no ordinary natural bridge, such as the types that are found all over this region. This bridge was huge. Pictures were soon being taken, and Dr. Cutler volunteered to accompany me on an attempt at an ascent. After much work we were on top, and by use of a silk line we were able to get the various dimensions. From the top to the wash below was 305 feet, just four feet short of the Rainbow Bridge. The span was 297 feet, while the bridge measured 114 feet in thickness.

It would be hard to describe the wonder and thrill that we felt in seeing this second largest known stone bridge in the world. In honor of Dr. Herbert E. Gregory, whose work in this desert country has contributed so much to our knowledge, we named this the "Herbert E. Gregory Natural Bridge." This bridge lies within the area encompassed by the proposed Escalante National Recreational Area. The best approach is by going down the San Juan River to the Colorado, thence upstream by power some 10 miles to the Escalante River. Our walk back to the boats was every bit as thrilling as in going up. This little known canyon has a place of its own in great scenic beauty. The high glossy walls of Navajo sandstone are superb in their breath-taking sheerness and beautiful natural tapestries. Someday there will be thousands of people admiring this canyon.

A full length book would be needed to describe the endless beauties and places of interest in Glen Canyon. Practically all the side canyons afford adventures. To the fortunate few who have partially explored some of these side canyons reposes a knowledge of an area that some day will be the "Playground of America." Leaving the Escalante we visited the Hole-in-the-Rock, famous crossing of the early day Mormons, and we wondered at the courage and fortitude of a group of people trekking across such rugged and almost impassable country. Outstanding of all the Glen Canyon attractions was our visit to Rainbow Bridge, in the Rainbow Bridge National Monument. So much has been written about Rainbow that it is unnecessary for me to elaborate. It is significant, though, that "Nonnezhosie" held us spellbound, in spite of all the spectacular scenery to which we had become accustomed.

Almost too soon were we at the mouth of Glen Canyon. On August 2, our three boats were tied up at Lee's Ferry. A few days were spent there to check over our boats and supplies before starting the last leg of the journey. Regardless of the record made so far, the steadily dropping river made the 333 rapid-filled miles of Marble and Grand Canyons between us and Boulder Dam seem seriously formidable.

August 4th -- The river was too low for satisfactory navigating, but I gave the word to shove off with the hope that summer storms in the headwaters would provide a bit of extra water. We soon passed under the tremendous span of Navajo Bridge, and we were thrilled by its spider-like beauty, literally hung in the sky. And 8 miles from Lee's Ferry brought us to Badger Creek Rapid. I lined this one on my high water trip, and it looked bad this time. But the next morning we were up early, and after looking the rapid over again I ran all three of the boats through.

The 61½ miles of Marble Canyon afford wonderful experience. There are plenty of thrills in the numerous heavy rapids. But the beauty spots hold the stage -- multicolored marble walls, caves, arches, springs, and cliff dwellings. The trip through this section is one of the highlights of the whole river route. I have been in this canyon with persons who couldn't swim, yet they never felt fear; only a constant growing wonder at the varying and interesting points of scenic interest. Beauty certainly lies in the eyes of the beholder, and this and the other canyons have a knack of presenting a perfect galaxy of scenery so that all will be pleased.

Passing the Little Colorado River, we entered the Grand Canyon. The first afternoon we explored some old copper mine tunnels; then we camped at the foot of Tanner Trail. A big fire was built that could be seen from the South Rim of Grand Canyon National Park, and advise of our safe passage to this point.

August 9th -- This marked a day of many thrills and experiences. The 19 miles from Tanner Trail to Phantom Ranch at Bright Angel Trail are guarded by some of the most formidable of all the Colorado River rapids. We ran them all - Hance, Sockdolger, Grapevine, and dozens of others - and the sight of the suspension bridge marking Bright Angel Trail was most welcome. Here, under the genial administrations of our hosts at Phantom Ranch we soon forgot the hardships involved in handling the boats in such water. A few days saw us again ready to set off down the river on the last 178 miles separating us from Lake Mead.

Below Bright Angel, B. W. Deason joined us again, and Anne Rosner went out. The steadily falling river was making navigation increasingly difficult. But our concern over navigation was secondary to our appreciation and enjoyment of the great majestic beauty of this immense gorge. The sections of granite are particularly beautiful, as they are shot through with color. We had no difficulty in finding ex-

cellent camping places. As a rule our camps were made at the mouth of a canyon where there would be a crystal clear stream of excellent drinking water.

As we wound 'round bend after bend, getting ever closer to Lake Mead, our anticipation in getting back to civilization and relatives was considerably dimmed by the realization that probably the greatest adventure in our lives was soon to be over. All of us had experienced a trip that was unique and wonderful. We disliked the thought of returning to humdrum ways. My good friend Harry Aleson, and his companion, Louis West, met us at Separation Canyon. Their boat got loose so we formed a rescue crew. The following day, after some steady rowing, we rescued the boat. Separation Canyon marked the end of our rapids, and it is surely a fitting and logical point to mark the head of Lake Mead. Here in 1869 three members of Major Powell's crew attempted to get outside by climbing up to the North Rim. They were met at the top and killed by Indians.

In token to the courage and fortitude of Doris Nevills and Mildred Baker, the first women to make this 1,100-mile trip through the canyons of the Green and Colorado Rivers, the National Park Service had a big boat, with some of our relatives, meet us at the head of navigation. Our hearts were full with the sense of a great accomplishment, and the pleasure of again being with relatives and friends. To the several Divisions of the National Park Service whose interest and help contributed so much in solving many of our problems, I hereby express for myself and party our sincere and grateful appreciation.

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# NATIONAL PARK SERVICE AREAS IN REGION III



- 1. Region III Headquarters
- 2. Bandelier National Monument
- 3. Chaco Canyon National Monument
- 4. El Morro National Monument
- 5. Gran Quivira National Monument
- 6. Carlsbad Caverns National Park
- 7. White Sands National Monument
- 8. Gila Cliff Dwellings National Monument
- 9. Chiricahua National Monument
- 10. Tumacacori National Monument
- 11. Saguaro National Monument
- 12. Casa Grande National Monument
- 13. Organ Pipe Cactus National Monument
- 14. Tonto National Monument
- 15. Petrified Forest National Monument
- 16. Montezuma Castle National Monument
- 17. Tuzigoot National Monument
- 18. Walnut Canyon National Monument
- 19. Sunset Crater National Monument
- 20. Wupatki National Monument
- 21. Grand Canyon National Park
- 22. Grand Canyon National Monument

- 23. Pipe Spring National Monument
- 24. Boulder Dam National Recreational Area
- 25. Lehman Caves National Monument
- 26. Zion National Park
- 27. Cedar Breaks National Monument
- 28. Bryce Canyon National Park
- 29. Timpanogos Cave National Monument
- 30. Capitol Reef National Monument
- 31. Rainbow Bridge National Monument
- 32. Navajo National Monument
- 33. Canyon de Chelly National Monument
- 34. Natural Bridges National Monument

- 35. Hovenweep National Monument
- 36. Yucca House National Monument
- 37. Mesa Verde National Park
- 38. Aztec Ruins National Monument
- 39. Arches National Monument
- 40. Colorado National Monument
- 41. Black Canyon of the Gunnison National Monument
- 42. Wheeler National Monument
- 43. Great Sand Dunes National Monument
- 44. Capulin Mountain National Monument
- 45. Platt National Park
- 46. Hot Springs National Park

