

back to Kanab Creek canyon, also predating Powell's expedition on this portion of the Colorado. Beaman then hiked back to Lees Ferry, but was unable to cross into Navajo country because of high water, so he went to the Buckskin Mountains on the Kaibab Plateau and obtained pictures of the Colorado from the North Rim. The account of his journeys was serialized in the now-extinct *Appleton's Journal*.

A new photographer, James Fennemore, was recruited in Salt Lake City to replace Beaman. He remained with the Powell party for only a few months, as ill health forced him to leave before the river trip was resumed in the latter half of August 1872. One of his major contributions to the expedition, however, was his training of Hillers, who then assumed the photographic responsibilities. In April 1872, while the rest of the party were at Kanab or off on their own individual adventures, Hillers accompanied Fennemore into the Grand Canyon to photograph Lava Falls. Then, in July 1872, Fennemore took a number of photographs in Glen Canyon—now submerged beneath Lake Powell.

The brief apprenticeship with Fennemore started Hillers on a promising photographic career. Hillers took the remainder of the pictures on the river trip—all of those in Marble and Grand canyons, and several in Kanab Creek canyon. Hillers remained with the Powell survey as its photographer and later became Chief Photographer for the U.S. Geological Survey. He retired from the Survey shortly after the turn of the century.

### **Importance of the Powell Photographs**

The pictures acquired on the second Powell expedition were the basis for illustrations in Powell's Smithsonian Report. Because the halftone process had not yet come into use, Powell used reproductions of line drawings made by artists from the photographs. These included scenes at various points in the upper canyons and in Grand Canyon and several outstanding portraits of Indians made by Hillers. Some liberties were taken by the artists who prepared the line drawings. In composing the pictures of the canyons, they often exaggerated the height and steepness of canyon walls.

The pictures also played an essential role in lecture tours that Powell made during the following years. These tours, one of them with Hillers as projectionist, provided Powell and Hillers with considerable income. In addition, Powell sold reproduction rights for a large number of stereophotographs, which were distributed throughout the country for home use in the then-popular stereopticon viewer.

Approximately 225 pictures or stereopairs of pictures suitable for reproduction were made by Beaman, Fennemore, and Hillers. About two-thirds of these were taken by Beaman, a few by Fennemore, and the remainder by Hillers. Most of the pictures are stereopairs taken on plates about 5" x 8"; each half of the pair measures 4" x 5". A smaller number of pictures were taken on the large 11" x 14" plates. Most of the views are of the canyonlands country along the rivers or of the rivers taken from the canyon rims. One

or more members of the Powell expedition are included in twenty-one of the photographs, and one portrays the entire group in the boats at the start of the second expedition.

Most of the photographs in the collection are excellent, and some are superb. The best of them are as good as any obtained by W. H. Jackson, famous for his western scenes. Both Beaman and Hillers deserve to be recognized among the giants of early western photography.

Less than 100 plates from the original set still exist. Some are in good condition, but many are not. Most have pinholes and scratches; some are chipped and broken. Nearly all the pictures have the spots or blemishes that were inherent in the old wet-plate process. Varnish was often used to preserve the surface emulsion, and brush marks are conspicuous on many of the plates. The skyline in many of the photographs was altered when the sky was opaqued to remove obvious defects in the plate emulsion.

During the 1930s, many of Hillers's plates and some of Beaman's were destroyed to conserve critical storage space at facilities of the U.S. Geological Survey. Reference prints of excellent quality, however, had been made by the Survey from these plates. The prints were photocopied at the Survey's Flagstaff, Arizona, Field Center, and some have been selected for this album.

The remaining original photographic plates (exclusive of pictures of Indians) compose the Hillers Collection, which now resides in the National Archives. Copy negatives of these plates filed in the U.S. Geological Survey archives in Denver, Colorado, along with the prints from the destroyed plates, provided the source of reference prints used on our river trip in 1968. The identifications of the pictures have become scrambled over the years. The only direct information that we have on the pictures consists of captions and sparse marginal notes in the U.S. Geological Survey's reference album of the Hillers Collection. In some cases, even these captions proved to be in error.

The photographs of Powell's second expedition down the Green and Colorado rivers have never been systematically published. The most extensive published use of the photographs was made by Frederick S. Dellenbaugh in his two books, *The Romance of the Colorado River* and *A Canyon Voyage*, both of which appeared more than thirty years after the time of the expedition. The pictures were reduced in size in these books and hardly do justice to the quality of the original photographs. Reprints of the books by the offset method in recent years have further degraded the quality of the pictures. The public thus has had very little opportunity to examine these historic photographs in anything near their original state.

A few of the plates from the 1871-72 expedition, especially those by Hillers, have been used in various publications of the U.S. Geological Survey. Most of the Beaman and Hillers pictures, however, have never been seen in any form by the public, except possibly as stereopticon pictures circulated more than three generations ago.

The most reliable source materials left today to aid in identification of the Beaman, Fennemore, and Hillers pictures are the diaries and journals kept by the various members of the party. A surprising amount

of factual information is contained in some of these accounts. Journals were kept by Major Powell, Thompson, Bishop, Jones, Steward, W. C. (Clem) Powell, Hillers, and Dellenbaugh. Of these, the journals of Thompson, Bishop, Jones, Steward, and W. C. Powell have been published by the Utah Historical Society. Dellenbaugh published his own account in his two books, particularly in *A Canyon Voyage*, which he intended to be the principal narrative record of the expedition. The book, however, is not in diary form and is not very useful as an account of day-to-day activities of the trip. His unpublished diary, upon which *A Canyon Voyage* was based, contains a great deal more of specific information.

Powell's journal was deposited in the Bureau of Ethnology of the Smithsonian Institution and may some day be published. Hillers's diary was published by the University of Utah Press (Fowler, ed., 1972). It does provide a daily account of the expedition and is quite detailed in places.

### **The 1968 Expedition: Purpose, Organization, and Photographic Techniques**

The U.S. Geological Survey, in conjunction with the Smithsonian Institution and the National Geographic Society, planned to commemorate in 1969 the centennial of Powell's first river voyage. As part of the Survey's participation in the centennial, E. M. Shoemaker proposed to the Survey to retrace the entire length of Powell's second expedition down the Green and Colorado rivers. The major objectives were to relocate as many of the Beaman and Hillers camera stations as possible, identify positively the pictures taken from the stations in 1871-72, and rephotograph the scenes from the original camera stations. The plan was for H. G. Stephens to accompany Shoemaker over the traverse and to be responsible for the photography.

The proposal was approved by the Survey and the logistics of the three-month 1968 expedition were planned forthwith. The Green and Colorado rivers were divided into six geographic segments, and about two weeks of field work were allowed for each segment. Fifteen-foot neoprene inflatable rafts, sometimes rigged with rowing frames and oars, and sometimes propelled with canoe paddles, were used—two on the upper parts of the Green and Colorado and five in Marble and Grand canyons. An eighteen-foot power boat was used to locate the positions of camera stations submerged by Flaming Gorge Reservoir.

The crews of our river party changed from segment to segment. They included members of the U.S. Geological Survey from Denver and Flagstaff and veteran river runners from Denver, Pasadena, and elsewhere (their names are listed in the acknowledgments). Several of the participating geologists prepared detailed geologic logs of various portions of the river, which have since been published by the Powell Society, Ltd., of Denver (see Selected Reading).

Field work on the river centered around the problem of locating each Beaman or Hillers camera station. A file had been prepared in advance, containing data folders devoted to each day of Powell's expedition.

## INTRODUCTION

For a given day, the folder contained copies of all the journal entries by Powell expedition members, prints from the Hillers Collection, and maps showing probable locations of camera stations and Powell's campsites occupied on that date.

Our detailed knowledge of the canyon geology was a major factor in locating the old camera stations.

Once we recognized the general geologic features in a Beaman or Hillers photograph, we landed and determined the exact camera site on the river bank by study of the reference picture and analysis of parallax between features in the near and far fields. When we were able to identify positively the foreground features in the photographs, we could usually find the camera station within a few inches of the exact spot. While Shoemaker prepared descriptive notes of the site, Stephens placed his camera on a tripod as near to the original camera position as possible and took a duplicate picture.

At a few places on the river banks, Stephens could not occupy the exact station because it had been changed by the river, a tributary stream, or a rock fall. In the Canyon of Lodore, for example, a ten-ton boulder from the high canyon wall now reposes on the station where Beaman had set up his camera to obtain photograph 504. The 1968 photographs, in such cases, were taken from an offset position, the extent of which is noted in their captions. At other places, we encountered heavy growths of tamarisk (introduced into the region some time around the turn of the century), box elder, or cactus that obscured the view from a formerly barren camera site. At one station on Kanab Creek, that cactus was not to be argued with! It was impossible, of course, to reoccupy sites now flooded by Flaming Gorge Reservoir and Lake Powell. We were able to duplicate roughly some of the gorge scenes, but the lake has drowned the Glen Canyon of Powell's day so completely that we omitted the 162 river miles between Hite, Utah, and Lees Ferry, Arizona.

It was unfortunate that the tight schedule of our trip did not permit us to photograph all the scenes at the ideal time of day. Especially in narrow side canyons, contrasts in light were at times so strong that details were lost in shadow. Conversely, to photograph some foreground details properly, we had to sacrifice the clarity of distant features. In this respect, Powell's photographers were sometimes more fortunate than we were. In almost all cases, however, where one picture has lost detail, its mate has not, and the reader can visualize the scene by studying the two together.

Stephens used a Graflex XL camera with a 2 1/4" x 3 1/4" format to rephotograph the scenes. His lens was an ultra-wide-angle lens, a Schneider Super Angulon of 47-mm focal length. For all exposures, he used Eastman Kodak Plus-X roll film, 120 size, rated at 160 ASA, and a medium-yellow filter. (Use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.)

Stephens's use of only the wide-angle camera came about by accident. At the beginning of our expedition, we did not realize that Beaman and Hillers had used a camera with extremely wide-angle coverage, and we planned to do our work with a standard-lens camera. We did have a back-up camera with us,

though—luckily a wide-angle one. When Stephens, who was carrying the standard camera on his back, fell on it while climbing steep slopes in Canyon of Lodore, the wide-angle camera was all we had. It proved, after all, to be the one best suited to matching the 1871-72 pictures.

### Preparation of the Album

Altogether, we identified about 150 camera stations of the Powell expedition. Of the resulting sets of photographs, we selected 110 for this album. We cropped and scaled our 1968 pictures to obtain a reasonably good match of the original pictures. Reference numbers assigned by the U.S. Geological Survey many years after the expedition are used by the National Archives to identify the Beaman-Hillers photographs. These numbers are retained in this album.

Restoration of the old photographs taken by Beaman and Hillers was a complex and difficult process. We were fortunate that it could be done in the Survey's photographic laboratory at Flagstaff, whose personnel had been processing the images obtained from lunar and planetary exploration and were familiar with techniques that would both enhance the photographs and remove artifacts. The laboratory produced 8" x 10" copy negatives from the contact positives made by laboratories at the National Archives. These negatives were retouched, and 11" x 14" positive prints were made from them in order to remove the undesirable effects of both opaque and clear blemishes. The 11" x 14" prints became the final product for publication. We used 8" x 10" copies of these prints for review and editing.

Introductory sections precede the photographs reproduced for each segment of the 1968 expedition. They are designed to provide continuity to the series of paired photographs and to acquaint the prospective river traveler with the character and mood of each canyon traversed; geologic comments here are of a general nature. (We have provided at the back of this book a glossary of terms, largely geologic, that may be unfamiliar to the general reader.) Captions under the pairs of pictures describe in greater detail the rocks viewed in each scene. (The river runners' guides published by the Powell Society, Ltd., listed in Selected Reading, provide a continuous account of the geologic formations and structures along the rivers together with historical background.) The dates given with the Powell pictures were obtained or inferred from the journals of the expedition members; therefore, some dates given are more precise than others.

Formally named geologic units that we describe are tabulated at the beginning of each segment of our 1968 trip so that the reader may know the proper position of each unit in the stratigraphic column. The units are listed in conventional order (youngest at top, oldest at bottom). The tables include *only* those units mentioned, and some that may be present in the area are therefore not listed. (For example, in Table I we show the Dakota Sandstone on the Curtis Formation, but in Table II the Morrison Formation rests

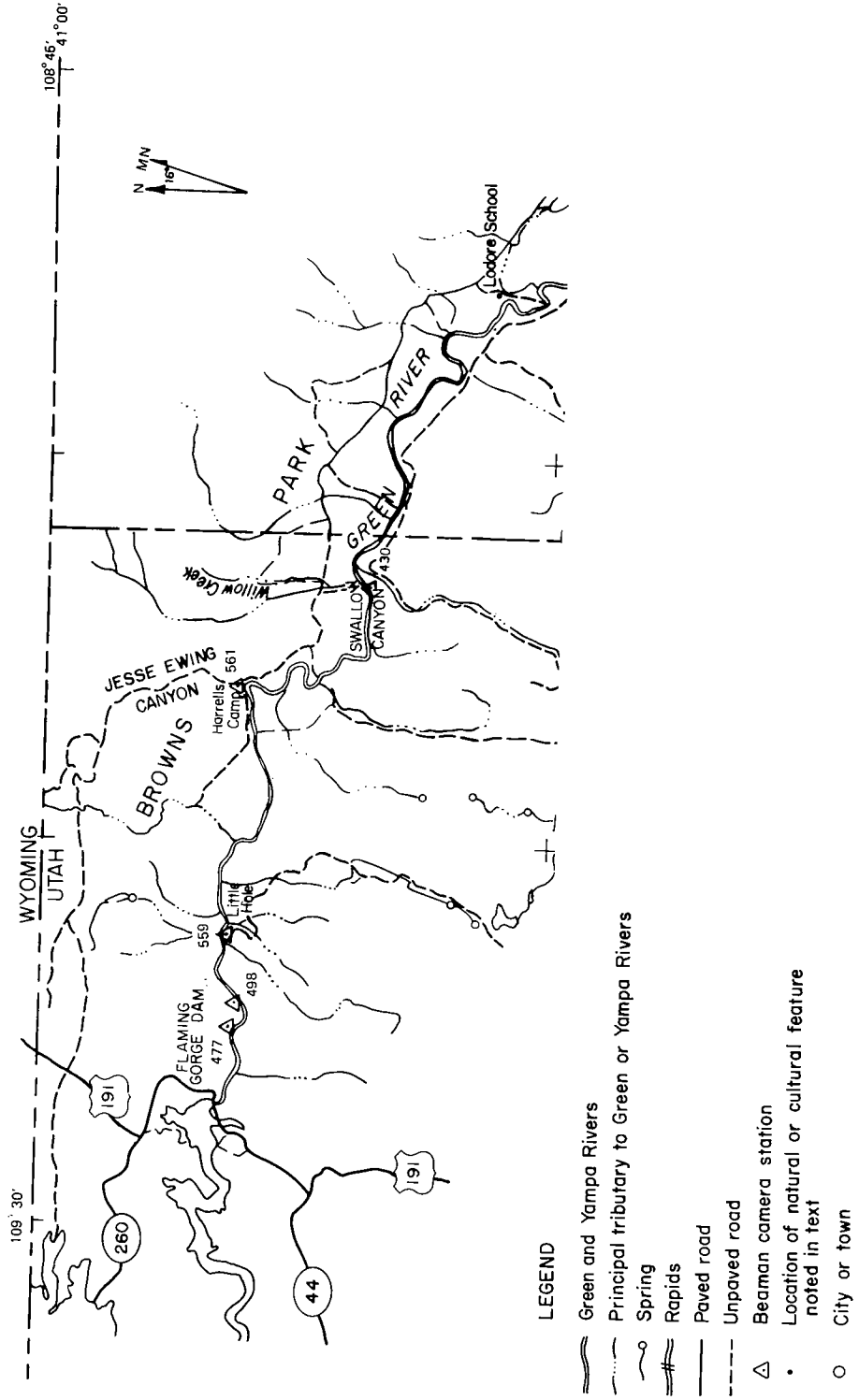
on the Curtis Member of the Stump Formation. A complete geologic section would include the Morrison Formation and the overlying Dakota Sandstone.) Nomenclature of the units has changed considerably since the 1870s as the geology of the region has become better understood. We use the names presently accepted by the U.S. Geological Survey, but we have included Powell's original nomenclature. A complete geologic time scale is given at the back of the book.

We feel certain that some readers will be interested in studying further the topography of individual areas. Therefore, with each of the 1968 pictures we give the name and size of the pertinent topographic quadrangle map. The scale of the quadrangles covering  $7\frac{1}{2}$  minutes of latitude and longitude is 1:24,000 (1 inch = 2,000 feet); that of the 15-minute quadrangles is 1:62,500 (1 inch = about 1 mile). All of these maps in the four states may be ordered from the Branch of Distribution, U.S. Geological Survey, Box 26286, Federal Center, Denver, CO 80225. Also available from this source are four special-area topographic maps that cover parts of the river traverse: Canyonlands National Park and vicinity, Utah; Dinosaur National Monument, Utah-Colorado; Glen Canyon Recreational Area, Utah-Arizona; and Grand Canyon National Monument, Arizona. (Grand Canyon National Monument is now part of Grand Canyon National Park.) Our usage and spelling of place names are those of the topographic maps.

A trip through the canyons of the Green and Colorado rivers provides the traveler with views of some of the most extraordinary exposures of geologic sections seen anywhere in the world. Beginning in rocks of Tertiary age, less than 60 million years old, at Green River, Wyoming, one travels nearly a vertical mile down through the geologic column to Early Proterozoic (Precambrian) exposures in the Inner Gorge of the Grand Canyon that are more than 1.5 billion years old. Through the photographs and notes in this album, we hope to convey the character of the rugged canyon country, the awesome views, and the fearsome but exhilarating rapids that confronted John Wesley Powell and his courageous party during their history-making explorations of the Green and Colorado rivers. Tens of thousands of people have run the Colorado River through the Grand Canyon since the time of Powell, but it remains one of the most adventurous and exciting experiences of our time.

Map of second segment of 1968 USGS expedition, showing location of camera stations: Flaming Gorge Dam, Utah, to Dinosaur National Monument Campground, Utah

North Half



South Half

