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-2-

This Bulletin is issued monthly for the purpose of giving information to those interested in the natural history and scientific features of the Grand Canyon National Park. Additional copies of these Bulletins may be obtained free of charge by those who can make use of them, by addressing the Superintendent, Grand Canyon National Park, Grand Canyon, Arizona.

M. R. Tillotson, Superintendent, Edwin, D. McKee, Park Naturalist

SCIENTIFIC WORK CONDUCTED AT GRAND CANYON

Dr. Vernon Bailey, Senior Biologist, U.S. Biological Survey, accompanied by his wife, Mrs. Florence Merriam Bailey, author of "Handbook of Birds of the Western United States," and "Birds of New Mexico, and by an assistant, Miss Hastings, arrived at Grand Canyon on May 6 for a visit of several months. During this period Dr. Bailey plans to make a detailed study of the animal and plant life, especially in its relation to the Life Zone principals, and to investigate the deer problem on the Kaibab. Mrs. Bailey meanwhile is making a study of the bird life.

On May 22, Dr. Douglas Johnson, Professor of physiography at Columbia University, arrived at the South Rim for a ten-day visit. Dr. Johnson is making a study of the Grand Canyon problems, especially those relating to the development of the educational work. He has given a number of interesting lectures at the Yavapai Point Station and the Campfire.

THE CHUCKWALLA

By - Miss Barbara Hastings.

Down in the bottom of the Grand Canyon and over the low hot deserts lives a large, dark, rough, rock lizard related to the iguanas. This lizard - the chuckwalla, is one of the largest found in the United States, second only in size to the gila monster, and for untold ages it has furnished a choice food for desert Indians. Many a prospector and desert wayfarer has made a meal on one of these big lizards and found its flesh palatable and wholesome.

Recently while following a faint trail along the Colorado River near Phantom Ranch, I was with Mr. Vernon Bailey of the U.S. Biological Survey when he secured a large chuckwalla. He collected it for a specimen and for study. Its stomach was carefully examined soon after it was collected and found to contain flowers and several of the local desert plants all of which were collected in the immediate vicinity for identification. The large flower heads of three species of milky-juiced composites had been eaten to the number of 118, and three fresh flowers of the yellow bean bush (*cassia covesii*). Those represented the breakfast of the chuckwalla. The second stomach contained a similar amount of flowers of the same general nature but in a digested condition.

The lizard was taken to camp, skinned and mounted for exhibit at the Yavapai Observation Station. The meat was carefully saved for a feast. It was roasted on coals late at night and eaten by a party of eight people. Cooked in this way it proved to be rather tough and dry, but the meat, which was white, tasted somewhat like chicken. Needless to say, there was only enough for each person to have a small bite.

As the chuckwallas are a part of the interesting fauna of the Grand Canyon, they are not recommended as an article of food, however, they will add much interest to the trails as they become better known and their habits understood.

LIFE ZONES OF THE GRAND CANYON

By - Vernon Bailey
Senior Biologist, Bureau of Biological Survey,
U.S. Department of Agriculture.

Few localities show life zones more distorted and extreme in their variation than the Grand Canyon of the Colorado in Arizona, but this unusual variation from the normal offers problems of special interest and importance.

In crossing the Canyon from Yaki Point down the trail, across the suspension bridge and up Bright Angel Creek to Bright Angel Point on the north side and back again via the Indian Garden Trail, 1928, I was able to check up the life zone levels and map a section of the Canyon in a very general way. To map the whole canyon as it should be mapped for life zone and distribution would require much more detailed work. Enough has been done to suggest the extent to which the Canyon may act as a barrier to the extension of range of many species of plants and animals.

Lower Sonoran Zone

Beginning at the bottom we have a broad area of Lower Sonoran Zone running up through the Canyon and through the Canyon of the Little Colorado River onto the low part of the Painted Desert, to a little beyond Cameron or to about the 4,000 foot contour. In the Grand Canyon the zone reaches up to approximately the 4,000 foot level on the northeast exposures and to the 5,000 foot level on the southwest exposures with higher and lower limits where the slopes are abrupt or very steep. Generally the zone is two to four miles wide but in places runs back into side canyons to a much greater width. It is characterized by a very hot and dry climate such as is found on the Colorado and Mohave Deserts and in the Death Valley region and by a large part of the plant and animal life of these deserts.

Its plants are the mesquite, catclaw, two species of arrow-wood [*Baccharis glutinosa* and *sergiloides*], Burro Brush [*Coleogyne ramosissima*], *Franseria dumosa*, *Xylorrhiza tortifolia*, *Encelia frutescens*, *Koeberlinia spinosa*, *Thamnosma montanum*, *Ephedra nevadensis*, *Audubertia incana*, Shadscale (*Atriplex* (not *canadensis*) ?), Mesquite (*Agave utahensis*), Narrow Leaved Yucca (*Yucca harrimaniae*), Prickly Pear Cactus (*Opuntia engelmannii*), *Echinocereus engelmannii*, *Echinocactus xeranthemoides*, and many other desert species that I have forgotten the names of.

The lower Sonoran reptiles noted are the chuckwalla (*Sauromalus ater*), western collared lizard (*Crotaphytus collaris baileyi*), whip-tailed lizard (*Cnemidophorus tigris*), large scaly lizard (*Sceloporus magister*), several species of small *Sceloporus*, *Uta stansburiana* and *Holbrookia maculata flavilanta*, and others not identified.

The snakes have not been collected or identified.

The Lower Sonoran birds are past the breeding season and can not be listed at this season of the year, although the Gambels quail, Cassin's kingbird, black phoebe and the canyon wren are still common.

The mammals of Lower Sonoran Zone in the canyon have not been thoroughly collected but among them are the antelope, squirrel, chipmunk (Amospermophilus cinnamomeus), desert wood rat (Neotoma desertorum), cliff mice (Peromyscus eremicus) and Peromyscus orinitus stephensi, desert harvest mouse (Reithrodontomys megalotis deserti), intermediate pocket mouse (Perognathus intermedius), pocket gopher (Thomomys perpallidus aureus?), little canyon bat (Pipistrellus hesperus), free-tailed bat (Tadarida mexicana).

Upper Sonoran Zone

Upper Sonoran Zone covers both slopes of the Grand Canyon above the lower Sonoran, or from about 4,000 to 6,000 feet on northeast exposures and from 5,000 to 7,000 feet on southwest exposures, varying greatly with the steepness of the slopes.

It is generally characterized by the nut pines and junipers, western red-bud, hackberry, two kinds of ash (Fraxinus anomala and macropetala), small leaved mountain mahogany (Cercocarpus paucidentatus), skunk bush, Apache plums, prickley leaved oak (Quercus turbinella), manzanita (Arctostaphylos pungens), Yucca baccata, a small prickley pear, and a mammillaria cactus.

Its reptiles are Sceloporus graciosus and 2 or 3 smaller species of the genus, hernandes horntoad, a little sand lizard, Utah ornata and a Holbrookia _____?

Its few resident birds found after the breeding season are over are the Woodhouse jay, Say's phoebe, rock wren, and house finch.

Its mammals are the mountain sheep, antelope, Gila chipmunk, rock squirrel, big-eared and Rowley white-footed mice, flat-tailed wood rat (Neotoma lepida), and round-tailed wood rat (Neotoma mexicana pinetorum), gray fox, ring-tail, spotted skunk, and several species of bats.

Transition Zone

Transition Zone extends from about 6,000 feet on northeast slopes and 7,000 feet on southwest slopes up to the highest part of the plateau along the south rim of the Canyon or to about 7,500 feet, and on the north side of the Canyon to about 8,500 feet on gently sloping southwest exposures, and to 7,500 feet or sometimes lower on steep northeast exposures.

It is well marked by the yellow pine, Gambel's oak, New Mexico locust, western ironwood, Acor Neomexicanum, sagebrush (Artemisia arbuscula), Mountain mahogany (Cercocarpus intricatus), Oregon grapes (Berberis fendleri and repens), and many other shrubs and flowering plants.

Its only noticed reptile was a big dark colored bull-snake, probably Pituophis catenifer stejnegeri, pulled out of a Callospermophilus burrow near the ranger station on the north rim of the Canyon.

Its resident or breeding birds are the western hairy and downy woodpeckers, Lewis's woodpecker, pygmy nuthatch, western wood pewee, vesper sparrow, Arizona chipping sparrow, and many others.

Its mammals are the Abert's and Kaibab squirrels, the Arizona ground squirrel, the bushy tailed wood rat, the fulvous pocket gopher, and the porcupine, the rufus deer mouse, and large brown bat.

Canadian Zone

On the Kaibab Plateau the Canadian Zone covers the high country from about 7,500 feet on northeast slopes and 8,500 feet on southwest slopes up to the highest parts at about 9,000 feet. On the steep canyon walls facing northeast strips of Canadian species extend along the base of sheer cliffs much lower down, and in many cases below the Transition Zone species which cover the more rounded slopes above. In some places these Canadian Zone strips reach the level of Upper Sonoran Zone on opposite slopes facing toward the warm rays of the sun. Many of these Canadian Zone strips show under the rims of the Canyon along both sides and tend to confuse the observer unless their origin is understood. Generally they are where the sun never shines or where it touches for only a short time during some part of the day, and often they are where snow drifts over in winter and lies late in spring, keeping the ground cool and moist.

Canadian Zone is characterized by Psudotsuga taxifolia, Picea engelmanni and parryana, Abies concolor, Juniperus siberica, Populus aurea and many of the shrubs and low plants of the Rocky Mountain Canadian Zone.

It has no reptiles.

Its birds are the Richardson grouse, Williamson sapsucker, long crested jay, red crossbill and many others.

Its mammals are the mule deer, the spruce squirrel (Sciurus fremonti) the Colorado chipmunk, the Colorado pocket gopher, and probably several mice and shrews that have not been collected.

WIND EROSION IN THE GRAND CANYON

The Grand Canyon of Arizona has long been featured from an educational point of view as the world's most magnificent example of erosion. Further explanation will in most cases specify that this erosion is due to the combined efforts of water, wind, temperature changes, vegetation and chemical action. Thus far nearly every geological student will agree.

As regards the effects of wind erosion, however, and the relative proportion and importance of its work as compared with the master undertaking in Grand Canyon, there are apt to be vast differences of opinion. Not only among the public but even among scientists there frequently appears to be a general feeling that in a semi-arid region, wind action is mainly responsible wherever large alcoves or semicircular curving cliffs are to be found. In many cases this is correct - but such features are by no means definite criteria.

Just recently the "Arches National Monument" in Grand County, Utah, was established by President Hoover. In creating this monument some 4,500 acres were set aside for their educational and scenic value - principally because they contained "extraordinary examples of wind erosion in the shape of gigantic arches, natural bridges, windows, spires, balanced rocks, and other unique wind-worn sandstone formations."

Still closer home, we find in the high country above Kanab to the north and in the Painted Desert to the east some very definite indications of wind action in the form of pebbles and limestone fragments which are actually polished on their exposed sides. Here on the flat, nearly barren plateaus, sand storms and gales are not at all rare and one has but little difficulty in realizing the importance of such wind blasts in carving many of the features, though even here it is believed by some imminent geologists that much of the fanciful sculpturing is due to water action.

In the Grand Canyon of Arizona we find no pronounced or prominent evidences of wind action - nor should it be expected. The Canyon, itself, is rather set-off from the main storm courses of the overlying plateau country, and its very depth acts as a protection against the wrath of the wind. To be sure, rather violent blows are encountered from time to time, yet they are all rather local, of comparatively short duration, and bear relatively little sand or other cutting tools.

Such features as the great alcoves of the Red Wall Limestone, and the numerous undercuttings in certain other cliffs are frequently suggested as typical of wind erosion. The former are readily understood when one considers the nature of the Red Wall - the chemical action of rains on the rather pure limestone, and when one watches the water courses of those rains - always draining toward the centers of these alcoves. In the case of undercuttings in some of the other massive cliffs, one again finds a rather easy explanation. Such conditions represent a rather world wide condition, where soft materials, underlying hard ones, somewhat easily disintegrate, and either fall or are forced out from beneath, perhaps by wind action but more likely by water. In brief it appears that erosion due to wind action is of comparatively small importance in the cutting of Grand Canyon.

ODDS AND ENDS.

Two interesting records of birds were recently made near Phantom Ranch. One of these was the rare little Flammulated Screech Owl which was collected by Mr. Vernon Bailey. The other was the Eastern Kingbird (*Tyrannus tyrannus*) which was seen by Mrs. Florence Merriam Bailey so close at hand that there was no possibility of misidentification.

The little Spotted Skunks (*Spilogale gracilis*) are reported as numerous this summer at Indian Gardens.

Tent Caterpillars appear to have colonized extensively along the South Rim this season - especially on the Service Berry Bushes on the Kaibab Trail. The Grand Canyon boy scouts, however, with their kerosene torches are making things very warm for them

Two Water Ouzel's nests were found recently on ledges in the sheer walls of the Box Canyon, Bright Angel Creek. In both cases, they were located about four feet above the stream bed. One nest which was examined by wading the stream proved to be built mostly of lichens and lined inside with soft grasses. It contained five pure white eggs.