

THE CARNEGIE INSTITUTION CALIFORNIA INSTITUTE OF TECHNOLOGY GRAND CANYON EXPEDITION

By Dr. John H. Maxson, '27

The Grand Canyon has long been known as one of the most spectacular and geologically important areas in the entire world. Since Major J. W. Powell made the first trip down the Colorado River in 1869, geologists have wished to decipher the history written in its thick sections of four great geologic eras. Some studies have been made by members of the United States Geological Survey, but these are either of reconnaissance nature or have been restricted to very limited areas. The great work of making detailed studies of the entire Grand Canyon remains to be done because many parts of the Canyon are virtually inaccessible. Field work is very expensive and few independent observers have been able to undertake research in the district. Several years ago Dr. John C. Merriam, President of the Carnegie Institute of Washington, decided to promote the detailed study. In 1932 and subsequently, portions of the work were undertaken by groups from various institutions supported by Carnegie grants.

The study of the Archean era represented in the Grand Canyon by the metamorphic schists of the Inner Gorge was begun by Doctors Ian Campbell and John H. Maxson ('27) in the fall of 1932. In subsequent field seasons they continued investigations at several localities of the more accessible portion of the Canyon, but the study of the crystalline rocks was greatly handicapped by difficulty in reaching their outcrop along the river. It was found necessary to make camps along the Tonto Platform, the great bench which lies some 3500 feet below the upper plateau and which forms the floor of the main or outer canyon. In this bench is cut the

smaller, narrower and steeper Inner Gorge, with the river at the bottom, some 1000 to 1500 feet below the bench of the Tonto platform. These camps were reached by mule trains and were located at the infrequent places where water appears. To these camps it was not only necessary to pack supplies for the men, but also grain for the pack animals. From these camps, descents were made down tributary canyons to the river but forbidding cliffs made impossible any extensive studies along the river itself. Therefore, it became necessary to consider a river trip to enable the completion of the studies.

Planning the details of river navigation was very much simplified for the geologists through the fortunate circumstance that the lower part of the Grand Canyon was surveyed in 1935-36 by Fairchild Aerial Surveys, Inc. This survey was made for the United States Reclamation Service in connection with the Lake Mead reservoir. The river work was necessitated by ground control for the airplane photographic survey. Under the direction of Mr. E. C. La Rue of the United States Geological Survey Colorado River Expedition of 1923, boats were constructed at the Pierce Boat Shop in Pasadena. They were constructed closely in accordance with the design worked out by the Kolbs and other early navigators of the Colorado River. They are made of Phillipine mahogany, are seventeen feet in length, four feet across the thwart and decked over fore and aft. This type of construction is necessary in order to keep provisions dry and to prevent swamping in rapids. A very sturdy construction is needed if boats are to withstand sharp impacts against boulders in swift water. During flood stages, velocities of thirty feet per second have been recorded. It is a tribute to the construction of these boats and to the skill of the boatmen that after two trips through the lower portion of the Grand Canyon and one trip through the entire length of the Marble Canyon and Grand Canyon they are still in good condition and could make the trip again.

It was decided to make the trip during the fall when there is an intermediate stage of water. Several factors influenced this choice. During high water it is often easier to run boats through rapids with less danger of striking submerged rocks; but boats are never controllable to any degree in excessively fast water and during floods a great deal of luck is required in getting through the worst rapids. On the other hand in very low water there is not a good channel between the rocks and portaging supplies and boats is necessary almost every mile. In intermediate water, not only is navigation best, but also camp sites are more easily found on the tributary deltas and good supplies of drift wood are available for



Dr. J. H. Maxson

Loading the boats at Lee's Ferry, Arizona, for the start of the trip. Vermillion Cliffs in the background.

fires. Intermediate water comes in fall when climatic conditions are best for geologic work. The weather is not excessively hot as in the summer and very few rains occur. However, the water of the river supplied from the high mountains of Colorado becomes progressively colder and the daily, sometimes hourly, duckings are not nearly as pleasant as they might be in summer.

Careful calculations were made of the amount of provisions required to maintain eight men isolated from all sources of supply over a period of two months. A portion of these were taken directly to Lee's Ferry, Arizona, the official starting point, and the remainder were deposited in warehouses of the United States National Park Service at Grand Canyon Village whence it could be brought by pack train to meet the expedition at Bright Angel Creek. During the first week of October, 1937, the boats were placed in the river, tested and prepared for the journey. The chief boatman was Frank B. Dodge, who has had much experience on the river. The other boatmen were Owen Clark and M. F. Spencer, both of whom were on the Fairchild Expedition. Doctors Campbell and Maxson were assisted in their geological study by Dr. J. T. Stark of Northwestern and Bob Sharp, class of '35. On October 11 the party set out from Lee's Ferry and by the end of the first day had had many memorable experiences. Badger Creek Rapids were reached about noon and since no navigable channel was to be found the boats were all unloaded and the supplies carried over the delta to below the swift water. The boats themselves were lined, that is, pulled and pushed over the rocks and through small channels adjacent to the bank. In this procedure all men had to participate, usually three on the bow line, three on the stern line, and two on the boat itself. The boats were awkward to handle, even when unloaded. They had weighed nine hundred pounds dry, and doubtless had increased to about one thousand pounds. When it was necessary to pull the boats directly over boulders, a block and tackle was used. So on the first day it was found that the descent down the Colorado River involved not only thrills and adventures, but also heavy physical labor in the hot sun.

As usual routine throughout the trip, camp was made at four o'clock in the afternoon and preparation for dinner begun. At five o'clock a portable shortwave broadcasting set was rigged by erecting an aerial over a drift wood pole. Considerable difficulty was experienced in making contacts because of the closely-hemming, nearly vertical walls of the Canyon. The central station was KNDO operated by the National Park Service at Grand Canyon Village, and on nearly every night satisfactory communications were established. These were useful in getting weather reports for the estimation of river conditions. In the past, expeditions have frequently lost boats and supplies through the water rising fifteen or twenty feet in one night.

Marble Canyon which was first traversed is cut in Paleozoic sandstones and limestones and in many places has a



Dr. Ian Campbell

Chief Boatman Frank Dodge starts through some rapids.

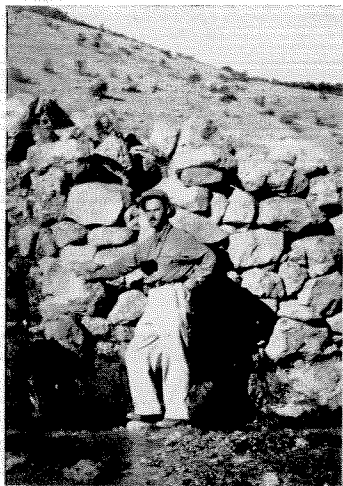
spectacular beauty. Numerous difficult rapids were encountered of which Soap Creek was perhaps the worst. Here one boat and the supplies were portaged. The remaining two boats were run through by Chief Boatman Dodge, the first time this has been done during a stage of intermediate water.

After a week the Grand Canyon itself was reached, and in it the first exposures of Archean rocks were encountered. Thenceforth the progress was slow because of the geological observations and mapping of the walls of the inner gorge. The mapping of rock types in the Archean was greatly facilitated by a series of overlapping vertical airplane photographs on a scale of six hundred feet to the inch made at an earlier date by Dr. Maxson. These enabled careful plotting of faults and contacts between rock types. Camps were usually made on tributary deltas within the narrow Granite Gorge and explorations extended up the tributary canyons. No great difficulties were encountered and a routine of study and work was developed. The expedition stopped over a day at the Suspension Bridge at the foot of the Yaki Trail below the Village of Grand Canyon while supplies were being packed down. On October 28 the expedition again started down stream and soon reached Horn Creek Rapids which has taken a toll of several lives. Two of the three boats were nearly swamped in shooting the rapids, but avoided collision with the huge rocks. The expedition proceeded, now and then lining around a particularly difficult or dangerous stretch of swift water, without accident. Many new geological data were obtained. At Upset Rapids the first boat was almost swamped by a wave near the top and became unmanageable as it was carried directly into a trough with a depth of about five feet. Chief boatman Dodge jumped overboard in the rapids and after some expert swimming caught up with the boat below and brought it safely to shore. This episode forms one of the most exciting sequences in the movies taken

of the trip. One or two other narrow escapes occurred when boats were thrown upon rocks in rapids. It could be easily seen that large flat boats with about a ton of weight apiece were much more difficult to handle in water flowing at six feet per second than a canoe on a quiet lake. At Separation Rapids, where three of Powell's men left his expedition to be subsequently murdered by Indians on the plateau, some understanding was gained for the fears and suspense prevailing during the first expedition when it seemed that the river was one continuous series of rapids and when there was no assurance that the next rapids might not be very much worse than any encountered theretofore.

After successfully running dangerous Spencer Creek Rapids which is now the last in the river, although it too will ultimately be covered by the rising water of Lake Mead, a certain amount of relief was felt by all members of the party and especially by chief boatman Dodge, whose responsibility it was to complete the navigation without mishap. It was, however, a letdown inasmuch as rowing the heavy boats through quiet water became somewhat monotonous. About sixteen miles from Pierce's Ferry, the motor boat belonging to the Grand Canyon Airlines gave the Institute group a tow, and on the evening of Thanksgiving Day the long river trip was officially terminated. The trip had been altogether pleasant and enjoyable, and the entire group immediately began to consider the pros and cons of again going down the Colorado River at another season.

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A snapshot of Dr. John H. Maxson, author of the preceding article, taken last summer at a spring near Hermis, S. E. Turkey, when he was employed as a petroleum geologist by the government of Turkey.

CALTECH GEOLOGISTS ABROAD

Former students of the California Institute have in the past five years travelled over much of the world. Geology is a science which has world wide applications, and searches for petroleum and ores which have been in progress have required the services of numerous Caltech men.

Willard A. Findlay, '29, left the Institute three years ago to work for Oil Search, Limited, in Australia. After spending an interesting year and a half studying the strata of this continent he was transferred to Portuguese East Africa and worked there for a considerable time. Subsequently he went to South Africa to continue the exploration for oil. He is now in London and expects to return for further work at the Institute the first of March, after having visited many countries and encircled the globe.

J. Clark Sutherland, '29, during a part of 1936, carried on mining investigations in Alaska, where he met many adventures including burial under an avalanche.

Francis D. Bode, '30, has spent the last year doing petroleum explorations in Italy and various Italian territories.

Burt Beverly, '26, is engaged in Standard Oil Company work out of Batavia, Sumatra. Ygnacio Bonillas, '33, for the past two years has been working for the Standard Oil Company in various parts of Mexico. Bernard Moore, '27, is going to Venezuela for petroleum work with Sinclair Oil. Willis P. Popenoe, Curator of Invertebrate Paleontology, has just returned from a five months petroleum investigation in the Philippine Islands. Nelson Harshman, '32, is now actively engaged in working for a mining corporation in the Philippines and has offices in Manila.

John Maxson, '27, spent 1936 and part of 1937 as petroleum geologist for the government of Turkey and made various explorations in Asia Minor. He subsequently attended the 17th International Geological Congress in Moscow and crossed through Siberia with the Siberian Excursion to Vladivostok. He returned via Japan and the Hawaiian Islands to Pasadena, where he has resumed his position on the staff of the Geological Sciences.

The great importance of petroleum and mineral resources in our modern civilization, together with the diminishing supplies, have brought about a great deal of exploration activity not only in the United States but also in the great undeveloped areas of the world. Many requests for Caltech geologists to enter foreign service are coming in to the Division of the Geological Sciences, and according to the best information available all men who have graduated in this department are employed.