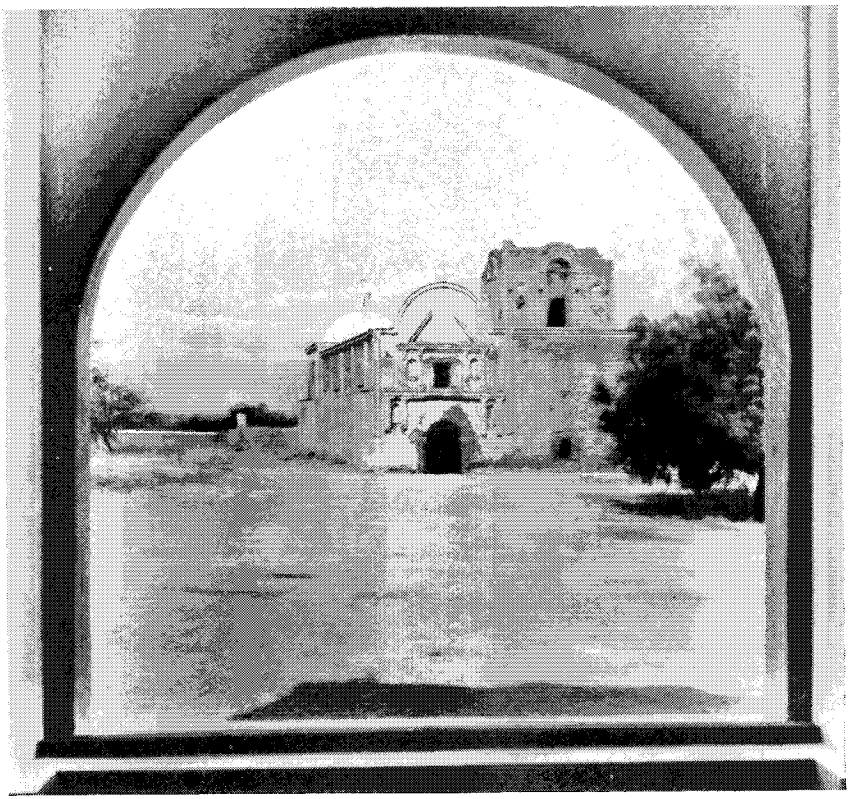
NATIONAL PARK SERVICE

FIELD MANUAL FOR MUSEUMS



THE MISSION AT TUMACACORI NATIONAL MONUMENT, ARIZONA,
AS SEEN FROM A WINDOW OF THE MUSEUM

Field Manual *for* Museums

by

NED J. BURNS

CHIEF, *MUSEUM DIVISION*

NATIONAL PARK SERVICE

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FOREWORD

THIS *manual has been prepared to aid those individuals—monument custodians, park naturalists, historians, and museum curators—who operate National Park Service museums in the field. For these men, who are creative experts in the art of interpreting their areas to the public, museums are among the important instruments employed in the notable service they perform. Therefore, they frequently require some convenient source of information on the intricacies of the various museum techniques.*

The contents have been determined by past experiences in answering the requests which come in from the field for advice on handling the many museum problems which arise. It would be impossible to encompass in one large book, or even several volumes, a complete description of all the phases of museum construction and maintenance. The allied techniques of collecting and preserving material objects, not to mention their preparation and exhibition, would require still more space.

Such facts of operation as occur infrequently or require the services of the specialist have been mentioned but briefly or entirely omitted. Other phases have been emphasized and in some cases repeated under several headings. This is particularly true of safe practices and precautions to be followed, so that injury to the custodian, as well as to the historic and scientific material under his charge, may be avoided.

It is hoped that this manual may also be useful to the State parks and various cooperating governmental agencies in answering some of the constantly recurring questions on technical museum subjects received from them by the National Park Service.

ARNO B. CAMMERER, *Director.*

ACKNOWLEDGMENTS

ALL members of the Museum Division staff aided in assembling information and writing certain sections of this manual. Their personal knowledge and experience have been augmented by consultations with many specialists and reference to Government and other technical publications. The drawings of equipment were made by Albert McClure.

Dr. Carl P. Russell, Supervisor, Branch of Research and Information, of which the Museum Division is a part, has participated in the writing and has reviewed the entire text. The section on historic house museums was prepared in cooperation with the Branch of Historic Sites. In compiling the chapter on collecting, cleaning, and preserving, the National Museum, the National Bureau of Standards, the National Herbarium, the Geological Survey of the United States Department of the Interior, and various bureaus in the Department of Agriculture, especially the Bureau of Agricultural Chemistry and Engineering, the Bureau of Entomology and Plant Quarantine, and the Bureau of Home Economics, were consulted. Extracts were made from the publications of these and other agencies. The series of pamphlets by the American Museum of Natural History and the National Museum on collecting and preserving were also used repeatedly. Among other standard publications used were the handbooks on technical methods by Douglas Leechman, Alfred Lucas, and H. J. Plenderleith, and the manuals of Coleman and Parker. These books are cited in the bibliography.

Appreciation is expressed to A. E. Demaray, Associate Director, whose guidance has been all-important in establishing the Museum Division in the administrative structure of the National Park Service; to Roy W. Miner, of the American Museum of Natural History for assistance in preparing the section on preserving invertebrates; to John W. Myer, of the Museum of the City of New York for important additions to the bibliography; to Carlos E. Cummings, Director of the Buffalo Museum of Science, for contributions to the general fund of ideas entering into this manual; to Douglas Leechman, of the National Museum of Canada, for personal suggestions on technical methods; to S. H. P. Pell and Milo S. King, of the Fort Ticonderoga Museum; to Sabra W. Vought, Librarian, United States Office of Education; to F. C. Bishopp, J. A. Hyslop, R. C. Roark, and R. A. St. George, of the Bureau of

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Special thanks go to Dr. H. C. Bumpus whose personal labors and discerning judgment have entered into the practical procedure and basic philosophy of park museum work from its early days to the present writing. This manual may well be regarded as evidence that the field museum program anticipated by Dr. Bumpus and his associates of the Committee on Outdoor Education is an established instrument in teaching Americans to know their heritage.

CHAPTER ·I·

THE ROLE OF MUSEUMS IN NATIONAL PARKS

IN 1895 George Brown Goode defined a museum as ". . . an institution for the preservation of those objects which best illustrate the phenomena of nature and the works of man, and the utilization of these for the increase of knowledge and for the culture and enlightenment of the people." This definition is as true today as when it was first presented. Museums in America have increased in number, size, and value during this period with remarkable rapidity and have developed from mere storehouses for curiosities to institutions alert to serve many of the educational and cultural needs of the community. National park museums have shared in this development.

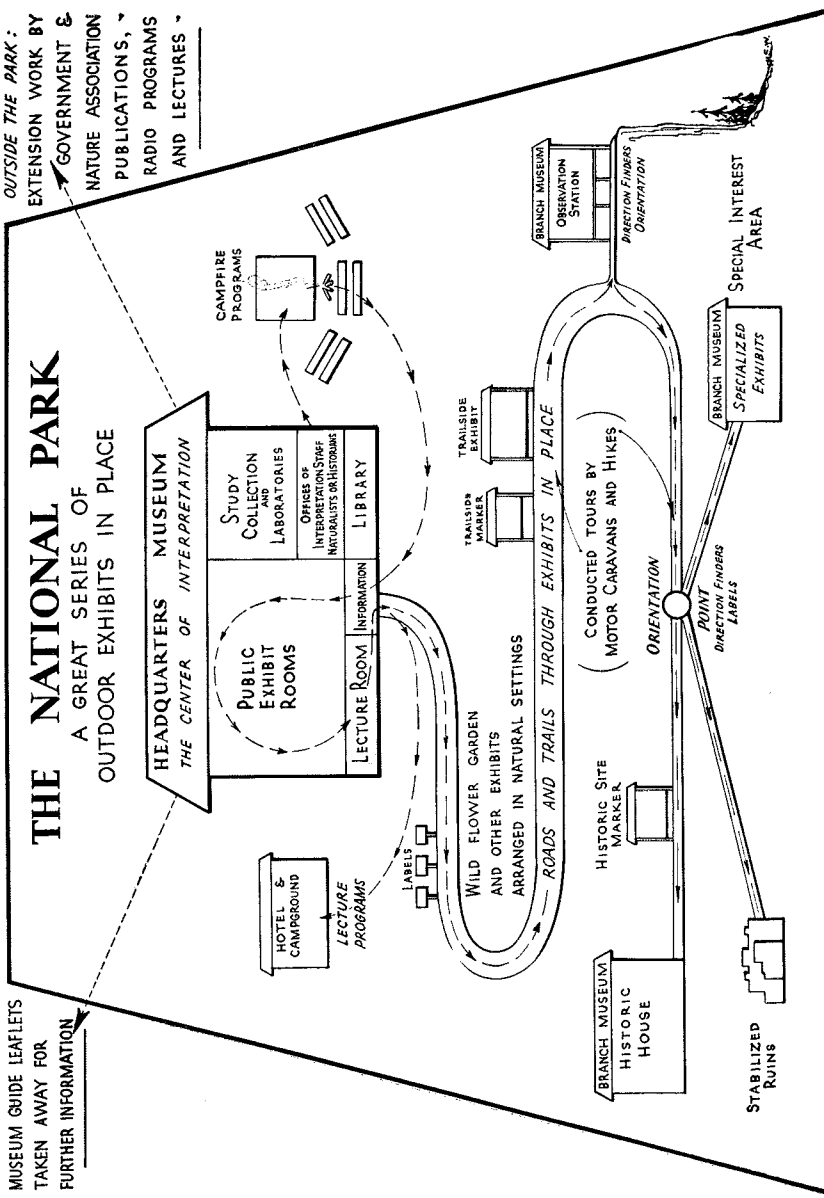
CHARACTER AND FUNCTIONS OF PARK MUSEUMS

The National Park Service has two main duties—to preserve the areas under its charge and to make them available for the enjoyment and inspiration of the people. Museums in national parks also have these functions of preservation and use, which are really common to all museums. They preserve the objects within a park which are too perishable or valuable to remain unsheltered or too fragile to withstand handling, and which thus need the protection afforded by the museum building and its cases. The museums also make available in comprehensible and attractive form the facts that will give the public a greater understanding, appreciation, and enjoyment of the natural and historical features of the park. Since this function of interpreting the park is all the average visitor sees in a park museum program, little thought may be given by the visitor to the even more important work of preservation. If not a single exhibit were displayed, a museum would still be needed as a haven for the irreplaceable objects of both historic and scientific value which form a part of every park. Although emphasis is rightly given the policy of leaving outdoor exhibits in place, this ideal is not always attainable. Most prehistoric artifacts, fossils, and even many minerals deteriorate rapidly when uncovered and left to the

elements and may invite theft or vandalism if unprotected. The hosts of animals and plant specimens which must be collected for identification and study require safe housing, and historical and ethnological objects need museum care.

While park museums perform the same general functions as other museums, they have a special character of their own. They are not independent, self-sufficient institutions but units in a larger interpretative program. In each park the naturalist or historian has a number of methods through which he interprets his area to the public. They include field trips, lectures, publications, and other activities, and the museum is one of them. Its exhibits tell the parts of the park story that are best explained by viewing original objects and the graphic devices which accompany them. Together these agencies interpret the park more clearly to more people than any one of them could do alone. The men who developed the park museum idea conceived of the subject matter for these museums as a story. In a park geology, biology, anthropology, and history are not widely separated fields of knowledge. They are so related and bound up in the features of the park that it is possible to integrate them in a coherent story which explains and illuminates the meaning of the park. With this conception on which to build, park museums have developed the narrative technique of exhibition further than have most others. Each exhibit case may be regarded as a chapter carrying the story forward in logical sequence. Park museums are small, isolated units widely scattered over the country, yet they are unique as a whole in forming a coordinated system with a common objective. Each museum tells the story of its area, but in so doing it tells part of a larger story which embraces the whole nation—the story of America which the national parks seek to present. Perhaps the main distinguishing characteristic of park museums, however, is their close relationship to the parks they serve. Since the museum is interpreting the park, its main exhibits are concerned with the park features and such phenomena outside its boundaries as may be pertinent. The formal exhibits in the museum building are merely explanatory devices to make clear the natural and historical exhibits outside. In a sense the park as a whole may be regarded as an exhibit and the museum as an explanatory label. This concept underlies all park museum work. (*See* Fig. 1.)

Each park museum is operated by the local naturalist, historian, or custodian, but the development and direction of park museum work as a whole is the responsibility of the Museum Division. This system permits each museum to adjust its work to the needs of its own park and at the same time gives to each many of the advantages of a professional museum


THE NATIONAL PARK
A GREAT SERIES OF
OUTDOOR EXHIBITS IN PLACE
OUTSIDE THE PARK:
EXTENSION WORK BY
GOVERNMENT &
NATURE ASSOCIATION
PUBLICATIONS,
RADIO PROGRAMS
AND LECTURES
MUSEUM GUIDE LEAFLETS
TAKEN AWAY FOR
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LECTURE PROGRAMS
LABELS
WILD FLOWER GARDEN
AND OTHER EXHIBITS
ARRANGED IN NATURAL SETTINGS
ROADS AND TRAILS THROUGH EXHIBITS IN PLACE
TRAILSIDE EXHIBIT
TRAILSIDE MARKER
CONDUCTED TOURS BY
MOTOR CARAVANS AND HIKES
ORIENTATION
POINT
DIRECTION FINDERS
LABELS
HISTORIC SITE MARKER
BRANCH MUSEUM
HISTORIC HOUSE
STABILIZED RUINS
BRANCH MUSEUM
SPECIALIZED EXHIBITS
SPECIAL INTEREST AREA
BRANCH MUSEUM
OBSERVATION STATION
DIRECTION FINDERS
ORIENTATION

Figure 1

staff to correlate the local with the national aspects of interpretation. Through the Museum Division every park has at its disposal the services of museum administrators, curators, and two well-equipped laboratories manned by preparators who are acquainted with the best methods of museum preparation and installation. After cooperating with the park staff on plans, the division specifies equipment, builds and installs the exhibits, and turns over to the park a museum ready for operation. It offers advice and assistance on exhibit problems arising in the field; gives instructions for preserving specimens or in the case of unusual and valuable specimens undertakes their treatment directly; and supplies collecting, storage, and study equipment. It endeavors to strengthen the individual museums and the system as a whole by maintaining high standards of preservation and exhibition.

HISTORY OF PARK MUSEUMS

The idea of presenting exhibits of interpretative nature to national park visitors had its inception in the minds of army officers who nearly 40 years ago administered Yosemite National Park. In Maj. John Bigelow's report as Acting Superintendent of Yosemite for 1904, there appears the following passage:

> Under date of September 15 I reported to your office (Secretary of the Interior) the establishment in the park of an arboretum and botanical garden under the designation of the arboretum. This institution has since that date been improved and developed by the posting of more signs and labels, the opening up of paths, the putting up of sign-posts, and seats, the trimming of trees, and removal of deadwood and other debris. The trees and plants now marked number 36. A number of labels are ready, and soon to be put up. Tags for temporary use have been ordered. In this connection I wish to acknowledge my indebtedness to First Lt. Henry F. Pipes of the Medical Corps, for his zealous and efficient assistance as officer in charge of the arboretum. Principally through the labors of this officer, the arboretum has been brought to a condition in which it may be considered as worthy and susceptible of development into a prominent feature of the park. I hope it will some day be supplemented by a building serving the purpose of a museum and library.

Subsequent reports of the acting superintendent reveal that the site chosen for the arboretum proved to be on privately owned land near Wawona. The arboretum project was abandoned and the museum-library plan bore no fruit.

Probably the earliest museum work of a practical nature done in a park area is traceable to the collecting of museum material by Frank Pinkley in the present Casa Grande National Monument in 1905.

In 1915, just prior to the establishment of the National Park Service,

F. S. Townsley, chief ranger, began preparation of mounted bird and mammal specimens which he exhibited in the ranger's office in Yosemite Valley. The ranger's office was the principal public contact station of the government, and much interest was manifested in the improvised exhibits. Mr. Townsley's displays may be considered to have been the first collection and exhibit from which grew the Yosemite Museum. The first park museum to be opened as such was the Mesa Verde Museum established by Superintendent Thos. Rickner in 1918. Three years later the Mesa Verde Museum was expanded greatly by Superintendent Nusbaum.

Ansel F. Hall, serving as information ranger and nature guide in Yosemite National Park, initiated the collection of scientific specimens and historical material to be added to the Townsley collection in Yosemite Valley, and by 1920 the idea of a Yosemite museum program had developed sufficiently to enable Mr. Hall to occupy the old Chris Jorgensen studio as museum and naturalist headquarters. The Yosemite Museum Association, predecessor of the Yosemite Natural History Association, was organized, and a fund of some $9,000 was raised for museum work. Director Mather in his fourth annual report to the Secretary of the Interior (1920) stated: "One of the most important matters to receive earnest consideration is the early establishment of adequate museums in every one of our parks," [1] and referred to museum work being done in Yellowstone, Mesa Verde, Casa Grande, and Yosemite. In 1920, also, a broad program of interpretative work—guided trips and regularly scheduled lectures—was instituted in Yosemite by H. C. Bryant, L. H. Miller, Enid Michael, and Mr. Hall. The next year, 1921, witnessed further work in exhibits preparation and installation, and by 1922 the Yosemite Educational Department was regularly established with Ansel F. Hall, appointed to the full-time position of park naturalist, in charge. From the beginning the Yosemite Museum functioned as headquarters for the Educational Department. Summer ranger-naturalists, of which Dr. H. C. Bryant was senior, centered their activities upon the Museum. *Yosemite Nature Notes* was produced in mimeographed form and became the official mouthpiece of the Museum and the Naturalist Service.

Chauncey J. Hamlin, president of the American Association of Museums, witnessed the effectiveness of the Yosemite educational work and determined to lend the support of his great organization. At the suggestion of Stephen T. Mather a committee on museums in national parks was estab-

[1] Stephen T. Mather. Museums for park visitors. Report of the Director of the National park service for 1920. p. 59.

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lished within the American Association of Museums. The personnel of this committee follows:

Chauncey J. Hamlin, chairman.

Dr. Clark Wissler, curator of anthropology, American Museum of Natural History, vice chairman.

Robert Sterling Yard, executive secretary, National Parks Association, secretary.

John B. Burnham, president of the American Game Protective Association.

Dr. H. C. Bumpus, of Brown University.

Laurence Vail Coleman, secretary of the American Association of Museums.

Dr. A. R. Crook, chief of the Illinois State Museum.

Dr. Vernon Kellogg, secretary of the National Research Council.

Dr. Frederic A. Lucas, honorary director, American Museum of Natural History.

Dr. John C. Merriam, president of the Carnegie Institution of Washington.

George D. Pratt, vice president of the Brooklyn Museum of Arts and Sciences.

Prof. Charles L. Richards, director of the American Association of Museums.

In making its report to the Laura Spelman Rockefeller Memorial, this committee at a meeting held June 18, 1924, said:

> If a museum (installed and supervised by a trained scientific staff) should be located in each of the more important national parks, and would take upon itself the preparation of the visitor for a profitable sojourn within the reservation, thus enabling him the better to understand the physiography, the fauna, and the flora, and, in short, preparing him to use these parks and their resources as instruments of instruction, it is conceived that an important educational need would be met and the plan would meet with such universal approval as to lead to its general adoption.

Dr. Bumpus was asked to assume leadership for the field program to be undertaken by the American Association of Museums when $75,500 was obtained from the Laura Spelman Rockefeller Memorial with which to create a model park museum to serve as a demonstration of educational possibilities in the field of national park activities.

In 1923 Mr. Hall was made chief naturalist for the entire park system and Carl P. Russell was appointed to the Yosemite Park naturalist position. The next year, 1924, plans for the new Yosemite Museum were perfected with Herbert Maier, Ansel F. Hall, and Carl P. Russell working under the guidance of Dr. Bumpus in constructing the building and preparing ex-

hibits in geology, biology, ethnology, and history. From the first planning a naturalists' library featured prominently in the scheme. The building was opened to the public on the 29th of May, 1926.[2]

During the first year of the new museum's work, its activity was extended beyond the congested floor of Yosemite Valley. Appreciative Yosemite visitors in growing numbers discovered that the Valley is a very small part of Yosemite National Park. Crowds of people frequented such localities as Glacier Point, Mariposa Big Trees, Tuolumne Meadows, and high-country lakes. It was deemed reasonable to follow a part of the summer population to points having unusual teaching value or outstanding scientific interest. Accepting the precept that the real museum is outside the walls of the building and believing that the purpose of park museum work is to interpret the exhibits of the out-of-doors, Dr. Bumpus and his committee on outdoor education introduced the idea of trailside or branch museums. With the cooperation of the Yosemite Natural History Association, the Yosemite Park & Curry Co., and the American Association of Museums the first focal point museum, the Glacier Point Lookout, was built and opened to the public in 1925.

The Yosemite School of Field Natural History, established in 1925 by Dr. H. C. Bryant, found laboratory facilities and classroom space within the park museum. The National Park Service and the Yosemite Natural History Association in fostering this school work anticipated needs for individuals trained to conduct interpretative work in parks. Museum service takes proper place in the program of the school as does the teaching of general conservation needs. Each graduate of the school returns to his or her community equipped through field experience to teach nature study and to aid the American public to comprehend the values of national parks. In 1940 nearly 300 graduates of the Yosemite School are advancing the cause of conservation. Twenty-four of the graduates hold full-time positions as rangers, chief rangers, park naturalists, custodians, librarians, museum curators, and wildlife experts in the national parks. Fifty-five have served in national parks as summer rangers or ranger-naturalists, and 23 have worked in organized summer camps, as naturalists in State parks, as museum specialists, or in government bureaus other than the National Park Service. A great majority of the graduates not accounted for in the above classification are employed as school teachers about the country, where they implant the national-park idea in the fertile mind of American youth. The museum method of nature teaching is not forgotten by many of these

[2] Chauncey J. Hamlin. Yosemite museum formally presented to Park service. Yosemite nature notes, 5: 95, December 31, 1926.

workers, and the Yosemite Museum remains in their minds as the home of the Yosemite School.

In brief it may be said that the Yosemite Museum is the hub of the educational endeavors of the park staff. It renders important service in helping to lay that foundation of public understanding so essential to intelligent administration of natural resources, and it has become indispensable to staff members who utilize it as headquarters for official labors and personal study. What is true of the Yosemite Museum may be said of other central museums in the national parks, generally.

The immediate success of the Yosemite undertakings [3] caused the American Association of Museums to ask for funds for two additional trailside museums: one at Bear Mountain in the Palisades Interstate Park, New York-New Jersey, and another at Yavapai Point on the South Rim of Grand Canyon National Park, Arizona. Again the Laura Spelman Rockefeller Memorial supported the work granting, in 1926, $20,000 for the development of the museums and $2,500 for committee expense. The Bear Mountain program, one of the first museum ventures in a State park, was adopted by the American Museum of Natural History. Under the direction of William H. Carr, it has grown until the original trailside museum built in 1927 is but one of several museums at Bear Mountain. The work is maintained jointly by the Commissioners of the Palisades Interstate Park and the American Museum of Natural History.

The Yavapai station in Grand Canyon National Park strives to serve the park visitor while his attention is focused upon the magnificent spectacle, the Grand Canyon of the Colorado. It is planned and equipped to interpret the essential features of that spectacle. Telescopes bring distant features within the clear vision of the visitor, graphic exhibits clinch the story for him, and competent attendants and popular publications coordinate the evidences presented by nature and the museum technician. The station is in effect a window through which one may look into the canyon and into the realm of science pertaining to this natural wonder. In perfecting this unique interpretative device, the National Park Service obtained the cooperation of the Carnegie Institution, the National Academy of Science, the Geological Survey, and the Biological Survey, as well as the American Association of Museums. Dr. John C. Merriam gave general direction to the development of the project. The Yavapai station has functioned since 1928 and has demonstrated that the park visitor can see and interpret for himself the magnificent geological exhibit that nature has provided in

[3] Carl P. Russell. The Yosemite Museum. Yosemite nature notes, 6: 25–27, 30–31, April 30, 1927. Gives an account of functions and describes the physical plant.

the Grand Canyon. It is one of the first experiments with trailside interpretative devices and also one of the most elaborate.

Early in 1928 the American Association of Museums obtained a third grant from the Laura Spelman Rockefeller Memorial—$112,000 was made available for a program in Yellowstone National Park, with $6,000 for committee expense. The Old Faithful Trailside Museum was the first unit to be built, with the Madison Junction Museum of History, the Norris Museum of Geochemistry, and the Fishing Bridge Museum of Lake Biology following in succession during the years 1929–32. Several small trailside exhibits were built at such significant points as Obsidian Cliff, beaver ponds at the roadside, Tuff Cliff, and the Firehole Canyon. These experiments with roadside interpretative devices led the way to an extensive program of similar work throughout the national park system. Outdoor theaters and library developments also were included in the work done by the American Association of Museums in Yellowstone. The Central Museum at Mammoth Hot Springs, which had been initiated in 1920 at the insistence of Supt. Horace M. Albright, received renewed attention during the period of trailside museum building. In the old bachelor officers' quarters of army days, Milton P. Skinner, park naturalist, had opened an information office. The billiard room, parlor, dining room, and pantry of the old stone structure had been remodeled as exhibit rooms, and since 1922 the collections of historic objects, geological specimens, and mounted birds and mammals had grown apace. Mr. J. E. Haynes served as acting director of the Mammoth Museum from 1925 until the American Association of Museums came into the picture. With funds from the Laura Spelman Rockefeller grant improvements were made in the Mammoth Museum building arrangement, exhibit cases, and display methods. In short, during 4 years of activity a very good beginning was made by the American Association of Museums in providing Yellowstone National Park with "a complete educational unit, fully serving the needs of the public." This broad development program received the general supervision of Dr. H. C. Bumpus. Details of building design and construction and all field administration had the guidance of Herbert Maier. Exhibit planning, curatorial work, and exhibit preparation were under the direction of Carl P. Russell, assisted by Park Naturalist Dorr G. Yeager.

The demonstrations made during this program of trials and experiments had an immediate effect in bringing about appropriation of government funds with which to enlarge and equip the central museum at Mammoth Hot Springs. The building interior was remodeled; large additions to the basement were excavated and developed as library rooms, laboratories,

and storerooms. Factory-built exhibit cases were purchased, and the entire exhibit scheme altered to make a creditable permanent installation. The offices, library, and laboratory facilities provided in the central museum have been of first importance in stabilizing the Yellowstone interpretative program and in establishing an educational plant consistent with the important work done in research and education by the local naturalist staff and the many scientists and educators who work in Yellowstone National Park each year.[4]

The demonstrations made in Yosemite, Grand Canyon, Bear Mountain, and Yellowstone had the further effect of convincing the Department of the Interior and National Park Service officials of the importance of museums in the interpretative program generally. A permanent position, field naturalist-museum adviser, was established July 1, 1929. Carl P. Russell was appointed to this first position of the future Museum Division. In 1930 Congress authorized the construction of, and appropriated funds for, the Sinnott Memorial[5] in Crater Lake National Park, Oregon. On the rim of the crater an observation station was constructed with a broad parapet overlooking the lake. The Carnegie Corporation presented $5,000 with which to equip the station with instruments and exhibits, and the Sinnott Memorial became the principal orientation point where park visitors are aided in knowing and appreciating the relationships between the scenic and scientific aspects of the deep blue waters and the volcanic crater. Planning and construction of this interpretative device were directed by Ansel F. Hall under the general supervision of Dr. John C. Merriam.

In 1931 Government appropriations were obtained with which to build a small museum and information office in Rocky Mountain National Park, Colorado. Dorr G. Yeager, who had transferred from Yellowstone to become the park naturalist in Rocky Mountain National Park, received the generous cooperation of the Jonas Brothers of Denver, Colo., and the Colorado Museum of Natural History in collecting, preparing, and installing a series of very effective habitat groups of birds and small mammals of the park. This was the beginning of a Rocky Mountain National Park museum program which has expanded to include a museum of history and ethnology at Moraine Park and a geology exhibit at Fall River Pass.

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[4] Carl P. Russell. A concise history of scientists and scientific investigations in Yellowstone National Park, with bibliography. 1933. National Park Service. (Mimeographed).

[5] Constructed as a memorial to Rep. Nicholas J. Sinnott, of Oregon, in recognition of great service to the State and Crater Lake National Park.

Further Government support was obtained when, in 1932, a museum of geology was provided at Petrified Forest National Monument, Arizona, and a museum of archeology was built at Casa Grande National Monument, Arizona. In both instances the buildings were designed to function as administration headquarters and naturalists' centers. The Casa Grande building became the headquarters for administrative work pertaining to the entire system of southwestern monuments, and within it the naturalists and archeologists developed their working facilities required in conducting research and interpretative work in 26 national monuments. Exhibits here, however, were limited to portrayal of the local story of the primitive people who had occupied the Casa Grande.

The fall of 1933 witnessed a great expansion of the museum program conducted at the Field Educational Headquarters in Berkeley, Calif. Under the Emergency Conservation Work program supervisors and technicians were employed to guide the work of Civilian Conservation Corps enrollees assigned to the laboratories to manufacture relief maps and other interpretative devices needed in the park museums. Civil Works Administration employees were made available as curators and research workers. Artists, sculptors, architects, and draftsmen, also employed under provisions of the Civil Works Administration program, enabled the Service to organize its first adequate staff of museum specialists. This very satisfactory program was halted when the Civil Works Administration program terminated April 28, 1934. The Emergency Conservation Work program was strengthened, however, and has continued through 7 years of intensive planning and exhibit preparation. Because curators and preparators were available under this emergency program, it was possible for the Field Educational Headquarters to give attention first to the new museum programs established at Aztec Ruins (New Mexico) and Scotts Bluff (Nebraska) National Monuments. Here new buildings were constructed in 1934 as part of the Public Works program.

In the East great impetus was given to museum programs when Public Works funds were made available for new museum-administration buildings at Morristown National Historical Park, New Jersey; Hot Springs National Park, Arkansas; Colonial National Historical Park, Virginia; and Chickamauga-Chattanooga (Georgia-Tennessee), Vicksburg (Mississippi), Guilford Courthouse (North Carolina), and Shiloh (Tennessee) National Military Parks. A beginning in central laboratory work was made by the Naturalist Division, Earl A. Trager, chief naturalist, in charge, first at Colonial National Historical Park and later at Fort Hunt, Va.; but, when Public Works allotments were made for the establishment of curatorial and

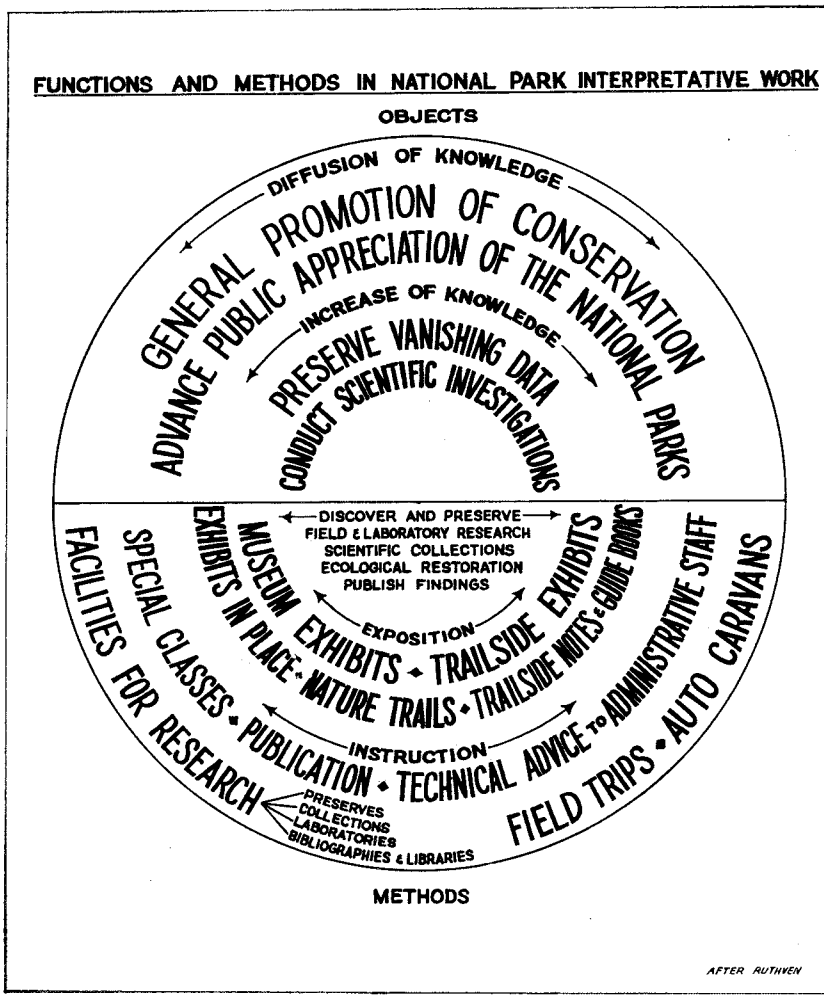

Figure 2

preparation programs early in 1935, a field laboratory was established at Morristown National Historical Park. Here the museum work for all eastern areas was centralized. The Field Naturalist-Museum Advisor was transferred from the Field Educational Headquarters, Berkeley, Calif., to Washington, D. C., where headquarters of the new Eastern Museum Division were established. Louis Schellbach also was transferred from the Berkeley offices to assist with the administrative work of the new unit in

Washington. On April 10, 1935, a code of procedure was approved for the eastern museum unit, and the museum program took its place in the functional scheme of the Service. Ned J. Burns, of the Museum of the City of New York, was employed on June 5, 1935, to direct the work of the Morristown Laboratories where 17 preparators were employed. Nine curators were sent to Colonial National Historical Park, Hot Springs National Park, and Chickamauga-Chattanooga, Vicksburg, Guilford Courthouse, and Shiloh National Military Parks where they became local staff members. These workers devised exhibit plans which became the specifications used in manufacturing exhibits in the Morristown laboratories.

A comprehensive museum of the Department of the Interior designed to occupy a wing and a half of the new Interior Building in Washington became a major part of the program of the Eastern Museum Division in March 1935. Mr. Schellbach was assigned to the chief curator position in this project. In September 1935 Mr. Schellbach was succeeded by Kenneth B. Disher. When park museum projects had been developed as far as funds would permit, all exhibits were shipped from Morristown to the parks, and it was deemed to be more efficient to transfer the staff of preparators and their equipment to laboratories that were established in unused space in the Ford's Theater Building, Washington. The Morristown staff reported in Washington in October 1936, and the small staff of CCC workers under William Macy vacated its Fort Hunt Laboratories on November 1, 1938, and joined the central staff in the Ford's Theater Laboratories, where Mr. Macy became chief of preparation. On October 31, 1935, all museum activities east and west were centralized, administratively, to form a Museum Division within the Branch of Research and Education, with headquarters in the Washington Office. Carl P. Russell was appointed Chief of this Division, and at the same time Dorr G. Yeager became Field Naturalist-Museum Advisor assigned to Field Educational Headquarters, Berkeley, Calif. Arthur Woodward was transferred from the Berkeley organization to Washington where he served as Chief Curator for all park programs. National Youth Administration and Works Progress Administration funds were made available to the western program early in 1936, and a staff of some 200 workers was added to the Civilian Conservation Corps and Public Works Administration appointees already employed in Berkeley, Calif. The Public Land Bank Building adjacent to the University of California campus provided excellent laboratory facilities for the Berkeley organization. Heavy preparation work and blacksmithing were handled in the College Avenue workshops nearby. Administrative offices continued to find space in Hilgard Hall on the campus. Ansel F. Hall, Chief, Field

Division of Education, was immediately in charge of the western museum program, and Mr. Yeager served as his principal assistant. (*See* Figs. 15 and 16.)

The staff of the Field Division of Education contributed in an important way to park library developments and bibliographical projects in addition to conducting an extensive program of exhibit planning and preparation. Yosemite (California), Mount Rainier (Washington), Lassen Volcanic (California), Rocky Mountain (Colorado), and Grand Teton (Wyoming) National Parks; Petrified Forest (Arizona), Aztec Ruins (New Mexico), Devils Tower (Wyoming), Scotts Bluff (Nebraska), Bandelier (New Mexico), Tumacacori (Arizona), and White Sands (New Mexico) National Monuments; Guernsey Lake Federal Reclamation Project, Wyoming, and Custer State Park, South Dakota, feature prominently in the record of accomplishment of the western museum unit. A notable innovation in the Berkeley program is the "miscellaneous service" through which the parks and other field offices are supplied with a variety of educational equipment such as laboratory tables, desks, specimen storage cases, posters, markers, signs, and lantern-slide filing cabinets. Mimeographing, repair of books, and photo finishing add to the service rendered to park superintendents and naturalists.

On July 1, 1936, Ned J. Burns was designated Acting Chief of the Museum Division, with headquarters in Washington, D. C. Dorr G. Yeager became Assistant Chief of the Division on June 15, 1937. He was placed in charge of the Berkeley program and the name, Field Division of Education, was changed to Western Museum Laboratories. On May 16, 1939, Mr. Burns was appointed to the regularly established position, Chief, Museum Division.

The Interior Department Museum, upon which the Museum Division had worked for 3 years, was opened to the public on March 9, 1938, and shortly thereafter it became a unit of the Office of the Secretary. H. L. Raul, an employee of the Museum Division, was appointed Curator In Charge.

The largest and most complex historical museum project to be undertaken by the Museum Division is the museum development for the proposed Jefferson National Expansion Memorial at St. Louis, Mo. On January 10, 1938, this project was assigned to the Museum Division and since that date most of the 15 employees located in Washington have devoted their attention to means of telling the epic story of the Nation's westward growth. One or more curators have resided in St. Louis where field studies have been made and research conducted in the important collections of fur trade materials possessed by the Missouri Historical

Society. Preparation of exhibits has progressed in the Ford's Theater Laboratories in anticipation of early occupancy of a temporary museum within the memorial area.

There follows below a chronological outline of 56 museum projects which have been launched within areas administered by the National Park Service. The list includes most of the better-known park museums but omits historic house museums which are given separately in chapter IX, a number of unfinished projects, and exhibits-in-place and trailside exhibits of the self-operating type.

Museum	Program initiated	Source of funds	Attendance, 1939
Mesa Verde Museum, Mesa Verde National Park, Colo.	1918	NPS, CCC, PWA, Mrs. Stella Leviston.	51, 414
Yosemite Valley Museum, Yosemite National Park, Calif.	1920	AAM, CCC, PWA, NPS	231, 500
Mammoth Hot Springs Museum, Yellowstone National Park, Wyo.	1920	NPS, AAM	86, 809
Crater Lake Information-Museum Bldg., Crater Lake National Park, Oreg.[1]	1921	Kiser Studio, NPS	33, 727
Glacier Point Lookout Museum, Yosemite National Park, Calif.	1925–37	NPS, AAM, etc	43, 744
Petersburg Museum, Petersburg National Military Park, Va.[1]	1925–40	CCC, NPS	10, 675
Montezuma Castle Museum, Montezuma Castle National Monument, Ariz.[1]	1927–35	NPS, in private building	4, 687
Uwekahuna Museum, Hawaii National Park, Hawaii.	1927–39	NPS, Hawaiian Volcano Research Association.	24, 641
Yavapai Station Museum, Grand Canyon National Park, Ariz.	1928	AAM, Carnegie Institution.	110, 036
Longmire Museum, Mount Rainier National Park, Wash.[1]	1928	NPS	61, 000
Loomis Museum, Lassen Volcanic National Park, Calif.[2]	1929	NPS, Mr. and Mrs. B. F. Loomis.	40, 000
Old Faithful Museum, Yellowstone National Park, Wyo.	1929	AAM	132, 838
Zion Museum, Zion National Park, Utah. [1]	1929–39	PWA, NPS	63, 387
Madison Junction Museum, Yellowstone National Park, Wyo.	1930	AAM	43, 258
Norris Museum, Yellowstone National Park, Wyo.	1931	AAM	70, 717
Estes Park Museum, Rocky Mountain National Park, Colo.	1930–31	NPS	13, 022
Mariposa Grove Museum, Yosemite National Park, Calif.	1930–32	NPS	26, 139
Watchman Museum, Crater Lake National Park, Oreg.[2]	1931	NPS	5, 000

[1] Temporary. [2] Incomplete.

Museum	Program initiated	Source of funds	Attendance, 1939
Sinnott Memorial Museum, Crater Lake National Park, Oreg.	1931	NPS, Carnegie Corporation.	63, 394
Petrified Forest Museum, Petrified Forest National Monument, Ariz.	1931	NPS, WPA	133, 834
Fishing Bridge Museum, Yellowstone National Park, Wyo.	1932	AAM	42, 290
Wayside Museum, Grand Canyon National Park, Ariz.	1932	Mrs. MacCurdy	12, 611
Casa Grande Museum, Casa Grande National Monument, Ariz.[2]	1932	NPS	22, 048
Lincoln Museum, National Capital Parks, Washington, D. C.	1932	NPS	61, 778
George Washington Birthplace Museum, George Washington Birthplace National Monument, Va.[1]	1932–39	PWA, CCC, NPS, Wakefield Association.	61, 534
Aztec Ruins Museum, Aztec Ruins National Monument, N. Mex.[2]	1934	PWA	14, 546
Ship Museum, Colonial National Historical Park, Va.	1934	PWA	.....
Richmond Battlefield Museum, Richmond Battlefield National Military Park, Va.[1]	1934–35	CCC	5, 183
Moraine Park Museum, Rocky Mountain National Park, Colo.	1934–35	PWA	10, 046
Dinosaur Museum, Dinosaur National Monument, Utah.[1]	1935	WPA	12, 032
Devils Tower Museum, Devils Tower National Monument, Wyo.	1935	PWA	21, 577
Vicksburg Museum, Vicksburg National Military Park, Miss.	1935	PWA	270, 400
Chickamauga - Chattanooga Museum, Chickamauga-Chattanooga National Military Park, Ga.-Tenn.[2]	1935	PWA	14, 107
Shiloh Museum, Shiloh National Military Park, Tenn.[2]	1935	PWA	30, 700
Guilford Courthouse Museum, Guilford Courthouse National Military Park, N. C.[2]	1935	PWA, CCC	.....
Fort McHenry Museum, Fort McHenry National Monument and Historic Shrine, Md.[2]	1935–36	PWA, Society of War of 1812.	88, 593
Scotts Bluff Museum, Scotts Bluff National Monument, Nebr.[2]	1935–36	PWA, CCC	7, 048
Fredericksburg Museum, Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park, Va.[2]	1936–40	PWA, CCC	5, 812
Bandelier Museum, Bandelier National Monument, N. Mex.[2]	1936	WPA, CCC	14, 200
Hot Springs Museum, Hot Springs National Park, Ark.	1936	PWA	30, 656

[1] Temporary. [2] Incomplete.

Museum	Program initiated	Source of funds	Attendance, 1939
Morristown Museum, Morristown National Historical Park, N. J.	1936	PWA, Washington Association.	24, 071
Fall River Pass Museum, Rocky Mountain National Park, Colo.	1936–37	CCC	78, 007
Fort Jefferson Museum, Fort Jefferson National Monument, Fla.[1]	1937	CCC	1, 112
Yorktown Historical Museum, Colonial National Historical Park, Va.[1]	1937	CCC	13, 704
Tumacacori Museum, Tumacacori National Monument, Ariz.	1937–38	PWA	20, 551
Jamestown Museum, Colonial National Historical Park, Va.[1]	1938	CCC	11, 209
Boulder Dam Museum, Boulder Dam National Recreational Area, Ariz.-Nev.[1]	1938	NPS	12, 639
Jenny Lake Museum, Grand Teton National Park, Wyo.[2]	1938	PWA, CCC	38, 332
White Sands Museum, White Sands National Monument, N. Mex.	1938–39	CCC, WPA	1, 330
Volcano House Museum, Hawaii National Park, Hawaii.	1939	George Lycurgus	.....
Chiricahua Museum, Chiricahua National Monument, Ariz.[2]	1939	CCC	.....
Fort Pulaski Museum, Fort Pulaski National Monument, Ga.[1]	1939	PWA, CCC	24, 658
Yakima Museum, Mount Rainier National Park, Wash.[1]	1939	NPS, WPA	10, 000
Ocmulgee Museum, Ocmulgee National Monument, Ga.[1]	1939	PWA, ERA, CCC	28, 272
Walnut Canyon Museum, Walnut Canyon National Monument, Ariz.[2]	1940	PWA, CCC	.....
Painted Desert Museum, Petrified Forest National Monument, Ariz.[2]	1940	PWA, CCC, NPS	.....
Total	.....	.....	2, 238, 868

[1] Temporary. [2] Incomplete.

A survey of the column, *Source of Funds*, reveals: (1) that the National Park Service made modest beginnings in museum work, 1918–24; (2) that the American Association of Museums (funds from the Laura Spelman Rockefeller Memorial) lent notable support to the parks museum program, 1924–32; (3) that some Government support (regular National Park Service appropriations) for museum work was forthcoming in 1931 and 1932; (4) that Public Works Administration allotments stimulated museum building 1934–37 which exceeded all previous activity; and (5) that

the Civilian Conservation Corps and Works Progress Administration have provided most of the support during 1938–40. Through the years private interests have donated funds to nine important field projects—The Lincoln Farm Association, The Hawaiian Volcano Research Association, Mrs. Stella Leviston (Mesa Verde Museum), Mr. and Mrs. B. F. Loomis (Lassen Volcanic Museum), the Wakefield Association, the Society of the War of 1812 (Fort McHenry Museum collections), the Washington Association (the Morristown Museum), Mrs. Winifred MacCurdy (Wayside Museum, Grand Canyon), and Mr. George Lycurgus (Volcano House, Hawaii). This list of donors does not reflect the important assistance obtained from a host of park visitors who have made materials available to park museums and libraries, nor those who have contributed funds in small amounts to the building and exhibits programs. Neither does it indicate those many cooperating organizations which exist for the purpose of advancing museum and library work in the national parks. This organized cooperation is of prime importance to the interpretative program generally.

The first of the cooperating organizations established for the purpose of advancing a park museum program was the Yosemite Museum Association formed by Ansel F. Hall soon after he entered upon Yosemite educational work in 1920. Some $9,000 was raised by this organization and it seems evident that this initial expression of active local interest had important influence upon those later workers who obtained a grant of $75,500 from the Laura Spelman Rockefeller Memorial with which to develop an adequate Yosemite Museum. The Yosemite Natural History Association replaced the Yosemite Museum Association in 1924. Articles of Association subscribed to on April 24, 1925, by 15 members of an advisory council and board of trustees defined these purposes:

PURPOSES OF THE ASSOCIATION

1. To gather and disseminate information regarding birds, mammals, flowers, trees, Indians, history, geology, trails, scenic features, and other subjects so well exemplified by Nature in Yosemite National Park and elsewhere in the Sierra Nevada Mountains.
2. To develop and enlarge the Yosemite Museum (in cooperation with the National Park Service) and to establish subsidiary units, such as the Glacier Point Lookout and branches of similar nature.
3. To contribute in every way possible to the development of the educational activities of the Yosemite Nature Guide Service.
4. To publish (in cooperation with the National Park Service) *Yosemite Nature Notes*, a periodical containing articles of scientific interest concerning the matters referred to in this statement of purposes.

5. To promote scientific investigation along the lines of greatest popular interest and to publish from time to time bulletins or circulars of a nontechnical nature.

6. To maintain in Yosemite Valley a library containing works of historical, scientific, and popular interest.

7. To study the living conditions, past and present, of the remaining Indians of the Yosemite region, for the purpose of preserving their arts, customs, and legends.

8. To strictly limit the operations, business, property, and assets of the association to purposes which shall be scientific and educational, in order that the association shall not be organized, constituted, or operated for profit, and so that no part of the net income of the association shall inure to the benefit of any member or other party thereto.

The Park Naturalist was designated director of the association and editor of its printed publication, *Yosemite Nature Notes*—a journal which in 1925 succeeded the mimeographed publication of the same name.

In July 1931, similar action was taken in Zion and Bryce Canyon National Parks so forming the Zion-Bryce Natural History Association. The Rocky Mountain Nature Association was organized in Rocky Mountain National Park in November 1931. The Grand Canyon Natural History Association entered upon its work in April 1932. The Yellowstone Library and Museum Association was organized January 26, 1933; the Mesa Verde Museum Association, 1934; the Shenandoah Nature Society, July 15, 1936; the Hot Springs Natural History Association, November 1936; and the Jackson Hole Museum and Historical Association (Grand Teton National Park), December 14, 1936.

Questions raised in 1936 regarding the legality of operations of these cooperating organizations caused the Director of the National Park Service to ask for recognition of the associations. The Interior Department Appropriation Act for the fiscal year 1937, approved June 22, 1936, contained the following provision:

> Appropriations made for the national parks, national monuments, and other reservations under the jurisdiction of the National Park Service, shall be available . . . for the services of field employees in cooperation with such nonprofit scientific and historical societies engaged in educational work in the various parks and monuments as the Secretary, in his discretion, may designate.

In 1937 the Secretary of the Interior designated all of the organizations mentioned above as nonprofit societies engaged in educational work in the parks and monuments in accordance with the appropriation act, so making it legal for park employees to collaborate with them. Other organizations designated by the Secretary in 1937, are:

The Washington Association of New Jersey, Morristown, organized 1873.

The Wakefield National Memorial Association, George Washington Birthplace National Monument, organized in 1922.

The Fredericksburg Battlefield Memorial Commission, formed in 1927.

The Petersburg National Military Park Commission, formed in 1927.

Since 1937 recognition has been given to the Southwestern Monuments Association, July 22, 1938; the Loomis Museum Association, Lassen Volcanic National Park, May 18, 1939; the Virginia Natural History Institute, Swift Creek Recreational Demonstration Area, April 23, 1940; and the Sequoia Natural History Association, May 1940.

Formal agreements have been entered into with the Ackia Battlefield Memorial Commission; the George Rogers Clark Sesquicentennial Commission; the Federal Hall Associates, New York City; the Carl Schurz Memorial Foundation, Philadelphia; the Society for the Preservation of New England Antiquities, Salem, Mass.; and, in connection with the Historic American Buildings Survey, with the American Institute of Architects. Cooperation also has been planned and developed with the Association for the Preservation of Virginia Antiquities (Colonial National Historical Park); Roanoke Island Historical Association, Inc. (Fort Raleigh); Whitman Centennial Association (Whitman National Monument); the Ochs Memorial Committee (Chickamauga-Chattanooga National Military Park); the Georgia Society for Archeology (Ocmulgee National Monument); the Oregon Trail Memorial Association (Scotts Bluff, Fort Laramie, and Whitman National Monuments); Society of the War of 1812 (Fort McHenry National Monument and Historic Shrine); the Missouri Academy of Sciences and the Missouri Historical Society (Jefferson National Expansion Memorial); the Colonial Dames of America (Ocmulgee National Monument); Hawaiian Volcano Research Association (Uwekahuna, Hawaii); and the United Spanish War Veterans (Spanish War Memorial, Tampa, Fla.).

A number of individuals, universities, and large museums have cooperated in the planning and research involved in the museum program in Federal areas, and State park authorities throughout the country have worked with the Service in developing museums in many State parks. The trailside exhibit idea, originated in Yellowstone by Dr. Bumpus, has spread to include certain sections of public highways. A plan of trailside exhibits development for the Navajo Trail is at the present writing being promoted by Ansel F. Hall, now manager of the Mesa Verde Co. Roadside markers and explanatory texts, patterned somewhat after the National Park Service trailside structures, are finding use in Wyoming, Washington, Georgia, Oklahoma, Texas, and New Mexico. The focal point or branch museum idea finds new expression in the plan of the Carl Schurz Memorial Foundation to develop a series of small cultural museums in Pennsylvania, all of them to be "mothered" by the central museum to be developed by the foundation in the Old Custom House in Philadelphia, now under the jurisdiction of the National Park Service.

State park museum programs exist in 64 State parks in 19 States. The work of William H. Carr at Bear Mountain, New York, stands as one of the splendid examples of the success of this activity. The National Park Service has made important contributions to several State park museum programs, notably Custer State Park (South Dakota); Mound State Park (Alabama); La Purisima Mission State Park (California); Torreya State Park (Florida); and the Overton Museum, Valley of Fire State Park (Nevada).

In the advanced training of its museum workers the National Park Service has had the generous cooperation of several agencies. Dr. Carl P. Russell was selected by the Carl Schurz Foundation of the Oberlaender Trust in 1936 to visit museums in northern Europe with a party of American museum men. In 1939 both J. Paul Hudson, a Museum Division curator, and Don Watson, park naturalist at Mesa Verde National Park, received Carnegie travel grants through the American Association of Museums to study in Europe. Mr. Hudson was able to visit museums in France, Germany, and England, but the outbreak of war prevented Mr. Watson from going. In 1935 the Adult Education Association and Yale University made available a graduate fellowship to park naturalists. Since then 10 park naturalists and historians have been awarded fellowships. These men are Frank C. Brockman, Dale S. King, Malcolm E. Gardner, Henry W. Lix, William E. Kearns, Merrill J. Mattes, Russell K. Grater, Edwin D. McKee, George C. Ruhle, and Bernarr Bates. Most, if not all, of these men have taken full advantage of the Peabody Museum of Natural History at Yale to improve their training in museum work. Some have engaged in the study of visitor-behavior, which was placed on a scientific basis by Professor Robinson of Yale, who also had taken an active interest in the National Park Service fellowships. Others have taken Prof. Cornelius Osgood's critical course in museum methods. In 1937 two Museum Division curators, Ralph H. Lewis and Robert D. Starrett, were appointed to Rockefeller interneships at the Buffalo Museum of Science for a year of intensive museum training. These appointments continued the active interest of this institution in the progress of park museums which had begun nearly two decades previously when Mr. Hamlin, president of the Buffalo Museum, also was president of the American Association of Museums.

Questions regarding preparation for museum work are asked frequently by park staff members and prospective staff members. Courses of training have been instituted by several universities for the purpose of preparing men and women for museum careers. The Yale and Harvard art schools offer courses designed to provide a transition between college and the

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museum. The foundation for careers in art museum work are laid at undergraduate level with provision for specialization made in the graduate schools. The objective in this work is to make scholars rather than technicians. At the University of Michigan, the University of Iowa, and the University of California courses in museum training are offered which are designed to prepare workers to enter upon the programs of science museums. The establishment of such work results from the recognition of the need for workers trained to handle scientific materials. At the University of Michigan the museum courses are regarded as an educational phase of the student's preparation rather than a training phase. Collections of scientific materials have been assembled to supplement the instructor's teaching and the courses are so shaped as to prepare the student to use scientific objects as research materials. As in the cases of the art schools mentioned above it is the purpose of the Michigan Museum course to make scholars.

In the programs of the national park museums it is sometimes necessary to use scientific materials for research purposes but there is also a very great necessity for using historic objects as research material. No college or university has trained its students to enter this field.

The National Park Service is responsible for the administration of some of the very significant historic sites of America. Upon these sites the Service proposes to preserve and present the authentic picture of cultural progress, political history, and military experience of the Nation. An attempt is made to locate all dependable sources of information and to draw from those sources the guidance that will enable national park employees to offer to eager visitors the whole truth and nothing but the truth. A skilled personnel is employed and the usual research is undertaken. The best of library sources are available and dependable reports are written on studies made by men who have demonstrated their ability as scholars. The value of such work done by research workers is not to be underestimated but it would appear that their studies do not include all sources. If architecture is involved, specialists can be found sometimes to interpret the architecture. If house furnishings must be studied, some collector may answer the questions and if glass, pewter, textiles, small arms, or cannon are thought of as sources, a museum curator possibly or an antique dealer can be found who will pass his opinion on them, but the historian regards this collaborator as an antiquarian and often doubts his testimony. He is seldom taken into the fraternity of professional historians. The usual result is a failure to utilize objects as sources of history even though the objects are at hand.

The archeologist is prepared to enter the field of the historian if it is excavation or mechanical treatment of finds which constitutes the problem. But it seems that few archeologists are prepared to interpret satisfactorily the historic objects which they unearth. Probably this is not to be wondered at since archeology is well occupied in teaching its students the significance of prehistoric materials.[6]

Perhaps there is not yet a great demand for historians trained to interpret the evidences offered by objective materials, but it would seem that much can be accomplished in fostering a general appreciation of our American inheritance and tradition if university students find opportunity to take regular courses of training which will prepare them to understand and appreciate the wealth of small cultural materials that come to light on all historic sites. An improved public appreciation of this class of material will lead to a better understanding of the route we have followed as a Nation in reaching our present state. In all likelihood, too, there soon will be a greater demand for the historian who has prepared to read the evidences offered by those lasting documents, the small historic objects left behind by our predecessors.

Since established courses in science and art have proved to be practical in preparing workers to enter upon museum careers it is reasonable to anticipate that some schools will recognize the importance of preparing scholars to enter the rather neglected field of research in historic objects. From a National Park Service standpoint there is a very practical reason for wishing to make such materials disclose their history. At such places as Colonial National Historical Park, Morristown National Historical Park, Great Smoky Mountains National Park, Fort Pulaski National Monument, Fort Laramie National Monument, Scotts Bluff National Monument, and in many of the battlefield parks important collections of historic objects are already on hand. These objects constitute documents of research value that must be treated with the same regard as are the materials that receive care in libraries. In many other National Park Service areas collections of historic objects may be expected to come to light. Their presence in park museums will constitute a challenge to the historian, naturalist or museum curator responsible for their interpretation. It is the defined policy of the Service to draw from these materials all information that they can yield and to present them in museum exhibits whenever their use is practical. The persevering worker will approach these collections with a determination to make them function even though he has not had the benefit of a special course of training in reading their meanings.

[6] Arthur Woodward. Archeology—the scrapbook of history. The regional review, 2:8–10, August 1938.

PRESENT STATUS OF PARK MUSEUMS

As the museum idea has spread through the national parks, two distinct types of museums have appeared, *park museums* and *historic house museums*. Historic house museums, which are considered in detail in Chapter IX, may be defined as historic buildings of any sort—either original or reconstructed—which are on exhibition for the public as survivals of the past. A park museum, on the other hand, is one placed in a park for the purpose of interpreting features of that particular area and using formal museum methods to tell its story. Where there is more than one such museum in a park, several kinds may be recognized:

(a) *Headquarters museums*—those which embrace the entire park story, when their exhibits are fully developed, and also contain the park study collections and library, and offices and laboratories for the interpretative staff. They function in an important way as information centers for the public and as headquarters for visiting scientists and organized classes.

(b) *Branch or focal-point museums*—museums located in the immediate vicinity of particular historic sites, physical features, or natural phenomena which their exhibits help to interpret. (Fig. 41.)

(c) *Observation station museums*—museums placed at a point commanding an especially significant view. The exhibits help to orient the visitor and enable him to understand the historic or scientific aspects of the scenery involved. (Fig. 36.)

A survey made in 1939 shows that there are 113 museum units under the National Park Service. Of these, 76 are park museums and 37 historic houses. When it is considered that during this same year approximately 4,000,000 people visited these museums, their importance as an educational force is apparent.

The total number of park museums here given includes those young and active but still lacking adequate housing or satisfactory exhibits and which are omitted from the list in the preceding section on history. Approximately one-third of the total, however, have permanent exhibits in permanent buildings. It should be remembered, of course, that permanent exhibits are so-called because of the planning and type of installation and not because they will receive no further revision or improvement, for an active museum must of necessity see periodical changes in exhibits. At present there are 73,847 square feet of exhibit space in the 76 park museums and several new buildings are in immediate prospect.

Tabulations from the recent survey also list 25 trailside exhibits and 4 exhibits-in-place with an attendance of 769,207 at those 13 where recording

was possible. A growing type of museum interpretation out-of-doors, these exhibits are becoming increasingly popular. Trailside exhibits—isolated museum cases under simple shelters placed within sight of the special features they interpret—are exemplified by the Obsidian Cliff and Beaver Dam exhibits at Yellowstone. (Fig. 39.) Exhibits-in-place, like the seed-fern fossil exhibit on the Kaibab Trail, Grand Canyon National Park, are perishable features protectively sheltered but left in place for visitors to see. (Fig. 40.) To these may be added trailside markers, field reconstructions, and stabilized ruins—all interpretative devices employed in national park areas, and presenting problems in museum technique. (Fig. 35.) The trailside exhibit idea found its first expression when Dr. Bumpus designed the Yellowstone trailside "shrines," built as a part of the museum program developed by the American Association of Museums in Yellowstone National Park, 1928–32.

CHAPTER ·II·

MUSEUM PLANNING

CAREFUL planning is an aid to sound museum development. This will hardly be questioned, although museum work is too much an art for a plan to guarantee complete success. More than one city museum owes its high effectiveness to years of preliminary planning. In national parks, where museums must be fitted into a larger program of interpretation, such preparation in advance is all the more important. Recognizing this, the National Park Service has established a regular planning procedure on which to base its museum development. This chapter is intended to serve as a guide in drawing up the prescribed plans—the museum prospectus and the exhibit plan. A third section on planning the museum building considers this highly important problem insofar as it is a museum rather than an architectural responsibility.

Before describing the plans in detail it may be helpful to review the whole logical sequence of park museum planning as it would be followed in an area just beginning its development. Certain work must precede any well-founded thought on museums in the area. The first necessity is basic research on the story of the park. Every park illustrates particularly well one or more aspects of the American story and is established to preserve and utilize this illustration. Through research the scope, content, and significance of the park story must be defined and developed and the major theme integrated with subordinate aspects. The guiding standard is formed by the reason for which the park was established, but a park created to commemorate some historical event, for example, should not ignore the geographical or biological factors which set the stage for history, nor should a scenic park neglect the significant history it contains. These preliminary investigations lead to an interpretative statement defining and evaluating the story the park is to tell. This statement is incorporated in the master plan of the park as the core of future interpretative work. In a real sense the interpretative statement is the first justification for museum development. Out of the statement grow plans for the whole program of interpreting the park to the public—of telling the park story. Museums form one phase of

this program, and following issuance of the interpretative statement museum planning can begin.

The museum prospectus is the first to be prepared. It is an examination of the whole park situation and public contact program and a determination of the number, scope, location, and costs of museums needed to help tell the park story. After the prospectus has been approved, museum sites should be marked in the master plan, and museum buildings can be included in the construction program. The next step normally awaits the allotment of money to build one of the museums called for in the prospectus or, as occasionally happens, a preliminary allotment for planning. When the erection of the building and preparation of exhibits are assured, a detailed exhibit plan is drawn up specifying all the displays for the museum. After this has been completed and approved it is possible for the architects and engineers to complete the construction plans. Finally, the building is erected, exhibits prepared and installed, and the museum placed in operation. The whole program of planning as it concerns museums may be outlined as follows:

I. Preliminary steps:
   1. Basic research on the park story.
   2. Interpretative statement.
   3. Museum prospectus with estimates of costs.
   4. Inclusion of museums in the master plan and construction program.

II. After allotment of funds for a museum:
   1. Exhibit plan.
   2. Building plan.
   3. Construction and installation.

In parks, development of which already is well advanced, this sequence may be considerably modified to fit existing conditions.

THE PROSPECTUS

Actual museum planning begins with the prospectus. which is a thoroughgoing survey of the museum needs of the park and a basic program for fulfilling those needs. The prospectus is drafted in the park but with the collaboration of the Museum Division. The coordinated efforts of both are required. There must be an understanding of the park story as well as a close familiarity with the interpretational work and all the local factors affecting it, which only a man who knows the park from personal experience can contribute. On the other hand, there also must be a sound conception of the potentialities and limitations of park museums,

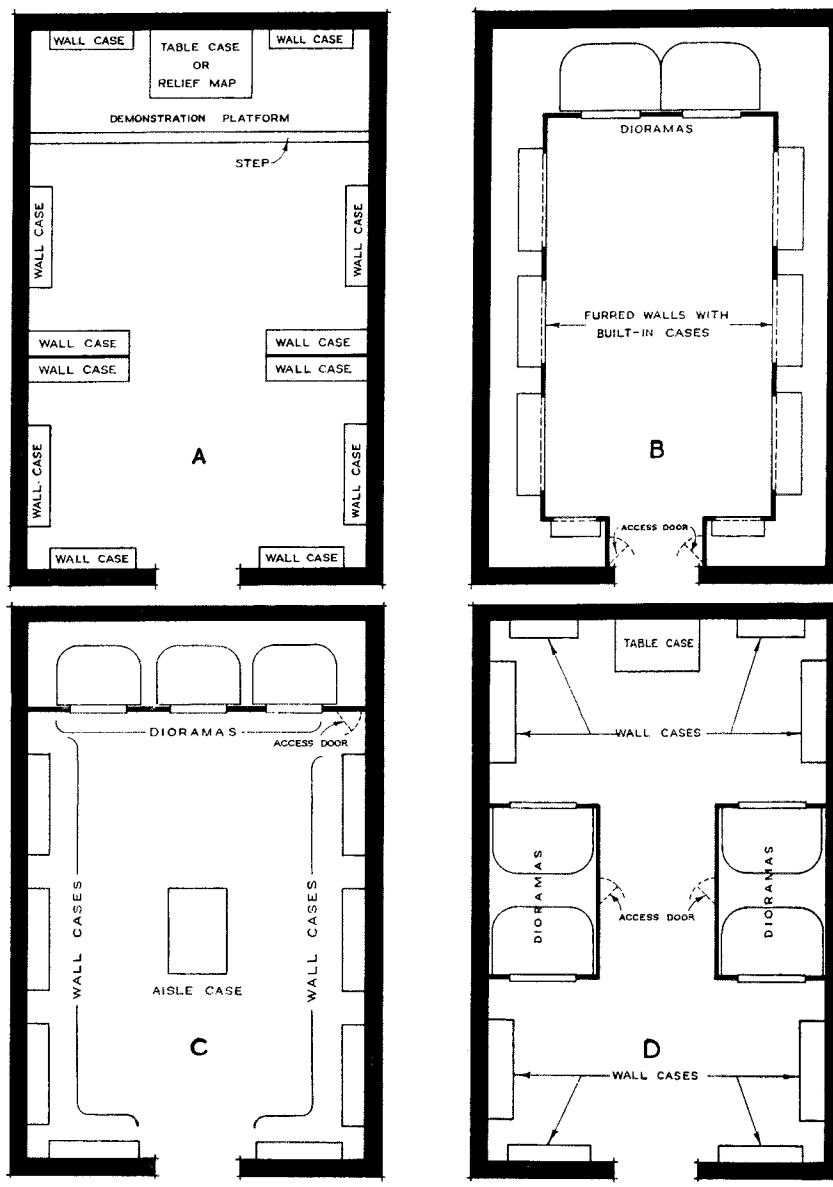

Figure 3.—EXHIBIT ARRANGEMENTS. FOUR IDEAL FLOOR PLANS FOR AN EXHIBIT ROOM SHOWING A VARIETY OF ARRANGEMENTS OF EXHIBIT UNITS. MANY ADDITIONAL COMBINATIONS ARE POSSIBLE

which comes from a broad acquaintance with this type of museum work. Someone must assemble and comprehend the information from these two sources, draw the necessary conclusions, and write the prospectus. Usually this is done by the park naturalist or historian, but sometimes a curator is sent into the park for the purpose.

There is no definite time at which the prospectus should be completed. Preferably it should not be done until the general interpretational program has begun to take shape or neglected until there is a critical need for it. The initiative for undertaking the preparation of a prospectus usually comes from the park naturalist or historian who realizes the value of museums in his work of studying and interpreting the park. He calls on the Museum Division for technical advice or assistance.

The importance of the prospectus should be appreciated. It embodies decisions that determine much of the future effectiveness of the museum program. While the plan is not immutable, permanent structures will be built according to its recommendations and these cannot be changed casually to correct some error in judgment. In recognition of its importance the prospectus is given full critical review by technical specialists before it is approved by the director. A standard routing sheet is included in each plan which sends it from the park superintendent to the regional office, and from the regional office to the Museum Division. After the Museum Division has recommended the plan, it is submitted to specialists in the architectural, historical, and scientific branches. Thus, when the Director finally approves the prospectus, the recommendations have been checked repeatedly.

The contents of the prospectus vary among different parks, being adapted to local situations, with no fixed outline prescribed. The whole should be in sufficient detail, however, to crystallize the ideas of the park staff and give the specialists an adequate basis for reviewing the conclusions reached. As a general rule the following should be included: a justification for museum development; an analysis of the local factors conditioning museum development; an outline of the development proposed; and estimates of costs. There should be a clear and strong statement of the reasons for establishing museums in the park growing out of a realization of their need. This comprises the justification.

The analysis of the factors influencing museum development should be worked out with particular care since it is largely on this that critical review must be based. Two sets of factors require consideration. One is the park story. It is advisable to include a condensed account of the story evaluated from two points of view—its significance (not local but national

significance as expressed in the interpretative statement for the park) and its adaptability to treatment by the several interpretational agencies in the park. Application of the second viewpoint tends to emphasize those parts of the story which the museums will be called on to interpret, rather than those to be covered by lecture, booklet, or field trip. This section of the analysis may take the form of the museum story properly referred and related to the total park story. It should be documented so that specialists can check its accuracy readily and should be accompanied by an adequate bibliography. The other set of local factors involves a number of things sometimes overlooked in museum planning. The geography of the park frequently is important here. The size of a park, its location in relation to main highways and centers of population, its climate, the park system of roads and trails, location of administrative headquarters and of hotels and campgrounds, the nature and location of principal park features all may affect museum work. An analysis of visitation is particularly useful.

The total number of visitors in the park and daily or weekly averages for rush and slack seasons will help to determine the museum space needed. The regions from which visitors come and the attractions and incentives which bring them to the park shed light on the intellectual backgrounds the museums will encounter. Where visitors go in the park, what they do, where and how long they stay influence museum locations among other things. The proportion of visitors reached by the other interpretative agencies also is important. In short, a thorough knowledge of the conditions of visitation in a park is essential for sound museum planning. If the prospectus must be prepared before these facts can be established, shrewd guessing may be required to anticipate the situations the museums will have to meet. The interpretative program of the park is another factor which must be reviewed with care, for the museums must dovetail into it as nearly perfectly as possible. Such points as its history, present staff and activities, probable development, and coverage of the park story should be discussed. In the case of many parks, nearby institutions will influence museum development. These include, for example, other museums, colleges, research laboratories, and patriotic or conservation societies. Each of these likely to affect the park museums through over-lapping fields, competition for support, opportunities for fruitful cooperation, or any other way, should be described and its influence evaluated. In some parks additional factors in the local situations will suggest themselves.

It is on this examination of the local factors that the plans for museum development are based. The prospectus should derive from the preceding analysis a statement of the functions the museum program will perform.

Figure 4.—MUSEUM AND ADMINISTRATION BUILDING, WHITE SANDS NATIONAL MONUMENT, NEW MEXICO

Then it is necessary to decide how many museums and related devices are needed to carry on these functions, where they should be located, what part of the story each should cover, their priority, and approximately what the building needs of each will be. This section, of course, is the heart of the prospectus and should be given the fullest possible thought. Each recommendation should be justified if it is not already apparent. The degree of detail reached in this development plan will depend on circumstances, but it will be found useful to carry it out to include tentative lists of exhibits for the headquarters museum (if not for all the proposed structures), rough floor plans of suggested buildings, equipment lists, cost estimates, and directive recommendations for building up the park collections.

The entire prospectus cannot always be completed and submitted at once. When only a partial prospectus can be prepared, it may be for a single museum or for one phase of the park story, or it may present the museum story in one installment, the park situation in another, and the development outline in a final report. A piecemeal prospectus is not altogether desirable, but sometimes it may be necessary.

THE EXHIBIT PLAN

The exhibit plan follows and is based on the prospectus. Typically a separate plan is drawn up for each museum as funds are allotted for it. By this time alert interpretative staffs will have done much of the preliminary work, so that drafting of the final plan can begin at once. The exhibit plan has two principal functions—it provides the specifications according to which the exhibits are prepared and installed, and it enables museum experts to review the design of each exhibit critically before construction

begins. Like the prospectus, the exhibit plan calls for cooperation between the park staff and the Museum Division since the special knowledge of both is involved. This time museum technique is more largely concerned and the contribution of the Museum Division correspondingly greater. Accordingly, the exhibit plan usually is written at one of the central laboratories with the assistance of a member of the park interpretative staff who is sent to the laboratory for this purpose. The completed plan is given just as careful review as the prospectus and uses the same standard routing sheet. In particular, it must be checked for the absolute accuracy of the information contained in the exhibits. Even the most trivial and obscure error will be pounced on by some visitor to the delight of the discoverer and the embarrassment of the park staff. On the other hand, strictly academic treatment of the museum story may be wholly unsuited for the prospective audience. There is room for divergent opinions regarding both the interpretation of subject matter and the art of exhibit designing, and the exhibit plan brings these various points of view into focus. Consequently, it is sometimes desirable to make the plan anonymous in order to promote unbiased adjustment of differences.

The exhibit plan is essentially a series of specifications. Each exhibit is taken up in sequence and described in such detail that preparators can reproduce it exactly as planned. A number of items should be included in the description of each case or exhibit unit. It is helpful to begin with a statement of the precise purpose of the exhibit. Purposeless exhibits have no place in a park museum, and the statement disciplines the planner as he designs the case. The type of exhibit case should be given next, along with the dimensions of the exhibition space it provides and of any special lighting equipment, shelves, diaphragms, or supports to be built into it. The location of the exhibit in the room is needed and usually should be given in actual distances from neighboring cases or the nearest corner. An effective supplement to this statement is a small-scale sketch of the floor plan, with the case location plainly marked. A list or summary of the case contents—specimens, illustrations, models, labels, etc.—is a convenience enabling a reviewer to check through quickly. This is followed by the detailed description of the case, item by item. The size of each object, illustration, or label and its exact position in the case should be given. For all manufactured exhibits the specifications should include description of content, medium to be used, color notes, and any other pertinent information. Sources which would help the preparator or verify the accuracy of the item should be referred to in footnotes. The wording for each label should be given and likewise documented in a footnote. No

exhibit plan can be considered complete without its label copy. Color notes on the case as a whole are desirable, with suggestions on background, decorative details, and special lighting. This detailed description is accompanied by a diagram showing the size and position of everything in the case. The diagram should be drawn to a scale of at least 3 inches to a foot, and each item should be designated by letter or other means to associate it with the specifications. Because the diagrams are easily understood and may be made quite attractive, they often are a principal selling point for the plan.

The exhibit plan usually should contain a few things in addition to the descriptions and specifications. One of these is a tabulation of the number of specimens, models, dioramas, water color illustrations, maps, labels, and so on which are specified. Such a tabulation is very useful in assigning the preparation work and budgeting funds. Equally useful is a list of all the specimens—both historic and scientific—required for the exhibits, with suggestions on how and where they are to be obtained. The building needs of the museum as planned should be outlined for the information of the architects designing the structure. The space needed for exhibition and the other museum activities should be defined, with suggestions on the equipment and relative positions of the rooms. Special study should be given to the circulation problem and to the arrangement of exhibit rooms, which largely controls visitor movement. It is not out of place to recommend the interior treatment and lighting of the exhibit rooms. A suggested floor plan of the entire building might be included. Still other ideas may be added to the exhibit plan whenever they contribute toward a clear and detailed pattern for making an effective park museum.

These suggestions for drawing up the exhibit plan have considered only its mechanical aspects. Chapter IV gives detailed information calculated to help in designing museum displays, but it may be appropriate here to outline briefly a proper approach to exhibit planning. The first requirement is to understand the park visitor. The exhibit must appeal to his interest and be comprehensible to him, yet it must not condescend or fail to advance his knowledge. With this understanding one may select the subject matter to be presented. Each exhibit is a chapter in the park story and must tell its share while fitting clearly into the sequence of ideas that make up the whole narrative. At the same time each exhibit must be understandable when seen alone, without reference to preceding or succeeding chapters, for the fact must be faced that the visitor pauses only before the exhibits that interest him. In selecting the subject matter it is to be remembered that a museum exhibit is not a good means of teaching people

a quantity of factual material. It must do its work in a few seconds. Consequently, one case can be used to convey only a few facts, and some museums confine each exhibit to only one idea. On the other hand, the exhibit unquestionably can impress its proper message on the visitor in a most effective manner. A really successful exhibit will be remembered for years. Once the subject matter has been chosen carefully with both the visitor and the function of the exhibit in mind, the graphic means of presenting the facts or ideas must be picked. Specimens, pictures, labels, and other exhibit materials that tell the story in the way it should be told must be selected or devised. Then comes the final step of designing the exhibit. Careful attention should be given to the case itself and the lighting. The exhibit devices must be arranged in a composition that is balanced and attractive and that also presents the subject matter in the proper order and with the desired emphasis. Good composition is indispensable to a successful exhibit. The finished exhibit should attract people to it and then transmit its story quickly. All this requires experience and skill. In practice the park naturalist or historian, the curators, and the preparators work hand in hand to plan museum exhibits.

As an example of an exhibit plan, the one recently written by Ralph H. Lewis, Field Curator of the Museum Division, for Kings Mountain National Military Park, South Carolina, is reproduced in the Appendix.

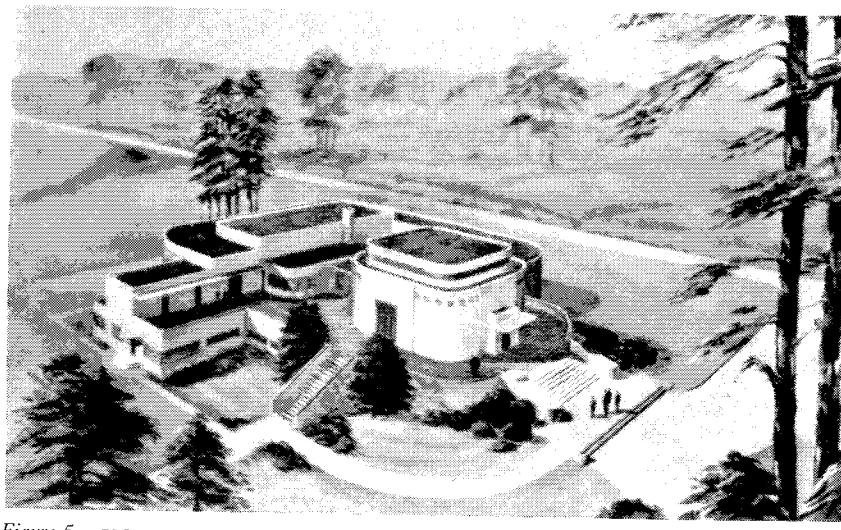

Figure 5.—PERSPECTIVE DRAWING OF MUSEUM AND ADMINISTRATION BUILDING AT OCMULGEE NATIONAL MONUMENT, GEORGIA. MODERNISTIC ARCHITECTURAL TREATMENT HAS BEEN EMPLOYED SUCCESSFULLY WHERE NO STYLE OF A PAST PERIOD WOULD BE APPROPRIATE

BUILDING PLANS

As an architectural problem the museum building lies beyond the scope of the prescribed museum plans. It is the responsibility of another technical branch which completes the building design after the exhibit plan has been approved. The architects, however, endeavor to plan a structure that will serve the needs of the museum as defined in the prospectus and exhibit plan. The present discussion is intended to help museum planners in drawing up their recommendations for the guidance of the architects, not to tell how to design a museum building.

The first problem to arise in connection with the museum building is the selection of a site, and it is by no means the least important. A favorable location must fulfill certain conditions, and all available sites should be examined with these in mind. Probably the criteria of a good site will differ among parks as the local situations differ, but several are of general application. Thus, in almost every instance the museum should be located on one of the main tourist routes in the park. Not only does such a location attract a higher percentage of park visitors and therefore function more efficiently, but also it serves the best interests of the hurried tourist who cannot afford time for side trips. Most park museums are now located on main park routes, and the few that are not tend to emphasize the importance of this condition. It is very desirable, also, that a museum site be near an important park feature. The vital characteristic of a park museum is that its principal exhibits are outside its walls. The close connection between the museum and the park should not be neglected, and the location of the museum is one means of realizing the inter-relationship. Incidentally, the placement of a museum near a major feature of the park may increase museum visitation and be more convenient because people can see both the outdoor exhibit of the feature itself and the museum which aids in its fuller appreciation without stopping and parking a second time. Since the museum must perform its work for most visitors in a minimum time, it is advantageous to choose a site where the visitors' receptiveness will be high. Theoretically, this should not be at the entrance where contact with the park has had no time to stimulate interest, or at the exit where visitors are beginning to think of the interests ahead, but in the midst of the park offerings. Probably this criterion does not apply in some parks which are only visited by people already sufficiently curious to make a special journey, but mental attitude is a matter to be considered in locating the museum. In many parks the need for administrative economy makes it preferable to build the museum at or near headquarters where extra guarding and time spent in supervision can be kept down. Frequently in

small parks the museum and administrative offices share the same building. Consideration has been given to the convenience of the hurried visitor. The people who use the park most effectively are those spending several days or an entire vacation there. These are the visitors who can return to the museum, pore over the exhibits, and use the library and study collections. Often they are the people whom it is most profitable to teach. For them the museum site ought to be near the campground or hotel—within easy walking distance at least. Finally, while the museum should have an attractive location, it should not be permitted to detract from any major feature, scenic or historic. The site should be chosen to keep the museum subordinate to the park. Few sites can fulfill all these conditions or others that may be applied, but by indicating what is desirable the criteria may help in selecting an effective location.

The size of a park museum is determined by the work it has to do, and existing ones vary considerably in this respect. Without exception, however, they are comparatively small museums and several factors tend to keep them so. A park museum is one unit in an interpretational program the emphasis of which is on outdoor features. It would not be in the interests of the program as a whole to keep visitors inside the museum at the expense of time spent in appreciative contact with the actual park. They are brought into the museum only to increase their understanding of what is outside,

Figure 6.—MUSEUM AND ADMINISTRATION BUILDING, GUILFORD COURTHOUSE NATIONAL MILITARY PARK, NORTH CAROLINA. MUSEUM BUILDINGS OFTEN CONFORM TO LOCAL PERIOD ARCHITECTURE

and the museum should serve this purpose as quickly as possible. Ordinarily, focal point museums are planned to deliver the gist of their story in about 20 or 30 minutes. Since every minute counts, small size is a distinct advantage. There is a demonstrated tendency for visitors to spend proportionately more time in a small museum than a large one. In other words, in a given time they will see fewer exhibits more thoroughly if the museum is small. The effectiveness of park museums is increased by keeping them small. Also, these museums have a definitely limited scope—the significant story of one relatively small area—which promotes restricted size. At the present time the average floor area of exhibit space in park museums is approximately 880 square feet and the average number of exhibit cases somewhere between 10 and 15. A large park museum may have as much as 3,500 square feet of exhibit space and perhaps 50 or 75 cases. Because they are and should be small, park museums may listen to Parker's challenge with special heed.

> The small museum has a more intensive task, perhaps, than the larger, for it has less room to waste through errors. Its faults stand out more glaringly and thus discount the value of the institution in greater proportion. Then *if any museum needs to be right in all details, it is the small one.* Fortunately a small museum can be so much of a gem that it becomes a real inspiration.[1]

Park museums have been built in keeping with the wild surroundings of the great scenic parks; they have employed the traditional styles peculiar to their regions; or they have adopted modern forms (*see* Figs. 4–7). Regardless of their exterior design, however, they should have certain characteristics which make for good museum plants. They should be fireproof, for museums contain materials that are not only valuable but often irreplaceable. At present less than half of the park museum buildings are constructed in accordance with fireproof standards, but the proportion is increasing as new ones are built, and it is hoped that eventually all may be. Since live museums tend to grow and future needs cannot always be predicted, enlargement should be anticipated in the initial design of every park museum. Perhaps most important of all, the museum interior should be functional. It should be planned to provide adequate space for the public, the staff, and the collections, and convenient flow of people and objects as required. It should permit economical operation. This challenges the skill of the architect, for there is no ideal floor plan to fit every park and many knotty problems are involved.

The building requirements of most park museums are in general similar,

[1] Arthur C. Parker. A manual for history museums. p. 57–58. 1935. By permission of Columbia University Press.

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and the following outline of the needs of a headquarters museum (or park museum when there is only one) is included as a check list of possible use to museum planners:

Entrance.—There should be only one public entrance, since additional entrances hinder good circulation of visitors and require extra attendants to guard them or collect fees. The entrance is desirably at grade level or only a little above to permit easy access.

Lobby.—The lobby often has an important function in park museums as a waiting room and gathering place for scheduled trips out into the park and for museum talks. It is an active center for public contacts. It also functions as a transition from the outdoors to the exhibit halls, permitting the eyes to adjust themselves to the different light, and the mind to the museum atmosphere. The lobby should contain seats and possibly certain orientation exhibits. It should not be made an extra exhibit room, however. The decorative possibilities might be used to create a feeling or atmosphere for the museum story.

Information office.—The lobby is presided over by an attendant whose principal function is to give information. His office should open directly into the lobby, preferably on the right-hand side toward which most people

Photo by Haynes

Figure 7.—THE NORRIS MUSEUM, YELLOWSTONE NATIONAL PARK, WYOMING. THE STORY OF THE GEOCHEMISTRY OF THE NORRIS GEYSER BASIN IS INTERPRETED IN A BUILDING DESIGNED TO BLEND WITH ITS NATURAL SURROUNDINGS

naturally turn. Ordinarily the office and lobby are separated by a counter. In many parks the same office should serve in selling or distributing park literature. To achieve full economy of operation, this office should be so placed that the one attendant also can keep an eye on the exhibit halls.

Exhibit rooms.—These are discussed in detail in the next chapter. They should open directly from the lobby by doorways at least 5 feet wide and should be kept on the main floor. It is desirable to have a separate room for each major field covered in the museum story. Each room should be considerably longer than wide and have only one entrance which should be located at an end rather than on a side of the room.

Library.—This is described in Chapter VIII. It should be an attractive room, inviting use, accessible to both the staff and the public, yet quiet.

Lecture room.—When a lecture room is needed, it should be equipped with an adequate platform, a good projection booth, proper ventilation, acoustical surfacing, and means of darkening the room during the day. It should be located where it can be used at night without opening the exhibit halls, library, or other parts of the building.

Staff offices.—There should be good offices with ample daylight for the members of the interpretative staff. The park naturalist or historian deserves a separate, reasonably spacious office. One staff office should include space for a laboratory where the study collection is used. This should have running water, work tables, and often additional special equipment. The staff space should be separated from the public rooms. At least the laboratory should be adjacent to the study collection room.

Study room.—An office or laboratory should be provided for the use of visiting scholars. Local conditions will determine its size and equipment, but it should be adjacent to the study collection rooms and staff offices.

Study collection room.—This room for the storage of collections is covered in Chapter V. It should be of ample size and placed above the basement close to the staff offices. There should be free passage at least 5 feet wide from this room to the workroom, the exhibit rooms, and the laboratory, but it should be removed from the public space. In some instances it will include a special vault for valuable objects and fire doors isolating it from the rest of the building.

Workroom.—The museum will need an all-purpose workroom where collections can be unpacked, cleaned, and treated, and exhibits can be assembled or repaired. It should be near grade level, with passage at least 5 feet wide from outside and into the exhibit and study collection rooms. A particular fire hazard, it should be insulated from the rest of the building.

Shop benches and tools should be provided. The workroom should contain the fumigating box or vault.

Photographic laboratory.—An adequate darkroom should be provided adjacent to the workroom where it can receive the same fire protection and will be handy for photographing new accessions. Usually a separate room for developing negatives is desirable.

Storage room.—Also adjacent to the workroom should be space for the dead storage of equipment and materials. This is not for the collections or for highly inflammable liquids. A separate building of special approved design should be used for storing paints, oils, and other inflammable material.

Other facilities.—The maintenance rooms—heating plant, mop closets, etc.—should follow good practice in public buildings. Toilets for the public are to be provided in some instances, but not in others, depending on the location of the museum in relation to other park structures. If present, they should open from the outside of the building but never in a conspicuous place at the entrance to the museum. Staff washrooms should be furnished whether or not public ones are available.

Branch, or focal point, museums will not require all these rooms. Ordinarily a lobby, information office, and exhibit rooms will suffice.

The amount of space allotted to the various functions will not be the same in every park. In general it may be said that the public rooms (exhibit halls, lobby, and lecture room) should never occupy more than two-thirds of the space in a headquarters museum. Usually it will be about equally divided between the public rooms and the study and workrooms and offices. Occasionally in parks with extensive and important collections, the public rooms will have considerably less than half the space. The usual development is such as to make study and storage rooms inadequate and overcrowded in a short time. To provide more space for this purpose than would seem necessary is a step in the right direction.

CHAPTER ·III·

THE EXHIBIT ROOM AND ITS EQUIPMENT

THE exhibit room and its equipment comprise the most important part of the museum so far as the visitor is concerned. As exhibition is the most highly specialized function of the museum, so are the exhibit halls specialized architecturally. Too much care cannot be given in the planning of an exhibit hall and in selecting its equipment.

THE EXHIBIT ROOM

Purpose

The purpose of the exhibit room in National Park Service museums is to display exhibits for park visitors in the most useful and attractive manner. Any other function will detract from this primary purpose. Consequently, lecture halls, libraries, staff offices, and storage rooms should be provided in other parts of the museum, aside from the exhibit rooms, while a lobby should be provided for such secondary museum functions as an information desk and place of assembly before lectures or hikes.

Location

The location of exhibit rooms depends a great deal upon the number o museum rooms and floors required to interpret the park story. Generally speaking, for direct and easy access they should be located near the entrance so that visitors may find at once what they are seeking and may receive a pleasing first impression. If possible the exhibit rooms should be on the main floor at ground level, separated from the main entrance door by only the museum lobby. Past experience reveals that a high percentage of visitors confine their stay to the first floor. In some museums containing several exhibit rooms it has been found advantageous to locate the rooms so that all open into a common foyer rather than place them end to end in a long series. When exhibit rooms open into such a foyer, the visitor will

not have to walk through several rooms to locate certain exhibits. If he is particularly interested in the geology of the area, he may then enter the Geology Room direct and avoid having to pass through rooms devoted to several other subjects with a possible distraction.

Shape and Size

No definite rule can be given regarding the shape and size of exhibit rooms. Once again the answer depends on careful consideration of the particular use to be made of the room, the number of exhibits to be installed, the space necessary to interpret each feature of the park story, and the type and size of exhibit devices. Where only one room is used for exhibits, a satisfactory shape is a comparatively narrow room about one-half to two-thirds as wide as long. Twenty to 25 feet in width and from 35 to 50 feet in length is commonly used and has proved to be satisfactory. Rooms which are extremely long and narrow, square, or irregularly shaped seldom prove satisfactory. Some museums have been provided with very high ceilings and balconies, with the exhibits installed around the balconies as well as on the main floor. Unless it is necessary to house some unusually large specimens such as a dinosaur skeleton or a locomotive, this design is not desirable. In most Service museums small separate rooms are preferable to large alcoves. Exhibit rooms should have relatively large, open floor spaces so as not to produce a crowded effect or cause congestion when large numbers of visitors are present. Supporting walls and buttresses should not jut into the room, and supporting columns should be reduced to a minimum or eliminated if possible.

The number of exhibit rooms in the museum depends upon the scope of the park story and the variety of subjects to be covered by the museum program. In small areas visited by relatively few people, a small room with approximately a dozen exhibit units, each portraying or interpreting a chapter in the park story, will suffice. In larger parks where the story is usually more complex and visitation heavy, several exhibit rooms may be necessary. In such museums each room will be devoted to one chapter of the story. In a small national monument, for example, a few exhibits in a part of one room may be so arranged as to present to the visitor in a very few minutes the most significant points of the monument story. One exhibit may be on the natural environment of the area, one on the geology, and others on prehistory, plants, animals, and early history, to mention only a few possible topics. In like manner, a large park or monument may have a similar story to interpret, but an entire room instead of one case will be necessary for each subject.

A small, well-planned museum, with a few exhibits carefully installed in modern, properly lighted museum cases, will be more effective than a large array of exhibits carelessly installed and lighted.

Interior Treatment

Interior treatment depends a great deal on what sort of material is to be exhibited, the size of the room, its relation to other rooms, and similar factors. In general, however, an exhibit hall should combine maximum flexibility, complete light control, accessibility, and adequate provisions for visitor comfort. If they cannot be avoided, service and utility ducts should be kept close to the supporting walls. Fire extinguishers, alarm boxes, thermostats, and other fixtures requiring free access should not be placed at random but kept near entrances or where they will not interpose between exhibits. The exhibits are fitted into the room by means of temporary sidewalls and partitions capable of many arrangements and finishes to suit the objects displayed. If possible, the exhibit rooms should have neither windows nor skylights but depend wholly on artificial lighting as discussed under "Lighting." Accordingly, ample outlets and circuits must be provided to light adequately as many exhibit cases as are to be installed and to afford general illumination of the room itself so that the visitor can walk around with comfort and safety.

In short, the interior treatment of the exhibit room demands careful designing, and a few suggestions may be helpful.

DOORS

If possible, there should be only one main doorway to each exhibit room. It should be large enough to admit passage of large exhibits or equipment which may be installed in the room from time to time and permit two persons to pass each other with comfort in the doorway. A service door or fire exit may also be added when necessary.

In many instances doors are not hung at exhibit room entrances, while in certain cases large ornamental doors or gates may be employed. Where it is desirable to prevent the possible spread of fire, a metal firedoor of approved construction may be concealed within the walls or placed in the open. Such fire doors are usually equipped with a fuse link permitting the door to roll shut by its own weight when heat melts the link.

FLOORS

The first requirement of a museum floor is that it be level and smooth to prevent tripping. It is also desirable, for visitor comfort, to install a

resilient, glare-proof floor covering such as rubber tile, composition cork, or linoleum. Stone, tile, and compositions of stone and cement are less satisfactory than the softer types because of their noise and tendency to tire visitors by their hardness. They must be used, however, under certain conditions to resist heavy wear caused by excessive tracking of mud or sand. Hardwood is often used as a compromise. Regardless of the type of floor covering used, it should be kept clean and in good condition at all times. Care should be taken, however, to avoid excessive polishing to the point where it may become too slippery for safety.

The flooring of all exhibit rooms on the same floor should be at the same level so as to eliminate hazards to safety. If steps are necessary, they should be well lighted and guard rails should be provided. Ramps are preferable to steps.

CEILINGS

Acoustical plaster or sound-absorbing composition board is desirable in ceilings to reduce noise. General diffusion of room lighting is always preferable and requires a white or light-colored ceiling. Heavy or complicated ornamentation above the exhibits distracts attention from the exhibits which invariably are placed as near eye level as possible.

WALLS

Smooth, even wall surfaces are preferable to heavy textures in stone or rustic wood. Plaster walls should be painted in neutral and pleasing light tones with a dull finish oil or casein paint so as not to produce glare or distract from the exhibits. The same wall color is often used throughout the exhibit room and is invariably darker than the ceiling but each separate room may have a different color to avoid monotony. Light buffs are most frequently employed, but French grays and blues in pastel tints have been used successfully. The use of strong color may be necessary for special types of exhibits, but textiles are generally employed where rich colors are needed.

Walls may be plastered or may consist of loose-weave cloth over wood sheathing. The latter is recommended in exhibit rooms where screws and nails will be used for frequently changed exhibits. The loose weave of burlap and monks cloth closes over to conceal nail holes. Oil cloth is usually pasted over wood sheathing before applying a cloth cover to prevent stains from dust drawn through cracks between the boards by air circulation. Similarly muslin is pasted over plaster walls before painting with oil to prevent cracks from showing.

The sole purpose of decoration in an exhibit room should be to provide a good background or setting for the material on display. Since any extensive architectural ornamentation is in competition with the exhibits and usually detracts from them, it is omitted entirely or greatly subdued. Cases are kept uniform with a neutral colored monks cloth background. Sometimes an unpleasant drabness may occur from neutral backgrounds. In such instances stronger and brighter effects in one color or in a combination of several may be used in solid areas, but not in patterns. Colors may be used functionally in some instances for general atmospheric effect. A pattern in greens may be employed for forest exhibits, while tans and buffs may be used for a desert display and blues for marine subjects. Inconspicuous walls are the general rule, although some park museums will find stronger colors an effective means of livening an otherwise dull museum room.

Lighting

Lighting in exhibit rooms should perform two functions—make the displays visible and enhance their appearance by making them attractive and appealing. Poorly lighted rooms and exhibits do more to defeat the purpose of the museum than almost any other factor. A specimen worthy of display and a label important enough to be read should be amply illuminated. The two extremes of glare on the one hand and deep shadows on the other should be avoided since both have a tendency to create fatigue and diminish attraction, thus destroying the effectiveness of exhibits. Insufficient lighting is prevalent in most museums and should be corrected wherever possible.

Since artificial light can be more readily controlled than daylight, which changes in intensity not only seasonally but every hour of the day, the tendency is toward elimination of windows and skylights.

NATURAL LIGHT

Natural light is not only an enemy to specimens but is injurious to museum accessories such as draperies, curtains, rugs, walls, and cloth-covered backgrounds. Most museum exhibits are changed occasionally, and if too much natural light has been permitted in the rooms, the cloth backgrounds will have a faded pattern around the place which was occupied by the picture or specimen. These unsightly patterns cannot be removed and new coverings or painting must be employed. Other objections are that windows and skylights permit the entrance of dust, insects, and the strong, direct, bleaching rays of sunlight, all of which are injurious to scientific and historical specimens. Many of these objects are fragile and

their colors are easily faded; even the structure of paper is known to deteriorate when exposed to strong sunlight.

WINDOWS

Windows sometimes are desirable to present the visitor a view of some unusual sight or phenomenon outside the museum building which relates directly to the exhibit and thus gives a better understanding of the story as interpreted in the museum. In this instance careful study should be given to the design and location of the window. (*See* Frontispiece.) It should be planned to frame the particular view desired so that it will serve as an integral part of the exhibit, harmonize with the other exhibits in the room, and at the same time reduce to a minimum the undesirable effects of daylight. It is often desirable to recess such a window deeply or shield it completely from the rest of the room. Windows also serve a useful purpose in providing an occasional relief from the subconscious feeling of confinement, which makes many persons uncomfortable. An occasional glimpse of the outdoors aids materially in overcoming this claustrophobia.

Since some museums find artificial lighting impractical because of their location or the expense of operation, natural light must be employed. In such instances the windows should be devised to admit only the necessary amount of light. In general they are placed on only one or two sides of the room, with exhibits on the opposite sides, and high enough to prevent a glare from falling directly upon the exhibit cases.

In certain localities subjected to intense heat, windows are necessary for ventilation. In such instances they may be placed well above the tops of the wall cases and near the ceiling. It is also necessary at times to build in windows for the external symmetry of the building. In these instances the blinds or drapes may be permanently dropped or a shallow alcove with neutral color installed to create the proper illusion from the outside while eliminating all daylight inside.

Skylights often are used in place of side windows. Some of the objections to their use are that they cause excessively warm rooms in summer, become covered with snow and ice in winter with a consequent loss of light, and have a tendency to leak. The bleaching effect of sunlight is intensified because of the more direct rays coming from above. Even when diffusers and filters are provided, the rate of bleaching is only slowed down and not eliminated, since rays in the visible spectrum bleach as well as those in the ultraviolet. When natural lighting must be employed, shades should be installed and drawn against the direct rays whenever possible during visiting hours and always drawn when the museum is closed.

ARTIFICIAL LIGHT

While artificial light is to be preferred and is free from many of the disadvantages of natural light, its use in the exhibit room should be studied carefully. General illumination in exhibit rooms should be indirect to protect the eyes of the visitors from glare, brilliant enough to illuminate the floor for safe walking, but not strong enough to compete with the case lights. When rooms are too dimly lit, the contrast with bright cases causes eyestrain and more guards are necessary for visitor control.

Reflections also should be eliminated so far as possible. The necessity of using large surfaces of glass for protecting specimens and displays adds to the difficulty. In dioramas the tilting of the glass fronts eliminates some of these undesirable reflections, but in other types of exhibit cases the elimination is accomplished only by properly controlling the volume of light. The principle of this control may best be explained by comparison with a screen door. At night the interior of a room may be seen from the darkness outdoors through the screen, which becomes almost invisible. In the daytime the brilliant outdoor sunlight makes the screen nearly opaque. Similarly a sheet of glass becomes a mirror when set against a dark interior, but the case which is brilliantly illuminated within offers no troublesome reflections in a dark room.

General illumination of the exhibit room is usually achieved by cove lights placed in recesses or niches above the museum cases in such a manner as to cast their rays against the ceiling, thus giving an evenly distributed indirect light. Ample light for general diffusion is usually set at approximately one-tenth the intensity of the case lights, and at this ratio usually will not compete with the latter.

ILLUMINATION OF EXHIBIT CASES

In most instances it is desirable to place the lights outside the case to eliminate the accumulation of heat and the resultant "breathing in" of dust-laden air. They should be placed in such a manner as to distribute the light evenly throughout the exhibit space and yet be hidden from sight. The usual method is to install a series of four to six frosted lamps, concealed behind a shield, above each case. A sheet of ground, frosted, or opal glass across the top of the case separates it from the light box and aids in diffusing the light, which is concentrated downward by reflectors. The lamps are centered some distance above the ground glass to produce a good distribution of light in the case since the illumination tends to be too bright near the top and dimmer at the bottom. The reflectors should be placed in correct relation to the lamps as revealed by experiment, screened from sight behind

the lighting shield which runs along the front and ends of the case top, and so designed as to blend with the exterior finish and be as inconspicuous as possible. It is obvious that this method of overhead lighting will cause shadows from opaque objects, hence the use of large opaque shelves should be avoided. In practice it has been found that a sufficient volume of light is distributed throughout the case and, if reasonable resourcefulness is used, such shadows may be overcome satisfactorily by placing the larger objects near the bottom. It is preferable to fasten specimens to the back of the case on individual brackets or supports, but in the few special instances where shelves must be used, plate glass with polished edges is employed.

Cases less than 12 inches in depth are difficult to light from above when large objects must be installed in them. Side lighting is often employed in such instances to supplement the overhead source, but careful diffusion is necessary to eliminate objectionable shadows. Footlights or bottom lights are not generally used because of unnatural effects and glare. It is good practice to exhibit the large objects near the bottom of the case not only for better lighting but for good composition as well.

FLUORESCENT LAMPS

Fluorescent lamps have so many advantages over the filament types that their use is spreading rapidly in museums. Among their advantages are a better diffusion of light, with consequent elimination of troublesome shadows and a greater brilliance of color reflection from the specimen. They are also comparatively free from heat and may be used with safety where the filament types would do damage. Greater economy is effected by the low wattage at which they operate. A 15-watt lamp often does the work of a 100-watt filament-type lamp. An activator is needed for their operation. Usually this small device is installed in the light trough, but where space is restricted it may be placed at some distance with appropriate wiring.

SPOTLIGHTS, COLORS, AND SPECIAL LIGHTING EQUIPMENT

An even flood of illumination is not enough for all musuem displays. A costume or uniform in diffused light has a flat, uninteresting appearance since there are no highlights and few color contrasts. The material itself loses some of its characteristic sheen and depth, while form lacks a necessary emphasis. There may be an adequate amount of light on the uniform, yet it is not well lighted. With the addition of a single beam of light properly concentrated, tinted, and directed, the specimen takes on new life. The shadows and highlights bring out the folds and structure in the material, and a greater intensity of color enriches the whole. Such a well-

planned use of light will attract visitors far more successfully than the mere piling on of light. It fulfills the fundamental purposes of the display—to attract attention and then stimulate the visitor to view and learn about the exhibit. The first lighting rule is to apply sufficient light to all parts of the specimen so no point is in dark shadow, then to light in front from above and from one side for emphasis.

Spotlights and other special lighting equipment are being used more frequently to call attention to certain important exhibits. By use of these devices the display acquires a new significance in its relation to the exhibit as a whole. In some instances color is effective if used with restraint to give additional brilliance to the objects displayed. Rose, amber, and daylight-blue filters are the ones most frequently employed.

Statues, portrait busts, ship models, mounted animals, and many other three-dimensional exhibits are enhanced by contrast in lighting, while the colors and brilliance of a painting may be increased by a well-concealed spotlight. Back lighting is also employed effectively to silhouette certain objects.

Color and balance in light, like other mediums, must be used with knowledge and discretion. Gaudy and startling effects are undesirable and should be avoided. The installation of special lights and color filters is the work of a specialist, but the possibilities of critical lighting should not be neglected in museum planning.

LIGHTING DIORAMAS AND HABITAT GROUPS

The placement of the intricate lighting equipment often needed in dioramas and habitat groups is closely akin to lighting a stage setting.[1] It is designed and balanced to highlight important details in the foreground, maintain a balance of intensity between foreground and background, and prevent shadows of trees, buildings, and figures in the foreground from falling across the background and spoiling the illusion.

The artist who paints the background selects a color key to match the foreground. This key, whether high or low, is determined by the intensity of the light source. To match a color on the horizontal surface of the foreground to the vertical background, considerable departure from the actual foreground color is often necessary. This explanation is made to emphasize the importance of proper maintenance of the lights after installation in the museum. Too often burned-out lamps are replaced with new lamps of any wattage or color which happen to be handy at the moment. The position of the lights may be moved through rough or careless handling

[1] Ned J. Burns. Group lighting. The museum news, 10: 5–7, June 1, 1932.

which also may ruin the effect. Prompt replacement of burned-out lamps with new ones of exactly the same type, color, and wattage is a part of proper maintenance. Without such careful maintenance in the exhibit room, all the painstaking work in the central museum laboratories to produce exhibits of high quality will be futile.

Circulation of Visitors

Exhibit rooms should be designed to permit a logical scheme of circulation but not in such a manner as to force the visitors to pursue a certain course since such regimentation is resented. Visitors should be led over a simplified course naturally and easily without any feeling of compulsion.

In museums limited to one exhibit room the various exhibits should be arranged in a logical order or sequence, like chapters in a book, but each exhibit unit should be planned to be self-contained so that the visitor will get something from it whether he follows the proper sequence or not. This applies equally well to the large museums containing several exhibit rooms. It might be desirable for the visitor to review the exhibits in the Prehistory Room before entering the History Room, but the exhibits in the latter room should be so planned that they will be interesting, understandable, and instructive as a separate entity.

Studies of visitor reaction have revealed that the wall to the visitors' right as far as the exit is usually of more value for display purposes than the one to the left. This, however, is not true in all instances. Many factors influence the direction taken by visitors. Traffic regulations dictate a habit of walking to the right and a majority tend to go in that direction. On the other hand, a page is read from left to right which may induce circulation in a clockwise direction. The types of exhibit devices employed, as well as their placement and lighting, have a strong effect on the course of the visitor. The direction from which a visitor approaches also has a marked effect. If exhibit rooms are so arranged that each is entered from the previous one instead of from a main hall or foyer, the doors should not be placed in line with each other, since an obvious open door tends to draw visitors through it whether they have seen the exhibits in the room or not. If possible, in a room with more than one door the doors should be located near each other, preferably on the same side of the room. In some museums table cases, exhibit screens, and other devices are placed in strategic locations to deflect the visitor flow in a certain direction. There is no objection to such placement, but it should not be installed permanently. The very nature of exhibits requires revisions, and at such a time it may be necessary and desirable to change the circulation routes because of a different

balance of attraction. In some instances the use of moderate-sized arrows and directional signs with small numbers placed on the exhibit cases have aided the visitors to study the exhibits in proper order; also, guidebooks listing in order the exhibit rooms as well as the exhibits in each room have been used successfully.

Attempts to influence visitors to follow certain routes through the exhibit rooms present difficulty. Only after experimentation and study is success ordinarily attained. Extremes such as labyrinthine passages similar to the mystic maze are to be avoided. The visitor should feel free to leave at any time and not be forced to walk through a series of narrow passages in only one direction.

Use of Exhibit Room as a Lecture Hall

The use of the exhibit room as a lecture hall where the audience is accommodated with folding chairs makes impossible its use as a museum room during the period of the lecture, while at the same time the exhibits distract the audience from what the lecturer is saying. This, of course, does not apply to lectures on the exhibits themselves during a guided tour. Where periodic talks are given on such a tour, it is frequently helpful to build a platform raised two or three steps above the floor at one end of the exhibit room. Here are placed the models, charts, and specimens used by the lecturer to explain the geological or other special features. During the intervals when no talk is being given, visitors should be free to examine the exhibits on this platform. They should be closely related to other exhibits in the room. (*See* Fig. 3.)

Special Exhibit Room

Almost every active museum employs frequently changing feature exhibits for the repeating visitors and as a seasonal subject for the interest of newcomers. Space for this purpose need not be large, but it should be located near the main entrance. Often this special exhibit room exceeds other exhibition space in flexibility and means of light control. It should be arranged for heavy visitation and for informal talks to groups and so placed that the flow of visitors will not impede the regular paths to the other exhibit rooms. It should be possible to close off the room temporarily for changing of exhibits without erecting an unsightly obstruction. A storage closet adjacent to this room to hold materials being assembled for installation is often desirable.

EXHIBIT ROOM EQUIPMENT

Museum Cases

PURPOSE

A museum case has a twofold purpose. It must protect exhibit material from damage and at the same time display the exhibits to the best possible advantage. Damage to specimens and exhibits may be listed in the following order of frequency:

1. Dust.
2. Insects.
3. Thieves and vandals.
4. Excessive moisture (mold).
5. Excessive daylight (fading).
6. Excessive heat (brittleness, charring).

If protection were of supreme importance and exhibition could be disregarded, a steel safe would afford the most effective protection. The exhibit function of the museum case makes it necessary to reach a compromise somewhere between full protection and the other extreme of full visibility which can best be obtained with no case at all. It is a satisfactory combination of protection plus effective display that is the outstanding characteristic of a desirable museum case.

TYPES OF CASES

There are many types and sizes of cases to meet special needs, but only a few standard ones are recommended for the average park museum. The four types described here will meet the needs of nearly every museum and will house all but unusual or extra large objects. In general, wood frames to hold the glass are considered unsatisfactory, since the larger wood members give a heavy, clumsy appearance and are more subject to warping and sticking than the metal frame. Aluminum and bronze are the two metals most commonly used for extruding frame members. Bronze is stronger and has a rich appearance. Its disadvantages are greater cost and tarnishing from finger marks. Aluminum is weaker, and threads are more likely to strip out than bronze; it is less subject to staining and is relatively cheaper. The frames are held together by pressure screws, while a groove in each member contains a cloth packing to keep out dust and insects. The glass is held in place with a special mastic or by a flat spring pressing the glass against a felt packing. The back of the case is usually made of plywood and may have a covering of cork composition for easy pinning.

Monks cloth is employed usually in lining cases since its loose weave will close to conceal a nail or screw hole. Its neutral color serves as a suit-

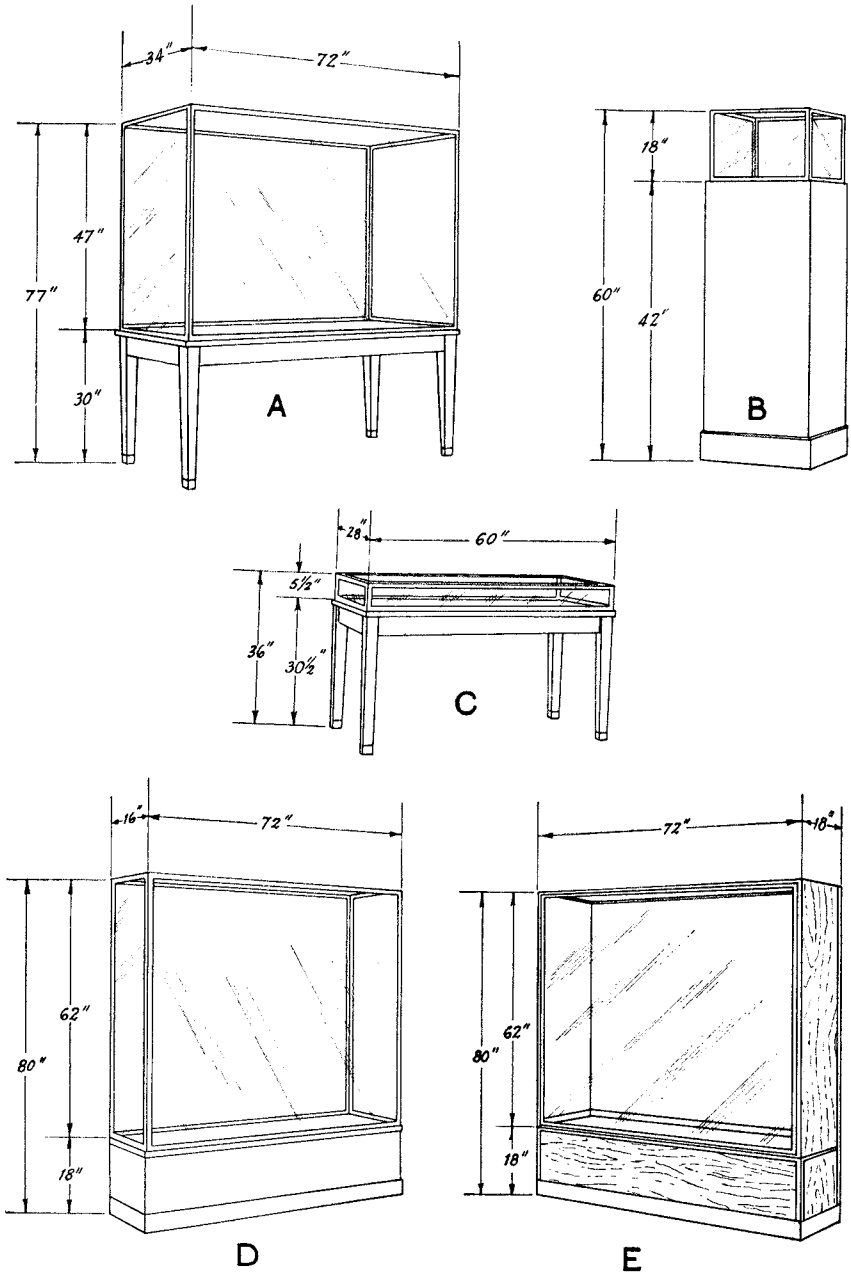

Figure 8.—MUSEUM EXHIBIT CASES WITH TYPICAL SHAPES AND STANDARD MEASUREMENTS. (A) AISLE CASE. (B) PEDESTAL CASE. (C) TABLE CASE. (D) FREE-STANDING WALL CASE WITH GLASS SIDES. (E) SPECIAL WALL CASE WITH SOLID SIDES, WHICH MAY BE SET INTO A RECESS OR USED FREE-STANDING

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able background for nearly every type of object, and since its color does not fade appreciably it is very popular. Casement cloth of the same neutral color as monks cloth is often used for cases which display jewelry, silver, and ornamental or semiprecious stones. Velvets or other fine cloths may be used or the inside may simply be painted with a dull finish paint, either oil or water color.

When doors are hinged, it is customary to use a piano-type hinge running the entire length of the joint. Hinged doors are a convenience when the case must be opened frequently, but the hinges cannot be sealed satisfactorily against dust or the doors closed as tightly as with pressure screws through all four sides. Case locks are usually of the cylinder type. Since case locks may be picked or pried open with greater ease, the use of pressure screws at 18-inch intervals all around is far safer.

Wall cases.—The most widely used and generally satisfactory type of case, and the one which is most suitable for nearly every exhibit likely to be installed in park museums, is known as the wall case. The one shown in Figure 8D, has glass front and sides with an 18-inch wood or enameled metal base and a frosted or ground-glass top. The case is illuminated from

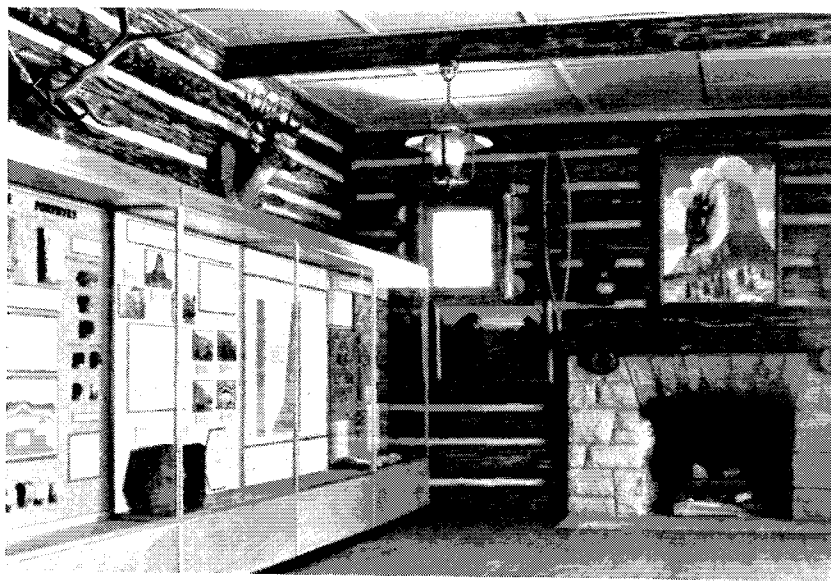

Figure 9.—SECTION OF MUSEUM ROOM AT DEVILS TOWER NATIONAL MONUMENT, WYOMING, SHOWING FREE-STANDING WALL CASES, LEGENDARY PAINTINGS, AND VARIOUS OBJECTS USED FOR DECORATION AS WELL AS INTERPRETATION

the top and the lighting unit concealed from view by an upright metal shield along the front and two sides. The size shown is standard but smaller or larger cases are available. If necessary, this type of case may be fitted with glass shelves on adjustable brackets, although shelves are seldom desirable.

Wall cases may be set into the wall as shown in Figures 3B and 10, and appear as part of the building or they may stand in front of the wall like a piece of furniture as shown in Figures 3A, C, D, and 9. Large and medium-sized museums profit by using the built-in type, while small one-room museums have greater flexibility when cases are treated as free-standing furniture.

Table cases.—Figure 8C shows a table case of standard dimensions. The lid may be hinged or the entire top and four sides removed from the table as one unit. Usually the glass is level, less often sloping. The height of the exhibition space may be varied to suit the individual needs of the exhibit by inserting a deck or box to bring small objects up close to the glass.

Table cases are used for display of books, documents, coins, minerals, and similar materials and can be used to particular advantage for some displays which are changed frequently and need not be fastened in place. Other items, as a general rule, can be displayed to better advantage in a wall case, as table cases are hard to light and compose, and are susceptible to bad reflections from overhead room light.

Aisle cases.—The aisle case shown in Figure 8A, is a free-standing case limited in use but suitable for large pottery, baskets, models of various sorts, and other large objects which must be viewed from all sides. The glass panels are held together by metal frames which are supported by a solid or table leg base of wood or metal, usually 30 inches from the floor. The dimensions shown are standard, but smaller sizes often are used. The interior of the case may be fitted with plywood diaphragms in steps, pyramids, or other shapes, or adjustable shelves. The end glass panels may be hinged and locked or held in place with pressure screws. As a rule, the use of aisle cases is discouraged since they tend to clutter up the exhibit room, spoil the vistas, and cause bad reflections.

Pedestal cases.—This type is generally used for the special display of some small and valuable object such as a jewel or miniature statue. The height of the pedestal or base shown in Figure 8B, is standard but the size of the case it supports may be varied to fill the required need. The pedestal is usually constructed of wood or composition to match the interior trim. This case is usually built as one piece for neatness and is attached to the base with pressure screws.

It is evident from the foregoing that exhibit cases should be carefully constructed, not only for neat appearance but for adequate protection as well. Cases should not be built locally without adequate facilities and skilled mechanics working from approved designs. It is more desirable to have them built in central museum laboratories or furnished from manufacturers of museum equipment.

The wall case illustrated in Figure 8E, has wood sides instead of glass. It is less expensive to build than the one with glass sides and is serviceable in many instances where cases are built into a room side by side. It is provided with a plate glass front which is set in a removable metal frame screwed tightly to a metal strip in the wooden body of the case. The top is of frosted plate glass similar to that described for the previous wall case.

As a general rule wall cases should not exceed a height of 7½ feet, a depth of 3 feet, or a width of 8 feet (10 feet in very rare instances). The larger the case the more difficult it is to handle and more men are required to remove the glass front when exhibits are changed. The average height found most satisfactory in park museums is 80 inches overall with an 18-inch base and 62 inches of glass. A depth of 18 inches and width of 72 inches also are used generally. Frequently the exhibits may not require a depth of 18 inches; if this is so, a deck or panel may be set in at the proper distance from the case front. The extra depth is always welcome when large objects are to be displayed. Labels and small objects are difficult to see when placed on case bottoms less than 18 inches from the floor. Consequently, this base usually is preferred for all wall cases.

Absence of Museum Cases

In some park museums it is possible to dispense with cases for large, durable exhibits. Cannon balls; large rock specimens; stoves, kettles, and large iron implements; mortars and pestles; millstones; milestones; and totem poles; wagons and carriages seldom need case protection. Many may be displayed attractively outside museum cases and even outdoors in a patio or courtyard. A slightly raised platform may be used effectively as well as niches, wall brackets, and pedestals. Sometimes a large object may be displayed on the floor of the exhibit room with no base whatsoever, but generally a low base simplifies floor cleaning.

Other types of exhibits consisting entirely of flat work—charts, maps, illustrated labels, photographs, textiles, laces, pressed plants, and the like—may be mounted attractively in glass-covered frames and hung on the walls like pictures. In some instances they may be mounted on dis-

Figure 10.—NATIONAL PARK SERVICE ROOM IN THE INTERIOR DEPARTMENT MUSEUM, WASHINGTON, D. C., SHOWING BUILT-IN WALL CASES, LARGE MAP MURAL, AND DECORATIVE SILHOUETTES WITH COVE LIGHTING FOR "ATMOSPHERE"

play panels or exhibit screens covered with monks cloth or other suitable material or having a painted background. The flat materials may be uncovered or covered with pieces of sheet glass, depending on the item displayed.

Swinging Racks

The swinging rack is a device with a number of frames, each about 2 by 3 feet in size, in which various flat exhibit materials may be mounted. These frames hang vertically on pivots and may be handled like the leaves of a very large book with thick pages. The frames are mounted on a metal base so that the visitor can view the exhibits without stooping. Each frame may be removed from the rack in order to change the exhibits from time to time.

The swinging rack offers a compact device for placing a large amount of material in a relatively small space in the exhibit room. It has been used with success for herbarium specimens, photographs, old newspapers, and documents. It enables the visitor to observe the exhibits at close

range. If both sides of the specimen are interesting it can be fitted in the frame so both are visible.

For material in which only a few persons are interested, such as herbarium sheets and large assemblages of photographs, the rack is especially satisfactory, because visitors who are deeply interested will be willing to search out what they want, and the other visitors will miss nothing of vital importance in the general scheme of interpreting the park story. (*See* Fig. 11.)

Fire Prevention Equipment

An exhibit room, like the museum building, should be of fireproof construction since it is to house valuable material, much of which is destructible and some of which is not replaceable.

Fire-fighting equipment such as extinguishers, hoses, and the like, should be placed in convenient locations, easily accessible to both the public and the museum personnel. The location and use of such equipment should be carefully explained to all personnel.

Benches

A few benches and chairs should be available in the exhibit room to aid in reducing visitor fatigue. They should not be placed, however, so as to interfere with visitor circulation or prevent visitors from seeing the exhibits.

Figure 11.—L–R: SHALLOW WALL CASE FOR PHOTOGRAPHS AND FLAT MATERIAL; SWINGING RACK FOR LARGE NUMBER OF PICTURES IN A SMALL SPACE; WALL CASE FOR MODELS AND OTHER THREE-DIMENSIONAL OBJECTS WITH ILLUSTRATIONS. VICKSBURG NATIONAL MILITARY PARK, MISSISSIPPI

CHAPTER ·IV·

MUSEUM EXHIBITS

PRESERVATION is the first main function of a museum; the second is to impart information by visual means about and through the objects which the museum contains. To explain these objects and give a better understanding of the story they tell, graphic devices of all kinds are employed, and most park exhibits should include both original specimens and graphic explanatory material. Although the exhibits are designed and constructed in the two central laboratories, park naturalists and historians should be familiar with the problems involved if they are to contribute fully to planning and are to use their museums effectively. There are many kinds of exhibits, each with its own strength and weakness; and the work to be done determines what should be selected for exhibit purposes. In park museums graphic devices play a large part because they are called upon to interpret the greater exhibits outside the museum walls—the natural and historical features of the park.

ORIGINAL OBJECTS

The most distinctive feature of a museum is its ability to present unbiased objective evidence by means of original material. The museum exhibits the original objects on which historical or scientific conclusions are based so that the visitor may see and judge for himself. While this is by far the most important function of the specimen, a broader purpose also may be served when it is shown with other objects in a synoptic series, thus aiding the visitor to gain a better understanding of the background into which these objects fit.

In addition to serving as evidence, the object may attract interest to itself because it has a symbolic value. For example, a Kentucky rifle and an Indian tomahawk may symbolize early border warfare.

Interest also may be stimulated by the object's association with important places, persons, or events. This appeal of association is deep and universal as is indicated by the popularity of souvenirs or heirlooms that

were used by well-loved relatives. A sword carried by George Washington could possess all three association elements and be cherished vicariously by a whole nation. Association value varies directly with the magnitude of the event or persons concerned just as the ripples caused by stones, tossed into a pond vary. A big stone creates waves that are larger and perceptible at a greater distance than does a small pebble. The official signing of a great state document may be cited as an example of a momentous event. The objects of primary association may be listed in descending order of value as:

1. The document itself.
2. The pen used in signing it.
3. The desk on which it was signed.
4. The ink well and sander used, and so on.

Of still less value would be specimens of secondary association such as personal effects of the signers or authors. In the case of a highly important document, appreciable interest value might extend to objects of secondary or tertiary association, as would be the case with the signing of the Declaration of Independence. The personal belongings of those who signed it have good association values. As the historic or dramatic importance of the document decreases the association must be progressively closer. Even Caesar Rodney's walking stick would be interesting in an exhibit on the Declaration of Independence, while little more than the pen used to sign, for example, the Migratory Waterfowl Treaty, would have notable association. Aesthetic appeal and its opposite, morbid appeal, are other strong stimulants to interest; the rarity or oddity of the object may also attract attention and arouse a desire to know more.

Intelligently used, these several deep-seated appeals to curiosity may have telling effect. If two objects have equal association value but one is inherently more beautiful than the other, it should be used by preference for its additional aesthetic value. It is well known that morbid curiosity is so deeply rooted in human nature its conscious use can easily lead to bad taste. The appeal of the rare and bizarre is too well known to need elaboration. If the object is the only one of its kind or one of very few, its exhibition value is greatly increased. The universal interest in oddities and abnormalities is also well known; here again care must be used not to descend to bad taste. Abnormalities should not be exhibited as such. They may be used occasionally to call attention to some very interesting facts about the normal. For example, two musket balls which mushroomed together in midair during the siege of Petersburg instantly arouse

the visitor's interest and lead to a desire to know more about the siege. Animal and plant abnormalities generally should be confined to study collections.

A single object may possess nearly all of the features enumerated. For example, a piece of glassware excavated on Jamestown Island is a source of evidence of the first permanent English settlement; it possesses association value through its connection with an important place and event and perhaps also with an important member of the colony; being a beautiful piece of glassware, its aesthetic appeal is clear; its rarity adds still another factor. The sum total explains the tremendous drawing power of this and similar specimens.

When sufficient original objects intimately concerned with the story to be told cannot be obtained, substitutions may be made. The following are typical examples of the problem. At Morristown National Historical Park the story of the Continental Army in winter quarters is illustrated by an ammunition cart and Abell's commissary account book, both original objects which were actually at Morristown with Washington's army. Revolutionary arms and accouterments, which are not known to have been used at Morristown, are used to supplement these. In addition, reproductions of uniforms, originals of which are very rare, have been made to help tell the story. At Fort McHenry National Monument and Historic Shrine the museum contains one of the original bombs which was fired into the fort but failed to explode. This original object is reminiscent of "bombs bursting in air." Other contemporary projectiles and ordnance not used in the attack help to develop the story. This order of diminishing returns in visitor interest may be stated as follows:

1. The original object.
2. Object of the same type and period.
3. Accurate facsimile, cast, reproduction.
4. Miniature model, photograph.
5. Drawing, diagram.
6. Printed description.

In exhibiting original objects a few general rules should be observed:

1. Resist the tendency to fill cases too full. A few specimens set off by plenty of blank space are effective; a large number of specimens is confusing, giving the impression of "visible storage" that is undesirable.

2. Great care should be taken in the selection of materials for exhibition. It is not necessary to show all the specimens in the collection, nor to show examples of every size or type. Care should be taken to avoid pointing out

minute or not easily grasped differences in specimens, which are important and perhaps even obvious to the specialist, but hardly understood by the layman. Exhibit cases are not the place for microscopic analysis of specimens.

3. Avoid duplication of specimens of similar appearance. Cases filled with arrowheads are far less effective than a small selection of half a dozen or so that give the visitor an idea of the range in size, shape, and method of chipping.

4. Specimens should not be exhibited for themselves alone. Each specimen is but a means through which a portion of the park story is explained. A stone axe, for example, is not itself interesting as an item of culture. The method of manufacture and the use of the axe have cultural significance. Wherever possible, include supporting graphic devices to explain methods of manufacture and the uses of the objects displayed. The objects thus become more interesting and meaningful to the visitor.

Live Specimens

The exhibition of living plants and animals is frequently the most satisfactory method of affording the visitor an opportunity to become acquainted with the life in a park. Living specimens are infinitely superior in most cases to preserved material or prepared casts and models.

Pressed flowers are not satisfactory for exhibition and belong in the study collections. Photographs and illustrations are limited in their application, while accurate reproductions of plants in wax and other mediums are usually impractical because of their great cost. Cut flowers exhibited in specially designed containers are superior to the preserved originals and facsimiles, provided they are kept fresh at all times; however, the ideal method of showing flowers is to transplant them from inaccessible parts of the park to a convenient area near the museum where visitors may walk among them on paths informally arranged to avoid any appearance of artificiality. Weatherproof labels which harmonize with their surroundings give the necessary information.

Live specimens of reptiles and amphibians may be shown in small terraria which are designed to avoid the appearance of cages and confinement. Labels should give the name and a description of their habits to aid in an easier identification in the field. In a similar manner, many interesting fish and other forms of aquatic life may be displayed in small aquaria to help the visitor become acquainted with interesting forms of local life which might otherwise go unnoticed.

The caging of birds and mammals has many objections and is rarely

justified in the national parks, which are wildlife sanctuaries where animals and plants should be seen and studied without artificial barriers. Consequently the technique of the zoological and botanical gardens should be strictly limited. Accurately mounted specimens of birds and small mammals serve the need for identification far better than drawings or photographs, while miniature models of large mammals are preferable to mounted skins for the same purpose.

Skeletal Remains

Desiccated bodies and skeletal material in situ have been exposed for exhibition in several areas and have proved to be of great interest to the public. When such exposures serve a definite educational purpose they are desirable, but too frequently they attract solely because of their morbid appeal. Fossil remains exposed in place in bedrock have an exceptional teaching value; consequently it is desirable to utilize the interest they create whenever a practical means of protecting such exhibits in place can be secured.

Special Devices for Exhibiting Specimens

Every specimen placed on public exhibition, no matter how commonplace it may be, should be displayed with the same care afforded the rare and unique. Attention is drawn more by the method of display than by the inherent beauty or attractiveness of the object itself. A rusty nail, common cinder, or any other object may be so displayed and lighted that it will attract attention quicker than the rarest and most valuable gem. Monotony of size, pattern, color, and design also should be avoided at every possible opportunity if interest in the display is to be maintained. It is often helpful to exhibit a specimen in a functional position, such as a ladle slightly tilted above an upright pot. Several special aids in displaying specimens both individually and in series may be mentioned as particularly useful, but museum workers are developing new ones continually to suit the objects being installed. Ingenuity in designing methods of installation often makes an exhibit outstanding.

Display Blocks

Minerals, sea shells, coral, seeds, cones, and similar objects have far less appeal if merely arranged on the floor of a case than if individually mounted on blocks, which add more to the appearance of a display than is generally realized. These blocks are cut usually from 1-inch or ½-inch boards in several standard sizes. One edge is beveled to hold the label while the other three are cut square, sanded to a smooth finish, and painted or covered with

cloth to match or form a pleasing contrast to the case lining. These blocks may be treated specially to call attention to rare and beautiful specimens by a covering of rich cloth chosen to make an ideal background for the color of the specimen. For example, a small gold ornament may be shown against silk or velvet in pale green, blue, cream, or white. Marble, alabaster, or silver may appear to advantage against dark red, black, or purple.

WIRE SUPPORTS

A neat wire frame bent to fit the shape of the object, or small clasps to grip it, may be used to hold the specimen away from the block. An upright support, bent out at right angles near the top to hold a small pendant such as an earring, often will add greatly to the specimen's attractiveness. Heavy wire rings with three short legs attached are used to support round-bottomed pots and irregular-shaped specimens of all kinds.

GLASS AND PLASTIC SUPPORTS

Neat supports for minerals may be made by heating glass rods of small diameter in the flame of a Bunsen burner and bending an irregular ring to fit a little below the greatest circumference of the specimen. Three glass legs melted on to this ring from the same rod will carry a surprisingly heavy weight for their slender appearance. Two strips of celluloid or other plastic, such as Lucite, notched and fitted together at right angles, with the upper edges cut to fit the specimen, also form a neat and inconspicuous support.

INVISIBLE FASTENERS

The universal rule in displaying specimens is to avoid clumsy supports and complete concealment is the ideal to be sought. Fasteners made of brass wire (screw hooks) threaded at one end and bent at a right angle at the other are quite useful. They may be screwed into the back of the case to clasp the specimen in place. As few as three generally are employed for dishes and similar objects. Sometimes the bent tips are touched with paint to match the specimen or the background. Stone specimens such as Indian artifacts may have a cloth disk cemented to the back with cellulose acetate. Before cementing in place, a wire bent like a hairpin is thrust through the cloth and used as a convenient ring for hanging on a hook simply by twisting the protruding ends together.

Light objects of cloth, leather, paper, or beadwork may be pinned or nailed to the background with small pins driven in behind natural folds for concealment. When the size and weight make strong supports necessary

and concealment is impossible, the surface may be painted a neutral color or a neat support may be fashioned in polished brass or black iron. Blocks of polished hardwood or painted plaster are employed also for heavy and irregularly shaped objects. Whenever nails, screws, and bolts are used for an installation, they should be concealed if possible. There are some instances, however, where this is not practical, and the nails or screws should be selected for heads which are neat in appearance. Blued steel gimp tacks or roundheaded brass nails are preferable. Where screw heads must show, the oval head is more desirable than round or flat ones, while the Phillip head is much neater than the common slotted type. Thumb tacks, if used, never should be allowed to show.

MIRRORS

Occasionally it is desirable to show some interesting detail of ornament or construction on the back or bottom of a specimen in addition to the front. A small mirror with beveled edges may be set at an angle to reflect to the visitors' eyes an image of this special feature.

MAGNIFIERS

A reading or magnifying glass mounted in a small, neat ring and wire tripod may be placed over or in front of some fine detail such as a cameo carving or minute crystals in a mineral specimen to aid in bringing out such details.

DIRECTIONAL AIDS

In addition to placing a series of numbers or letters on a specimen corresponding to explanations in the label, small arrows cut out of metal or cardboard and painted in a bright color may be affixed to some significant part of a specimen to direct special attention to it. A ring also may be painted around such a feature or a wire ring constructed and held in place by any convenient means. A more elaborate method consists of installing a series of miniature spotlights with each beam directed at a particular spot on the specimen. Each light is wired to a push button on a separate label describing the special features of each location.

GLASS CONTAINERS

Watch glasses and petri dishes make attractive containers for exhibiting seeds, soil, or other materials composed of small particles. Specimens of various kinds have been embedded in methacrylate resin, which has a clear, glasslike appearance.

LABELS

The most difficult achievement in museum work is a satisfactory label. Many are misled by the apparent simplicity of the carefully written result into overlooking the several important factors which must be borne in mind if a good label is to be attained.

Labels should be short and simple. Nearly every museum label is too long or too technical. Every descriptive label should be written with as much care as an advertisement. The relative value and weight of each word should be considered. Technical terms and professional phrases must be avoided or explained. There are many terms which are a part of everyday professional conversation and may easily creep into a label to the utter confusion of laymen. Terms such as "culture" and "horizon" mean entirely different things to the archeologist and the man in the street. A "fault" in geology is considerably different from a fault in everyday life. It is a recognized principle of good pedagogy to go from the known to the unknown and from the general to the specific, and this usually applies to labels as well as exhibits. There is an almost universal tendency on the part of advanced students in history and science to disregard the need for elementary explanations in labels and totally ignore the fact that the average layman is not well enough informed on each and every phase of history and science to comprehend a technical label. Such advanced knowledge as the specialist may have gained was acquired patiently over a long period of years. The layman can hardly be accused of stupidity for failing to grasp in a few seconds what may have required weeks of study on the part of the label writer. Generally speaking, the knowledge of the average visitor is greatly overestimated, while his intelligence is grossly underestimated. The vast majority of museum labels are inclined to be too pedantic and technical for the visitor and an effort at greater simplicity will be a step in the right direction with little danger of error in the opposite extreme. It has been noted that labels written for exhibits in children's museums are greatly appreciated by adults. Evidently the effort to get down to the child's level has resulted only in reaching the adult layman's level, while the satisfactory child's label may still have to be written. (*See* Fig. 17.)

So far as possible, every term unfamiliar to the average visitor should be defined briefly if the term must be used for further explanation. Careful selection of type style and size is important in label making, while a choice of paper color is equally essential. Bold-faced type which may be easily read at a distance of 2 to 3 feet is necessary. Many people have impaired vision and their comfort should not be overlooked in selecting and spacing

type. White or cream-colored stock usually is employed as a satisfactory base for the ordinary label. Special color combinations, such as silver and gold lettering on black, are used occasionally for jewelry and silverware. Other color combinations may find use in particular cases, while the texture of the paper may harmonize with the exhibits. A yellow parchment-like paper or a dull linen texture, for example, may be utilized with pleasing effect for special types of objects. Transparent labels made by photography on a glass or cellulose plate are attractive and easy to read by light transmitted through a diffusing glass from the rear. Too many of them cause eyestrain, but an occasional one is emphatic. Sometimes transparencies can be installed to use the daylight from blocked-off windows. Small illustrations, maps, and mounted capital letters are also used to enliven the appearance of a label. Labels composed of cut-out letters, which may be made of a plastic, composition board, or metal, are fine for some situations, particularly case titles and general room labels. Letters cut into plates of glass or transparent plastic appear to good advantage when illuminated through the edges. Temporary labels may be written neatly by hand in black India ink or printed on a typewriter but these are not very effective and should be replaced by labels printed from movable type at the first opportunity. The mechanical limitations of the typewriter in spacing, letter size, and sharpness make its use unsatisfactory. Hand-lettered labels produced by an expert draftsman may be fully as good as printed ones, but there is a tendency to make the letters too ornate and to embellish the text with scrolls and other superfluous designs.

A method for preventing curl or buckling in labels is described in the section on Paper and Parchment in Chapter VII.

BILINGUAL LABELS

Bilingual labels are sometimes desirable in park museums visited by large numbers who cannot read English, notably along our southern border and in the Hawaiian Islands. A special booklet printed in the foreign language may be supplied in such cases. Another effective device consists of a light board similar to a ping-pong paddle which has the label printed in one language on each side and the handle fastened to the exhibit case with a cord or padded chain.

GUIDE LEAFLETS

The use of a guide leaflet containing copies of the museum labels with additional printed information on the exhibits is increasing in museums. These leaflets have the advantage of permitting visitors with impaired

vision to adjust the distance between the page and the eye to suit their individual needs for more comfortable reading. If the leaflet may be carried away, it also permits the visitor to review at a later date what he has seen in the museum.

PLACEMENT

A few simple rules regarding label placement should be observed. Labels should always be placed as near as possible to the objects they explain, but it is seldom good practice to attach a label where it covers any part of the specimen. No object should be exhibited without a label giving at least its name and origin or date. The name of the donor may be included but should always be subordinate to the data on the specimen itself.

EXHIBIT VALUE OF GRAPHIC DEVICES

While the original object is of paramount importance in the museum exhibit, its nature and association with places, persons, events, and forces must be explained just as the object or exhibit introduced in a court of law as real evidence must be accompanied by expert and reliable testimony to bring out its significance.

Figure 12.—THE MASS. DIORAMA IN MUSEUM AT TUMACACORI NATIONAL MONUMENT, ARIZONA. A PHONOGRAPH PLAYS SELECTIONS OF ORGAN MUSIC TRANSMITTED BY A CONCEALED AMPLIFIER, ADDING GREATLY TO THE EFFECTIVENESS OF THE SCENE

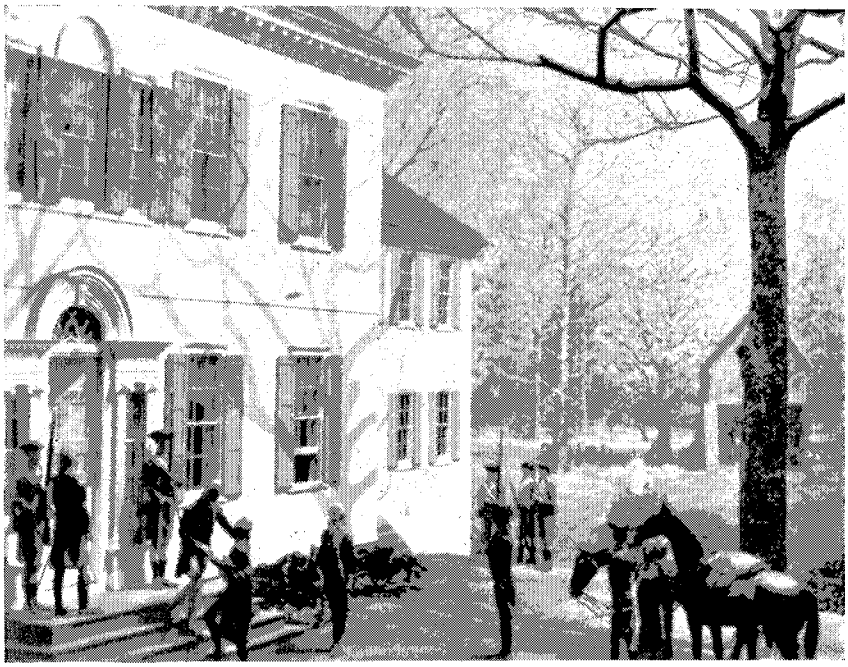

Figure 13.—MEETING OF WASHINGTON AND LAFAYETTE. DIORAMA IN THE MUSEUM AT MORRISTOWN NATIONAL HISTORICAL PARK, NEW JERSEY. HISTORICAL EVENTS AND PERIODS ARE DRAMATICALLY PORTRAYED BY DIORAMAS IN MINIATURE SCALE

The simplest form of graphic device is the label (discussed above) which may be a mere printed account of the known facts relating to the object. This information supplied in a label may be made more understandable by the addition of a map or diagram, which, in turn, may be supplemented by an illustration in black and white, in oil, or water colors. Developing the idea still further, a more elaborate and graphic setting may be desired to drive home the facts relating to the object; for this, the higher forms of graphic devices—the model, habitat group, and diorama—may be employed.

The ideal museum is a well-balanced combination of real objects and manufactured devices. The extreme of all specimens and no interpretative devices is as undesirable as the opposite one of a totally synthetic exhibit. No one type of exhibit or graphic device can be regarded as a cure-all. The values for explanation and attraction differ in each type of device; all have distinct advantages and limitations. A well-planned combination of the various accepted types with original specimens is the

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ideal to be sought. (*See* Figs. 17, 19, and 20.) The relative exhibition value of manufactured devices measured in terms of attracting and holding visitor interest may be tabulated roughly as in the following list of more common types, which rates the most effective devices first and others in decreasing order from excellent to fair. Under each type of device is a list of subjects appropriate to that medium given in the order of their effectiveness. This rating has *only* general application and it should be borne in mind constantly that while one type of device may serve in a very minor capacity in one exhibit scheme it may occupy first place in another.

Dioramas are miniature groups of modeled figures in a three-dimensional foreground which merges into a curved, painted background. They employ perspective and are viewed from the front only.

Close-up of the climax of an important and dramatic event.
Close-up of details of violent action (fire, earthquake, wreck, battle scene).
Panoramic view of violent action.
Close-up of subdued or limited activity (everyday village street scene, garden, period interior, forest or ecological setting).
Panoramic view of the above in small scale.
Manufacturing plant in operation—employing animating devices.
Industrial plant without animation.
Panoramic view of whole city or countryside with no activity in extremely small scale.

Since dioramas require a considerable amount of time for accurate and detailed construction, they are relatively more expensive than other types of exhibits. Consequently, it is desirable to choose the best possible subjects for the limited number which can be employed to make them exhibit highlights. (*See* Figs. 12 and 13.)

Models are three-dimensional reproductions in any given scale viewed from all sides and employing no perspective or illusions of distance.

Miniature:

Topographic. Close-up of a limited area of territory permitting individual buildings, trees, and landmarks to be seen. Widespread area at a scale too small for buildings and such features, showing only topography and large streams, lakes, and roads.
Architectural. Complete models and cross sections of buildings showing their details and construction features.
Equipment. Miniatures of large tools, machinery, and appliances, used to save exhibit space.

Human. Model figures to show costume or physical type, or to illustrate use of tools.

Life-size:

Modeled portraits of famous persons, full length or busts.

Life casts or models of plants and animals such as fish, reptiles, marine invertebrates; also foodstuffs.

Life casts or models of head and hands demonstrating physical characteristics, the use of tools, wearing of costumes or jewelry.

Facsimiles of tools, instruments.

Over-life:

Models magnifying jewelry, coins, textural and structural differences, plants and animals, weaving and other industrial processes.

While models usually lack the dramatic attractions inherent in the diorama, they play an important part in museum exhibits. The three-dimensional model usually has more carrying power than the flat painting or drawing and serves particularly well as an explanatory device.

Illustrations:

Oil paintings of large dimensions outside exhibit cases, naturalistic in treatment.

Murals, symbolic in treatment.

Bas-reliefs, either symbolic or naturalistic.

Water colors, naturalistic and detailed.

Black and white, pen and ink, and pencil.

Published illustrations from papers and magazines.

Graphs:

Employing lifelike figures in varying quantity and sizes.

Employing simple geometric designs, masses, or lines.

Employing numbers only.

Maps:

Simplified to show only essential details with vignetted illustrations in color.

Same as above in black and white.

Published maps and charts, simple in content.

Published technical maps, altered by hand to show special features.

Photographs:

Contemporary—historical.

Portraits—action.

Scenery, architecture, illustrations of specimens in use.
Full-size facsimiles of documents.
Photostats of documents.
Substitutes for original objects.
Blueprints, Van Dykes.

It should be noted that in the last two sections maps and photographs are not considered as original objects, but as graphic aids. They may, and often do, serve in a dual capacity as original specimens and graphic devices.

DIORAMAS

Since dioramas have come into such prominence as graphic devices, some attention may be given to their history as well as their present use and construction.[1]

History of Dioramas

The value of miniature groups as a teaching medium has been well demonstrated. The irresistible appeal to the imagination of the miniature is universal in all of us who, as children, delighted in the toys with which we built our own miniature worlds. By taking advantage of this fundamental human psychology, it is possible to convey the museum story in a pleasant yet equally effective and long remembered way. In doing this it may be remembered that only a new application of an old idea is being made.

Within the last few years the word "diorama" has been used with increasing prevalency and apparently has come to stay. The use of this word to describe what had been known formerly as miniature groups and models of all kinds began in the United States shortly before the Century of Progress Exposition in Chicago in 1933–34. It had come into use previously in England following the Wembley Exposition in 1924 where miniature figures arranged in groups and accompanied by painted backgrounds were used to depict scenes of the World War.

The word "diorama" is derived from the Greek *dia* "through" and *horao* "to see," and means, literally, "to see through." It apparently was applied first in Paris about 1823 by Louis J. M. Daguerre, inventor of the daguerreotype, and Charles-Marie Bouton to designate their invention of a new kind of painting on translucent cloth. According to *The New English Dictionary on Historical Principles* [2] the word was patented in 1824 by J. Arrowsmith and was used not only for the *dioramic* view exhibited, but for

[1] Ned J. Burns. The history of dioramas. The museum news, 17: 8–12, Feb. 15, 1940.

[2] Sir James A. H. Murray, *ed.* The new English dictionary on historical principles. 1888–1928.

the building that contained it. The term was later used for exhibitions of dissolving views. The diorama of Daguerre and Bouton is described by *The New English Dictionary* as "a mode of scenic representation in which a picture, some portions of which are translucent, is viewed through an aperture, the sides of which are continued toward the picture, and which is illuminated by light from above which is capable of being increased or diminished at will." By such regulation of light, changes in the scene represented were made in view of the spectators. The device was an outgrowth of the panorama, invented by Robert Barker at the end of the eighteenth century, which grew to be the great popular exhibition of the nineteenth century, and which we know as the cyclorama of today. Certainly the diorama of Daguerre and Bouton, with its series of transparencies, differs vitally from our modern miniature groups which consist essentially of three-dimensional modeled foregrounds in forced perspective blending with curved painted backgrounds.

It is obvious, therefore, that while the use of the word diorama to describe miniature groups is not entirely correct, it is probable that we shall be forced to accept its usage by sheer weight of circumstance. The public is rapidly becoming familiar with the word through the increased commercial applications of models in advertising, and lexicographers probably will take note eventually and include it in future dictionaries in the new sense.

The development of the modern museum group, with its full scenic perspective in modeling and painting, takes its rise directly from the nineteenth century panoramas, whose creators brought within reach of modern perfection many of the techniques and principles of this art form.

In Bullock's Museum in London in 1815 there was displayed a naturalistic group of "various animals, such as the lofty giraffe, the lion, the elephant, the rhinoceros, etc., exhibited in their native wilds and forests, while exact models, both in color and figure, of the rarest and most luxuriant plants from every clime give the appearance of reality; the whole being assisted with a panoramic effect of distance and appropriate scenery, affording a beautiful illustration of the luxuriance of a torrid clime." [3]

It is to be noted that this was the same Bullock whose View of the North Cape was one of the early panoramas and whose use of real objects in combination with a painted background preceded the panoramas of Langlois, which used objects in the foreground.

The relation of the Bullock natural history group to the panoramas of the period is obvious. However, conservative museum authorities, con-

[3] Frederic A. Lucas. The story of museum groups. 4th ed. 1926. New York, The American Museum of Natural History. (Guide leaflet series, no. 53.)

ceiving their duty to be exclusively the preservation of specimens and relics, were slow in catching on. It was not customary in Europe to paint skies and landscapes in cases of birds and other animals, but to line up the mounted specimens in rows against backgrounds of white paper according to size and natural classification. Following the Revolutionary War, the museum of Charles Willson Peale in Philadelphia exhibited both a rudimentary habitat group and a series of changing transparent scenes described as "moving pictures."

Ornithological groups, as we know them today, were introduced in museums by E. T. Booth, an English bird collector, who mounted them in various naturalistic poses, with accessories which copied more or less accurately the scenes where they were taken. Booth's method was taken up by Montague Brown, who, in 1877 or 1878, made the first habitat group for the British Museum. Meanwhile, in America, in 1869, a group was exhibited representing an Arab courier riding a camel and attacked by two lions, which had been designed originally for and purchased from the Paris Exposition of 1867. Other groups soon followed at the American Museum in New York and the National Museum in Washington, notably Hornaday's groups of orang-utans and a group of bison. Accessories such as wax and cloth flowers and foliage were added gradually, and finally the modeling of accessories was carried to the point of carefully modeling the animals themselves before applying the skin, instead of the old-fashioned smoothly rounded upholstery.

Much could be said of the interesting development of natural history habitat groups and the contribution of the many outstanding taxidermists, sculptors, painters, and accessory makers who have devoted their tireless efforts toward the present-day perfection of these exhibits. One of the greatest steps forward was taken when curators finally became reconciled to permitting the use of casts and models of natural-history specimens such as fish, batrachians, and invertebrates because such totally "artificial" replicas gave much more realistic impressions of the living animals than stuffed skins. Birds and mammals, covered by feathers or hair, retained much of their natural appearance by virtue of these same feathers and hair, but it was difficult to prepare specimens of fishes and frogs for exhibit so that they would retain their lifelike qualities. Trivial and even humorous as it may seem today, the step from the stuffed snake skin to the carefully colored cellulose, wax, or latex cast was deeply significant.

The development of electric lighting since the turn of the century has made possible many of the refinements in modern museum groups. To serve their function properly, backgrounds require a constant volume and

quality of light. The illumination admitted by the old overhead skylight changed hourly in intensity and prevented the attainment of many of the effects which are accepted as commonplace today. The introduction of constant artificial light and the custom of viewing the group from the front only permitted the equally important innovation of a slanting window to minimize reflections. Every improvement which adds to the comfort and convenience of the visitor advances public interest and appreciation.

A logical outgrowth of the natural-history habitat group was the life-size ethnological exhibit, first without, then with, a painted background. The next step, from ethnological to historical subjects, was an easy one. The desire to show whole villages of Indians and ceremonies and events, involving a great number of figures, made it necessary to resort to miniature scale. The further need of placing these scenes against backgrounds of natural or historical locales logically led to the use of curved backgrounds for the miniature models.

Construction

New materials and methods have been tested, many have been discarded as evanescent or otherwise unsatisfactory, and others have been adopted for their superiority over old types. The use of animation has brought forth many new adaptations of miniature groups to advertising and the demonstrating of mechanical processes, but such animation is not always an unmixed blessing when applied to museum exhibition and should be used with discretion. The true worth of the miniature lies in its power to tell a vital story in a dramatic way through its inherent attractiveness and appeal to the imagination. Animation carelessly used can degenerate easily into the category of the mechanical novelty. "Sidewalk superintendents" often watch a steam shovel operate for hours in a building excavation without necessarily learning anything useful about the construction of buildings.

The size of a diorama depends upon the space available and the subject to be portrayed. The size of the shadow box (or aperture) varies with the size of the case, its edges usually being about 15 inches from each side of the case. Thus a case 6 feet wide would have an aperture about 42 inches wide and 36 inches high, while in a smaller diorama the dimensions would be correspondingly less. The horizontal center line of the shadow box always remains constant at the average eye level of 5 feet from the floor. The glass in the shadow box is always slanted inward at the bottom to eliminate reflections. A 4-inch slant is usual on a 3-foot height. Fluorescent lighting is more efficient and satisfactory than ordinary filament lamps in

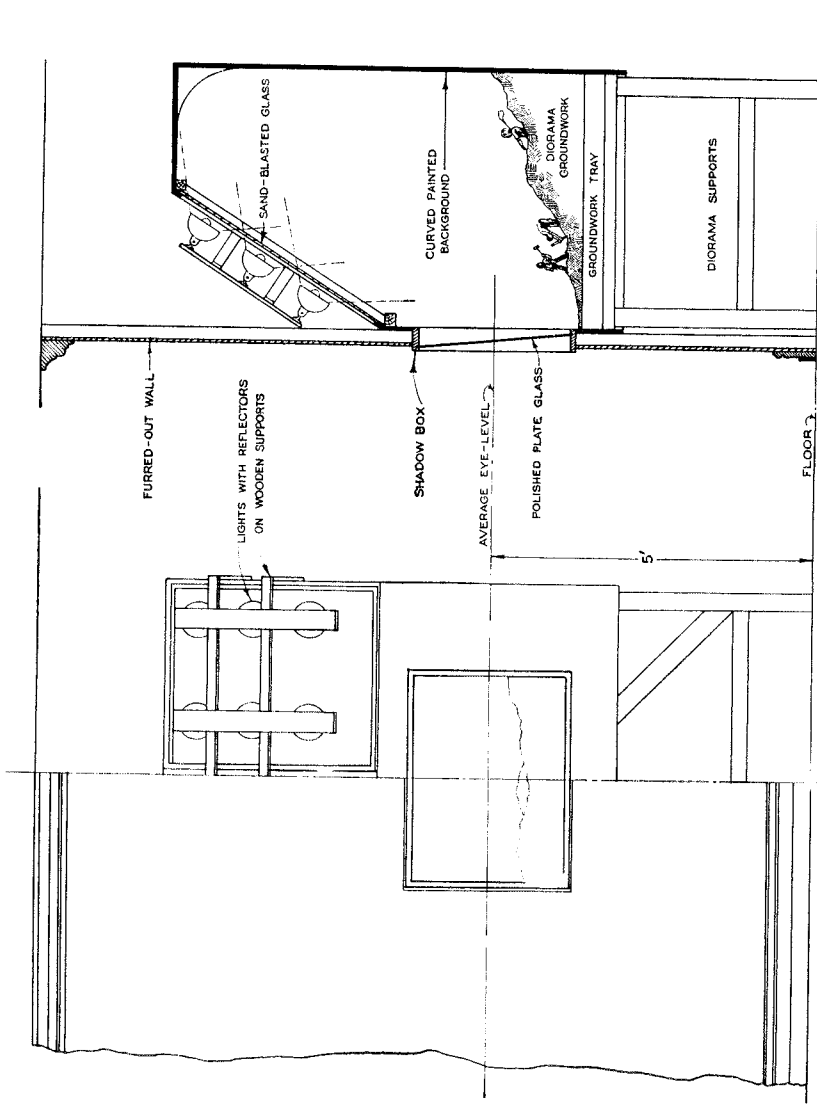

Figure 14.—METHOD OF CONSTRUCTING AND INSTALLING THE DIORAMA IN THE EXHIBIT ROOM

most instances. The diorama case is supported on a strong, rigid framework usually built of lumber 2 inches thick and from 2 inches to 6 inches wide. The case contains a curved galvanized-iron background, on which is painted a projection of the three-dimensional scene depicted in the foreground. The wall of the exhibit room should be furred out, preferably from floor to ceiling, to conceal all the construction features and lighting equipment, allowing sufficient space between the back of the diorama case and the building wall for adjustments and access to the lighting unit. These details are shown in Figure 14.

Long experience has shown that a scale of 1½ inches equalling 1 foot is most satisfactory for a scene which portrays some historic event where portraits of the principal characters and the details of their clothing, tools, or weapons must be shown with accuracy. Dioramas are rarely made at a greater scale since space in the exhibit room is usually too valuable to allow a housing wider than 6 feet. When extensive areas such as a wide street or a countryside must be covered, the scale may be diminished sufficiently to permit the scene to be encompassed in a case of reasonable size.

It is customary to construct the figures of hard wax modeled on a wire framework and enforced with fiber. Clothing is sometimes cut from fine leather or silk and worked on the figure, but more often is modeled into the wax as an integral part.

Weapons or tools are made of a variety of woods, metals, and plastics, while buildings and groundwork are modeled in plaster, papier mâché, or composition board. Windows are invariably made of glass, and tree trunks are modeled in papier mâché, with minute paper or metal leaves added to terminal frames of fine wire.

Miniature and Life-Size Dioramas

Some comparison may be drawn between the relative merits of life-size groups and miniature groups or dioramas.[4] Life-size groups may be used with more telling effect in some instances than miniatures, since they command attention by sheer size alone. Life-size groups and figures, however, may be objectionable when portraying some historical scene or personage. The realistic life-size figure often has a startling and unpleasant effect similar to that of the commercial "wax works" at places of amusement. It has been found by experience and experimentation that such realistic figures should be avoided except when necessary to display costumes or

[4] Ned J. Burns. The value of miniature and life-size historical groups. The museum news, 10: 7–8, January 1, 1933.

uniforms. Even in such cases the features should be formalized. The purpose is to display the costume with as little competition from the figure as possible. Unpainted, carved wood and simplified portraits painted in a neutral monotone have been tried as ways to avoid this unpleasant condition.

Life-size figures can show more effectively the way original objects work or are used than can any drawing or diagram, and have a legitimate use in this connection.

Miniature models and figures are entirely free from the foregoing objections, since they subconsciously establish the convention of scale and do not approach too close to startling realism. They also have the advantage of economy in construction and require less valuable exhibit space. Miniature figures may be employed in conjunction with original objects to demonstrate the uses of the larger specimens. In addition to these advantages, an important factor is the universal love of the miniature already described.[5]

MODELS

Topographic Relief Models

Topographic relief models are indispensable for showing the visitor the geography and terrain of the park in miniature. This is of great assistance

[5] Ned J. Burns. Life in miniature. Natural history, 28: 546–554, 1928.

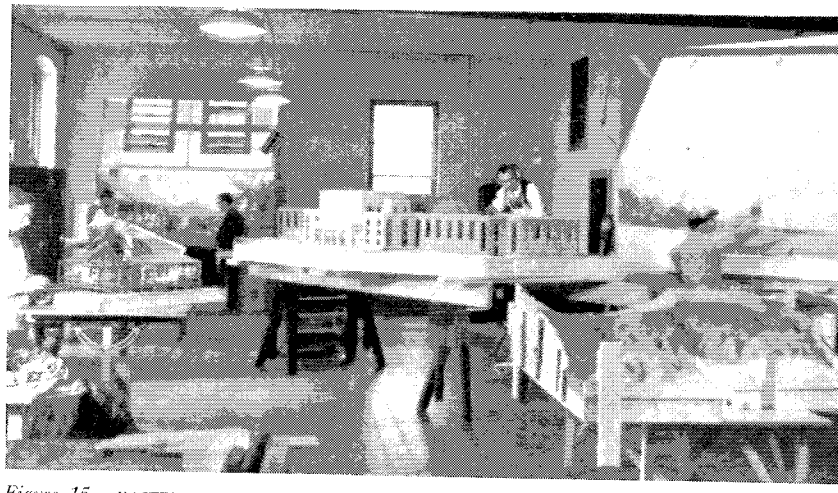

Figure 15.—EASTERN MUSEUM LABORATORIES, WASHINGTON, D. C. MUSEUM EXHIBITS AND EQUIPMENT ARE DESIGNED AND PREPARED FOR NATIONAL PARK SERVICE MUSEUMS IN TWO CENTRALLY LOCATED LABORATORIES

Figure 16.—WESTERN MUSEUM LABORATORIES, BERKELEY, CALIF., WHERE EXHIBITS AND EQUIPMENT FOR PARKS AND MONUMENTS WEST OF THE MISSISSIPPI RIVER ARE CONSTRUCTED

in orientation and gives a clear understanding of the relationships of the various areas within the park boundaries. The usefulness of these models and their appeal to the average museum visitor can be enhanced by making them pictorial, and, where possible, using a large enough scale to obtain models rather than just relief maps. The common practice of making relief models of the entire area of the park in small scale is not always as satisfactory as selecting an outstanding portion of the scenic or historic area and using a larger scale. If the model is built at a scale sufficient to show in miniature the buildings, campgrounds, waterfalls, lakes, and other features it will have greater interest for the spectator because he can locate his position easily in relation to the points he may wish to visit.

PROCEDURE

Before a relief model can be built, a topographic map of the area must be supplied. These can be obtained from the United States Geological Survey if the territory in question has been mapped by the topographers. In many cases the War Department can supply complete surveys not on file with the Geological Survey. If good topographic maps cannot be furnished by either of these organizations, the Engineering Department of the State in which the area is located should be consulted. Sometimes a private company or government agency having an interest in the section has taken aerial views and may be willing to supply a set of the pictures. In the absence of contour

maps, aerial photographs can be used as a fairly satisfactory basis for relief models. As an aid to modeling, good photographs taken of the terrain at various locations are very helpful in giving "character" and authentic shape to mountains or other features that seldom show in the contour tracings or aerial views.

METHOD OF CONSTRUCTION

The usual method of constructing relief models is as follows: The relief is built up by means of a number of sheets of cardboard, veneer, or other suitable material of uniform thickness, called laminations, each lamination representing a different contour line which is traced from the topographic map at the desired scale or enlarged by projection with a stereopticon. The shape of the contour which the lamination represents is then cut out with a jig saw, knife, or special machine. When the laminations are assembled in the order of their elevation, they represent the topography in a series of terraces or steps. The steps are then filled in with plasteline or other suitable plastic material to make a smooth slope. Little skill is necessary to cut out and assemble the laminations, but the work of applying the clay and modeling details, as well as casting, coloring, and final lettering requires greater skill for good results.

SCALE

The size of a model does not always determine the best scale to use. Often a flat, colored, wall map will show satisfactorily the location of the park and its relation to surrounding territory. The relief model should function as an aid in understanding the salient features of the park. To arrive at a satisfactory relation between the vertical and horizontal scale, it is necessary to bear in mind that elevations appear small in proportion to horizontal distances. A reasonable exaggeration of the vertical scale is therefore necessary if the landscape is to look natural. The amount of exaggeration should be greater if the scale is small and decrease as the scale increases. Two or more different scale ratios on the same model are not recommended. The amount of vertical exaggeration also is determined by the type of country depicted. For example, the Grand Canyon requires little or no vertical exaggeration, while a locality on the Great Plains needs considerable forcing to show any distinction in the slight elevations.

MAINTENANCE

Relief models are usually painted in oil colors for indoor use. It is important that the colors remain fresh and not be allowed to become dull or coated with dust. Frequent cleaning is necessary to prevent this condition.

Where there is no complicated surface texture or models of trees and buildings, a damp cloth may be used to remove dust and other foreign substances. It will not harm the paint to add a little pure white soap when plain water will not do the work. If a surface texture has been added to represent trees, grass, or other vegetation, cleaning must be done by blowing out the dust at frequent intervals, preferably with the blower attachment of a vacuum cleaner. Minor scratches and breaks in the surface may be repaired with plaster or a commercial crack filler and painted to match the surrounding area with oil colors. Extensive repairs or recasting should be done in one of the central laboratories. Waterproof lacquers are used generally as a protective coating on models exposed to the weather. Washing with water or soap and water is recommended for these also.

Architectural Models

In the construction of architectural models, light and durable materials such as aluminum, plywood, composition board, cardboard, celluloid, and various newer plastics have replaced plaster to a large extent. Papier mâché is used in modeling instead of plaster whenever possible. Being much lighter and far less fragile than plaster, these models withstand shipping and handling better, but their principal advantage lies in their ability to show the interior arrangement and construction of a building instead of the mere external appearance. The interesting illumination which can be applied adds greatly to the value of the model as an instructive exhibit.

Over-Life and Life-Size Models

The two factors which enter into the selection of a medium for making reproductions of animate and inanimate objects are: First, permanence or durability and, secondly, convenience in achieving a lifelike result. Beeswax and plaster are the two casting and modeling mediums most commonly employed, and coloring is almost invariably done with oil colors or dry color. Many pieces are carved directly in some suitable woods or hammered and filed out of soft iron, copper, brass, aluminum, or tin. An infinite variety of cloths, paper, and leathers also enter into this fabrication in addition to plastics and composition boards. When a life-size model is needed, it is customary to obtain a cast from the original, if possible. Humans or animals are generally modeled from life or from photographs, while miniature as well as over-life pieces are modeled in clay or plasteline and cast in wax or plaster or else built in wood, metal, or plastics directly from measured drawings or photographs. For accurate reproductions it is necessary to have the original object or detailed descriptions, measurements, and color notes.

TWO-DIMENSIONAL EXHIBIT DEVICES

Illustrations and Maps

Museum illustrations vary in size and subject from large, symbolic murals to simple, diagrammatic pen-and-ink sketches. Unless of considerable size, they do not have the carrying power of a model or diorama, but have the advantages of requiring less room for display, being intimately associated with the original material objects they interpret and costing relatively less than the three-dimensional devices. Illustrations more than 2 feet in length usually are painted in oils on canvas for greater richness, while those under that size are rendered in water color or drawn in black or brown ink. Pencil, crayon, and pastel rarely are used for permanent exhibits. Every illustration requires an amazing array of factual data to insure the accuracy of every detail of period, season, place, architecture, costume, botany, and geology, also the technical details of tools, machinery, and processes, to mention but a few.

Maps may be regarded as specialized illustrations. Usually they are drawn in attractive contrasts of color, and occasionally are given added interest by the inclusion of vignetted illustrations of places or events sketched on the map close to the locations they portray. Decorative and symbolic figures may line the border in imitation of antique maps. It is always desirable in exhibits to reduce maps to their simplest elements. Too much detail confuses the visitor and may defeat the original purpose.

Graphs

To convey a clearer understanding of comparisons and statistics, graphs are often employed. The familiar types of line and bar graphs in which the horizontal coordinate may represent time and the vertical coordinate costs or quantities, with the relationship of one to the other shown by a curve or solid bar, are not as satisfactory for display as the modifications which use symbolic figures of varying sizes or numbers. These figures of men, piles of coin, or bags of wheat, colored for emphasis when necessary, are far more attractive and easier to comprehend. (*See* Fig. 18.)

A graph may be made in model form using square sticks of varying lengths held together in a block to show, for example, the total number of pupils attending each of the 12 grades for a period of years. Graphic and startling presentations of comparative numbers, for example the population of insects compared to mammals, may be represented by using two similar jars, filling one with fine bird shot or mustard seed and the other with large ball bearings or metal-covered marbles.

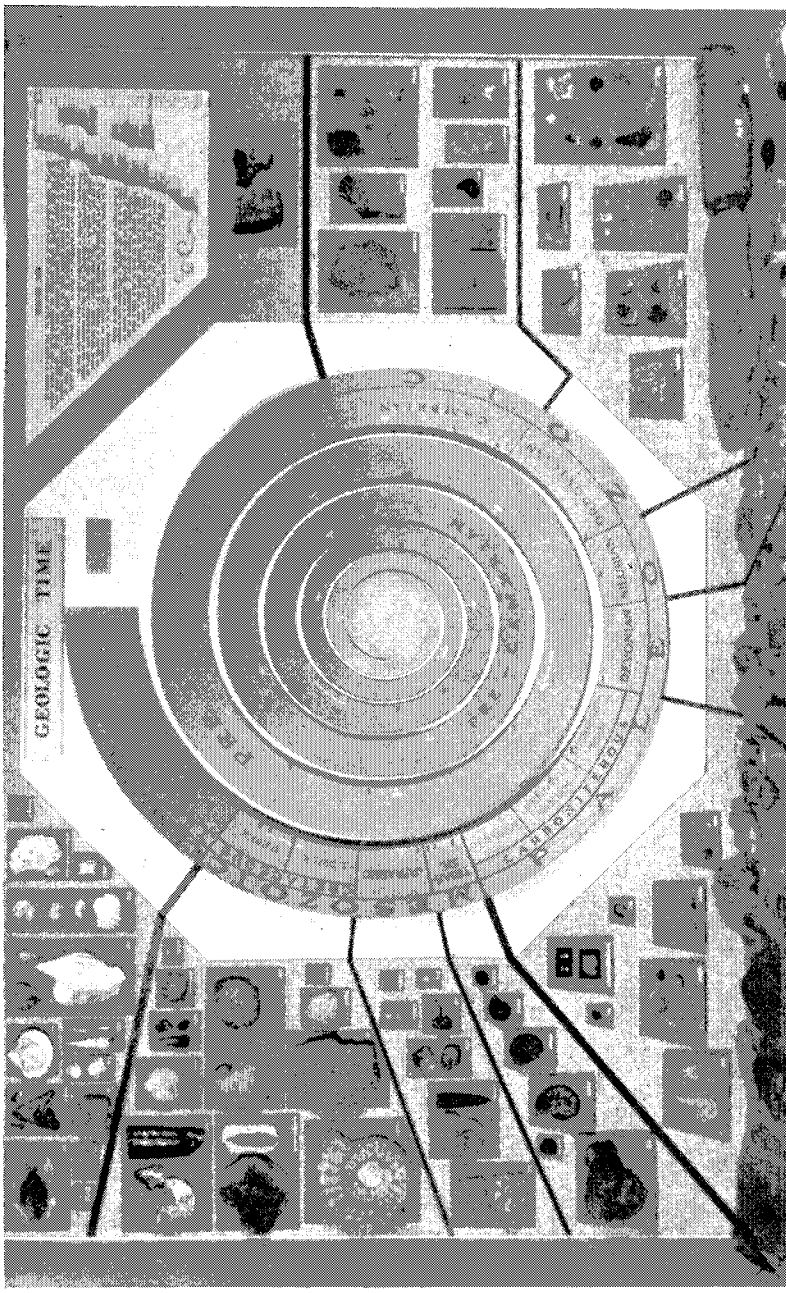

Figure 17.—EXHIBIT OF "GEOLOGIC TIME" IN THE INTERIOR DEPARTMENT MUSEUM, WASHINGTON, D. C. ORIGINAL FOSSIL SPECIMENS BEARING SIMPLE, COMMON NAMES SUCH AS "CLAM," "FERN," ETC., WHEREVER POSSIBLE, ARE TIED IN WITH A GRAPHIC REPRESENTATION OF GEOLOGIC PERIODS

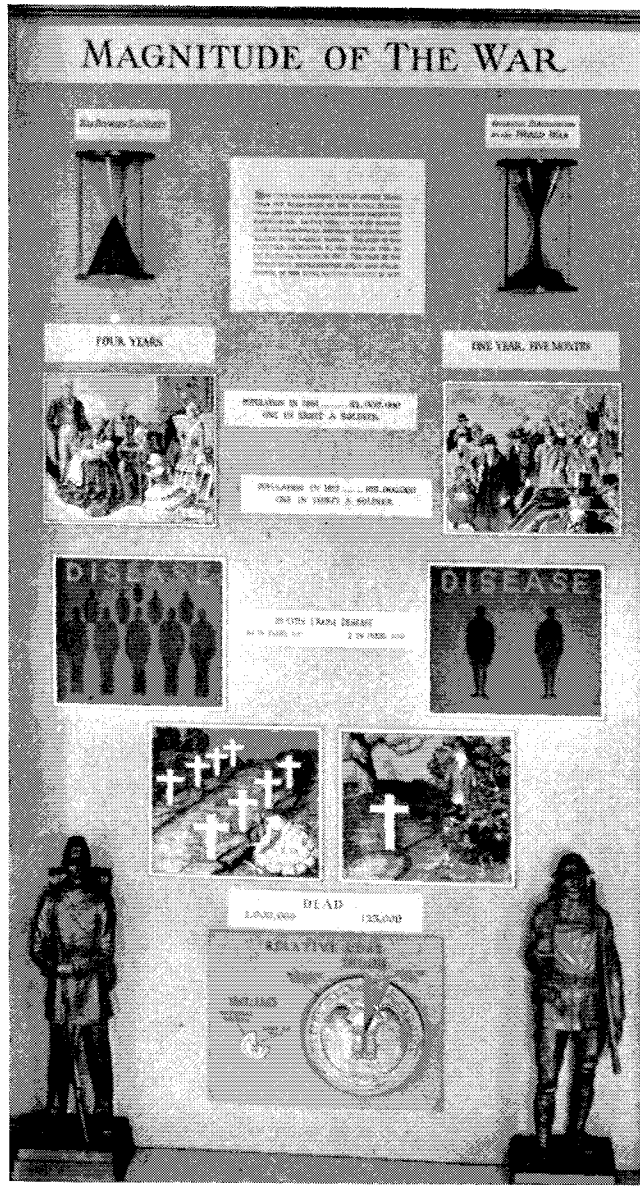

Figure 18.—WALL CASE EXHIBIT UNIT SHOWING THE MAGNITUDE OF THE WAR BETWEEN THE STATES COMPARED WITH THE WORLD WAR AND ILLUSTRATING COMBINED USE OF SEVERAL TYPES OF GRAPHIC DEVICES. VICKSBURG NATIONAL MILITARY PARK, MISSISSIPPI

Photographs

While photographs often may be classed as original objects because of their value as contemporary evidence, they are used frequently as inexpensive substitutes for hand-made illustrations or as a means of depicting accurately some detail which cannot be shown as well by drawings. The principal value of photographs and photostats lies in their accuracy and the feeling of conviction which they carry in this regard as compared to hand-made illustrations.

ANIMATED EXHIBIT DEVICES

Exhibits are designed and built primarily to be instructive. If the subject lends itself to aesthetic treatment as well, the interest of the spectator is increased accordingly. Exhibits that are purely educational are inclined to be dull and may fail to hold the visitors' attention. To overcome this tendency, many unique methods have been devised for arousing and holding interest. Judgment and restraint must be exercised in their use, however, since they are easily overdone and may result in something quite different from the original conception. While exhibits should invite inspection, they should not be put in competition with each other. The result of a clamor for attention between visual exhibits may be seen in any fair or exposition where the loudest and largest tend to overpower those which perhaps would be better appreciated in a quieter atmosphere.

Models with moving parts are employed frequently in museum exhibits to show the operation of industrial plants, simple machines, geological processes, or biological sequences. When animation is used in a model or diorama, it should be for the purpose of explaining more fully and clearly the story which is being told, and its use merely to attract attention should be avoided. Models that the visitor can operate by hand add an element of participation which sometimes increases their teaching power. Since mechanically operated models are not only expensive to construct but often costly to maintain, they should be simple in design and mechanism and sturdily built to require a minimum of repair. It is well to remember that, while an exhibit may attract and hold the visitor's attention because of its animated devices, such interest may be concentrated in an effort to find out how the model works rather than in an appreciation of the story the model conveys. Animation is most effective when it is limited to exhibits which are among the main focal points of the museum. When used for unimportant exhibits, it has a tendency to distract attention from the sequence of the story and may prove more of a nuisance than a help.

An excellent type of animation particularly adaptable to small museum

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dioramas is the dual, alternating scene. When a story can be told most effectively by portraying the same subject in different circumstances or locations, no better method can be desired. Its operation requires only a switch of the light from one diorama, which is located directly in back of a semitransparent mirror, to the second diorama installed directly above the mirror at a 90-degree angle to the other. The reflecting glass is placed at an angle of 45 degrees. When the lower diorama is illuminated, it can be seen through the glass. and when the light is transferred to the upper its reflected image is seen in exactly the same position as was the one behind the mirror. The advantages of this type of exhibit are that two scenes can be shown in the same space, generally at less cost than separate installations; that it gives life and motion to the display; and, particularly, that it makes possible a striking visual comparison.

Series of lantern slides and short runs of motion pictures in automatically operated machines are especially attractive but usually should be placed where they will not interfere with normal circulation. If the length of the reel or the number of pictures warrants sitting down to watch, a few chairs in the alcove where the machines are placed will give the added opportunity for a brief rest. The naturalist or historian lecturing on natural processes or the complex movements of a battle finds that animated drawings presented in a motion picture are more effective in giving a clear understanding of the subject than are a series of static lantern slides or charts.

ATMOSPHERE

The creation of "atmosphere" to place the visitor in a receptive mood is an important consideration in museum teaching. General color schemes, murals, silhouettes, and other means are employed deliberately to effect a desired result. (*See* Fig. 10.) If in addition to visual instruction—which is itself an extremely powerful method—a museum uses devices to appeal through the other senses, further advantage may be gained. Hearing, touch, and even smell can help to impress the museum story on the visitor's mind.

Music and Other Sounds

The tremendous emotional appeal of music is too well known to need explanation. Its use in conjunction with exhibits is just as desirable as color and design. The music should be subdued, unobtrusive, and usually serious. Except where a work with specific associations is wanted, accepted classics should be chosen. Compositions played by stringed instruments, a full symphony orchestra, or an organ appear to be the most satisfactory, although certain moods can be evoked best by other instruments such as

the banjo. (*See* Fig. 12.) The use of sound effects other than subdued music is often too theatrical, while a voice on a record or sound track mechanically explaining an exhibit is not satisfactory for many reasons, among them the distractions caused to other exhibits and the expense of maintenance. Accurate reproductions of such natural sounds as bird songs, animal calls, or the buzzing of a rattlesnake, however, have a definite interpretative value.

Touch

There is an ever-present instinct to touch objects to learn more about them than one can by sight alone. Unfortunately, many specimens will not permit handling by a large number of people without being destroyed. Since it is more desirable for a large number of visitors to gain a partial knowledge of such objects over many years than for comparatively few lucky individuals to examine them before they are worn out or broken, it is necessary to prohibit handling. Whenever it is possible to secure an abundant supply of specimens such as common minerals, pine cones, clam shells, or tree sections, visitors should be encouraged to handle them and thus add to their knowledge.

Color Applied to Exhibit Backgrounds

The skillful use of color patterns and contrasts will add much to the effectiveness of exhibits. Backgrounds which complement the specimens are particularly desirable. Steel and iron, such as weapons, and armor, appear enriched against a dark red or maroon velvet. Silverware appears to advantage against black, but this must be used sparingly since it is depressing in great masses. Very dark colors also tend to make a mirror of the glass case front. The numerous pastel shades are favored over the strong colors for general use, but in special instances even brilliant tones might be tried. In one exhibit concerning a British rifle the bright red of the army uniform has been specified for a mounting panel.

Texture in Exhibit Backgrounds

Cloth with patterns is rarely used on backgrounds for the display of specimens, although cloth woven with two or more colored threads may give a pleasing effect. The texture of the cloth, however, is quite important. Coarse weaves such as burlap and canvas may be used for large objects such as agricultural tools and kitchen utensils, while finer textures are desirable for delicate specimens. Jewelry and ornaments generally are displayed against casement cloth, velvets, or silks of suitable colors. If cloth with a weave or texture related to the specimens is used, an extra advantage is

gained. A replica of walnut-dyed homespun might be used as a background for a display of articles used on the early frontier, dark blue might serve for marine instruments, or a rich silk for oriental materials. Matting has been used for ethnological objects from the South Seas. The texture of stone, adobe, or wood also may be simulated by modeling and painting in a case background to aid the display of appropriate materials. Case linings of wool or fur should be avoided because they are especially liable to attack by moths. Fabrics with permanent, fast dyes should always be chosen.

Picture Frames

The traditional gold frame for oil paintings still carries over into museum display. It is customary to provide a frame reminiscent of the appropriate period in both design and color. Narrow black frames are the most usual for black and white drawings and prints, but plain frames of natural raw wood, or with gray paint rubbed into the grain, are being used increasingly for prints and drawings as well as photographs and water colors. These frames are a simple square molding with a fine square groove cut into the front as the sole elaboration of the flat surface. Modifications can be made to suit the character of the individual picture, but the important thing to

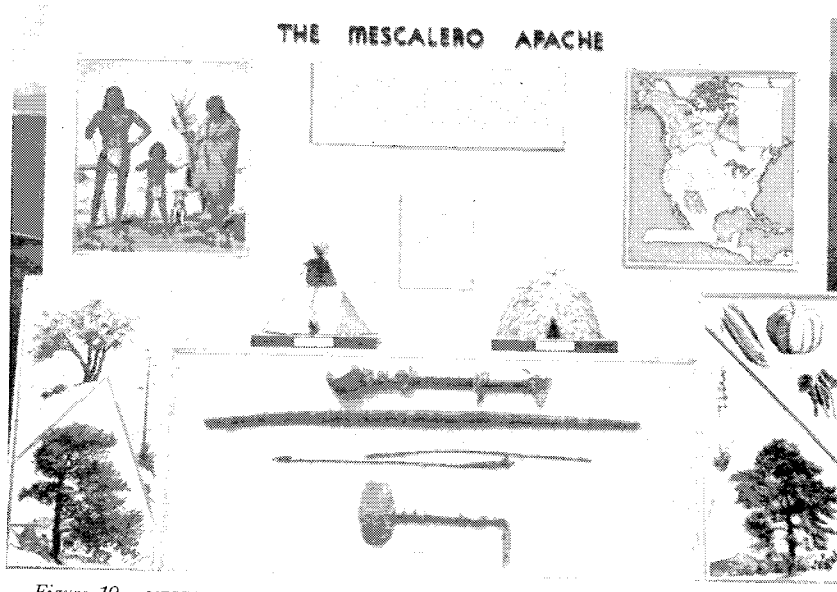

Figure 19.—MESCALERO APACHE EXHIBIT UNIT, WHITE SANDS NATIONAL MONUMENT, NEW MEXICO

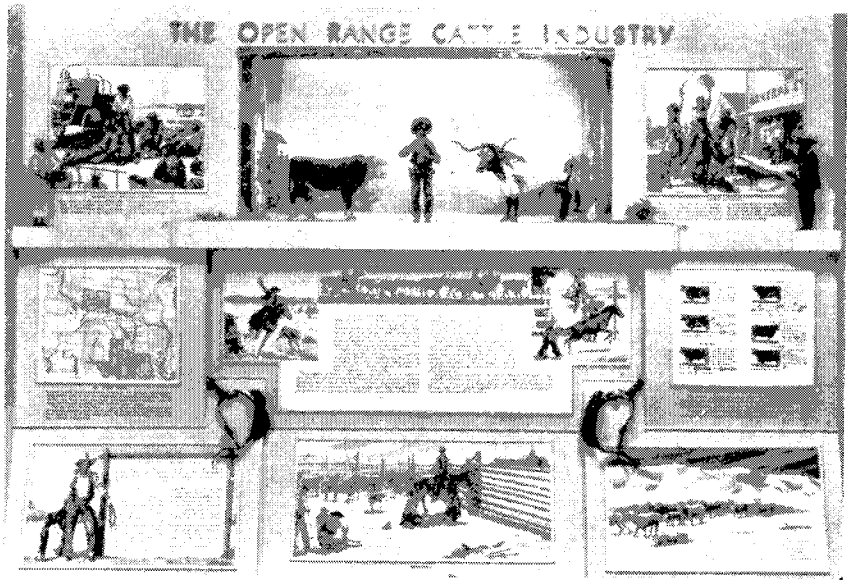

Figure 20.—OPEN RANGE CATTLE INDUSTRY EXHIBIT UNIT IN GUERNSEY LAKE FEDERAL RECLAMATION PROJECT, WYOMING. ORIGINAL OBJECTS ARE COMBINED WITH MAPS, ILLUSTRATIONS, AND MODELS ARRANGED IN SEVERAL PLANES FOR EMPHASIS AND TO BREAK THE MONOTONY OF A FLAT SURFACE

remember is that the picture and not the frame should attract attention. Too elaborate frames tend to defeat this purpose. Glass should be used whenever the picture needs protection from handling.

TRAILSIDE EXHIBITS

Several references have been made elsewhere to the important place occupied by exhibits outside museum walls in the basic philosophy of the National Park Service. The trailside markers and exhibits are the principal aids to a better appreciation of these park features. Trips may be made to strategic points of interest under the guidance of skilled contact men with telling success, but no matter how frequent or well planned these trips may be, a large number of visitors will not be reached. Trailside markers become the silent guides on constant duty, serving those who are unable to arrange their schedules to the times of the trips, or who prefer to go by themselves. Conducted tours of necessity must have defined time limitations if they are to reach all places on the itinerary. Visitors may wish to spend from a few minutes to several hours in one locality and the trailside exhibit serves their need for information when they want it.

Graphic Devices in Trailside Structures

The stand to accommodate interpretative material concerning a particular park feature may be a simple board on which a waterproofed diagram or map accompanies the explanatory text, or it may be a large structure protected from the weather by a roof and containing illustrations, models, and sample specimens as well as the labels. The former usually are termed "markers" and the latter "trailside exhibits." In both, texts should be brief and illustrations as simple as possible, for the same principles apply to outdoor interpretative structures as to those inside the museum. The two main problems peculiar to the outdoor structures are protection from vandalism and from the elements, and these are given special attention in later paragraphs. Trailside exhibits or markers should be so located as to give to the visitor an unobstructed view of the geological formation, prehistoric remains, beaver house, or whatever the point of interest may be. The interpretative device also should be placed where its labels may be read and the outdoor exhibit examined simultaneously. There is a noticeable confusion and loss in comprehension when it is necessary for the observer to turn his back on the scene to study the signs. Reflections and glare from glass and varnished surfaces also are annoying. An overhanging roof helps to relieve this objection, but it also may be necessary to employ a sloping glass front similar to that used on dioramas to throw reflections toward the ground. Dark backgrounds in trailside cases and frames increase the reflections, so a light cream or green color is preferable. (*See* Figs. 34 and 39.)

Specimens sometimes may be installed without the need of protection from the elements or vandals. This is particularly true of mineral samples too large for easy removal. To cite an example, the face of a cliff may reveal several interesting types of rock structure which are hard to distinguish from a distance. A scale drawing of this cliff face can be made exactly as it appears from the trailside structure. On it may be shown in colors similar to those in the cliff a strong outline of the various features with names painted into each particular area. Labels, diagrams, and possibly a few models placed around this chart can explain the story of the cliff—when, why, and how the formation occurred, and its relation to the immediate area or distant localities. To supplement this explanatory material in the case, several large samples of the rock may be embedded in concrete at the visitors' feet to complete the lay-out for study. Trailside exhibits in historical areas may have large pieces of artillery restored to their original location to help develop the story of the battlefield in much the same fashion as described for the cliff. A topographic model cast in metal or concrete also

may be used to explain the relationship of terrain to history or geology, or to visualize any vanished buildings and earthworks which cannot be restored. Exhibits-in-place, which are left in position but require protective shelter, often need little more than a label to explain their nature and significant relationship. While simple devices may be used, the interpretative value of the explanatory exhibit located so strategically often deserves a greater outlay in planning and building than would the same exhibit inside the museum building.

Trailside markers and similar outdoor labels sometimes are made of cast iron, bronze, or other metal with raised letters. Since these are hard to read when the letters and background are the same color, it is customary to paint the face of the letters a different color to make them stand out. Painting the letters individually by hand is a time-consuming process. Equally good results can be obtained much more quickly by using a small printer's inking roller. The paint should be spread on a glass or marble plate, the roller rolled on this, then rolled over the marker transferring an even coat of paint to the face of the letters. On cast iron a background of aluminum paint with black letters is quite satisfactory, while on bronze a dark umber background with bronze powder in lacquer for the letter faces affords good legibility.

Vandalism

If regular policing of the site cannot be provided, little can be done beyond building the labels and illustrations into a structure which is as vandalproof as possible. This may preclude the use of glass as a label covering and of hand-made illustrations on paper and cardboard which are too expensive to replace. One solution is to reproduce a quantity of copies from the original labels and illustrations by photography, photostating, or other process. These may be used to replace the torn and mutilated ones at intervals. The only other recourse is to build the illustrations of resistive materials, such as heavy cast iron anchored in strong masonry. There are many parks where vandalism of trailside structures is practically unknown, while in some areas, particularly those close to cities, the problem is almost too difficult to overcome without constant ranger patrol. It has been noted that structures of massive and dignified appearance are less apt to be molested than some trailside device so flimsy that it tempts the mischievous visitor.

Waterproofing

Where the problem of vandalism does not exist or can be overcome, some attention still must be given to protection against the elements. Seepage from rain and condensation of moisture from the air require adequate water-

proofing of the labels and illustrations. Cardboard which has been dipped in a waterproofing lacquer of bakelite will resist moisture for a much longer period than it could if coated with cellulose lacquers or shellac, neither of which are truly waterproof. Warping of paper and cardboard in damp air can be overcome by painting the sign or drawing the map with oil colors on a heavy sheet of aluminum and waterproofing as described, or by following the method of cementing paper to a metal background (Chapter VII, Paper and Parchment) then waterproofing after the cement has dried thoroughly. These precautions are necessary unless the case is absolutely moisture-tight, which is an unlikely possibility. Ordinarily, the case is constructed to exclude rain and seepage but is provided with "weep holes" in the bottom and sides to diminish condensation of moisture from the wet air that will get in and to drain off the water that accumulates.

A critical point in the construction of a weatherproof case is the joint between the glass and the frame. If a metal frame is used, the glass may be set in one of the commercially prepared mastic compounds employed for show windows. Aquarium cement may be substituted for ordinary putty in wood frames, or may be used with metal instead of the mastic. It can be made by mixing finely powdered litharge with sufficient thick glycerin to give a consistency like putty. White lead or red lead mixed with boiled linseed oil makes another good waterproof putty. The red lead mixture dries more slowly, but seals the joint before it hardens. Asphaltum, rosin, and sand sometimes are added to increase the bulk or strength, but either of the simple formulas given should prove satisfactory.

Sighting Devices

At many trailside overlooks and observation station museums direction finders and other devices to aid the visitor in orienting himself and locating important features in the distant landscape are employed. These range from simple directional signs and markers to a plane table, waist or shoulder high, with an arrow or pointer pivoted in the center. When this arrow is pointed at any prominent feature in the landscape either the head or butt will rest on the name of the peak, rock formation, lake, or river sighted. The elevation, depth, distance, or other brief fact also may be included with the name. A fixed view finder, somewhat like a gun sight, consists of an iron ring or perforated disc with a hole of convenient size used as the eyepiece. The diameter of the aperture may vary downward from 2 inches. The front sight is merely a vertical rod the tip of which is lined up with the center of the hole and with the eye, thus locating the desired landscape feature. The device is easier to use if another and larger

ring is substituted for the front sight rod so that when the eyes make the two rings coincide the view is within the circle thus formed.

Telescopes and binoculars are aligned on some distant feature which needs magnification to tell its story and are fixed in that position. They are often knocked out of adjustment and usually need constant attention from the naturalist or historian on duty. The eyepieces, being valuable, must be locked in the barrel or the use of the instrument closely supervised. The installation of telescopes or binoculars on swivels has little interpretative value and frequently becomes a nuisance since a few visitors monopolize and use them in an aimless sort of way. The use of viewers equipped with coin slot devices also is regarded as objectionable for this and several other reasons. (*See* Fig. 36.)

CHAPTER ·V·

THE STUDY COLLECTION ROOM AND ITS EQUIPMENT

EQUAL in importance to the exhibit rooms are the study collection rooms. To keep park museums up to date in their interpretation of facts and enable them to contribute to knowledge in the various fields of science and history, ample facilities for study, including good collections and properly equipped space to store and use them, should be available for the park staff and visiting scholars. Easy access to the study collections for any visitor showing a special interest should be provided under the guidance of the park staff.

HOUSING THE STUDY COLLECTION

Study collections not only should be protected properly from all the forces of destruction and loss—since many specimens are unique and irreplaceable—but they also should be housed in an orderly manner so they can be used. Every specimen should be accessioned, numbered, cataloged, and made easily available for use by the park staff, visiting research workers, and other interested individuals. In many instances the most valuable objects in the museum are in the study collections, and consequently the collection rooms should be fireproof, dry, and dark, with the air free from dust and chemical pollution, and with adequate protection against theft, insects, and rodents. There should be room enough to allow systematic storage. In order to secure these conditions, it often has been found desirable to separate the collection space into two parts—the storage rooms which are planned for protection, and study rooms which are for use. In some park museums, however, the study collections are housed in a single room because of space limitations. In these instances the study collection room should meet, as far as possible, the protective requirements set for the storage room. Daylight can hardly be excluded from the room, but as much as possible should be kept away from the cases. For its study functions the room should have sufficient working space with good light and fresh air.

In such a combination study-storage room the objects should not be kept on open shelves but placed in standard storage cabinets, with the possible exception of frequently changing series displayed in exhibit cases for student use. (*See* Fig. 23.)

The amount of space in the museum allotted to the study collections depends upon several factors, but in general there should be at least as much space assigned for their storage and use as for the exhibits. The estimate of space requirements for storing the collections is based on their probable size when they finally cover the field of the museum adequately. Almost invariably, however, the storage facilities should be considerably larger than the anticipated needs, because new materials usually are added at a rate far beyond expectations. The size of the study section is determined by many local conditions, including the scope of the museum. In some parks the staff laboratory may be the only study space needed, but ordinarily separate accommodations for visiting students should be provided. These may range from a single table among the storage cases to a complete laboratory with an adjoining class or lecture room.

Study collection rooms should be located as near the staff offices as is practical, for it is the staff that will utilize them most and that must supervise their use by others. They also should be readily accessible for controlled use by the public. The average visitor with a hobby is as welcome as the famous scholar, and some of the most effective interpretative contacts occur when an interested layman is introduced to the study collections. It is desirable to have a rather direct connection between the study collection rooms and the exhibit rooms for accessibility and for other reasons. This arrangement will save much time for staff members who must pass from one to the other frequently. There are occasions when only one person is available to care for the exhibit rooms and supervise the study and storage rooms, making a close connection among them essential. This also will facilitate the continual movement of specimens that is typical of a progressive museum. The basement usually is not recommended as a suitable location for the study collections because dampness is harmful to them. The first floor above ground meets the desired conditions much better, while the top floor is always the best.

EQUIPPING THE STUDY COLLECTION ROOMS

The equipment for study rooms offers no special problem. Good working light, running water, and ample table surface—usually in individual units—are basic requirements. The collections, on the other hand, call for highly specialized equipment that will give them adequate protection from light,

dust, and vermin and at the same time leave them accessible. Compact arrangement is necessary, but the specimens never should be crowded together or piled on one another. Probably more damage has been done to museum specimens by overcrowding than by insects, rodents, or mold. The rubbing and tangling that accompany crowding lead to excessive wear and breakage. For a few types of large and relatively indestructible objects, open steel shelves similar to library stacks are satisfactory, but most collections require enclosed cases.

Standard Case

A typical study collection case is a strongly built cabinet opening at the front and completely filled with shallow drawers (Fig. 21). Such cabinets combine protection, accessibility, and compactness to a satisfactory degree. Specimens of many sorts can be laid in the drawers directly or placed first in cardboard trays. The collection can be arranged systematically by assigning the proper number of drawers to each class of specimens in order. With all the drawers interchangeable, expansion and rearrangement are easy. When specimens are higher than the shallow drawers, it is necessary merely to use fewer drawers in the case. Customarily, the cases are made only about 3½ feet high so that their tops form a convenient working surface. As the collection expands, a second tier of cases can be placed on top of the first. Drawers are made small enough to be carried handily by one man, and doors usually are detachable rather than hinged so adjacent cases can be open at the same time.

The standard construction for this typical case is a strong wood frame completely sheathed in galvanized or enameled sheet metal with all joints made dust- and insect-tight by soldering or other means. The detachable door is metal sheathed and is pressed shut by window fasteners or other clamping devices. It is sealed with rubber strips or poisoned felt. The drawers have wood frames and stiff composition board bottoms. This type of construction has several advantages. It gives better protection from fire than either an all-wood or all-sheet-metal case; it is more rodent-proof than a wooden case; and it gives as good protection from insects, dust, and light as any other. Furthermore, it is relatively inexpensive and can be done in any well-equipped shop.

Specialized Cases

While the standard case is well adapted to most kinds of objects, a few sections of the collection require special types of cases designed to meet their peculiar needs. For study skins and other objects especially liable to

attack, the metal-sheathed standard case always should be used, but a similar case of all wood construction may be substituted for storing geological specimens or metal, glass, and ceramic objects if economy so demands.

Insect Case

These should have the wood-and-metal construction of the standard case, but require a different internal arrangement (Fig. 22). Three types of

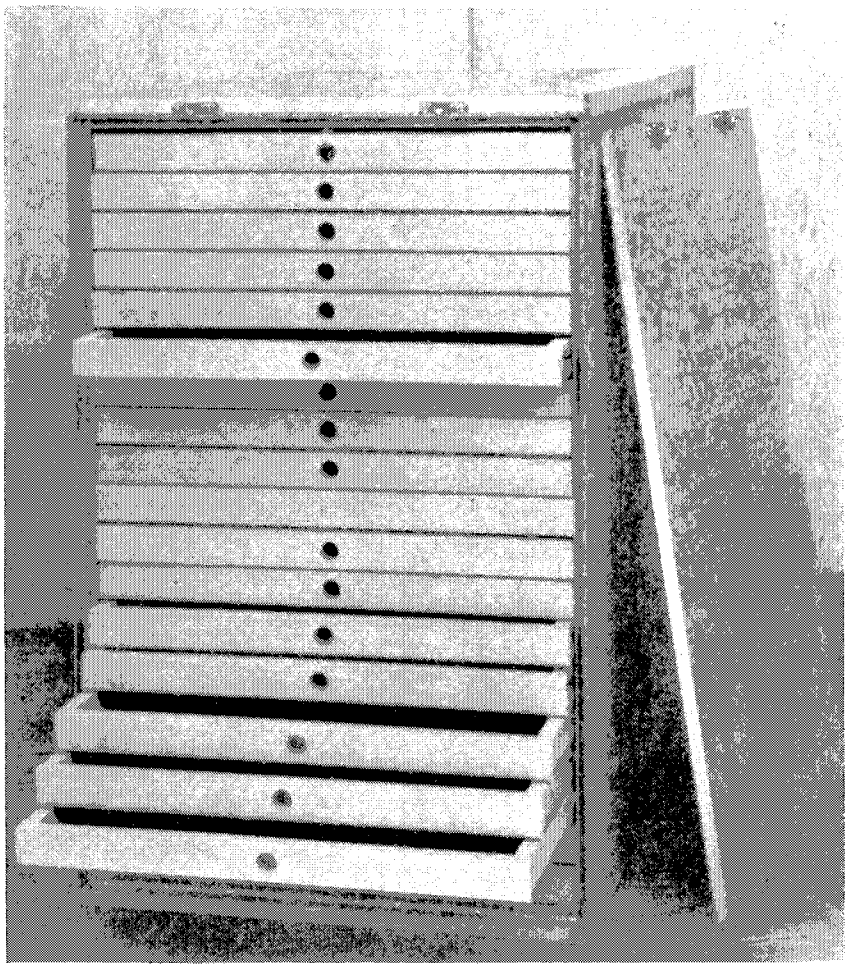

Figure 21.—STANDARD STUDY COLLECTION CASE COVERED WITH GALVANIZED IRON. DOOR IS SECURED WITH WINDOW FASTENERS. THIS TYPE IS MANUFACTURED BY THE WESTERN MUSEUM LABORATORIES

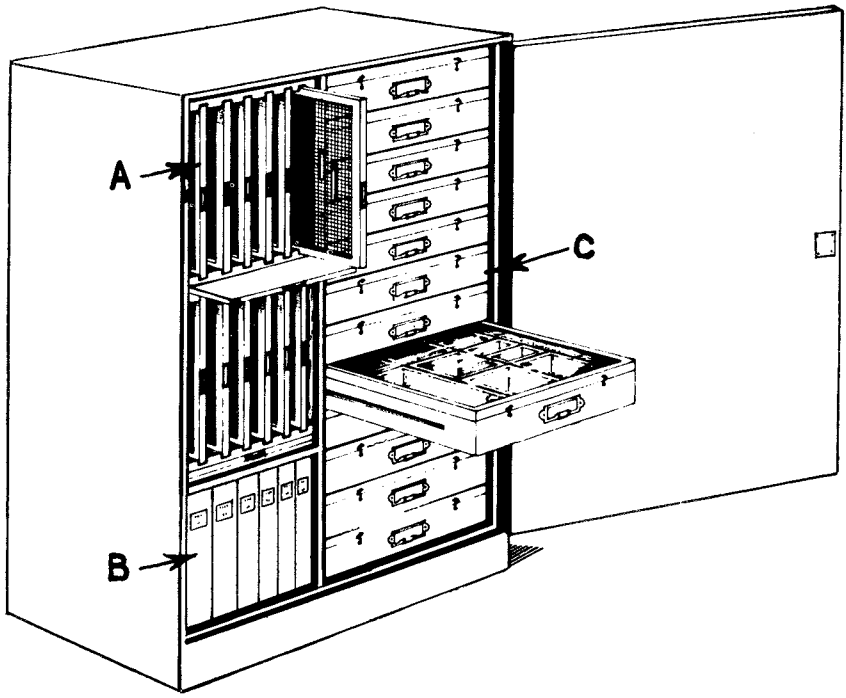

Figure 22.—INSECT STORAGE CASE CONTAINING (A) WIRE MESH RACKS FOR HANGING VIALS, (B) BOXES FOR MICROSCOPIC SLIDES, (C) DRAWERS FOR PINNED INSECTS

space are needed—for pinned insects, alcoholic specimens, and microscope slides. The interior of the case is divided vertically with a tier of 12 drawers occupying one side (C). The drawers are for pinned insects and need to be of special design. Each drawer is nearly 3 inches deep to accommodate the pinning trays and has a tight-fitting glass cover which protects the specimens even when the case is open and retains more of the paradichlorobenzene or naphthalene fumes. Specimens are pinned in cardboard trays having special pinning bottoms. These unit trays are an important part of the case, making it possible to expand and rearrange the collections by simply transferring trays instead of repinning hundreds of specimens, and preventing the loss of any parts that may break off. Each tray contains the specimens of a single species or form, and several graded sizes are provided to fit different insects. The unit-tray system has been adapted to drawers of several dimensions and none is recognized as standard. The National Museum and Cornell types probably are used most widely.

Figure 23.—STUDY ROOM IN YOSEMITE MUSEUM, YOSEMITE NATIONAL PARK, CALIFORNIA. NOTE FURRED WALLS AND BUILT-IN CABINETS FOR RESEARCH COLLECTIONS

Alcoholic specimens occupy the upper section of the remainder of the case (A). This section contains a series of upright, wire-mesh racks on which the vials can be hung. The compartment is lined with metal to prevent leakage of any spilled liquid into the rest of the case. The third section, below the racks, is a simple compartment to hold several microscope slide boxes of the booklike style which keep the slides flat (B). In larger collections separate cases for each of the three types of material are more advantageous, since many more drawers will be needed than racks or slide boxes. The racks are useful for storing any small alcoholic specimens.

Herbarium Case

Herbarium cases are divided into pigeonholes in which standard herbarium folders can be laid flat. The numerous compartments allow the collection to be filed systematically in easily accessible lots and prevent the sheets from being piled too deeply. The cases should be of the wood-and-metal type with all its protective features, and should correspond in height to the standard case. Frequently herbarium cases are built in double units having four tiers of compartments and two detachable doors. For the supplemen-

tary herbarium collections of seeds, wood specimens, and other unmounted material, standard storage cases are used.

Miscellaneous Cases

Maps, documents, and prints may require special equipment if they are well represented in the collections. Otherwise, the drawers of the standard case are staisfactory. One style of cabinet for this sort of material has a series of large map frames enclosed in an upper compartment and mounted on runners so they may be pulled out for inspection. The lower part of the case contains shelves for document or print storage. Photographs can be kept in ordinary correspondence filing cabinets, but negatives should have more particular care (*see* "Photographs," chapter VII). An important part of the storage equipment for any study collection is the record file. Card-catalog cases, preferably of metal, should be provided for the accession and catalog cards and field records.

Storage Vault

Park museums having the responsibility of preserving objects that are rare, valuable, or of special scientific or historical importance should keep them in a safe or storage vault. The type of vault is specified in each instance according to the particular situation. Vaults differ in the length of time they can resist internal heating, and it should be remembered that a specimen can be ruined by baking as well as by burning. The objects kept in vaults should be inspected regularly, especially for mold growth and insect attack.

Storing Oil Paintings

Oil paintings on canvas usually are stored upright on racks or hung from partitions of heavy wire netting. The room should be free from dust and dampness, and air should be able to circulate all around each painting. Unequal circulation produces strains on the painted surface with resultant damage.

CHAPTER ·VI·

MUSEUM COLLECTIONS

THE museum movement is firmly grounded in man's "collecting instinct." It is through their collections that museums are able to present ideas accompanied by the objects on which the ideas are based so that people may decide for themselves instead of blindly accepting quoted authority. This is a unique contribution to public education.

Museums gather collections for two purposes. One is to preserve objects that would be lost to the future without special protection; the other is to bring objects together for use, either in research or in exhibition. The National Park Service museum is charged with the preservation of certain classes of objects which can be saved only by collecting and housing, and with their use in interpreting park values. The assembling of these collections entails the obligation of adequate care.

It is a well established practice to separate museum collections into two series. Of these, the exhibit series normally is much smaller, consisting of choice specimens selected for their condition and attractiveness, carefully groomed for display, and intended for specific use in the exhibit cases. Since the light, heat, moisture changes, and other conditions in exhibit cases are harmful to many types of objects, those which it is important to preserve should seldom be put on display. The study series is more extensive and has a different purpose. Usually it is kept out of sight of most visitors. Here the character of the object is more important than its appearance. Preservation is of first concern, and all specimens are kept as safe as possible. The study collection contains the raw materials for research and preserves objects that have been the basis of research. It is stored in an orderly and accessible fashion so that every object is easily available for study. The distinction between the two series is not absolute, and in a live museum there is a continual interchange between them.

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ACCESSION POLICIES

The value of a museum collection is measured not by its size but by its utility. It is easy enough to assemble a big collection. A few years of promiscuous gathering and unrestricted growth can jam the storerooms full. Few persons realize how fast specimens accumulate, and many museums have learned it too late. Such large, unplanned collections are almost useless for research and contribute relatively little to the exhibit series; their care wastes the time of the staff, and preservation of really valuable objects is made more difficult if not impossible; they occupy space that should be available for productive activity; in some instances they force the museum's work into unforeseen and undesired channels; inevitably they become a handicap. This does not mean that collections must be small, but that they must be regulated. The key is selective, purposeful collecting, and to do this a museum must define its scope. A collection so controlled increases in value as it grows. Fortunately, park museums are restricted in scope from the start, and in them there is no excuse for hypertrophied collections. They are limited geographically by the boundaries of the park or of the region which the park is called on to represent and in fields of subject matter by the significant features which justified the establishment of the park. Furthermore, the relative importance of the subjects is predetermined by their significance in the park story. Thus the direction of growth for a park museum collection can be clearly marked.

Specific accession policies must be worked out in each park on the basis of local circumstances created by the park's purpose and story, but it may be profitable to discuss in general what to collect although this will be familiar to field men who have studied the problem.

Natural Science Collections

In most scenic areas the study collections are concerned principally with the natural sciences as illustrated in the park. The first requisite in such a park is an adequate reference collection of the fauna and flora, and of the rocks, minerals, and fossils occurring within the geographical limits set. Which of these are gathered most diligently depends on their relative significance in the park story and on the danger of their disappearance if neglected. In one park it may be vertebrate fossils, in another flowering plants, or perhaps igneous rocks. Next in importance are unique forms and those which are of particular interest to park visitors. Abnormalities which may be of real scientific interest may be kept in the collections, but it is seldom good practice to exhibit them. The archeology or history of a scenic park may call for further additions to the reference collections.

The goal, remote and perhaps unobtainable, is a complete reference series including the lowliest and most common as well as the conspicuous or rare. One example of each species usually is not enough for a well-rounded collection. Sexual forms, immature specimens, seasonal forms, and series to show the range of variation are needed. Photographs are useful to fill gaps, to make comparisons, or to show type specimens that are in other collections. To be of full use, also, the specimens in the reference collection should be identified by recognized authorities in each group. Usually this means sending the specimens away for study. Some park naturalists submit their specimens to the National Museum; others enlist the aid of specialists in nearby universities or elsewhere. At present the Southwestern Monuments have a cooperative agreement with the University of Arizona for securing the determination of plant specimens. The Museum Division will locate specialists willing to make determinations whenever a naturalist encounters difficulty in getting it done. Specimens may be lost to the park museums by this method of obtaining identifications, for the specialist may claim the right to keep the natural history specimens he needs in return for determining the rest of the collection submitted. The results nevertheless are usually more than worth this fee. When good series of each species are collected serious losses are rare. The reference collection functions in several ways. Its authoritative determinations are the basis for many of the facts transmitted to park visitors in every phase of the interpretative program. From it are drawn the checklists and other parts of scientific publications. It is an important tool for visiting scientists and students. In some museums with large study rooms less perishable types of objects from the reference collections can be displayed as synoptic series. Such displays are for the interested few, not the general public, and, for the sake of the specimens, should be changed frequently.

Further collecting beyond the needs of the reference series calls for a somewhat different policy. Specialization is required to prevent random accumulations. A practical plan is to base collections on a definite research problem. Collecting then is done with a specific purpose, and, when the results are published, the specimens and field observations preserved in the study collection become scientific records of importance. Concentrated collecting of this sort does not need to be postponed until the reference collection is even near completion, but it should not lead to neglect of the main reference series.

Type specimens should be deposited in the National Museum, Washington, D. C. Casts or photographs of these types should be retained in the park collection with the series of related specimens.

Anthropological Collections

In an archeological area the accession policies aim to provide collections that illustrate the life of the people whom the park story concerns, whether it involves a single site or a broad culture region as does Ocmulgee National Monument. These collections are made as complete as possible to illustrate as fully as objects can the cultural story of the people. To do this, they may go beyond artifacts to include ethnobotanical and zoological specimens. They also may exceed the cultural limits to obtain comparative material from other sites, tribes, or regions—but only so long as their function is truly comparative. Collections may start as reference series illustrating known facts, but they normally grow toward complete representation of the mode of life with its development and relationships and become sources of new information. Particularly when they are the result of scientific excavations, these collections are research records of major importance and cannot be too complete nor too carefully preserved.

A restrictive principle which has been adopted by leading museums as an ideal, and one which park museums may well follow, is the discouragement of commercial or amateur pothunting by refusal to acquire any artifacts so collected. Before any ethnological or archeological material is accepted, it is of utmost importance that both the material itself and the information regarding it should be studied carefully. Not only are fraudulent anthropological specimens common, but specimens about which little or no information is available frequently are offered. Such specimens are usually worthless. In rare instances ethnological materials whose place and period of manufacture are not known to the donor can be identified on both counts by experts who have made special studies of such classes of materials. It would be well to have the benefit of expert opinion before these materials are accepted. Most museums housing archeological materials receive numerous offers of collections that are absolutely worthless. Unless the locality where a specimen was found, its associations in situ, and the conditions of finding are known exactly, usually the specimen is valueless for exhibition or study. This practically limits the acceptance of artifacts to those that have been discovered as the result of systematic excavations or bona fide surface surveys.

As an aid in the identification of specimens, it is desirable that workers in the parks having ethnological or archeological materials become acquainted with those persons or institutions that specialize in the study and identification of the kinds of material found in the collections of that area. Published material does not exist that will aid in the identification of many types of objects. In such cases it is necessary to rely entirely upon the

opinion of experts. Archeologists have long recognized the value of consulting experts in the identification of many types of specimens. Such institutions as the Ethnobotanical Laboratory and the Ceramic Repository at the University of Michigan have proved most cooperative in the identification of botanical and pottery materials from archeologic sites. Paleontologists, conchologists, dendrochronologists, research chemists, students of trade beads, etc., all cooperate in helping the field man in his study of the collected materials. It is important that the field man master his subject and know to whom he should turn for consultation on special problems. When in doubt, he may request advice from the Museum Division or the Archeologic Sites Division.

In collecting ethnological and archeological specimens, it is well to keep in mind the needs of other Service areas in addition to one's own. Ethnological materials in particular may occur in collections at distant points from their places of manufacture. At the same time specimens that will not fit into the story of any Service area should be politely refused. Museums in archeological areas may develop reference collections in natural history or history. These are legitimate when they are secondary to the anthropological series and support the interpretative work of the park.

Historical Collections

Policies that will direct satisfactorily the growth of collections in historical areas are more difficult to define. The limits are set well enough, both in time and space, by the significant history of the park, but the relationship of objects to the story tends to be less obvious and unplanned collecting may result. The random accumulation of historical objects is especially dangerous to a museum. These specimens often are bulky and quickly fill the available space. They require more time and more varied methods to preserve them. Many historical objects come from individuals for whom they have sentimental value far in excess of their significance, and the proper evaluation and rejection or acceptance of such objects cause repeated worries unless a definite policy governing them is established. In general, the collection of first importance in a historical area consists of objects illustrating, or associated with, the park story. This collection may be of more direct use in the interpretation of the park than in research. It includes the perishable objects from the park area that need museum care, historic documents and maps that played a part in the story or that illustrate its significance, characteristic articles used in the period or event, personal objects of the leading participants, and objects of like nature. It is not easy to build up such a collection, for the most significant items

are the hardest to get and it takes critical judgment to decide what associated objects are worth collecting or to determine authenticity. The gaps may be filled temporarily with reproductions, photographs, or typical objects from other areas that fit into the plan of the collection. The problems are numerous, but in many parks there is a real work to be done and the historian or museum curator should meet his responsibility as best he can even though he has not had previous experience in discerning the values of historic objects.

The opportunity exists in many historical areas, also, to develop research collections in material culture. To be effective, these collections need to specialize on one problem at a time—a problem, of course, having application to the park. Several parks have outstanding collections of this sort already. The study of material culture as represented in these collections can go beyond description and classification to contribute directly to social or military history.

Some park naturalists, historians, and museum curators now employed in National Park Service areas have demonstrated their ability to work with historic objects. Others have expressed their belief that they are incapable of using this class of material as a source of history. Being unable to read the history revealed by cultural objects, these workers are also unable to present certain invaluable evidences when they install their museum exhibits. It is quite unreasonable, probably, to insist that every park interpretative officer become a specialist in the field of historic objects but it is not unreasonable to expect that at least one worker in each especially important historic area enter this realm of specialization. In some instances it will be possible to justify the establishment of curator positions and the requirements of eligibility can be so defined as to guarantee the employment of a worker qualified to draw the story from the wealth of objective documents possessed by certain parks. In other instances it may not be possible to justify the establishment of new positions but the presence of important collections in the parks places a responsibility upon administrative and interpretative officers which must be met. In these cases present employees must adapt themselves and prepare to use these unique sources of history. To fail to do so is very much like ignoring one section of a library. [1]

[1] For further comment on the importance of historic objects as sources of history see: Arthur Woodward. Archeology—the scrapbook of history. The regional review, 1: 8–10, August 1938; Arthur C. Parker, History is written in objects. The regional review, 1: 21, December 1938; and minutes of interbranch conference, branch of historic sites and branch of research and information, February 29, March 8, 14, and 21, 1940. (Mimeographed.)

A good example of the value of objects as a source of history is found in the accomplishment of a historian who applied himself in deciphering the story of pewter making on Jamestown Island, Va. [2]

The work of Thor Borresen in his definitive Report on Spanish Guns and Carriages, 1686–1800; [3] the studies of James W. Holland on glassware from the moat at Fort Pulaski; and the continual research of Dr. Alfred F. Hopkins on the cultural and military objects possessed by the Morristown Museum are representative of the original work done by Service employees in the field of historic objects. There is a demand for similar investigations at Fort Laramie National Monument, Scotts Bluff National Monument, Great Smoky Mountains National Park, Ocmulgee National Monument, the several military parks and elsewhere throughout the Federal park system wherever large collections of historic objects are preserved or may be obtained.

Correct identification of some important historical objects may have to depend on outside specialists. Because the intrinsic value of these specimens is high, they are not subject to retention by the specialist as are scientific specimens. The Museum Division will help in locating qualified experts.

Gift and Loan Policy

An integral part of the accession policies for every park is the Service-wide policy on gifts and loans, a full statement of which is on file in each area. Briefly, this policy permits the local superintendent or custodian to accept gifts or loans which are clearly significant to his particular area but not of broad importance, which are small enough to make no excessive demands on his museum space, and which carry no restrictions. It requires the local officer to submit to the Director of the National Park Service all offers involving objects which are of more than local importance, which will need considerable space in the museum, or on which the donor proposes any restrictions whatever regarding their use or disposal. It forbids the acceptance of any objects not appropriate to some park area. The gift and loan policy protects park museums from accessions that might weaken or destroy their usefulness and relieves local administrators of the responsibility in questionable cases. By insisting that all gifts and loans be recognized with a form letter signed by both parties, the policy makes it certain that both the donor and the museum understand the conditions and

[2] Worth Bailey. Joseph Copeland, seventeenth century pewterer. Antiques, April 1938. p. 188–190.

[3] Thor Borresen. Report on Spanish guns and carriages, 1686–1800. National park service. November 1938. (Typewritten.)

provides a written agreement to protect the museum or local officer from any possible legal involvement.

An accession policy that should be in effect at all times is the insistence on full records for every object. A specimen without data is practically worthless.

ACCESSION METHODS

There are several ways to obtain specimens for museum collections, and all may be employed to some extent. Their use will depend on local circumstances and the nature of the material sought.

Purchase

Purchase of specimens is an uncommon practice in park museums because little of the available funds can be used for this purpose, but buying is a good way to get particular items for the exhibit series and may be the only way to acquire some historical materials. Mineral, and sometimes ethnological specimens, can be bought to advantage also. Perhaps most purchases for park museums are of complete collections. It is better to buy or else turn down such a collection than to accept it as a loan or a gift with hampering conditions attached. Usually a special appropriation is necessary. These collections often represent the life work of an ardent collector who expended thousands of dollars on his hobby. Their real value is hard to determine, but generally it is far below the price set in good faith by the seller, who often places a high value on its sentimental attachments. Aside from such collections and certain types of historical objects, few purchases are made for study collections, which seem to thrive on a personal enthusiasm that buying does not always generate. Some museums may be bothered with a special problem—individual visitors bringing objects to sell. It is common experience that these people ask exorbitant prices and are suspicious of being cheated. It is unwise to buy from them. In buying any museum specimen it must be remembered that without adequate and authentic data it has little value.

Gifts and Loans

Another way of acquiring objects is by gift. This is an excellent method when the material is desirable and when no restrictions are made. Many donors who sincerely want to help the museum demand that their gift be kept on display permanently, or kept intact in one room, or retained forever in that particular museum. Museums in America and Europe have accepted such conditions in order to obtain much-wanted material and have been harmed or even ruined by it. Extremely few collections

are worth such a price. In accepting a gift the museum should be free to transfer it to another park, sell it, exchange it with another museum, give it away, or even destroy it; and the donor should be made to realize that his gift may not be kept on display but will be serving just as important a purpose in the study collections. Along with more serious consequences, this will avoid embarrassment when the donor comes back a year or two later to see his donation. Museums in parks, as elsewhere, need to be alert to escape the less sincere givers. Some people have used museums to provide safe and free storage for objects, perhaps for years, and then demanded them back to pass on to their children. Others have found it cheaper to turn cast-off material over to a museum than to have it carted away and destroyed. The whole matter of gifts calls for diplomacy and good judgment to avoid giving offense or losing valuable friends and still keep out unwanted material. The established gift and loan policy is designed to help in this problem.

Borrowing is, of course, another way to acquire museum material, but one which it is advisable to avoid as far as possible. Two sorts of loans may be useful, however. One is a short-term loan for some special temporary exhibition. In this case the museum borrows certain definite objects for a specified time, rarely longer than 2 months, and for a particular purpose. The other is an indefinite loan for permanent exhibition, and is nearly equivalent to a gift. When some outside institution supplies a needed specimen to a park museum, it often retains technical ownership of the object without any intention of ever recalling it.

When a gift or loan is placed on exhibition, public acknowledgment often is desired and can be made by placing the donor's or lender's name at the bottom of the specimen label. If the gift comprises a large collection, a single tablet or special label may be used instead of repeating the name with every specimen.

Circulating loans of duplicate exhibit material from park museum collections to schools, museums, or similar responsible institutions seldom have been made. They present an opportunity for expanding public service, however, and their more frequent use may be anticipated.

Field Collecting

The most satisfactory way to acquire museum specimens is to collect them in the field. Collections made in this manner are usually the most interesting, and they can be the most valuable, for the collector can insure the completeness and accuracy of the all-important data and set his own high standards of preparation and care. Furthermore, they are within

the reach of every park museum. Instructions for collecting are beyond the scope of this manual, being almost as varied as the kinds of objects gathered. In some fields collecting methods require special training, in others simple ingenuity. Archeological field work, for example, is so exacting that no one but a trained archeologist should attempt it. Collecting in the natural sciences usually demands some knowledge of the forms desired, some field equipment, and familiarity with tried methods of locating and capturing or removing specimens. Various written directions, some of which are cited in the bibliography, may be helpful in this sort of collecting. The following chapter gives the methods for further treatment. Historical collecting may involve archeological methods, in which case an expert is needed, or it may consist of interviewing old settlers, rummaging through attics, and tracing down elusive possibilities. Actually, this kind of collecting may be very fruitful if it is done selectively and with a definite purpose. Otherwise it is likely to be harmful.

COOPERATION IN COLLECTING

The park naturalists and historians have so many duties that collecting usually must be a secondary activity. It is good museum practice to let others share in this work. The natural history associations that have been established in some areas, and other local or regional organizations of interested amateurs, can make important contributions to park collections. Their work requires encouragement and direction but is worth while. Amateur collecting in archeology, however, is not to be fostered. The exchange of specimens among park museums, which is only beginning to be developed, is a practical way of strengthening collections. Some parks have a surplus of one type of objects which other parks lack; objects are offered to one park that are appropriate to another; and so on. Such cases call for a transfer of specimens from one museum to another. This is not done on a "value received" basis. The park giving up the objects may receive nothing in return but gains through the improvement of the Service as a whole. At present steps are being taken to establish a central clearing house system in the Washington office of the Museum Division to handle the transfers of specimens.

MUSEUM RECORDS

Museum collections are like libraries—not of much value unless one knows what they contain and can locate what is wanted. It is essential that full records be kept for all museum specimens if the collections are to

be useful to the staff or other scholars. To aid in establishing a practical record system, standard form cards are provided which may be requisitioned in the same manner as other National Park Service forms. The use of these cards is required in the interest of uniformity in the basic records of park museums.

The Accession Record

There are two basic records which experience shows are necessary in a museum—the accession record and the catalog. The accession record is a chronological list of the lots or batches of objects received by the museum. The material received from one source at one time constitutes an accession, no matter how many individual items comprise it. Thus, a large collection of guns donated to the museum is one accession, and the cannonball dug up by a repair crew is another. Each lot of material as it comes in is assigned a number immediately. This number is attached temporarily to the objects or container to identify them until they can be cataloged. At the same time the essential information about this lot of specimens is recorded. The primary accession record should be a bound volume in which the accession number, brief general description of items, date of receipt, conditions of acquisition (gift, loan, etc.), and donor are entered. This volume should be a ruled record book of high-grade paper, and entries should be written legibly with a permanent carbon or india Ink. In addition to the accession book, an accession card should be filled out and filed alphabetically by donor or other source. Later, when the objects have been cataloged, the catalog numbers should be added to the accession record in the book and on the card.

One problem which may be encountered in museums late in starting their record system is that of bringing the accession records up to date. Accession Number 1 should be the first lot of specimens which the museum received, and so on. If records have not been kept up in the past, this information may not be available for all the material now in the museum. Until numbers have been assigned to these old accessions, it is impossible to know where to begin the numbering of current receipts. It is recommended that all past accessions for which the dates are known be entered chronologically with as complete information as is available. Following this series, those of unknown date should be listed and noted as received before such and such a date, using the date on which the current records begin. Once the accession records are brought up to date, little difficulty should be found in keeping them so. A sample accession card and book entries may be found at the end of this chapter.

The Catalog

The catalog is a full record of every specimen in the museum. Each specimen is assigned an individual catalog number which is affixed permanently to the specimen. (In the case of insects, numbers are not given to individual specimens, but a card for each species is included in the catalog.) Numbers are given in the order in which the objects are cataloged, which is more often the order in which they are studied than that in which they were accessioned. In other words, the two series of numbers do not correspond. When the catalog number has been fastened to the specimen and entered in the accession record, the temporary accession number may be removed from the object. The record of each object is entered first in a loose-leaf book. This catalog book is a numerical list of all specimens. The entry for each item should give the catalog number, accession number, identification and description of object, date of entry, collector, locality, date of collection, and remarks (identified by, condition, value, etc.). Since the basic catalog is kept in numerical order, it is possible to refer from the catalog number on a specimen to full information about it. The catalog record should be typed in duplicate so one copy can be kept in the office and one with the collection. In addition to the two copies of the catalog book, the catalog cards should be filled out.

The catalog card contains the same information recorded in the book and also a more complete description of the object with photographs or sketch whenever possible, its classification, location in the museum, and references to pertinent correspondence in the park files. The present location should be noted in pencil because this information will change from time to time. The matter of description and picture is best explained, perhaps, by pointing out that the catalog card is a research tool. One should be able to gain a good idea of the nature and importance of the object by consulting the catalog card file. The catalog cards should not be filed numerically but should be classified, thus serving as an index to the collection. A space is provided on the card for recording the classification of the specimen. Whenever an object should be cross-indexed, it is simply necessary to make out additional catalog cards. In museums of history the real problem in this state of cataloging is the devising of a classification system, while science collections use the standard classification of the various sciences. The system should be broad enough to include all types of objects within the scope of the museum, yet detailed enough to be useful in organizing the collections. As a matter of fact, both ends of the classification are fairly easy to get; it is the middle portion, on which the organization of the collection and index will depend most heavily, that is difficult.

The detailed break-down is dictated by scholarship in the several fields involved, i. e., muskets are classified according to students of firearms, coins, and medals according to numismatic practice, and so on. At the other extreme a broad classification that will cover everything is offered by the following from Coleman's *Manual for Small Museums*, p. 154:

I. Material Culture:
   1. Foods.
   2. Clothing and personal adornment.
   3. Buildings and public works.
   4. Furniture and interior decoration.
   5. Domestic implements and utensils.
   6. Agriculture.
   7. Sanitation, medicine, and surgery.
   8. Engineering and transportation.
   9. Industry.
   10. Commerce.
   11. Money and banking.

II. Social Life:
   1. Customs and social structure.
   2. Organizations.
   3. Government.
   4. Education.
   5. Warfare and military organization.
   6. Individual life.
   7. Recreation.
   8. Music, poetry, and drama.

III. Religion and Church.

IV. Biography.

For the intervening categories, a majority of which might fall, for example, under II, 5, in the foregoing general system, it is suggested that headings adapted to the local park collections be worked out, carrying the break-down as far as the material warrants, and having regard to likely future expansion.

The bottom of the catalog card contains space for a full disposal record. It is customary to retain the card when a specimen is disposed of. The disposal record is entered on the card, and it is left in place in the file or segregated in a special disposal file.

A sample catalog card and book entries may be found at the end of this chapter. For a good discussion of museum records, see Coleman's *Manual for Small Museums*, p. 173–186.

For the best method of affixing catalog numbers to various types of objects the following is recommended:

For objects of wood, metal, stone, leather, porcelain, glass, etc.—

Paint a small oblong with high quality, white oil paint directly on the specimen. The most desirable is a fast-drying paint containing a base of tung oil, celluloid, or bakelite. On glass and white china a clear celluloid lacquer may be used instead of white, if desired. The whole affair can be removed easily with acetone, if necessary. This oblong should be only large enough to hold the number and should be placed where it will not show when the specimen is on exhibition. The same position should be used for all objects of a kind so the number can be located easily. When the paint has set, the number is written on it in India ink with a fine pen. When the ink is dry, the oblong is painted over with clear shellac. It may be desirable to thin the shellac slightly with alcohol.

For textiles—

Some textiles are woven tightly enough to permit the number to be lettered on directly with India ink. If not, the number should be lettered on a small oblong of white cloth in India ink and this oblong attached to the specimen by sewing, stapling, or gluing with cellulose acetate cement. Again it should be inconspicuously placed, but where it can be found readily.

For paper—

Historic documents should be numbered in pencil, using a medium grade that does not scar the paper, but will not rub off (between HB and 2H). Other paper objects can be numbered directly in India ink. Many museums use a rubber stamp containing the name of the institution with a blank space for the number. This stamp is inked with a light brown printer's ink to insure permanence. This is good library practice and discourages theft. If documents have exhibit value, judgment should be used in locating the stamped impression.

For plant and animal specimens—

Standard procedures for these are well established. Herbarium specimens are numbered and labeled in the lower right corner of the sheet. Study skins are tagged, as are alcoholic specimens. The tags should be linen and lettered in India ink. Insect specimens usually are not numbered since the full data are given on the pin labels, but important accession numbers can be added in the same way.

For very extensive collections of archeological material more specialized catalog records may be required. It is well to have both a master (i. e.

numerical) file in which all objects are filed in order of their specimen number, and a materials file in which all objects are filed numerically on the primary basis of the material of which they are made (i. e. stone, bone, pottery, etc.). If the materials in the museum are from a number of sites, it is useful to have a third or site file—in which all the objects from a given site are listed. This threefold system of cataloging archeological specimens is now employed in the museum at Ocmulgee National Monument where it provides quick means of access to more than a million and a quarter specimens.

The catalog card used for archeological specimens should provide entries to suit the needs of research in that subject. Not only should the artifact be named and briefly described but its place of origin should be carefully indicated as to site name or number; soil element, structure, or room from which it was taken; its depth in the soil element; and the horizontal location of the find in reference to excavation ground plans. In addition, the field specimen number, by which the object is referred to in field notebooks, should be given, and the location of the specimen in the storage or exhibition hall should be indicated. References to mention of the object in field notebooks, catalog notebooks, its appearance in field or laboratory photographs, and reference to excavation plans or profiles covering the area in which the specimen was found are also needed. Park museums interested in these special methods can obtain sample cards from the Museum Division.

SAMPLE ENTRIES IN MUSEUM RECORD BOOKS

ACCESSION BOOK

74 2 barrels of 19th century china, Jan. 10, 1940, purchased from the estate of Charles Jones. Cat. No. 1703–1725, 1991–2000.

75 4 Civil War muskets, Feb. 12, 1940, gift of Sarah A. Smith. Cat. No. 2563, 2564, 2565, 2707.

76 1 musket ball, April 3, 1940, excavated by CCC crew in park. Cat. No. 3825.

77 1 opossum, May 6, 1940, found dead on park road by superintendent. Cat. No. 2623.

78 42 rock specimens, May 16, 1940, collected in park by Regional Geologist Black. Cat. No. 5040–5081.

79 1 fossil leaf, May 29, 1940, loaned until July 1, 1940, by the University Museum, Smithton. Cat. No. 2904.

CATALOG

2564 Acc. No. 75. U. S. Springfield rifled musket, 1861 model, lock-plate dated 1862, entered May 6, 1940, found in her attic by Sarah Smith of Montross, fair condition but ramrod missing, valued at $5, identified by Capt. John C. Smith of the National Museum.

2565 Acc. No. 75. U. S. Springfield rifled musket, 1861 model, lock-plate dated 1862, entered May 8, 1940, found in attic by Sarah Smith of Montross, complete but considerably rusted, valued at $5, identified by Park staff referring to description and illustrations on p. 87, *Fire Arms in American History*.

* * * * * *

2623 Acc. No. 77. *Didelphis virginiana* Kerr, adult male (weight and measurements on catalog card), entered May 28, 1940, collected by the superintendent on Highway 62 inside park boundary, May 6, 1940; had been killed by automobile, study skin by Enrollee Jones, identified by Park Naturalist A. C. Brown.

* * * * * *

2904 Acc. No. 79. *Sassafras parvifolium*, single leaf in Smithton shale, bears University Museum No. 7783, entered June 1, 1940, specimen loaned for exhibition by University Museum, Smithton, to be returned by July 1, 1940. Returned June 28, 1940. (Cataloging of short term loans is an optional procedure.)

* * * * * *

5075 Acc. No. 78. Smithton shale, entered Dec. 5, 1940, collected May 14, 1940, along South Brook 50 yards above bridge by Regional Geologist Black during reconnaissance survey, identified by Black.

MUSEUM RECORD CARDS

Smith, Sarah A. *Donor*
10 Shepard Street
Montross, Pa. *Address*

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Fredericksburg NATIONAL PARK
ACCESSION RECORD

Accession No. 75
Date Received Feb. 12, 1940

CLASSIFICATION OF ITEMS	CATALOG NUMBERS	GENERAL DESCRIPTION
Firearms Long arms Civil War	2563-2565 2707	4 Civil War muskets

CONDITION OF GIFT—LOAN—EXPEDITION, ETC.	ACKNOWLEDGMENT	DOCUMENT FILE
Unrestricted gift	Superintendent to S. A. Smith, Feb. 14, 1940	S. A. Smith to Superintendent Jan. 28, 1940 Superintendent to S. A. Smith Feb. 4, 1940 and Feb. 14, 1940.

10—254 U. S. GOVERNMENT PRINTING OFFICE 0—9296

Springfield rifle *Object*
1861 model
May 6, 1940 *Date of Entry*

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Fredericksburg NATIONAL PARK
CATALOG RECORD

Catalog No. 2564
Accession No. 75

CLASSIFICATION (NATURE OF SPECIMEN, ORIGIN, SPECIES, ETC.)	WHERE AND BY WHOM COLLECTED	DONOR	DESCRIPTION, MEASUREMENTS, SKETCH, ETC.
Firearms Long arms Civil War Springfields	Attic of S. A. Smith home, Montross, Pa. Feb. 1940	Sarah A. Smith	U. S. Springfield rifled musket, 1861 model, lock-plate dated 1862, .58 cal., 40" barrel, rifled with three grooves, usual U. S. proof marks on barrel, lock-plate stamped with eagle, "U. S. Springfield" at right, "1862" at left. Fair condition, but ramrod missing.

PRESENT LOCATION	DOCUMENT FILE	REMARKS (VALUE, ETC.)	
Case 6 Drawer 4	S.A.Smith to Supt.1/28/40 Supt. to Smith 2/4/40, 2/14/40	Value $5.00 Identified by Capt. John C. Smith, Nat'l Museum	(sketch or photo)

DATE OF DISPOSAL	TO WHOM SENT	CONDITIONS OF DISPOSAL	HOW SENT (MAIL-EXPRESS)	ACKNOWLEDGMENT OF RECEIPT	DOCUMENT FILE

10—254 U. S. GOVERNMENT PRINTING OFFICE 0—9297

Figure 24

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CHAPTER · VII ·

TECHNICAL METHODS

WHEN objects are collected and placed in a museum, their preservation becomes a major responsibility of the museum staff. The proper care of specimens is exacting work which demands knowledge, skill, and ingenuity. Every class of objects, and often every object, is a separate problem, and the problem is never solved completely for care must continue as long as the specimen lasts. After it has been collected, an object must be cleaned, mounted, or repaired; perhaps given a protective treatment to ward off the most prevalent danger; then stored properly and inspected frequently. When it is attacked in spite of precautions, the destructive agency must be eliminated and the damage repaired. This chapter contains brief descriptions of some of the methods most likely to be needed in park museum work. The treatment of historic and prehistoric objects and of natural history collections are discussed in turn. A separate section covers control measures for the principal enemies of museum collections. The special cleaning problems of museum equipment, descriptions of casting mediums, and safe practices in museums also are given separate treatment. At the end of the chapter will be found an alphabetical list of materials employed in caring for museum specimens. This glossary makes no claim to completeness but is intended to include most of the substances commonly used in the field. When difficult problems arise, the Museum Division should be consulted.

CLEANING AND PRESERVING

If an object is worth saving for exhibition or study in a museum, it deserves careful cleaning and repair. Much harm has been done in the past by well-intentioned attempts at repair or restoration of specimens without a full knowledge of the principles involved. It is essential to know, first, the physical and chemical properties of the object to be cleaned; secondly, the most effective method of arresting further deterioration and restoring

it as nearly as possible to its original condition; and, thirdly, the nature and effect of the chemical formulas and processes to be employed in effecting a restoration. With the exception of certain newly excavated material and objects exposed to unusual wetting or active attacks by insects, there is seldom any need for extreme haste in applying preservative treatment. Therefore, when in doubt the best policy is to do nothing until existing conditions are fully understood and a remedy is decided upon both by inquiry into methods already proven to be satisfactory and by experimentation on a small and inconspicuous part of the specimen. The chemical nature of the material to be preserved as well as the composition of foreign substances to be removed should be determined by tests to avoid mistakes in treatment. Specimens of the same kind recovered from different localities will differ materially in the nature and degree of incrustations and in the salts with which they may be impregnated. In a like manner, stains on costumes, statuary, and many other objects may appear superficially alike but require quite different methods for removal. Excessive cleaning and repair until the object becomes almost a reconstruction or even a counterfeit of the original is not sound practice and should be discouraged. The other extreme theory which deliberately retains the dirty or deteriorated condition of the specimen just to emphasize its antiquity is likewise undesirable. Such an attitude reflects the too often encountered lack of appreciation of the importance of order and cleanliness in exhibits. The ideal is to exhibit the piece in as near its original condition as careful cleaning and repair will permit without the addition of deceptive reconstructions or forgeries.

Historic and Prehistoric Objects—Organic

PAPER AND PARCHMENT

Manuscripts, prints, and drawings are among the most fragile and easily damaged objects in a museum collection. The cleaning of a valuable manuscript or print should not be entrusted to an inexperienced operator since more harm than good always has resulted from improper methods. Fortunately the rate of deterioration in paper is slow enough to permit inquiry into the application of correct preservative treatment.

Protection against tearing and other mechanical injury is second in importance only to preservation from attacks by insects and the development of molding or "foxing." The destruction of mold and insects is effected in large institutions by placing the material in a tank or vault where a vacuum is established and a mixture of carbon dioxide and ethylene oxide or some other toxic gas is admitted which destroys insects in all

stages of development as well as mold spores. Thymol, a powerful fungicide, has been used effectively against mold in small museums. Infested material can be exposed to its fumes by using the heat of a 40-watt electric lamp placed under a small dish of the crystals to evaporate this highly volatile solid. If allowed to burn for a half hour, the heat of the lamp will release enough fumes to affect the contents of a small airtight cabinet of about 16 cubic feet capacity for 24 hours. A repetition of the process for 2 or 3 days is recommended; no harm will result from prolonged treatment. Any deposit of thymol as a result of cooling may be evaporated easily by exposure to the open air. Oil paintings or paper on which oil paint and particularly varnish have been used should not be treated with thymol, which has an undesirable softening effect on varnishes and linseed oil.

It is desirable to remove creases, folds, and wrinkles from paper whenever possible. This is accomplished by dampening and pressing, although no moisture should be applied unless the ink and colors are known to be waterproof. Printed illustrations and etchings which employ printing ink are usually safe, but manuscripts, especially those later than 1840, are liable to run in the same manner as a hand-tinted illustration or water color. If the ink has been found to be safe, enough moisture is applied in cold vapor form to allow the paper to relax sufficiently to be flattened. It is then dried between large photographic blotters under heat and pressure. Steam may cause condensation of objectionable drops of water on the paper and should be avoided.

Minor tears may be mended by carefully pasting the torn edges together and backing with thin, strong paper extending well beyond the point of tear. After pasting and adjusting the tear itself, apply a small quantity of paste with a brush to the mending strip only. Then press the strip into place, being sure the torn edges remain accurately joined, and dry the whole under pressure. Waxed paper is placed over the mending strip during the drying process. All mending should be done with a good grade of library paste. Glue, household cement, rubber cements, and adhesive tapes which cause discoloration, undesirable stiffness, and cracking should be avoided. Many large libraries have trained operators who repair tears and reenforce weak paper by backing with a long fiber Japanese tissue or a silk chiffon crepeline paper. A still more satisfactory method, but one which requires extensive apparatus such as is employed by the National Archives, consists of a sheet of cellulose acetate on both sides of the paper which is then subjected to heat and great pressure resulting in a complete bonding of the plastic and an excellent degree of permanence and protection. Other cellulose materials such as cellophane and cellulose nitrate sheetings, including cel-

luloid, are not regarded as satisfactory for permanent use in protecting paper.

The removal of deep-seated stains should not be attempted without previous experience. Minor stains may be removed with a kneaded or "soap" eraser, but since strong grease solvents affect nearly every form of ink and bleaches affect the paper, it is wise not to experiment on a valuable print or document.

While the majority of prints can be exhibited with little danger under properly controlled light, the showing of valuable manuscripts is always dangerous. Daylight and even artificial light will fade the ink and affect the fiber of the paper, and no satisfactory way is known to restore them, once a serious fading has taken place. It is desirable, if a rare document or valuable print must be exhibited, to protect it from the direct rays of the sun and so far as possible from constant exposure even to diffused light. Installation of an opaque cloth cover, which may be raised by the visitor and which will fall back into place automatically after the object has been examined, is often used with satisfactory results. It is also good practice to give added protection by drawing the shades whenever the museum is closed to visitors. Prints or manuscripts may be exhibited with a sheet of glass pressing them lightly against a soft cloth cushion when such is desirable, but they never should be cemented to a stiff backing. No pressure should be exerted on attached seals or ribbons, which are often quite brittle. The tape fastening the seal to old documents is apt to be rotten and the weight of the seal should be supported with inconspicuous fasteners when exhibited vertically.

Much damage is caused to prints and manuscripts by improper filing methods. A folder of good rag paper, usually 8½ inches wide by 14 inches high, should be made for each manuscript. This forms a strong cover and will accommodate open letters. It is best to open letters or manuscripts and keep them that way in the cover since opening and folding wears out the paper at the fold.

On the cover (fold at left) are listed the pertinent facts regarding the manuscript enclosed. These may be as follows:

1. Collection Name. This is placed at the top middle of the page and usually refers to the person who is the subject of the collection. For instance, the Chouteau Collection consists principally of papers relating to the Chouteau family. Another method is to name the collection for the donor.

2. Summary. This is placed directly below the Collection Name and consists of a short paragraph describing contents of the manuscript. This

is an invaluable aid to research students for it saves one the trouble of reading through lengthy and almost illegible papers not relating to the researcher's problem.

3. Addressee (to whom addressed).
4. Addressor (writer of letter).
5. Date and Place.
6. Persons referred to.
7. Places referred to.

The last two are time savers for research students.

8. Sometimes it is desirable to list the subject of the paper.

Finally, the manuscripts in their covers should be placed in heavy manila folders with the title, description, and other desirable information typed on the outside, and filed flat on the shelves of a fire resistive storage cabinet in a moisture-free room, care being taken to prevent any part of the paper from protruding beyond the protective coverings. Manuscripts may be arranged alphabetically on the shelves and chronologically in the folders. It is dangerous to store prints in glass frames which are liable to breakage and a resultant serious damage from the fragments of glass.

Mounting paper on metal.—Labels, charts, illustrations, and other exhibit devices prepared on paper or cardboard often warp under the moisture and temperature changes within the exhibit case. While they may be held flat under glass plates, a less conspicuous method is to mount them on metal sheets which are stiff enough to hold them flat. Aluminum, zinc, or tin may be used. Some museums obtain the used zinc plates from photoengraving plants for this purpose. Ideally, the surface of the metal should be grained (it can be purchased in this condition), but the mounting method given below does not demand graining. The metal used should not be thinner than .029 gauge, although the heavier gauges may have to be cut on a plumber's cutting machine rather than by hand. The exhibit should be mounted on the metal in the following manner:

1. Clean all the surface grease from the metal as follows:

(a) Wet the metal plate with water.

(b) Spill a small amount of concentrated hydrochloric acid on the wet plate, and rub thoroughly with a wad of cotton. Enough water should be used on the plate to bring the concentration of the acid to approximately 1 part in 100 parts of water.

(c) Wash off the acid with water and dry the plate. Be careful not to handle the cleaned surface.

2. Apply a coating of Sphinx, or similar printer's "make ready," paste to the metal. Use a printer's or squeegee roller to obtain an even coating.

3. Apply a coating of the paste to the paper. A synthetic sponge is good for applying it. It is important that both coats of paste be even.

4. Mount the paper on the metal and squeeze flat with a roller, using only moderate pressure.

BOOKS

The same methods used for fumigating and repairing prints and manucripts apply to the pages and illustrations in a book. If a book has been dampened excessively or immersed in water, the leaves should be dried one at a time with an electric iron, using photographic blotters on both sides and gently pressing against a hard, flat surface such as a sheet of aluminum. Silverfish feed on the paste in bindings, and other insects also may cause serious damage but the most frequently encountered trouble with books comes from the drying of leather bindings. This damage may extend from a slightly worn corner to a hopeless condition of cracking and powdering. Whenever possible the original binding should be saved. The excessive dryness of the leather may be corrected by the application of a neutral lubricant free from acids and alkalis. Purified petroleum jelly or white vaseline of medicinal grade is preferred by many, while others show a preference for one of the following formulas expressed in percent by weight.

Neat's-foot oil, pure, 20° C. cold test	25.0
Lanolin, anhydrous	17.5
Japan wax, pure	10.0
Sodium stearate, powdered	2.5
Water, distilled	45.0

Lanolin, anhydrous	30.0
Castor oil	12.0
Japan wax, pure	5.0
Sodium stearate, powdered	3.0
Water, distilled	50.0

Lanolin, anhydrous	40.0
Neat's-foot oil, pure, 20° C. cold test	60.0

Lanolin, anhydrous	50.0
Neat's-foot oil, pure, 20° C. cold test	35.0
Japan wax, pure	10.0
Sodium stearate, powdered	5.0

Lanolin, anhydrous	55.0
Sperm oil, winter strained	25.0
Japan wax, pure	15.0
Sodium stearate, powdered	5.0

Neat's-foot oil, pure, 20° C. cold test	50.0
Castor oil	50.0

These lubricants should be rubbed into the cover by using the fingers, a wad of cheesecloth, or a soft brush. The purpose is to work into the dry leather as much oil as it will absorb without leaving a greasy excess. Usually this can be controlled by working in a small amount which is allowed to penetrate for 12 or 24 hours before another light layer is applied.

In cases where the bindings crumble and rub off excessively as a powder on the hands and clothing, it is desirable to work in as much lubricant as

possible without an external excess, after first smoothing off the leather where necessary with fine emery or crocus cloth, and to finally coat with a cellulose-nitrate lacquer. On the market are several ready-made lacquers for this purpose which can be used satisfactorily if diluted sufficiently with their respective thinners. It is undesirable to apply too thick a coating which would result in an unpleasant, highly varnished appearance. It is important that the lacquer contain a high percentage of castor oil for flexibility and be free from gums and resins. The following is a satisfactory preparation. Quantities are stated by weight in ounces avoirdupois.

Cellulose-Nitrate Lacquer

	Ounces
Cellulose nitrate, one-half second, for lacquers, ready mixed with 30 percent by weight of alcohol	1
Monoethyl ether of ethylene glycol	2
Ethyl acetate	3
N-butyl alcohol	1
Toluene	5
Xylene	2
Castor oil, U. S. P	½

This mixture is highly inflammable and explosive and consequently should be used and stored with due caution.

LEATHER

The problem most often encountered in leather specimens such as boots, shoes, fire buckets, harness, and equipment is excessive dryness. Application of vaseline or Neat's-foot oil is very desirable. The detailed treatment described for leather bindings under "Books" applies to all forms of overdry leather.

Excavated leather, if very wet, is generally in bad condition and should be kept wet until proper treatment can be arranged. Washing with alcohol containing a small amount of carbolic acid to kill bacteria, and transferring to melted vaseline for 2 or 3 days, followed by a transfer to melted paraffin in extreme cases, is helpful in saving such material.

RAWHIDE

Excessive dryness and attacks by insects are the two principal problems with rawhide. Vaseline applied judiciously will relieve brittleness generally. On rawhide boxes, drum heads, and bags it is best applied to the under or flesh side of the skin since the structure is such that penetration is more easily effected and there is less danger of darkening the outside.

Badly broken heads on old military drums, where no original painted device or insignia is present on the skin, can be removed and a new covering substituted for the sake of appearance. When an old head is to be retained, because of its marking or for other reasons, it may be dampened for safe removal, mended with a backing matched for color, and restretched with

just enough tension to keep it flat. The excessive use of vaseline on painted rawhide such as drumheads and Indian parfleches may cause damage and discoloration; in such cases it should be applied sparingly.

TEXTILES

When cloth is in very good condition it may be washed with a small quantity of saponin in cold or lukewarm water and its appearance improved by pressing with a hot iron between damp cloths. Otherwise milder treatment is necessary.

Fabrics are seldom found in the damp soil of excavations unless some preservative has penetrated whatever remains of the cloth. Usually this is treated in place, like other materials too fragile to extract, by coating with a thin solution of gum arabic or shellac or, after it has dried out sufficiently, with a solution of celluloid or cellulose acetate in acetone. When sufficiently strengthened, it is removed from the excavation and sent to the laboratory for special preservative treatment according to its particular nature and needs.

A reasonable degree of mothproofness can be imparted to fabrics by saturating them with a 0.5 percent aqueous solution of sodium silicofluoride. This can be used only with cloth that will stand treatment with water so it should not be applied to very old or weak specimens. Later washing removes the mothproofing, which must be renewed after each laundering.

Wool uniforms and costumes.—Uniforms and other heavy wool garments still in good condition may be freshened by cleaning with Stoddard solvent or benzol, but in all cases it should be remembered that it is more important to save a valuable costume in poor condition than to destroy it by an unwise attempt at cleaning. All clothing which is exhibited or stored should be padded out with tissue paper in the legs and sleeves and between folds to prevent a sharp bend in the fabric. In time such sharp folds are sure to be the points of breakage in the fibers. Naphthalene flakes or paradichlorobenzene, which are insect repellents as well as insecticides, should be kept in the cases with costumes and all other textiles.

Old cloth.—When cloth is very old and has disintegrated to a point where it cannot be handled safely or support its own weight, it is customary to back it by neatly stitching to a heavy linen background of a suitable neutral color. Skilled needlework is required to do this so as to conceal the binding threads. The cloth so stitched may be protected further by the addition of sheets of heavy cellulose acetate placed on each side of the backed cloth and stitched through to form a durable covering.

Silk flags and costumes.—The use of water, benzol, or heat in cleaning

old silk is extremely dangerous. All-silk regimental flags and silk costumes usually offer the most difficult preservation problems encountered in textiles. Frequently the fabric has deteriorated to a point where it crumbles to dust or shreds apart at the slightest touch. If the fibers have rotted so much that they cannot be secured to a cloth foundation by stitching with thread or held down with a fine net, such as a hair net touched with dye to match the old fabric, nothing remains but to employ cellulose acetate filler, backing the material on a rigid support. This treatment is much the same as would be necessary in rotten cloth from an excavation, except that here we have extreme dryness and the effect of chemicals instead of dampness as the causes of weakness. Such extreme measures of preservation are costly but are warranted where the object is of unusual scientific or historical value.

Upholstery.—Cloth-covered upholstery, if not too badly soiled, may be lightly shampooed with water and saponin, while grease spots can be removed by local applications of benzol or Stoddard solvent, care being taken to avoid wetting the padding underneath. Leather upholstery is often too dry and brittle and needs the same treatment described for leather book bindings. Large areas of leather may be worked over with vaseline and black or other colored dye used to retouch worn spots. When "horse hair" covering is badly damaged, little remains to be done except reupholstering. Vaseline may be used sparingly to relieve brittleness.

The most frequent cause of trouble in old furniture lies in the hair stuffing which may have become excessively dusty and infested with moths. Thorough fumigation and renovation are called for in these instances. A cleaning and reupholstering with the original materials whenever possible are desirable. Upholstery in old vehicles is generally in bad condition when it comes into the possession of a museum. Since it is seldom possible to find a fumigating chamber large enough to contain the entire vehicle, remove all loose cushions and go over them carefully with whiskbroom, brush, and vacuum cleaner to remove all loose dirt. If it is impractical to strip down and reupholster, dose liberally with carbon tetrachloride. A thorough soaking with this liquid usually will destroy the moths but should be repeated immediately on the first indication of further activity. Care should be used to prevent the liquid from running over painted surfaces, where its solvent action will cause damage. After all insect activity has ceased, it is desirable to spray on a repellent every 3 or 4 months and keep a quantity of paradichlorobenzene in all available recesses.

Carpets and rugs.—The cleaning and repairing of valuable oriental rugs and European carpets require the services of an experienced worker in

that field. Small rugs, where the dye is known to be fast enough to permit, may be cleaned with mild soap and water, saponin being preferred because free alkali is absent.

The rug is laid out on a clean, flat surface and a good lather worked all through to remove dirt, after which it is thoroughly rinsed several times to remove every trace of the cleaner. Persistent stains may be treated as indicated for costumes, care being taken not to injure the colors in the process.

Infestation with moths or carpet beetles calls for thorough cleaning and fumigation. Rugs on exhibition should be sprayed with moth repellent every 1 to 6 months—according to local conditions.

Never fold a rug or any other textile in storage; always roll it up, using a round pole as a core, and keep in a clean, dry place. Paradichlorobenzene should be kept in stored rugs to ward off insect attacks.

Stain removal.—The removal of stains from textiles should be undertaken only when experimentation has proved no harm will be done to the fabric or dye in the process. Rinsing in water and saponin will remove a large percentage of the dirt and discolorations while benzol usually takes care of free grease and oil.

The large variety of stains usually encountered on modern clothing may be removed by a number of satisfactory methods that have no apparent immediate effect on the strength or appearance of the cloth, which will normally wear out or be discarded by the owner before the latent results of such treatment become known. Much of the decay in old fabrics is traceable to substances retained in the cloth from normal wear or from original sizing and chemical bleaches or cleaning fluids. The slow chemical changes, from oil to acid, for example, become apparent only after the passage of time when the object may have become of real historical value.

Since it is a desirable practice whenever possible to clean uniforms, costumes, rugs, upholstery, linens, and laces before placing them on exhibition, every effort should be made to make them presentable without employing drastic measures. With this in mind the following methods recommended for stain removal by the Bureau of Home Economics of the Department of Agriculture [1] are included here for convenience with particular cautions relating to old fabrics. Bleaches such as Javelle water and potassium permanganate are as dangerous on old fabrics as the various other strong chemicals necessary for taking out persistent stains. Frequently a costume may be exhibited in what appears to be a totally satisfactory

[1] Stain removal from fabrics. U. S. Department of Agriculture, Farmers' Bulletin No. 1474, 1930.

condition by judiciously arranging so that portions undesirable for display are hidden from view.

Nature of the Stain

The nature of the stain should be known, if possible, before its removal is attempted, because this determines the treatment. If an unsuitable remover is used, the stain may be "set" so that its removal becomes difficult or even impossible. For example, if boiling water, which easily removes most fresh fruit stains, is applied to stains containing protein, such as those from milk, blood, eggs, or meat juice, it coagulates the albumin and makes it extremely difficult to remove.

Kind of Fabric

The kind of fabric upon which the stain occurs should also be known and the method of treatment chosen which will affect that particular fabric the least. In removing stains from fabrics made from two or more kinds of fibers, such as silk and cotton mixtures, the effect of the stain removers upon all of the fibers should be considered. No chemical should be used which would injure the most delicate of the fibers.

Cotton and Linen

Strong acids destroy cotton and linen and even weak ones attack these fabrics to some extent. Therefore, concentrated acids never should be used in removing stains from these fibers. When dilute acids are employed, they should be neutralized afterward with a weak alkali, such as ammonia water, and removed by thorough rinsing; otherwise the acid may become concentrated upon drying and destroy the fibers. Generally speaking, alkalis do not attack cotton or linen fabrics to the extent that acids do. However, long-continued or repeated exposure to alkalis, especially in hot solution, weakens them. All bleaching agents are also somewhat harmful to these fibers and should be used with care and never in concentrated form or for extended periods of time. Where valuable historical items are concerned it is well to avoid acids and alkalis even in dilute form.

Wool and Silk

Strong alkalis dissolve both wool and silk, and even washing soda or strongly alkaline soaps often seriously injures these fibers. The only alkalis that should be used in laundering or removing stains from wool and silk are the milder ones like borax or dilute solutions of ammonia. Dilute acids, with the exception of nitric, which weakens and turns the fibers yellow, do not attack wool and silk readily. Bleaching agents containing chlorine, such as ordinary bleaching powder, are very destructive to both wool and silk and should not be employed.

The use of very hot water on these fibers must be avoided, since it turns both wool and silk yellow, shrinks wool, and injures the finish of silk. Excessive rubbing felts wool, causing it to shrink and thicken, while silk fabrics are likely to be torn. The removal of stains from silk should be done with great care as the mineral salts that are often used to weight such fabrics tend to weaken them.

Rayon and Similar Synthetic Fibers

Of comparatively recent origin, these fibers are not encountered in historic costumes. Fabrics in this class, however, are often used for case linings, drapes, etc. These artificial fibers are manufactured by various processes, which make a difference in the stain

removers and methods that can be used. Many fabrics of this type must be handled very carefully when wet, for water weakens them. Boiling is likely to decrease their luster. Dilute acids are not usually harmful to them, but concentrated acids should not be used. If the fabric is composed of cellulose acetate, it will be dissolved immediately by concentrated acetic acid. Acetone, an organic solvent which is valuable for removing many stains, will also dissolve cellulose acetate. Since there is a great deal of this material on the market, it is well to test a sample with these liquids before using them for stain removal. Alkaline solutions rapidly destroy most synthetic fibers, and bleaching agents are often harmful and should be used with great care.

COLORED FABRICS

Bleaches and other chemicals strong enough to remove stains will usually attack dyestuffs. It is therefore necessary to handle colored fabrics more carefully than white ones. They should be treated rapidly and rinsed thoroughly. If the color changes shade when treated with an acid, the original color can often be restored by a weak alkali, such as ammonia solution or ammonia fumes. Acetic acid will often restore a color that has been changed by alkalis.

SUBSTANCES USED FOR STAIN REMOVAL

Almost all of the materials used for stain removal may be classified as absorbents, solvents, or bleaches, although there are a few miscellaneous ones whose action is different. Sodium thiosulphate ("hypo"), which forms colorless water-soluble compounds with iodine, and corrosive sublimate, which will act similarly with certain medicinal stains, are examples. These are discussed under the treatment of individual stains.

ABSORBENTS

Such substances as chalk, magnesium carbonate, fuller's earth, and corn meal are known as absorbents. When spread on stained fabrics, these often absorb the staining material. They can then be brushed off readily. Such materials are effective if the stain is light or freshly made, but they cannot be relied upon when it is set or very extensive. They are harmless to all fibers.

To use the absorbent powders, lay the stained fabric upon a flat surface and spread a layer of the absorbent over the stain. Work it around gently so as not to pull the fibers. As soon as it becomes gummy, shake or brush it off, and repeat the process until the bulk of the stain is removed. Then apply another layer of the absorbent and allow it to remain overnight, or longer if necessary. This removes all traces of the stain, and in the case of slight stains the preliminary treatment is unnecessary. Then dust or brush off the absorbent thoroughly. If it is not convenient to let the stain stand overnight, place a layer of cloth or brown paper over the absorbent and apply a warm (not hot) iron for several minutes. In the case of stains made by solid fats, which must be melted before they can be absorbed, the use of the warm iron is necessary.

STAIN SOLVENTS

Water and such liquids as ether, wood or denatured alcohol, benzol, acetone, gasoline, chloroform, and carbon tetrachloride are common stain solvents. A large number of stains can be removed by water without harm to the fabric. Unless the stain is known to be insoluble in water and the fabric water spots or the colors run, it is best to try water first. Test by placing a little water on an inconspicuous part of the specimen if there seems to be danger of injuring it.

The other solvents mentioned are particularly good for removing stains of a fatty or greasy nature. As the vapors from all organic solvents are injurious when inhaled in large quantities, they should be used out of doors or in a well ventilated room.

Gasoline, naphtha, and ether are very inflammable and may be the cause of serious fires. For this reason it is not recommended that these be used in quantities large enough to immerse an entire specimen. Not only will gasoline take fire easily and often burn with serious explosions, but in dry atmospheres a garment saturated with gasoline will sometimes burst into flames owing to the static discharge caused by rubbing one part of it against another. If small quantities of either gasoline or ether are used for removing spots, they should be plainly marked "inflammable," kept away from flames, and preferably used out of doors. Benzol and acetone are also inflammable. Some of the noninflammable grease-spot removers sold under trade names consist entirely or in large part of carbon tetrachloride. All of the solvents mentioned above are harmless to most fibers, but water of course injures many fabric finishes and dyed materials.

Bleaches

It is often necessary to bleach out a stain, but chemicals should be used carefully. Almost all of them will remove the color of the fabric as well as the stain and, if used in too concentrated a form or allowed to remain on the fabric too long, will weaken it. A number of the more common bleaches are given below.

Javelle water

Javelle water may be used successfully in removing a number of stains, but should be applied only to uncolored cotton or linen materials, since it bleaches colors and rots silk, wool, and some kinds of rayon.

The solution usually called Javelle water (more correctly termed Labarraque solution) is prepared as follows: Dissolve one-half pound of washing soda in 1 quart of cold water. To this solution add one-fourth pound of ordinary bleaching powder (commonly called chloride of lime). Filter this liquid through a piece of muslin to remove the sediment which remains. Keep the clear liquid in tightly stoppered bottles.

In treating stains with Javelle water stretch the stained portion over a bowl filled with water and apply the Javelle water to the stain with a medicine dropper. Do not allow the Javelle water to remain in contact with the fabric for more than 1 minute. If necessary, the entire specimen may be placed in the liquid. Then apply a solution containing one-fourth ounce of sodium thiosulphate and one-eighth ounce of 36 percent acetic acid in 2 quarts of water. Sodium thiosulphate ("hypo") is found where photography is being done and is very effective in removing the chlorine which remains in the fabric after treatment with Javelle water. Rinse thoroughly. Oxalic-acid solution may be used instead of the thiosulphate but is not so satisfactory.

If allowed to remain too long in contact with the fibers, Javelle water rots even linen and cotton materials. It should therefore always be followed very promptly by a solution of thiosulphate and the fabrics rinsed thoroughly to remove all traces of the chemical. With persistent stains Javelle water and thiosulphate to neutralize it, may need to be applied several times. Commercial ink removers are similar in action to Javelle water and are very convenient for removing stains as well as ink spots.

Potassium permanganate

Potassium permanganate can be used in removing certain stains from all white fabrics except rayon. One or more repetitions of the treatment may be necessary in the case

of persistent stains. Potassium permanganate may also be used successfully upon many colored materials but should always be tried first on an unexposed portion of the goods in order to determine its effect on the dye. As it may harm delicate fibers, it should be used with great care. Prepare and use the permanganate as follows: Dissolve 1 teaspoon of the crystals in 1 pint of water and apply a little of this to the stain with a medicine dropper, a glass rod, or a clean cork, and allow it to remain for about 5 minutes. Remove any pink or brown stain left by the permanganate by applying one of the following chemicals:

Hydrogen peroxide, made very slightly acid (if not already so) with hydrochloric, acetic, oxalic, or tartaric acid. This treatment is suitable for wool. Follow by thorough rinsing.

Oxalic acid (poison) in saturated solution or lemon juice for cotton, linen, or silk. Follow by thorough rinsing.

HYDROGEN PEROXIDE

Hydrogen peroxide, as obtained for medical purposes, has usually been made slightly acid to give it better keeping quality. For use in removing stains make a small quantity of the peroxide slightly alkaline with ammonia solution. Since hydrogen peroxide affects the fiber also, in the case of cotton and linen materials, follow it by very careful rinsing. Apply it to the stain with a medicine dropper, a glass rod, or a clean cork, or sponge the stain with it. The method of using it in connection with potassium permanganate is described above.

OXALIC ACID

Oxalic acid is poisonous and should be used carefully. The bottle in which it is stored must be marked "Poison" and kept out of the reach of visitors. To prepare a solution, dissolve as many of the crystals of the acid as possible in a pint of lukewarm water. Put into a bottle, stopper tightly, and use as needed. Apply this solution to the stain with a medicine dropper or glass rod and after allowing it to remain for a few minutes, rinse thoroughly in clean water. Neutralize with a solution of ammonia.

HYDROSULPHITES

Hydrosulphites are perhaps the most generally useful bleaching agents for stain removal, sodium hydrosulphite usually being employed. Stable forms are available under many trade names. They should be kept dry in tightly closed cans and not moistened until ready to use. The powder may then be moistened and worked directly onto the stain with the fingers, or it may be dissolved in water and the fabric wholly or partially immersed in the warm solution. These compounds are particularly useful in removing dye which has stained the fabric and are effective on almost all stains which are not greasy in nature. They cannot be used on colored material unless the treatment is very rapid and the fabric well rinsed as soon as the stain is removed. Even under such conditions, the color of the fabric is often removed with the stain.

GENERAL METHODS OF TREATING STAINS

Sponging With Water or Other Solvent

If the nature of the stain is not known and it does not appear to be greasy, sponging with a wet cloth may be effective. However, it is always well to try the action of water on some inconspicuous part of the material unless it is definitely known that the fabric will not water spot or the color be affected.

Spread the article on a flat surface in a good light. Lay the stained material with the wrong side up and apply the liquid to the back, so that the foreign substances can be washed from the fibers without having to pass through the material. A cloth folded several times to form a pad, or, better, a clean piece of blotting paper may be placed under the stain to absorb the superfluous liquid. Change the pad or paper occasionally as it becomes soiled. Sponge with a clean, soft, lintless cloth which has been dipped in the liquid and wrung until partially dry. Do not have the cloth excessively wet. Use light brushing motions, spreading the moisture irregularly into the surrounding fabric in order to prevent rings.

Application of Chemicals

Chemicals should not be used until after water has been tried, unless it is definitely known that water will not remove the stain or that the fabric is unsuitable for water treatment. There is always danger that chemicals will attack the fiber.

However, there are a few common chemicals which are necessary to remove some stains. As some are poisonous, they should be known and treated as such. Chemicals most commonly used in removing stains are Javelle water, potassium permanganate, oxalic acid, ammonia water, and carbon tetrachloride. The utensils needed are a medium-sized bowl, a medicine dropper, a glass rod with rounded ends, several pads of cheesecloth or old muslin, a small sponge, and sheets of white blotting paper.

Work rapidly when using chemicals to remove stains, so as to give them as little time as possible to act on the textile fibers. Many brief applications of the chemicals, with rinsing or neutralizing after each application, are preferable to allowing them to remain on the stain for a long time.

Stretch the stained portion of the cloth over a bowl of clean water and apply the chemical with a medicine dropper. The chemicals may be rinsed out quickly by dipping in the clean water. Another method is to place the stained portion over a pad of folded cloth and apply the chemical with a glass rod. The neutralizing must be thorough, and should be followed by rinsing in several changes of water.

The chief difficulties encountered by the inexperienced are ring formation and roughening of the fabric. Rings are caused by the excess dressing of the fabric which runs back into the edge of the damp portion and is deposited there as the fabric dries. They are overcome by skill in handling. After a spot is removed it is well to go over it lightly with a moist sponge or cheesecloth, absorbing the surplus liquid and barely dampening the surrounding fabric enough to spread the dressing out in an irregular, indistinct line. It is sometimes helpful to go over the spot with a piece of cheesecloth moistened in alcohol. Do not have the cloth too moist, as some colors are affected by alcohol. Rapid drying is always a wise precaution in all cases of stain removal where there is danger of ring formation. An electric fan can be used to good advantage or the object may be hung where a good breeze strikes it. If it is impossible to prevent rings by these methods, it may be necessary to wash the specimen or to dip it in Stoddard solvent, carbon tetrachloride, or benzol. This dip is the remedy generally used by commercial cleaners.

A roughened fabric is due, of course, to too hard and too much rubbing. Only practice can bring the light touch which is part of the skill of an experienced cleaner. The use of a medicine dropper as described is a great advantage.

METHODS OF TREATING INDIVIDUAL STAINS

In cases where the nature of the stain is not known it should be first sponged with cold water, provided that the fabric is not injured by water. Hot water should be avoided in

treating unknown stains until after other substances have been tried, since it will set many stains and make their removal more difficult. If the stain is not removed by cold or warm water, chemicals should be applied.

Acids

With the exception of nitric acid, acids do not generally produce stains upon white fabrics but often even in dilute form change or destroy the color of dyed materials. Most acids do, however, dissolve or weaken textile fibers, especially those from plants. Acid spots on textiles, therefore, should be removed at once by water or neutralized by some alkaline solution. Use one of the following:

1. *Water.*—If the material is washable, rinse the spot several times in a large volume of water. This checks the action of the acid, but usually has no effect upon any discoloration due to it.

2. *An alkaline substance.*—Apply a weak alkali to the acid spot. The alkali forms a salt with the acid, and this must be removed later by rinsing or sponging with water. The acid should be neutralized completely with the alkali or the discoloration may reappear after a while. To determine when the acid spot is completely neutralized, touch it with a piece of litmus paper, moistened with pure water. Litmus paper is turned red by acids and blue by alkalis. If litmus paper is not available, touch the spot with the tongue. If alkaline, it will taste bitter; if acid, it will taste sour. Any of the following may be used to neutralize an acid spot:

Ammonia. If the spot is slight, neutralize it by holding it in the fumes from an open bottle of strong ammonia solution. This is a good method to use if the fabric waterspots easily; otherwise the ammonia solution may be applied directly. However, some dyes are affected by ammonia. To guard against this, have dilute acetic acid or white vinegar convenient and apply if there is an undesirable color change.

Sodium bicarbonate (baking soda). Sprinkle this on both sides of the stain, moisten with water, and allow to stand until the acid is neutralized (at that point the effervescence will cease). Remove the excess by rinsing with water.

Ammonium carbonate. Apply in the same way as sodium bicarbonate or use a 10 percent solution.

Alkalis

Dilute alkalis have little effect on cotton and linen, but strong alkalis cause the fibers to swell and become yellow and the cloth to contract. Wool and silk, on the other hand, are yellowed or destroyed by alkalis even in dilute solutions. The color of any fabric may be changed or destroyed even though the fiber is not noticeably affected by the alkali. It is important, therefore, to neutralize alkali spots at once. Use any of the following agents:

1. *Water.*—If the material is washable, rinse thoroughly with water. This is generally fsufficient in the case of such alkalis as washing soda and ammonia.

2. *A mild acid.*—Apply the acid with a cloth until the fabric changes back to its original color, or until the stain is slightly acid as shown by its reaction to litmus paper or by the taste. Then rinse the treated spot thoroughly in water. In the case of colored goods rub the spot dry, using a piece of the same material as the stained fabric, if possible. Use any of the following mild acids:

Lemon juice. Squeeze the juice on the stain. As long as the spot remains alkaline the juice is bright yellow in color, but when the spot becomes acid the color disappears almost entirely. Apply the lemon juice until this color change takes place.

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Vinegar. If the vinegar leaves a spot, sponge with water.

Acetic acid. Apply a 10 percent solution of acetic acid to the stain and remove the excess by rinsing or sponging.

Blood

Hot water will set the protein in bloodstains and therefore should never be applied until after treatment with cold or lukewarm water. Use any of the following agents:

1. *Cold or lukewarm water.*—If the material is washable, soak the bloodstains or rub them in the water until they turn light brown in color; that is, until most of the coloring matter is dissolved. Then wash the material in hot water. For stains on silk or wool, sponge with cold or lukewarm water.

2. *Ammonia solution.*—If the material is washable, soak in a solution containing about 1 ounce (2 tablespoons) of household ammonia to 1 gallon of water, until the stains are loosened. Then wash in the usual manner. For old stains ammonia is somewhat more satisfactory than soap.

3. *Hydrogen peroxide.*—Sponging with a little hydrogen peroxide often will remove the last traces of bloodstains after the main part has been removed by cold or lukewarm water, as described above. This agent can be used on all fibers provided it does not injure the color of the material.

4. *Javelle water.*—Use Javelle water only as a last resort and not on wool or silk.

5. *Starch.*—Raw starch mixed to a paste with cold water may be used for stains on thick materials, such as flannel and blankets, which cannot conveniently be soaked in water. Apply the paste thickly to the stain and brush it away when it becomes dry. Repeat the application until the stain is removed.

Butter and Butter Substitutes

Stains from butter and butter substitutes are essentially grease spots, although they contain, besides the fat, small quantities of salt, casein, and sometimes coloring matter. Since the salt and casein usually are carried away mechanically when the fat is removed, the reagents and methods for removing butter spots are the same as for spots from any solid or semisolid fat. The coloring matter is also removed by the grease solvents.

Candle Wax (Colored)

Candle-wax stains usually consist of paraffin colored with pigment or dye, in modern candles. Beeswax and bayberry wax may be found in old candles. Remove the paraffin or wax as completely as possible. Then dissolve the dye remaining on the fiber by sponging with wood alcohol. These also are effective: Carbon tetrachloride, chloroform, acetone, or benzol.

Candy

Candy stains are due to the sugar sirup and any coloring matter or chocolate which may be present.

1. *Laundering.*—If the material is washable, ordinary laundering is sufficient.

2. *Water.*—Sponge with clear warm water in other cases.

Chewing Gum

Chewing gum usually contains a gum known as chicle which has been boiled down, flavored, and sweetened. Resins of various kinds may replace the chicle.

1. *Water.*—If the material is washable, soften the gum stain with egg white and then wash.

2. *Carbon tetrachloride.*—Prolonged treatment with carbon tetrachloride is usually satisfactory, although it may be necessary to remove the traces of sugar by sponging with water. Treatment alternately with carbon tetrachloride and water is often effective.

Chocolate and Cocoa

Stains from chocolate and cocoa are composed of fat, resinous coloring matter, fibrous material, starch, sugar, and sometimes milk solids. Chocolates and cocoa prepared as beverages differ from cake chocolate in containing a larger porportion of milk and less fat, but none of these stains are set by hot water. Part of the stains from cake chocolate, confectionery, frosting, and the like can be scraped off with a dull knife.

1. *Soap and hot water.*—If the material is washable, this if often all that is necessary, but Iavelle water may be used on cotton or linen to remove any persistent stain.

2. *Wood alcohol and ammonia.*—Soak the stained portion of the fabric in wood alcohol made alkaline with ammonia solution. This is a particularly effective method.

3. *Grease solvents.*—If the fabric is not washable, grease solvents will dissolve the fatty contents of the stain and the remainder can be removed by hydrogen peroxide.

Coffee

The brown stains from coffee are due, at least in part, to certain compounds formed in the roasting process, which are soluble in water. Alkalis, such as soap, Javelle water, washing soda, ammonia, and the caustic alkalis, change the color of coffee stains to a bright yellow. The stains are not more difficult to remove after this change, although the treatment with alkali may cause a stain to appear much more distinct than before. Fresh coffee stains usually are not difficult to remove, but the last trace of old stains sometimes proves resistant. Cream in the coffee often necessitates the use of grease solvents in addition to other reagents. If the fabric is washable, use method 1, 2, 3, or 4; if not washable, use method 5, 6, or 7.

1. *Soap and water.*—Fresh stains and most old ones on washable materials can be removed by ordinary laundering. A slight trace sometimes remains in the case of very heavy or old stains. Drying the material in the sun will frequently remove these or a bleaching agent may be employed.

2. *Boiling water.*—Pour boiling water on the stain from a height of 2 or 3 feet. This is effective upon stains which are not more than a few hours old.

3. *Potassium permanganate.*—See previous reference.

4. *Javelle water.*—This agent is effective in some cases in removing stains which remain after treatment with soap and water but is less satisfactory than potassium permanganate. Do not use Javelle water on wool or silk.

5. *Cold or lukewarm water.*—If the stains are on wool or silk material, sponge with cold or lukewarm water. If a grease spot from the cream remains after the spot has dried, remove it by the use of grease solvents.

6. *Damp cloths and a hot iron.*—Fairly good results are obtained in removing small coffee stains from light-colored silk material by placing the stain between clean, damp cloths and pressing the whole with a hot iron.

7. *Hydrogen peroxide.*—Sponge nonwashable materials with a very little clear water and then use hydrogen peroxide solution.

Dyes and Running Colors

As the dyes of textiles differ greatly in chemical composition and as it is impossible in most cases to know the character of the color, different methods must be tried, begin-

ning with the simplest. It is impossible to remove some of these stains entirely. Each of the agents named below is satisfactory in some cases, but it should be remembered that they are not guaranteed to be successful for all stains.

1. *Water and sunlight.*—If the material is washable, rinse the stains in cold or warm water, or soak them for 10 to 12 hours if necessary, and then dry in the sun. Repeat the treatment if the stains are not removed entirely the first time. Spots on woolen and silk materials sometimes may be removed by soaking or washing in cold water.

2. *Hydrosulphite.*—One of the hydrosulphites is the most satisfactory for general purposes.

3. *Hydrogen peroxide.*—Soak stains on white wool or silk in hydrogen peroxide made slightly alkaline with ammonia solution. Rinse thoroughly after stains disappear.

Egg

The chief constituents of egg stains are albumen, or egg white, and fat, of which the yolk contains about 33 percent. A yellow pigment is also present in the yolk. Heat, which coagulates albumen, renders egg stains somewhat difficult to remove; therefore hot water should never be applied first. Sometimes a large part of the stain hardens on the surface of the material and may be scraped off with a blunt knife. Use cold water followed by one of these agents:

1. *Hot water and soap.*—If the material is washable, use these as in ordinary laundering.

2. *A grease solvent.*—Allow the stained place to dry after being sponged with cold water; then apply grease solvent.

Fly Paper (Sticky)

See Resins and resinous substances. Carbon tetrachloride and benzol are particularly effective.

Fruits and Berries (Cooked)

Stains of cooked fruits, including small fruits and berries, are somewhat different in character from those of the same fruits when fresh. More sugar usually is present, and the chemical nature of the tannin compounds and coloring matters apparently is altered in some way by the cooking. In many cases these changes render the stains much easier to remove than those of fresh fruit, and they often disappear during ordinary laundering. Stains from some cooked fruits, however, especially those that are dark red and purple, are similar to those from fresh fruit in being set by alkaline substances. Use one of the following agents:

1. *Boiling water.*—If the material is washable, use method 1 under "Fruits and berries (fresh)."

2. *Warm water.*—Sponge delicate fabrics with warm water.

Fruits and Berries (Fresh)

Most fruits contain coloring matter which often causes persistent stains on textiles. Practically all fruit stains, when they are fresh and still moist, can be removed with boiling or even warm water. After they have dried they become much more difficult to remove. This is true especially of stains from peaches and red or purple berries. Such stains in many cases are set by soap and other alkaline substances, the red color changing to a green or blue and becoming much more resistant to treatment. Some fruit stains may safely be attacked with soap and water; but as the majority are set by alkalis, it is better to avoid the use of soap on all fresh-fruit or berry stains.

The citrus fruits, such as grapefruit and lemon, often produce very persistent stains.

These develop markedly if the fabric is pressed with a hot iron before being washed. Although such stains are sometimes removed by ordinary laundering, bleaches may be necessary. Potassium permanganate is particularly effective. The color of some materials may be affected by the acids present in fruits such as these. However, the color can generally be restored by the methods used for acid stains.

Fresh fruit stains are more difficult to remove from silk and wool fabrics, although the stable hydrosulphites are valuable agents if the material is white. Oxalic-acid solution can also be used on such white fabrics. Sponging with a 10 percent solution of acetic acid is sometimes helpful when stronger chemicals cannot be used on very delicate colored fabrics. Stains remaining on silk or wool (white or dyed with fast colors) after sponging with warm water frequently can be removed with a little hydrogen peroxide, made slightly alkaline with ammonia.

1. *Boiling water.*—If the stain is on white or fast-colored washable material, stretch the stained material over a bowl or other vessel, hold it by a string or an elastic band, if necessary, and pour boiling water upon it from a teakettle held at a height of 3 or 4 feet, so that the water strikes the stain with some force. With some stains, especially those in which fruit pulp is present, a little rubbing alternated with applications of boiling water is helpful. A stain remaining after this treatment oftentimes can be bleached out by hanging the wet material in the sun to dry.

2. *Lemon juice and sunlight.*—Stains remaining after treatment with boiling water can often be bleached by moistening with lemon juice and exposing to the bright sunlight.

3. *Acetic or oxalic acid.*—A stain which turns blue or gray and cannot be removed readily by boiling water sometimes can be loosened by moistening with acetic acid (10 percent solution) or oxalic acid. This restores its original color and renders it more easily soluble in the boiling water. If necessary, apply the acid several times, alternating with boiling water.

4. *Hydrosulphites.*—Stable hydrosulphites are very satisfactory for removing fruit stains from any white fabrics.

5. *Javelle water.*—Javelle water is effective for white cotton or linen materials.

6. *Potassium permanganate.*—May also be tried with caution.

7. *Potassium acid oxalate.*—Treat the stains with boiling water and then boil them in the acid oxalate solution. A 3 percent solution made by diluting a saturated solution (which contains about 6 percent of the oxalate at ordinary temperature) with an equal volume of water is satisfactory.

Glue

Glue is soluble in water, but if it has become thoroughly dried, long soaking is necessary before it becomes soft enough to dissolve completely. Use one of the following agents in removing glue spots:

1. *Water.*—If the material is washable, soak the spot in warm water. Occasionally it is necessary to boil the stained material.

2. *Acetic acid.*—Sponge the spot with dilute acetic acid using absorbents such as clean blotters or a pad of soft cloth. White vinegar may be used instead of the acid but is not always so satisfactory.

Grass and Other Fresh Green Foliage

The green stains from grass or fresh foliage are due to chlorophyll, the coloring matter present in green plants. Use one of the following agents in removing stains of this character:

1. *Hot water and soap.*—If the material is washable, use hot water and soap as in ordinary laundering, rubbing the stain vigorously. Remaining traces may be bleached out with Javelle water if the material is cotton or linen, or potassium permanganate. These bleaches will remove the dark brown stains caused by the juice of the dandelion.

2. *Ether, grain, or wood alcohol.*—Apply by sponging. This is useful on fabrics that laundering might injure.

Grease and Oils

Fresh grease spots may consist of the pure fat or oil. Old grease spots or stains from automobile, wheel, or machine greases, usually contain more or less dust, dirt, or fine particles of metal. Sometimes it is possible to scrape or wipe much of the adhering grease from the stained material. After this has been done there is a choice of three general methods of treating the stain itself: Wash it with soap and warm water to remove the grease; absorb the grease with dry substances; or dissolve the grease in an organic liquid. Use one of the following agents:

1. *Warm water and soap.*—Grease spots usually can be removed from washable materials with warm water and soap as in ordinary laundering if care is taken to rub the particular spot thoroughly. Soaps containing naphtha or kerosene are efficient.

2. *Absorbents.*—Use blotting paper, fuller's earth, brown paper, French chalk, powdered magnesia, or white talcum powder for fine materials; corn meal or salt for carpets, rugs, and other coarse materials. The use of absorbents generally is effective only on spots of grease or oil unmixed with particles of dirt or metal. The advantages of using them are that they do not wet the fabric or leave rings as often happens when water or grease solvents are employed.

3. *Organic solvents.*—Carbon tetrachloride, chloroform, ether, Stoddard solvent, and benzol are effective in the removal of common grease and cedar and other vegetable oils. Carbon tetrachloride is best for removing cod-liver oil, although a bleaching agent may also be necessary if these stains are old.

Place a pad of clean cloth or a white blotter beneath the stain and change it as soon as it becomes soiled. Sponge the stain with a clean cloth, preferably a piece like the stained material, moistened with the solvent. To prevent the spreading of the grease and solvent it is best to use small quantities of the solvent at a time and to work from the outside of the spot toward the center. It is well also to surround the stain with a ring of French chalk or other absorbent mentioned in method 2. After applying the solvent rub the spot with a clean cloth until it is thoroughly dry.

In removing grease spots which contain dirt or fine particles of metal, more rubbing and a larger quantity of solvent are necessary. It is best to apply the solvent from the wrong side of the material so that the particles will be washed mechanically from the fibers onto the pad of cloth placed underneath. If the spot does not yield to this treatment, immerse it in a small bowl of the solvent, and brush it gently with a small, soft brush. The brushing serves to loosen the insoluble particles, which then fall to the bottom of the bowl.

Generally if the stained place must be dipped in the solvent, it is more satisfactory to immerse the whole article finally in clean solvent, which prevents the formation of rings. If sufficient solvent is not at hand for this, the ring usually can be removed by careful and patient sponging with small quantities of fresh solvent. Replace the cloth, pads, or blotter often as suggested above, and work from the wrong side of the material.

A paste made by mixing the solvent with French chalk, magnesia, or other white absorbent is often used. Spread the paste over the spot, leave it until thoroughly dry, and

brush it off. Repeat this treatment if necessary. The spreading of the solvent and the formation of a ring will be avoided to a considerable extent in this way. The method is especially useful for cleaning light-colored unwashable materials, laces, and the like.

Ink

INDIA INK

Genuine India ink is finely divided carbon mixed with gum and formed into a cake which, when used, is rubbed up with water. Drawing inks often contain shellac and borax in addition to the gum. Finely divided carbon or colored pigments may be added. If these have penetrated the fabric deeply they are impossible to remove completely. Wood or grain alcohol, glacial acetic acid, chloroform, or benzol (try in the order named) are helpful in dissolving the waterproofing ingredients and mechanically removing the carbon.

MARKING INK

So-called indelible or marking inks are of two common types: those with an organic dye, usually aniline black, as a basis, and those containing silver nitrate or other silver compound.

Ink of the aniline-black type may be recognized by the directions for its use, which generally state that the articles marked with it must not be ironed until after they have been washed. Aniline-black inks are remarkably fast, and it is practically impossible to remove them after they have once become dry. None of the methods given for the removal of silver-nitrate ink stains are effective on aniline-black ink stains, nor do most of the methods used for ordinary writing-ink stains give satisfactory results.

Ink of the silver-nitrate type may also be recognized generally from the directions for its use, which state that articles marked with it must be laid in the sun or pressed with a warm iron before they are washed. This is to bring about the precipitation of metallic silver, which gives the black or brown color to the marks. Use one of the following agents in removing stains from silver-nitrate inks:

1. *Iodine and sodium thiosulphate* ("*hypo*").—Moisten with a few drops of tincture of iodine, sponge out, and then remove with a solution of sodium thiosulphate made by dissolving several crystals in one-half cup of water.

2. *Corrosive sublimate* (*poison*).—A dilute solution of this chemical is very effective, but it is so poisonous that its use is not recommended unless extra precautions are taken to keep it from the fingers and to remove all traces of it from the vessels used.

3. *Javelle water.*—If the stain is on white cotton or linen, Javelle water may be applied repeatedly until the color of the spot disappears. Then soak the stained place in ammonia solution to remove the silver chloride formed.

PRINTING INK

The coloring matter of black printing ink consists of finely divided carbon, usually in the form of lampblack. This is suspended in linseed oil with resin, turpentine, etc. Colored printing inks are obtained by adding colored pigments instead of carbon. Stains from ink of this type are very similar to paint stains. Use one of the following agents for removing printing-ink stains:

1. *Soap and water.*—If the material is washable, fresh stains may be removed by applying an abundance of soap and water and rubbing thoroughly.

2. *Lard.*—Rub the stained place with lard and work it well into the fibers. Follow with soap and water, as in method 1.

3. *Turpentine.*—Soak for a few minutes in turpentine and then sponge out with chloroform, ether, or alcohol.

WRITING INK

The coloring matters commonly used in writing inks include the following: Combinations of logwood or nutgalls with ferrous or ferric salts or with salts of other metals; aniline dyes, which are used either alone or with coloring matters of the type mentioned above; finely divided carbon in the form of lampblack. Colored inks are usually solutions of aniline dyes. Gums, sugar, or glycerin often are added to thicken an ink and hold the coloring matter in suspension, and phenol may be used to keep it from molding.

On account of the differences in the composition of writing inks, it is impossible to find agents which are equally effective in removing all ink spots. Each of the agents mentioned below is satisfactory with some type of ink. For an ink spot of unknown composition, it is necessary to try various agents, beginning always with the simplest and that least likely to injure the fabric.

If the ink has been spilled on the carpet, first apply absorbents as in method 1. These are more satisfactory than the following methods which will remove the color from the carpet unless used very carefully. Try repeated applications of oxalic acid (method 4) or potassium permanganate (method 6), or rub with the cut surface of a lemon, squeezing on the juice and rinsing between applications with a clean, wet cloth until no more ink can be removed. Rub the spot then with a clean, dry cloth. For ink stains on other fabrics, use one of the following:

1. *Absorbents.*—To a moist stain apply corn meal, salt, French chalk, fuller's earth, magnesia, or talcum powder to remove any ink not absorbed by the fibers and to keep it from spreading. For a large ink spot, apply one of these substances before trying other agents. Work the absorbent around with a blunt instrument and renew it when it becomes soiled. When the dry absorbent fails to take up more ink, make it into a paste with water and apply again.

2. *Soap and water.*—If the fabric is washable, soap and water as in ordinary laundering is satisfactory for some types of ink.

3. *Milk.*—Soak the stains for a day or two, if necessary, changing the milk as it becomes discolored. Pasteurized milk usually is not so satisfactory for this purpose as milk that has not been heated.

4. *Oxalic acid.*—Soak the stains for a few seconds in a saturated solution of oxalic acid, then rinse in clear water, and finally in water to which a few drops of concentrated ammonia solution have been added.

5. *Potassium acid oxalate.*—Soak the stains for several hours, if necessary, in a solution of 2¼ teaspoons of potassium acid oxalate dissolved in one-half pint of water.

6. *Potassium permanganate.*—Potassium permanganate is satisfactory for stains on many delicate fabrics as well as on ordinary materials.

7. *Javelle water.*—Do not use Javelle water on silk or wool.

8. *Commercial ink removers.*—These are generally satisfactory if the directions furnished with them are followed and the excess of the substance is removed by thorough rinsing in clean water.

9. *Hydrogen peroxide.*—May be applied but should be immediately rinsed out to prevent change in color of fabric.

10. *Acids.*—Citric or tartaric acid (2 tablespoons to one-half cup of water), lemon juice, or dilute hydrochloric acid may be used. Apply the citric or tartaric acid in the

same way as oxalic acid, method 4. In the case of lemon juice, keep the stain moistened and exposed to the sun. In the case of hydrochloric acid, moisten the stain with it and then rinse thoroughly.

Iodine

Iodine dropped on unstarched material makes a brown or yellow stain. The presence of starch causes the stain to become deep blue or black, and the heat of ironing sometimes turns it a dark brown.

1. *Soap and water.*—If the material is washable, soap and water will often remove a fresh stain.

2. *Denatured or wood alcohol.*—Sponge the material. This agent can often be used on materials which water would injure.

3. *Ammonia solution.*—Sponge the stain with a dilute solution of ammonia.

4. *Sodium thiosulphate* ("*hypo*").—Immerse the stains in a solution containing 1 tablespoon of this chemical to 1 pint of water.

5. *Sodium sulphite.*—Apply in same way as sodium thiosulphate.

Iron Rust

Use one of the agents below for iron-rust stains on white washable materials. In the case of colored materials, try the effect of the agent first on a sample or in an inconspicuous place.

1. *Lemon juice.*—Spread the stained place over a vessel of actively boiling water and then squeeze lemon juice on the stain. After a few minutes, rinse the fabric, and repeat the process. This method is rather slow, but does not injure delicate white cottons or linens.

2. *Lemon juice and salt.*—Sprinkle the stain with salt, moisten with lemon juice, and place in the sun. Add more lemon juice if necessary.

3. *Potassium acid oxalate.*—Immerse the stain in a solution of one-half teaspoon of potassium acid oxalate to 1 pint of water. More crystals may be added if necessary. Boil until the stain disappears, and then rinse thoroughly.

4. *Oxalic acid.*—Prepare a saturated solution of oxalic acid, spread the fabric over a bowl of hot water and apply the solution to the stains, or put the crystals of the acid directly on the fabric and moisten with hot water. Rinse in hot water, and repeat until the stains disappear.

5. *Tartaric acid.*—Boil the stained place in a solution of 1 teaspoon of the acid to 1 pint of water until the stain disappears, and rinse thoroughly.

6. *Cream of tartar.*—Boil the stained place in a solution containing 4 teaspoons of cream of tartar (potassium acid tartrate) to 1 pint of water. Rinse thoroughly.

7. *Citric acid.*—Immerse the stain in a solution of 1 teaspoon of citric acid to 1 pint of water and boil for 15 minutes or longer. Rinse thoroughly.

8. *Hydrochloric acid.*—Dilute the strong acid (U. S. P.) with four times its volume of water. Spread the stained place over a bowl of hot water and apply the acid drop by drop until the stain turns bright yellow. Then immerse at once in hot water and rinse thoroughly. Repeat the treatment if necessary. Add a little ammonia solution or borax to the last rinse water to neutralize any acid which may remain in the fabric.

9. *Hydrofluoric acid.*—This acid and its salts are excellent agents for this purpose but are so corrosive that they must be employed and handled with a great deal of care. Many of the commercial rust-stain removers contain such substances, and it is often better to

purchase them in that form. Unless the cloth is reasonably new and of no historic value, it is desirable not to go beyond the use of lemon and salt.

Leather

The stains caused by the rubbing of leather on textiles probably contain tannin compounds and are difficult to remove.

If the fabric is washable and capable of withstanding the treatment, use an abundance of soap and rub thoroughly.

Lime (Slaked)

Allow the spots to dry, brush carefully, and treat in the same way as alkali stains.

Linseed Oil

Organic solvents, such as acetone, carbon tetrachloride, and benzol, are very effective.

Meat Juice or Gravy

Stains from meat juice are similar to those from blood. Boiling water sets them and should not be used until the protein has been removed by cold water.

Medicines

Because of the great number and variety of substances used in medicines, it is not possible to give methods or materials for removing all medicine stains from fabrics. If the nature of the medicine is known, the remover can be chosen accordingly. For instance, a tarry or gummy medicine can be treated with the same agents as tar spots; a medicine containing much iron can be removed by the agents used for iron rust; medicines in a sugar sirup usually can be washed out with water; those dissolved in alcohol sometimes can be removed from fabrics by sponging with alcohol. Many of the medicines used in swabbing sore throats contain silver nitrate and should be treated like the marking inks containing silver nitrate. If the nature of the medicine stain is not known, it is necessary to try various agents until one is found which serves the purpose. Each of the following agents is satisfactory in removing some medicine stains:

1. *Boiling water.*—Pour boiling water on the stain as for fruit stains, or launder washable fabrics.
2. *Acids.*—Dilute solutions of hydrochloric or oxalic acid sometimes are useful for stains containing metallic salts.
3. *Wood or grain alcohol.*—Some stains can be sponged or soaked out with alcohol.
4. *Javelle water.*—Javelle water sometimes bleaches a stain that resists other treatment, but should not be used on silk or wool.

If the article is valuable, it is best to stop with water and saponin; the other methods are too drastic on old fabrics.

Metallic Stains

The tarnish of copper, brass, and other metals often stains textile materials. In removing such stains avoid the use of oxidizing agents such as bleaching powder and potassium permanganate. The following is usually effective:

Apply dilute acetic acid, hydrochloric acid, vinegar, or lemon juice. Rinse well as soon as the stain has dissolved.

Mildew

Mildew spots are growths of some species of molds on fabrics that have been allowed to remain damp for a time. The spots may be of various colors but often are grayish

green, brown, or almost black. The growth of mildew is merely upon the surface of the material at first, but if allowed to continue it attacks and destroys the fiber itself. The spots must be treated when fresh if injury to the fabric is to be avoided. Use one of the following agents:

1. *Soap and water.*—If the fabric is washable, very fresh stains can be washed out with soap and water. Drying in the sun helps to bleach the spots.
2. *Sour milk.*—Soak the stains overnight in sour milk and then place in the sun without rinsing. Repeat the treatment several times if necessary. Slight stains can be removed in this way.
3. *Lemon juice.*—Moisten the stains with lemon juice and salt and allow them to remain in the sun. This often removes slight stains.
4. *Javelle water.*—Old stains may be bleached out with Javelle water, but it should never be used on silk or wool.
5. *Potassium permanganate.*—Old and persistent stains may also be removed with potassium permanganate.
6. *Oxalic acid.*—A 10 percent solution of oxalic acid will remove some forms of mildew.

Milk and Cream

Milk stains consist chiefly of protein and fat. For removing these use one of the following:

1. *Cold or lukewarm water.*—If the material is washable, rinsing in cold or lukewarm water followed by hot water and soap is generally sufficient.
2. *Grease solvents.*—Use carbon tetrachloride, acetone, gasoline, or other grease solvent. For fabrics which ordinary laundering would injure, first sponge with the solvent, allow the spot to dry, and then sponge carefully with water. If allowed to remain in the cloth for a long time the fat probably will become rancid and harder to remove by safe methods.

Mud

Allow mud stains to dry and brush carefully before any other treatment is used. Sometimes nothing else is needed. The following agents are satisfactory:

1. *Soap and water.*—If the fabric is washable, use soap and water or water alone.
2. *Wood or grain alcohol.*—Sponge the stains with alcohol.
3. *Cut raw potato.*—For black silks of firm weave, brush thoroughly and rub the spot with a cut raw potato. This leaves a thin film of starch on the surface of the cloth, which can be brushed off when dry. This treatment is too harsh for any but rather smooth, firm goods and leaves a spot on all but black materials.

Paints

Oil Paints, Varnishes, and Enamels

Oil-paint stains generally consist of a finely divided inorganic pigment, held in the fiber by drying oil. Varnish spots contain gums or resins, but usually no pigment. Enamels and some types of wood stains, generally known as varnish stains, contain both a pigment and the gums or resins of varnish. The hardening or drying of both paint and varnish stains forms a resinous solid which holds the pigment or gum firmly within the fibers and renders the removal of old stains almost impossible. Before using any agent on paint or varnish stains, it is best to scrape off as much of the stain as possible from the

surface of the material. If the stain has hardened, apply the solvent on both sides and give time for it to soften. Excessive rubbing roughens the fabric. Methods 1, 2, and 3 are for fresh stains. For those that have hardened but have not oxidized in the fiber, methods 4, 5, and 6 are more suitable.

1. *Soap and water.*—If the material is washable, fresh stains are removed easily by carefully washing with plenty of soap. Older stains sometimes can be removed in this way if they are first softened by rubbing oil, lard, or butter into them thoroughly.

2. *Turpentine.*—Sponge the stains with pure turpentine or wash the whole article in it, if the spots are large or scattered. Rinse several times in fresh quantities of the solvent.

3. *Turpentine and ammonia.*—Stains which are not fresh and yet have not entirely hardened can be softened by moistening them with ammonia solution and sprinkling them with a little turpentine. Roll the article up for 15 or 20 minutes, or soak it for several hours, if necessary, and then wash with warm water and soap.

4. *Oil solvents.*—Carbon tetrachloride, chloroform, or benzol, applied in the same way as turpentine, are satisfactory. Gasoline, kerosene, and alcohol are helpful but usually less effective.

5. *Benzol and acetone.*—Benzol and acetone used in equal parts make a very good paint remover. Equal parts of benzol, acetone, and alcohol also make an excellent solvent. Benzol is a good solvent for the usual type of spar varnish, and wood alcohol will remove stains of shellac varnish.

6. *Sodium carbonate (washing soda).*—Boil the stains in a solution containing 3 tablespoons of washing soda to 1 gallon of water. This is successful for such fabrics as will stand the treatment.

ALCOHOL PAINTS OR STAINS

In paint of this type a pigment is suspended in alcohol with small quantities of shellac and other resinous material. The methods of removing it from fabrics differ somewhat from those for ordinary paint stains. Treatment with turpentine alone or with other oil solvents, which usually will remove ordinary paint stains, is ineffective. Use one of the following agents:

1. *Soap and water.*—If the material is washable, use for very fresh stains.

2. *Wood or grain alcohol.*—If the stains are fresh, sponge them freely with alcohol.

3. *Strong ammonia.*—Soak the stain for half an hour in strong ammonia and then wash, or use ammonia and turpentine.

WATER-COLOR PAINTS

Water-color paints consist essentially of a pigment mixed with some substance which is soluble in water, such as glycerin. These stains are easy to remove from washable fabrics, but from materials like finished silks it is almost impossible to get out all traces. The appearance of the spots may be improved greatly, however, by method 2, 3, or 4.

1. *Soap and water.*—If the fabric is washable, both fresh and old stains can be removed in this way.

2. *Turpentine and benzol.*—Sponge the stained portion with turpentine until the water color is removed and then with benzol, if necessary, to remove the turpentine.

3. *Gasoline.*—Dip the stained portion in gasoline and rub vigorously, but *see* page 130.

4. *Glycerin and water.*—Sponge the stain with glycerin until the water color is removed and then with lukewarm water to remove the glycerin. In case a ring is left, treat as described under "Application of Chemicals."

Paraffin or Paraffin Wax

The stains from paraffin do not spread like ordinary grease spots, but harden on the cloth, and much of the stain usually may be scraped away. For colored paraffin, *see* "Candle wax (colored)." For removing the part of the paraffin stain which has penetrated the fiber, use one of the following agents:

1. *Blotting paper.*—Use blotting paper and a warm iron.
2. *A grease solvent.*—If a trace of the stain remains after treatment by method 1, sponge the stain carefully with a solvent.

Pencil Marks

LEAD PENCIL

The marks from lead pencils contain graphite, which is insoluble. The methods of removing pencil marks from textiles are the same as for removing tinfoil marks. A soft eraser sometimes can be used successfully in effacing the marks, especially on stiff or starched materials.

INDELIBLE PENCIL MARKS

Indelible pencil marks also contain graphite, and a dye which usually is not apparent until the marks are moistened. If the stains are known to be indelible pencil marks, do not wet them as this spreads the dye and makes them more difficult to remove. The dye may vary with different makes of pencils, but the following are usually effective:

1. *Organic solvents.*—If the stain has not been moistened it can usually be removed by soaking in ether, or acetone. Graphite marks may remain which can be removed by sponging with soap and water.
2. *Javelle water.*—Javelle water will usually bleach out the dye but can be used only on white cotton or linen.
3. *Potassium permanganate.*—This also is an effective bleach in removing the dye.

Methods 2 and 3 should be used with caution on old fabrics.

Perspiration

Colors changed by perspiration are very difficult to restore, but treatment may be found satisfactory in some cases. Though the perspiration of the body is usually acid, old stains may be alkaline due to decomposition. The yellow stains sometimes produced upon white material by perspiration are removed by the following agents:

1. *Soap and water.*—If the material is washable, exposure to the sun after using soap and water helps to bleach out the stains.
2. *Hydrogen peroxide.*—May be used with caution.
3. *Javelle water.*—Do not use Javelle water on wool or silk.
4. *Potassium permanganate.*—May be used with caution but will injure colors.

Pokeberry

Besides the red color of the juice, there is present in most pokeberry stains a green color, probably chlorophyll. In removing such stains these two colors must be dealt with. If the fabric is washable, to take out the red color use boiling water as for "Fruits and berries (fresh)"; otherwise sponge with warm water. See previous directions given for "Grass," etc. for removing any green color that remains.

Resins and Resinous Substances

Resinous substances are best removed from textiles by means of organic solvents, the particular solvent most effective depending on the nature of the material which has caused the stain. Use one of the following: Turpentine, benzol, carbon tetrachloride, chloroform, wood or grain alcohol, ether, kerosene, gasoline. Sponge the stain with the solvent or dip the spot in it and rub if the material can stand such treatment.

Scorch

Scorch on cotton and linen sometimes can be removed, if the fibers are not actually burned. Wool and silk usually cannot be restored to their original condition after being scorched, but wool may be improved by brushing with emery paper. For removing slight scorch stains from cotton and linen, use one of the following:

1. *Soap and water.*—If the fabric is washable, soap and water are sufficient to remove very slight stains.
2. *Water and sunlight.*—Wet the spot with water (or soap and water) and expose to the sun for a day, or longer if necessary. The scorch disappears more rapidly if the material is moistened first.
3. *Hydrogen peroxide.*—Light scorch stains can be removed from any white fabric as follows: Dampen a white cotton cloth with hydrogen peroxide and place over the stain. Place a clean dry cloth over this to protect the iron and then iron with a medium warm iron, replacing the top cloth if the hydrogen peroxide soaks through. Repeat the operation if necessary. *Precaution!* Do not iron directly on the cloth moistened with peroxide or on the moist fabric after the dry cloth has been removed. If this is done, the iron leaves rust stains on the specimen.

Shoe Dressings

BLACK SHOE DRESSINGS

The most common kinds of black shoe polish are the pastes, consisting chiefly of lampblack moistened with turpentine or water, polishing waxes, and sometimes a black dye; and the liquid dressings containing black dye, but generally no lampblack, and a polishing agent such as wax or shellac. Use one of the following agents in removing stains caused by black shoe polishes:

1. *Soap and water.*—If the material is washable fresh stains made by one of the paste dressings can be removed by sponging or washing thoroughly with an abundance of soap.
2. *Turpentine.*—Use only for the pastes containing turpentine. This may be detected by the odor. Immerse the stained places and rub gently in turpentine.
3. *Potassium permanganate.*—Use potassium permanganate for stains from the black liquid dressing. First remove as much of the stain as possible by sponging or washing as in method 1.
4. *Javelle water.*—Javelle water is also useful for stains from black liquid dressing. Do not use on silk or wool.

TAN SHOE DRESSINGS

The common tan leather dressings consist of either a liquid cleaning solution or a polishing wax, or both. The cleaning solution sometimes contains a considerable quantity of free oxalic acid, which may weaken a fabric seriously if allowed to remain long in con-

tact with it. Sometimes water-soluble dyes are present also, and these make a much more persistent stain on wool than on cotton. Use one of the following agents:

1. *Soap and water.*—Use for stains on cotton and linen.

2. *Wood or grain alcohol.*—The stains on wool are removed more succesfully by sponging with alcohol than with soap and water.

WHITE SHOE DRESSINGS

For spots caused by white shoe pastes or liquids use the following:

1. *Water.*—First sponge the spot with water and when dry brush thoroughly or rub in the direction of the weave with a piece of the same material.

Soap

When a material has not been rinsed sufficiently and is ironed with soap still present in the fiber, stains sometimes appear which resemble iron-rust stains, but usually are lighter yellow in color. Soap and water is usually sufficient to remove these. Bleaching in the sun helps to remove stains which are especially persistent.

Soot

Soot spots, being composed of fine particles of carbon, are insoluble and must be removed mechanically from a fabric. Use one of the following agents:

1. *Absorbents.*—First brush the stain, then place on it such absorbent powders as fuller's earth, French chalk, cornstarch, corn meal, or salt. Work them around until they become soiled and brush them away. If the fabric is washable, then sponge or wash the stain with soap and water.

2. *Organic solvents.*—Chloroform, gasoline, or Stoddard solvent may be used to rinse the soot from materials injured by washing. First brush the stain lightly or treat it with absorbent powder, as in method 1, then immerse it in the solvent and rub gently, or brush with a small, soft brush.

Stove Polish

Stove polish usually contains carbon in the form of graphite. It is difficult to remove such stains completely. The following agents are fairly satisfactory:

1. *Soap and water.*—If the fabric is washable, this method is fairly successful, especially if the soap is rubbed thoroughly on the stain.

2. *Organic solvents.*—Chloroform, gasoline, or Stoddard solvent may be used for material injured by washing. While immersed rub it gently or brush it with a small soft brush.

Tar, Road Oil, Creosote Oil, Asphalt, Asphalt Paint, Axle Grease

The stains from these substances are grouped together because they are somewhat similar in their chemical composition and certain solvents may be used for all. The stains are rather difficult to remove, especially from cotton. After the oily or tarry part has been taken out, dark-colored organic or mineral impurities are likely to remain. Use one of the following agents:

1. *Carbon tetrachloride.*—Sponge the stains with carbon tetrachloride or immerse them in the liquid and rub. The latter treatment is best if the fabric is not too delicate. Follow by a thorough washing in soap and water if the fabric is washable. For stains on carpet, scrub with a cloth soaked in the solvent, changing to a fresh cloth as soon as it becomes discolored, and continuing as long as any color comes off.

2. *Carbon disulphide—Caution.*—This is the best general solvent for these substances but it is very inflammable and poisonous. If used, it should be kept far away from any flame and the article cleaned in a very well-ventilated place. It is better not to store the unused portions of the liquid.

3. *Benzol, chloroform, or turpentine.*—These may be applied in the same way as carbon tetrachloride, method 1.

4. *Lard.*—Rub thoroughly into the stain, then wash in hot water and soap. Repeat the treatment, if necessary.

Tea

Tea stains contain a brown coloring matter which is not difficult to remove when fresh, but which becomes very persistent when allowed to remain a long time in contact with the fiber. Stains from tea containing milk or cream are removed more easily from cottons and linens than are stains made by clear tea. Use one of the following:

1. *Borax and boiling water.*—If stains are on cotton or linen and only a few days old, soak them in a borax solution (½ to 1 teaspoon of borax to 1 cup of water) and then rinse in boiling water.

2. *A strong soap solution.*—Use a half-inch cube of soap to each cup of water, and boil the stained material in this. Stains 2 or 3 weeks old can be removed if they are on small articles of white washable material which can be boiled in a small quantity of liquid.

3. *Potassium permanganate.*—Use potassium permanganate for stains which resist other reagents.

4. *Javelle water.*—For persistent stains, Javelle water is slightly less satisfactory than the potassium permanganate and cannot be used on wool or silk.

5. *Lemon juice and sunlight.*—Keep the stains moist with lemon juice and expose them to the sun for a day or two. They will be practically removed.

Tinfoil

The stains caused by the rubbing of tinfoil, as for example when it is used to wrap stems of cut flowers, consist of finely divided particles of metal. Since these are not soluble in any chemical that would be harmless to textile fibers, they must be removed from the fabric mechanically. Use one of the following agents:

1. *Soap and water.*—If the material is washable, use the soap freely and rub the stain thoroughly. Sponge woolen materials.

2. *Chloroform or other organic solvent.*—Immerse the stained place in a small vessel of the solvent and brush gently with a small soft brush or rub with a cloth.

Tobacco

Stains from tobacco juice consist of the brown coloring matter of the tobacco plant and may contain, in addition, molasses which has been added to the tobacco for sweetening and flavoring. Treat stains from the tarry substances in the stem of a pipe in the same way as previously indicated for tar. Use one of the following reagents in removing tobacco-juice stains:

1. *Soap and water.*—Sponge materials that cannot be washed. If a stain on washable materials cannot be completely removed by washing, bleach it in the sun. Moistening it with lemon juice makes it disappear more quickly.

2. *Alcohol.*—Traces of color remaining on wool fabrics after sponging with water can be removed sometimes by sponging with alcohol.

3. *Potassium permanganate.*—Use potassium permanganate for stains that washing will not remove.

4. *Javelle water.*—Do not use Javelle water on wool or silk.

Urine

These stains are so variable in composition that it is impossible to give methods which will be successful in all cases. If the color is not destroyed but only changed, one of the methods given for acids or alkalis may be used successfully. Normal human urine is usually acid and that of herbivorous animals alkaline.

1. *Salt and water.*—A warm solution of salt is sometimes effective and often will not destroy the color of the fabric.

2. *Hydrogen peroxide.*—Add hydrogen peroxide to the salt solution. A little sodium perborate may be used instead of the hydrogen peroxide.

Vaseline

Stains from vaseline are usually merely greasy in nature and can be removed readily with one of the following solvents:

1. *Turpentine.*—Sponge fresh stains with this agent. Old stains, even those which have been washed and ironed, usually can be removed by soaking in turpentine.

2. *Absorbents and solvents.*—Use as previously described under Grease and Oils.

Walnut (Black)

The persistence of stains from the husks of black walnuts is probably due to their content of tannin, which most fibers absorb or combine with very readily. It is possible that the tannin acts as a fixing agent, holding the coloring matter of the husks firmly to the fiber. Fresh stains, which are still moist, usually can be removed, provided the material is strong enough to stand the treatment, but old stains or stains on delicate fabrics in many cases cannot be removed. The following reagents are satisfactory in some cases:

1. *Concentrated soap solution.*—Use a half-inch cube of laundry soap to a cup of water, and boil the stained material in this solution. The treatment is successful only with fresh stains on cotton or linen. In the case of week-old stains, a gray color persists which can sometimes be removed by Javelle water. (*See* method 2.)

2. *Javelle water.*—Dilute the Javelle water with an equal volume of hot water. Soak the stained place for 1½ hours in this solution, then rinse thoroughly, treat with dilute oxalic acid, and rinse again. This is effective in removing a week-old stain and the fibers of the material are not seriously injured. Soaking the stain in Javelle water of full strength, however, rots the material. Do not use Javelle water on silk or wool.

Water Spots

Some silks and wool are spotted by water, a frequent condition in costumes stored in attics or cellars. This probably dissolves a part of the finishing or weighting substances, and, when the water evaporates, they are deposited irregularly or in rings. A satisfactory method for removing such spots is to dampen the entire material evenly and press it while still damp. This may be done either by sponging the material carefully with clean water or by shaking it in the steam from a briskly boiling teakettle until it is thoroughly damp. Another method is to dip the garment in an organic solvent. Scratching with the finger nail or a stiff brush is sometimes sufficient.

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Costumes frequently come to a museum with a combination of stains associated with water spots, particularly rust from iron trunks. A study of each stain is essential before applying one or several of the methods described under the various preceding sections.

BASKETRY

All baskets, coarse fiber bags, and mats are subject to brittleness resulting from excessive drying. Impregnation with a thin beeswax paste is usually satisfactory. The consistency of the beeswax, ranging from a watery liquid to a stiff paste, can be controlled for special needs by varying the proportion of benzol. Dry color may be added where necessary to darken the wax to match the basket or mat if it is of one color.

WOOD

The principal agents of destruction in wood are woodboring insects and wood inhabiting fungi.[2] Numerous species of bark beetles are destructive to logs with bark covering while other beetles, particularly in larval form, may riddle the interior of the wood. Termites are especially likely to attack timbers in buildings which have a contact with the earth. Treatment for infestations in the framework of standing buildings is usually impossible unless each affected piece can be removed for impregnation with a suitable preservative. Structurally weak members must be replaced wherever necessary. Decay caused by fungus growths can take place only when sufficient moisture is present to encourage their advance. If excessive moisture cannot be eliminated, the wood must be treated with a fungicide preservative. Of the many wood preservatives the following two are most frequently used.

Coal Tar Creosote is most commonly employed for railroad ties, bridge timbers, and other work which will not require close contact with persons or need painting. Among its objectionable qualities are a dark brown stain and a disagreeable odor. Wood treated with this oily substance cannot be painted. This is a serious drawback in historic houses.

Zinc Chloride is free from an unpleasant odor, does not cause serious discoloration, and does not interfere with the application of paint.

Application of preservative by spraying or painting on with a brush is the least satisfactory method and is regarded by some experts as a waste of time and material. A better method used with water soluble preservatives such as the zinc chloride is to immerse each piece in a tank full of the solution for several days. The object may be immersed in oily preservatives like creosote also and the surplus drained off after 15 minutes. Dipping

[2] J. F. Shanklin. Wood preservation. Occasional forestry note no. 4. National Park Service. April 22, 1940.

the wood in a tank of hot creosote, allowing its temperature to rise to that of the liquid, and then transferring to a cool batch is also considered effective. The most satisfactory results are obtained by shipping the timbers to a plant equipped to subject the wood to complete infiltration under pressure.

Reconstructions of log cabins have been built successfully using the following preservative process. Untreated logs stripped of bark were notched and fitted, the cut portions being brushed with a strong solution of zinc chloride. The logs were then removed to the processing plant and subjected to pressure which placed from ¾ to 1 pound zinc chloride in each cubic foot of wood. This treatment imparts a weathered gray appearance, takes up most of the shrinkage, and is definitely known to be a protection against termites. Being water soluble, the salts may eventually leach out to a point permitting decay, but in all probability the life of these logs will be extended so many years beyond normal that the process may be considered as fully satisfactory.

Painted wood which shows signs of infestation or decay cannot be impregnated without removal of the paint down to bare wood to allow penetration. Paint will prevent surface weathering but under wet conditions will do little more than retard decay since it has no antiseptic properties.

Excessively wet or waterlogged wood may be preserved by very slow and careful drying if warping, checking, and shrinking do not set in and seriously change the shape.

Some wood objects from excavations or dredgings have been saved only by retaining them in water to which enough preservative has been added to prevent mold growth, but wood taken from wet soil has often yielded to successful treatment with alum. The method is based on the fact that alum crystallizes immediately upon cooling. After cleaning away external dirt, the specimen is boiled at 170° F. from 12 to 24 hours, depending on size, in a concentrated solution of alum. After cooling, the surface is washed free of crystals with hot water and dried at a constant temperature until no further loss in weight occurs. When thoroughly dry, the surface is painted with several light coats of boiled linseed oil, each being allowed to dry. Thus care is taken not to have a thick coat of oil which may harden on the outside, leaving a gummy interior. When the oil has completely hardened after several weeks, a final coating of cellulose lacquer is applied. A darker color results, and the wood becomes hard and shiny. Alum treatment should not be attempted without expert guidance.

The infiltration process similar to that employed on animal specimens

also has been used successfully in preserving valuable but badly decayed wood objects from wet excavations. The method consists in placing the object in successively stronger solutions of wood alcohol beginning at 10 percent and continuing up to 95 percent. The wood is then transferred to a bath of xylol which is changed repeatedly until the xylol has replaced all the alcohol. Finally the specimen is suspended in melted paraffin which is kept boiling until all the xylol is replaced with paraffin. After cooling, the excess paraffin is removed from the surface with benzol or carbon tetrachloride. The final result is a durable solid replacing the water in all the pores of the wood.

Large wooden objects out of doors should be dried whenever possible and impregnated with a wood preservative as already described, but where the surface is painted and this must be preserved, a method similar to that used on badly decayed totem poles by Harlan I. Smith, Canadian archeologist, may be employed. Mr. Smith describes his procedure as follows: [3]

When the pole to be treated was still standing, it was supported in an A-frame by means of ropes. Chafing was avoided by wrapping the pole in burlap where the ropes touched it. The pole was then sawn off at the ground-level and lowered to the ground, where it was supported on cross timbers. A channel about a foot wide and a foot deep was excavated along the back of the pole for a distance of half or two-thirds of its length. In the channel thus prepared a new timber, cut to fit snugly, was laid and bolted to the pole with bolts running from side to side and from front to back. The heads of the bolts and nuts were sunk in square sockets in the pole which were subsequently filled with plugs so that the bolts would not be conspicuous. The new pole thus laid into the old one was allowed to extend about 6 feet beyond the butt, and this protruding part was set in cement in a pit dug to receive it. Temporary struts were fastened solidly to the new pole and forced into the ground in such a way as to hold it steady while the cement was setting; otherwise, wind-shake would have stirred the pole enough to prevent the cement setting in close contact with the wood, a condition that would have allowed the infiltration of water.

The new pole, before being laid in the old one, was treated very thoroughly with creosote. The cement foundation came close to, but not actually up to, the ground-level and the old pole was supported about an inch above the foundation. This space of an inch was filled with a waterproof, plastic gum which neither hardens when cold nor runs when hot. The gum was beveled off where it came in contact with the cement foundation in such a way as to throw off any rain water that trickled down the pole, and the surface of the foundation was leveled off even with the ground and covered with gravel or sod to match the surroundings.

The old pole was painted with warm, double-boiled linseed oil. It is possible that raw linseed oil would have been better, but it dries so much more slowly that the time lost in waiting seemed too great a price to pay for the slight extra advantage. When the oil had dried, and any surplus had been removed to prevent a glossy appearance, the

[3] Douglas Leechman. Technical methods in the preservation of anthropological museum specimens. National museum of Canada, annual report, 1929. p. 151–152.

pole was painted. Difficulty was encountered here, as the old colors had almost entirely vanished, and the Indians themselves were in great doubt as to what color should be used in certain parts of the carvings. The final decision was always left to the Indians, and the old native colors were approximated as closely as possible. The poles, when re-erected and repainted, looked somewhat crude and glaring, but experience has already shown that the colors are rapidly softened by weathering and there is no doubt that the treatment has been of very material assistance in prolonging the existence of the poles.

The top of the pole, and all projecting parts well above eye level were capped with plastic gum to prevent the penetration of rain water, and on top of the pole the plastic gum was further covered with a sheet of canvas and a second layer of plastic gum. The application of double-boiled linseed oil darkens the pole slightly, but this may be overcome by adding to the oil a small quantity of light earth color, sufficient to counteract the darkening effect of the oil. Experiments have to be made to determine the correct amount to use.

In some cases the poles were found to have decayed beyond the point at which they could safely be re-erected. In such a case the pole was laid on cross timbers, treated to a very thorough oiling and held together as firmly as possible with bands of strap iron. The pole was protected from the weather by the erection of a long penthouse over it with a railing to keep out intruders.

It should be noted that the native colors were never pure. They were confined largely to red and black, though white and yellow were also used to a less extent, and occasionally a blue. The colors were generally made by calcining rock. The black paint made from charcoal was, apparently, not used by the natives on totem poles. The red has a large proportion of black in it due to the presence of impurities, and the black has a decided reddish cast for the same reason. The "Indian Red" of commerce is far from being the color here discussed, the "Garnet Brown" of Ridgway being a closer approximation.

Tool handles, gunstocks, wagon wheels, and agricultural implements, as well as furniture, are among the objects most frequently found to be infested with the powder-post beetle (*see* Protection from Insects). Its presence is indicated by many fine holes from which a yellow flourlike powder falls or can be shaken. If the specimen is unpainted and not incorporated with some other fragile parts, an old ax, for example, these beetles and their larvae may be effectively destroyed by baking at a temperature of 130° F. for 12 hours. Extreme cold, also, has been used effectively in destroying these and other pests. Where the climate permits exposure to subzero temperatures for a considerable period, good results have been noted. Solid carbon dioxide or "dry ice" has been used to produce an abnormally low temperature for this same purpose. Where extreme temperature methods cannot be employed, fumigation is desirable, preferably under a vacuum which will drive the toxic gases deep into the borings. A slower method, which gives results if persisted in over a period of time, is to carefully insert a drop or two of carbon disulphide or ethylene dichloride in each hole with a quill or fine medicine dropper. After all evidence of continued activity

has ceased, the holes may be impregnated with a thin cellulose lacquer which further aids the destruction. If the surface will not be damaged, a thorough soaking in carbon tetrachloride, or if no fire hazard is created, with carbon disulphide or ethylene dichloride is effective. The first two of these chemicals are excellent paint and varnish removers, and their use should be governed accordingly.

Furniture.—The proper care of furniture requires a correct finish to start with and daily wiping thereafter with a soft cloth. The application of a cleaner and polish depends on the type of finish.

Valuable pieces of old furniture may have the original finish of up to a dozen coats of shellac. Between the application of each coat of shellac, the surface was rubbed down with pumice and a very few drops of linseed oil. The last coat was a very thin layer of shellac, and no oil at all was used to avoid blind spots. The result was a soft finish of high brilliancy. For this type of finish a soft flannel cloth is sufficient for daily dusting, but once a week a flannel cloth moistened with linseed oil should be used, and afterwards the entire surface should be rubbed dry with another flannel. Highly varnished surfaces may be treated with a paste of three parts turpentine and two parts beeswax. It should be applied evenly and very sparingly with a flannel cloth and rubbed in by circular motion. The final rubbing is done with the grain of the wood when all excess wax is rubbed in. A rich polish is often obtained on fine wood by penetration with beeswax and carnauba wax. A high gloss may be given to raw wood by applying shellac and immediately rubbing with a cloth slightly moistened with linseed oil. Oil polish does not take well on wax, and since the two types do not mix properly knowledge of the nature of the finish is important. Veneered furniture benefits from an oiling with warm linseed oil, care being taken to remove the excess. Occasional treatment of inlays with olive oil prevents excessive brittleness and consequent cracking and chipping.

Painted surfaces on wood may be washed with mild soap in cool water followed by wiping dry and a light wiping with oil polish. Furniture suffers greatly from excessive dryness which warps the wood and affects the glue. Humidity should be regulated, if no air-conditioning system is available, by exposing pans of water to counteract the lack of moisture in the air.

SHELL

Shells buried for long periods in the ground require different preservative treatment from shells of living mollusks prepared for natural history collections. In excavated specimens much of the binding material may be destroyed, and the shells will crumble like dry chalk unless kept wet until

they can be cleaned and strengthened. If not weakened too much by long burial, the shell is washed to remove salts which may be present and then, after drying, impregnated with cellulose lacquer. When too fragile to stand this treatment, they may be immersed in a 5 percent gelatin solution and cleaned there with a brush. They are then placed in another clean bath of the same solution and after draining are placed in formaldehyde for hardening and subsequent slow drying.

Mother-of-pearl and shell inlays in bad condition may be reset with cellulose cement after cleaning and preserving as described above.

BONE, IVORY

Excavated bone or ivory should be dried as slowly as possible. Very fragile material should not be moistened with water. Much trouble may be caused by warping if the drying process is too rapid. Impregnation with cellulose acetate is desirable in fragile specimens. Mending of broken pieces may be done with equal parts of beeswax and carnauba wax or with cellulose acetate cement. Glues and cellulose nitrates should be avoided and no unnecessary heat applied. The maintenance of an even humidity and temperature is probably the most satisfactory method of preserving ivory. Without this no additional treatment will guarantee success.

HAIR

Hair is one of the more durable organic substances and unless attacked by insects will outlast the hide or leather in which it is embedded. Insect attacks may be warded off with repellents and insecticides, and the specimen should be fumigated when there is suspicion of pest activity. Clean hair is seldom attacked, although accumulations of fat, oil, and other dirt on hair invite infestation. The use of vaseline to restore gloss and pliancy to hair is usually sufficient.

HORN

If horn is kept free from grease, there is seldom any occasion for insect attack as long as it is given the same routine care received by the other specimens. Benzol may be used to remove dirt and dust. Cellulose cement is satisfactory for repairing breaks and affording a protecting coating whenever necessary. Powder horns often contain old powder which may still be potent and should be removed.

FEATHERS

Individual feathers can be cleaned by washing in benzol. Masses of feathers may have to be sponged with a wad of cotton dipped in benzol and

wiped down toward the tips. Badly bent or crumpled feathers respond remarkably if held in the jet of steam from a teakettle while stroking and manipulating to rehook the barbules.

DESICCATED BODIES (MUMMIES)

Usually mummies are found only under extremely dry conditions in caves and need little preservative treatment beyond keeping them in a dry place and fumigating to destroy insect pests. An occasional application of vaseline to the overdry parts may be necessary to counteract excessive brittleness.

Preservation occurs but rarely under damp conditions and then only when natural preservatives such as sodium and potassium nitrate or arsenic are present. A specimen of this type was found several years ago at Mammoth Cave National Park, Kentucky, which started to disintegrate after the delicate balance through which it had remained stable under excessively humid conditions had been upset by removal from the ledge to an exhibit case. [4] To retain it in the cave as an exhibit-in-place it was dehydrated and the fungicide thymol used to destroy mold growth. A waterproof case having a special device for constant dehydration with anhydrous calcium chloride and fumigation with thymol was designed and the specimen installed with satisfactory results so far.

Historic and Prehistoric Objects—Inorganic

IRON

Iron artifacts may be cleaned chemically by several methods. The objects should first be freed of dirt and loose rust by the use of brushes and steel wool. For small objects, or a small quantity, rust may be removed by the use of a solution of 2 parts of stannous chloride C. P. to 8 parts of water. A solution of 1 part of potassium cyanide to 9 parts of water is also effective but is not generally recommended because of the danger in its use.

If preservation is to be done on a larger scale, clean the artifacts by boiling in a solution of sodium hydroxide and zinc. This is done in the following manner: Place a tub on an unlighted stove and cover the bottom with powdered zinc or wrap the objects in sheet zinc; put the objects to be treated in the tub, surrounding and covering each object with the zinc; add sufficient water to immerse the objects completely; next add sufficient sodium hydroxide to make a strong solution—say 5 pounds to 5 gallons of

[4] Ned J. Burns. Preservation of the Mammoth Cave mummy. The museum news, 17: 8, Nov. 1, 1939.

water; boil the objects for 2 or 3 hours; then remove to clear water and boil or rinse several times until the alkaline reaction is slight. This last trace of alkalinity must be neutralized by the use of small quantities of nitric acid, added to the water with an eye dropper. The complete removal or neutralization of the sodium hydroxide is important, since if left in the iron it will continue to react and inflict considerable damage.

The objects should be thoroughly dried by baking in a fairly hot oven from 20 minutes to an hour, depending on their size. Moisture must be completely removed, as otherwise corrosion will go on inside the preservative coating. The objects should then be coated with cellulose lacquer to prevent a new attack of rust. (*See also* Firearms.)

SILVER

Silver may be cleaned with precipitated chalk and strong ammonia solution, polished with rouge powder on a wet cloth, and finally rinsed in water and polished dry with a soft clean cloth. A simple and satisfactory chemical method consists of boiling the article in an aluminum vessel with one ounce of baking soda (sodium bicarbonate) and one ounce of common salt (sodium chloride) to two quarts of water. Some part of the silver object is kept in contact with the aluminum during boiling. A zinc tank may be used instead of aluminum. It is not advisable to use soap on silver since it tends to dull the finish. Silver blackens very quickly in the presence of sulphur fumes. Plasteline or modeling wax is largely composed of flowers of sulphur and should be kept away from silver objects. Minerals containing sulphur or sulphur casts of coins should not be exhibited in the same case with silver objects. Gum camphor is commonly kept in cases with silver to prevent tarnishing.

Silver which has been recovered from excavations, particularly where it has been alloyed with copper, may have undergone a chemical change even to the extent of becoming entirely converted to brittle silver chloride. A treatment employing sodium hydroxide and zinc in a reduction process carried on under laboratory conditions will produce satisfactory results.

GOLD

Being one of the few metals which does not corrode, gold seldom needs cleaning. A weak solution of hydrochloric acid in water or a 10 percent solution of ammonia may be used to remove stains if rinsing in soap and warm water is not effective. A more drastic method for obstinate stains is as follows:

Chloride of lime	1 part by volume	Table salt	1 part
Sodium bicarbonate	2 parts	Water	15 parts

After being washed in this solution by gently rubbing with a soft cloth or brush, the object should be dried and cleaned in jewelers' sawdust.

Gold nuggets.—Pure gold is very soft and should not be subjected to severe mechanical rubbing. Mud and soil adhering to pure gold, as well as to other soft metals, can best be removed by applying a small jet of steam generated with a Bunsen burner under a well-stoppered bottle and delivered through a small rubber tube having a fine, tapered glass nozzle. To prevent an explosion of the apparatus, a separate glass tube should run down through the rubber stopper almost to the bottom so it is always under the water; the upper end should extend well above the top of the bottle. The use of the steam jet and a small wooden pick will generally free the specimen from adhering impurities.

Potassium cyanide solutions are generally used in the jewelry trade and by museum laboratories for cleaning rare metals. Its use in the field should be definitely discouraged since it is one of the deadliest poisons known in its solid, liquid, or gaseous forms and can cause quick death through the slightest lack of knowledge or carelessness in its use. Objects requiring cyanide cleaning should be entrusted to the central museum laboratories or a professional jeweler.

LEAD

This durable metal seldom needs cleaning except in excavated material such as bullets and seals. Musket balls which have been buried in the earth for over a hundred years appear like new when chemically cleaned, showing even minute scratches and mold marks undiscernible in their coated form as removed from the ground.

Attempts to clean with abrasives always end in failure, since the metal is too soft. An effective method of removing the white carbonates is by soaking in a 10 percent solution of acetic acid in water followed by a soaking in a 1 percent solution of sodium hydroxide. After the specimen is freed from the deposits, it should be washed thoroughly in several changes of distilled water, previously boiled to drive off any carbon dioxide which might be in suspension. After drying it should be kept in a room free from acid fumes for several days, during which time a protective but invisible patina will form. It then may be coated with cellulose lacquer. It is desirable to handle the specimen with tongs, first, to protect the fingers from the caustic soda and secondly, so as not to stain the new surface during the final washing and drying.

PEWTER

Pewter objects from excavations are usually treated by the same method as lead. Eating and drinking utensils of pewter may be cleaned by rubbing

with rotten stone and oil on a soft rag. The metal is soft and a vigorous rubbing may obliterate interesting and valuable marks. Dents may be gently hammered back into shape by light tapping on the inside of the vessel, but usually these are not disturbed unless the damage is extensive.

COPPER, BRONZE, AND BRASS

Objects removed from the ground are often corroded to a point where nearly all the metal is gone. In such extreme cases the piece must be preserved with this corrosion intact unless full laboratory facilities are available for restoration by electrolysis. Extensive and active corrosion known as "bronze disease" can only be treated effectively by electrolysis or local neutralization with acid. All such operations require skilled specialists for successful results. Adhering dirt should be cleaned off, and the specimen soaked and washed in several changes of water to remove soluble salts. It is then immersed in cellulose lacquer until all parts have been penetrated, then drained and dried. A fine, even patina is very much to be desired on antique bronze statuary and should never be removed.

The green patina may be removed from specimens when necessary by immersing for several hours in either of the two following solutions:

1. 15 parts sodium potassium tartrate (Rochelle salt).
   5 parts sodium hydroxide.
   100 parts water.
2. 10 parts glacial acetic acid.
   100 parts water.

After a thorough rinsing in clear water, a stiff bristle brush is used to clean away loosely adhering particles. The process may be repeated for several days, using a fresh bath each time.

Stubborn particles of corrosion may be removed mechanically by carefully working with a fine pick or knife blade under water. It is desirable generally to prevent further attacks on the surface by applying cellulose lacquer after thorough washing and drying.

Brass and copper utensils, such as cooking pots, candlesticks, trays, and warming pans, may be cleaned effectively with a saturated solution of table salt in vinegar and a thorough scrubbing with a stiff brush followed by vigorous rubbing with a cloth over the finger tips. Excess of the cleaning solution should be washed away with water, and in the case of tableware washing should be followed by a rubbing with tripoli powder or rotten stone in sweet oil to produce a deep luster. A buffing wheel on a lathe will save much hard rubbing and produce an excellent effect where brass is to be examined at close range. Careful lacquering with cellulose acetate solution is usually advisable to make frequent cleaning unnecessary.

It is desirable to remove or loosen old lacquer with acetone before cleaning unless a buffing wheel is available, in which event it can be removed mechanically. Prepared brass polishes usually contain an acid and fine abrasive and do effective work, but a thorough washing and rubbing is necessary after their use to prevent a quick retarnishing of the surface.

Brass knobs, handles, or ornaments on furniture or wood should be removed, if possible, for cleaning to prevent staining and damage to surrounding varnish, paint, and wood finishes. If this is impossible, a cardboard or metal shield should be improvised for their protection and all cleaner removed from crevices.

ALABASTER

Acids, caustic alkalis, strong cleaning agents, and heat should be carefully avoided in treating alabaster statues and ornaments. Usually a soaking in water or a washing in soap and water will remove stains. Benzol, acetone, or alcohol may be tried for obstinate stains. This material is very soft and easily scratched. It can be mended with cellulose cement and, where extensive replacements are necessary, with tinted plaster.

MARBLE

Marble should be treated in the same manner as alabaster. An occasional washing with mild soap and water with a little ammonia should suffice to keep it clean. Stains caused by soot, ink, lipstick, and dyes are often impossible to remove entirely even by complex processes; consequently, white marble statues should be protected from vandalism as much as possible.

STONE

Stone artifacts may be mended with cellulose cement after removing mud and soil by cleaning with water or, in obstinate cases, with dilute acetic or hydrochloric acid. Acid should not be used on limestone. Lichens usually can be softened sufficiently for removal with dilute ammonia. Carbonates incrusting a specimen may be removed mechanically if the stone object is hard enough to withstand this treatment. A 5 percent solution of hydrochloric acid may be used if experimentation shows that the type of stone in question will not be affected by the acid.

CERAMICS

Unglazed pottery.—Practically all aboriginal pottery excavated from Indian sites is unglazed and the following methods may be used for mending it.

After washing and drying broken pieces of a pot and freeing them from any grease which may be present by cleaning with benzol, each part is fitted into its proper place, beginning at the bottom. The pieces are held in correct position in a sand box aided, if necessary, by bags made of light canvas sewn into long cylinders 1 to 3 inches in diameter and 4 to 12 inches in length and loosely filled with sand or birdshot. Cellulose acetate cement is applied to the broken edges and firm pressure exerted to obtain a close joint. In very porous pottery it may be desirable to size the edges first with a thin solution of the cement which should dry before the adjoining pieces are affixed. If bubbles form, they should be pricked with a pin. To fill the gaps caused by missing pieces, a flat slab of modeling wax or plasteline is pressed out to about one-quarter of an inch in thickness and applied to the inside and pressed firmly to the vessel where it overlaps the breaks. This affords a backing to prevent the plaster from running out of control. Molding plaster is mixed to a creamlike consistency (*see* "Casting Compounds," Plaster) and forced into the depression, care being taken to secure a uniform joining with the pottery edge. After it has set, but before it dries, the surplus is carefully cut down to the desired contour and smoothed with a sharp knife and sandpaper without cutting into the original pottery. Dry color may be mixed into the dry plaster to approximate the color of the pot. The wet plaster will appear considerably darker but will return to almost the same light color upon drying. Some prefer to use white plaster and employ oil colors thinned with turpentine to produce a dull finish. Generally there should be a slight difference in color between the patch and the original, apparent on close inspection, so as not to deceive while at the same time presenting a consistent appearance which aids greatly in visualizing the original contours. Imitation of incised or painted design should be limited lest the restorer be accused of attempting to mislead. Vinyl acetate also is used in the restoration of pottery following methods developed by William Todd of the Royal Ontario Museum of Archeology. The acetate of 15 viscosity is mixed with clay of not more than 200 mesh to make a plastic clay. This clay becomes extremely hard and strong after it sets. The restored pots are less fragile than those mended with plaster or cellulose cement.

Glazed ware.—The mending of all forms of glazed ware from the finest hard china to heavy crockery is essentially the same. If the fragments have been buried, they should be washed in water carefully to free them from salts. Grease and other stains should be removed if present. Cellulose cement is employed to make the bond, while plaster or vinyl acetate clay putty is used to fill in gaps caused by missing pieces. Wire supports, made

to fit the individual piece in a neat and inconspicuous way, may be used when the breakage is such as to leave the specimen too weak to stand of its own strength after mending.

Unbaked clay—adobe.—Objects of sun-dried mud or clay may be strengthened by applications of thin cellulose lacquer and mended with the same material in thick form. No attempt to clean such articles, beyond blowing and a gentle brushing, should be employed since wetting will cause disintegration. Missing parts can be replaced with tinted plaster. Particularly valuable specimens should be baked in a pottery kiln for preservation. The oven should be regulated to bring the baking temperature only high enough to impart strength; cracking and warping will result from too high firing. Since the baking temperature of the clay involved can be determined only by experiment, due caution should be practiced and the work done by an experienced operator.

Many experiments have been tried in an effort to find a satisfactory preservative method to stabilize ancient structures of adobe, mud, and packed clay. The difficulty lies in finding a liquid which will penetrate completely, or even to a reasonable depth, and still solidify into a waterproof bond for the particles of clay. Penetration of only a few inches of the surface and subsequent hardening usually creates a hard shell which tends to break away from the mass through subsequent wetting at the point where the waterproofing bond has stopped. It is too early to state which, if any, of the numerous experiments being tried in various places are successful.

Clay structures.—In general, the materials used for structures include earth of various types, masonry, timber, and combinations of these materials. Although a great deal of thought and experiment has been given to discovering means of preserving structures, the results so far have not been too encouraging. Structural materials are broken down by mechanical processes such as that of the formation of ice crystals within the structures; they are carried away in solution by a solvent percolating through the material; they are worn down by the cutting effect of windblown abrasives; and they are subjected to chemical and physical breakdown of the elements of which they are composed. The principal objectives of preservative treatment are to minimize the effect of these causes, and the methods used consist essentially of protecting the surface particles by coating them with some protective film, and of preventing seepage through the interior of the material with its consequent destructive effects.

Various materials have been used, including the resins, waxes, silicates, and cement-mortar. These preservatives have, for the most part, been

applied on the surface in a liquid state, so that they would penetrate more or less into the pores of the material. In the case of stone, the methods have met with a fair degree of success because the preservative did not materially affect the inherent stability of the material itself. That is, the addition of the preservative did not create a shell of either greater or lesser structural stability than the original material. In the case of earth structures, however, the preservative does form a shell which has structural characteristics entirely different from the body of the material itself. Both the coefficient of expansion and the natural period of vibration may be changed more or less with the result that in the great majority of cases the preservative-stabilized skin has eventually separated from the main body of the material, and the effect of the preservative completely lost, or even, in some cases, aggravating the destruction.

The fact must be faced frankly that today we have no preservative methods for structures that can be applied generally with any assurance of success. Where those methods have been used in the past with some degree of success, that success has, no doubt, been due to contributing influences which have not yet been sufficiently well defined to permit a general statement to be made.

One of the natural forces which is highly effective in preserving earth structures is the pressure due to capillary forces. So long as these forces are not neutralized, either by submergence of the free surface of the capillary or depletion of the capillary water, they are surprisingly effective. When, however, the free surface of the capillary tubes is submerged, as is the case when a thin film of water covers the face of the structure, their effectiveness is immediately neutralized, and destruction of the surface continues as long as the free surface of the capillaries is submerged.

Capillary forces maintained a satisfactory condition of the floor of the council chamber at Ocmulgee National Monument at Macon, Ga., until ventilation was installed to protect the timbers of the chamber. This resulted in a depletion of the capillary water, and its recession in the tubes, which completely freed the surface particles, permitting dusting to take place, and also resulted in serious shrinkage cracks. To eliminate dusting of the floor, it was treated with a synthetic resin. The resin used in this case was Alvar, a polyvinyl acetate. Seven parts by volume of the resin was dissolved in acetone and the solution was applied by means of 2-inch paint brushes. The area to be treated was first saturated with pure acetone, after which the Alvar solution was applied. This was followed by a second application of pure acetone.

At the time this application was made, it was believed that the resin

would form a tight membrane which would prevent further depletion of the capillary water through evaporation, and that the capillaries would consequently be completely effective. This could happen only if the film were sufficiently dense to prevent the passage of water vapor. Subsequent tests made in the engineering laboratory proved conclusively that Alvar is highly porous, and that it had very little effect in the prevention of evaporation from a wet soil sample prepared in the laboratory, and which was completely covered with a much heavier film of Alvar than had been applied to the floor of the council chamber. In this particular case, therefore, the only effect of the resin is to tie the surface particles and prevent dusting. It cannot have any effect upon deep drying and consequent shrinkage. It can assist in preserving vertical surfaces, such as those of the fire pit, only if the film is sufficiently tenacious to support the tensile loads which come upon it without separation or rupture.

In the present state of knowledge of preservative methods and materials for structures, all problems must be approached with extreme caution. Past practices have not been sufficiently subjected to critical physical and chemical analysis to establish their fundamental soundness.[5]

GLASS

If careful inspection discloses no cracks, a simple washing in soap suds and ammonia followed by thorough rinsing in clean water and polishing with a clean towel is usually sufficient for ordinary glassware in good condition. Old glass should not be washed in hot water. Dirt may be removed from crevices and the insides of narrow necked vessels with test tube brushes and pipe cleaners aided by a weak solution of hydrochloric acid, usually not over 5 percent. A weak solution of hydrofluoric acid has been used in obstinate cases but this acid ordinarily is used for etching rather than cleaning and only an experienced operator should be entrusted with its use.

Dilute hydrochloric acid is used to remove incrustations of lime and mollusk shells. The beautiful iridescence found on glass bottles from colonial and Revolutionary sites is due to a disintegration of the surface resulting from long burial. The appearance of this iridescence may be improved by removing the sodium carbonate usually present. This is done by soaking the glass in water for several hours, immersing it for a few minutes in a weak bath of hydrochloric acid (usually not over 5 percent, although occasionally a higher percentage is used), immediately rinsing

[5] Section on clay structures contributed by Edmund F. Preece, Branch of Engineering, National Park Service, Washington.

in several changes of tap water, then putting it through several washings of distilled water, followed finally by grain alcohol, after which it is dried. Badly disintegrated glass is merely put through several washings of distilled water and coated with cellulose lacquer.

The neat repairing of broken glass calls for considerable skill. Several cements are in common use, the two most useful being cellulose acetate cement and isinglass. If isinglass is to be used, it is soaked until as much water as possible is absorbed. The surplus water is drained off and the the glue dissolved in alcohol with the aid of heat. Many workers prefer the isinglass cement, which does not set as quickly as the cellulose cement. After thorough cleaning and applying cement, the edges of the breaks are held together with as much steady pressure as possible, usually with the aid of rubber bands. The specimen may be held in position in a box of sand or with the supports described under "Ceramics."

Historic and Prehistoric Objects—Miscellaneous

PAINTINGS

Oils.—The cleaning and restoration of oil paintings calls for the attention of highly skilled specialists; consequently, the inexperienced should take no chances with valuable paintings.

Oil paint is usually applied on canvas after a preliminary sizing of glue and whiting has dried thoroughly. When the artist has finished his painting and allowed it to dry and harden, he may apply a fine varnish for protection. Sometimes a paste of beeswax in turpentine is applied as a further protection to the varnish or directly to the paint. Frequently the appearance of a painting may be greatly enhanced by a careful washing of the surface with saponin and cool water to remove excess dirt. Even this should not be attempted in the field without previous consultation. The safest course is to have such work performed by the central laboratories or a professional restorer. Often the varnish becomes darkened while the pigments underneath retain most of their brilliance. Skill and dexterity are necessary to remove the varnish without disturbing the paint.

Occasionally in a damp climate fungus will attack the canvas of an oil painting by living on the glue size with which it is treated before the paints are applied. Painted canvas has been treated successfully as follows: Saponin and water are used first to wash the surface, after which the beeswax coating is removed with alternate applications of turpentine and alcohol. A 5 percent solution of thymol is applied as a fungicide, and after its work is completed the dead mold is removed with a dilute solution of ammonia in alcohol.

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Water colors.—No attempt at cleaning should be made beyond the use of an art gum eraser. Water will dissolve the paint immediately and all other liquids should be kept away from the paper.

PHOTOGRAPHS

Daguerreotypes.—A daguerreotype is a photograph made on a silver-coated copper plate. The surface of this plate is *very easily damaged* and should never be touched by any substance other than liquids used for cleaning. Even the softest brush or cloth, not to mention fingering, will leave marks and scratches.

To clean a daguerreotype extreme care in handling is essential. First, remove the plate from its case and mat. Holding it by the edges, blow the dust from the surface. Next, place the plate in a bath of distilled water, face up, and rock gently. Now remove it from this bath and immerse in a 1 percent solution of potassium cyanide in distilled water, rocking the solution as before. Continue this operation until all discoloration caused by oxidation has disappeared. If it is slow in disappearing, the solution may be heated slightly. During the operation the plate should not come in contact with the air, and it should not be left in the solution too long. As soon as the discoloration disappears the daguerreotype should be taken from the solution. Attention has been called elsewhere to the importance of the utmost care in handling potassium cyanide as both the liquid and the fumes are poisonous. Use it in the open, if possible, or in a well-ventilated room, being careful not to get it on the hands.

After taking the plate from the cyanide bath, it should be thoroughly washed in distilled water to remove the cyanide and then immersed in another bath of 95 percent grain alcohol. After remaining in this solution for a brief time, it should be removed with a pair of tongs. Holding the plate by one corner, a place that will be covered by the mat thus concealing any mark, the alcohol should be drained from the plate. Next, in order to remove all liquid film, the plate should be held above a small flame. The alcohol may be ignited, or the process may be carried out slowly by holding it some distance from the flame.

As soon as the plate has been thoroughly dried the mat and glass cover should be cleaned and placed over it and the glass firmly bound to the plate itself. For this purpose commercial adhesive paper may be used, but rubber cement or "scotch" tape should be avoided. The metal binder should then be put in place and the whole returned to the daguerreotype case.[6]

[6] Robert Taft. Photography and the American scene, a social history, 1839–89.

Too much emphasis cannot be placed on the warning that a daguerreotype surface is easily damaged when not protected by glass.

Ambrotypes.—An ambrotype is a photograph on glass. Usually the back of the glass has been varnished to make the details of the photograph clearer. Quite frequently this varnish begins to crack or peel. To repair an ambrotype, another coat of varnish may be applied to the back or a piece of black silk or velvet placed against it with adhesives to achieve the same purpose.

Tintype.—This type of photograph is taken on a thin, japanned iron plate. Such a photograph should be handled carefully, but it can be cleaned by washing with warm water and a mild, pure soap or saponin. Rinse well with clean water, then swab with cotton or some other soft substance to dry. Never use a brush to clean a tintype.

Calotype.—A calotype print or paper negative should always be handled very carefully as it cannot be restored. For display purposes it should be placed between two sheets of glass.

Wet plate negatives.—Old type wet plate negatives are rather numerous. Sometimes these are scarred or appear to have small cracks running over them. This usually is caused by the fact that the binder has given away or that the varnish with which it may have been covered has cracked or peeled. These negatives cannot be restored. If it is desired to display them, they should be covered with clean glass and the edges bound to prevent further deterioration. Contact prints should be made for a record of the subject lest it be lost.

Photographs (filing).—In order to protect photographs they should be stored in a dry place. The best system is to put them in paper folders or envelopes and keep them in a file case. Never place photographs or negatives in a basement, cellar, or damp room.

Negatives (filing).—Photographic negatives should be placed in regular negative jackets or preservers and then filed in a book case or a similar type case. There is no special need for keeping them in a dark room or vault. Many negatives are made on cellulose nitrate, which is highly inflammable and explosive. Such files should be kept in a vault specially constructed and ventilated for this purpose. Insects will attack the gelatin emulsion on both negatives and positives, and care should be exercised to prevent their entrance.

FIREARMS

If a firearm has not been buried in the ground, there is no excuse for exhibiting it in a rusty or dirty condition. Every specimen should be cleaned methodically and always kept in good condition. It is permissible to replace minor parts such as the nipples on percussion type arms, flints

on flintlocks, occasional screws or bolts, and sling straps. The deliberate counterfeiting of parts or assembling of several parts improvised from different makes or models is not good museum practice. The proper thing is restoration by repair and cleaning to as near original condition as the piece will permit. "Arsenal condition" should be maintained as much as possible.

There are occasions when it may be desirable to exhibit the rusty remains of a gun dug out of the ground or salvaged from the sea bottom. Usually these pieces have corroded to a point where little or no metal remains, and the oxides will give no response to a magnet. The important thing to save in these cases is whatever may be left of the outside shape. If salts were present in the soil or if the piece has been dredged from sea water, it is first necessary to soak it repeatedly in water free from salts or other chemicals until all the salts have been extracted. It should then be dried thoroughly and given a protective coating to prevent further disintegration. Very often clay, mud, or oyster shells are firmly affixed to these iron pieces. They are removed by softening with hydrochloric acid and then boiling in caustic soda. There are effective methods of cleaning and restoring iron by electrolysis, but this treatment is too complicated for limited field facilities. One of two preservative methods may be used:

1. Boil the specimen in paraffin or beeswax until the liquid penetrates every crack and hole, then drain away the hot wax and permit the object to cool. Excess cold wax may be removed with turpentine, Stoddard solvent, or benzol.

2. Paint or spray the specimen with a thin solution of cellulose acetate in acetone and repeat the coats upon drying until a sufficient impregnation is obtained.

The same process also may be employed for any large iron object such as cannon, shot, machinery, and structural fragments. If rust has not penetrated too deeply, it may be cleaned off with wire brushes and sandpaper, using a pick to clean out little rust pockets. Chipping of rust and brushing is often done more effectively under water, which cleans away accumulations and prevents chips from flying into the eyes. After cleaning and drying, the specimen is primed with red lead, aluminum powder in lacquer, or one of the several standard metal primers. Finally, two coats, usually black, of a suitable outdoor metal paint are applied.

To properly clean a gun or pistol, first be certain it is not loaded and then proceed to take it completely apart. Every nut, bolt, and spring should be removed systematically until each piece can be arranged on the work table. The springs may be compressed in a vise to facilitate removal.

Having segregated the wood parts from the metal for separate cleaning, soak the iron and steel pieces in kerosene oil to soften the rust which is then removed from the inside mechanism with steel wool and fine emery paper. Where rust has caused pits to form, they should be cleaned out with a hard wood pick and fine steel wool rubbed into the hole with the hands. In cleaning the outside of the barrel, emery or sand paper, as well as steel brushes, should be avoided. It takes longer to use steel wool, but the results justify the time. If gold or silver inlays are encountered, cleaning must proceed with due care for these softer metals. If the original bluing, browning, or nickel plating still remains, it should not be removed. Rust pits should be cleaned out individually and no attempt made to re-blue the barrel. If the gun is in good condition and still capable of being fired, the inside of the barrel should be cared for as in a modern gun in service.

To clean out the bore, a steel cleaning rod fitted with a standard brass- or bronze-bristle brush is employed with a powder solvent. This preparation may be bought ready mixed or made up of equal parts of gum spirits of turpentine, refined sperm oil, and acetone. They are added to each other in the order mentioned and kept tightly corked when not in use. The mixture is inflammable and should be used away from fire. After cleaning the bore with the solvent, dry it thoroughly with flannel wads attached to the cleaning rod. If gun oil or gun grease is not available, a light machine oil or vaseline may be employed to protect the barrel from further rust.

The wood parts usually can be cleaned by wiping with linseed oil. Gold, silver, and mother-of-pearl inlays should be protected from damage in the process. More serious cases require a fine steel wool or complete removal of varnish or other undesirable finishes with acetone. Dents in the wood may be removed by wrapping the stock in a cloth rinsed in hot water and pressing with a hot iron, the steam thus raising the wood back to its original level. Linseed oil may then be rubbed in, allowed to dry, and followed by a beeswax paste to restore the original luster. Wood parts of firearms should never be varnished or lacquered, since the soft sheen of carefully rubbed wood is just as desirable on a walnut gunstock as on a fine mahogany table. All the metal parts, internal as well as external, should have a protective film of oil. Sometimes exhibition requirements make it necessary to lacquer the metal. This should be done without touching the wood parts. The inside of the barrel and mechanism should be heavily coated with gun grease. The bore should be left unplugged, since plugging often causes harm by retaining moisture.

Every flintlock should have a flint of suitable size and shape mounted

in the jaws flat side up, with a packing of leather soaked in tallow. It is customary to exhibit a flintlock with the pan open and lock off tension or at half-cock.

Proper storage of guns requires racks to hold them upright side by side. They take up less room this way and are less liable to damage by falling against each other. Pistols may be laid out in drawers or on shelves. Special racks also are recommended for swords and pole arms. Guns and pistols should be kept out of leather holsters while in study collections. The leather causes a much more rapid rusting by attracting and retaining moisture.

Armor, swords, pole arms, and similar objects principally made of iron and steel should be cleaned in the same way as guns by the use of steel wool, except for such parts as are of gold, silver, brass, nickel, wood, mother-of-pearl, or other materials. Descriptions of cleaning methods for each class of material are given in another part of this chapter.

Natural History Objects

ROCKS, MINERALS, AND FOSSILS

The collecting, cleaning, and preservation of geological specimens are, with notable exceptions, relatively simple and require few special tools. Rocks for the study collection should be of uniform size and shape—about 3 inches by 4 inches by 1 inch. The edges should be fairly straight and the top and bottom surfaces slightly convex. To prepare such a specimen a fresh, unweathered piece of the rock broken directly from the outcrop should be used if possible. This piece should be shaped into a hand specimen by holding it in one hand and breaking off the edges a little at a time by sharp, oblique blows of a light geologist's hammer. Holding the specimen in the hand is important in giving the proper character to the blows. Practice, of course, will be required. Specimens that illustrate special structures or dynamic geology often will need to be larger and of individual shape. They should be trimmed by the same method as required. While hand specimens are excellent for the reference collection, they are not always best for study or for exhibition. For study thin sections are often needed and will have to be prepared with special apparatus in laboratories equipped for that purpose. Specimens that are to be exhibited are usually much larger than for study and appear to better advantage if the central portion of one surface is polished. This is particularly true of granites and other rocks having a structure not readily seen in rough form. Minerals which are transparent or partly so reveal much hidden beauty

when exhibited in thin slices which have been polished. They may be placed in front of a light which is diffused with etched or opal glass or merely placed in a window. Mica, jade, obsidian, alabaster and other kinds of gypsum, marble, dripstones, and other calcites, as well as the many forms of quartz such as agate, chalcedony, and onyx, are particularly suited for this treatment.

Some rocks will be weak and friable. If strengthening is needed to consolidate the specimen, it may be dipped in white shellac, cellulose acetate, or a solution of gum arabic in water. Porous specimens should be left in the liquid for several hours to permit good penetration.

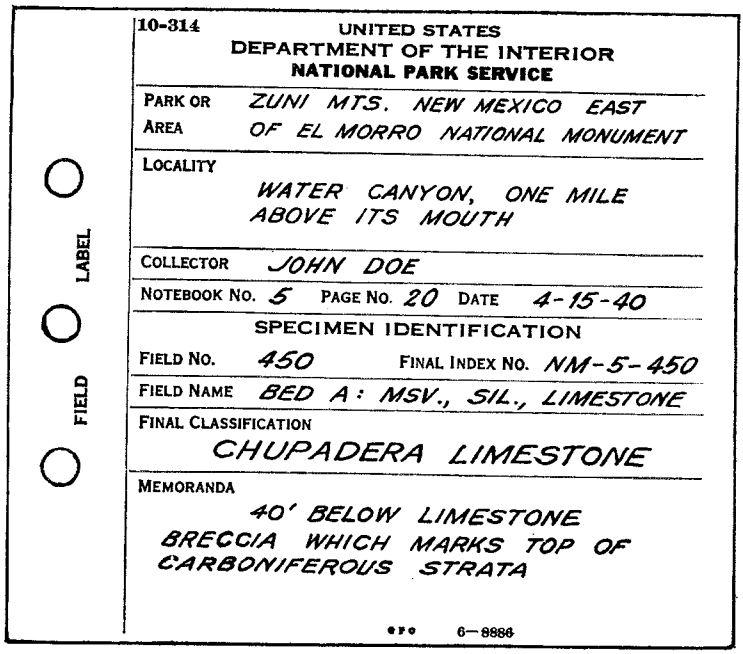
Mineral specimens, as a rule, are not trimmed to any specified size because of the nature of their occurrence. Portions of the surrounding rock or matrix which interfere with the display of the mineral should be removed, but it is often advisable to leave the matrix as a base for the specimen so that the mineral associations may be illustrated. This may be done in part by the hammer as described above for trimming rock specimens. The finer remnants may then be removed with small steel tools and brushes. Crystals may be worked out of their matrix with the same steel tools when this is desirable. Sometimes specimens have crystals artificially fastened in a manufactured matrix. A soaking in acetone and several other solvents will usually detect such a fraud. Cleaning is all that most minerals require, but a few need special preservative treatment. Minerals that deliquesce should be sealed dry in small glass jars to keep moisture-laden air away from them. Some specimens of lignite also must be sealed in airtight jars to prevent them from falling to pieces. The colors of some minerals fade in the light, and simple precautions should be taken to keep them in the dark as much as possible. A few minerals undergo chemical changes when exposed to the air which may even transform them into other minerals of different color and character. In such cases the specimen should be coated with shellac or with cellulose acetate. Other minerals may decompose badly and in so doing give off decomposition products harmful to adjacent specimens. If these products are acid, the specimen should be washed thoroughly and even treated with an alkali, if necessary, to remove every trace of the acid. It then should be coated with cellulose acetate or shellac.

Fossils require more preparation than most other geological specimens. They are usually entirely removed from their matrix for either study or exhibition. Invertebrate fossils embedded in hard rocks are worked free by means of small steel tools and brushes applied with painstaking care. The tools should be of hard steel sharpened to a variety of points and edges and can be made from awls, fine chisels, and discarded dental probes. By chip-

ping, pressing, prying, scraping, and brushing the specimen can be removed and cleaned. This work must be done with great care to avoid breaking or marring the fossil. Fine scratches sometimes can be erased with a little dilute hydrochloric acid. When fossils are embedded in shale, much of the cleaning can be done by alternate baking and slaking. The fossiliferous rock is heated in an oven, then sprinkled with water, and the process repeated until the shale is largely disintegrated. The fossils then can be washed out or worked out with tools. Nodules containing fossils can be split open by heating in an oven and dropping into cold water. In some instances it is better to split nodules with a sharp hammer blow. To remove fossils from clay, potassium hydroxide may be used. A piece of the solid caustic may be laid on the clay and allowed to remain until it absorbs water from the air and attacks the clay. After the hydroxide has acted for some time, the loosened clay may be washed away. When siliceous fossils occur in limestone, they can be etched out with dilute hydrochloric acid, giving very delicate and fragile specimens. These refined methods are used particularly to obtain small forms which could not be tooled out successfully. Fossils which are friable or not well indurated may be strengthened by soaking in shellac, cellulose acetate in acetone, or a gum arabic solution. These solutions should be used very thin.

Vertebrate fossils are worked free from their matrix by the same sort of delicate, patient tooling used with invertebrate material. Frequently the bones are left attached to the matrix along the lower side, which serves to support them and keep them in position. It is often necessary to harden vertebrate fossils. This is done by impregnating and coating them with a gum arabic solution, shellac, cellulose acetate, or similar material. The treatment should be given to each new section as soon as it is exposed. Vertebrate fossils in particular may require expert handling, and field men unfamiliar with the methods should not attempt it. Various techniques in mineral and fossil preparation require special training and experience. Valuable specimens should be entrusted only to a competent operator.

Geologic specimens in the museums are labeled by the catalog number, which is lettered on in permanent form. This number refers to the catalog book and file where full data on the specimens are kept. For convenience, a small specimen label may be kept with the specimen. If the specimen is to be exhibited, the number should be applied to the least interesting part, thus keeping the "show side" free from markings. Preferably each specimen should be in an individual cardboard tray placed in the drawer of the storage cabinet, and the specimen label can be laid in the tray with it. Every specimen must have a full field label, made out at the time of


10-314 UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

PARK OR AREA ZUNI MTS. NEW MEXICO EAST OF EL MORRO NATIONAL MONUMENT

LOCALITY WATER CANYON, ONE MILE ABOVE ITS MOUTH

COLLECTOR JOHN DOE

NOTEBOOK NO. 5 PAGE NO. 20 DATE 4-15-40

SPECIMEN IDENTIFICATION

FIELD NO. 450 FINAL INDEX NO. NM-5-450

FIELD NAME BED A: MSV., SIL., LIMESTONE

FINAL CLASSIFICATION CHUPADERA LIMESTONE

MEMORANDA 40' BELOW LIMESTONE BRECCIA WHICH MARKS TOP OF CARBONIFEROUS STRATA

6—8886

FIELD LABEL

Figure 25.—STANDARD LABEL USED FOR MINERALS

collection and kept with the specimen until it is cataloged, giving the name of the specimen, its geologic significance or place in the geologic column, the area and locality in which it was found, a reference to the field notebook where further information is recorded, the date collected, and the collector (*see* Fig. 25). A photograph of its location in the outcrop is frequently a valuable record. If the specimen is a small fossil, the photograph of it which should be taken for the catalog will be more detailed and satisfactory if the specimen is first coated with a thin film of sublimate of ammonium chloride. To apply this coating first clean the specimen with dilute alcohol, then by means of a simple apparatus blow fumes of concentrated hydrochloric acid and ammonium hydroxide onto the specimen. The fumes react in the air and deposit the chloride in a fine layer. After photographing, the film may be wiped off with alcohol. Descriptions of the apparatus may be found in the naturalist handbook or in *The Regional Review*, January 1940.

INVERTEBRATES (EXCLUSIVE OF INSECTS)

Marine invertebrates should be exhibited either alive in aquaria or modeled in some plastic medium like wax. Specimens in fluids are suitable

only for the study collections. Since the proper methods of preserving these animals are exceedingly complex—differing even for species of the same genus—and only a few park museums are concerned with marine organisms, detailed directions will not be included here. It should be sufficient to refer to an old but standard publication which may serve as a starting point, viz, *The Methods Employed at the Naples Zoological Station for the Preservation of Marine Animals* translated by E. O. Hovey from the Italian of Dr. Salvatore Lo Bianco. This is Part M of Bulletin No. 39, United States National Museum. A visit to the preparation department of one of the marine biological stations also is recommended. In addition, a few methods of general application may be mentioned. Jellyfish and other fragile, transparent coelenterates should be preserved in formaldehyde, but for almost all other forms alcohol is better. Few arthropods should be kept in alcohol stronger than 70 percent. If corals are allowed to dry uncleaned, an impervious coating forms that is difficult to remove. When first collected, they can be cleaned by placing in running fresh water until all the animal tissue is macerated and washed away. Otherwise, the specimens will require bleaching, which may be done as follows:

1. Soak in water with trisodium phosphate or "Oakite" (1 handful to a pail of water) for 24 to 48 hours.
2. Spray with a stream of clear water to wash thoroughly.
3. Soak overnight in a solution of Javelle water (1 cup of Javelle water to a pail of fresh water).
4. Wash for 1 or 2 hours in running water, the length of time depending on the size of the specimen.
5. Dry in sunlight.

A narcotic of wide usefulness in relaxing invertebrates for killing is a solution of exactly 153.74 grams of magnesium sulphate to a liter of water. When completely narcotized, specimens are killed in formaldehyde—5 parts of commercial formalin to 95 parts of water—then fixed in 90 percent alcohol. It is desirable in most cases to dilute the fixing solution gradually to 50 percent, then increase the strength to 80 percent for final preservation, a precaution which should prevent shrinking. This method preserves both form and color very well.

The shells of marine, or of land and fresh-water, mollusks do not present as difficult a problem. If the soft parts are not retained, the shells may be preserved readily. The soft parts can be removed by leaving the animals in dilute alcohol for a day, or better by placing them in lukewarm water and slowly bringing it to a boil. Shells should be removed from the water as soon as it starts to boil. After one of these treatments the visceral mass

can be removed from gastropods by a hooked wire or by other convenient instruments. The operculum, if present, should be saved and vaseline used to prevent its cracking. The adductor muscles of pelecypods can be severed and the soft parts removed without breaking the hinge ligament. The valves then should be closed and tied shut with white string until dry. When the soft parts have been extracted, the shells should be washed clean with water and small brushes. Hard incrustations can be flaked off very carefully with small steel tools such as are used to clean fossils or dissolved in dilute hydrochloric acid. The acid will damage the shell unless handled carefully. Actually, incrustations are often more interesting than the shell itself. Iron oxides can be removed with dilute oxalic acid, but this should be applied to the outside only. Lingering odors can be eliminated by syringing the interior with ammonium chloride. The surface of marine and fresh-water shells should be treated with vaseline. A small amount is rubbed in thoroughly and the excess wiped off; too much will leave the shell greasy. Some fresh-water shells have a thin epidermis which may tend to crack in drying. This should be remedied by dipping the shells in calcium chloride solution. Small land or fresh-water shells can be cleaned by shaking them in a vial containing sharp sand and filled with water or by soaking in alcohol and arsenic. Larger land shells can be cleaned with a tooth brush and water or by the heating treatment described above. Acids and oil should never be applied to land shells. Shells can be polished with rouge powder or putty powder and a buffing wheel, and a few drops of boiled linseed oil will restore the sheen of fresh-water unionids. The catalog number should be permanently lettered on each shell and this should be done before applying vaseline or oil. Shells are kept in cardboard trays in the drawers of the storage cases, using one tray for each species as a general rule. Smaller, fragile specimens should be placed in vials with cotton to prevent breakage. Specimen labels may be put in the trays if desired. The most important precaution in storing shells is to avoid extreme changes in temperature and moisture. Those with delicate colors, particularly yellow and some reds, should not be exposed continuously to sunlight as the color will fade. The bodies of aquatic mollusks can be preserved in an expanded condition by drowning in deaerated water to which a few drops of tobacco juice have been added, then transferring to 25 percent alcohol, and gradually increasing the strength over several days to 95 percent alcohol, in which they are stored. To kill land mollusks, fill a jar to the brim with water, immerse the specimens, screw on the lid, and leave for 12 hours. Complete the killing in formaldehyde, 3 parts commercial formalin to 97 parts water. The specimens then should be washed and

placed in 70 percent alcohol for preservation. Do not leave in formaldehyde nor use stronger than 4 parts commercial formalin to 96 parts water because shells are affected by it.

Fresh-water crustacea are not very difficult to preserve. The higher malacostracan species should be killed in weak alcohol, which is gradually increased to 75 or 80 percent, the correct strength for preservation. Ostracods are killed in 70 percent alcohol and preserved in 80 percent. Copepods can be killed and preserved in 75 percent alcohol, cladocerans in 95 percent, and phyllopods in 70 percent. A few genera of cladocerans need to be killed in a chloral hydrate solution and worked up through the alcohols gradually to prevent distortion. Ostracods have to be dissected for study, and this can be done in glycerin.

The less conspicuous land and fresh-water invertebrates usually form an important, if neglected, part of the park fauna. Preservative methods are specialized, and such a manual as Ward and Whipple's *Fresh-water Biology* should be consulted. Only general methods are outlined here. Water mites are killed and preserved in the alcohol-glycerin-acetic acid mixture mentioned in the next section for smaller insects. Bryozoa should be narcotized in chloral hydrate to keep the polypides expanded and preserved in 10 parts of commercial formalin to 90 parts water. Earthworms can be killed in weak alcohol which is then gradually strengthened to a preserving percentage. The aquatic annelids, however, should be narcotized in chloretone and fixed in a solution of corrosive sublimate. They should be held straight while hardening and then stored in formalin of moderate strength. Free-living nematodes should be killed and fixed in Bouin's fixative, washed, and transferred to water containing 5 percent of glycerin. The water is allowed to evaporate slowly until strong glycerin remains. The worms then can be mounted in glycerin jelly. These forms are delicate enough to require this rather specialized treatment. Parasitic nematodes are killed in a heated solution of 9 parts of 80 percent alcohol to 1 part glycerin, and can be preserved permanently in this same solution. For study in glycerin, the solution should be allowed to evaporate slowly until the glycerin is concentrated. Heating an alcohol solution requires special care, of course. As a matter of fact, the roundworms require such complicated treatment that ordinarily they should be placed in alcohol and sent to a specialist. Tapeworms can be preserved in 4 percent formalin. Flatworms should be narcotized in chloretone, fixed in hot corrosive sublimate (if 5 percent of glacial acetic acid is added to the sublimate, it may be used cold), and preserved in formalin. The corrosive sublimate and acetic acid mixture is a good fixative for hydra also. Sponges should be

preserved by thorough drying, but for study, spicules will have to be removed by boiling fragments in nitric acid, washing, and mounting in balsam. Protozoa are attached to a slide with albumen adhesive, fixed with one of the standard fixing solutions, then dehydrated and mounted in balsam.

INSECTS

Insects, as the most numerous and varied of the animal groups in any park, should be well represented in park scientific collections in spite of the fact that their preservation demands more special equipment than most other forms. The general methods of killing, mounting, and preserving insects are standardized and are well described in easily available sources to which field workers should refer for detailed instructions, e. g.,

Felt, E. Porter. A Popular Guide to the Study of Insects. New York State Museum Handbook 6.

Klots, Alexander B. Directions for Collecting and Preserving Insects. Ward's Natural Science Establishment, Inc.

Lutz, Frank E. How to Collect and Preserve Insects. American Museum of Natural History, Guide Leaflet Series, No. 39.

Of possible importance for future reference on special methods for various groups of insects is the *Compendium of Entomological Methods* being issued one part at a time by Ward's Natural Science Establishment. At present copies are obtainable without charge as parts are completed and published.

The traditional means of killing insects is the cyanide bottle. This device, which may be purchased or home-made, is the most satisfactory for all the larger species of insects. A killing bottle may be made by placing a thin layer of potassium cyanide crystals in the bottom of a wide-mouthed glass jar and covering it with a layer of dry sawdust. The sawdust should be covered in turn by a thin layer of plaster of paris or several layers of white blotting paper cut in disks slightly larger than the bottle diameter and forced down onto the sawdust. The cyanide jar should be kept tightly closed except when opened to put in captured insects, both because the gas is poisonous and because the bottle loses its strength when left open. Cyanide always should be handled with caution. Do not keep your pipe and killing bottle in the same pocket, for example. If general collecting is being done, more than one bottle will be needed. Moths and butterflies must not be placed in the same bottle with other insects because their scales will rub off and disfigure the others. One bottle should be marked and reserved for the moths and butterflies exclusively. Insects should not be left in the cyanide bottle longer than is necessary, never overnight, because the interior becomes damp and soiled, and speci-

mens sometimes adhere to the sides and become stained. An alternative and somewhat cheaper killing bottle can be made by omitting the cyanide and soaking the sawdust with carbon tetrachloride. The carbon tetrachloride so used is perfectly safe from the human standpoint, and it kills insects rapidly. On the other hand, it tends to leave them rigid so should not be used with insects that are to be spread. Care must be taken, also, that the carbon tetrachloride does not wet the specimens. Some insects should not be killed in bottles of this sort. Minute species which are to be mounted on microscope slides are collected into liquid in vials. Alcohol (75 to 85 percent) may be used for this, but it is better to use a mixture of 70 or 75 percent alcohol with glycerin and acetic acid, which preserves without excessive hardening and also resists evaporation better than alcohol alone. In cold weather, beetles may be killed in 85 percent alcohol instead of the killing bottle. This will not do when it is warmer as the beetles spread their wings in the liquid, and it is practically impossible to readjust them satisfactorily.

After killing, most insects are mounted on pins and preserved dry. Special insect pins are required for this work—very sharp, slender, japanned steel pins with wire heads. They must be purchased from dealers in entomological supplies. Several sizes may be required but number 3 is a medium one of wide usefulness. In pinning there is a particular spot in the insect's body through which the pin should pass. This differs with different orders and the pamphlet by Klots or Lutz should be consulted for the approved position. The underlying principle is to keep the pin away from important body structures but near the center of gravity. Every specimen should be horizontal on the pin when viewed from the side or from the end, and the upper surface of each should be the same distance below the top of the pin. Many insects are too small to be pinned in this manner, yet should be mounted dry like the larger ones. If such an insect is soft bodied, it is mounted on a short, headless, extremely fine pin called collectively *Minuten nadeln*. This fine pin is mounted near one end of a small rectangular block of balsa wood, which in turn is mounted near the opposite end on a regular insect pin. Thus the small insect can be pinned in the collection along with larger ones. *Minuten nadeln* are best handled with forceps. When the small insect is a hard one, it is cemented to the tip of a small triangular cardboard point. The point is first mounted on a regular insect pin through its broad end. A slight drop of glue, shellac, cellulose acetate cement, or similar adhesive is placed on the tip of the point, which is pressed against the under surface of the right side of the insect near the center of gravity. The insect should be horizontal and

firmly attached to the cardboard. It then can be pinned in the collection with the rest. A punch can be purchased for cutting out the points from good grade white index cards. Before most beetles are pinned, they should be cleaned in a vial of 85 percent alcohol and left for 2 weeks. If they are still greasy, they should be transferred from the 85 percent alcohol to absolute alcohol and then to xylol for a brief degreasing treatment, after which they can be mounted. Green orthopterous species will retain their color better if placed in formaldehyde for a day or two immediately after killing.

Some insects must be spread as well as pinned. This is particularly true of the moths and butterflies. Spreading requires a special type of board and considerable time and skill. The directions in Klots will be found helpful. Spreading must be done while the insects are relaxed, and they stiffen as they dry soon after being taken from the killing bottle. Consequently, it often happens that moths and butterflies are collected faster than they can be spread. In this event each specimen, as it is removed from the cyanide jar, is placed in an envelope with wings folded. Small, transparent envelopes can be purchased for this purpose, or sheets of white paper can be folded into triangular containers (*see* Klots for directions). The data for the specimen are written on the envelope. Thus "papered," the insects can be kept until it is convenient to spread them. Before spreading dried specimens, however, it is necessary to relax them. This is accomplished by placing them overnight in a tight box or jar partly filled with wet sand. It is necessary to support the specimens above the moist sand so they will not be wet, and to add a few drops of carbolic acid to the water for preventing mold. Dragonflies and damselflies also should be spread, following the same general method employed for moths and butterflies. Along with this, a fine, stiff wire or broom straw should be run through the body from the head to the extremity of the abdomen to strengthen the fragile parts of these elongated forms. The wire or straw should be clipped off close to the head. When insects have been stretched on the spreading boards, they must be left for about a week to dry. While on the spreading boards they are subject to attack by mice and ants particularly. If such pests are likely to appear, the boards may be kept in a drying cage of wire mesh to exclude the mice, raised on legs set in pans of water to protect against ants. In very humid areas it may be advantageous to supplement natural drying by installing one or two 25-watt lamps under the cage. Sheathing the unit in muslin will help to hold in the heat while permitting circulation of air.

Proper labeling of pinned insects is highly important. Labels must contain at least the locality, date, and collector, and this information must be compressed onto an oblong slip of high quality white paper about ⅜ to ⅝

inch long by ¼ inch wide which can then be mounted on the pin below the insect. If the locality name is long, it and the date can go on one slip and the collector's name on a second, spaced below it on the pin. These labels can be lettered by hand in India ink with a crow-quill pen, but it is far better and not very expensive to have them printed. The printed label will bear the locality on one line; the month, space for the day, the figures 19, and space for the last two digits of the year on the second line; and the collector's name on the third. The proper date can be filled in with a crow-quill pen and India ink. Labels should be printed for the principal collecting localities and months when most collecting is done. Good standard labels of this type can be ordered from the supply houses. When the specimen has been determined by an authority, an additional label should give the name of the species and the determiner. The labels on all pins should be at the same height and face the same way (preferably parallel to the long axis of the specimen with the top of the label to the left) so that they take up a minimum amount of space. A pinning block with holes of the proper depth for each label is a great time saver.

Some insects cannot be mounted on pins satisfactorily because they are too small or too frail or shrivel when they are dry. Many of these may be kept in alcohol, or, better, in the alcohol-glycerin-acetic mixture mentioned above. This method is used for spiders, centipedes, and millipedes, and various other arthropod forms. Alcoholic specimens are kept singly in small glass vials, and the labels are lettered in India ink and placed in the vials with them. Vials should be kept tightly stoppered with the level of the alcohol just below the cork. Should the cork be left in contact with the liquid, it will deteriorate more rapidly and also discolor the contents. Alcoholic specimens must be inspected regularly to insure the presence of enough liquid to cover them. Very small species which cannot be pinned are mounted whole on microscope slides. The processes are specially adapted for different groups of insects and cannot be described in detail here. Essentially, the specimen is gradually dehydrated in increasing strengths of alcohol, cleared in xylol, and mounted in Canada balsam. Since such a whole mount is relatively thick, the cover glass should be supported by glass fragments. Specific directions can be obtained from experts working in the various groups.

Caterpillars and other larvae may be preserved in alcohol or inflated and dried, or the skins may be mounted on wax manikins.[7] Pupae and chrysalids may be pinned and dried after soaking in carbon tetrachloride for killing and degreasing.

[7] Ned J. Burns. Preparing insects for exhibition. The museum news, 7: 7–8. March 1, 1930.

Satisfactory methods of housing insect collections have been worked out after years of experimenting by workers in many groups. For pinned insects, the best is the unit-tray system, which provides a separate tray for each species with four or five standard sizes to choose from depending on the size of the insect and the extent of the series of specimens. The trays are fitted into glass-topped drawers in a cabinet. The vials of alcoholic specimens should be suspended on vertical, coarse wire screens by means of hooks, easily made of copper wire, attached to the necks of the vials. The screens are slid into a cabinet also. The essential feature in storing microscope slides is to keep them flat with the cover glass up. They should never be left resting on their sides because even thin whole mount slides dry out very slowly (10 to 20 years after mounting the center still may be soft) and gravity may cause the cover glass or specimen to drift downward, ruining the mount.

It usually is necessary to send insects to authorities working on special groups for determination. In doing so, it is particularly important to pack them carefully. Pinned insects should be placed in a small, stout box like a cigar box and the pins set into the pinning bottom with extra firmness. Pinning forceps should be used if possible, for if one pin jars loose, several specimens will be injured as it shakes around. A thin layer of quilting cotton may be spread on the floor of the box to catch broken appendages, and if all pins are the same height, a sheet of cardboard may be laid over them with enough cotton above it to allow the cover to hold the cardboard—and thus the pins—gently in place. This small box should be wrapped in paper and tied to keep out dust and dirt, then placed in a larger carton and packed with crumpled newspaper or excelsior all around. Finally, the larger box should be wrapped and tied securely. Vials of alcoholic specimens can be mailed by boring holes slightly wider and longer than the vials in the edge of a small wooden board. The vials should be set snugly in the holes with a little cotton for packing. The holes should be sealed by tacking a thin strip of wood along that side of the board. This can be wrapped and addressed for mailing. Single vials can be packed safely in stiff mailing tubes. Microscope slides may be packed in small wooden slide boxes, wrapped, and then packed in a larger carton as above. All these should be marked "fragile."

COLD-BLOODED VERTEBRATES

Fishes, amphibians, and reptiles will find an important place in the study collections of many parks. When they are being collected for record and study, all these forms are preserved in alcohol and therefore require gen-

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erally similar methods of treatment. It should be emphasized that alcoholic specimens make highly unsatisfactory exhibit material and are not intended for this purpose. The lower vertebrates should be cast in wax, plaster, or other material for display—a procedure that demands considerable technical skill not usually available in the field. The central laboratories are prepared to handle the casting of these animals when needed for exhibition. Preservation in alcohol involves the use of bottles or jars. The specimens must be kept permanently immersed in the liquid. Since alcohol evaporates rapidly, the containers must be kept tightly closed; and since the specimens must be gotten in and out, containers should be nearly as wide at the mouth as in the body. Two sorts of glass jars are in common use—those with stoppers ground in and those with tops held tight by pressure. The containers with glass stoppers ground in are manufactured as museum specimen jars. They give the tightest cover, but are rather expensive. Special jars of the pressure type also are made for museum use. These have no neck, being of equal diameter throughout, and the top is held in place by a screw clamp. Such containers are valuable for large specimens, particularly wide ones like skates or flounders, but for smaller specimens they tend to be top-heavy and a little awkward to use. Incidentally, these come in larger sizes than the other types. The pressure jar in widest use is the familiar spring top fruit can, which makes an inexpensive and generally satisfactory specimen jar. Both kinds of pressure-topped containers require rubber gaskets. The rubber deteriorates and must be replaced every few years. Accordingly, these jars cannot be considered as tight as those with ground-in stoppers. However, all alcoholic collections must be watched closely and the alcohol replenished before any part of the specimen is uncovered. As an added precaution valuable specimens may be wrapped carefully in cheesecloth which acts as a wick, keeping the specimens moist in case the alcohol level falls unexpectedly.

It is possible and customary to keep several specimens in each jar. This saves space and also expense in containers and alcohol. It necessitates very careful labeling, however. When first preserved, before they are identified and cataloged, all the fishes or amphibians or reptiles collected at the same time and place, i. e., having identical field data, may be put together in a jar. The data should be written in pencil, not ink, on a slip of strong white paper and placed in the jar with the specimens. Later, when the material is worked into the collection, permanent labels should be prepared. The scientific name, sex (if known), date, locality, collector, determiner, and catalog number should be lettered in India ink on a white linen tag and tied securely to the specimen with six-cord white linen

thread. Each specimen should have a separate label. With salamanders and lizards fasten the thread not too tightly around the body just back of the front legs, with frogs and toads just in front of the hind legs, with snakes around the first third of the body, and with turtles tightly around one leg. It is essential that the India ink be thoroughly dry before it is immersed in the alcohol. Warming the finished label over a lamp will hurry the process. These linen tags should be purchased with the label form printed on them. A convenient size is 2½ by ⅝ inches. (*See* Fig. 26, for the similar label used for study skins.) An alternate method of labeling may be used when all the specimens in a bottle are of the same species and also have the same field data. In this case a single large label may be placed in the jar against the glass where it may be read conveniently from the outside. These labels should contain the same data as the individual labels (with the exception of sex). They should be lettered in India ink on special paper that remains strong in liquid. Suitable brands of paper are in use at the larger museums.

The method of preserving these lower vertebrates involves three steps. The first step is to kill the animal in a relaxed condition. Then it is hardened in the desired position. Finally it is immersed in the preservative solution where it remains. Killing methods that leave the muscles relaxed are used to prevent the specimens being contracted and twisted into awkward shapes. Curled and distorted specimens are more difficult to study, they take up much more room in the jars, and they are more easily broken in handling. With fishes muscle contraction is not a serious problem and the killing and hardening can proceed together. The procedure for each group is as follows:

Fishes:

1. Killing:
   Drop alive into a solution of 1 part of 40 percent formalin to 10 parts of water.
   Leave in the formalin solution for several days.
   Wash well in water.
2. Preserving:
   Immerse in 75 percent alcohol (or higher concentrations up to 85 percent).

Amphibians:

1. Killing:
   Drop alive into a saturated solution of chloretone in water, or use as a substitute a weak solution of lysol.
   Leave in the solution not longer than an hour.

2. Hardening:
   Lay in a pan, straightening the body and tail and adjusting the limbs.
   Pour into the pan carefully a solution of 1 part of 40 percent formalin to 16 parts of water to cover the specimens.
   Leave in the formalin solution for 48 hours or longer.
   With all larger specimens inject some of the formalin solution by means of a hypodermic needle into the body cavity and tail soon after hardening has begun.
   Wash off formalin with water, but handle specimen carefully because it is now rather brittle.
   Preserving:
   Immerse in 60 percent alcohol.

Reptiles:

1. Killing:
   Drown in warm water. The process may be hastened by adding chloretone or a small amount of lysol to the water.
   Anesthetics such as ether and chloroform cause muscular rigidity and objectionable contraction.
2. Hardening:
   Snakes. Coil in a cylindrical pan or jar about the same diameter as the preserving container.
   Lizards. Lay in pan, straightening the body and tail and adjusting limbs.
   Turtles. Lay in pan, extending head, tail, and limbs.
   Cover with a solution of 1 part of 40 percent formalin to 16 parts of water.
   Inject the formalin solution into the body cavity and tail, making an injection every few inches. (Injection into the tail is important.)
   Wash well in water.
3. Preserving:
   Immerse in 75 percent alcohol or stronger.

BIRDS AND MAMMALS

The mounting of birds and mammals for exhibition is an art which requires years of practice to master properly and should be done in the central laboratories equipped for this highly technical work. On the other hand, study collections of the higher vertebrates are a local park responsibility and often form a large part of the scientific collections. The preparation of study skins requires considerable practice but little equipment and can be done in any park museum. A study skin is one prepared to be used for study

rather than for exhibition. The treatment has three objectives—permanent preservation, easy examination, and compact storage. The general methods used in making study skins of birds and small mammals are standardized and are familiar to most park naturalists. For the preservative value of alum, borax, and salt see "Preservatives" in the "List of Materials" at the end of this chapter. Adequate instructions are readily available in published form. Accordingly, full directions will not be repeated here. For these, workers are referred to the following sources:

Anderson, R. H. Methods of Collecting and Preserving Vertebrate Animals. Bulletin No. 69, Biological Series No. 18, National Museum of Canada.

Anthony, H. E. The Capture and Preservation of Small Mammals for Study. Guide Leaflet No. 61, The American Museum of Natural History.

Chapin, J. P. The Preparation of Birds for Study. Guide Leaflet No. 58, 2d ed., rev., The American Museum of Natural History.

Miller, Gerrit S., Jr. Directions for Preparing Specimens of Mammals. United States National Museum Bulletin 39, Part N, 6th ed., rev.

More extensive directions may be found in the following books:

Rowley, John. Taxidermy and Museum Exhibition.

Hornaday, William T. Taxidermy and Zoological Collecting.

Naturalists responsible for preparing large collections of study skins might well consider special training in this important phase of museum work. The University of Iowa conducts a regular course in museum methods of this sort, and by special arrangement instruction probably could be obtained at a number of larger museums and universities actively engaged in zoological collecting and research. Since improper preparation of the skins has caused the loss of many valuable collections, speed must never be sought at the expense of care.

Three aspects of study skin preparation may be called to particular attention. The necessity of removing all fat from the skin should be emphasized. No matter how carefully a skin is kept, it will deteriorate if the grease has not been removed. The grease will become rancid and "burn" the skin to excessive brittleness and soak through to discolor the feathers or hair. The greatest difficulty is with water birds, which require special attention, but every skin should be freed from grease with painstaking care. Without proper attention to this point the making of study skins is largely wasted effort. Secondly, attention is called to the use of

arsenic. Study skins have to be poisoned thoroughly to prevent destruction by insects. The free use of powdered arsenic is not dangerous if handled properly, but carelessness may bring unfortunate consequences. Arsenic is a stomach poison and should be kept away from the mouth. It is also a powerful skin irritant which ought to be kept out from under the fingernails, out of cuts, and away from the eyes. It is best not to dip the fingers into the arsenic. The third aspect is the importance of labeling. An unlabeled skin is worthless. A proper label should be a white linen tag, tied to a leg of the specimen with strong linen thread, and bearing in India ink the sex, date, locality (include elevation in mountainous regions), collector, and collector's number, catalog number, and the standard measurements. The reverse side is left blank for the scientific name when determined, together with the name of the determiner. Tags 2½ by ⅝ inches are generally used. Data should be recorded in a uniform manner, preferably as shown in Figure 26, in order to facilitate rapid study of specimens. The scientific value of the collection will be increased if a much fuller record is kept on file under the catalog number of the specimen. This record should be made when the skin is collected and prepared and should include the weight of the animal and notes on the condition of the reproductive system, number of embryos, stomach contents, parasites, and any other points of special interest.

A problem which sometimes arises with collections of bird and mammal skins is the cleaning and restoration of old specimens. If the question is solely one of cleaning, the following methods may be employed. Superficial dust can be removed with a vacuum cleaner, using a small upholstery cleaning nozzle and holding a piece of fine wire mesh between the fur or

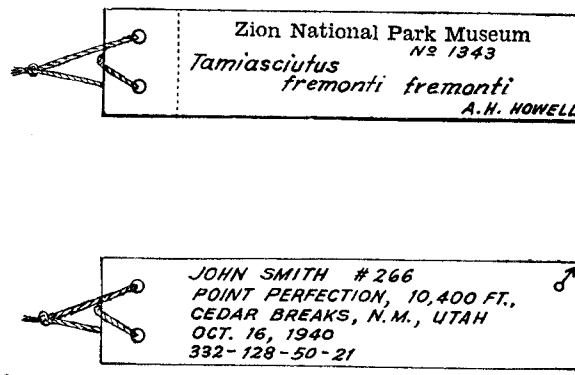

Figure 26.—FRONT AND REVERSE OF STANDARD LABEL USED FOR STUDY SKINS OF BIRDS AND MAMMALS

feathers and the nozzle to prevent them from being sucked in. More persistent dirt can then be dissolved in benzol, sponging the skin with a soaked wad of cotton and, in the case of birds, fluffing out each feather with forceps as it is washed. The dirt dissolved in benzol should be removed from the skin by a liberal application of dry plaster of paris. The plaster is removed by shaking and gently beating the skin. With very dirty specimens, the washing process may have to be repeated. Restoration is most frequently necessary with old mounted specimens that have become grease-burned. The process usually consists of relaxing the specimen, opening the incision, cutting the wires, and carefully removing the stuffing. Wires rusted in place need to be manipulated out with great care. Vaseline and sometimes heat applied to the end of the wire are helpful at this stage. When the skin is unstuffed, any remaining grease may be removed by soaking it in benzol and then dusting thoroughly with plaster of paris. Extremely brittle skin can be softened somewhat by working vaseline into it. After the skin has been made as clean and pliable as possible, it should be restuffed as a study skin.

A well-made study skin needs proper storage to preserve it in good condition. Tight, metal-sheathed storage cases are important to keep out insects and rodents, much of the dust, and sunlight. Frequent inspections should be made also for the poison and storage cases do not eliminate entirely the insect danger. Loose feathers and hair are a danger sign even when no insects are seen. Study skins of small animals are rather fragile and should always be handled with care. The danger of breaking and soiling through handling is lessened by enclosing each skin in a cylinder of cellulose acetate. These cylinders are easily made. Two round blocks of wood about half an inch thick and of slightly larger diameter than the specimen are cut for the ends. A strip of the acetate is cut wide enough to encircle the blocks without overlapping and long enough to include the specimen and the two end blocks. The cylinder is assembled by bending the strip around the blocks and fastening it in place by tacking it firmly to the wood with small escutcheon pins. The other wooden block is held in place by only one or two pins so it may be removed easily when the specimen needs to be taken out for close examination. The cut edges of the cellulose acetate are softened with acetone and molded together to make the cylinder tighter. These cylinders may be used for especially valuable or often-handled skins, particularly birds, or they may be adopted for all the smaller study skins. Some museums employ sections of glass tubing closed with corks, but there is danger of cutting the specimens in case of breakage.

Every study skin of a mammal should be accompanied by the animal's

skull. So many taxonomic characters are in the skull that the skin is of little value without it. Every skull should be permanently marked with catalog number and sex so it can always be associated with the skin. This may be done by lettering directly on the bone with India ink. The delicate skulls of smaller mammals should be placed in individual glass vials with cotton to prevent damage from shaking. Larger skulls may be laid in the cases without special containers or placed individually in cardboard pill boxes or trays, but the catalog number should go on both the cranium and the loose lower jaw. Skulls should be roughed out and labeled with collector's number on the same day they are collected; that is, all the flesh that can be removed safely should be cut off with scalpel and scissors. Also, if thorough cleaning must be delayed, as is often the case, skulls should be soaked in water for a day before drying. Before skulls can be cataloged and placed in the collection, they should be thoroughly cleaned. The brain cavity should be cleaned out cautiously with a wire, working through the spinal opening at the base of the skull. A syringe and water may help considerably. According to one good method, the skull then should be immersed in strong household ammonia for 48 hours. After this grease-removing treatment it should be immersed in hydrogen peroxide for from 48 to 72 hours to bleach the bone. Finally, any remaining bits of flesh should be picked off with forceps. Many workers find it more satisfactory to clean skulls by macerating, and all large skulls must be so cleaned, unless the dermestid method is available. Skulls are macerated by heating in water and bleached by direct sunlight, possibly aided by repeated spraying with hydrogen peroxide. For macerating, the water should not be boiled vigorously but held at a very slow simmer until the flesh becomes loose enough for removal. Chloride of lime should not be used in cleaning or bleaching skulls. During the cleaning process, care must be taken not to lose the identity of the skull. For larger skulls, a small metal label should be wired on if several are to be done at once. Smaller ones may be treated in separate jars or vials and these marked with the proper number. The dermestid method of cleaning skulls, referred to previously, is impracticable for small park museums; and on account of the danger of spreading the destructive dermestid beetles throughout the collections, it should be used only if the special facilities of a large museum are available.

Occasionally specimens will accumulate faster than study skins can be made up. If a refrigerator is available, the unskinned carcass can be kept for several days. An alternative method is to inject the specimen with formaldehyde and glycerin. Two solutions are used: The first, 1 part of

40 percent formalin in 9 parts of water, and the second, 3 parts of glycerin in 1 of water. The formaldehyde is injected first, inserting the needle into the vent, abdomen, flanks, neck, head, and limbs. The glycerin is injected in the same thorough manner 3 or 4 minutes later. The mouth should be swabbed out with the formaldehyde and, in birds, the crop given a separate injection. The amount of each solution injected is the same, varying from 3 cc. of each for a sparrow to 50 cc. for a rabbit. With larger mammals a little stronger formaldehyde should be used (15:85). This treatment will keep specimens in good condition for a period of several months if temperature and humidity are favorable. Birds and mammals should be preserved in liquid only when extra specimens are wanted for later dissection. A solution of 1 part of 40 percent formalin to 10 of water or one of 85 percent alcohol may be used for this purpose, but a mixture of 4 parts of alcohol (95 percent) to 6 of formaldehyde (2 percent), the latter saturated with table salt in solution, is preferred.

PLANTS

Herbarium specimens include plants (bacteria, algae, fungi, mosses, liverworts, ferns, horsetails, lycopods, conifers, and flowering plants) and any portions of a plant (spores, fronds, leaves, seeds, cones, bark, fruits, and the like) collected for display and study purposes.[8]

Collecting.—Every service area whose story deals partially or wholly with natural history and whose equipment includes a comparatively dry and fireproof storage room should strive to assemble a complete collection of plants which grow in and near the park or monument area. Collecting, however, is an art in itself and should not be attempted by the uninitiated without a knowledge of how, when, and what to take.

The equipment necessary for gathering plants depends somewhat on the distance the collector may be from headquarters. For a 1- or 2-hour trip a few newspapers moistened and wrapped around the plants may be sufficient, but a vasculum is the best receptacle in which to carry specimens for a few hours. Both a vasculum and a plant press should be included for an extended trip. The vasculum is an oval tin box about 16 inches long, 8 inches wide, and 6 inches deep, with a cover that occupies nearly the whole of one side. Its weight is approximately 3¾ pounds. There is usually a ring at each end for shoulder straps and sometimes a small,

[8] Samuel N. F. Sanford. The collection and preservation of flowering plants. Boston society of natural history, Bulletin no. 79. April 1936. p. 3–17; and S. F. Blake, Directions for collecting flowering plants and ferns. United States Department of agriculture, Circular 76.

separate compartment at one end in which the more delicate flowers may be placed. On hot days a wet newspaper should be inserted as a lining to the box to offset the increased evaporation. If the vasculum is painted white or aluminum, it will avoid absorption of the sun's rays and preserve specimens in a fresher condition. For ordinary work a collecting portfolio of some sort should be used unless the press is carried into the field. A simple and inexpensive one consists of two pieces of heavy binder board, each 12 by 17 inches. These are held together by a strap which may be tied or buckled together and passed over the shoulder. Some collectors find very useful an implement resembling a small, short-handled pickaxe, such as a geologist's pick, for digging and cutting roots. A trowel and intrenching knife are also useful pieces of equipment.

For collecting purposes a notebook and an indelible pencil are as important as a vasculum and press. When a plant is taken, the collector should note the locality, date, time of day, approximate elevation or life zone, condition of soil, and the habitat (such as wet border of pond, low or moist pasture, dry, open woods, and the like). The name of the plant is not of primary importance for this can be determined later, but the various features of the plant's habitat are most significant. A collector's number should be marked on the folder and used to designate the plant in the notebook.

The collector should not make the mistake of snipping off the tops of plants with only the flower and a few of the upper leaves. Many trees and shrubs may be determined by the leaves alone, but these form only a small part of the flora of any region. If possible, specimens should be selected that have both flowers and fruit on the same plant. If these cannot be found, two specimens should be collected, one with flowers and one with fruit. It should be borne in mind that most specimens are to be mounted on sheets approximately 16½ by 11½ inches, and if plants are longer than that they should be bent sharply once or twice before being put into the vasculum. When plants are too large to collect entire, they may be cut in sections, in sizes to fit the collecting sheets. In the case of tall plants, not only the upper part should be collected but also a portion of the base in order to show the basal leaves. A branch about a foot long should be collected from trees and shrubs along with specimens of the bark and of the sucker or shoot leaves when they differ from those on the main branch. Seeds and small fruit may be placed in envelopes and in the collecting sheets with the specimens from which they were taken. It is always a good idea to collect a few extra seeds and flowers to be used for analysis, to avoid disfiguring the mounted plant. Fleshy fruit, thick roots,

and large fleshy flowers should be preserved in alcohol and provided with labels. It is desirable that photographs of such material be made, of natural size if possible, otherwise on some definite scale. In the case of very fragile specimens, such as orchids, a wet newspaper should be wrapped around the plant, then a dry newspaper, then a piece of paraffin paper. This, in turn, should be placed in a cardboard box. Plants treated in this way will keep for several days.

Many of the fine-leaved water or aquatic plants, such as pondweed and bladderwort, collapse entirely if dried by the usual method. Such plants should be rolled up in a very wet paper in the field and brought to the museum. They should then be placed in water and floated out on sheets of white paper, which must be drawn carefully out of the water so that the finer divisions of the leaves will not stick together. These white sheets should then be placed in collecting papers and given the same treatment as other specimens.

Several groups of plants need special attention. Sedges and rushes are of little use unless collected in mature fruit. In all other groups it should be the aim of the collector to secure specimens showing flowers and fruit, as well as roots. Some trees, such as willows and oaks, flower before the leaves are expanded. In such instances flowering specimens should be collected and the shrub or tree from which they are taken should be marked so that the fruit and mature leaves may be secured later from the same plant.

Plants usually have a preferred habitat, such as dry, sandy areas, clay soil, limy soil, acid soil, or gravelly soil. If one desires to collect certain plants only, he should acquaint himself with their habitat and then go directly to the proper place. A knowledge of geology and soil conditions of a region may be necessary. If the collector's purpose is to record the flora for a definite canyon or meadow, he usually takes one or more specimens of everything. A thorough survey of such a canyon or meadow will require many trips at different seasons of the year, repeated over a series of years.

Pressing and drying.—After returning from the field, specimens should be transferred to the plant press as soon as possible. Inasmuch as the whole purpose of pressing plants is to get rid of the moisture, the best results cannot be obtained by putting them between the leaves of a magazine or book, since the glazed paper does not readily absorb moisture. Also, when two boards or the old-fashioned letter press is used, evaporation is limited to the sides and ends.

There are a number of plant presses on the market, including one with top

and bottom of wire meshwork, but the type in general use has a top and bottom composed of lattice frames made of strips of seasoned ash or oak strongly riveted together. Five or more pieces of this material, each about 18 inches long, 1 inch wide, and ½ inch thick, are selected for the long axis, and six or more similar pieces 12 inches long are fastened to them at right angles. Such a press allows free evaporation through the top and bottom as well as the sides. These presses can be made in the museum, purchased from dealers of botanical supplies, or obtained from the Western Museum Laboratories. It is a mistake to make a press of pine wood, for it will break under pressure.

Sheets of absorbent paper about 23 by 16½ inches, similar to the stock used for newspapers, are folded with the long hinge at the left. Ordinary newspaper may be used instead if desired. A fresh plant is placed within this specimen sheet, in the same position it is to occupy on the permanent mount. Some of the flowers should be spread open to show clearly the arrangement of the petals, stamens, and other appendages, and the leaves should be separated and flattened so as not to overlap other leaves or stems more than necessary. Always reverse one or more leaves so that any pubescence present will show, thus avoiding the necessity of breaking off a leaf for analysis. A little patience during this process improves the specimens. Unless plants are extremely fresh, some curling of the petals and leaves may be expected. The leaves should be flat when the upper side of the folder is brought down over them. Narrow strips of wet newspaper placed over them will hold them flat while the folder is adjusted, and extra moisture will soon evaporate. Specimens longer than the plant press should be bent sharply once or twice, in V–shapes or N–shapes, making it apparent that the angles are artificial. Creeping roots may be draped about the sheet to indicate their running habit. The collector's number, corresponding to a notebook record, and the date of collection should be marked on the folder.

Between every two specimen sheets containing fresh plants should be placed a sheet of absorbent felt paper or a large desk blotter, about 12 by 18 inches, the size of the press. It is of great advantage to have the pads or blotter hot before inserting them in the press. Sheets of corrugated cardboard (usually smooth on one side and corrugated on the other) should be placed at frequent intervals in the press in order to hasten the evaporation of moisture. The sequence of the process is to place on the bottom piece of lattice frame a felt pad or sheet of blotter paper, one or two specimen sheets containing fresh plants, a blotter, a sheet of corrugated paper, then another pad or sheet of blotter, another specimen sheet, and so on, thus building up a press with as many plants as possible, according

to the bulkiness of the specimens, finally adding the top frame and binding the entire apparatus with two or three strong leather straps, or rope. The straps should be tightened from time to time. When the press is full, it should be exposed to the sun or kept in a warm room. After a few hours the pads should be removed, and another set of warm pads inserted in their place. If the first two or three changes of pads are made soon after the plants are put in the press, the chances of preserving the colors are more favorable. Grasses dry quickly, while plants with thick leaves require a longer period of time. Experience will determine the time element.

Roots and stems are usually thicker than leaves and flowers and naturally will produce unevenness. This can be offset to some extent by slicing the thick roots lengthwise and placing them in the press flat side down. Wads of newspaper, distributed in the folders, will help to level the press. Crumpled tissue paper may be put into the baggy petals of such plants as the ladyslipper. Plants with dense clusters of flowers or fruit may be thinned out carefully, taking care not to destroy the outline of the head. Pricking with a needle the juicy fruit of such plants as the blueberry, the grape, and the plum will allow the slow exudation of the liquids without the loss of form that follows the crushing under pressure. Naphthalene flakes sprinkled in the folders with the plants help prevent molding. Many fleshy plants, such as purslane and orpines, are very hard to dry properly, their moisture content allowing them to live a long time in the press. If placed in boiling water for a short time, better specimens will be obtained. Care should be taken not to immerse the flower. Ironing such plants while in the folder with a very hot flatiron has been recommended. Cacti with flattened joints may be slit, scraped out, and dried in the usual manner. Those with round stems should be cut into transverse sections and dried.

The permanent retention of color in plants is almost impossible. Some collectors use color preservatives, but in most cases these have proven unsatisfactory. The United States Department of Agriculture has developed a process for preserving and displaying unpressed plant specimens in natural colors in a transparent methacrylate plastic. The plant, or any part of it, imbedded in this plastic is ready for permanent display but must have been thoroughly dried before being treated. The expense of such a process at the present time, however, is extremely high. Another process known as the Fessenden Process is being developed by the Department of Agriculture. The following brief description is taken from *The Florists' Review*:[9]

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[9] Flower colors preserved. The florists' review, 85: 42, March 7, 1940.

A chemical process for preserving plant tissue in natural color and form has been developed by G. R. Fessenden, of the Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture. This new method makes it possible to retain indefinitely the original beauty of flowers and the exact appearance of leaves, stems, roots and even cross sections of fruits.

Specimens of fresh material are treated by immersion in specially formulated water-removing syrups which set the pigments and toughen the tissues. Individualized treatment is necessary for nearly every species of plant, thus requiring highly specialized laboratory equipment and technique. After the proper formula has been worked out for retaining the natural coloration of a particular type of plant, the material to be preserved is immersed in its particular treating compound and kept at a lowered temperature until completely permeated.

The specimens after treatment, are sealed in a moisture resistant compound between sheets of transparent film, or on the surface of glass plates, so as to be thoroughly protected from mechanical injury and from insects and mold, and dehydration is then completed.

While numerous specimens have been prepared and are on exhibition by the department, the process is still in the experimental stage and will not be available for general use until it has been simplified and a number of technical difficulties worked out.

For practical purposes the frequent changing of absorbent pads or blotters and the application of heat will help retain the color.

The proper degree of dryness may be determined roughly by placing the palm of the hand on the plant when the press is opened. If the plant feels damp, or if the stems and leaves do not appear to be stiff, the specimen should be replaced and the drying process continued until all moisture is evaporated. To speed up the drying process the use of mechanical driers is recommended. Two types of drying cabinets have been used with good results, one that opens from the side by the use of swinging doors, and one that opens from the top by the use of a removable lid. These can be made inexpensively and are nothing more than a wooden box or cabinet heated from below by several 25-watt lamps. Above the lamps is placed a flooring of lattice strips and on this flooring plant presses are placed with the side or edge standing on the lattice floor. The number of bulbs used is determined by the size of the drier but under no conditions should the temperature in the drying cabinet be high enough to "burn" the plants, which should be inspected at frequent intervals. When plants are dried in a mechanical drier, the following preliminary drying method is suggested by Dr. William R. Maxon of the National Herbarium:[10]

It is very strongly recommended to those who use artificial heat in drying specimens that they wilt the plants by permitting them to dry slowly for the first 24 hours in specimen sheets *between driers only* under normal pressure. After this period corrugated

[10] Ivan Murray Johnston. The preparation of botanical specimens for the herbarium. 1939. Arnold arboretum of Harvard university.

boards or ventilators may be alternated with the driers and artificial heat applied. *Fresh plants, as a rule, should not be placed directly between corrugated boards alone, and heat applied at once, as this may result in very brittle specimens.* Material prepared by the method advocated above will be more pliable and will last much longer in the herbarium.

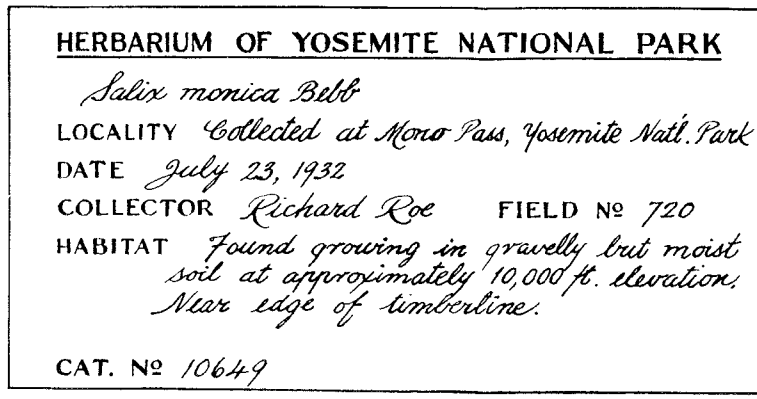
Poisoning.—Only an experienced technician should attempt to poison plant specimens in the field or in any of the National Park Service museums. The chemical used for such a process, corrosive sublimate, is extremely dangerous and, if used in an improper manner, may cause serious harm to both the operator and the plant. The National Herbarium does not poison its collection but depends upon the constant fumigation of plants after they have been mounted and placed in the herbarium case. At frequent intervals a tumbler of the mixture of 3 parts of ethylene dichloride and 1 part of carbon tetrachloride is placed in each herbarium case for 3 days or longer. For experienced museum technicians the poisoning formula used by the United States Department of Agriculture is recommended. Half a liter of 95 percent grain alcohol and half a liter of water are poured into a large photographic developing tray. Into this solution is added 60 grams of mercuric chloride. The technician, using rubber gloves and wooden tongs, dips the dried and pressed plant into the solution until it is thoroughly saturated. As much of the solution as possible is drained from the plant which then is placed in the press for several days until thoroughly dry. Several changes of blotter paper may be required for the operation. After the plant is thoroughly dry, it is ready to mount on the herbarium sheet.

Mounting.—Plant specimens should be mounted on standard herbarium sheets which are obtainable from the Government Printing Office or biological supply companies. These sheets, made of a good quality linen ledger paper, are standard in size, 16½ by 11½ inches. Only one plant should be mounted on a sheet and under no condition should any but standard size herbarium sheets be used. The arrangement of a specimen on the mounting sheet is largely a matter of taste. The plants should not all be mounted in the middle of the sheet, as this will produce a ridge with sloping sides. The lower right hand corner of the herbarium sheet should be left clear for the label. Three methods are usually employed to fasten specimens to the sheets: (1) A sheet of glass about 12 inches by 18 inches is covered evenly with herbarium glue and on this the dried specimen is placed face up to coat the back with glue, after which it is transferred to the mounting paper. This process requires care and skill, for if the flowers and delicate leaves are left too long on the plate of glue they will be torn on removal. This method has the advantage of thoroughly attaching all parts of the plant to the herbarium sheet, but once mounted this way it is almost impossible to tear the plant

or any part of it from the sheet. (2) The plant is attached to the herbarium sheet with strips of gummed linen paper. This is the fastest method and the one recommended by the National Herbarium. Scotch tape or adhesive tape should not be used for this purpose. (3) The first two methods are combined. The plant is not only glued to the paper with herbarium glue, but strips of gummed paper or cloth are applied also to hold it in place. For flowers and delicate parts of the plant, glue may be sufficient, but for thick stems gummed linen paper should be used. Seeds, nuts, small cones, and the like which are too bulky to be attached to the herbarium sheet may be placed loosely in a muslin bag and the bag fastened to the mounts. Large cones and fruits should be numbered and cataloged and placed in separate compartments in the herbarium.

Labeling.—The lower right hand corner of the herbarium sheet is usually reserved for the label. The size of the label is a matter of taste, but once it is decided on, it should be uniform on every mounted sheet. A common size is 4 inches by 2 inches. The labels should be made of thin, but strong paper and the ink should be of good quality so as to be permanently legible. India ink is recommended. It is customary to have printed on top of the label the words "Herbarium of ——— National Park." The label should include the name of the plant, where collected, habitat, date of collection, collector's name and number, catalog number, and any other information which aided (or will aid) in the identification of the plant. See Figure 27. Full data should accompany all specimens sent away for identification. Labels should be attached to herbarium sheets in a neat manner with a good grade of library paste or glue.

Storage, filing, and fumigation.—Herbarium cases constructed by the


HERBARIUM OF YOSEMITE NATIONAL PARK

Salix monica Bebb

LOCALITY *Collected at Mono Pass, Yosemite Natl. Park*

DATE *July 23, 1932*

COLLECTOR *Richard Roe* FIELD № *720*

HABITAT *Found growing in gravelly but moist soil at approximately 10,000 ft. elevation; Near edge of timberline.*

CAT. № *10649*

Figure 27.—STANDARD LABEL USED FOR PLANT COLLECTIONS

museum laboratories for storing study collections of plants will hold more than 2,000 mounted specimens. The cases are constructed of solid wood frames with sheet metal on the outside and are divided into two sections with five shelves in each. The mounted plants belonging to the same genus should be put together and inserted in a folder of heavy manila paper known as a genus cover, which is a trifle wider than the herbarium sheets. On the lower left hand corner of the manila cover should be written the name of the genus, and on the lower right hand corner the names of the species. The family name should be written in the middle of the lower margin of the cover. A separate compartment (or several together) should be used for each plant family. After plants have been mounted and filed in the herbarium case they should be fumigated at frequent intervals. This can be done by placing a tumbler of the ethylene dichloride-carbon tetrachloride mixture in the case for 3 days or longer. In addition to fumigating, paradichlorobenzene crystals should be kept in the herbarium cases at all times.

PRESERVATION OF SPECIAL TYPES

Bacterial cultures.—A culture of bacteria on agar agar is prepared in the usual manner and the sterilized cotton retained in the mouth of the test tube. A hypodermic syringe is used to inject a small quantity of formalin into the tube, and this is followed by placing a sterilized cork in the tube above the cotton and sealing with paraffin wax. The mouth of the tube is covered with a rubber cap.

Algae.—Most filamentous and other aquatic green algae can be preserved by a special copper sulphate process. Brown algae have been preserved successfully by immersing for several days or weeks as the case may be, in a mixture of 50 percent alcohol and 50 percent glycerin. If the glycerin disappears after the plant has been on display for some time, more may be applied with a small brush.

Liverworts.—Many liverworts can be preserved by immersing the fresh plants first in a mixture of equal parts of alcohol and acetone until the chlorophyll is extracted, and then transferring to a mixture of equal parts of the former mixture and glycerin until the plants are no longer brittle. They are then removed and allowed to drain. When the surface of the plants is fairly dry, a thin spray of oil paint of the shade desired may be applied.

Delicate ferns.—Delicate ferns are dried and pressed in the usual manner and then sprayed with a thin coat of oil paint resembling the color of the plant when collected. When such plants are mounted for exhibition, they

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are raised on pins about an inch from the background. The length of the supporting pins is varied so that the plant will not lie in one plane and possess a flat appearance.

Ferns and flowering plants.—It may be desirable sometimes to preserve especially important or interesting botanical study specimens by a method that will retain indefinitely their natural texture and pliability. Such specimens may be handled and examined without damage and may also be recolored with oil paints to resemble closely the natural plant.

Standard alcohol-acetone-glycerin solutions have been found to be the most satisfactory preservatives for general field use. They are used regularly in treating coniferous foliage. The usual proportions of the formula are 1 part of alcohol, 1 part technical acetone, and 2 parts glycerin. These proportions must be varied to meet the requirements of a particular specimen.

Alcohol and acetone in the formula are employed as dehydrating and bleaching agents, while the glycerin acts as a permanent substitute for the natural juices of the plant. The fresh specimen should be immersed in the solution and allowed to remain there until most of the chlorophyll is discharged. This may take from 24 hours to a week or more, according to the nature of the specimen. As a general rule, dense or fibrous material such as coniferous foliage requires a longer period of treatment or a preliminary immersion in a solution relatively stronger in acetone and alcohol.[11]

PROTECTION OF COLLECTIONS

Protection From Insect Pests

Of all the agencies attacking museum collections insects are the most dangerous.[12] They can be extremely destructive, and they are the hardest to keep out. It is almost inevitable that they will get into a collection sometime, and only eternal vigilance will prevent serious damage. Insects will attack practically all organic materials, including bone, horn, wood, and paper, but they are most likely to destroy such animal matter as wool, hair, fur, feathers, and skin. Insect collections are also especially liable to their attacks.

There are certain general precautions which should be taken without fail against insect pests. These preventive measures will keep the danger at a minimum, but insects are so ubiquitous that they cannot be eliminated

[11] Cyril J. Lane. Preparation of plants for exhibition. The museums journal, 39: 488, March 1940.

[12] Circulars of the U. S. Department of Agriculture dealing with the control of household insect pests have been consulted freely in preparing this section.

entirely. The first consideration is to prevent infested material from being introduced into the collections. All animal material received by the museum should be fumigated as soon as it is accessioned, and before it is allowed near the collections. Any material of plant origin which is at all likely to be infested also should be fumigated. For this fumigating a well-built, metal-lined chest should be provided in the museum workroom. A convenient size is 6 feet long by 3 feet wide by 3 feet deep. The cover should be removable and should be gas-tight when in place. A gasket of rubber tubing has been recommended to accomplish this, but the rubber must be replaced periodically. Common window fasteners may be used to clamp the cover shut. Since the fumigating gases are heavier than air, pans should be suspended from the under surface of the cover or from bars across the top to hold the liquid fumigant. The pans may be filled after the box is sealed by means of short lengths of pipe passing through the cover and tightly capped at their outer ends. Although several fumigants are in general use, the most satisfactory is a mixture of three parts by volume of ethylene dichloride and one part of carbon tetrachloride. This is far less dangerous to humans than hydrocyanic acid gas, and, unlike carbon disulphide, it is practically noninflammable. The ethylene dichloride before mixture with the carbon tetrachloride is, however, a highly inflammable liquid and should be handled with care. Fumigation should continue for 1 day, using between one-half pint and a pint for a chest of the size indicated. This will kill all the adult and larval insects but not necessarily all the eggs. Following fumigation the material should be quarantined for from 2 weeks to a month, preferably in a fairly warm place. This will permit any living eggs to hatch. Quarantining will consist of keeping the material in the workroom or elsewhere away from the collections, and an extra storage case should be on hand for this purpose. After a sufficient period of quarantine, the material should be fumigated a second time as described above. It is then ready for cleaning and incorporation with the collections. Accessions of plant material which are not fumigated should undergo quarantine before being placed with the collections, with a thorough examination for insect pests at the end of the quarantine period.

Having guarded against introducing infested material into the collection, the second general consideration is to keep out insect pests from other sources. This is done in two ways—by making the collection hard to get at and making it unattractive to the pests. The former involves tight cases. All storage cases should be metal sheathed and have tight fitting doors sealed with rubber or cloth gaskets, or with poisoned felt. The latter requires the use of toxic chemicals. In every drawer containing organic

material a liberal amount of paradichlorobenzene or naphthalene flakes should be kept. These substances evaporate slowly and must be renewed occasionally. The flakes may be scattered through the material or placed in a small open container in the drawer, depending on whether loose flakes might cause mechanical damage to delicate specimens. Avoid moth balls for this reason and also because they are bound with an oily material that may cause undesirable stains.

The third general preventive measure consists of frequent thorough inspections to detect any infestation at an early stage before it spreads to a dangerous degree. In most instances these inspections should be made once a month.

In spite of all these precautions and plain, good housekeeping, which is really important because several species breed in dust rolls and lint, occasional insect outbreaks may occur. There follows an account of the principal insect pests of museum collections with specific suggestions for their control.

THE CLOTHES MOTH (MOTH MILLER, MILLER)

Adult clothes moths are familar to most people. They are small, buff-colored insects having a wing spread of about half an inch, and are seen flying about the darker parts of rooms or running to conceal themselves when disturbed. They should be killed on sight. The larvae, which cause the damage, are white with a dark head when full grown and may be up to half an inch in length. Eggs are very small, white, and soft. Another evidence of the presence of moths is a fine web filled with pellets of excrement. Moth eggs hatch in from 4 days to 4 weeks, depending largely on temperature. The larvae may mature in a few weeks or they may live for 2 or 3 years in the destructive stage. The adults rarely live as long as a month.

Moth larvae feed on animal substances, particularly wool, hair, fur, and feathers. Woolen fabrics, upholstery, and study skins of birds and mammals are danger points. A serious infestation in a park museum was once found where the collector, transferring to another area, left behind a box of uncleaned mammal skulls without making provision for their proper care.

Control of the clothes moth, once an outbreak has commenced, depends on the nature of the material infested and the extent of the infestation. If the fumigator is available, all infested and adjacent material should be fumigated at once. In case the insect is already widespread, the whole room or even the whole building must be fumigated with hydrocyanic acid gas. Since cyanide is a virulent poison, this should not be attempted

by the local staff, but by a professional exterminator. When the attack has been caught soon enough and the fumigator is not at hand, individual items may be washed or dry-cleaned to destroy all stages of the moth. Should the emergency occur during the winter, exposure of the material to below zero temperatures for several days often will be sufficient to eradicate the pest. Chemical sprays—usually a high-grade kerosene with pyrethrum or derris extracts as poison—can be used to reach into cracks or other inaccessible spots, but they must be applied with a power sprayer to assure proper penetration. The poison must actually hit the insect to be effective. Frequent inspections of the collections should make the more drastic measures of power-spraying and room fumigation unnecessary.

CARPET BEETLES (BUFFALO BEETLES, BUFFALO MOTHS, MUSEUM PESTS)

There are several species of dermestid beetles which may cause serious museum damage. While they differ somewhat in appearance, the adults are all very small, oval, hard beetles, usually less than a quarter inch long. They are black or mottled above and often are seen on window sills. The larvae, which do the damage, are about the same size as the adults and are covered with long black or reddish-brown bristles, tufts of which protrude caudally. When carpet beetles are at work, the hairy, shrivelled, cast-off skins of the larvae are more often seen than the larvae themselves. The eggs of carpet beetles hatch in 1 or 2 weeks under ordinary conditions, but the larvae usually feed for about a year. During the larval molts the insects often crawl some distance from their food to a more protected place. This habit increases the difficulty of control. Adult beetles may live for several months.

The carpet beetle larvae are very destructive to the same animal materials as the clothes moth. Wool clothing, carpets, and upholstered furniture are among their most frequent feeding places, but leathers and study skins are very often attacked. One species is the worst pest of insect collections. It crawls up the pin and devours the inside of the specimen, completely ruining it. Often the only evidence that this destruction is in progress is a fine brown powder about the base of the pin. Sometimes carpet beetles feed on flour and similar plant products.

The best control method for limited infestations of carpet beetles is fumigation in the fumigating box. In the insect collection a heavy dose of paradichlorobenzene or naphthalene in the drawer may be sufficient. For upholstery, soaking with carbon tetrachloride, especially if the piece of furniture is covered with canvas to hold in the fumes, or using a power sprayer with oil and pyrethrum spray is effective. In using a power sprayer or

room fumigation to clear out a general infestation, the larval habit of molting in seclusion should be recalled. Several spaced treatments may be required to eliminate them.

DRUG-STORE AND CIGARETTE BEETLES (BOOKWORM, TOW BUG)

These two very small, reddish-brown, oval species have white larvae which assume a characteristic half-curled position. They multiply rapidly, completing the life cycle in only 2 months under favorable conditions. Dried vegetable materials and old books are subject to damage by these beetles, and they should be guarded against in park libraries and herbarium collections, particularly in the dried seeds and roots, and in dried herbs, corn, and similar items in Indian or colonial collections. A fine, brown powder at the openings of their burrows is a sign of their activity. Control should take the form of thorough fumigation of infested and suspected objects. In the case of books, to which the bookworm is the worst insect menace, fumigation in a vacuum with a liquid mixture of ethylene oxide and carbon dioxide is recommended, although hydrocyanic acid gas may be effective. This treatment requires special equipment and would have to be done at one of the libraries or archives possessing it. Accordingly, serious infestation of valuable books should be referred to the Museum Division so arrangements for treating can be made.

WOOD-BORING BEETLES (POWDER-POST BEETLE, DEATHWATCH BEETLE)

Wood borers, like the powder-post beetle, are discovered by the fine dust that accumulates below the openings of their tunnels. They should be watched for in wooden artifacts and furniture. In cases of heavy infestation these inconspicuous pests may riddle the wood with their burrows and cause apparently sound furniture to collapse. Ordinary fumigation may not be effective in controlling wood borers except under ideal conditions. Some workers have found it sufficient to coat the surface of the wood with cellulose acetate in acetone, filling the tunnels in the process. A more drastic measure that might be required is to immerse the object in carbon tetrachloride or benzol until the tunnels are surely permeated and then, after drying, coat the surface with paraffin or cellulose lacquer. If benzol is used, every precaution should be taken to prevent fire. Baking in an oven may also be used with success if the wood is not painted, varnished, or glued.

SILVERFISH (FISH MOTH, FIRE BRAT)

Silverfish are grayish, wingless, running insects, with tapering bodies covered by glistening scales. They are less than half an inch long and

have three long tail-like filaments. Their rate of development varies with circumstances, but under usual indoor conditions the life cycle may take 1 or 2 years. Their best environment is warm, moist, and dark.

These insects are increasingly destructive. They feed on vegetable materials, particularly those high in starch or sugar. They destroy paper to get the starchy sizing; they attack bookbindings, starched cloth, and especially rayon. Gummed labels, the surface of cheap cardboard tags, and photographic prints may be damaged. Their destruction of labels sometimes has diminished greatly the value of museum specimens otherwise not subject to their attack.

The recommended control is by poisoned bait placed in shallow cardboard boxes and covered loosely with a crumpled sheet of paper. Ordinary handerchief or necktie boxes are convenient. The baited boxes should be placed near where the siverfish are found. A good bait formula is:

	Parts by weight		*Parts by weight*
Oatmeal (ground to flour)	100	Granulated sugar	5
Sodium fluoride	8	Salt	2½

Mix the ingredients thoroughly. Remember to keep children and domestic animals away from the poison. If a bad basement infestation is found, it might be advisable to spray the walls and floor with a saturated solution of paradichlorobenzene in carbon tetrachloride, and then close it up for 24 hours. In mild cases a sprinkling of sodium fluoride along baseboard cracks and around pipes might be sufficient.

COCKROACHES (BLACK BEETLE, CROTON BUG, WATER BUG)

There are five species of cockroaches which commonly occur indoors in the United States. All are very flat, oval insects with rather long legs. Both immature and adults have the same general shape, but the adults have strong wings, extending down to cover the abdomen except for the females of one species. In color the various species range from light brown to brownish-black, and some have yellow or black markings on thorax or wings. Cockroaches vary in size from the newly hatched nymphs less than one-eighth of an inch long to the 2-inch adults of one species. The life cycle of most cockroaches takes about a year but may be prolonged by unfavorable conditions. Cockroaches feed at night, tending to collect in dark hiding places during the day.

Cockroaches show a preference for starch but are practically omnivorous. They damage bookbindings and the surface of other objects often in search of paste. Insects on spreading boards are particularly liable to roach attack. All stages of the insect are destructive. Not the least of the harm

done by cockroaches is the bad impression their presence makes on museum visitors.

Cockroach control is fairly easy if the museum is not subject to frequent reinfestation from the out-of-doors or neighboring buildings. The best method is to use poison. Fresh, finely ground pyrethrum powder should be applied thoroughly to the cracks and crevices where they have been seen to enter. The powder should be blown into the cracks by means of a bellows or other device for greatest effect. So far as possible the stupefied roaches should be swept up and destroyed within a few hours. Since pyrethrum loses its effectiveness in a few days, the treatment should be repeated at intervals of about a week until no more roaches are seen. Pyrethrum is nonpoisonous to humans and domestic animals so it may be used with perfect safety. Sodium fluoride powder may be used in the same manner and sprinkled in the areas where cockroaches are most often seen. This is a stronger poison which must be handled carefully to avoid harm to children and animals. It remains effective longer than pyrethrum, but it should be cleaned up after 2 or 3 days and treatment repeated after a week or two. Arsenic mixed in library paste is sometimes used to control cockroaches but demands caution in use. A good method for protecting books is to cover one side of a strip of light cardboard with phosphorus paste, roll the cardboard with the paste inside, and place it out of sight behind the books.

ANTS

Ants can be a nuisance in a museum. Unprotected spreading boards of insects may be subject to attack, for example. The best control is to trace the ant workers to the nest which may be destroyed by pouring carbon disulphide into the opening, and covering it. If the nest is indoors, carbon tetrachloride is safer. When the nest cannot be located, sodium fluoride powder may be used as with cockroaches, but with care. There are numerous other methods of ant control including poisoned sweets which are effective for certain species, but these should suffice for most cases of park museum infestation.

TERMITES

Termites are somewhat like ants in general appearance and in their colonial habits. They differ, however, in having thick waists and wings (when present) twice as long as the body. In contrast to this, ants are characterized by narrow, wasplike waists and wings only slightly longer than the body. Termite workers are white and soft-bodied, while sexed individuals are dark colored and have the long white wings. Termites are

rarely seen except when colonizing swarms of winged individuals emerge, usually in spring or fall.

Termites may be very destructive to unprotected wood, including furniture, and to paper, cloth, leather, or many other materials left in contact with wood. They are particularly destructive in the Southern, Southwestern, and Pacific States but may occur in any of the parks. Since they are inconspicuous, watch should be kept for emerging swarms and for piles of discarded wings or dead winged adults. Branching shelter tubes on the surface of impenetrable materials and, in the case of dry wood termites, pellets dropped from occupied holes are signs of termite activity. Collections should be housed in tight, metal-sheathed cases as far as possible, and kept away from infested parts of the building. Furniture can be protected to a considerable extent by keeping the wood finish intact, particularly on cut ends. Wooden objects found to be infested may be soaked with orthodichlorobenzene several times, but this chemical is destructive to paint and varnish and has a bad odor. A simpler treatment is to blow sodium silicofluoride or paris green into the termite holes, or into holes bored for the purpose. In case of serious infestation in buildings, experienced exterminators will be needed.

Protection From Rodents

Museum collections that are not properly cared for invite rodent attack. There have been park museums where field mice made nests of irreplaceable labels and of woven grass artifacts. Insects on spreading boards left out to dry are particularly vulnerable, and many hours of painstaking work have been destroyed in a night. In fact, the principal danger from rodents is that they can cause much damage in a short time. Among the materials that should be protected from rodents are paper (including labels and herbarium sheets), mounted insects, dried plant specimens, archeological specimens of woven grass or similar material, bone, horn, and mounted skins. Temporarily housed study collections should be given special care. All the smaller rodents are possible museum pests. Mice, rats, chipmunks, squirrels, and similar forms should be guarded against rigidly. Pack rats are a special problem in some areas.

Fortunately, rodent control in museums usually is not very difficult. The first precaution is to place the collections beyond reach of the animals. This is one of the main reasons for using metal-sheathed storage cases. Open shelves and wooden cabinets should be considered only for specimens not subject to rodent attack. Even then the safety of the labels must be guarded. Since human food is attractive to rodents, lunches and candy

should be kept out of the museum buildings as a general rule and not allowed to remain in desk drawers or lockers. Partly cleaned skulls and "roughed out" skeletal material should not be left exposed for the same reason. When rodents are discovered in the museum, traps should be set for them and kept baited until all appear to have been caught. Ordinarily no further measures will be needed. If a particularly serious outbreak should occur, the remedy is general fumigation.

Protection From Fungus

Molds and mildews cause more damage to museum collections than generally is realized. Perhaps paper suffers the most, but leather, textiles, wood, and bone often are subject to attack, and molds have been found growing even on a thin coat of polish over metal. It is probably true that more of the literature of classical antiquity was lost by mold than by the willful destruction of barbarians. The present age may leave as fragmentary a record from the same cause. Mold growth is favored by warmth and moisture, and museums have difficulty when their collections are exposed to warm air of high relative humidity. In some park areas on the seacoast and in other humid regions, therefore, mold is a constant danger. Elsewhere it may occur seasonablly or during a period of unusually wet weather. Materials stored in damp basements and unventilated vaults are particularly subject to mold. Often the presence of mold will be apparent from the familiar velvety surface growth, but at other times discoloration of the attacked material will be the only visible evidence. However inconspicuous, growing mold is destructive to museum specimens and should not be tolerated.

The basic factor to be considered in controlling fungus in the museum is the constant presence of spores in the air. Whenever the proper conditions for germination exist, the mold may be expected to appear since there is no likelihood of keeping out the infective spores. Since mold cannot be kept away from the collections by any methods yet perfected, the most practical and effective control method is to maintain conditions unfavorable for its growth. This can be done readily with air-conditioning. It has been found that collections kept at a temperature of 70° F. and 50 percent relative humidity are untroubled with fungus attack. Some park museums should be air-conditioned throughout, but where this is not the case, any vault provided for storing valuable material should be equipped with an air-conditioning unit. It is possible to deter mold growth to some extent even without air-conditioning. Storage and study collection rooms should be above ground, preferably on the top floor. Underground basements are generally

unsatisfactory. At times when relative humidity is dangerously high in the study collection rooms prompt measures should be taken to dry the air. The first measure should be to increase ventilation, using electric fans if necessary. Often this will be enough to remove the excess moisture. If sweating walls, usually occurring in underground rooms in hot, humid weather, are the source of the humidity, anhydrous calcium chloride can be placed in open pans, or if possible, a silica gel installation should be made to absorb the water from the air.

If mold appears in the collections, either through neglect of these preventive measures or in spite of them, it should be destroyed without delay. The surface growth should be removed with a soft camel's hair brush, care being taken not to scatter the spores any more than necessary. Then the infected objects should be fumigated with thymol to kill the remaining fungus. For this purpose the objects should be spread on a rack 18 to 24 inches above an open dish of thymol crystals in a tight box and the treatment described in this chapter under "Paper and Parchment" applied. Mercuric chloride has been used often as a fungicide but generally speaking this violent, corrosive poison should be avoided and thymol employed in its stead.

Often after the mold has been killed an undesirable stain will be left on the specimen. If the stain is from a fresh growth, it can be removed quite easily (*see* "Textiles" in this chapter). Soap or saponin and water may be used on specimens for which washing is suitable. Dilute household ammonia may be used on wood or bone. An art gum eraser should be tried on paper stains. Discoloration resulting from long-standing infection is another matter. The stain itself is likely to be persistent, and also the mold will have weakened the specimen. If the specimen is valuable, it probably should be referred to the central laboratories. A bleaching method will be required that will not injure the already weakened object.

CASTING COMPOUNDS

PLASTICS

Cellulose nitrate or celluloid and cellulose acetate are used for casting both in liquid form dissolved in acetone and in thin sheets softened by heat. A surface first made impervious to one of these cellulose cements by glue or gelatin may be coated with several thin layers of the solution if each is permitted to dry before the next application. One difficulty with this method lies in the intrusion of numerous air bubbles which are hard to eradicate and require special skill to avoid. If a sheet of the material is subjected to the heat of boiling water or live steam, it suddenly becomes limp and may be pressed quickly into any desired shape between the two

halves of a mold. It will retain the molded shape upon cooling. Metal molds usually are necessary to withstand the pressure, although satisfactory casts have been made with plaster molds hardened for the purpose. Many new and useful plastics are being developed and are finding increasing use in the construction of museum displays. Clear, colorless methacrylate resin is apparently one of the most promising, but it cannot be cast successfully except under special laboratory conditions.

PLASTER

The most widely used casting material is plaster of paris made from gypsum, a natural hydrated calcium sulphate, by heating and grinding into several grades. The three most commonly used are building plaster, the coarsest grade which is mixed with lime for slow setting and used for plastering walls; molding or casting plaster, the medium grade, which is finer ground, reasonably slow setting, and is used for running mouldings with templates; and dental plaster, which is usually ground finer and has the property of setting much faster. The medium grade is used most frequently in museum work for casting and modeling. Dental plaster is not recommended except for casts from living persons or where quick setting is particularly desirable. Care must be exercised in storing plaster before use since too long an exposure to the air or dampness causes it to deteriorate.

Plaster should be mixed by placing in a bowl or pan clean water equal to the volume of plaster desired. The powder is evenly sifted into the water where it sinks until it piles up above the surface of the water and absorbs nearly all that remains. It should be stirred gently with the bare hand or a large spoon after scum and bubbles have been drained off with a little of the remaining water. It should not be whipped or stirred too much since this induces rapid setting. The plaster should be entirely free from bubbles when poured over the surface to be cast. It should be worked into the crevices and any air bubbles slid out with a soft bristle brush which should be kept wet and frequently washed in clean water to prevent plaster setting between the bristles. To prevent the plaster from sticking to a surface, a thin coat of oil or grease should be applied before casting. Olive oil, mineral oil, vaseline, or paraffin which has been dissolved in kerosene may be used for this purpose. This is always necessary with wood, stone, earthenware, animal bodies with hair or feathers, and nearly all vegetable material. If too thick a coat of grease is applied, however, the plaster will take the impression of the grease surface instead of the true surface of the specimen. Setting may be hastened by using warm or hot water, extra vigorous mixing, or the addition of table salt. The setting

period can be retarded by using ice water, little or no stirring, or the addition of a little glue water or vinegar. These last two substances make a stronger plaster when it finally sets. Additional strength may be imparted by soaking the cast in boiling paraffin or beeswax or by painting the surface with glue water or linseed oil. Dry colors may be added to the dry plaster before mixing until it approximates the final color desired. It immediately darkens when added to water but upon drying out will return to the original light color. The addition of too much dry color weakens the mixture.

In making large casts supports are necessary for strength since it is not considered good practice to make the casts more than a few inches in thickness at any point. After applying a layer to the surface to be cast and permitting it to set undisturbed except for a roughening of the top surface to gain a good bond, a second layer is applied by dipping flat wads of fiber such as hemp, sisal, or jute and applying them evenly over the surface. Burlap or rags may also be dipped and applied flat. Further reinforcement is obtained by fastening pipe, rods, or wooden strips to the back with plaster-dipped rags or fiber. If wood is used, it should be shellacked and fastened only at intervals, the rest left free from the cast, since water absorption by the wood will cause swelling and consequent damage to the cast.

To take a plaster positive cast from the negative mold the same procedure as outlined above is followed, care being taken to have the surface well oiled and free from undercuts which, if present, will lock the two pieces together forever. Where undercuts are present a piece mold is necessary. This is made by a series of castings against the surface of the specimen, covering only such a portion as will permit the negative to be pulled away in one direction without damage. The edge of the first piece is trimmed all around at a right angle from the surface and deep notches cut to make "keys" for accurate reassembly. This clean-cut edge is coated with thin shellac, and after it drys, with separating grease before another section is cast against it. When the specimen is too irregular in shape or complex in surface structure, a mold is made over it with latex, gelatin, agar agar, or a special casting glue. When these substances set they are elastic enough to permit removal, after which they spring back to their original shape. A positive plaster cast then can be taken from the inside after proper oiling. Since they are elastic, it is necessary to build a case or cuplike covering to hold them in correct position.

Many years of experience are necessary to master the fine points of casting. No one should attempt to make a cast of a valuable specimen without enough previous instruction and practice to avoid the numerous

errors leading to failure of the cast and permanent damage or loss of the specimen.

WAX

Beeswax has been used universally as a casting, modeling, and painting medium since the most ancient times and is one of the few organic substances which will last for thousands of years with little chemical change.

White beeswax is simply raw, yellow beeswax which has been purified and bleached. It generally is used in museum preparation where the yellow color may be objectionable.

Wax casts are made by melting the wax in a double boiler and pouring into a plaster mold which previously has been saturated with warm (not boiling) water. Casts are usually strengthened by backing with jewelers' or medical cotton fluffed out and dipped in the hot wax. Wax may be colored before casting by the addition of a little artists' oil colors or inert dry powder pigments such as painters' dry colors or precipitated chalk. The addition of too much powder may cause the wax to "liver" and become useless. The surface of a wax cast may be colored with artists' oil paints, dry color mixed with kerosene, flat water paints in a casein base, or merely by rubbing in dry powder.

Carnauba wax may be added to beeswax for greater hardness, but its excessive use causes brittleness. Melted rosin also increases the hardness while Canada balsam makes it more pliable. The use of these last two substances is no longer general in museums since they interfere with permanence.

The preservative use of wax is described under several headings such as "Wood." A synthetic wax known as "cerowax," which is one of the many petroleum byproducts, is used often in museums since it has many of the properties of natural beeswax with the added advantages of cheapness and a slightly higher melting point. It does not have, however, the colorless quality of bleached wax, which restricts its use to some extent.

Both the natural and synthetic waxes are soluble in such common liquids as turpentine, benzol, carbon tetrachloride, and acetone. These solvents are employed in making up various wax pastes and polishes.

PARAFFIN

Paraffin wax is composed of solid hydrocarbons chiefly of the methane series and is well known for its permanence. It has a low melting point, which makes it unsuitable for castings subjected to excessive summer heat. There are several types of paraffin, each with a different melting point, which should be borne in mind when this medium is used for a specific pur-

pose. It is soluble in benzol, xylol, chloroform, turpentine, carbon tetrachloride, and carbon disulphide and is impervious to acids and water. It is used frequently as a cheap adulterant or substitute for the more expensive beeswax in commercial casts and is responsible for the wilting so often seen in old-fashioned artificial fruit, flowers, and wax figures. Being soluble in xylol, it is excellent for infiltration as described under "Wood."

LATEX

A liquid suspension of raw rubber which may be thinned by the addition of distilled water, latex is one of the more recent casting mediums introduced in museum work. The simplicity of its use makes it feasible for the inexperienced to secure good casts from objects in place in the field. A layer of the latex, previously thinned as desired, is poured over the object and worked into crevices with a small brush or wire loop. After it dries, which usually is from 12 to 24 hours depending on the prevailing humidity, successive layers are applied and dried until a sufficiently thick coating has been achieved. This will vary according to the size of the cast from ⅛ to ½ inch. A plaster shell may be cast over the latex to serve as a receptacle to hold the model in correct shape. Usually no lubricant other than talc or soapstone powder is necessary as a separator. Ordinary talcum powder may be used since it is generally easier to obtain locally. It is important to apply the latex in thin layers since it will not be strong if built up too rapidly in thick layers. The material sets upon contact with the drying air and will remain soft and weak inside unless properly dried.

SULPHUR

Molten sulphur produces a cast of unusual sharpness and is often used for duplicating coins and medals. It should always be melted and poured under a hood to avoid the highly objectionable fumes. Sulphur casts should not be exhibited in the same case with silver or other metal coins since they will be affected seriously.

PRESS CASTING

Any pliable substance like plasteline, putty, or clay may be used to make a cast simply by pressing it firmly and evenly against the surface to be copied, which should be free from undercuts, and then gently lifting it off. A positive cast may then be made with wax or plaster. This is often a quick and convenient method of recording moldings and ornaments in building trim, or small inscriptions or relief on stone, metal, and pottery.

CLEANING MUSEUM EQUIPMENT

In addition to the information on cleaning and polishing various types of museum specimens and on the materials used in repairing and processing them, the following standard formulas are given for use with case equipment and utility furniture when commercially prepared products of known composition are not available.[13] It has been pointed out already that old and fragile specimens require special treatment, and each should be treated as described under those classifications.

GLASS

The large amount of plate glass usually present in museums calls for daily attention, since it is practically impossible to prevent visitors from touching the exhibit cases. Much of this fingering leaves an oily deposit which calls for cleaning with a solvent such as soap, trisodium phosphate, or ammonia. The use of powders and pastes is objectionable for daily use, since the dried, white powder cakes in the crevices of the frames and soon becomes unsightly. Clear water and ammonia are used most frequently for general glass cleaning. The liquid spray used for automobile windshields and windows also serves well to remove quickly local stains from finger marks which occur between washings. These glass cleaners are usually composed of 15 to 25 percent grain or denatured alcohol, colored with dye and sometimes perfumed. A small amount of glycerin or ethylene glycol may also be included, while isopropanol and other alcohols or solvents may be employed. A solution of 1 fluid ounce of diethylene glycol to 15 ounces of water to which a small amount of ethyl alcohol has been added is reported in the patent literature. The use of these cleaners in an atomizer adds greatly to their efficiency, since just enough is sprayed on the glass to loosen the dirt, which is wiped away immediately with a clean, dry cloth.

METAL

Bronze and aluminum case frames frequently are soiled and tarnished by visitors' hands, which leave behind a variety of deposits of oils and salts as well as stains from candy and chewing gum.

After cleaning the new metal with polishes and abrasives at the factory, a coat of cellulose lacquer usually is applied as a protection. So long as this coating remains unbroken the metal will not stain, but the lacquer is

[13] Circular C424, National Bureau of Standards, has been consulted freely and many of the washing, cleaning, and polishing formulas contained therein have been cited.

scratched easily and a coating of wax paste should be applied often for its protection. A paste made of equal parts beeswax and carnauba wax cut in turpentine or carbon tetrachloride is satisfactory, or a standard wax paste, such as is used for polishing automobile bodies, may be employed. The old lacquer may be removed with acetone when badly marred and the metal relacquered, or, if preferable, the wax paste may be used alone. Bronze stains from handling more quickly than aluminum and is in greater need of lacquer.

Brass, nickel, and other metal parts on furniture and equipment which need cleaning may be treated with a standard metal polish, but care should be used in cleaning nickel plating to employ a polish containing a finer abrasive than would be desirable for solid brass.

A satisfactory cleaner for chromium and nickel plating consists of one part precipitated chalk to five parts orthodichlorobenzene. Coarser abrasives, such as the diatomaceous earths, tripoli, and silica dust, of a fineness to pass through a No. 325 sieve may be added for brass and copper.

The electrolytic method of cleaning silver in a solution of sodium bicarbonate in an aluminum vessel has been discussed under "Silver." All metals should be washed with water after cleaning and rubbed dry with a clean cloth.

FLOORS

Wood, linoleum, cork, and composition floors should be kept in condition by cleaning followed by the application of a standard floor wax containing a large portion of carnauba wax. Tile and stone should be swept clean before washing. Trisodium phosphate should not be used on marble or limestone. Visitors to museums usually are devoting their entire attention to the exhibits and are not likely to watch their footing. Consequently, every care should be exercised to keep the floors from becoming slippery.

WOODWORK

Ordinary painted and varnished woodwork may be cleaned with a standard polish or a cleaner which will remove grease and dirt easily, restore the luster, and at the same time be removable to prevent dust from clinging to a slightly sticky surface. Mineral oil is the basis of nearly all oil polishes, which often contain linseed oil as well. Beeswax, carnauba wax, and synthetic waxes are the principal ingredients of wax polishes, while combinations of both wax and oils often are made for general use. Paraffin oil is used straight as an oil polish, while an emulsion of one part linseed oil and one part denatured alcohol in three parts of water is used

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frequently. This mixture must be shaken well before using. Another polish frequently used consists of:

Raw linseed oil	1 pint
Turpentine	2 pints
Beeswax	2 ounces

Directions given under "Furniture" should be followed when dealing with special woodwork.

Cellulose lacquer finishes and other modern plastics are being used with increasing frequency in museum equipment. Polishes containing abrasives generally should not be used because a vigorous rubbing will injure many of the softer surfaces. The following formula has been used successfully:

	By weight		*By weight*
Carnauba wax	4.5	Stearic acid	3.5
Beeswax	2.0	Triethanolamine	1.25
Mineral spirits	39.0	Water	37.25

To the above, diatomaceous earth or tripoli not exceeding No. 325 mesh may be added if an abrasive is necessary. The stearic acid and triethanolamine are added to the water and boiled to form a soap solution. The waxes are melted together and added to the mineral spirits and, after dissolving thoroughly, the solution is added to the soap mixture when it has cooled sufficiently to prevent loss of the mineral spirit by boiling. The abrasive also is added at this time, if it is desired, and worked in by shaking and stirring. The mixture should be shaken each time before using.

A wax polish for cellulose lacquer on metal such as automobile bodies and case frames may be made as follows:

	Parts by volume		*Parts by volume*
Carnauba wax	2	Benzol or gasoline (sp. gr. about 0.73)	3
Ceresin	2		
Turpentine	3		

Melt the waxes together in a double boiler and be sure to remove to a safe distance from the stove before adding the turpentine and benzol. Stir vigorously until cool to produce an even paste. Increasing the amount of solvents will make a liquid wax, while synthetic waxes such as "cerowax," as well as other hard waxes like Chinese wax, may be substituted in different proportions to fit a special need.

RUGS, UPHOLSTERY

Recommendations for cleaning museum specimens of oriental and antique carpets and rugs should be followed as listed under those headings in "Textiles."

Rugs and upholstery used by the public are spot cleaned for removal of grease and chewing gum with carbon tetrachloride until a wet cleaning by shampooing is necessary. The following mixture may be used on cotton, silk, velvet, and plush:

Stoddard solvent, ½ gallon.
Carbon tetrachloride, ½ gallon.
Turpentine, 2 ounces.
Denatured alcohol, 2 ounces.
Benzene soap (dry-cleaning soap), ½ ounce.

When dry cleaning is not sufficient, a wet cleaning may be resorted to, but care should be taken to avoid wetting the article any more then necessary. Soap made from coconut or olive oil is preferable for drapes and carpets. The following mixture has been used with success:

Olive oil soap, 2 ounces.
Coconut oil soap, 2 ounces.
Dissolve the above in 3 gallons hot water.
Add 4 ounces glycerin, 1 ounce borax and after becoming luke warm, add 2 ounces ethylene dichloride.

LEATHER

Follow instructions given under "Leather" in cleaning historical objects or museum specimens. Modern and synthetic leather may be cleaned or polished as follows:

Russian calf, white kid, black or tan vici:

Dissolve 8 ounces granulated castile soap in 1 gallon hot, soft water.
Add 3½ gallons warm, soft water; cool.
Add 16 ounces ethyl ether and mix.

A smaller quantity in the same proportions may be made.

Patent leather:

Dissolve 4 ounces granulated castile soap in 1 gallon hot, soft water; cool.
Add 2 quarts of denatured alcohol, followed by 16 ounces ammonia water; mix.

The following dressing for leather permits polishing and may be used on utility leather in place of manufactured liquid or cream polishes if desired, but its use on museum specimens is not generally recommended:

	Parts by weight		*Parts by weight*
Carnauba wax	2	Neat's-foot oil	1
Beeswax	2	Turpentine	4

MILDEWPROOFING TEXTILES

While not a cleaning process, mildewproofing can be applied to fabrics used as museum equipment if they are subject to fungus attack. It should not be attempted with specimens. Cloth is made mildew resistant by first placing it in a solution of 1 or 2 ounces of good laundry soap per gallon

of water, bringing to a boil, and continuing the heating for 20 minutes. Then the cloth is removed, the excess soap is squeezed out without rinsing, and the wet cloth placed in a solution of cadmium chloride, 3 ounces to a gallon of water. The cadmium chloride solution is heated for 30 minutes. Finally the cloth is wrung out and dried without rinsing. In drying use a cloth line rather than wire, for the latter will cause a stain.

Federal specifications have been prepared to suit the needs of various branches of the government for cleaners, polishers, and other specialized needs and are listed in the Federal Standard Stock Catalog. Technical descriptions of these various substances are contained in publications which may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Museum Division should be consulted on special cleaning problems dealing with museum specimens in park museums.

SAFE PRACTICES

In describing methods of cleaning and preservation frequent reference has been made to the dangers inherent in the various substances employed from the standpoint of bodily injury and the spread of fire. The careless use of inflammable liquids may not cause wholesale destruction in a fireproof building, but the contents of a collection room in such a building may be damaged and irreplaceable objects destroyed. Since it is desirable to use every modern safeguard to protect museum buildings, it is necessary to employ safe practices in their daily operation. Descriptions of standard safety methods and precautions are available elsewhere so are not repeated here, but certain potential sources of danger peculiar to museums are not commonly appreciated.

SAFETY EXHIBITS

Museum exhibits showing safe practices are desirable in parks where mountain climbing, skiing, and other sports are enjoyed extensively. The proper use of equipment and hazards likely to be encountered on various types of snow and ice are among topics which lend themselves to exhibits. The disastrous effect of a forest fire on scenic beauty as well as on ecological conditions also may be effectively shown as a museum exhibit. A portrayal of the methods used in detecting and fighting such a fire may be installed in a park museum or at a fire lookout frequently visited by the public.

INFLAMMABLE LIQUIDS

So far as possible carbon tetrachloride and Stoddard solvent should be used in place of the more dangerous benzol, alcohol, acetone, carbon

disulphide, and ether. None of the latter should be used near an open flame or fireplace or in a room with poor circulation. Obviously, smoking anywhere in the vicinity of these liquids is also dangerous. Ethylene dichloride before being mixed with carbon tetrachloride is another dangerously inflammable liquid. While these precautions in handling may be common knowledge, thought seldom is given to disposal of such inflammable liquids after use. The customary practice is to pour them down the sink, but it should be remembered that the trap underneath will hold most of the liquid if it is not completely washed out with water. The accumulated fumes have been known to cause an explosion hours afterward when another person unaware of the previous use approached the sink with a lighted cigarette. There is seldom enough of any inflammable liquid used at one time in a museum to create a dangerous condition in a cesspool, but it should be borne in mind where small systems are in use. All inflammable liquids should be kept in approved type spring-cover cans and only enough allowed in the museum building for immediate use. Extra supplies should be stored well away from the museum in a building specially designed for this purpose.

Static electricity generated by vigorously rubbing fabrics, chamois, or leather in the above-mentioned dangerous liquids may result in a spark causing ignition. This is another reason for preferring the use of Stoddard solvent and carbon tetrachloride.

COTTON

Seldom regarded as dangerous, cotton can cause a brisk fire when large quantities, usually loosely fluffed out on a table near piles of excelsior, tow, and similar materials used in making up study skins are ignited. All such stuffing material except that in immediate use should be kept in metal cans with spring covers. Large supplies should be kept in a special storage building away from the museum.

PARAFFIN

Paraffin is easily ignited while being melted in a double boiler over an open flame if some of the liquid runs down the side of the pot. Cloth or paper dipped in paraffin will also burn briskly when ignited.

BEESWAX

Beeswax will also burn, but usually at so slow a rate as to be easily extinguished. Good housekeeping requires that all stoves and pots be kept clean and free from accumulated drippings and that all inflammable materials be kept well away from stoves.

CELLULOSE NITRATE

Highly inflammable in solid form as well as in solution with acetone, cellulose nitrate, or celluloid, should not be used if the safer and incidentally more lasting cellulose acetate can be obtained. Extra quantities should be stored in special well-ventilated vaults or separate buildings if it is necessary to keep any on hand.

PAINTS, VARNISH, AND SHELLAC

Standard, safe practices should be followed in the use and storage of paints, varnishes, and shellac, all of which are dangerous.

FIREPROOFED CLOTH

Cloth may be fireproofed easily. Drapery and cover cloths should be treated for added protection to the building and collections.

Fireproofing solutions made according to the following formulas will impart satisfactory fire resistance to inflammable materials. All the solutions are prepared in the same way. The fireproofing substance is simply stirred into the water until a clear solution is obtained. In treating water-resistant fabrics, enough soap is added to the solution to form a suds. If the fabric to be treated has been laundered, probably no soap will be needed, as laundering removes sizing and makes the fabric absorbent. The cloth is dipped in the solution and the excess squeezed out. In the case of large pieces the liquid may be sprayed on.

FORMULA 1

Borax	7 ounces.
Boric acid	3 ounces.
Water (hot)	2 quarts.

If allowed to stand, this borate solution will usually become turbid and sometimes jellylike, but warming will quickly restore it to its original condition.

FORMULA 2

Ammonium sulphate	1 pound 9½ ounces.
Water	1 gallon.

If fertilizer-grade ammonium sulphate is used, strain the solution to remove dirt and debris. It is further recommended that just enough household ammonia be added to the solution to impart a distinctly ammoniacal odor. This will neutralize any free acid and temporarily retard the setting free of acid which causes deterioration.

FORMULA 3

Diammonium phosphate	2 pounds 1⅓ ounces.
Water	1 gallon.

FORMULA 4

Ammonium sulphate	12½ ounces.
Diammonium phosphate	12½ ounces.
Water	1 gallon.

In general, it will be found that one of the above formulas can be used on any material which is adapted for fireproofing in the home. Only formula 1 is recommended for clothing and household fabrics. Formulas 2, 3, and 4 may be used when the effect on tensile strength is not important as, for example, on sawdust, fiberboard, and loose cotton for insulating purposes.

Formula 1, the mixture of boric acid and borax, is one of the best fireproofing materials because the two compounds interact to give the solution just the properties needed to provide effective fireproofing.[14]

POISONS

Potassium cyanide.—The extreme danger in using potassium and sodium cyanides in solid or liquid form as well as the hydrocyanic acid gas derived from these solids has been emphasized whenever its use is mentioned in this manual. In a few instances there is no effective substitute, but its use in the field should be discouraged as far as possible since few poisons can kill as quickly as cyanide.

Mercuric chloride (bichloride of mercury or corrosive sublimate).—A violent poison when taken internally, mercuric chloride is also very dangerous as a dust in the eyes or nostrils and as a liquid on the skin. Nowadays its use in museums is greatly limited, and it should be avoided as much as possible.

Strychnine.—Limited in its use as a killing agent and dangerous internally or in cuts, strychnine should be avoided or used with due caution in park museums.

Snakes.—Care should be taken in handling poisonous snakes. It is sometimes difficult to determine when all life has ceased and no "experiments" should be tried with the reflex action of the muscles around the fangs or poison sacs.

Carbolic acid (phenol).—In concentrated solutions or as a solid carbolic acid causes severe burns and should be handled accordingly. Prompt flooding with water is advisable after accidental contact.

Arsenic.—White arsenic is a poison when taken internally. Its principal danger in museum use lies in the sores it causes if introduced into the eyes, nostrils, mouth, or cuts on the hands. It is an effective tissue killer, and severe sores resulting from its presence are extremely slow in healing. When used as a dry powder, it should be applied to animal skins with a cotton swab and never agitated to cause a dust to rise. It should never be touched with the hands or allowed to fall on the clothing. Prompt and thorough washing with soap and water is desirable when accidental contact is made.

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[14] Fireproofing fabrics. U. S. Department of Agriculture, Farmers' Bulletin No. 1786.

FUMES

Fumes from any of the fumigant mixtures described elsewhere should never be inhaled. The same rule applies to such volatile solids as paradichlorobenzene, thymol, and naphthalene in confined areas. Severe headaches and painful smarting of the eyes may result. Thymol should not be touched with the hands unless unavoidable since it is highly irritating to the skin, particularly in hot weather when the skin is perspiring. Flooding the parts with water and alcohol relieves the smarting. Contact with the skin or inhaling the fumes of acetone, benzol, ether, chloroform, formalin, and wood and denatured alcohol should be avoided as they all may cause unpleasant or even dangerous results.

INFECTIONS

There is seldom any danger in handling freshly killed birds or mammals, but care should be exercised in preparing animals which have been dead long enough for bacterial action to become well advanced. Open cuts received during skinning are dangerous but are less likely to cause trouble than needle pricks received while sewing up the skins. Immediate attention should be given to every cut no matter how small and medical aid secured at the first indication of soreness or swelling around such cuts or punctures which may have gone unnoticed at the time they happened. Since it is possible to contract Rocky Mountain spotted fever, tularemia, and plague from infected mammals while making study skins, adequate precautions should be taken. The best policy is to wear rubber gloves while handling specimens which might be infected and to wash in antiseptic solution afterward. If spotted fever ticks are the only danger, the specimen can be placed in a strong solution of phenol (about 10 percent) before skinning.

FIREARMS

The first thing to do with a gun is to be sure it is not loaded. This rule applies to ancient as well as modern firearms. Old-fashioned black powder is known to retain its explosive qualities even after a lapse of 75 years. With flintlocks and percussion type pistols and long arms a wire is inserted into the barrel and the distance it penetrates carefully measured along the outside. If it does not come well back of the touch hole, an extractor or worm specially designed for the purpose should be inserted and the charge removed. A rusty or green corroded percussion cap in place is always a danger signal. The chambers as well as the magazine of every gun should be examined for cartridges before attempting to disassemble

or clean the weapon. There are several instances where "I didn't know it was loaded" applied to serious and fatal accidents with antique firearms. Collections of small arms ammunition and percussion caps as well as old shells and grenades should have the powder and detonators removed by men experienced in this field. If the pieces are too badly corroded for safe extraction, they should be buried in a safe place or dumped at sea.

LIST OF MATERIALS USED FOR COLLECTING, CLEANING, AND PRESERVING SPECIMENS

As a convenient reference to the materials commonly used for museum work in the field, the following list has been compiled to supplement instructions already given for the various classes of specimens. A large number of chemicals and materials used for specialized purposes in the central laboratories but not of importance in the parks and monuments have been omitted to simplify the list.

ABRASIVES

Paper and cloth.—Garnet papers in all grades of fineness with the powdered abrasives glued to the surface are useful on flat surfaces. Numbers 1½ to 3/0 are most commonly used in woodworking while grades down to 6/0 or 8/0 are used on finer work and metals. Some of the finer papers called "wet or dry" are waterproofed and may be used on wet surfaces. Emery cloth is used generally on iron and steel, and crocus cloth is used in fine cleaning and polishing.

Powder.—Garnet, sand, emery, carborundum, pumice, tripoli, rotten stone, rouge, and precipitated chalk are a few of the many powders which give an array of abrasives from the coarsest to the finest. These are rubbed on with a cloth, or with steel wool and crude oil, for cleaning and polishing every metal from hard steel to pewter. A buffing wheel of stiff cloth may be attached to a power lathe and the dry abrasives applied for a quicker and stronger rubbing. A wheel brush with the lubricant added in paste form also is employed quite frequently. Care should be taken to avoid damage to the specimen by too vigorous an application to the wheel and a resultant wearing off of surface detail and manufacturers' marks. Hand cleaning takes longer but is always safer.

Steel wool.—Steel wool in various degrees of fineness, selected according to the size and nature of the work, is most acceptable for mechanical cleaning both dry and with kerosene or powdered abrasives. Fine grades are used for refinishing wood. An irregular surface can be cleaned to

greater advantage with steel wool than with cloth or paper abrasives which tend to reduce the high spots too much while the cavities are difficult to reach.

ABSORBENTS

Aside from the well known absorbent qualities of cloth and blotting paper, a few items of importance may be mentioned.

Corn meal.—Corn meal is a convenient absorbent in skinning birds and small mammals.

Photographic blotters.—Large photographic blotters used for drying prints are excellent as to size and quality for most flat drying. They are particularly desirable since care is used in their manufacture to exclude harmful chemicals.

Plaster.—Dry plaster of paris is also used as an absorbent powder in removing grease from bird skins after softening with benzol.

Precipitated chalk, fuller's earth.—Removal of grease by absorption may be effected by application in powder form of one of these earths. They are helpful in removing grease stains from porous stone such as marble when a solvent like benzol is applied and followed by a dry poultice of the absorbent earth which is kept in place for a day and replaced as often as necessary.

Sawdust.—In preparing mammal skins and large birds, sawdust is a most desirable absorbent of blood and grease.

Sphagnum.—The unusually high absorbent qualities of dry sphagnum often make this a convenient material in the field, when no other is at hand, for drying and control of moisture in excavated specimens.

Talc.—Powdered talc is used to absorb excess grease from a glue mold preparatory to the application of alum for toughening.

ACETONE (DIMETHYL KETONE)

A volatile, highly inflammable liquid. *See* Solvents; Cleaning Compounds.

ACID, ACETIC

Used for cleaning metals and as a stain remover. When diluting to a given percentage, note whether the bottle contains glacial (99.5 percent) or U. S. P. (36 percent). Vinegar is a weak and impure acetic acid and frequently is used as a convenient substitute for cleaning brass and copper.

ACID, OXALIC

A solution in water is used for ink removal. *See* "Textiles, Stain Removal."

ADHESIVES

Aquarium cement.—*See* section on waterproofing trailside exhibits in Chapter IV.

Casein.—Casein glue is prepared from milk curd and regarded generally as superior to fish and animal glues for museum work. Prepared for use by dissolving in cold water.

Cellulose acetate cement.—The most satisfactory and widely used adhesive for repairing and preserving museum specimens is composed of cellulose acetate dissolved in acetone, sold ready-mixed as a household cement in collapsible tubes or in quart and gallon cans. When used as a cement it has the consistency of honey, or it may be diluted with acetone to a watery consistency for finer work and use as a lacquer. It should not be confused with celluloid or cellulose nitrate which are not generally recommended because of greater inflammability and impermanence of color.

Chicle (chewing gum).—Frequently used as a convenient method of fastening specimens with irregular bases to glass shelves to prevent shifting caused by vibration and jarring.

Glue.—Varies from coarse animal glue used on furniture to isinglass, made from fish bladders, used for finer work. All are prepared by soaking in water until the dry glue has absorbed enough water to melt into a thick syrup by boiling in a glue pot or double boiler. Prepared liquid glues are more convenient to use but cabinetmakers prefer to use the boiled glue. (*See* "Glass" for preparation of isinglass in alcohol.)

Gutta-percha.—Commonly used in thin sheets for dry mounting photographs and other papers on cardboard backings. Becomes sticky while hot, adhesion being obtained with an electric iron or dry mounting press. Has a limited use in fastening cloth without sewing or wetting.

Herbarium glue.—While some workers use a good grade of prepared liquid glue, others prefer a special mixture of equal parts of cabinetmaker's glue and tin paste, such as is used commercially for pasting labels on cans.

Mucilage.—Mucilage is usually prepared with a good quality animal glue to which vinegar, alcohol, and alum are added. Its use in museum work is limited because of its yellow color on paper.

Paste.—Starch in various forms such as dextrin, wheat, and rye flour is used generally as a paste for paper and cloth. Arabic and other gums may be used separately or in various combinations with flour or dextrin. A small quantity of carbolic acid usually is added to prevent mold growth, while small quantities of glycerin prevent too great a brittleness after drying. This is important when fastening paper labels on glass bottles. Arsenic or mercuric chloride may be added also as an insecticide against silverfish

and roaches, but being poisonous these chemicals should be employed only where little or no handling will occur.

Plaster.—While generally regarded as a casting medium, plaster often is used to repair and fasten pottery, stone, and similar substances.

Adhesive for postage stamps.—The Bureau of Printing and Engraving uses the following formula for a postage-stamp adhesive:

65 percent Cassava dextrin (from Java only).
35 percent water.

Mix the two ingredients and stir while cooking until 100° F. is reached. Then apply hot.

Apparently no other dextrin has proved as satisfactory for this purpose. Domestic dextrin is used extensively in other water-soluble adhesives.

Rubber cement.—Rubber dissolved in benzol. Convenient and clean for fastening paper to cardboard mountings without wetting. Should not be used for permanent mounting since it deteriorates in time.

Wax.—Melted beeswax is an extremely useful adhesive for bone, ivory, and many other substances as well as for casting. May be mixed with carnauba wax for greater hardness. A synthetic wax, "cerowax," also is useful for this purpose, having the advantage of a higher melting point.

ALCOHOL, GRAIN (ETHYL)

This is preferable for all museum use in preserving, cleaning, and as a solvent. Denatured alcohol has a foreign substance added to render it unfit to drink. Wood alcohol may be used as a fuel. Neither wood alcohol nor denatured alcohol is recommended because of impurities which may damage specimens.

ALUM

An astringent sometimes used on bird and mammal skins in an emergency to prevent their total loss through skin slip.

AMMONIA (AMMONIUM HYDROXIDE)

Concentrated aqua ammonia is 35 percent ammonia gas in water. Used as a solvent and paint remover.

AMYL ACETATE

Solvent for cellulose acetate and nitrate. Not used as frequently as acetone in museum work. Often referred to as "banana oil," this chemical is used in metal lacquers.

ARSENIC

Commercial white arsenic is powdered arsenious oxide or arsenic trioxide. Used as a poison and preservative on bird and mammal skins. An irri-

tating and corrosive poison on living tissues. Used as insect repellent in paste form and a killing agent in some insect baits.

ART GUM

A safe material for rubbing out dust and pencil marks on paper.

BAKELITE

A plastic made by the action of formaldehyde on phenol. It is a hard, tough material used extensively for manufacturing ornaments and utility articles. It is sold in liquid form and is used effectively as a hard, durable, waterproof lacquer.

BEESWAX

Naturally yellow in color but bleached white. Used extensively for casting, modeling, and in polishes.

BENZINE

A petroleum derivative used as a dry cleaner and thinner in paints.

BENZOL (BENZENE)

Highly inflammable liquid derived from coal tar by fractional distillation. Preferable to benzine for museum use. The term "benzol" has been used throughout this manual to avoid confusion.

BLEACHES

Ordinarily bleaches are employed with great caution on museum specimens because of the danger of injuring the fibers in cloth and paper.

Hydrogen peroxide.—Most commonly used by being sprayed on cleaned skeletal material in sunlight. Also effective for bleaching textiles.

Javelle water.—Useful in removing stains and dyes from paper and cloth where the permanency of the fibers is not important. Its use should be avoided as much as possible on museum specimens.

Potassium permanganate.—An effective oxidizing agent, it must be used with great care.

Sodium hydrosulphite.—Frequently used as a bleaching agent.

Sulphur dioxide.—Commercially used as a straw bleach but rarely employed in museum practice.

CALCIUM CHLORIDE

Used to absorb excessive moisture in specimens.

CAMPHOR GUM

Sometimes used as an insect repellent and for preventing tarnish in silver.

CANADA BALSAM

Used for mounting specimens on slides for microscope work.

CARBOLIC ACID

See Phenol.

CARBON DISULPHIDE

An insecticide and solvent with limited uses since it is highly inflammable.

CARBON TETRACHLORIDE

A noninflammable solvent for fats and chewing gum; an insecticide, fumigant, and general killing agent.

CARNAUBA WAX

Harder than beeswax and frequently added for greater strength. Used extensively in floor and automobile waxes.

CASEIN

Prepared from milk curd. Used as a base for many water paints and an excellent glue for general museum work.

CASTOR OIL

A lubricant and dressing for leather.

CELLOPHANE

A viscous, transparent sheeting used to protect specimens from dust. Not desirable as a permanent cover for prints or manuscripts.

CELLULOID

A transparent compound of cellulose nitrate, camphor, and other ingredients. Not as permanent or satisfactory as cellulose acetate. Celluloid is highly inflammable.

CELLULOSE ACETATE

Used in transparent sheets as a protective covering on textile specimens, prints, and manuscripts. As a liquid it is the most generally used cement and lacquer in preserving excavated specimens and repairs of all kinds.

CHLORETONE

A white crystalline compound used in water as a killing agent for reptiles, amphibians, and invertebrates.

CHLOROFORM

A solvent and killing agent, preferable to ether since it is not inflammable.

CHALK (PRECIPITATED)

Used as a fine, polishing powder on metals, a filler in beeswax, and an absorbent of grease.

CLEANING COMPOUNDS

See "Textiles, Stain Removal," and "Cleaning Museum Equipment."

Clean water alone or with pure white soap is the most universal cleaner. In general, strong laundry soaps and cleaning powders which depend partly on free alkalis for their detergent action should be avoided in cleaning museum specimens. Since even the mildest soaps may leave behind a trace of alkali, saponin is generally recommended for museum specimens as being free from this objection. It is used in a similar manner by working up a cleansing froth; removes dirt quite effectively.

Ammonia.—Aqua ammonia is helpful in washing glassware and china.

Trisodium phosphate.—Trisodium phosphate or "Oakite" is a powerful and useful grease solvent but should not be used on marble or aluminum on which it has an undesirable reaction. It also is used in concentrated form as a paint remover and for cleaning corals.

Dry cleaners.—Under this heading come a variety of grease solvents such as benzol, gasoline, ether, acetone, Stoddard solvent, chloroform, and carbon tetrachloride. All but the last two are inflammable, but Stoddard solvent is generally used commercially, being inexpensive and less liable to ignition than the others. While acetone should never be used on rayons or synthetic fibers since it acts as a solvent, it often is effective in softening substances which resist the other cleaners. Carbon tetrachloride is especially effective for softening chewing gum, gutta-percha, and rubber.

Mechanical and absorbent cleaners such as bran and bread dough are helpful in removing stains from paper, as are "art gums" and rubber erasers.

CREOSOTE

See "Wood" for a description of its use as a preservative.

DERRIS

The active ingredient in many insecticides.

DEXTRIN

A vegetable mixture of soluble starch used as an adhesive for paper and an ingredient of papier mâché.

DIATOMACEOUS EARTH

An abrasive and polishing powder.

DRY MOUNTING TISSUE

See Gutta-percha under Adhesives.

ETHER (SULPHURIC)

A solvent for grease, fats, and resins. An anesthetic and killing agent. Highly inflammable. Acetic ether is not satisfactory for the above uses.

ETHYLENE DICHLORIDE (OR CHLORIDE)

The most generally satisfactory fumigant in combination with carbon tetrachloride. *See* Fumigants. Ethylene dichloride alone is an inflammable liquid requiring careful handling.

FIBER BOARD

Among the characteristics of pressed composition boards used in exhibit construction, resistance to warping is most important. Three and five ply boards are used frequently but the raw wood is painted or filled with a moisture resisting coating. Several of the pressed boards are made very hard and durable by great compression in manufacture and are preferred to the lighter, softer kinds where durability and permanence are of paramount importance.

FISH GLUE

An impure gelatin prepared from fish heads, bones, and skins.

FORMALDEHYDE

A preservative fluid substitute for alcohol. Formalin is a 40 percent solution of formaldehyde in water. This is the usual commercial strength and is further diluted for specific needs. This chemical is irritating to the eyes and nose and has a damaging effect on the skin.

FRENCH POLISH

This is not a compound but a method which consists of applying shellac which is rubbed into wood with a cloth slightly moistened with linseed oil as described under "Furniture."

FULLER'S EARTH

An absorbent in removing oil and grease stains from porous stone and from textiles.

FUMIGANTS

Infestations of insects and fungi are destroyed effectively by several lethal gases which should be employed only where a suitable fumigation chamber is available. If cyanide is used, these chambers should be provided with an exhaust fan to blow out the fumes after the proper length of exposure and thus prevent injury to the operator. When the chambers are provided with a pump to reduce air pressure a more efficient penetration is obtained.

Carbon disulphide.—This has a dangerously high inflammability and consequently has been superseded largely by the mixture of ethylene dichloride and carbon tetrachloride.

Carbon tetrachloride.—This is less effective as a killing agent in gas form than carbon disulphide but is free from the objection of fire hazard.

Ethylene dichloride and carbon tetrachloride.—Three parts of ethylene dichloride to one part of carbon tetrachloride form a most satisfactory liquid fumigant. Fourteen pounds per 1,000 cubic feet is generally sufficient for complete extermination. This mixture is particularly satisfactory since it is not only effective but also noninflammable because of the carbon tetrachloride, although ethylene dichloride by itself is highly inflammable. It should be given preference whenever possible.

Other gas mixtures which prove satisfactory are ethylene oxide-carbon dioxide, 30 pounds per 1,000 cubic feet; and methyl formate-carbon dioxide, 25 pounds per 1,000 cubic feet.

Hydrocyanic acid gas.—One pound sodium cyanide will generate enough gas when placed in acid for 1,000 cubic feet for 24 hours and is usually sufficient to destroy all life. It is quite efficient but among the deadliest known gases. Inhalation of even a small amount is usually fatal, and consequently it should be used only by experienced fumigators working under carefully controlled conditions.

Naphthalene and camphor.—These two solids often are substituted for paradichlorobenzene although their fumes are not as effective.

Paradichlorobenzene.—This white crystalline solid is highly volatile and in a small, confined space its fumes will kill the adult insects present and repel those which try to enter. It is used more as a repellent than an outright fumigant.

Thymol.—The white crystals are highly volatile and its vapors are used as a fungicide.

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GASOLINE

Sometimes used as a grease solvent and dry cleaner for coarse work. Modern automobile fuel contains poisonous additions and should not be used for cleaning.

GLYCERIN

A heavy, colorless liquid soluble in water. Often added to glue and paste to retain flexibility and used in some preserving fluids.

GLYCOL, ETHYLENE, AND DIETHYLENE

Used with alcohol in cleaning glass.

GRAPHITE

A black, native form of carbon. Lubricant as a dry powder in lock tumblers or dissolved in oil for heavy bearings. Protective coating for heavy iron in the form of "stove polish."

GUM ACACIA, ARABIC

A water-soluble adhesive for cloth and paper.

HYDROGEN PEROXIDE

An effective bleach for bone and textiles.

ISINGLASS

Pure gelatin obtained from fish bladders. An adhesive for fine work.

JAPANESE TISSUE (CREPELINE)

A thin, tough paper made from the long fibers of mulberry, used for mending and strengthening. *See* "Paper and Parchment."

JAVELLE WATER

A powerful bleach and disinfectant. Composed of chloride of lime, washing soda, and water. It must be used with great caution to prevent damage. *See* "Textiles, Stain Removal."

KEROSENE (COAL OIL)

Used to loosen rust on iron and as an aid in its mechanical removal. It is a fuel and not a true lubricant.

KILLING AGENTS

While it is a universal rule that no life be taken needlessly, a limited amount of collecting for scientific study of the fauna in park areas is neces-

sary. At times it also is desirable to dispose humanely of animals which have been wounded seriously or affected by disease. It goes without saying that when killing is necessary it should be done in the quickest and most painless manner known to science. Such killing of larger animals requires some skill and knowledge of anatomy which should be acquired from a veterinary surgeon or someone familiar with the most humane methods. Ordinarily for scientific collecting where shooting is not necessary the use of a lethal chemical causes less pain and does less injury to the specimen. *See* "Natural History Objects" for special methods of killing fishes, amphibians, reptiles, insects, and other types.

Alcohol.—Grain alcohol from 50 percent up is regarded generally as a satisfactory killing agent for beetles, scorpions, and other hard-bodied invertebrates.

Boiling water.—This is used in much the same way as grain alcohol for killing beetles and other hard-bodied insects, but the specimen should be transferred to alcohol or dried as soon as possible to prevent disintegration.

Carbon disulphide.—Because of the objectionable odor and high inflammability of this liquid it is seldon used as a killing agent except in fumigation.

Carbon tetrachloride.—This clear liquid readily evaporates into a gas heavier than air, and advantage may be taken of this fact in collecting insects on the ground or in holes by simply uncovering the killing bottle charged with the liquid and completely tipping over the bottle to pour the fumes on the insect. Results are quick unless a breeze is blowing, which may dissipate the gas before it takes effect. In liquid form carbon tetrachloride may be applied with a medicine dropper or with a wad of cotton to practically every type of air-breathing, small animal—both vertebrate and invertebrate. In the case of small vertebrates a liberal quantity of the liquid may be poured in a jar or can with a tight cover to form a convenient lethal chamber.

Chloral hydrate.—This drug has an action similar to chloretone and is preferred in some cases.

Chloretone.—In killing cold-blooded vertebrates, particularly snakes, it is important that the muscles remain relaxed. The white solid chloretone dissolved in water is used generally as a killing agent simply by placing the specimen in a covered jar of the liquid and allowing it to remain there until some time after bodily motion has ceased.

Chloroform.—This is used for the same purpose as ether and has the advantage of not being inflammable.

Ether.—Sulphuric ether may be used to anesthetize and kill mammals, birds, and all other air-breathing vertebrates by applying the liquid to cotton

or gauze held tightly over the mouth and nostrils. With insects a few drops are applied to the thorax. Ether must be kept away from fire.

Acetic ether has little or no use in museum work.

Formaldehyde.—Used sometimes as a quick killing agent for cold-blooded vertebrates, being injected into the brain. For some invertebrates formaldehyde is used regularly.

Lethal gases.—Any of the gases or their combinations as listed under Fumigants will serve equally well for killing specimens desired for scientific purposes or those which have been injured accidentally and should be dispatched as painlessly as possible.

Lysol.—This is commonly sold as a household disinfectant. It has a similar narcotic effect and may be substituted for chloretone. It has the advantage of being easier to procure in the field away from large centers of distribution.

Potassium cyanide.—Both potassium and sodium cyanide are used to generate hydrocyanic acid gas for fumigation by dropping into sulphuric acid in an earthenware vessel. This forms a quick acting lethal gas, which is extremely dangerous to use. For this reason cyanide is rarely used as a killing agent by museums except in bottles for collecting insects. These killing bottles are described in the section on insect collecting. A few drops of vinegar supplies enough acid to generate the gas rapidly and keeps the bottle highly active for several days, although the acid is not essential. Carbon tetrachloride has replaced cyanide in many instances since it is comparatively harmless and equally effective for most insects.

Strychnine.—Frequently this is used to kill large mammals by hypodermic injection. Specialized knowledge is required to mix the poison safely and in proper proportions and administer an injection in a humane manner.

LINSEED OIL

Used in furniture polish and as the principal binder in oil paints. Boiled linseed is preferable for nearly all purposes, particularly in the out-of-doors. Raw linseed oil is used chiefly in white lead and light colors. A drier may be added for quick setting.

LUBRICANTS

Watches, clocks, and the mechanism of guns, as well as large pieces of machinery, need oil for lubrication and protection from rust. It is important to select a lubricating oil of the best quality and proper weight for each purpose. These range from clock oil used on delicate mechanisms up through light, medium, and heavy machine oils to light cup grease and heavier grades. Since the structure of oil breaks down after considerable

use its periodic renewal in constantly moving parts is as important in a watch as in an automobile.

Graphite.—Used as a satisfactory lubricant in lock tumblers in place of oil, which tends to gum up and cause trouble.

Kerosene.—Kerosene is a fuel oil and should not be mistaken for a lubricant. It is useful during the process of removing rust by mechanical means but should be replaced by a true lubricating oil of the proper weight lest it permit rust to re-form after evaporation.

Paraffin.—Sometimes used on wood to eliminate friction (such as in cabinet drawers). Soap, however, is used more often for this purpose.

Vaseline, Neat's-foot oil, and castor oil.—Used to limber up leather. Vaseline is usually freer from acid and alkaline impurities and is preferable to the other two.

LYSOL

A common disinfectant used as a killing agent in place of chloretone.

MAGNESIUM CARBONATE

Used as an absorbent in stain removal.

MERCURIC CHLORIDE (CORROSIVE SUBLIMATE)

Insecticide and fungicide. A violent poison and a corrosive on metal.

MOTH BALLS (OR FLAKES)

Made of paradichlorobenzene or naphthalene.

NAPHTHALENE

A white, volatile, crystalline solid used as an insecticide. Inferior to paradichlorobenzene.

NEAT'S-FOOT OIL

Soluble in alcohol, ether, or chloroform. Used as a leather dressing and softener. *See* "Books" and "Leather."

ORTHODICHLOROBENZENE

A liquid used to kill termites by soaking infested wood in the chemical. Also used with precipitated chalk as a cleaner of chromium and nickel plating.

PARADICHLOROBENZENE

Volatile white crystals used extensively to kill or repel insects and deter mold growth in collections.

PARAFFIN

Used to afford a waterproof coating. Also used to impregnate animal and vegetable tissues. A lubricant for plaster molds when dissolved in kerosene. A cheap adulterant of beeswax.

PHENOL (CARBOLIC ACID)

A disinfectant and preservative; an insecticide and fungicide in book paste. Removes mold on pinned insects.

PHOSPHORUS PASTE

A mixture of phosphorus applied as a bait for killing insects.

PLASTELINE

A modeling wax compound of various lubricants such as petroleum jelly and olive oil with clay and powdered sulphur. It is not satisfactory for making permanent exhibits since it dries and cracks in time and the oil spreads and stains surrounding objects.

PLASTER

See "Casting Compounds," Adhesives, Absorbents.

PLASTIC WOOD

A mixture of cellulose acetate with fine sawdust or wood flour. Other ingredients such as glue, resin, and castor oil also are used to make this putty satisfactory as a crack filler.

PLASTICS

Bakelite is one of the best known of the older plastics. It is hard, durable, and resistant to attacks by water and acids. More recent plastics, particularly the transparent methacrylate resin, commercially known as Lucite and Plexiglas, are finding increased use along with many others. Opaque and transparent plastics are being cast under heat and great pressure into raised letters for exhibit captions and imitation of water in dioramas and are applied in liquid form for protecting and preserving many types of specimens. When plastics are used to impregnate fragile specimens, better penetration can be obtained in a partial vacuum. The air can be drawn from a tightly stoppered glass jar for this purpose by means of a tire pump. The pump can be converted easily to a suction pump by reversing the leather plunger and fitting a tire valve into the cap of the jar.

POPPY-SEED OIL

Used in preparing artists' oil colors; preferable to linseed oil for fine work.

POTASSIUM ACID OXALATE

Used to remove fruit and berry stains from textiles.

POTASSIUM CYANIDE

A violent poison used as a killing agent and fumigant; also a metal cleaner.

POTASSIUM PERMANGANATE

Purple-red crystals used as an oxidizing agent in bleaching out stains.

PRESERVATIVES

Alcohol.—The most effective preservative in liquid form for nearly all animal and plant specimens in strengths varying from 50 percent to 95 percent. Wood and denatured alcohol are not recommended for this use since they usually produce an undesirable white precipitate and have other objections.

Alum.—White powdered potassium alum is a combination of potassium and aluminum sulphate and is unusually astringent. Some formulas for preserving bird and small animal skins include alum with arsenic, but its use is not generally recommended except in an emergency to save the skin of a specimen which has been dead too long before skinning. Its application as fast as the skin is removed may prevent skin slip if it has not progressed too far. Its use should be limited, however, since it toughens the skin in a way unsatisfactory for future manipulation in mounting the specimen. This same toughening effect on gelatin is employed in hardening glue molds for longer wear.

Arsenic.—The commercial white arsenic, or arsenious oxide, in powder form is used for poisoning and preserving the skins of birds and mammals. It is dusted on the moist skin after cleaning and just before mounting. Sometimes it is added to a thick paste made of yellow laundry soap and warm water. Water may be added to thin the paste if desired. This arsenical soap has the advantage of being easy to apply evenly to all parts of the skin. The soap tends to neutralize any free fats remaining which would turn to acid eventually and cause great harm. Mixing in soap also prevents the dry powdered arsenic from flying into the air and entering eyes and nostrils where severe sores may be caused by its presence. Arsenic is an excellent meat preservative and its injection into animal tissues will permit them to be dried out and mummified.

Borax.—In dry powder form borax often is used as a substitute for arsenic in preparing study skins of birds and small mammals. While some collectors regard arsenic as much more preferable, borax has the advantage of being nonpoisonous. A strong borax solution also may be used to preserve large specimens of plants.

Carbolic acid.—Carbolic acid, or phenol, is a solid when pure and quickly turns to a pink oily liquid in the presence of heat or with a small amount of water. Its germicidal and fungicidal qualities are well known. It may be used to retard decay by immersing specimens in a 20 percent solution or by injection into the body cavities. It has been successfully used in concentrated form applied with a camel's hair brush to destroy mold growths on pinned insects. It is a poison when taken internally and causes severe burns to the skin in concentrated form.

Creosote.—*See* "Wood."

Formalin or *formaldehyde.*—Formaldehyde usually is obtained as commercial formalin, which is approximately a 40 percent solution of formaldehyde in water. It is used for preserving large specimens where the more expensive alcohol is not essential. It is also used as an embalming fluid and will hold off decay in a specimen for a considerable length of time when injected into the body cavities. Its toughening and hardening effect on gelatin is used in photography and for preserving mollusk shells which are in danger of disintegration. *See* "Shells."

Mercuric chloride or *corrosive sublimate.*—A powerful fungicide and insecticide soluble in alcohol and frequently used to protect botanical specimens from mold and insects but not generally recommended for this purpose. It has a corrosive effect on metals, reacts unfavorably on many other substances, and is a violent poison in the human system. Consequently it should not be used where frequent handling might permit its being carried to the mouth or the hands or where it will come in contact with metal or paints.

Salt.—Common table salt, sodium chloride, is essential in preserving large mammal skins which should be liberally covered on the flesh side immediately after removal. After applying the salt the skin may be rolled up for several hours or even a day to allow the salt to work in thoroughly, and after the adhering fat and other material have been removed and a second application of salt made, the skin may be dried and shipped to the tanner. The skins of ducks, cormorants, loons, and other water birds which cannot be cared for immediately have produced excellent mounts and study skins by applying salt to the inside of the fresh skins. Later the salt is scraped out along with the fat, and after washing thoroughly in water and

benzol leaves a clean pliable skin. Large fish which cannot be attended to immediately may be laid on a board and covered completely with salt which is replenished as it dissolves. The salt may be washed out at the laboratory before permanent preservation.

PUMICE

A light spongy stone used as an abrasive.

PYRETHRUM

The principal ingredient in many insecticides.

ROCHELLE SALT

Sodium potassium tartrate, used in cleaning bronze.

SALT (SODIUM CHLORIDE)

Common table salt. A universal preservative applied to animal skins immediately after removal. An accelerator in setting plaster. Used combined with vinegar for cleaning brass.

SAPONIN

Preferable for washing specimens since no free alkali will be left behind. *See* Cleaning Compounds.

SHELLAC

A rapid drying varnish soluble in alcohol. White or bleached shellac is used when the natural brown or orange color is objectionable.

SODIUM HYDROSULPHITE

Frequently used as a bleaching agent. Useful in removing dyes and other stains not greasy in nature. *See* Bleaches.

SOLVENTS

The following abridged list of convenient solvents is confined to those substances commonly used in field work. *See also* "Textiles, Stain Removal."

Arsenic.—In water, or better, sodium hydroxide.

Camphor.—In carbon tetrachloride.

Carbolic acid.—In water.

Cellulose acetate (household cement).—In acetone, amyl acetate.

Cellulose nitrate (celluloid).—In alcohol, acetone, amyl acetate.

Chicle (chewing gum).—In carbon tetrachloride.

Gelatin, glue.—In water.

Grease and *oil.*—In Stoddard solvent, carbon tetrachloride, benzol, chloroform, ether, acetone, trisodium phosphate ("Oakite"), ammonia, washing soda.

Gutta-percha.—In carbon tetrachloride.

Latex.—In distilled water (disperses but does not actually dissolve).

Linseed oil.—In turpentine, benzol.

Mercuric chloride.—In alcohol.

Naphthalene.—In carbon tetrachloride.

Oil paints.—In turpentine or benzol when fresh; in acetone when paint is old and hard.

Paradichlorobenzene.—In carbon tetrachloride.

Rosin.—In alcohol.

Rubber.—In carbon tetrachloride, petroleum ether, benzol.

Shellac.—In alcohol.

Sulphur.—In carbon disulphide.

Thymol.—In strong alcohol.

Varnish.—In benzol, acetone, turpentine.

Wax (*beeswax, carnauba, paraffin*).—In benzol, turpentine, carbon tetrachloride, acetone.

STODDARD SOLVENT

In order to reduce the fire hazard and to obtain a satisfactory cleaning fluid, the National Association of Dyers and Cleaners of the United States and Canada, through research associateships at the Mellon Institute of Industrial Research and at the National Bureau of Standards, developed a special petroleum distillate for use as a dry-cleaning solvent. This distillate, known in the dry-cleaning and petroleum industries as Stoddard solvent, has a minimum flash point of 100° F. in a closed-cup tester. The use of this solvent is urged wherever it may be substituted for benzol, acetone, and other highly inflammable solvents and cleaners.

THYMOL

Volatile white crystals used as a fungicide.

TRIPOLI

Porous, siliceous sandstone used as an abrasive.

TUNG OIL

Used in lacquers and paints. Dries with a high gloss. Evens out on the surface before drying, thus eliminating brush marks.

TURPENTINE

A paint and varnish thinner. Spirits of turpentine is a distillate of crude turpentine or balsam from conifers. Turpentine substitutes are cheaper petroleum derivatives and are not advisable in museum work.

VASELINE (PETROLEUM JELLY)

Used as a dressing and lubricant for dry leather, rawhide, hair, sea shells; also as a protective coating against rust on metals.

VINYL ACETATE (POLYVINYL ACETATE RESIN)

This material, soluble in acetone, is a lacquer sometimes preferable to the cellulose lacquers. When mixed with clay it forms a putty which may be modeled and used in repairing pottery. Upon drying it becomes extremely hard.

WATERGLASS

An aqueous solution of potassium or sodium silicate used as an adhesive and a filler.

ZINC CHLORIDE

"Butter of zinc," white granular crystals soluble in water, alcohol, ether; a wood preservative and disinfectant.

CHAPTER ·VIII·

THE PARK LIBRARY

PARK libraries are closely related to park museums because normally they occupy the same building, are supervised by the park naturalist or historian, cover the same fields, and are coordinated parts of the same interpretational program. The problems of libraries and museums correspond at many points and they present many historical parallels.

BACKGROUND OF THE LIBRARY MOVEMENT IN NATIONAL PARKS AND MONUMENTS

The library movement in national parks had its beginning nearly a quarter of a century before the establishment of the National Park Service, and since then has developed into one of the principal educational features of the park system.

Yellowstone National Park was established in 1872, but it was not until after 1891 that Capt. George S. Anderson, in charge of United States troops stationed in the park, established the nucleus of a library that was to be the forerunner of all Service libraries.[1] Almost 50 years have passed since the founding of the first park library, and yet, while Service libraries have expanded, they have been unable to meet the demands placed upon them. This has been caused principally by the lack of sufficient funds for purchasing necessary reference material and by the rapid growth of other educational work in park areas. Until park libraries can keep pace with the work of the naturalists, historians, and museum curators they cannot be considered as adequate to their needs.

Organizations outside the Service have taken an active part in the devel-

[1] Carl P. Russell. Libraries in national parks. The library journal, 65: 330, April 15, 1940.

opment of libraries as well as museums in a number of the park areas. Over a period of years the American Association of Museums has assisted both financially and through constructive planning in the raising of museum and library standards in parks. Through the Laura Spelman Rockefeller Memorial Foundation it backed the construction of a fireproof museum and library in Yosemite National Park. (*See* Fig. 29.) The association continues to influence museum exhibits and supplementary libraries in other units of the system.

The American Library Association has continued over a number of years to exert its influence in the planning of libraries for the national parks. For 10 years the A. L. A. has maintained a Committee on Libraries in National Parks, and its members have visited many of the areas for the purpose of studying library needs.[2] In 1933 it submitted to the Secretary of the Interior a plan of development for national park libraries. This proposal organized a basis for initial development of a plan that would make for uniformity in all libraries in the National Park Service.[3] Lack of funds has prevented the carrying out of the plan as submitted, but many of the suggestions have been accepted and put into practice.

Local organizations have given generous support in a number of instances, supplying funds, books, and personal services. A good example is the assistance rendered by the Yosemite Natural History Association. This group of active individuals sponsors a publication, *Yosemite Nature Notes*, and since 1925 has provided substantial aid to the Yosemite National Park library.[4]

Further aid has come from such prominent institutions as the American Museum of Natural History, the Buffalo Museum of Science, the Carnegie Institution of Washington, the Sierra Club, the University of California, and other interested organizations. Quite often visitors desire to contribute to the library, and a number of the eastern military parks have been the recipients of valuable manuscripts, papers, and books pertaining to the battlefield areas. This practice has been encouraged for a longer period in the western parks as the libraries in those areas are older.

With the assistance of such good friends as those mentioned above, the prospects for park libraries seem bright, and it is the hope of those responsible for the respective libraries that funds can be obtained with which to develop an adequate library service.

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[2] Russell, op. cit.

[3] American Library Association. A plan of development for national park libraries. April 1933.

[4] Russell, op. cit.

ORGANIZING THE PARK LIBRARY

Purpose

The library should function as a source of ready information for all members of the local staff, for the visiting public, and for research students engaged in local problems. The Service has expressed the view that libraries should "* * * function as administrative and technical tools for local staffs, and to a smaller degree as public libraries." [5]

Since the library often will be a normal development of the museum, it follows that it will be of greatest use in this connection. Dr. Parker has written:

> By keeping the library the accessory arm of the museum, and as such designed to afford more extended knowledge of the subjects treated by the museum, its growth will be a healthy one. This will be the case if books are acquired as needed, especially those dealing with details and special facts. A static library, fixed and finally founded, will prove as deadly as the finished museum. The useful library is the growing library, and one that grows naturally as subjects need more light.[6]

Range

The range or scope of the library ordinarily is governed by local requirements, although an attempt should be made to prevent the works from becoming too general. The keynote of the library program in each area should be *service;* service first to research and secondly to the park visitor. Each library must develop its own program of acquisition and build up collections of literature on the history or sciences of special interest to that particular area. All available National Park Service literature should be assembled in each library. Dr. Russell has stated:

> * * * As might be expected, the Nation-wide program of establishment, preservation, and interpretation of the country's scenic wonders and historic treasures has resulted in notable contributions to our conservation literature. Thousands of technical reports and popular articles have been written * * *.
>
> In addition to these reports and articles of Service origin, the central and administrative offices of the Service must acquire collections of reference works in history, archeology, geology, biology, and the general field of recreation. These materials, like the Service reports, are to be regarded as tools for staff use; they have no direct relationship with a public contact program, yet they do demand the attention of librarians.
>
> In the parks and monuments similar, if smaller, collections of source materials are organized for staff use.[7]

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[5] Russell, op. cit.

[6] Arthur C. Parker. A manual for history museums. p. 151–152. 1935. By permission of Columbia University Press.

[7] Russell, op. cit.

The library should be expanded in proportion to the demands made upon it. Funds for the purchase of books are limited, consequently those works in greatest demand should be acquired first. Suggestions for more extensive literature on a particular subject often are to be found in bibliographies contained in handbooks or textbooks. L. V. Coleman, in his *Manual*, states that:

> The most practical way to develop a small library is to secure books only as they are needed, beginning with a few general works that have good bibliographies. When these books are inadequate new ones may be selected from the references which they contain, and these will suggest others in turn.[8]

As the library grows it may be desirable to lower earlier restrictions and secure such types of books as general reference works, books on local history, natural history magazines, periodicals, and publications of a historical, scientific, and popular class. When funds permit, a section on children's literature may be established.

When it happens that the park library is the only one in a wide area, it will be called upon to furnish recreational reading for park employees and permanent residents. In such instances, decisions are made locally and influenced usually by the desires of the readers. At the first meeting of park naturalists in November 1929 it was recommended that all books in a park library be directly or indirectly related to the park, not only in the field of science but also fiction and poetry.[9] This seems to be an unnecessarily hard and fast rule, but local conditions will dictate in most instances.

During summer months or other periods when the demands upon the library's facilities are extremely heavy, it may be possible to secure outside aid. State, county, university, or other libraries are usually glad to lend necessary material during this peak period. This is known as an interlibrary loan. Conditions of such a loan vary, but generally the library borrowing the books pays transportation charges, is required to return books via registered mail or express, and must agree to a time limit.

Gifts or Donation Policy

Park officers must be discerning in accepting books which are donated to the library. Books pertaining to the particular park or monument in which they will be used and to which no "strings" are attached are most acceptable. Be cautious regarding loans. Books, manuscripts, or docu-

[8] Laurence Vail Coleman. Manual for small museums, p. 265. 1927.

[9] C. A. Harwell. Proceedings of the first park naturalist's training conference, November 1929, p. 192.

ments of historic importance because of age, rarity, or association should be subject to the same gift and loan policy as museum specimens. These regulations are outlined in Chapter VI.

Housing

Usually the library should be housed in a room or rooms set aside for this purpose in the museum building. From an administrative point of view this arrangement is advantageous as the staff member supervising the library (usually the park naturalist or historian) generally has his office in or adjoining the museum.

Fortunate are those areas that have had museum buildings constructed in which provision was made for libraries. Yosemite was a pioneer in this arrangement (1925) and the results obtained have been of considerable value in shaping plans for more recent structures. Particularly worthy of note are those combined administration and museum buildings which have been erected during the past few years in a number of eastern and southern national historical and military parks. Shiloh, Vicksburg, Fredericksburg and Spotsylvania, Chattanooga, and Morristown now have fine, new administration-museum buildings which have provided rooms for a library. Planners will do well to keep such arrangements in mind when buildings are proposed for other areas in the system. The Morristown facilities are especially noteworthy.

Arrangements for housing and shelving books will be as varied as are the parks; however, there are a number of generalities that, with variations, can be applied to local conditions. It must be remembered that moisture and heat favor the growth of mold and that any excess of heat without moisture is injurious. Also, sunlight is injurious and too much daylight over a long period can ruin books and papers. The ideal arrangement is to have a room or rooms in which temperature, moisture, and light can be controlled, but as this is well nigh impossible to achieve, the following suggestions are drawn up at the instance of Arthur E. Kimberly, Chief, Division of Repair and Preservation of the National Archives:

1. In any library which is so extensive as to require stacks, these stacks should be located in a room which is kept dark at all times except for the periods when the librarian is searching for books. Under no condition is sunlight allowed in this room.

2. In those areas where the moisture content of the air is unduly heavy, as in coastal areas or in areas where considerable moisture condenses after sundown, the librarian should take steps to see that the library or stacks are kept dry. Some arrangement should be made to raise the temperature

for such short drying periods as are necessary or for employing anhydrous calcium chloride.

Temperature and humidity readings can be taken with a "sling psychrometer" that can be purchased from the government schedule. With a little practice the reading of this instrument is soon perfected, and it is an accurate guide to follow in keeping the library at the proper conditions. For more explicit instructions regarding maintaining the correct temperature and humidity, see United States Bureau of Standards *Miscellaneous Publications*, No. 128, October 1931.

3. In reading rooms it is almost essential to have good daylight, although daylight conditions can be approximated artificially by means of fluorescent-type lights.

4. If it is essential to have books shelved in the reading room (as is most commonly the case), make certain that no books are exposed to the direct rays of sunlight. In the event the more valuable or rare books are shelved in this same room, make certain that they are kept in bookcases with wood panel doors. They should be kept in darkness. If open shelves are the only type justifiable, they can be constructed locally or by park craftsmen. Sections should not be longer than 32 inches between supports as shelves longer than this will sag. A standard width of 11½ inches is suggested; height will vary according to requirements.

ADMINISTRATION

This is a problem which must be solved in the individual park or monument, so varied are the conditions that exist throughout the Service. The subject of the administration of a park library was discussed in an early conference of park naturalists, one conferee stating:

> The actual administration of a park library should be designated to an appointed librarian who has entire charge, subject to approval by a park naturalist. Whether this position is held by a specially trained person under regular pay, by an outsider who contributes his services, or by a ranger naturalist given the additional title, is a question which can be decided only by individual circumstances such as the state of development of the library and the demand for its services. In most cases it will be possible to have it open to the public only part time each day, but in any case regular hours should be maintained.[10]

Conditions in park libraries have not changed greatly since 1929 when the above description of circumstances was given. The museum attendant, or park historian or naturalist, as the case may be, necessarily will arrange hours that will be of greatest service to the visitors. Loans may or may

[10] Edwin D. McKee, Proceedings of the first park naturalist's training conference, Nov. 1929, p. 195.

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not be encouraged, conditions in each area being the controlling factors in this respect.

There are a number of other duties which a librarian will find necessary in any library. They are:

1. Recording accessions; acknowledgment of gifts.
2. Keeping an up-to-date shelf list.
3. Maintaining a card catalog.
4. Maintaining a list of desirable books.
5. Purchasing books and publications.
6. Maintaining duplicate library lists; one copy to be kept in the superintendent's office.
7. Marking books for shelving.

Accession Record

As previously mentioned, a duty of the librarian is to keep an accession record. This ordinarily consists of a consecutively numbered list of all bound books in the library. A ruled, loose-leaf ledger is recommended for this purpose and a number is given to each title (some titles, etc., may require more than one line but one number only is given to each book or set of books). The loose-leaf form is recommended since it can be removed conveniently for typing data.

In the ledger are spaces for recording:

1. The author's name.
2. Title.
3. Publisher.

These to be recorded as given on the title page, not as shown on cover, as the cover title is often abbreviated.

4. Whether or not the book is a purchase or gift.
5. Cost.
6. Notes about rebinding, withdrawal or disposal.

The number on each line becomes the accession number and for uniformity is entered in the book itself at the bottom of reverse of title page.

Classification

This is the process of grouping books into logical order according to subject and giving to each book a class mark which will indicate the particular group to which it belongs. Classification must not be confused with cataloging, which is described elsewhere in this chapter.

The Dewey Decimal classification is the one commonly used for bound volumes; for librarians interested in a more complete description than follows, the system is published in book form.

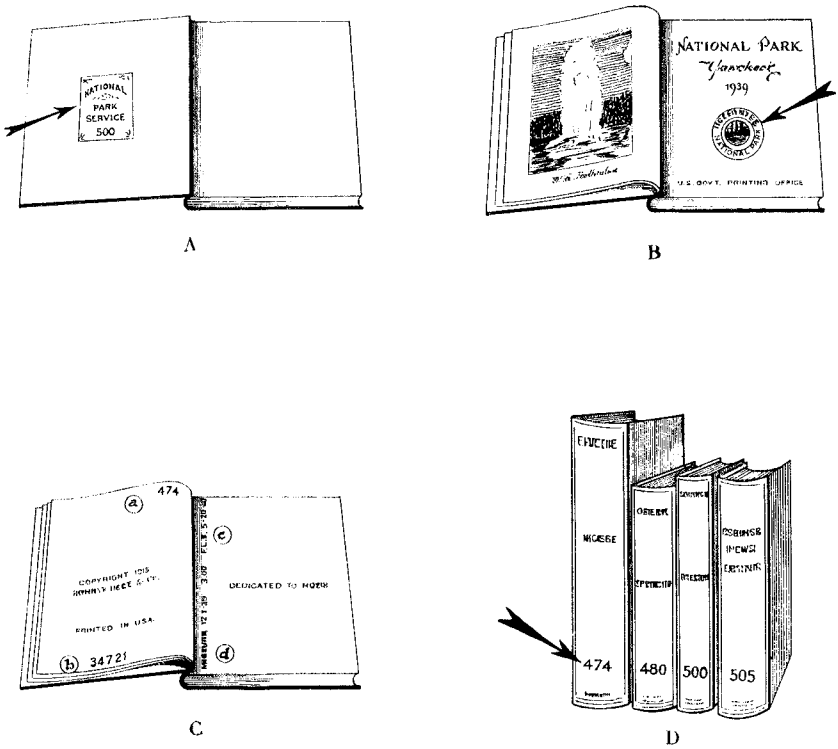

Figure 28.—STANDARD METHODS OF MARKING BOOKS

A. Bookplate (inside front cover).
B. Ownership stamp (title page).
C. a. Classification number (reverse of title page).
   b. Accession number (reverse of title page).
   c. Cataloger's initials and date.
   d. Dealer's name and cost. If book is a gift, follow name (in lieu of dealer's) with letter "g."
D. Classification number placed uniformly 1½ inches from bottom of book.

The decimal system divides the field of knowledge into nine main classes which are numbered from 100 to 900. Encyclopedias, periodicals, etc., which are so general in character as to belong to no single class, form a tenth class numbered 000. As before mentioned, we are not interested in all classes in a park library, so only essential class numbers are given. For classes other than listed below see an unabridged published form. The American Library Association's Committee on Libraries in National Parks recommends the Dewey System and suggests that Library of Congress

catalog cards be used.[11] Since the Dewey Decimal numbers are now printed on these cards the combination is very practicable.

CLASSES LIKELY TO BE USED IN A PARK LIBRARY

000 General Works

Encyclopedias	Atlas	Manuscripts
World Almanac	Rare books	

300 Social Science

Law	Customs	Folklore
Administration	Costumes	

500 Pure Science

Crystallography	Biology	Collector's manuals
Mineralogy	Archeology	Botany
Geology	Ethnology	Zoology
Paleontology	Anthropology	

600 Useful Arts

Public health	Fish culture—fishing	Building
Engineering	Camp cooking	Heating
Agriculture	Explosives	
Forestry	Mechanic trades	

700 Fine Arts, Recreation

Art galleries	Architecture	Numismatics, coins, medals
Landscape gardening	Public buildings	Photography
Public parks	Museums	Outdoor sports
National park circulars	Hotels, inns	Amusements
	Utility buildings	

800 Literature, General Works

American literature	English literature	Fiction, drama, poetry

900 History

Chronologies	Biography	Geography
Charts	U. S. history	Explorations
Outlines	Periodicals	Genealogies
Early travels	Historical magazines	Descriptions

Fiction is not classified by the Dewey Decimal System nor is it given an author's number. It is placed in a separate section, and the books are

[11] American Library Association. A plan of development for national park libraries. April 1933.

arranged alphabetically by the author's last name. If the latter has not been printed on the back of the book, it should be lettered thereon with white ink or, if possible, with India ink and, when dry, covered with clear shellac. In the same manner the classification, or call number is lettered on the back of all nonfiction books. It sometimes is necessary to remove sizing with alcohol before lettering. Remove it only from a space large enough to accommodate the call number or name.

REFERENCE BOOKS

The class number for reference books should be preceded by an "R," as R 833. Sometimes the letter is placed above the call (class) number on the back of the book. The letter "R" can be hand-lettered, or glued letters are obtainable at stationers. Reference books should not be removed from the library, especially during the summer season.

Shelf List

This is a card record filed by class numbers as the books stand on the shelves. Under each class the cards are filed alphabetically by the author's last name. It aids in classification; it is an aid in buying as it shows what works the library has in each class; it should be used in taking an inventory. It is customary to allow one card for each title in the library; in other words, only one card is required for a set or series of two or more volumes. This last fact is noted on the card.

Card Catalog

This is the most useful record in the library from a practical viewpoint. It is a record on cards of all books in the library, and each book may have several cards. It is arranged alphabetically like the words in a dictionary; that is, proper names, subjects, titles, first letters, etc., are given in alphabetical order. All cards are arranged according to the first word (except *a*, *an*, *the*) on the top line.

Library of Congress cards may be employed in a card catalog. They may be adopted for all other cards in the card catalog—author, title, subject, and shelf list card.

CARDS IN THE CATALOG

1. Author Card: This is the main card. It should contain:
   a. Class number—location of book on shelves.
   b. Author's name, last name first.

c. Title of book as it appears on *title page;* omit capital letters except proper names and first word of title.
d. If important, the editor's, translator's, or illustrator's name may follow the title.
e. Surname of publisher and date on title page, or the copyright date if there is no date on title page. In lieu of above dates use preface or introduction date.
f. Statement of pagination, plates, illustrations and maps.

	Dunbar, Seymour
910	History of travel in America
	Tudor, 1937
liv; 1533 2 maps; 12 plates; 400 illus.	

2. Title Card:

Every book which may be asked for by a well known title should have a title card. If in doubt, always prepare a title card. If the "catch title" is better known, use it.

	History of travel in America,
910	Dunbar, Seymour
	Tudor, 1937
liv; 1533 2 maps; 12 plates; 400 illus.	

3. Subject Card:

   This is more difficult to prepare and subjects are usually selected upon examining the table of contents, introduction, or by reading the book itself. The title is not always an accurate guide to the subject and cannot be depended upon. Some books may require more than one subject card.

TRAVEL, U. S.

910 Dunbar, Seymour

History of travel in America

Tudor, 1937

liv; 1533
2 maps, 12 plates; 400 illus.

CANAL BOATS, U. S.

910 Dunbar, Seymour

History of travel in America

Tudor, 1937

liv; 1533
2 maps; 12 plates; 400 illus.

ARRANGEMENT OF CATALOG CARDS

All cards are arranged in alphabetical order as are the words in a dictionary. Arrange all cards by the first word on the top line. (Disregard *a, an, the.*)

For more efficient directions, since there are so many rules to follow, the reader is referred to the following:

Akers, Susan G. Simple Library Cataloging. American Library Association, 2d ed., 1933.

Dewey, Melvil. Decimal Classification and Relative Index. Forest Press, Edition 13, 1932.

Miller, Zana K. How to Organize a Library. Library Bureau, Remington Rand, Inc., 10th ed., 1939.

Sears, Minnie E. List of Subject Headings for Small Libraries. Wilson, 3d ed., 1933.

Some Suggestions for Librarians

Care of the books

1. Book shelves.

   Discussed more fully elsewhere in this chapter.

2. Care of manuscripts.

   See section on preservation, Chapter VII.

3. Care of leather bindings.

   See section on preservation, Chapter VII.

4. Care of pamphlets and papers.

   It is possible to secure from stationers and supply houses pamphlet boxes or binders made expressly for this purpose. The Western Laboratories of the Museum Division are equipped to make pamphlet holders, and can furnish as many holders as ordered free of charge except for shipping. (This applies only to National Park Service Libraries.)

   Instructions on the care and cataloging of reprint collections are now in preparation. This work will be standardized so far as practical as the library project of the Washington Office is developed.

5. Fire precautions.

   There should be in the library at all times a sufficient number of carbon dioxide type fire extinguishers. This type smothers fire without wetting the paper and, consequently, is preferable to the water-bicarbonate of soda-sulphuric acid type. The after effects of the latter are almost as bad as a fire itself.

Service

It will be well to remember a few important generalities regarding a park library. First, that the library is to serve as a source of ready information for members of the park staff, and as far as the visitor is concerned it

Figure 29.—VISITORS USING LIBRARY IN YOSEMITE NATIONAL PARK, CALIFORNIA

is secondary to the talks given by the park naturalist or historian. It is the source to which all may turn when further information is desired on details pertaining to the area. It is the repository for important books and magazines relating solely to the park or monument. In some cases it is the only library available to the park personnel and local inhabitants. It is one of the very important technical tools for the park educational staff.

SUGGESTION FOR ESTABLISHING THE USEFULNESS OF A PARK LIBRARY

Sabra W. Vought, Librarian, United States Office of Education, Federal Security Agency, has made a stimulating suggestion regarding the service a park library can render park visitors:

> As a visitor passes through one of the national parks his perception is quickened by the scenery and beauty before him. It is then that he is most interested in the history of the area, the wild animals, the plants, or the Indians. Why not, then, lend him a book describing the subject of most interest to him and allow the book to be returned at the point of departure from the area? Ninety-nine percent of our visitors are honest folk who will not take undue advantage of so liberal a loan.

This suggested service presupposes that support for library work maybe

obtained. Adequate allotments for the purchase of books must be made, equipment must be purchased, and personnel employed. In short, a system of library work must be instituted before such service can be offered in the parks.

It is highly important that all park officers give careful study to library needs and that every possibility be explored in attempting to correct the faulty condition that now exists in the library phase of the interpretative program of the National Park Service. First steps have been taken in the Washington Office to organize the library materials of all branches on a coordinated basis. Out of this work it is intended that there shall grow a coordinated program of library work Service-wide in extent.

CHAPTER ·IX·

HISTORIC HOUSE MUSEUMS

HISTORIC house museums are historic buildings of any sort—either original or reconstructed—which are on exhibition for the public as survivals of the past. The determining factor in the preservation of a historic structure in a National Park Service area, as of an area with great scenic or scientific values, is that it possess certain matchless or unique qualities which entitle it to a position of first rank among other structures of the same type. This quality of uniqueness exists:

1. In such historic structures as are naturally the points or bases in which the broad aspects of American life can best be presented and from which the student of the history of the United States can sketch the large patterns of the American story. These structures are significant because each contributes its part to the complete story of American history.

2. In such structures as are associated with the life of some great American and which may not necessarily have any outstanding qualities other than that association.

3. In such structures as are associated with an epochal or dramatic incident in American history, and which, though possessing little or no architectural merit, are unique and symbolical of some great idea or ideal for the American people.

The historic house museums under the supervision of the National Park Service include an ecclesiastical structure (a Spanish mission), military structures (forts and encampment huts), civil structures (custom houses, courthouses, and the like), industrial structures (such as a historic iron furnace), and private dwellings (from the log cabin of Abraham Lincoln to the colonial mansion of Robert E. Lee).

REASONS FOR ESTABLISHMENT

If for no other reason than to preserve historic structures from fire, vandalism, and decay, such a duty of the National Park Service is justified.

Most buildings perish soon; fires and elements have taken a heavy toll of structures which once played an important part in the early history of American life. Even buildings constructed as late as the second half of the nineteenth century, when the western third of the continent was being settled, have long since disappeared from the American scene and with them many physical records of the picturesque Far West.

Other reasons of equal importance justify the preservation and furnishing of historic structures. There is an increasing desire for more constructive recreation stimulated by places where history lives again, and this increasing popularity makes more urgent their acquisition, preservation, and interpretation.

LOCATION

The 35 historic house museums exhibited by the National Park Service include a variety of structures such as forts, plantations and their outbuildings, lighthouses, military barracks, iron furnaces, a mission, a courthouse and other civil structures, and homes of the people. They

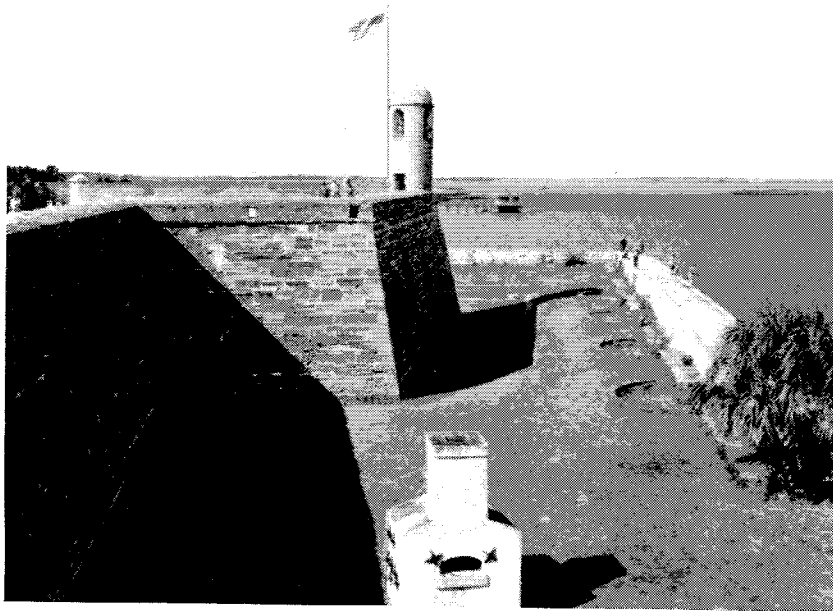

Figure 30.—EASTERN WALL OF CASTILLO DE SAN MARCOS, FORT MARION NATIONAL MONUMENT, FLORIDA. THIS OLD SPANISH FORT IS AN EXAMPLE OF ONE TYPE OF HISTORIC HOUSE MUSEUM

are fairly well distributed across the country. Eight are located west of of the Mississippi; 27 are east of that river. In general, they are found "where celebrity is born, where fame makes its home, where art or science labors in erstwhile obscurity, where important incidents occur, where death visits the great—such, for the most part, are the places chosen to survive." [1] All under the Service thus far make an incomplete picture of the American historical scene. States, municipalities, public and private societies, and individuals maintain the great majority which cover the high points of the whole of American history.

The National Park Service discourages the moving of historic structures from their original sites. The original setting is as important historically as the building itself and no less essential to a proper interpretation of the association or event it is sought to commemorate. A California rancho moved to the far east would lose much of its effectiveness without the natural surroundings of the western landscape.

FURNISHING AND INTERIOR DECORATION

A historic house should be furnished as nearly as possible as it was during its heyday or at the time when some epochal or dramatic event associated with it occurred. If possible, the original furnishings should be used. In most cases, however, these have disappeared, so the next best expedient is to furnish the house with period pieces. The third course is to use reproductions.

The process of furnishing a historic structure is usually a slow one and in most cases covers a period of years. The memorial mansion at Washington's Birthplace was furnished first with reproductions in 1932. Since that time these reproductions have been replaced gradually with period furniture and tableware until at present approximately nine-tenths of this work is complete.

The furnishing of a historic structure should be undertaken only after consultation with a specialist and on the basis of a carefully prepared and approved plan. Far too often a hasty selection of furnishings is made, and as a result a heterogeneous accumulation takes the place of an orderly and pleasing atmosphere. When a society or individual offers to furnish a room or any part of a building, the offer should be accepted only after all parties concerned have agreed to abide by the decision of a competent authority regarding the furnishings required, thus preventing the accumulation of a mass of irrelevant material.

The importance, however, of cooperating with interested groups and

[1] Laurence Vail Coleman. Historic house museums. 1933. p. 17.

individuals cannot be overemphasized. Many a historic house supervised by the National Park Service would be only partially furnished if it were not for the cooperation and liberal support of these groups and individuals. The acceptance of furnishings for historic structures should be governed by the rules and regulations as set forth in the Director's memorandum of March 13, 1940, on museum policy and procedure in national parks and monuments and as described in Chapter VI of this handbook.

The finer details are perhaps the most important and difficult tasks in furnishing a historic structure. Too often a historic house, as well as its grounds and outbuildings, has an air of arrested decay, almost of gloom. To avoid such an undesirable atmosphere it is necessary to pay careful attention to those details which make a house a home. Furniture should be placed naturally so as to give the room a feeling of comfort. The chair near the fireplace might face the fireplace just as the master of the house would have placed it, while on a nearby stand a pipe, tobacco, and an open book may be placed as if the owner had just left the room. The clocks in the house should run and keep correct time. Fresh-cut flowers should be in appropriate places and artificial ones carefully avoided. Writing materials should be on the desk, sewing materials in the work basket, and a few toys on the floor. If the place had military or other special occupancy, the appropriate items should be arranged to recreate the desired atmosphere. It is not necessary to resort to extremes in theatrical properties in order to effect this setting. With the exception of occasional concealed lighting, little beyond the careful use of original pieces is necessary.

MUSEUM EXHIBITS

The use of exhibit devices or the installation of supplementary collections in museum exhibit cases is to be discouraged in historic houses. Not only is it bad museum practice but it defeats the purpose of exhibiting historic structures, which is to portray them to the public as they were at a certain period or when some important event occurred. It is quite obvious that the main features of a historic structure are the structure itself and its furnishings.

If excavated materials, exhibit devices, or supplementary collections are to be used in connection with a historic structure, they should be housed in a separate room or building constructed for such a purpose. The exhibit devices and documents which are utilized to portray the activities of George Washington and the American Army at Morristown, N. J., during the winter of 1779–1780 are not housed in the historic Ford Mansion but in a separate museum building nearby where modern museum facilities

Figure 31.—WASHINGTON'S HEADQUARTERS, MORRISTOWN NATIONAL HISTORICAL PARK, NEW JERSEY. THE FORD MANSION WAS PURCHASED BY THE WASHINGTON ASSOCIATION IN 1874 AND WAS AMONG THE FIRST AMERICAN BUILDINGS SAVED AS A HISTORIC HOUSE MUSEUM

are available for safeguarding these material objects from fire, insects, and other museum enemies. In the same building are located the various graphic devices employed to explain the use and history of such valuable specimens.

In special cases where a historic structure, such as a fort, contains many rooms and the period furnishing of all of them appears impractical, there is usually no objection to using one or more of the rooms for interpretative displays. Such a practice, however, is an exception to the rule and should have the approval of the Director after careful study of each individual case.

The use of labels on or near historic house furnishings is not desirable. Items of exceptional historic value should be pointed out by the ranger-historian or should be described in a pictorial guidebook or by an explanatory label on the doorway of the room. The importance of a guidebook cannot be overstressed, and wherever possible one should be distributed to the visitors.

In short, nothing should be exhibited in the historic house museum which conflicts with the historic atmosphere.

REPAIRS AND ALTERATIONS

Repairs and alterations to historic structures require careful research to avoid serious mistakes. Skilled artisans working under competent

supervision from accurate plans are essential. Before undertaking such alterations in the areas administered by the National Park Service approval must be obtained from the Director. Subsequent changes, no matter how trivial, must also have the Director's approval.

PROTECTIVE MEASURES

Barriers

Unattractive and objectionable as they may appear, barriers are necessary for the protection of furnishings against injury or loss by vandalism or theft as well as constant wear and tear. Waist-high, metal gates with a deep concavity are recommended for placement at room entrances in structures where the guides or guards cannot see visitors at all times. This will permit visitors to enter a short distance into a room to better see the furnishings and yet will prevent them from wandering about haphazardly. Inconspicuous plush-covered rope cords are preferable where constant but unobtrusive surveillance is possible. When adequate personnel is available rails or cords can be dispensed with entirely. In many Service areas where historic structures are exhibited the crowds are so large that the ideal of personnally conducted tours and the absence of barriers is impractical, as in the case of the Lee Mansion which was visited by 436,163 persons during the 1939 travel year.

Visitors should not be permitted to handle draperies, curtains, or other fragile fabrics, sit in antique chairs, wind grandfather clocks, or needlessly examine any of the furnishings. A few persons touching a colonial bedspread would do no harm, but hundreds handling such a fragile piece would soon destroy it. Furnishings of a historic house museum are not intended to be used by the public but to serve as agencies of instruction and inspiration.

Fire Protection

Since few historic structures can be regarded as fireproof and none of the furnishings may be so considered, constant vigilance is necessary to prevent destruction. Suitable firefighting equipment as recommended by the fire inspector should be placed in locations inconspicuous to the public but easily accessible to the park personnel. Special care should be taken to instruct temporary personnel as to the location and use of such equipment. Whether or not an automatic sprinkler system should be installed in historic house museums depends on a study of each case, but an automatic fire alarm system connected with a fire station, guardroom, or other location with a 24-hour personnel is recommended.

INFLAMMABLE MATERIALS

All inflammable materials used to keep historic house museums in good order, such as cleaning fluids, dust cloths, and the like, should be kept in fireproof containers, preferably away from the building in accordance with standard practices.

FIRE HAZARDS

Smoking should never be permitted in historic house museums, nor should fireplaces be used for heating, as every possible danger from smoke and fire should be eliminated in the structure. Even the use of fireplaces in colonial kitchens for demonstration purposes should be carefully supervised at all times. Furnaces and central heating plants are usually installed in separate buildings for the same reason.

Dust

Unlike specimens in a modern museum case, historic house furnishings are subject to dust and good housekeeping is essential. Furniture should be dusted daily, rugs, curtains, and upholstery cleaned with the utmost care; silver, pewter, china, and glassware should be kept clean and polished; and halls, stairs, and other places used by the visitor should be swept at frequent intervals. Little inspiration can be derived from a museum where dust and dirt are to be found.

Insects, Molds, and Rodents

Danger from insects, molds, and rodents in historic house museums is far greater than in museums where materials are protected by almost airtight cases. Because of this, rugs, curtains, upholstery, draperies, and other fabrics and textiles should be treated as frequently as necessary and inspected at least once a week for signs of such incessant enemies.

Dampness

Dampness in historic structures will ultimately cause mold to form on leather, textiles, and paper and will hasten the formation of rust on iron materials. A properly adjusted heating and ventilating system will go a long way to eliminate such a condition.

SERVICE ARRANGEMENTS

So far as possible modern cleaning and servicing tools and equipment necessary for the upkeep of a historic structure should be kept out of sight of the visitors when not in actual use. These include vacuum cleaners,

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brooms, mops, pails, and other cleaning equipment as well as lawn mowers and other garden tools. All these modern appliances destroy in some measure the illusion of another age which it is so desirable to create.

For the same reason heating, lighting, and plumbing devices should be hidden so far as practical, and telephones used by the staff may be equipped with buzzers instead of bells.

ACCESSIONING AND CATALOGING

As in the case of park museums, every item in a historic house museum should be recorded properly. Every item should be numbered in an inconspicuous place and, if possible, should be photographed. For a description of the accession record and the catalog record, see Chapter VI where such procedures are described in detail.

VISITOR COMFORT

While visitors should not be permitted to sit on antique chairs, couches, sofas, and the like, reproductions of such may be placed at convenient points for their use, since visitor fatigue is not limited to formalized museums.

HISTORIC HOUSE MUSEUMS SUPERVISED BY THE SERVICE

In order to provide a background for the proper understanding of the historic house museums program supervised by the National Park Service, the following partial list of such structures, as of June 1, 1940, may prove of interest.

Arizona

MOCCASIN. Pipe Spring National Monument. An old stone fort and a spring of pure water connected with Mormon pioneer history.

TUCSON. Tumacacori National Monument. Mission San Jose de Tumacacori, an old mission founded by Father Kino, a Jesuit padre, about 1691 during Spanish expansion in the Southwest. The mission later was taken over by the Franciscans. When discovered by the Americans about 1850, it was a ruin. Stabilization and partial restoration have been carried out.

California

KINGS CANYON NATIONAL PARK. The Gamlin cabin was the first known structure to be built in the history of white man's attempt to inhabit the park. Constructed by Israel and Thomas Gamlin in 1872, it has now been restored.

POINT LOMA. Cabrillo National Monument. The Point Loma lighthouse or white tower was built during the years 1847–50 and is one of the oldest lighthouses on the Pacific coast. It was at this point, in 1542, that Juan Rodriguez Cabrillo, discoverer of California, first sighted land.

YOSEMITE NATIONAL PARK. Cedar Cottage or "Upper Hotel."

District of Columbia

WASHINGTON. House Where Lincoln Died. A red brick house located at 516 Tenth Street N. W. just across the street from Ford's Theater. It was to this house that President Lincoln was carried immediately after being mortally wounded on the night of April 14, 1865. Here, in a room on the first floor, the President died early the following morning. The first floor has been furnished as of 1865. Some few articles were formerly the property of Lincoln.

Ford's Theater. A 3-story, red brick building erected by John T. Ford, a theatrical producer, in 1863. It was in this theater that President Abraham Lincoln was assassinated on the night of April 14, 1865, while attending a performance of the play *Our American Cousin.* The interior of the building has been completely changed and bears no resemblance to a theater today. The first floor houses the Lincoln Museum containing the Osborn H. Oldroyd Collection of Lincolniana. This collection was purchased by the Government in 1926 and consists of objects and materials pertaining to the life and death of Lincoln.

Pierce Mill. An old gristmill located in Rock Creek Park. The mill was constructed by Isaac Pierce, an early settler, about 1820 and was in operation until 1897. It has now been restored and is operated as an educational and historical project.

Florida

DRY TORTUGAS. Fort Jefferson National Monument. The largest brick fortification built by the United States. Located on Garden Key on the Dry Tortugas Islands, Fort Jefferson was planned as the key to American defense in the Gulf of Mexico. Construction was started in 1846 but was never fully completed. During the War between the States it was used as a Federal military prison. Several alleged confederates of John Wilkes Booth, the assassin of President Lincoln, were imprisoned there.

ST. AUGUSTINE. Fort Marion National Monument. Fort Marion, the oldest defensive fortification still standing in the United States, was

begun by the Spaniards in 1672 as a protection to the town of St. Augustine. Constructed of coquina (sea shell rock), the fort was never captured in siege or battle and has withstood for generations the effects of wind and weather. At one time Osceola, the famous Seminole leader, was imprisoned there. Most of the rooms are open to the public and are marked as to their former use and occupancy. Museum exhibits include artifacts excavated from the moat.

Fort Matanzas National Monument. A small coquina fort located on Rattlesnake Island at the South Inlet of Matanzas River. This fort was built by the Spaniards about 1737 when they were anticipating an attack from the English in Georgia.

Georgia

SAVANNAH. Fort Pulaski National Monument. Fort Pulaski is a well-preserved brick fort located on Cockspur Island at the mouth of the Savannah River. Begun in 1829, it contains some of the finest brick arch masonry in America. During the War between the States it was held by the Confederates until forced to surrender on April 11, 1862, after a severe bombardment by Union forces. Some of the projectiles fired at the fort are still to be seen embedded in its shell-torn walls.

Kentucky

HODGENVILLE. Abraham Lincoln National Historical Park. A large memorial building constructed of Connecticut granite and Tennessee marble houses the log cabin believed to be the one in which Abraham Lincoln was born.

Maryland

BALTIMORE. Fort McHenry National Monument and Historic Shrine. Fort McHenry is a brick star fort constructed between 1795–1805 as a protection to Baltimore harbor. The defense of this fort against the British on September 13–14, 1814, inspired Francis Scott Key to write The Star Spangled Banner. The dungeons, powder magazines, and some of the rooms are open to the public. Museum displays include reproduced furniture of period and type, the E. Berkley Bowie firearms collection of representative specimens from the early colonial period to the World War, maps, and models.

Massachusetts

SALEM. Salem Maritime National Historic Site.

(*a*) Derby House. This house was built in 1762 by Richard Derby,

one of the leading merchants of Salem. It is furnished with period furniture and objects associated with the Derby family.

(*b*) Custom House. This building was constructed about 1819 and was associated with the early mercantile and maritime business in Salem. It contains objects associated with Nathaniel Hawthorne while he was the customs officer in Salem.

Missouri

ST. LOUIS. Jefferson National Expansion Memorial. Old Courthouse. This structure was begun in 1839 and completed in 1862. Built in the form of a Greek Cross it was considered the finest courthouse in the United States when finished. It was the scene of several of the Dred Scott trials and was associated with Thomas Hart Benton. Today it is one of the best surviving examples of the classic architecture of the mid-nineteenth century in the Middle West.

New Jersey

MORRISTOWN. Morristown National Historical Park.

(*a*) Washington's Headquarters: Jacob Ford Mansion. This house was constructed by Col. Jacob Ford, Jr., in 1774 and has been well preserved. It was the official army headquarters for the Continental

Figure 32.—REVOLUTIONARY PERIOD KITCHEN IN THE FORD MANSION, MORRISTOWN NATIONAL HISTORICAL PARK, NEW JERSEY

Army during the period from December 1779 to June 1780. General and Mrs. Washington made this their home while the army was encamped near Morristown. It is a striking example of the type of dwelling owned by the more prosperous eighteenth century family. Among the exhibits in the mansion are some of the original furniture, early eighteenth century furniture, household utensils, pewter and china, and military weapons. (Figs. 31 and 32.)

(*b*) Wick House. Located in the Jockey Hollow area, this dwelling and farm were closely associated with the winter (1779–80) encampment of the Continental Army there. The frame house was built about 1748 by Henry Wick, who had lived on the part of Long Island settled by emigrants from Connecticut. This representative dwelling of an eighteenth century yeoman farmer contains characteristic architectural features of the Connecticut Valley. Maj. Gen. Arthur St. Clair, commander of the Pennsylvania Division, established quarters in the Wick House in 1779. It has been restored since 1934 and refurnished with period furniture, the selection of which was guided by Wick inventories and several existing pieces of furniture owned by this family.

(*c*) Jockey Hollow Encampment Huts. Reproductions of an officers' hut, a soldiers' hut, and a hospital hut. These have been constructed on approximate original sites and are based on contemporary descriptions and archeological evidence. With their crude bunks they are effective exhibits.

New York

HYDE PARK. Vanderbilt Mansion National Historic Site Project. This mansion, constructed in 1898 by Frederick W. Vanderbilt, houses an extensive collection of objects of art. The house represents a way of life, a style, even a habit of thought which belongs to our past as much as does Colonial Williamsburg.

North Carolina

CAPE HATTERAS. Cape Hatteras National Seashore Project. In the late nineteenth century the Cape Hatteras lighthouse was one of the most famous in the United States. Completed in 1870, it replaced an earlier lighthouse and guarded the famous Diamond and Outer Shoals area, considered the most dangerous stretch of coast along the Atlantic seaboard. It is an outstanding and picturesque example of a fast disappearing type of lighthouse and is equipped with several types of lighting equipment of the period.

Pennsylvania

BIRDSBORO. Hopewell Village National Historic Site. Hopewell Village consists of a "feudal" village of stone houses. The chief points of interest are the iron furnace and iron master's home. The furnace is one of the oldest cold-blast furnaces still standing in this country. Established before the Revolutionary War by William Bird, it was operated during the war by his son, Mark Bird, and furnished arms and ammunition for Revolutionary soldiers. The furnace was continued in operation until 1883.

FARMINGTON. Fort Necessity National Battlefield Site. Fort Necessity was a small fortification erected by George Washington in 1754. On July 3 of that year it was the scene of a battle between a body of Colonial troops commanded by Washington and a large force of French and Indians. This conflict marked the beginning of the French and Indian War in America. The reconstructed log stockade covers about one-third of an acre and is built on the site of the original. Inside the stockade is a 1-story log cabin.

GETTYSBURG. Gettysburg National Military Park. General Meade's Headquarters. The Lydia Leister house was used by General Meade as his headquarters during a part of the battle of Gettysburg. The house has been restored but has not yet been furnished.

PHILADELPHIA. Old Philadelphia Custom House National Historic Site. This structure dates from 1819 and is a notable example of the architecture of the Greek Revival in the United States. After its completion in 1824 it was occupied by the Second Bank of the United States. It was this bank that became the center of the historic controversy between President Andrew Jackson and his followers on the one hand and Nicholas Biddle, Henry Clay, and the Whigs on the other. The building was also used as a custom house for many years. As a result of a cooperative agreement made under the authority of the Historic Sites Act of August 21, 1935 (49 Stat. 666) and entered into by the Department of the Interior and the Carl Schurz Foundation, Inc., the building is now cooperatively administered and used as a national historic site. When repairs now in progress are completed the foundation will have its headquarters in the building and will also maintain a museum.

Virginia

ARLINGTON. Lee Mansion National Memorial. The Lee Mansion, or Arlington House as it was also known, was built by George Washington Parke Custis, the only grandson of Martha Washington. Work on the

Figure 33.—SEWING AND SCHOOL ROOM, LEE MANSION NATIONAL MEMORIAL, VIRGINIA

mansion was begun in 1802, and it was occupied by Mr. Custis and his wife, Mary Lee Fitzhugh of Chatham, after their marriage in 1804. In 1831 Mary Ann Randolph Custis, the only one of the Custis children to survive infancy, was married to Lt. Robert E. Lee. Thereafter, until the outbreak of the War between the States, much of the Lees' married life was spent at Arlington. Shortly after the beginning of the war the mansion was taken over by the Federal Government. It was later restored to the eldest son of General and Mrs. Lee who sold it back to the United States. The mansion has been refurnished with period furnishings, including some of the original Lee possessions. (Fig. 33.)

FREDERICKSBURG. Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park. Stonewall Jackson Shrine. A small frame building at Guinea Station in which Stonewall Jackson died on May 10, 1863. Museum exhibits include the bed in which Jackson died, other furnishings of the period, personal belongings of Jackson, photographs, prints, and other military objects.

PETERSBURG. Center Hill Mansion. This house was built in the 1820's by Robert Bolling, a distinguished Virginian. It survived the bom-

bardment of the city by Federal artillery during the War between the States and served as the headquarters of Maj. Gen. George Hartsuff during the Federal occupation of the city. The mansion is a good example of the architecture of its period and is rich in historic associations.

WASHINGTON'S BIRTHPLACE. George Washington Birthplace National Monument. A memorial mansion of eighteenth century architecture representative of the home in which George Washington was born. The mansion is partially furnished with period furniture of the type mentioned in Westmoreland County court inventories.

YORKTOWN. Colonial National Historical Park.

(*a*) Moore House. An eighteenth century dwelling house where the American, French, and British Commissioners met to draw up Articles of Capitulation on October 18, 1781, terminating the siege of Yorktown. The house has been restored as nearly as possible to its colonial appearance and has been partly furnished in keeping with the period.

(*b*) Swan Tavern Group. (1) The Swan Tavern, built by Joseph Walker and Thomas Nelson before 1722, has been reconstructed on the original site. It has been partly furnished with reproduced period furniture. (2) Swan Tavern Kitchen. This building has been reconstructed on the original foundations. It is furnished in part with reproductions and designed as an eighteenth century kitchen exhibit. (3) Swan Tavern Stable. This building has been reconstructed on the original foundations.

Washington

MOUNT RAINIER NATIONAL PARK. Longmire Homestead Cabin. This cabin, located on the "Trail of the Shadows" nature trail, is the only remaining building of the original Longmire settlement. It was built by Elcain Longmire as a residence homestead cabin in 1888.

Wyoming

FORT LARAMIE. Fort Laramie National Monument. Fort Laramie was located at the forks of the Laramie and North Platte Rivers. From 1834 to 1890 this site was associated with fur-trading, western exploration, migration, and the Federal Government's relations with the Plains Indians. During the great migrations to the Far West in the 1840's, it was an important outfitting base for the pioneers. In 1849 it became a military post. A few of the buildings such as "Old Bedlam," the Cavalry Barracks, the Sutler's Store, and the Old Guardhouse remain today.

CHAPTER ·X·

THE MUSEUM IN USE

PREVIOUS chapters have described in detail the planning and development of the museum, including the building, its equipment, and collections, from the first written plan to a functioning institution. The full value of the museum can be realized only through proper utilization, which involves the methods of handling visitors, the correlation of the museum visit with all other parts of the interpretative program, and the maintenance of high efficiency in the exhibits themselves.

The ideal visit to the park and its museum should have three phases—preparation, actual visit, and recollection. Radio broadcasts from the museum and other points of interest in the park, the distribution of printed literature, and the natural contact work of previous visitors often create the desire, or cause actual plans to be made, for a visit to the park, and incidentally, to the museum. Various factors and devices to be considered later make the actual experience enjoyable and profitable. Later, the radio and printed guidebook again serve as agencies for a re-living of the visit.

Definite facts regarding visitor reaction have been learned by experience and experiment, and are briefly outlined here as an aid in dealing with visitors in the museum rooms. With a little experience and close observation it is possible to devise a simple method of leading the public through the exhibit room in an orderly fashion, which may serve as the first step toward fully adequate utilization of the museum.

METHODS OF HANDLING THE MUSEUM VISIT

Certain conditions must be avoided, others cultivated. We will consider the undesirable ones first. Visitors resent being forced; they may be too polite to express their displeasure openly, but it is present to some degree nevertheless, and every effort should be made to prevent any such unsatisfactory reactions. Common instances of forcing include hurrying visitors through the room to maintain some schedule and directing openly or

diverting their attention to specific exhibits, as well as controlling rigidly the path they must follow. The museum visit can be spoiled easily by too obvious and close a watch on every move. Many persons are made uncomfortable by the careful scrutiny of guards who bear a resemblance to the military or police. Favorable conditions which should be encouraged are the converse of these. Unmolested browsing is a pleasure to many, and leisurely observation should be permitted. The general character or feeling of the museum is more subtle but important. An atmosphere which avoids ostentation on the one hand and cold dignity on the other should be created. By retaining a spirit of welcome friendliness and simple sincerity the museum helps to further a better understanding of historic and natural values. The museum is no longer a place of visible storage containing a monotonous array of many similar objects. On the contrary, the atmosphere of the museum should encourage a deliberate examination

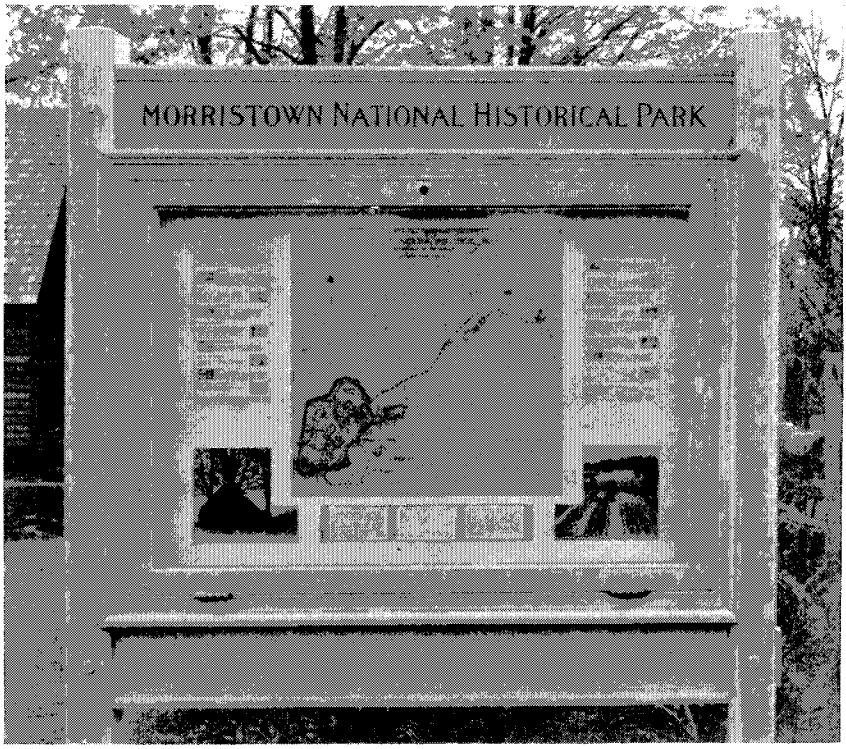

Figure 34.—HISTORICAL TRAILSIDE MARKER, MORRISTOWN NATIONAL HISTORICAL PARK, NEW JERSEY

of historical and scientific evidence. The visit should result in a realistic picture of life and the forces of nature leading to a better appreciation of our natural resources and national achievements. Anything which illuminates the past throws light on the present. Free circulation in a natural manner through rooms clear of obstacles is helpful in creating the desired feeling for the visit. Center aisle cases which compel abrupt turns in narrow spaces defeat this purpose.

There are several possible ways of handling the museum visit. None is best for every situation, for in addition to the peculiarities of each museum, the personality of the attendant is a major factor. The simplest method, and perhaps the commonest, is to let visitors use the exhibits without guidance or suggestion. They may enter whenever they please (during open hours), go to the exhibits in any order, stay as long as they like. All exhibits in park museums are planned to be self-explanatory, so are adapted to this type of visit. It is an excellent method in several respects. It avoids all forcing and automatically adjusts itself to the interests, background, and energy of the individual visitor. It costs less than any other since it demands fewer and lower-salaried attendants. This method need not be as haphazard as it appears on the surface. By carefully arranging the exhibits in order according to the known facts of average visitor behavior, it usually is possible to induce a good majority of the visitors to pass the exhibits in the correct sequence without being conscious of control. Attention can be drawn to the most important ideas by displaying them with some of the more powerful devices for attracting and holding interest. The labyrinth system whereby the visitor sees only one exhibit at a time and must approach it from a predetermined direction is not always satisfactory for park museums. It gives control and emphasis and is fine for handling large crowds, but frequently leaves the visitor with the impression of being forced. While it has met with success in large expositions and in specialized exhibits in art museums, too much floor space is required in proportion to the number of exhibits shown for the small one- or two-room museums in the parks. A simple counterclockwise circulation probably should be the basis of arrangement in most instances. The effectiveness of this method of handling the museum visit rests wholly on the exhibits. It works well for the more alert and those with a special interest in the subject matter, but since it requires initiative, many visitors get less than they would by some other method. While every park museum should be adapted for use in this informal manner, more elaborate methods probably should be used in conjunction with it.

At the other extreme in ways of handling the museum visit is the complete

guided tour in which an attendant marshals a group of visitors, leads them from case to case explaining the exhibits and recounting the story, then ushers them from the building. Its principal advantage is that all the visitors are given a definite and coherent body of facts and ideas which will help them understand the park features. While some receive less than from a free visit, others receive considerably more. Much depends on the ability of the guide. This system is perhaps the least satisfactory as a general rule because it demands regimentation, but in certain park museums it may be not only necessary but very successful, especially in areas where the museum visit is part of a regular park tour.

Between these extreme methods are three that may be mentioned as combining some of the advantages of both. The demonstration or gallery talk is a way of handling visitors which is well developed in city museums. Instead of conducting visitors through the museum, rather informal talks are given, usually at stated times. These talks center in one or a few particular exhibits and explain them in some detail. Often they are supplemented by demonstrations. A good speaker, provided with specimens and graphic devices such as topographic models designed to show the result of geologic forces or military maneuvers, or using simple demonstrations with clay or raffia to explain the manufacture of pots or baskets, is appreciated. An explanation of how a flintlock is loaded, choosing an original musket, powder horn, and other accessories for the demonstration, is but one of the many possibilities for such work. Often specimens can be handed around the group to illustrate some point. Following the talk, visitors are free to resume their unhampered inspection of the other exhibits. In museums where the demonstration is used extensively, the exhibit room may well include a low platform which will give visitors a better view of the speaker (*see* Fig. 3*A*). A second intermediate method involves the presence of an attendant in the exhibit room—not a guard, but a trained worker who keeps in the background and gives no formal talks, but who can give intelligent guidance when visitors want it. A friendly attendant who answers questions accurately, or, when he does not know the answer, promptly admits it and offers to look it up or suggests a reliable source of information, is a great asset to any museum. A few words of explanation regarding some place or phenomenon in the park or aid in settling the identification of some bird or flower by showing the questioner a picture or a specimen in the study collection is regarded more as an opportunity for service than as an annoyance. The third way is the use of guide leaflets. A proper leaflet can induce visitors to spend more time at the exhibits, read more labels, and in general get more out of the museum; but to be effective it must be free, brief, and

carefully written. Experiment has shown that the leaflet should refer specifically to things which can be seen in the exhibit and not to general information about the subject. The general account may be read at home, but it is not used in the museum. Leaflets are most satisfactory when they are handed to the visitor personally by a polite attendant who suggests their use.

It should be obvious that these several methods of handling the museum visit are capable of numerous combinations and modifications. Most visitors do not care to see every exhibit, and no one exhibit has a similar appeal to all. Some few are interested in each type of exhibit, and an effort should be made to supply the wants of every class of visitor. If a complete selection of methods is made to suit the individual needs of all visitors, a greater service will be performed than if an attempt is made to force the interest of all on one type of presentation. In nearly every instance the best solution for a park is a studied mixture of the available methods. This is a responsibility of the park naturalist or historian, and in a number of areas it has been done with conspicuous success. For example, a guided trip through the exhibit rooms is provided for many who find that the combination of hearing a description while viewing the material objects requires less mental effort on their part. A competent guide stimulates interest

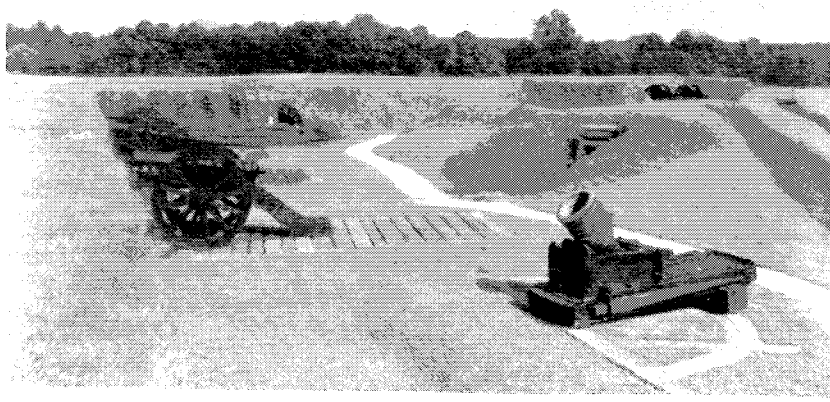

Figure 35.—HISTORICAL EXHIBITS IN PLACE. RESTORED EARTHWORKS, ORIGINAL ORDNANCE IN NEW MOUNTINGS. GRAND FRENCH BATTERY, COLONIAL NATIONAL HISTORICAL PARK, VIRGINIA

which leads to a more detailed personal examination after the talk is over. The trips are abbreviated to save time, thus enabling the small staff to accommodate a larger number of visitors. The main points of interest and only the most important specimens are singled out in the talk. Those who wish to do so may go over the intermediate exhibits at their leisure. Much is left for the visitor who wants to go through the exhibits unaccompanied by a guide and select, cafeteria fashion, whatever pleases him. Easy access to the offices and study collections is permitted. To deny anyone who is seriously seeking knowledge is contrary to sound policy. Sometimes the interruptions so caused may slow up the progress of regular work, but a few minutes "behind the scenes" often will leave a pleasant, lifelong impression on the visitor.

A specialized method which museums in large cities have developed for work with children is the museum game. This might have a limited use in some park museums, for example in stormy weather. The game usually consists of cards bearing illustrations without names or sentences with missing words. The answers are to be found in the exhibits. More complex questions are adaptable to adults.

Since the exhibit rooms are constantly, if unobtrusively, teaching every minute of the day when there are visitors, it is obviously desirable to extend the open hours as far as possible. Pressure of work during the months of heavy visitation, as well as the cost of illumination, often makes it difficult, if not impossible, to keep museums open at night. They should be open as much as possible in the evening, however, particularly where nearby camps or hotels may provide a large number of persons who have ample time on their hands before and after the lecture around the campfire or in the auditorium.

CORRELATION OF INTERPRETATIVE WORK

The interpretative program is based on the principle of making the park more available and enjoyable through a system of closely interrelated devices such as signs, markers, lectures, guided trips, and exhibits. None can be wholly successful if indifferently pursued, and all tie in basically with the natural and historical exhibits which are the principal park features. The museum with its explanatory displays cannot be isolated from the rest of the program. Every method of reaching the visitor to aid him in a better understanding and greater enjoyment of the park needs to be developed and carefully correlated. The problem of correlating subject matter is considered briefly in Chapter II. From the museum standpoint the exhibits, both in the building and on the trailside, should avoid unneces-

sary duplication of information that can be given better by word of mouth or in printed form. They should concentrate on the many phases of interpretation for which museum methods are particularly suited. The museum in use also must be coordinated with the other interpretative activities, playing a well-defined role in the program. The arrangements will vary widely to fit local conditions. In those areas where visitors are conducted through the park on a guided tour, the museum usually is one station on the route. This is frequently the case in the battlefield parks. The museum may be used as a starting point for the tour, an intermediate stop, or the terminus. When the museum visit is first on the itinerary a preliminary talk may serve as an excellent introduction and orientation to the park area. In some respects the intermediate stop is especially good, for it gives visitors time to become actively interested in the park before introducing them to the explanatory material in the museum. The museum visit in this type of program usually is accompanied by a brief lecture and demonstration giving sufficient background for the field trip or summarizing it, and exhibits are provided to illustrate the talk. Sometimes two stops are made at the museum, the second ending the trip. With such an arrangement visitors can examine the exhibits at leisure for answers to questions that have occurred to them in the field. This is a good opportunity for a final

Figure 36.—TELESCOPES AND BINOCULARS IN FIXED POSITIONS, WITH DESCRIPTIVE LABELS UNDER EACH, ARE USED AT THE YAVAPAI OBSERVATION STATION MUSEUM, GRAND CANYON NATIONAL PARK, ARIZONA. NOTE RELIEF MODEL ON LEFT USED IN PERIODIC LECTURES

Figure 37.—BROADCASTING "NATURE SKETCHES" FROM ROCKY MOUNTAIN NATIONAL PARK, COLORADO, BY SHORT WAVE TRANSMITTER

summation of the park story to clear up any vague impressions and emphasize salient points. A formal lecture with slides or motion pictures might follow. In parks where a guided tour is not the rule, the museum may function quite differently. It may be the main reliance of the interpretative staff for reaching the 1-day visitor who has no time to engage in the field and lecture activities. The exhibits give these visitors an introduction to the park, orient them, send them to the important features, and provide them with some understanding of the meaning in what they will see. The museum is particularly useful here because it requires only half an hour or an hour to do its work and can do it whenever the visitor arrives regardless of staff schedules. In some parks the hurried visitor comprises a large percentage of total attendance. For the extensive program of field trips, auto caravans, and other outdoor activities developed in many parks, the museum serves as an assembly point and terminus. The exhibits can do much casual interpreting while the group is gathering, and many trips can end profitably in the study rooms. The museum in a large park is the focus for much of the contact program. It can fit into campground activities, key into the subject matter of lectures, and stimulate the informal personal

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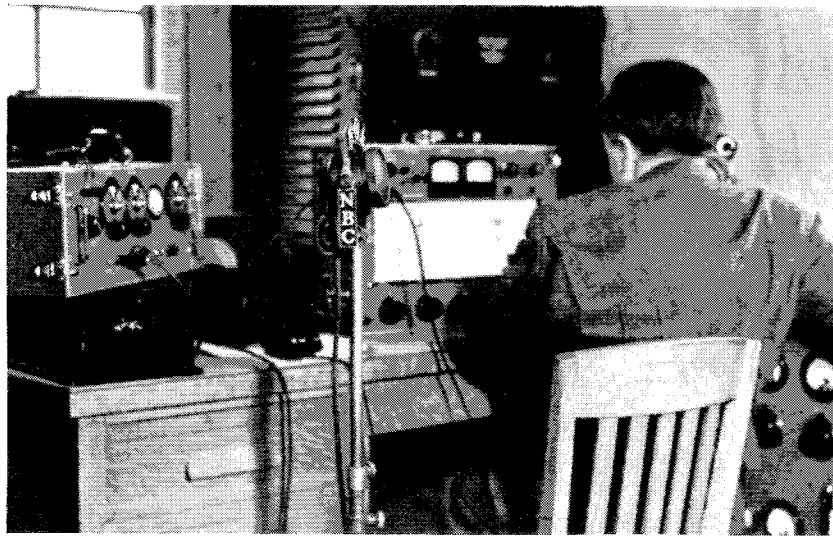

Figure 38.—TRANSMITTING EQUIPMENT AT HEADQUARTERS MUSEUM FOR RECEIVING SHORT WAVE FIELD PICKUP AND RELAY FOR NETWORK RELEASES

contacts that are important because they are unusually effective. As headquarters for the interpretational program the museum occupies a strategic and responsible position. It requires careful planning to integrate the various activities so that they supplement each other without overlapping and competition; but properly coordinated, they form a notable method of interpreting parks to the public.

Correlation of the museum with special activities of the interpretative staff has been developed in some areas. Radio broadcasts from the park out-of-doors and in the museum, for example, have been successful, notably in Rocky Mountain National Park. (*See* Figs. 37 and 38.) In adopting radio techniques to museum situations the work of several city museums in this line also might be noted. Broadcasts from the National Museum are outstanding, and other museums have coordinated their radio programs with school work, Sunday newspaper supplements, timely events, and anniversaries.

CHANGE AND GROWTH IN THE MUSEUM

Once a satisfactory interpretative system has been worked out for the park, its success is only temporary. It should change gradually or suddenly as new visitor reactions are noted. The finished museum is a dead museum. Exhibits should be dynamic and as fresh as today's newspaper. The

perfect exhibit will never be designed, the ideal arrangement never achieved, the faultless label is still to be written. A lecture becomes hackneyed with long repetition and must be revised. Constant observation of visitor reaction will reveal changes in interest as time advances. Original objects used to illustrate parts of the story will be replaced with better or more representative specimens. Labels must be rewritten frequently seeking a finer choice of words to explain the story more clearly. A careful choice of words in the lecture as well as the label is essential, not only for clear, correct English, but also to avoid word and thought associations of a detrimental nature. This is just as true in park interpretative work as it is in the field of commercial advertising, where the selection of a product name, slogan, or description may well mean great popularity or total failure.

Changes of interest occur with the seasons as well as with the shifts in percentage of visitors from various localities and economic strata. Special exhibits of timely and seasonal interest should be installed to capitalize on their current values. It is with this in mind that cases and exhibit equipment are designed for easy rearrangement and replacement of their contents. The need for such changes is recognized in standard procedure and equipment.

The American public is ever becoming more discriminating in its choice, perhaps in large measure because of the constant efforts of merchants to package and display their goods in an attractive manner under carefully chosen surroundings. Progressive museums are also alert to the value of such presentation and employ every method known to the artist, the exhibitor's sense of dramatic values, and all the craft of the designer. A direct appeal should be made to the intellect, but the easy access through the emotions should not be neglected entirely. While it is the primary purpose of an exhibit to teach, it need not be pedantic. High entertainment values are latent in every phase of nature and history, and they should be developed.

EVALUATING THE MUSEUM

The need for change and steady improvement in park museum exhibits is realized, but aimless change is in itself of little account. The museum staff may forget that what the public wants may not be exactly what the staff thinks it should have. Alterations in the exhibits should be purposeful and this demands some knowledge of how the existing installation is operating. The behavior of visitors in a museum is a complex matter and theories about it are not always reliable. Before a program of exhibit revision is undertaken, the reaction of visitors to the present conditions should be

analyzed. Only then can the change be mapped satisfactorily, and what is equally important, its effectiveness measured. In studying the operation of the exhibits rather critical methods should be used. The staff should observe enough visitors to establish a reliable average of behavior. The typical visitor is an exploded myth and dependence must rest in long series of carefully recorded observations. Observing visitors involves both the methods of watching and the actions to be watched. The requisite in sound method is to eliminate every possibility that the observer's presence may alter normal behavior. Usually this means simply that the observer act so that visitors do not know they are being watched. In this the staff member in uniform is at a disadvantage unless he can seem to be carrying out other duties as he observes. An information desk that gives a clear view of the exhibit room would be ideal. Records should be made at the time of observation, but as inconspicuously as possible. The behavior which is to be observed will depend on the local problem. Frequently the following questions enter into an analysis of significant behavior:

1. Routes of circulation. The percentage of the total attendance that goes to the right or left, that enters each room, and so on. The results should give a clear picture of where visitors go in the museum and what path they follow in getting there.

2. Total time spent in the exhibit rooms. This is one of the best means of inferring the effectiveness of the museum. It permits a direct comparison after changes have been made.

3. Relative effectiveness of individual exhibits. This can only be inferred from objective evidence, but the implications probably are valid. The evidence should consist of the percentage of visitors stopping at each case, the average length of time spent at each case, the number of labels read, and similar reactions. Time records require a stop watch for they range from 4 or 5 seconds to rarely more than a minute. This information should reveal strong and weak points in the installation and permit a general measurement of the effects of a change in an exhibit.

More refined studies will suggest themselves and may be applied to the museum as a whole or to individual cases. In using the results it must be remembered that the behavior observed is not a direct indication of what people are getting out of the museum. The exhibit that holds them the longest may not teach them the most. Nevertheless, such observations are the best means of arriving at an adequate picture of how the museum is working. Studies of this kind have been rare in park museums.

Another valuable source of information in this connection lies in the questions asked by the visitors. It will be found more often than otherwise

Figure 39.—TRAILSIDE EXHIBIT, OBSIDIAN CLIFF, YELLOWSTONE NATIONAL PARK, WYOMING. NOTE LARGE SPECIMENS ON FLOOR AND COMPOSING SUPPORTS OF STRUCTURE

that the guided tours, lectures, and explanatory exhibits are keyed too high for the education and experience of a majority of the visitors. Such questions should be collected over a considerable period to give as general a picture as possible. Surveys also can be made by casual questions as to what interested each visitor the most. Frequently a remedy for a poor response may be found in some simple detail inadvertently omitted from a label or lecture. To cite an example, a ranger-naturalist was giving a talk and demonstration on local geology. After a few introductory remarks he picked up a pointer and without any preliminary explanation began to indicate certain features on a topographic model. It was observed that many in the audience were momentarily puzzled by this model and apparently had never seen a scale model of this type. Before they had discovered the nature and purpose of the model, the speaker had advanced so far into his talk that their train of thought was broken and the main points of the lecturer's otherwise well organized story were partially lost on that particular group.

The importance of careful timing, well recognized on the stage and radio and by good public speakers, should be considered carefully in mu-

seum work. Ideas are conveyed and absorbed at a definite rate. Any increase over the normal will end in confusion and failure. This applies not only to talks and lectures but to exhibits as well. Vacant spaces are substituted for time to give the eye and the mind a rest in moving from one display to another. Important exhibits are accentuated just as the important points in a lecture program are emphasized. Emphasis is placed judiciously by larger type in the labels and the prominence of lighting and arrangement. Crowded exhibits are as deadening as a long lecture. Frequently interest is lost by attempting to divert attention too suddenly into unfamiliar channels. Usually a visitor will come to a park for the first time to see some natural phenomenon or famous structure of which he has heard a great deal. His principal interest will not be satisfied until he has fulfilled this purpose and learned as many facts about the feature as may appeal to him. As it would be poor salesmanship to try to divert the interest of a family visiting an electrical equipment salesroom from a radio to a vacuum cleaner if they came intent on buying a radio, it would be equally unwise to try to divert the attention of the visitor bent on seeing a famous waterfall with some less known feature in archeology; or, again, to insist on pointing out the seasonal wild flowers when the main desire, still unsatisfied, is to visit the house occupied by a great national leader.

RESEARCH

From the inception of the idea of an interpretative program, it was obvious to all workers that naturalists and historians engaged in planning and conducting the work must be provided with organized information relating to the features that they were to interpret. A research program was organized. Cooperation on special problems was obtained from the National Museum, the Biological Survey, the Geological Survey, the Bureau of Fisheries, and from many universities and museums.

In addition to investigations conducted by outside agencies, the Service established small staffs of research specialists in forestry, wildlife, geology, history, archeology, and the general field of museum work. The attitude of the Service toward its research program is reflected in the recommendation made by national park superintendents in conference at Santa Fe, N. Mex., October 1939:

"The interpretation of natural and human history in national park areas is recognized as a primary objective. The basis of such interpretation should be organized research. A sense of balance must exist in arranging research and interpretative functions, and the role of research, generally,

in the National Park Service program should be reexamined. National Park Service problems are national in scope relating to physical, biological, and human values inherent in some of the most perishable of Federal possessions. They pertain to mental health, constructive living, social traditions, enjoyment of life, and other basic matters bearing on the health, education, recreation, and psychology of America's population. The National Park Service is most advantageously situated to develop a national perspective in ethnology, history, wildlife, and aesthetic appreciation of scenery."

This advantageous situation is both an opportunity and a challenge. The Service can make the most of the opportunity only if it provides its officers with full understanding of its assets. Research in national park areas should be recognized, encouraged, and strengthened in every practicable way. The research program should procure a constant flow of essential facts relative to the natural features, the interrelations of life forms, history and prehistory, and their interpretation to visitors or to administrative policies. To make the facts worth while, the researcher must be free to discover and report with complete impartiality all facts ascertained in a given situation. Basic data are frequently obtained through the coop-

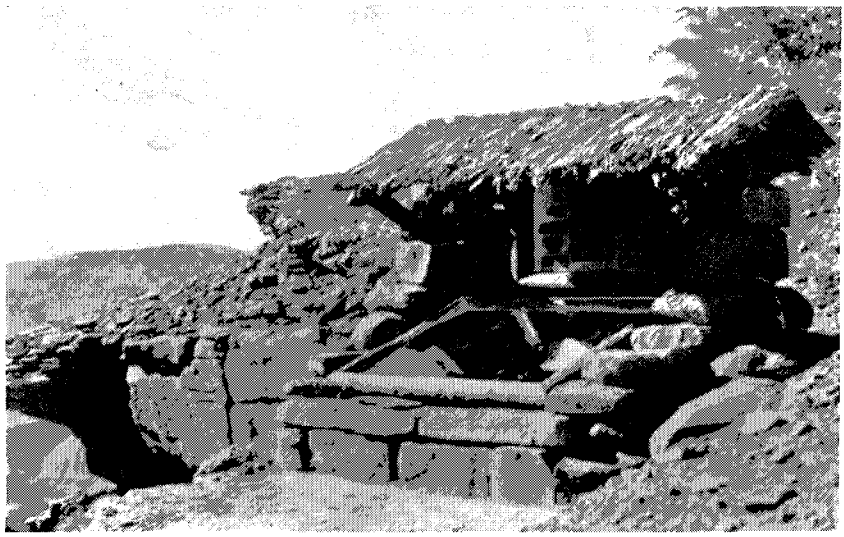

Figure 40.—EXHIBIT-IN-PLACE, GRAND CANYON NATIONAL PARK, ARIZONA. THIS SHELTER IS BUILT OVER A FINE EXPOSURE OF FOSSIL FERNS WHICH HAVE BEEN LEFT IN PLACE FOR VISITORS TO SEE

eration of outside agencies because most parks do not have adequate funds and personnel to carry on a sustained research program. However, reliance wholly on outside agencies for research is not satisfactory.

As a foundation of the research program, a small staff of professional personnel has been employed to study problems concerning the maintenance, protection, preservation, and interpretation of the historic, scenic, and scientific values in national park areas and to submit recommendations pertaining thereto. The professional personnel have many duties other than research that make heavy demands on their time. Consequently, only the most vital problems receive attention.

Because of the press of public contact and other administrative or routine duties, qualified members of the park staff seldom have sufficient time to conduct sustained investigations. Most of the field staff have neither the facilities nor opportunity to develop suitable research technique. Those who acquired some ability in college before entering the National Park Service have an advantage over those who have never taken part in any such program. However, field staff men generally are in an excellent position to recognize situations that require thorough investigation and can recommend that university groups undertake research to solve these problems or enter upon the studies themselves.

Cooperation is frequently forthcoming from universities, colleges or qualified individuals. These agencies are particularly well fitted to conduct a specific research project when the regular park staff lacks adequate time or facilities. Individuals and privately controlled universities have more opportunity to conduct pure research not directed to the immediate solution of a practical problem than have Government agencies. If the Service indicates willingness to provide access to its areas, it thereby encourages scientists and students from universities to utilize the park areas as field laboratories. In many instances graduate students do the actual field work in a national park area and prepare theses to support their candidacy for academic degrees. In such cases, the result of their field work is carefully checked by professors and in general can be relied upon. This type of research calls for the expenditure of little time or money on the part of the Service but often results in a valuable addition to the fund of available knowledge.

This should not be construed to mean that Service officials should avoid the responsibility of organizing and prosecuting a vigorous research program when time, funds, and qualified personnel are available. Results of routine observations or taxonomic studies are not classified as the results of research in the strict sense of the word. True research involves bringing to

light new data, information or a new or revised interpretation. However, it frequently happens that such new data may arise from routine observations or taxonomic studies. Thus, these routine duties, usually carried on by park naturalists, wildlife rangers, foresters, etc., have an immense value in the park program and should receive every encouragement. Special reports on these studies even though they are not published should be given careful handling and preserved in the library collections of the parks, regional offices, and the Washington Office.

The greatest need preliminary to research in all parks is the provision of adequate workrooms and facilities to be made available for the use of the park staff and visiting scientists. These facilities include laboratory apparatus, supplies, reference material, and access to suitable libraries. Apparatus may be accumulated over a period of years. Key books covering the major sciences may be purchased through the Washington Office from the annual National Park Service Library Fund; may be purchased by the local library and museum associations; or borrowed from State libraries. The various scientific fields should be reviewed each year, and books by recognized authorities purchased soon after release from the press. In this connection the notices contained in the *Park Service Bulletin*, *The Regional Review*, and the monthly report of the Branch of Research and Information should be of assistance.

If research is to be of maximum value, findings must be published promptly or made available for general use in some other form. Publication may be in abstract form or in entirety in scientific magazines or in journals of the learned societies. In some instances, the complete results of investigations may be presented in the form of government releases. The present policy of the Publications Committee of the Service is to provide funds for the publication of the results of original work by staff members so far as appropriations will permit.

One device adopted by some bureaus to stimulate research is the organization of advisory committees. The contribution of these committees depends on the energy of the group, especially the chairman, the frequency of meetings, attitude of Government officials, competency of individual members of the committee, and the funds available. An advisory body for a park or a region may be extremely valuable in pointing out deficiencies in the knowledge of an area and in recommending steps to fill the gaps.

Constantly recurring park problems, requiring for solution scientific data obtainable through research in the fields of physical, geological, biological, archeological, and historical sciences and in the fields of recreation and

aesthetics, indicate the desirability of this type of study. Investigations of plant assemblages, ecological problems, wildlife diseases, insect infestations, bird migration, and fish culture require a thorough and almost constant surveillance. Archeological surveys and surveys of collections of historic objects in park museums will reveal many subjects that require study and justify publication.

Superintendents and other administrative officers having such problems for investigation may request through appropriate channels the detail of qualified personnel to advise on the situation. If agencies outside the Service are involved, the research activities should be correlated through the Washington Office in order to avoid duplication of effort. It is the desire of the Director and the branch heads that field employees use initiative in defining research projects and undertake independent studies whenever problems arise that should be solved without delay. The naturalist, historian, or museum curator who shows determination to meet research obligations usually is especially successful in advancing his interpretative program.

The majority of the people who come to the parks are bent on relaxation. When they find something which is genuinely inspiring, be it beautiful scenery or the place where some patriotic sacrifice was made, they respond instantly. Museums should likewise cause a favorable response by being attractive to the eye and diverting to the mind. Behind the scenes in every instance, however, must be that substantial provision for authenticating all that the educational officer says and all that the museum exhibits present.

CHAPTER ·XI·

ADMINISTRATIVE RELATIONSHIPS AND PLACE OF MUSEUM WORK IN THE NATIONAL PARK PROGRAM

TO THE field employee held close to his local program by the incessant demands of the growing crowd of park visitors, it is sometimes difficult to form a proper perspective in viewing the physical set-up and broad objectives of the National Park Service. It is the purpose of this concluding chapter to orient the naturalist, historian, or other officer engaged in museum work in the administrative scheme of the National Park Service, and to summarize for him much of the prescribed procedure and definition of policy that has been elaborated upon in the preceding chapters. Actually this chapter may be accepted as a unit complete in itself, and for those employees who cannot devote leisure time to careful study of the entire manual, it will serve as a concise guide to regulations and administrative practice. It does not, of course, cover technical aspects of exhibit planning and preparation, nor does it treat of collections and their care.

Considerable space is given here to exposition of the educational functions of both branches of the Service responsible for the interpretative program—the Branch of Research and Information and the Branch of Historic Sites. Special effort has been made to provide a background of understanding regarding objectives and methods of general interpretative work in order that the picture of park museum activities may be projected upon it. The rather full account of natural history associations and their founding is presented with the hope that those parks that have not enjoyed the cooperation of such nonprofit organizations may encourage the establishment of cooperating societies for the purpose of advancing library and museum programs.

Most of this chapter is taken verbatim from the *National Park Service Administrative Manual*, Washington, 1940, Chapter II, General Organization Structure, and Chapter III, Objective Functions.

GENERAL ORGANIZATION STRUCTURE OF THE NATIONAL PARK SERVICE

DIRECTOR

The National Park Service is administered by the Director of the National Park Service, under the direction of the Secretary of the Interior, in accordance with the act of August 25, 1916, as amended; the act of June 8, 1906; the Executive order of June 10, 1933; the act of August 21, 1935; and the act of June 23, 1936.

ASSOCIATE DIRECTOR

In his administration of the National Park Service, the Director is aided by the Associate Director, who serves as the Acting Director of the National Park Service during the absence of the Director.

GENERAL FUNCTIONS OF THE SERVICE

The Director and the Associate Director formulate policies and direct protective work from the standpoint of preserving and utilizing the areas administered by the National Park Service and their enjoyment by visitors; direct construction from engineering, architectural, and landscape viewpoints, including sanitation facilities; further public interpretative service in the natural sciences, history, and archeology; provide for museum developments; supervise the annual estimates and expenditures of the Service, the Commission of Fine Arts, and the George Rogers Clark Sesquicentennial Commission; maintain the Executive Mansion and Grounds; and are responsible for the investigation and organization of new national parks, monuments, historic sites and buildings, and other areas.

DIRECTOR'S SPECIAL DUTIES

The Director is charged with general supervision of the Civilian Conservation Corps work on Federal and State park lands. He also is executive officer of the National Capital Park and Planning Commission and of the Thomas Jefferson Memorial Commission, and is a member of the District of Columbia Zoning Commission, and Alley Dwelling Authority, and of other commissions, committees, and boards.

THE WASHINGTON OFFICE

The headquarters and office of the Director of the National Park Service, hereinafter referred to as the Washington Office, are located at Washington, D. C., and constitute an organization unit of the Department of the Interior, being a major bureau thereof.

Administrative Relationships

For effective administrative control and coordination, the technical and other work of the National Park Service in the Washington Office is organized functionally into 10 units, each headed by a designated official who is directly responsible to the Director and Associate Director for the efficient conduct of the work assigned to him.

The functional units of the Washington Office, with the titles of the heads thereof, are as follows:

UNIT	UNIT HEAD
Branch of Operations.	Chief of Operations.
Branch of Research and Information.	Supervisor of Research and Information.
Branch of Historic Sites.	Supervisor of Historic Sites.
Branch of Recreation, Land Planning, and State Cooperation.	Supervisor of Recreation and Land Planning.
Branch of Plans and Design.	Chief of Planning.
Branch of Engineering.	Chief of Engineering.
Branch of Forestry.	Chief of Forestry.
Branch of Memorials.	Superintendent of Memorials.
Office of Chief Counsel.	Chief Counsel.
Office of Information.	Chief of Information.

The Museum Division is a unit of the *Branch of Research and Information*, the functions of which branch "are to coordinate administrative matters pertaining to scenic and scientific areas, and the scientific research, planning and interpretative programs pertaining to such areas; to supervise the collection and preservation of records pertaining to interpretation of natural phenomena; to coordinate wildlife and fish protection management; to supervise the compilation of educational and scientific data and the preparation of scientific manuscripts; development of helpful relations with scientific organizations; and rendition of advice regarding the conservation and utilization of the natural resources of park areas."

To accomplish these purposes close cooperation with the other branches of the Service is necessary. The activities of the Museum Division especially must be coordinated with the programs of work conducted by the Branch of Historic Sites, the Branch of Recreation, Land Planning, and State Cooperation, and the Branch of Plans and Design. The Branch of Historic Sites is responsible for the coordination of administrative matters pertaining to historic and archeologic sites and for the supervision of the historical and archeological research, planning, and interpretative programs pertaining to American historic and archeologic sites. Obviously,

the two administrative units—the Branch of Research and Information and the Branch of Historic Sites—share responsibilities in the field of museum work in historic areas. Relationships between staff members in the two units are such as to assure concerted action in meeting problems. All administrative planning and execution for museums in historic areas, whether handled in the Washington Office or in the field, are shaped to include both branches in the study, review, and concurrence involved.

The Branch of Recreation, Land Planning, and State Cooperation supervises the Civilian Conservation Corps work on national, State, county, and metropolitan park and recreation areas and it coordinates the interests of State, county, and metropolitan park authorities and various planning commissions. These interests include museum programs in many areas other than those administered by the National Park Service. Sixty-four museums exist in State parks in 19 States (1940) and there are many more park museums in county and metropolitan areas. In many of these museum programs the Civilian Conservation Corps makes important contribution in planning and development. The CCC also plays an important role in the museum work in national parks and national monuments. There is, then, necessity for cooperation between the Branch of Research and Information (Museum Division) and the Branch of Recreation, Land Planning, and State Cooperation in planning and executing museum work programs and estimates of costs.

The Branch of Plans and Design supervises all architectural and landscape designing, planning, development, and construction in each area administered, or developed, under National Park Service supervision and prepares master plans for the control of physical development in National Park Service areas. Drawings, specifications, and estimates for museum structures are prepared by this branch and it is essential that the Museum Division work with it closely from the very inception of each museum project.

The Branch of Engineering has charge of engineering planning, radio installation, invitations for construction bids, construction contract preparation and management, and acquisition and disposal of surplus equipment. There are frequent occasions to ask this branch to assist in meeting museum needs.

All fiscal matters are supervised by the Branch of Operations. It supervises and coordinates the general personnel program of the Museum Division in the field units and in the Washington Office. The allotment of appropriations, control of expenditures, supervision of building fire reduction programs, and custody of general records are some of its functions. A

close contact must be maintained at all times between the Branch of Research and Information (Museum Division) and the Branch of Operations.

THE REGIONAL OFFICES

To facilitate administration, the areas of the National Park Service are divided into four geographical regions, each in charge of a regional director who is assisted by an associate regional director, two or more assistant regional directors, and a staff of technicians and other employees.

The regional directors are the Director's field administrative representatives and are generally responsible for the furtherance of the Service's programs in the regions. They are in general charge of public contact work in accordance with approved plans and policies, and of the development of cooperation with Federal, State, and local agencies, etc. The regional directors have supervision over and are responsible for the coordination of the authorized water rights and historic sites and buildings surveys, and of the park, parkway, and recreational area study. By administrative control, they coordinate the functions of the technical forces within their respective regions and handle such additional work as may be assigned to them by the Director.

The Museum Division finds no direct representation in the regional organizations but practically all museum projects of the National Park Service are studied in the regional offices and many of the justifications, estimates, and working drawings for museum buildings are prepared in these offices. Such work involves cooperation between the Washington or Berkeley, Calif., offices of the Museum Division and naturalists, historians, engineers, and architects in the regional organizations.

TYPICAL NATIONAL PARK AREA ORGANIZATION

All national park areas are organized and operated in the same general manner as the same broad purposes and functions extend to all areas. Differences in internal organization structures, where they exist, are minor and are due, almost entirely, to variations in the size of the areas. An individual park area, whether large or small, has individual characteristics which make it a distinct entity of the National Park System. All park areas are considered on an equal basis in the general organization scheme and are so regarded in the general administration of the Service.

THE PARK SUPERINTENDENT

Each park area is under the direct charge of a superintendent who is the responsible administrative representative of the Service in the area.

The superintendent supervises the business management, protective work, interpretative services, research work, public relations, operation of park utilities and facilities, the operations of park operators, permittees, and contractors, maintenance and construction, and the planning and execution of the general development program of the park area.

The superintendent cooperates with other Federal, State, and local agencies and with civic bodies and private citizens in the vicinity of the particular park area in furthering the objectives and in maintaining the policies and rules and regulations of the Service. He collaborates with the proper regional director in the study and solution of local problems and receives technical advice and assistance from the regional office or from other authorized sources. He reports directly to the Director with respect to certain approved matters. He is expected to coordinate effectively all functions in his area and, while he usually is permitted wide discretion in the method of direction of administrative affairs, including the assignment of functions and the delegation of authority and responsibility, it remains his primary responsibility to enforce observance of the applicable laws and regulations and to adhere rigidly to the established policies and procedures of the Service and of the Department.

FUNCTIONAL DIVISIONS

The work of a park area logically falls into the following well-defined divisions or departments:

1. Administration Division.
2. Protection Division.
3. Maintenance and Construction Division.
4. Research and Information Division.

THE RESEARCH AND INFORMATION DIVISION OF A NATIONAL PARK

The Research and Information Division supervises the guidance of the visiting public to a fuller understanding and appreciation of the area's natural features, wildlife, human history, etc., interpreting such objects of interest through the medium of nature study trips, auto caravans, and indoor and outdoor lectures with visual instruction and exhibits in museums and roadside or trailside "shrines."

This Division operates the museums, prepares and maintains the exhibits, and catalogs the scientific and other accessions therefor; conducts scientific researches into geology, biology, history, archeology, and other related physical or natural science fields of the areas; studies especially wildlife problems in conjunction with the Protection Division and special scientific

subjects peculiar to the area; sponsors the enlargement and proper maintenance of the local general library, and encourages the activities of authorized cooperating nonprofit organizations, such as local museum, library, or natural history associations; publishes *Nature Notes* periodically and may supervise the sale of Government maps and publications; and assembles and maintains a collection of scientific data pertaining to the area.

All of the seasonal park interpretative and museum employees work under the supervision of the park naturalist or historian who is in charge of the Division and, in the larger parks, has one or more permanent assistants.

BASIS FOR INTERPRETATIVE PROGRAM

The interpretative program of the National Park Service is intended to develop in the visitor the *maximum of understanding and appreciation* of the characteristic park features, to stimulate his thinking, and to encourage him in the proper use of the park.

INTERPRETATIVE SUBJECTS

The subjects upon which interpretation in the areas administered by the Service should dwell include the physical, geological, biological, archeological, and historical sciences. The superlative quality of the teaching materials available makes it essential that interpretation be conducted on the highest attainable plane with respect to accuracy of fact and quality of personnel, ever mindful that the interpretation must be in terms readily understood by the average park visitor. Park areas are to be considered as field exhibits or laboratories of all the natural sciences.

The National Park Service has saved many of the country's finest scenic, scientific, historic, and archeologic exhibits. Proposed additions to the National Park System are evaluated on the basis of their scenic and scientific, or historic and archeologic, merit and must be of sufficient national interest to warrant their commitment to national care. There is implied in the commitment something more than custodianship. In the defined objectives of Service undertakings is imbedded the ideal that inspirational values come first. Neither the Government nor the citizen benefits by the mere physical possession of a superlative area; only with proper use and interpretation are the maximum values derived.

Approximately fifteen and a half million persons visited areas of the National Park Service in 1939. Their demand for explanation of the features unknown to them must not be ignored since a full measure of understanding is the most satisfying element in the visitor's reaction to his experience.

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Science, art, history, and archeology are interrelated. The study of one frequently leads to interest in another. Hence, there must be utilization and coordination of all sciences pertinent to park interpretative programs.

INTERPRETATIVE OBJECTIVES

The objectives of the interpretative service are:

(*a*) To develop and maintain a program devoted to the interpretation of the typical features within the Service areas so that visitors may obtain the maximum of understanding, appreciation, and enjoyment therefrom. This service will normally include a museum program, personally conducted trips, lectures, and a general information source within all areas of the National Park System.

(*b*) To preserve permanently from alteration or destruction the natural fauna, flora, scenic, geologic, and historic features of the areas.

(*c*) To coordinate all scientific activities within each area.

(*d*) To stimulate a greater appreciation and thus interest the public in the conservation of these national resources.

(*e*) To foster research in the natural and social sciences in the parks so that basic data will be available for use in the interpretative program.

(*f*) To maintain the highest standards in scientific thought and educational methods.

(*g*) To strive for unusual accuracy in all National Park Service informative publications.

(*h*) To assist schools or other educational institutions in utilizing by direct observation or contact the superlative examples of history, natural science, and biologic phenomena available in Service areas.

(*i*) To preserve and make available for future generations, facts relating to the age and conditions of prehistoric occupation by cooperating in excavations of prehistoric sites associated with human remains or artifacts.

(*j*) To advise in the physical development of park areas on matters affecting and affected by geologic, biologic, or historical values.

INTERPRETATIVE POLICY

The policy applicable to the interpretative service follows:

(*a*) To conduct the interpretational program on the highest attainable plane with respect to the accuracy of fact and to the dignity and clarity of presentation.

(*b*) To keep the public informed regarding the latest thought on natural processes exemplified in the national parks so that these areas will serve their highest function of inspirational appeal.

(*c*) To present the pertinent, interesting, and understandable facts regarding the geological and biological phenomena and the historical phases illustrated in the park area.

(*d*) To instill in the visitor a love of nature by actual contact with its manifestations, emphasizing its beauty and orderliness, its inspirational and educational values, and thus engendering an appreciation of and interest in its conservation.

(*e*) To encourage self-instruction and stimulate individual research so that education will become a continuous process and avocational pursuits will be encouraged, which will result in an effective use of leisure time.

(*f*) To obtain the benefit of study and opinion by the most advanced students of problems connected with the natural and social sciences.

(*g*) To supplement the Service staff by specialists who can contribute to the interpretative program.

(*h*) To advise other officials regarding development projects which affect or make use of the biological, geological, or historical resources of the parks.

INTERPRETATIVE FUNCTIONS

The functions of the Branches of Research and Information and Historic Sites as they relate to the interpretative service include:

(*a*) The correlation, stimulation, and technical supervision of all research activities within the national parks and monuments, including historical areas.

(*b*) Editing of all scientific data included in national park publications.

(*c*) Advising and cooperating with superintendents and custodians, in:

1. The selection of especially qualified naturalist and historian personnel to conduct the educational and interpretative functions.
2. Methods of training staff members.

(*d*) Correlating, assisting, and giving technical guidance to the field staff through the superintendents and custodians in matters pertaining to the educational activities, embracing:

1. Organization of a program including guide trips and museum exhibits.
2. Assistance in conducting or correlating, or providing basic research necessary as corollary to the educational program.
3. Advice and assistance in obtaining suitable visual or demonstration aids.
4. Library research for field staff located in isolated areas.

(*e*) Cooperation with representatives of other Government bureaus or scientific societies on matters relating to naturalist or historian activities.

(*f*) Collaboration in the preparation or review of scientific exhibits or labels for use in museums or along the trail and markers for historic sites.

(*g*) Cooperating with, and assisting, schools in availing themselves of the opportunities for scientific study and field observation in the areas administered by the National Park Service.

(*h*) Preparation of monthly and annual reports and statistical studies of naturalist and historian activities including a summary of the attendance by the public through the interpretative channels.

(*i*) Assisting other officers in establishing policy relating to naturalist and historian activities.

(*j*) Furnishing technical supervision of and assisting in formulating policies for the collection of specimens and documentation of historical records for scientific use within the areas administered by the National Park Service.

(*k*) Correlating the research activities of outside agencies cooperating in the solution of park scientific problems and stimulating research related thereto.

(*l*) Supervising and coordinating generally the informative program in the respective areas to the end that emphasis shall be placed upon a guide program designed to assist visitors to gain personal experience with natural phenomena and historic features.

INTERPRETATIVE PROGRAM

The interpretative program in national parks, monuments, and historic areas is founded on the knowledge that there is a demand from the public for such a program and that a great public benefit is to be derived from the Government's custodianship of the park areas. This program, emphasizing avocational pursuits and stimulating proper use of leisure time, is planned and executed by the park naturalists and historians, park rangers, and museum technicians.

INTERPRETATIVE METHODS

Methods used should emphasize the encouragement of visitors to study nature by actual contact. Lectures, literature, field trips, exhibits, and other visual aids are used as a means of explaining what has been seen and as a key or prospectus to what may be seen. Opportunities for self teaching should have a part in the program. Guidance of visitors is practiced only insofar as it may give visitors opportunity to discover the things of major interest, and to inform themselves fully, if they so desire. There must be an awakening of interest in the natural objects seen; a presentation of interesting

facts which will interpret the things seen; and an inspirational presentation and guidance for further study which will leave with the park visitor an intelligent appreciation of natural forces and phenomena.

INTERPRETATIVE PERSONNEL

Each member of the Service personnel participating in the interpretative program must be preeminently fitted by personal qualifications, training, and experience to direct or take a specialized part in the carrying out of such a program. So important are these qualifications that they are summarized below:

(*a*) *Scientific Training and Experience.* A thorough fundamental scientific background or knowledge of history is necessary for each staff member whether he be engaged in research in specialized fields or in the interpretation of scientific or historical facts in popular and nontechnical language. As the work touches many sciences, even in individual parks, it is essential that all workers have a broad perspective of the entire field of history or science as a whole.

(*b*) *Executive Ability.* Each member of the educational staff must have the ability to initiate and carry out successfully the interpretative program in his particular field. This qualification is especially important in individual parks where the sudden expansion during the summer makes it necessary for the officer in charge to build up an esprit de corps that gives life to the organization and to the work which is being presented to the public. The same qualification is as vitally necessary to workers in specialized fields and even to individual workers where enthusiasm, force, and *tact* govern the successful planning and execution of individual activities.

(*c*) *Ability in the Field of Education.* The practical success of educational workers depends to a large extent upon their understanding of the public and their application of the principles of learning to the presentation of their subject. Park educational workers must understand the park visitor, and also must be thoroughly familiar with the methods which will place facts before the visitor. The objective is development of understanding and appreciation, but it must be remembered that the usual park visitor resents being "taught." Training in the work of contacting visitors may come entirely from experience, but if backed by thorough understanding of educational psychology and methods, it will be more intelligently applied.

LECTURES

The objectives of the lectures given in park areas are to provide accurate information in such an interesting form that it will add to the visitor's

enjoyment of the park and give a comprehensive perspective of the park as a whole or its individual esthetic, historical, and scientific features. The subject matter of the lectures should have a distinct bearing on the park and should lead the interest of the audience to what they can observe for themselves in the field. In practice it has been found that comprehensive, carefully planned talks, covering a comparatively wide field, are preferable to lectures on individual details. Subject matter must be based upon authentic facts and recognized hypotheses and should be checked by the park naturalist or historian, or with his representative in charge of lectures.

At the beginning of every lecture and every guided trip a concise statement should be made regarding the aims, extent, and activities of the National Park Service. The introductory statement should outline very briefly activities of the Department of the Interior and then the policies and work of the National Park Service. Particular stress should be laid upon the operations of the hotels, camps, and transportation systems as public utilities operating under contract with the Department of the Interior and under strict supervision by the National Park Service. Emphasis should be given the fact that all rates charged by the public utilities for services to the public are approved by the Secretary of the Interior as being reasonable alike to the public and to the investing operators. In the case of the national monuments and the less visited national areas, lecturers should stress the fact that these areas are a part of the same system as the Yellowstone, Yosemite, Grand Canyon, Mount Rainier, and other world-famous national parks. Among worth-while statements that should be included are the following:

(*a*) The National Park System, which started with the creation of Yellowstone National Park in 1872, now comprises more than 150 areas of varying types containing a total of approximately 21,500,000 acres.

(*b*) The national parks have been set aside for the benefit and enjoyment of the people.

(*c*) The national parks contain the finest natural phenomena of the Nation, and, therefore, every visitor should gain from the increased knowledge and inspiration.

(*d*) To aid the visitor in understanding and interpreting the principal features, the National Park Service has established in Washington a Branch of Research and Information and a Branch of Historic Sites. Rangers, ranger-naturalists, and historians in uniform are in the field to answer questions, take visitors on guided trips, furnish illustrated lectures, and explain museum exhibits.

(*e*) The public roads, trails, bridges, campgrounds, telephone lines, etc.,

within these parks are built and maintained at the expense of the Federal Government. A park superintendent or other administrative officer is in direct charge of all governmental activities.

(*f*) Hotels, stores, transportation service, and similar public utilities are owned by private individuals or corporations and are operated under a permit or contract from the Department of the Interior. Such facilities are closely regulated by the Government as to rates and service.

(*g*) Every effort is being made by the National Park Service to make the visitors' stay within the park safe, enjoyable, and profitable. They are, in effect, our guests and should be treated as such.

A typical statement used in one of the national parks, that has been found satisfactory for that area, is as follows:

"As an introduction to my lecture you will be interested to learn that (name) National Park was created in (date). Each park has an individuality of its own and has been established in recognition of that peculiar characteristic, so there is no duplication of the parks in the series. You will find this park different from the Grand Canyon and both varying from the Yosemite. There are also some 80 national monuments, which were created because of some outstanding scientific and historical features and not primarily as great recreational centers for the enjoyment of the visitors.

"In these national parks the Government provides roads and trails and a ranger patrolling force, as well as a staff of naturalists and historians all of whom are specially trained to help visitors enjoy their trip in a most profitable and safe way.

"To provide safe and convenient transportation and sleeping accommodations for you, the Government has contracted with responsible concerns for the installation of transportation, hotels, public camps, and the like.

"The representative of the Government in charge of the park is Superintendent (name), whose headquarters is at (location). He will be glad to receive any suggestions that you may offer to better the services or accommodations."

In some cases, the same lecture is repeated daily, but it has been found advantageous for one individual to prepare several lectures to be offered at intervals. Special preparation of new subject matter for each lecture best retains the interest of the lecturer, but has the disadvantage of consuming time which can often be used to greater advantage in current service to the public; also, except in the hands of an expert, a new lecture often lacks the finish that comes with practice in delivery. In most cases a reasonable compromise is advisable. The length of a lecture varies with conditions. Experience has shown that, in general, the optimum time for

lectures, without slides, is from 20 minutes to a maximum of 30 minutes, and for illustrated lectures about 45 minutes. Illustrated lectures are unfailingly popular and far more effective than talks which depend upon hearing only. The park naturalist or historian is responsible for the classification and maintenance of a park slide collection which will furnish adequate illustrative materials. A careful inventory should be made periodically of all slides, breakages mended or slides replaced, and new slides ordered. Motion pictures are valuable educational aids but should never be introduced within the body of a lecture illustrated by slides. Almost always they are used to greatest advantage following a lecture. Illustration by the use of specimens often adds great interest to a lecture and is especially applicable to shorter talks.

Each park naturalist or historian should prepare in writing a general lecture on his particular area, and at least three or four additional lectures on as many especially interesting features (history, geology, Indians, flowers, archeology, birds, etc.). Accompanying each written lecture should be listed 60 to 75 slides which will illustrate it more effectively.

The saving from destruction of scenery, of fauna and flora, and historic objects is one of the duties imposed upon park officials. The contact of the ranger-naturalist or historian with the public makes him the natural one to turn the interest of people in this direction. This is easily accomplished by telling a story relative to depletion of the various trees, birds, animals, or objects encountered. The story of the passenger pigeon may be used when encountering band-tailed pigeons; to the elk may be tied any story of depletion of big game mammals; a plant used by the Indians and still abundant leads to the pertinent comparison of Indian and white man as conservationists.

Each member of the naturalist or historian staff will be expected to lecture from one to six evenings a week. Such lectures, sometimes delivered before large gatherings, should be expressed in simple language and be backed by a thorough knowledge of the subject.

FIELD TRIPS

Guided field trips are intended to develop in the visitor, through personal contact in the field, a sympathetic understanding of natural communities of plants and animals, and their physical environment, with special emphasis on the individual features including historical aspects as best exemplified by the particular park or locality.

A ranger-naturalist or ranger-historian will be called upon to lead the trips afield and to explain the points of interest to the visitors. To do this, he must be able to identify the birds, trees, flowers, mammals, and other

natural features, and be familiar with the geologic phenomena and historical phases of the region. It is important, therefore, that his knowledge of the area be not only scientifically correct but that it be expressed in interesting, everyday language which all can understand.

Educational method has turned from the dry study of books about nature and history to a study of nature herself and history at the point of origin. In this advance the interpretation program of the National Park Service, because of its exceptional opportunity, leads the way. Careful observation of the use of nature trails, self-guiding trails, trailside exhibits, museums, etc., shows that all are exceedingly important correlative activities but that they do not replace personally guided trips to the greater museum of the out-of-doors.

All trips afield should be planned with a certain definite objective in view and an arrangement of details of observation and discussion so as to work toward the end desired. If possible, it is advisable to stimulate discussion among visitors and guide it along the main topic. Merely giving names and introducing a great number of irrelevant observations are to be avoided. The party should be left with natural and human history ideas rather than with a catalog of facts.

Emphasis should be placed upon great scientific concepts that have come from long years of analysis and study. Geographic environment and unified nature need to be stressed. Suggested as suitable field discussions relative to plant life are competition in plant life, adaptation to environment, reaction to soil and climatic conditions, interrelations of organisms, and plant succession, possibly the most compelling story of all. In like manner, similar subjects should be utilized in connection with geology, zoology, archeology, and history.

Teaching methods should adhere closely to the furnishing of a series of experiences which make great truths stand out as fully substantiated. Ranger-naturalists and ranger-historians have a greater function than that of presenting isolated facts.

Another development, which experiment has proved useful, is the specialized guided trip devoted to the study of flowers, trees, animals, and birds. These types of trips are desirable in all the larger parks where interested groups may be formed for such study.

Experience has shown that the maximum size of a field party led by one guide should be 30 persons, and preferably 25. Increasing numbers greatly decrease effectiveness to individuals and probably also the total effectiveness of the trip. Until such time as the interpretative staff is large enough to make the allotment of one guide to each 30 visitors, an effort

should be made to reach all who are sincerely interested even though it results in the attenuation of the information offered.

NATURE AND SELF-GUIDING TRAILS

Nature trails and self-guiding trails, when first established experimentally in the national parks, were expected to replace partially the personal guiding services of a limited educational staff. It was found, however, that these trails supplement rather than replace personal guiding and lecture service, and that individuals who made use of the trails were also stimulated to take advantage of the other educational opportunities offered by the Government. A further study of the use of the trails also disclosed the fact that two classes of visitors who were normally not reached made use of the trails—those who found it impossible to take advantage of the guided field trips and lectures on the time scheduled, and those who preferred to explore singly, or in small parties "on their own."

A careful study of the area should precede the location of the trail to determine the educational features to be reached. The trail should not be too long, usually about one-half to one mile. Longer trails should be less intensively labeled. Resting places should be frequent and labels concentrated at these points. Before writing labels, there should be a reconnaissance of the entire trail to determine materials available for demonstration. Labels should be so planned as to proceed from simple to more complex facts, culminating in a clear understanding of the general principles of the branches of natural history best exemplified. It is exceedingly important that the visitor should carry away with him such a perspective rather than a catalog of unrelated facts. The wording of labels should be planned to stimulate the visitor to observe things for himself—the labels should teach the visitor how to read the story which the exhibits have to tell. Labels should be interesting, short, and concise; where longer explanations are necessary, the data should be divided and recorded on consecutive labels. It has been difficult to find labels which would stand weather, consequently at the beginning of the open field season nature trail labels often are in very poor condition. All that need replacement should be prepared and held in readiness for installation early in the season.

In laying out a nature trail for the first time, tags or other temporary labels should be used. A transcript should be made of all labels, with notes on location, so that lost or destroyed labels can always be replaced immediately. Various types of rustic labels have been devised and information concerning them will be supplied by the Western Museum Laboratories on request. Small embossed metal labels also can be furnished. The park

naturalist or park historian should supply a copy of the text desired, which should be limited to a maximum of 50 words per label.

In order to keep nature trails always up to date, the park naturalist, or his representative, should revise all temporary labels (flowers in bloom, etc.), and replace damaged or lost labels at least once weekly, and preferably more often.

LIBRARIES

Recognizing the need for reference books, each park has built up a useful library. Plans for a unified library system were shaped in 1930. The Committee on Libraries in National Parks of the American Library Association, after 2 years of study, furnished a plan of development on April 12, 1933, which was approved by the Secretary of the Interior on April 18, 1933. Later orders directed that the Interior Department Library would become the center of library work for the Department.

On February 27, 1934, the Educational Advisory Board passed the following resolution:

"It is the opinion of the Board that adequate working libraries be encouraged in the several parks as needed, rather than combined in a centralized library. Centralized administration should be maintained for the purchase of books, union cataloging, and interchange of books to various park libraries."

It is desirable that the parks have adequate libraries in order to have available for the use of the park staff and the park visitors all of the best reference works on subjects pertinent to that individual park, with a view to encouraging self-improvement and to care for leisure reading needs.

Books on human and natural history, especially those of local interest, and general reference books should be acquired for the use of the park naturalist or historian and his staff, also of visiting scientists who frequently make protracted visits in the parks in the pursuit of special investigations. Natural history books of a more popular type, especially those of inspirational value, such as the writings of John Muir, should be acquired for the use of the visiting public in parks where the average length of sojourn of visitors is greatest. Books on the various aspects of administration of the national parks should be included for the benefit of the park staff.

Wherever possible, books should be borrowed from county or State libraries to supplement the collections in the park during the rush season. For emergency work, books could be similarly borrowed at any time of year.

The park naturalist or historian is responsible for the development and maintenance of the park library with the technical assistance of the Branch of Research and Information. Libraries in the parks should be located in the museum buildings, wherever possible. In the case of parks developing

a system of branch museums, as at Yellowstone National Park, the nature of the books at these museums would be determined by their location and purpose. At a location such as Fishing Bridge in Yellowstone, where there is a comparatively large summer population, it might be worth while to establish a separate library in a building of its own containing the more popular nature literature, especially children's books, to be operated like a public library.

All library books are to be purchased through the Supervisor, Branch of Research and Information, who shall coordinate the purchases.

It is hoped to have eventually a master library located in the Interior Building in Washington, D. C., to be under the direct control and supervision of a Chief Librarian of the National Park Service who is to be responsible to the Supervisor of Research and Information. The Chief Librarian would have direct control and supervision of the master library and would exercise control in an advisory capacity over all the national park libraries. All purchases of books would be centralized in the Chief Librarian. In the master library there should be kept a card bibliography of material of interest to each and all of the national parks.

NATURE NOTES

To stimulate interest in scientific features of a park and in the widespread dissemination of information, a mimeographed or printed publication known as *Nature Notes* (or with some interesting title such as Glacial Drift) is issued monthly in a number of the parks by the naturalist staff. Interested visitors, schools, libraries, and scientific institutions placed on the mailing list have indicated thorough appreciation. In most instances, this type of publication has been taken over by the local natural history association and forms a tangible return for dues paid. In Yosemite *Nature Notes* is printed, and in Grand Canyon it is issued by an offset process. In several parks there has been a shift from short notes to scientific manuals on wild flowers, trees, birds, and mammals which are helpful to the visiting public as a guide. A list of recognized works to make standard the use of scientific names has been issued and directions given on the necessity for accurate recording of the species, date, locality, time, and observer with each item.

Newspaper items are expected to reach one class of readers, whereas *Nature Notes* is designed to care for those particularly interested in natural history. Reputable magazines are utilizing the better written articles. As a consequence, the editorial policy should have high standards, and the material should be of a kind to receive approval by the scientist and

educator and yet be simple and understandable to the layman. Attention, therefore, is directed to the importance of the following:

(*a*) Selecting only those articles decidedly informational in nature or bearing on new or significant observations. All should be founded on scientific fact and personal experiences.

(*b*) Careful editing of articles to see that grammar and diction are beyond criticism.

(*c*) Checking all statements to determine accuracy and permanent value.

(*d*) Preparing an attractive publication with illustrations whenever possible.

The numbers that have received most favorable comment have been those where a symposium on a particular subject has been attempted or where a report has been made of some striking observation. Those numbers receiving most criticism have contained unsound or incomplete items hurriedly written under pressure, and those using newspaper style. Long articles are not desirable. The winter season should afford more time for reflection and opportunity to do careful editing and to prepare notes more carefully. Periodical revision of mailing lists for *Nature Notes* is important.

Museum specialists and all others engaged in interpretative work in Region I should contribute regularly to *The Regional Review*. In Region III the *Quarterly* provides a medium of expression for museum workers.

NATURAL HISTORY ASSOCIATIONS

To aid in the expansion of educational programs, the receiving of gifts, and the performing of helpful services in national parks and other Service areas, the organization of nonprofit voluntary organizations may be undertaken. Authority for such organizations appeared for the first time in the Interior Department Appropriation Act for the fiscal year 1937 and has been continued annually in succeeding acts in the following language:

> Appropriations made for the national parks, national monuments, and other reservations under the jurisdiction of the National Park Service, shall be available for the giving of educational lectures therein and for the services of field employees in cooperation with such nonprofit scientific and historical societies engaged in educational work in the various parks and monuments as the Secretary, in his discretion, may designate.

The above-quoted legislation makes possible the creation of the type of association or society mentioned therein. Subject to the required designation by the Secretary of the Interior, it may assemble a library, aid in the preparation and installation of exhibits, establish markers, print nature

notes and educational leaflets, and sell publications. Since these activities are, and must be, restricted to the interest of Service operation, the organization may use space in Government buildings, and utilize the services of Federal employees in the various activities enumerated and in the temporary receipt and transfer of funds obtained from the sale of maps, and educational and scientific books and pamphlets. For an account of the cooperating organizations that have been designated by the Secretary of the Interior to work in National Park Service areas, see pages 18–20 of this manual. It is advisable that the funds accruing from the sale of publicaions in the national parks be handled by someone not connected with the National Park Service. The annual report of the organization, including a financial statement covering the receipt and disbursement of funds, shall be furnished promptly to the superintendent, in duplicate, and one copy of same shall be forwarded to the Director. The Constitution and By-Laws of the *Yellowstone Library and Museum Association* are given below as an example for new organizations.

Constitution and By-laws

Purpose

1. To stimulate interest in the educational activities and encourage scientific investigation and research in the fields of botany, zoology, geology, history, and related subjects bearing on the Yellowstone region.

2. To assist—

(*a*) In the establishment and development of a Yellowstone Park Library for the use of the rangers, ranger-naturalists, and others dealing with park visitors and the public.

(*b*) In the care and development of the Yellowstone Park museums.

(*c*) In obtaining photographs, slides, movie films, and other materials for explaining and exhibiting facts relating to the history, earth sciences, and life sciences as illustrated in Yellowstone Park.

3. To publish, in cooperation with the National Park Service, *Technical Bulletins* dealing with some phase of investigation in or related to Yellowstone Park.

4. To handle, buy, and sell the Government and private publications on Yellowstone Park subjects; the profits from these transactions to be used for the development of the Yellowstone Park Library and Museum exhibits, and for printing stationery and miscellaneous supplies in connection therewith.

The operations, business, property, and assets of the Association shall be strictly limited to purposes which shall be scientific and educational, and no part of the net income of the Association shall inure to the financial benefit of any member.

Administration

The Association shall have a Board of Directors, an Executive Secretary, a Treasurer, and an Advisory Committee. All of these officers shall serve without compensation.

The Board of Directors shall be composed of seven members, namely: the Executive Secretary, the Treasurer, and five members at large. It shall formulate the policies of the Association and shall direct its activities through the Executive Secretary.

The Chairman of the Board of Directors shall be elected from the five members at large at the beginning of each annual meeting, and shall serve for one year as chairman, unless reelected by vote of the Board of Directors for a second year.

The Executive Secretary shall be the park naturalist or such other person as the Board of Directors shall appoint to this office. It shall be his duty to supervise the activities of the Association and to submit an annual report of its affairs to the Board of Directors on or about the last Saturday in October of each year. He shall be the editor of the Association publications. He shall authorize the expenditure of Association funds for printing, stationery, traveling, secretarial employment, and incidental expenses incurred in the furtherance of the main purposes of the Association.

The Treasurer shall be nominated by the Executive Secretary and appointed by the Board of Directors. He shall administer the finances of the Association, including money obtained from the sale of publications and donations. He shall disburse these funds under the direction of the Executive Secretary. He shall supervise the keeping of books, and shall submit a monthly and an annual financial statement to the Executive Secretary. The annual report shall be audited and presented by the Executive Secretary to the Board of Directors for approval.

The Advisory Committee shall be composed of interested scientists and friends of the Yellowstone National Park, available for consultation on Association matters and technical questions. They shall represent the principal fields of the Association's endeavor and shall be invited and encouraged to offer suggestions and criticisms of the policies and work of the Association.

TERM OF OFFICE

The term of office for members of the Advisory Committee, Executive Secretary, and Treasurer shall be three years, subject to reappointment by the Directors.

The term of office of a Director shall be three years, subject to reappointment. In order to make the Board rotational, the five members at large shall be selected as follows: One member to be appointed for one year, two members for two years, and two members for three years. Upon the expiration of first appointments, the appointments will be for three years.

The term of office of the Chairman of the Board of Directors shall be for one year.

All officers, directors, and committee members shall be nominated by the Executive Secretary, subject to the approval of the Board of Directors.

MEMBERSHIP

Any person interested in the furtherance of the purposes of the Association may become a member.

Any permanent employee in Yellowstone National Park is eligible for membership and may become a member by subscribing to its purposes, rules, and regulations.

Any person who has donated or will donate a book, picture, or any object of value to the Yellowstone Park Library or the Museum, or the sum of five dollars ($5) or more to the Association is eligible for membership, and may become a member upon request.

Board Meetings

An annual meeting of the Board of Directors shall be held each year on the last Saturday in October. Extra meetings may be called when desired by a majority of the members of the Board and notice mailed to each director at least ten days in advance of the meeting.

Four directors shall constitute a quorum.

Amendments

The constitution and by-laws may be amended or changed at any meeting of the Board by a unanimous vote of the directors present.

SALE OF PUBLICATIONS

The sale of all authentic publications relating to the parks, whether publicly or privately printed, is encouraged by the Service on an impartial basis, as of distinct value in augmenting the educational program. The sale of Government publications may be handled by the Service staff. When possible, the sale of Government, or other, books and similar material of an educational nature may be handled on a nonprofit basis by a natural history or library association. Extreme care should be exercised by the superintendent, custodian, naturalist, or historian to see that sale of publications handled by natural history, library, or museum associations, in Government facilities, are offered for sale only by display or upon inquiry. All publications sold should be given fair consideration in selection and equal prominence in display.

No special effort should be made by the park staff to concentrate on the sale of any one publication or to stimulate book sales. Special care should be exercised during or at the conclusion of talks, auto caravans, guided trips, or when in general contact with the public to avoid promotion of sales. Where the author of a sale publication is an employee of the Service in the area where the publication is sold, or is a member of the immediate family of the employee, the sale of that particular publication, if a profit is to accrue to the author, will not be made by the association or any Service employee, but should be handled through the authorized park operator.

MUSEUMS

The main objectives of the museum program of the Service are to orient the visitor; to give him a comprehensive interpretation of the story of the area as a whole as well as that of the place of each major distinctive feature; to lead him with understanding to the points of greatest interest and inspiration in the area; to form a center for public contacts; to provide a headquarters for the interpretative staff; to afford safe storage space and

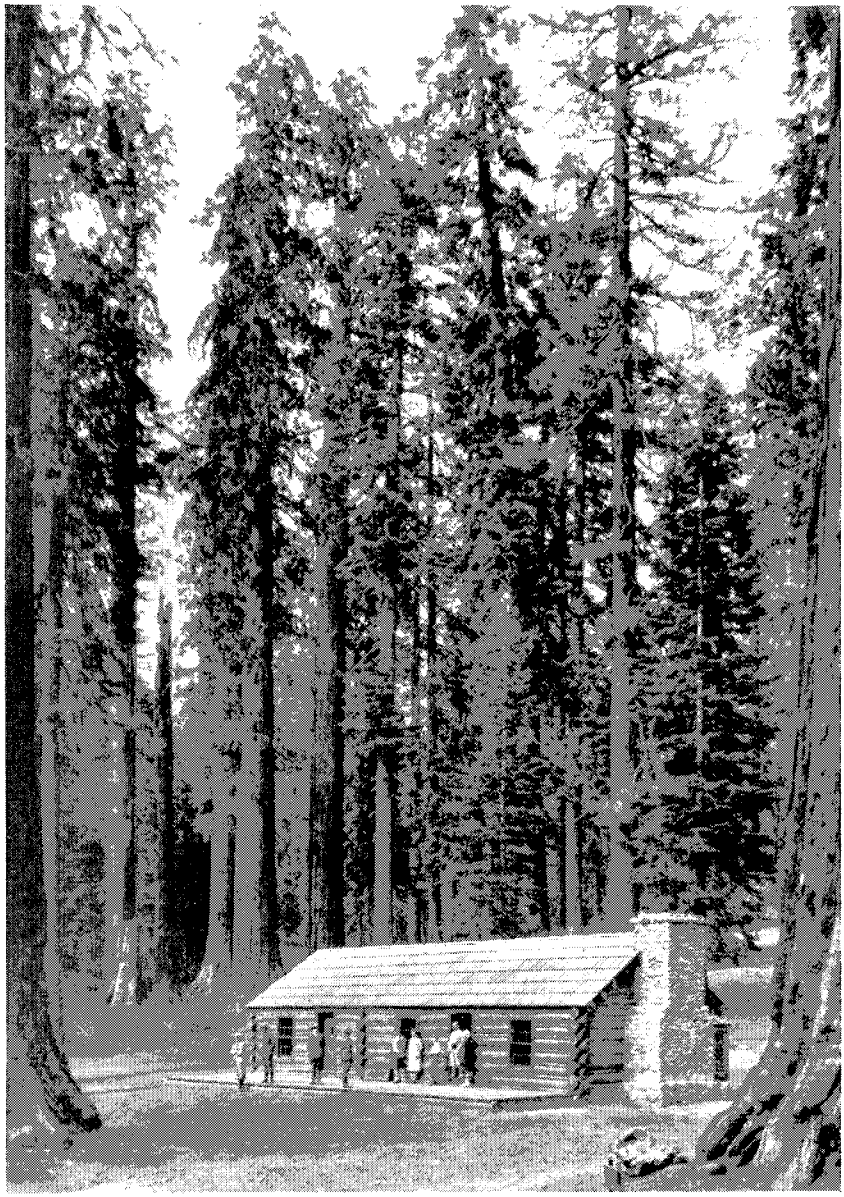

Figure 41.—TRAILSIDE MUSEUM IN MARIPOSA GROVE OF BIG TREES (SEQUOIAS) IN YOSEMITE NATIONAL PARK, CALIFORNIA

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library facilities; and to provide general working facilities for visiting scientists and historians.

The national parks themselves may be considered great outdoor displays where exhibits are in place awaiting interpretation by the visitor. Their vastness, however, necessitates a collection in one place of sufficient illustrative material to present to the visitor the consecutive story of the park as a whole. This concentration allows the presentation of material which is seldom or never seen in the field, but which bears an exceedingly important part in the general story. It also allows the preservation of historical, ethnological, and other perishable material.

The museum program interprets the park story by means of graphic presentation within central museums and branch museums, and clarification by means of labels or trailside exhibits of specific field features in place. The museum building provides a center for public contacts as the assembly point for field trips and serves as a lecture and interpretative center. It provides educational staff headquarters and offices for staff members, laboratories, studios, and shops for scientific investigation and museum preparation; and it houses adequate library and study collections for research use by staff members. Working facilities for visiting scholars include desk space, library, and study collections.

MUSEUM PLANNING

In general, park museums are small and materials displayed must be local and directly pertinent to the park. The scope of museum exhibits is defined by the considerations for which the park areas were established. Care should be exercised in assigning to each class of exhibits the proper proportion of space warranted by its importance in the park or its bearing on the park story. The exhibits displayed should be carefully planned to allow the casual visitor "to make a circuit" intelligibly in from 20 to 30 minutes. In major parks the central museum is of such size as to contain specialized exhibits, the library, research collections, and duplicate material to be made available to those specially interested, but not to be placed on display. Museum development also includes branch museums, trailside and roadside exhibits, markers, wild-flower gardens, terraria, aquaria, and miscellaneous exhibits.

In a park where no museum has been established or where a new museum is projected, the park naturalist or historian is expected to assemble the basic data of the park story into condensed reports in which all sources of information are cited. If previous research proves inadequate, further studies will be necessary. A survey of these reports by the superintendent, natural-

ist or historian, museum curator, or other park employees capable of approaching the problem will result in conclusions regarding the number and nature of the museums required by the park. Findings should be transmitted by the officer in administrative charge as "The Museum Prospectus" to the Director.

When the objectives of the museum program have been defined, it is next necessary to plan exhibit details for each building or trailside structure. The preliminary exhibit plan is drafted by the park staff, concurred in by the superintendent, and then forwarded to the proper regional office in Regions II, III, and IV. Following clearance of the preliminary plan in the regional office, it is forwarded to the Western Museum Laboratories at Berkeley, Calif., for refinement by the central technical staff whose duty it is to select the best methods of presentation and to correlate the plan with that of the other Service areas.

After study and concurrence by the Western Museum Laboratories staff, the preliminary plan is returned to the park area for preparation of the final plan and concurrence by the superintendent. The final plan is then sent to the proper regional director for review, recommendation, and transmittal to the Western Museum Laboratories. After concurrence by the latter unit, the plan is forwarded to the Director in Washington.

In Region I, the same procedure is followed, except that the preliminary and final plans are sent by the regional office to the Director at Washington and marked for the attention of the Museum Division, instead of being forwarded to the Western Museum Laboratories at Berkeley. When plans have been approved and equipment funds made available, museum specialists provide specifications for exhibit cases, library equipment, and all other furnishings required by the museum.

In transmitting plans, copies of the correspondence should be forwarded promptly to all interested service units.

MUSEUM EQUIPMENT PURCHASES

All orders for museum exhibition cases and major equipment are cleared through the Chief of the Museum Division. Large quantities of supplies should also secure advance approval.

MUSEUM EXHIBITS

Exhibit materials are prepared according to the specifications of the exhibit plans in one or more of the central preparation laboratories of the Museum Division and are shipped to the park. Occasionally, it is advantageous to assign preparators to construct certain exhibits in the park. Local park employees, usually aided by technicians from the central labora-

tories, install equipment and exhibits according to the approved plans. The work of the laboratories is described in detail below.

The park naturalist or historian should assemble all available material called for in the exhibit plan or within the scope of the study collection, and for which adequate incombustible storage can be provided. Efforts should be concentrated upon securing historical and archeological specimens and others which, once gone, can never be replaced. With the nucleus once established, however, efforts should be made to gather the material most needed to round out the collection as a whole. During the period of planning and preparing exhibits, the park naturalist or historian may devise temporary exhibits if adequate display equipment is available.

GIFTS AND LOANS

Park museum collections are built up by means of gift, loan, purchase, or field collecting. Gifts are extremely important, especially when the museum is being started; possibilities in this field are almost unlimited for a resourceful park naturalist or historian. Gifts of exotic material should be discouraged unless they have value as exchanges. No gifts should be accepted with limitations and it should be made plain to the donor (by issuance of a formal document, the wording of which may be obtained from the Washington Office) that their use, display, and disposal will be governed entirely by the Service.

Loans should be accepted with the understanding (backed by a formal document, the wording of which may be obtained from the Washington Office) that neither the Government nor the park naturalist or historian is responsible for the safety of the exhibit in case of fire, theft, or damage. Loans should be subject to no restrictions, except the obligation to redeliver, and this fact should be included in the document issued. Much loan material may be utilized during the early stages of museum development but this should be replaced as soon as possible, or else acquired permanently, as is often possible after being for some time on display. Each gift or loan should be acknowledged officially in writing and accession records immediately made.

Gifts and loans may be accepted by the superintendent or custodian if they are of local significance and require no extensive museum space. In cases where the gifts or loans are of national significance, require appreciable museum space, or have any restrictions on their use, display, or disposal, the power of acceptance rests with the Director. Reports of all accessions, with copies of the documents issued, should be sent to the Director.

Administrative Relationships

CURATORS

During the preliminary stage the park naturalist, or historian, may be museum director, curator, and staff. When active planning begins, a museum curator is often assigned to the park staff. With the cooperation of the park naturalist or historian and the technical staff the curator prepares the development and exhibit plans. These plans, submitted by the curator, are studied and correlated by the Museum Division staff in Washington.

After approval of the museum plan, the Museum Division staff purchases supplies and equipment, constructs the exhibits, and assists in installing them. Continued attention is essential to the proper functioning of the park museum. Work of upkeep is attended to by the local staff members. Enlargement, extension, or revision is regulated by the central offices of the Museum Division.

As development takes place and both museum and general interpretative service grow, the park naturalist, or historian, usually finds it necessary to divide the interpretational activities in the park into two or more groups, specializing on one himself and delegating the others to one or more of his assistants. The park naturalist, or historian, may, therefore, be the ultimate museum director, or may exercise general supervision over its operation through an assistant to whom this specialized activity has been assigned.

MUSEUM HOURS AND PERSONNEL MATTERS

Museum hours should be based upon utilization by the public. The museum should be open each day of the park season during all hours that it will be used effectively, with due consideration for available personnel.

All museum administrative and personnel matters are to be handled by, or cleared through, the Museum Division, following their receipt from the field offices by the Director. All routine and special reports relating to museum activities shall be transmitted to the Director. All plans for museum buildings and equipment, the general museum development plan, and all detailed exhibit and installation plans will be transmitted through the usual channels to the Chief of the Museum Division for approval by the branch or division concerned and by the Director.

STUDY COLLECTIONS

The twofold purpose of the National Park Service is to preserve and to make available to the public the natural phenomena and historic features of the areas entrusted to its care. These find an exact parallel within the objectives of park museums. In regard to study collections, the first of

these is the preservation of the material objects of scientific or historic value related to the park areas and assembled there, for whose safekeeping the park personnel is responsible. These specimens require professional attention for their cleaning, mounting, repair, and preservation.

Many specimens in national park museum collections are invaluable and irreplaceable and unless constant protection is provided by skillful and experienced technicians serious loss and irreparable damage will result through their deterioration. To make these collections available the objects must be identified, labeled, cataloged, and properly stored. Cataloging involves the formulation of a system of classification and the maintenance of records. The interpretational staff is responsible for the maintenance of these essential records under direction of the Museum Division. Catalog and accession cards as well as specific instructions as to procedure in cataloging are furnished by the Museum Division.

BRANCH MUSEUMS

Branch museums should contain only sufficient exhibits to cover adequately their limited field and to correlate it with the rest of the park story; and, where possible, advantage should be taken of the opportunity of utilizing natural exhibits in place. Restorations, trailside exhibits, or markers may be necessary to gain this end.

One of the chief advantages of the branch museum is the opportunity for personal contact of the ranger-naturalist, or historian, in charge of comparatively small groups of specially interested visitors. The branch museum is exceedingly important as a demonstration station and much of its effectiveness depends upon the successful and continuing program of personal service to the public.

OBSERVATION STATIONS

Sometimes a special device is needed to explain scientific features to visitors. Several observation stations have been built to cover this need. Typical is the one at Yavapai Point, Grand Canyon National Park. Here the attention of the visitor is directed to the canyon itself and to the answers to questions which normally come to the visitor, such as: How was the canyon made? What is the meaning of the layers of rock forming the canyon walls? What changes in plant and animal life have taken place through the ages? What life is found in the canyon today? The station is in effect a window through which one looks into the canyon from an unusually favorable place and with the aid of interpretative apparatus.

Operation of the station involves two groups of aids to the visitor; first, the parapet views arranged along the outer or parapet wall of the observa-

tion porch, and second, the supporting exhibits of photographs and specimens in the exhibit room to the rear of the porch.

The parapet views are so arranged as to locate features of extraordinary interest, to give closer views in many instances by telescopes or field glasses, to give small close-up views with photographs accompanying the telescopes, to illustrate the localities with specimens, and to point out trails by which they can be reached. One telescope permits a view of the rushing, muddy Colorado River, another the top of Cedar Mountain, and still others, certain rock strata. In the exhibits may be seen the tools used by the river in cutting its channel—mud, silt, sand, pebbles, and boulders. A sample of the water from the river shows the large amount of sediment carried. Other exhibits show specimens indicating crustal movement, oldest rocks of the canyon, remains of ancient life, and present-day life.

A "formations column" constructed of actual rocks brought from the strata in the canyon forms a notable exhibit at the southwest corner of the porch. Alongside is a "fossil column" which shows the evidence of life that has been found in the different horizons. A remarkable block illustrating an unconformity of hundreds of millions of years is displayed at the rear of the observation porch. Here also are several large sandstone slabs exhibiting fossil footprints.

Supporting exhibits in the interior room amplify by means of transparencies, specimens, motion pictures, and lantern slides the story of the canyon as told on the parapet. Exhibit cases are oriented to correspond to the parapet views and are similarly numbered. Automatic machines show films of the Colorado River in action.

The Yavapai project is considered as an educational experiment to determine the best methods to employ in interpreting national parks to visitors. In construction, installation, and method of presentation, it is unique. It is designed to be self-operating. The visitor may, on his own initiative, obtain such general or orientation views as will present the major features in their natural relation to each other. Emphasis is upon leading the visitor to see and interpret the thing itself from the best viewpoint rather than lead him away from it to see fragments or artificial explanations.

CHIEF OF MUSEUM DIVISION

The Chief of the Museum Division is responsible for all museum planning and preparation work in the park system and the type, quality, and effectiveness of museums. He is also responsible for developing proper museum policies and museum methods. With the aid of assistant chiefs, he directs and supervises museum laboratories manned with technically trained

workers and through the Supervisor of Research and Information acts as technical adviser to the Director on all matters pertaining to the museum program. He inspects and makes recommendations regarding the improvement of all exhibit materials used in the park educational program. Supervision of a research staff of curators necessary to insure the accuracy and professional standards of exhibits is an added duty.

Two assistant chiefs of the Museum Division help to administer the program and they may be aided by chief preparators who direct operation of museum laboratories wherein preparators are engaged in the actual preparation of exhibits and in the repairing and preservation of exhibit materials.

CENTRAL LABORATORY

A museum laboratory is primarily an agency for producing museum exhibits. It makes available to parks and monuments the services of curators and exhibit preparators not ordinarily at the command of superintendents. Its services are available not only in relation to new or proposed museum developments but for problems of revision and maintenance of existing museum exhibits.

The laboratories develop bibliographies and, when feasible, advise as to library needs and administrative problems concerning their activities. They also assist in correlating libraries with other educational work. When possible, the laboratories endeavor to procure and distribute material to park libraries.

WESTERN MUSEUM LABORATORIES

For convenience and efficiency, many details relating to the interpretational and research activities in the West are delegated to the Western Museum Laboratories located at Berkeley, Calif. A staff of specialists plan and aid the various park programs and, as mobile field experts, each specialist acts as a technical adviser on western educational activities. Well-equipped laboratories make possible the preparation of exhibit materials.

The laboratories function as a coordinating agency by collaborating with the park superintendents and their staffs, with the Branches of Plans and Design, Engineering, and Historic Sites, with technical experts within the National Park Service, and with independent cooperating specialists. Although the laboratories assume no direct supervision of any construction of buildings or improvements, they are concerned with every project affecting interpretational or museum interests.

The duties of the Western Museum Laboratories staff are:

(*a*) To assist the superintendent in preparation of the museum development outline and the general museum development plan in his park or monument;

(*b*) To conduct studies or museum lay-out and arrangement of exhibits for proposed museum development to form the basis for building plans;

(*c*) To assist in the planning, purchase, and the installation of equipment for museums;

(*d*) To direct the planning of exhibits;

(*e*) To assist in the preparation and installation of exhibits, making available to the parks and monuments as far as possible the services of the technical staff and physical resources of the Division;

(*f*) To assist in the development and administration of park libraries, developing bibliographies when feasible, and endeavoring to procure and distribute library material;

(*g*) To assist in the coordination of educational activities in the field, especially those related to museums and library development.

In addition to the foregoing, the laboratories when desired:

(*a*) Provide nature trail, wild-flower garden, and museum labels;

(*b*) Assist in the preparation of naturalists' manuals;

(*c*) Advise on the collection and preservation of records;

(*d*) Act as a clearing house for technical information relative to the preparation of exhibits, protection of natural features in place, and methods of interpretation;

(*e*) Study and advise in matters pertaining to the coordination of educational activities in the field to provide for unity of program, when feasible in connection with other work;

(*f*) Prepare special exhibits, when requested by the Director;

(*g*) Supply at cost storage, collecting, and filing equipment adapted to park museum needs.

EASTERN MUSEUM LABORATORIES

For all park areas in the East the Ford's Theater Laboratory in Washington functions in a similar manner. Its curators are prepared to assist in developing plans and the preparational staff provides the facilities for constructing and installing exhibits. This Laboratory is available for expert advice and instruction in the complex and highly important work of preserving (cleaning, repairing, etc.) the valuable specimens in museum collections. It also offers assistance in identifying these specimens.

BIBLIOGRAPHY

THIS short bibliography has been prepared to aid the museum worker in the field. It would be impossible to include a complete list of books, articles, or pamphlets on any one of the topics dealt with in the *Manual*. Such a list would be so voluminous that an entire book would be required for this purpose alone. Standard references in American history and for the identification and classification of natural history specimens have been omitted as these works are well known to all park naturalists and park historians. Many subjects rarely encountered in the field of history also have been omitted. A few of the more prominent publications dealing with museum work in general have been included. A majority of the books listed contain bibliographies for each of their specialized subjects and are obtainable in any large library.

An effort has been made to include basic papers pertaining to National and State Park museums even though some of these items are multilithed or mimeographed, or in a few instances are still in manuscript form. These items appear under the section "Museums, Park."

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Hobbies, Buffalo museum of science (issued monthly).

Indian leaflet series. Denver art museum (issued at various intervals).

The masterkey, Southwest museum, Los Angeles (issued bimonthly).

Museum service, Rochester museum of arts and sciences (issued monthly or bimonthly).

Plateau, Museum of northern Arizona, Flagstaff.

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1924 Down to the sea in ships. *Philadelphia, The Penn Publishing Co.*

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1935 The history of American sailing ships. *New York, W. W. Norton & Co.*

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1922–28 The sailing ships of New England. *Three series, Salem, Mass., The Marine Research Society.*

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1937 The hooked rug. *New York, Tudor Publishing Co.*

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1932 American and European swords in the historical collections of the United States national museum. *United States National museum. Washington, U. S. Government Printing Office. (Bulletin 163.)*

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1901 Historical military powder-horns. *Harrisburg, Pa., Harrisburg Publishing Co.*

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1917 Text-book of ordnance and gunnery. *1st ed. New York, John Wiley & Sons.*

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Appendix

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MUSEUM EXHIBIT PLAN

KINGS MOUNTAIN
NATIONAL MILITARY PARK

South Carolina

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NATIONAL PARK SERVICE

APRIL 1940

KINGS MOUNTAIN NATIONAL MILITARY PARK

MUSEUM EXHIBIT PLAN

		Date
Recommended:	Oswald E. Camp Superintendent	Apr. 11, 1940
	Fred T. Johnston Acting Regional Director	5/7/40
	Wed J Burns Chief, Museum Division	5/10/40
Concurred:	Thos Wint Chief Architect	5/14/40
	Herbert E. Kahler Actg Supervisor of Historic Sites	5/19/40
	C P Russell Supervisor of Research and Information	5/20/40
Approved:	Irno B Lammers Director	5/21/40

FACSIMILE OF APPROVAL SHEET

[In all exhibit plans for museums west of the Mississippi River the recommendation and signature of the Assistant Chief, Museum Division, is included immediately below the signature of the Regional Director.]

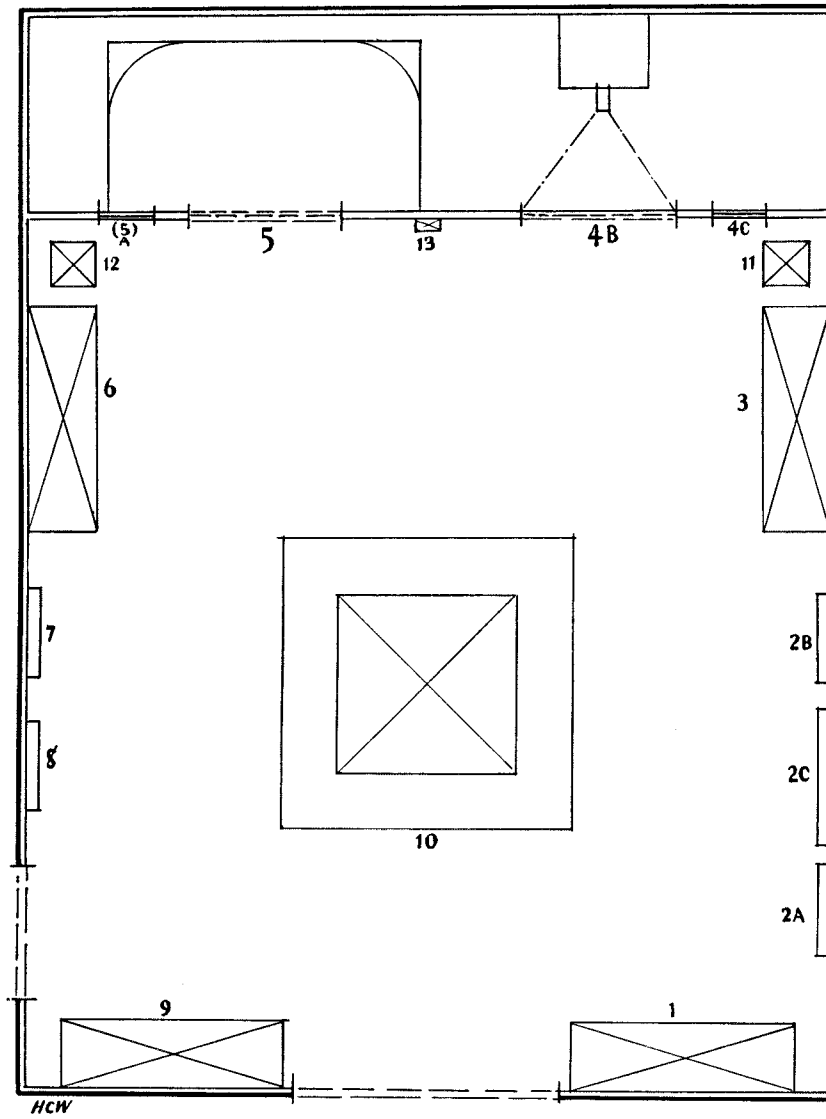
INTRODUCTION

THIS EXHIBIT plan for the museum at Kings Mountain National Military Park contains specifications for 13 exhibits. These exhibits are designed to perform well-defined functions in the interpretational program of the park. Briefly, the museum exhibits are intended to do three things:

1. To interpret the significance of the "mountain men"—the central theme assigned to the museum.
2. To tell those phases of the park story which are not immediately associated with, or readily comprehended on, the battlefield, leaving the narrative of the actual engagement for field presentation.
3. To provide effective assistance in visualizing the combat.

For reasons of necessary economy the number of exhibit cases is kept at a minimum. Since historical objects require adequate protection, wall cases are specified for the exhibits containing them. Most of the exhibits which contain only graphic material, however, are to be mounted directly on the walls without glass covering. This will effect a substantial saving in equipment costs, and if experience proves it satisfactory, it may form a useful precedent. One exception should be noted where a wall case is specified for an exhibit without specimens. This instance is justified on the need for balance in the museum room and as a provision for the display of historical objects which may be acquired later. A few other exhibits, e. g., the diorama, require special cases which can be constructed in the laboratory.

The general interior treatment of the museum is an important consideration, related to the special requirements of the museum as well as to the plans for the building as a whole. Considering only the former, the following suggestions are advanced. The general wall color of the museum should be a light gray, which would provide a better setting for the exhibit colors recommended than would the more usual buff. Case bases should be gray also, of the same intensity or a little darker. The baseboard and kickplates should be dark, probably black. The ceiling should be white and the floor a dark red linoleum. While the general room lighting will be derived largely from the exhibits, it should be augmented by a single indirect source in the center of the ceiling. It is recommended that the two spotlights specified for Exhibits 10 and 13 be incorporated with this fixture to form a single unit. This lighting unit should be kept close to the ceiling to permit a full view of the mural from the entrance. As a final decorative and interpretative item it is recommended that a statement in cut-out letters be installed over the museum entrance



FLOOR PLAN SHOWING LOCATION AND ARRANGEMENT OF CASES

where it will be seen as the visitor leaves the room. The letters should be ¾ inch high and in red. This statement is to be by one of the leaders of the Revolution referring to the significance of Kings Mountain. Rogers W. Young will supply the statement.

The specifications call for the following materials, which are here summarized for convenience in estimating costs and work schedules:

CASES.

4 wall cases, 2 pedestal cases, 1 diorama case, 1 special projection case, base for relief model (with seat), flag stand, (7 exhibit items to be mounted on walls without cases, but 2 having aluminum label frames).

DIORAMAS.

1

ILLUSTRATIONS.

1 mural
6 water colors

MAPS.

1 topographic model
2 flat maps

MODELS.

2 modeled figures
3 modeled objects

CHARTS AND ILLUSTRATED LABELS.

10, containing 39 label units, 14 illustrations and diagrams, 3 maps, 5 cut-out figures, 4 photographs, 1 graph, 1 silhouette, 5 specimens, and several marginal sketches.

CUT-OUT LABELS.

7

LETTERED LABELS.

26 (including 5 with one small marginal sketch each).

SPECIMENS.

21 (including those in charts).

The specimens needed in the present plan form a special problem which is closely connected with any program for building up the collections of the park. Those for which there is immediate need must be obtained from outside the park, since there is practically no collection at Kings Mountain. It is to be hoped that a number of them can be secured from other parks by transfer. In several instances other parks now have specimens that would be displayed more appropriately at Kings Mountain, or that are duplicates

which could be put to better use here. It seems apparent that such transfers of historical objects would be in the best interest of the Service as a whole. Specimens which must be obtained outside the National Park Service probably will have to be purchased. The Revolutionary Period is so remote that relatively few suitable objects can be looked for from donations. While it is to be hoped and expected that the park collections will grow by this means, accessions will be slow. In the meantime a number of purchases should be anticipated in executing the plan.

As an aid in securing the specimens needed for exhibition and in building up the collections of this park museum there follows a preliminary annotated list of historical objects pertinent to Kings Mountain:

I. SPECIMENS CALLED FOR IN THE EXHIBIT PLAN.

1. FERGUSON RIFLE.

Fortunately, the National Park Service already possesses one of these rare guns. This specimen was purchased for eventual use at Kings Mountain and is now in the collection of Colonial National Historical Park. While definite proof is still lacking, it is probable that the Ferguson rifle was used in this battle. At any rate it seems more appropriate to the story of Kings Mountain than to that of any other present park area because Ferguson himself is so prominent here. This particular specimen presumably was not used at Kings Mountain, but such an original is at present unknown. Park officials should keep in mind the great desirability of finding a Ferguson rifle among the inhabitants of the regions from which troops came to the battle.

2. KENTUCKY RIFLE.

There are Kentucky rifles in the collections of several parks. Some are duplicates, but some at least are bound to the parks where they are now located by restrictions of gift. If the required specimen cannot be transferred from another park, it should be purchased. Again, it would be desirable to obtain one known to have been used in the battle or belonging to one of the participants, and the park staff should maintain a continuing search.

3. BOLT-ACTION RIFLE.

If a recent Springfield cannot be obtained from the War Department, a second-hand specimen can be purchased and will serve adequately.

4. BRITISH BAYONET.

British bayonets of the Revolutionary War period are purchasable, if one cannot be obtained from another park. One found at Kings Mountain

would be ideal, but none is known at present. At least some Ferguson rifles were equipped with a special bayonet slightly broader than the usual "Brown Bess" type. It is doubtful whether one of these special weapons can be obtained, but the ordinary type will be satisfactory.

5. ACCESSORIES OF THE KENTUCKY RIFLE.

Plans call for the display of a ball, patch, flint, vial of powder, powder horn, and shot pouch. The first four of these are to be used diagrammatically, and modern specimens will do. However, it is probable that a ball and flint can be obtained from some other Revolutionary battlefield park. The powder should be simulated. The powder horn can be purchased if necessary, but this item should be included in the list of desired originals. The shot pouch probably will have to be simulated, although some are in collections.

6. CLAYMORE.

Campbell's own sword should be sought, although either the sword of any other Whig officer at the battle or a claymore from one of the Scotch communities of the southern colonies would be suitable. In the meantime it will be necessary to purchase a sword for exhibition. Claymores of the proper period are on the market.

7. TOMAHAWK.

While there may be some hope of finding an original in the future, it is likely that this specimen will have to be purchased.

8. SHEATH KNIFE.

A knife of the period may prove difficult to find or purchase. A more recent specimen from the Appalachian region, perhaps obtainable from one of the mountain parks, would be acceptable.

9. FLAIL.

It is hoped that this will be obtainable from Great Smoky Mountains or Shenandoah National Parks. If not, a specimen surely can be located by the park staff, and a simulated specimen can be substituted until it is found.

10. AX.

Early axes of the heavy polled American type are relatively rare. Possibly one of the mountain parks may have a handmade specimen of the correct design. This can be simulated temporarily and the helve, probably, will have to be manufactured. Since such specimens are not often for sale, it should be made an object of search, and the reproduction displaced as soon as possible.

11. HAND SPINDLE AND DISTAFF.

While these objects were apparently in common use on the frontier, they are not often seen in collections. If the mountain parks cannot supply the specimens, a more extended search will be required. Reproductions can be manufactured for temporary use.

12. FIDDLE.

A mountaineer's fiddle of fairly recent date would be satisfactory, since very old ones are not likely to be found. If necessary, an ordinary cheap violin can be made to serve for the time being.

13. BIBLE.

An old Calvinist Bible of pre-Revolutionary days is desired, and should be obtainable by purchase if not by gift.

14. FLAGS.

The modern American flag presents no problem. The two Revolutionary flags are probably not obtainable as originals, since few, if any, authentic specimens are known. It is planned to have replicas manufactured.

Note.—When simulated specimens are used, it should be made clear in the specimen label. Particular specimens may call for other additions to the labels. These changes will be made when the status of specimens becomes known.

II. SPECIMENS DESIRED FOR THE PARK COLLECTIONS.

The following specimens should be searched for and obtained as opportunity may permit. Some of them may be used for exhibition in the museum, others are intended to build up the study collections. The various objects listed are pertinent because they either illustrate some aspect of the park story or have historic associations with it. This list is by no means complete, but is offered as a contribution toward an adequate one.

1. BATTLEFIELD RELICS.

The park museum should have at least a representative collection for study purposes of bullets, guns, bayonets, buttons, etc., which have been found on the field. Specimens obtained from collectors should be reasonably authenticated.

2. BATTLE TROPHIES.

The literature contains references to a number of objects gathered by the victors and presumably carried home as souvenirs. These include:

Ferguson's sword (broken).
DePeyster's sword.
Ryerson's sword.

Several other British officers' swords. (*See* Draper, p. 286, 287. Two of these were loaned by the Colonial Dames to the National Museum in 1917.)

Ferguson's table service (6 dinner plates, coffee cup and saucer).

Two silver whistles belonging to Ferguson.

Ferguson's sash.

Ferguson's commission.

Ferguson's saddle.

Ferguson's pistol.

Ferguson's silver watch. (*See* Draper, p. 291, 307, 308. The men obtaining these articles are listed.)

3. PERSONALIA OF PARTICIPANTS.

Any military objects belonging to any participants would be desirable, such as weapons, accouterments, and uniform items. The leaders might also be represented by nonmilitary material to some extent, but this should be selected with caution. Particularly suitable would be the presentation swords granted to Campbell, Sevier, and Shelby in honor of their victory. (*See* Draper, p. 413, 559.)

4. OBJECTS ILLUSTRATING THE PARK STORY (their value not dependent on historic association).

Uniforms and accouterments—whole or fragmentary—of the following:

Revolutionary militia of Virginia, North Carolina, and South Carolina.

The King's American Regiment.

The Loyal American Regiment.

The New Jersey Regiment.

The 70th Regiment.

The 71st Regiment.

Costume items used by men of the up-country settlements and on the frontier during the late eighteenth century.

A "Brown Bess" musket, with accessory equipment.

British officers' swords, and other side arms.

British military saddle and harness.

Saddle of the type used by the mountain men.

Additional cultural objects pertaining to the overmountain settlers, such as agricultural tools, spinning and weaving equipment, household utensils, etc.

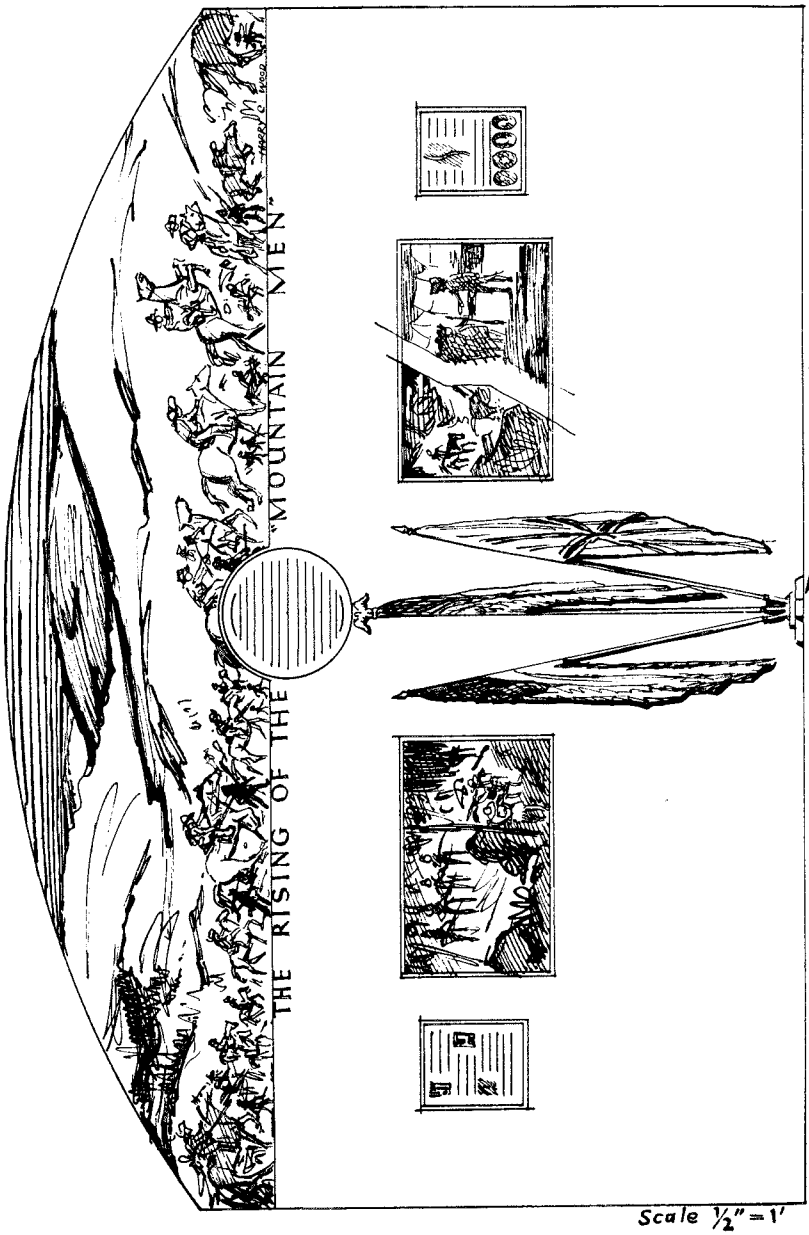
5. DOCUMENTARY MATERIAL.

There seems little chance of obtaining original manuscripts of importance on the Battle of Kings Mountain, since libraries and historical societies

apparently have assembled all that are available. The extent to which facsimiles should be collected is a matter for consideration, but a few, like the "Official Report" (New York Historical Society, Gates MSS.), certainly should be. It may be more feasible to obtain contemporary printed sources—newspaper reports, etc. Autographs of Campbell, Sevier, Shelby, Ferguson, or De Peyster would be very appropriate. Contemporary published maps of the region, especially those available to the British commanders, would be desirable and probably available. Manuscript maps would be even more valuable, but are not likely to be found.

6. PICTORIAL MATERIAL.

The collection should include originals or thoroughly adequate reproductions of all the known illustrations concerning Kings Mountain. These include illustrations in Draper, facing p. 279, Lossing's *Pictorial Field Book of the American Revolution*, *The Pageant of America*, vol. 6, p. 237, and the *National Historical Magazine*, September 1938, p. 84. The park superintendent has already secured copies of these and perhaps others, but originals or better reproductions should be sought. Portraits of the leaders should be included in the collection; perhaps all known portraits of all of them should be set as the goal. Contemporary, or other, plates showing uniforms or other costumes of groups engaged should be searched for, although none are known at present.



ELEVATION OF WEST WALL SHOWING RELATION OF MURAL TO DIORAMAS AND FLAGS

EXHIBIT I.—REVOLUTION IN THE SOUTH

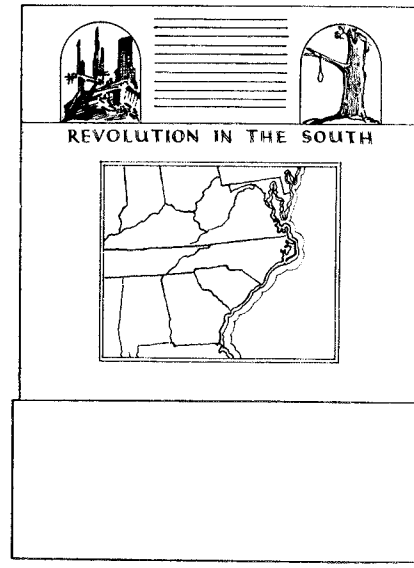


EXHIBIT 1

PURPOSE—to state simply and graphically the general military situation into which the Battle of Kings Mountain fits.

CASE—standard aluminum-framed wall case, exhibit section 5 feet high by 5 feet wide by 1½ feet deep, base 2 feet high. A single shelf, 6 inches deep, is to be installed 1½ feet below the top of the case, and a sloping panel is to extend from the front of the shelf to the front of the case floor.

LOCATION—on the front wall of the museum at the right of the entrance.

CONTENTS

1. TITLE LABEL—cut-out letters, approximately 2 inches high, mounted on the sloping panel about 4 inches below the shelf, to read: REVOLUTION IN THE SOUTH.

2. KEY LABEL—lettered directly on a separate panel covering the case back above the shelf, centered between the two arched openings in this panel described under Nos. 3 and 4, to read (1):

In the North the British had tried for 5 years to crush the revolution. Then, in 1780, they brought the war to the southern colonies.

After the capture of Charleston, Lord Cornwallis led his army inland to conquer the Carolinas. His victory at Camden exposed even Virginia to invasion.

As the British advanced, another type of warfare ravaged the South. Whigs and Tories feared and hated each other. Roving bands of both sides pillaged, burned, and murdered in a bitter struggle of neighbor against neighbor.

3. MODEL—the ruins of a burned house, about 12 inches high, placed on the shelf near its left end, using the arched opening in the special panel (No. 2)—12 inches wide by 15 inches high—as a background.

4. MODEL—a tree trunk, gaunt and blasted, with a hangman's noose suspended from a limb, standing about 12 inches high, placed on the shelf near its right end, with the arched opening in the panel as background.

5. MAP—3 feet wide by 2½ feet high, centered on the sloping panel with its upper edge about 6 inches below the shelf. It would be desirable to have the map mounted behind a beveled opening in the sloping panel. The area to be included in this map extends from Cape Hatteras to the western extremity of South Carolina and from Cape Henry to Savannah. The map is to be white and contain the present State lines. The four States—Virginia, North Carolina, South Carolina, and Georgia are to be named, as are Savannah, Charleston, Camden, Charlotte, Ninety Six, Georgetown, and Kings Mountain. Georgia is to be colored light red, with red stippling extending up to a line from Ninety Six through Camden to Georgetown, indicating the area and intensity of British control. A heavy red band, at least 2 inches wide, is to extend from Charleston through Camden to Charlotte, and a narrow red line in the Atlantic is to lead to Charleston from the north. The following points are to be marked by white numbers in solid red 1½-inch circles and labeled as indicated:

At Charleston—

1. The British captured Charleston and its defending army—May 12, 1780.

At Camden—

2. Cornwallis destroyed an American army under Gates—August 16, 1780.

At Charlotte—

3. Cornwallis invaded North Carolina and occupied Charlotte—September 22, 1780.

At Ninety Six—

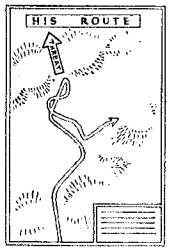
4. After Charleston, Ferguson was sent to Ninety Six to raise troops and drive Whig bands from the foothills.

A 1½-inch circle is to be outlined around Kings Mountain. Aside from these details, the map is to be left as plain as possible.

The 12-inch border on either side of the map might be utilized for mounting small weapons should the park collection acquire them later (2).

COLOR SUGGESTIONS—Since this case forms an important introduction to the exhibit series and yet lacks highly attractive material, it is recommended that strong colors be used to heighten its appeal. It is suggested that the sloping panel framing the map and the special panel above the shelf be painted a bright blue, leaving the white map, white lettered labels, white archways, and white shelf in contrast. The red on the map and the black models would add to the contrast. Other color schemes can be considered at the time of preparation.

EXHIBIT II.—FERGUSON'S EXPEDITION



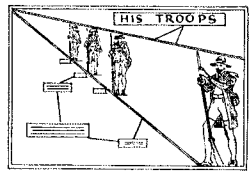


EXHIBIT 2A, 2B, 2C

PURPOSE—to illustrate the more significant features of this expedition, which was the military precursor of Kings Mountain.

TITLE LABEL—the following title in cut-out letters (blue) is to be mounted directly on the wall between units IIA and IIB: FERGUSON'S EXPEDITION. *This exhibit is in three parts to be described separately.*

EXHIBIT IIA.—FERGUSON'S MISSION AND METHODS

PURPOSE—by showing the special duties assigned to Ferguson and the methods he used in performing them to present the immediate military background of the battle and illustrate the nature of the Loyalist activity involved.

CASE—this exhibit is a wall chart requiring no special case. A shielded tube light attached directly to the wall at the top will light the exhibit.

LOCATION—on the right wall of the museum, its right side 3 feet from the front wall, its top 7 feet from the floor.

CONTENTS—a chart or poster 3 by 2 feet, the lettering detailed below placed directly on the main panel which is pierced by three circular openings to frame the three illustrations described.

1. TITLE LABEL—in approximately ¾-inch letters at the top of the panel: HIS MISSION AND METHODS.

2. KEY LABEL—lettered on the panel directly below the title (3): While Cornwallis advanced, Ferguson was sent out to rally and train the Loyalists and break Whig resistance.

3. ILLUSTRATION in water-color showing Ferguson in uniform chatting informally with a mixed group of Loyalists in front of a tavern. Since he is engaged in arousing their patriotism, he might be pointing to a British flag hoisted above the tavern door. This illustration is to be mounted behind a circular opening, 10 inches in diameter, placed below the key label and toward the right side of the panel. The following text is to be

252142°—41——24

lettered on the panel to the left of the opening (4): He persuaded many to renew their allegiance to the king.

4. ILLUSTRATION in water color showing Ferguson drilling the Tory militia. He should be shown mounted observing or directing a bayonet drill. The militia should not be in uniform, but in a mixture of town and frontier civilian costume with hunting shirts in the minority. Their muskets should not have regular bayonets, but have sheath knives inserted in the muzzles. This illustration is to be mounted behind a circular 10-inch opening in the panel below and to the left of No. 3. The following text is to be lettered on the panel at the right of the opening (5): He taught discipline and fighting technique to raw volunteers.

5. ILLUSTRATION in water color showing Ferguson with a small party of his provincial regulars riding in pursuit of Whigs, perhaps galloping along a narrow dusty road, after setting fire to a Whig homestead. This illustration also is to be mounted behind a 10-inch circular opening in the panel, this one below and to the right of No. 4. The lettering to be placed at the left of the opening should read (6): He was bold and successful against the Whig border bands.

COLOR SUGGESTIONS—It is recommended that the panel color be yellow, contrasting well with the blue in Case 1, and that lettering for title and key label be in this same blue. A narrow blue edge for each of the circles might have a rectangular extension for the individual label.

EXHIBIT II B.—THE FIELD OF FERGUSON'S OPERATIONS

PURPOSE—to introduce the dispatch of Ferguson's threat to the mountain men and trace his force to its encampment on Kings Mountain.

CASE—this exhibit is a wall chart requiring no special case. A shielded tube light attached directly to the wall at the top will provide illumination.

LOCATION—on the right wall of the museum 4 feet to the left of No. IIA, its top 7 feet from the floor.

CONTENTS—a simple map 3 by 2 feet comprising the territory in which Ferguson's expedition operated. Using a scale of 4 miles to the inch, the map is to extend from Camden on the east to a little beyond Ninety Six on the west, and from above the Catawba River to below Ninety Six.

1. TITLE LABEL—lettered at the top of the map in approximately ¾-inch letters: HIS ROUTE.

2. THE MAP is to show the general course of Ferguson's advance from Ninety Six to the Catawba and his withdrawal to Kings Mountain. The

route should be indicated by cutting out the path ¼-inch wide in the map panel to reveal a contrasting color beneath. On the face of the panel should be shown and named: Ninety Six, Gilbert Town, Kings Mountain, Camden, and Charlotte. From Camden to Charlotte Cornwallis's route is to be shown lightly and labeled "Cornwallis" with an arrow showing the direction of his advance. At Gilbert Town a prominent arrow is to point 5–10 degrees west of north in the direction of the Watauga settlements and is to be labeled as follows: THE THREAT. Sent from here about September 8.

The following dates are to be shown inconspicuously along the route:

At Ninety Six—July 9.
At the farthest north—September 16.
At Kings Mountain—October 6.

The rivers are to be indicated lightly on the face of the panel and the following inconspicuously named: Saluda, Broad, Catawba, Wateree. The arrow marking dispatch of the threat should be given considerable prominence in the execution of this map, and the central position of Kings Mountain may call for some special treatment (7).

3. KEY LABEL—to be lettered on the map panel in a 6- by 10-inch rectangle of contrasting color placed near the lower right corner of the panel (8):

Far out on Cornwallis's flank, Ferguson worked to crush local sparks of revolution.

As he approached the mountain in pursuit of Whig bands, his presence menaced the security of the little settlements beyond the mountains. It is said that he sent a threat of vengeance to the rebellious folks across the mountains. Little did he know whom he threatened!

COLOR SUGGESTIONS—It is recommended that the map be colored yellow as the panel in IIA, with the map lettering and streams and the key label rectangle in the same blue as used previously, and the two routes in the same red as used in the map in Exhibit No. I.

EXHIBIT II C.—FERGUSON'S TROOPS

PURPOSE—to specify the British force engaged at Kings Mountain, both as to size and components, and to add this important information to the picture of Ferguson's expedition.

CASE—this exhibit is a wall chart requiring no special case. A shielded tube light at the top should illuminate both this chart and the general title label above it.

LOCATION—on the right wall of the museum, centered between IIA and IIB, the upper edge of the panel 6 feet above the floor.

CONTENTS—a cut-out chart occupying the entire exhibit area of the panel. The base panel is to be partially covered by 2 pieces as follows: a triangular piece covering the lower left corner extending from the upper left to within 6 inches of the lower right corners, and another triangular piece covering the upper right corner extending from the upper left corner to 6 inches below the upper right corner, thus leaving a wedge of the under panel exposed with its apex in the upper left corner. The upper and under sections of this compound panel should be in contrasting colors. The details of the chart are to be distributed in the three panel areas as described below.

1. TITLE LABEL—lettered directly on the upper right panel area in approximately ¾-inch letters: HIS TROOPS.

2. CUT-OUT FIGURE of a Loyalist militia infantryman in cutaway coat, waistcoat, and knee breeches of civilian costume tricorne hat, crossed belts with regulation British cartridge box, musket grounded with hunting knife inserted in muzzle for a bayonet. The figure is to be 17 inches high, mounted against the wedge of the under panel at the right side (9).

3. CUT-OUT FIGURE of a private of the King's American Regiment in uniform (red coat, olive facings), rifle grounded and with bayonet fixed. The figure is to be 10 inches high, mounted against the exposed portion of the under panel about 16 inches from the right side of the panel (10).

4. SIMILAR CUT-OUT FIGURE of a private of the Loyal American Regiment (red coat, buff facings), rifle grounded and with bayonet fixed. The figure is to be 8 inches high and mounted against the under panel about 21 inches from the right edge (11).

5. SIMILAR CUT-OUT FIGURE of a private of the New Jersey Volunteers in uniform (red coat, blue facings), rifle grounded and with bayonet fixed. The figure is to be 6 inches high, mounted against the under panel about 26 inches from the right edge (12).

6. LABEL lettered on the lower left panel area in a rectangle, 3 x 9 inches, painted the same color as the exposed under panel, to read (13):

TORY MILITIA
ABOUT
1000

The label is to be placed near the lower left corner of the panel with a line of the same color extending to the cut-out figure of the militiaman

7. LABEL lettered on the lower left panel area in a 3- x 6-inch rectangle painted the same color as the exposed under panel, to read (14):

PROVINCIAL REGULARS
ABOUT
125

(Men from at least three regiments were included but it is not known how many from each.)

This rectangle is to be placed directly above that for Label 6. Three lines of the same color are to extend from the right edge of the label to the three remaining cut-outs, respectively, where smaller rectangles, 1 x 4 inches, will contain the names of the regiments, as follows from the right:

KING'S AMERICAN REGIMENT
LOYAL AMERICAN REGIMENT
NEW JERSEY VOLUNTEERS

COLOR SUGGESTIONS—It is recommended that the under panel and label rectangles be yellow to correspond with II A and II B, and that the upper and lower panel areas be blue as used in the label rectangle of II B and in Case No. 1. The use of lines to outline a secondary wedge with its apex at the title label and base at labels 6 and 7 should be tried.

EXHIBIT III.—ORIGINS OF THE "MOUNTAIN MEN"

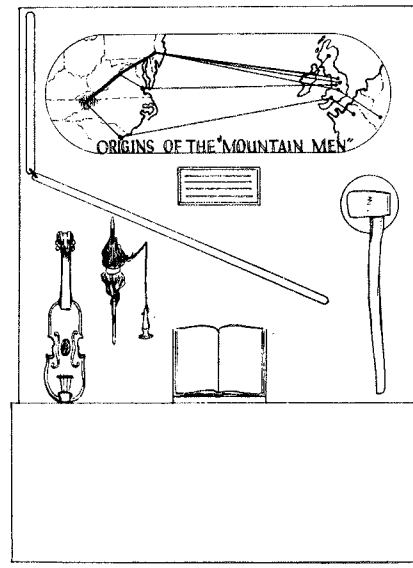


EXHIBIT 3

PURPOSE—to define the term "Mountain Men" by illustrating typical aspects of their origins, migrations, and culture. While this case will provide a background for understanding the nature of the American force at Kings Mountain, the mountain men themselves are considered the most significant phase of the story. Accordingly, this is an important exhibit.

CASE—standard aluminum-framed wall case, exhibit section 5 feet high by 5 feet wide by 1½ feet deep, base 2 feet high.

LOCATION—on the right wall of the museum, 2 feet from the furred wall at the far end.

CONTENTS

1. TITLE LABEL—cut-out letters, approximately 2 inches high, mounted on the lower edge of the panel opening described below so they will be seen against the exposed under panel, to read ORIGINS OF THE MOUNTAIN MEN.

2. A COLORFUL MAP to be mounted behind the main display panelframed by an opening 18 inches high by 52 inches long, with semicircular ends having a 9-inch radius. The top of this opening is to be 4 inches below

the top of the case and it should be centered. The left end of the map is to show a portion of the eastern United States and the right end a part of western Europe. The scale for both is to be 9 inches to 500 miles. At the left end the center about which the semicircular end was described is to coincide with Raleigh, N. C. The corresponding center at the right will be London. The following lines are to be shown indicating migration routes:

From Scotland to northern Ireland to Philadelphia to the Shenandoah Valley to the Watauga region.

From the Palatinate (Rhine Valley) to Philadelphia, crossing England en route, joining the first at Philadelphia.

From central England to Philadelphia joining the first there.

From central England to Williamsburg, Va., to Shenandoah Valley to Watauga region.

From northern France to southern England to Charleston to the Watauga region.

The lines are to be about ⅛ inch wide except the composite section from Philadelphia to Watauga, which is to be wider. Immediately above each line in the Atlantic Ocean section is to be lettered the name of the people signified. These are, respectively, Scotch-Irish, Germans, English, Huguenot French. National and colonial boundaries, including those between England and Scotland and between Ulster and the rest of Ireland, are to be shown lightly. The only cities to be named are to be Philadelphia, Baltimore, Williamsburg, and Charleston. By shading the Blue Ridge and Alleghenies are to be shown clearly, but not named. Likewise the headwaters of the Tennessee are to be shown with emphasis, and the region of the Watauga settlements indicated by name and an arrow. The map should be strongly colorful, and it is recommended that the land areas be in red, the ocean and Tennessee streams in blue, and the lines and lettering in white (15).

3. KEY LABEL—lettered on a rectangular card approximately 12 inches wide by 5 inches high, centered about 3 inches below the panel opening for the map, to contain (16):

THE "MOUNTAIN MEN"

After years of poverty or persecution their grandfathers or fathers had come to America—from several countries and by many routes—seeking a better life. Their fathers had pushed out to the foot of the mountains. They—the hardiest sons—had crossed over to settle the farthest frontier.

They lived in hardship, but had attained freedom. It was their homes Ferguson threatened; their leaders he might hang.

4. A THRESHING FLAIL, the beater mounted vertically at the left of the panel opening and the handle diagonally to the right below the key label.

4a. SPECIMEN LABEL—not larger than 2 by 5 inches located close to the handle of the flail below and to the right of the key label (exact position to be determined at installation), to contain a small line sketch of a man wielding a flail and the text:

FOOD

The *flail* is used to thresh grain. The "mountain men" had to grow their own food or obtain it by hunting.

5. A DISTAFF with hand spindle suspended below it, mounted below the flail to the left of the case center (17).

5a. SPECIMEN LABEL, not larger than 2 by 5 inches, located just to the right of the yarn suspending the spindle, to contain a small line sketch of a pioneer woman hand spinning and the text:

CLOTHING

The *hand spindle* is used to spin yarn for weaving. The mountain settlers had to make their own cloth and garments.

5b. SPECIMEN LABEL, not larger than 2 by 5 inches, located a little below the spindle to contain:

COLOR

The background of this case is butternut color. The frontier settlers often used such native colors to dye their homespun garments.

6. AN EARLY HANDWROUGHT AX of the American type, mounted vertically in the lower right part of the case with a circular area of contrasting color under the head (18).

6a. SPECIMEN LABEL, not larger than 2 by 5 inches, located to the left of the ax near the head, to contain a small line drawing of a man felling a tree and the text:

SHELTER

The *ax* was a vital tool on the frontier. With it the "mountain men" built their homes and cleared their fields.

7. AN OLD PRESBYTERIAN BIBLE resting on the sloping top of mounting block on the floor of the case. The size of the mount will depend on the

size of the specimen, but the height at the back should be not more than 12 inches.

7a. SPECIMEN LABEL, not larger than 2 by 5 inches, located just above the mounting block, to contain a small line sketch of a Calvinist preacher and the text:

RELIGION

A stern religion, rather than books or schools, was the center of culture in the lives of the mountain settlers.

8. AN OLD MOUNTAIN FIDDLE resting on the floor of the case at the left.

8a. SPECIMEN LABEL, not larger than 2 by 5 inches, mounted on the background just above the fiddle, to contain a small line sketch of an old fiddler and the text:

RECREATION

Life on the frontier had its lighter side. The *fiddle* for singing and dancing hung beside the rifle in many cabins.

COLOR SUGGESTIONS—It is recommended that the panel of this case be colored a butternut brown characteristic of the frontier, with labels, the circle behind the ax head, and the top of the mounting block in buckskin. It is possible that the contrasting color should be used with the other specimens also.

EXHIBIT IV.—THE RISING OF THE "MOUNTAIN MEN"

PURPOSE—to emphasize the significance of the over-mountain settlers by relating the story of their march in pursuit of Ferguson. Since the mountain men are being considered as the most important element in the museum story, this exhibit is planned to dominate the hall.

This exhibit is in three parts to be described separately.

EXHIBIT IV A.—THE RISING OF THE "MOUNTAIN MEN"

PURPOSE—to create, as the pervading theme of the museum a dramatic feeling toward these men who rose to defend their freedom.

INSTALLATION—a furred wall is to be constructed across the room 4½ feet from the rear wall. The top portion of this partition, above 8 feet from the floor, is to be set back sufficiently to be lighted by tube lights set in the cove formed at its base. The pictorial part of the exhibit will occupy the upper setback section of the wall, while the labels will be placed on the lower wall section.

CONTENTS

1. TITLE LABEL—in 3-inch cut-out letters mounted directly on the furred wall at, or just below, the top of the lower section, to be letter-spaced and to read: THE RISING OF THE "MOUNTAIN MEN."

2. KEY LABEL—lettered in a colored circle about 24 inches in diameter placed in the center of the wall with its upper edge extending 9 inches above the top of the lower wall section in front of the cove, to read (19):

> "Suddenly and without warning, the wilderness sent forth a swarm of stalwart and hardy riflemen, of whose very existence the British had hitherto been ignorant. Riders spurring in hot haste brought word to the king's commanders that the backwater men had come over the mountains. The Indian fighters of the frontier, leaving unguarded their homes on the western waters, had crossed by wooded and precipitous defiles, and were pouring down to the help of their brethren of the plains."
>
> THEODORE ROOSEVELT.

3. MURAL—to fill the entire upper setback section of the furred wall. The scenic setting is to be the wooded slopes of the Carolina mountains on a bright day in early fall. The mural is to depict the mountain men on their march to Kings Mountain. The composition should convey the feeling suggested by Roosevelt in the phrases describing the "swarm" of men "pouring down" out of the hills. It is to be remembered that a force of

more than 900 men was in pursuit of the British. The painting should catch the idea of numbers and of appropriate speed.

COLOR SUGGESTIONS—The color of the circle for the key label and of the cut-out letters for the title should be the same, selected to harmonize with the mural, but to contrast strongly with the wall color.

EXHIBIT IV B.—THE STORY OF THE MARCH

PURPOSE—to narrate by pictures the story of the pursuit of Ferguson.

CASE—a ground glass projection screen is to be mounted in an opening in the furred wall. This opening will approximate 28 by 42 inches wide, but will correspond exactly to that of the diorama shadow box described below (Exhibit V). Behind the wall is to be installed a small Kodachrome slide projector equipped with a motor-driven rotating slide carrier for six slides. This slide carrier will have to be contrived in the laboratory, since no suitable model is on the market. A mirror will be used between the projector and the screen to increase the size of the image by lengthening the distance of projection and also to bring the projector close to the furred wall for ready servicing. The mechanism is to be designed so that a pushbutton pressed and released will cause the six slides to be projected in turn for about 15 seconds each and the machine to stop automatically at the end of the series. The pushbutton should be centered immediately below the opening. If the projected image is smaller than the opening, which must balance that of Exhibit V, the opening may be masked down with decorative elements, e. g., framed in trees. Probably this decorated border should be lighted when projection is not in progress to balance the diorama in effect as well as in size. On the sloping lower sill of the shadow box a title label and pushbutton directions are to be lettered as follows:

THE STORY OF THE MARCH
(Push button to start, then release)

LOCATION—on the rear partition, the opening approximately 42 inches from the right wall and 46 inches from the floor.

CONTENTS—the six slides are to be photographed in natural color from water color paintings described below. Each painting is to be made 26 inches high by 42 inches wide including a title lettered at the bottom. (Experiment may indicate the advisability of enlarging or reducing the original pictures to fit the requirements of color photography and projection, but this proportion should be maintained at any event.)

1. FERGUSON'S THREAT REACHES WATAUGA—This picture is to show the

arrival of Shelby at Watauga with news of the threat. According to tradition he came "hot with hard riding" to the home of Sevier, who was holding a barbecue and horse race. Draper, p. 170, and Roosevelt, p. 136, describe the scene briefly. While the arrival of the news is the central incident to be portrayed, the background should reveal much of the picturesque culture exemplified by the sports of the barbecue. The picture is to be entitled (20): FERGUSON'S THREAT REACHES WATAUGA.

2. THE RENDEZVOUS AT SYCAMORE SHOALS—This picture is to show the men of Shelby, Sevier, and Campbell—nearly 900 mounted men—gathering at Sycamore Shoals on the Watauga. The time is early in the morning of September 26. Most of the men arrived the day before and the expedition is practically ready to start. The central incident in this scene is the minister leading a final prayer before the departure. It is described in Draper, p. 176, and Roosevelt, p. 140, and pictured in the Pageant of America, vol. 6, p. 237. The title is to read (21):

THE SWORD OF THE LORD AND OF GIDEON
THE RENDEZVOUS AT SYCAMORE SHOALS, SEPTEMBER 26

3. ON THE MARCH—On the afternoon of the 27th the expedition reached the crest of the first mountain range, between Roan High Knob and Big Yellow Mountain. Here on a 100-acre bald the men were paraded. The ground was covered "shoe-mouth deep" with snow. The picture should show the march in progress across the bald, with the force compact and in some semblance of order. (*See* Draper, p. 177, and Roosevelt, p. 141.) The picture is to be entitled (22): ON THE MARCH, SEPTEMBER 27.

4. SELECTING THE FITTEST—This picture is to show the force in camp on the night of October 6 at the Cowpens. During the early evening, while the men were roasting the corn foraged from nearby fields, the officers went through the camp selecting the strongest men and horses and the best rifles. The fatigue of the long chase probably was evident, although a similar selection had been made the night before. The chosen men were busy saddling their horses or already mounted and ready for departure at nine in the evening. Draper, p. 221, and Roosevelt, p. 151, describe the weeding out. The title is to read (23): SELECTING THE FITTEST, OCTOBER 6.

5. FORDING THE BROAD—At sunrise on October 7 after an all night ride the picked force forded the Broad River in a pouring rain. The picture is to show the actual fording, which is described in Draper, p. 229, and Roosevelt, p. 157. The title is to read (24): FORDING THE BROAD RIVER AT DAYBREAK, OCTOBER 7.

6. CLOSING IN—The final picture is to show the American force emerging from the Hambright Gap to surround Kings Mountain. All but the officers had dismounted, and the men were formed in four columns of two files each. The time was about 3 p. m. and the rain had stopped. This scene is described briefly in Draper, p. 245. The picture should be entitled (25): CLOSING IN, 3 P. M., OCTOBER 7.

EXHIBIT IV C.—THE MARCH OF THE "MOUNTAIN MEN"

PURPOSE—to give the important factual details of the events high-lighted by pictures in parts A and B of this exhibit.

CASE—a simple aluminum label frame, with inside dimensions 18 inches high by 15 inches wide mounted against the furred wall.

LOCATION—on the rear wall, its lower edge 51 inches above the floor and its left edge 9 inches from the right edge of the opening for 4B.

CONTENTS—a single chart, 18 by 15 inches, to contain the following elements:

1. MAP—showing the route of the march from Sycamore Shoals to Kings Mountain. This map is to be sketched and shaded on the chart without borders, the route extending down the center of the chart. With a scale of about 12 miles to the inch, Sycamore Shoals should be about 2 inches below the top of the chart and Kings Mountain about 9 inches below the top. The route is to be marked by a solid line. A section of the Virginia-North Carolina line and of the North Carolina-South Carolina line are to be shown and labeled inconspicuously. The main ridges of the Alleghenies and Blue Ridge are to be shaded in and so named. The rivers are to be shown and the following ones named—Watauga, Catawba, and Broad. The following places along the route are to be named: Sycamore Shoals, Gillespie Gap, Gilbert Town, Cowpens, and Kings Mountain. The following arrows in the same color as the route line are to be drawn in to indicate the assembling of the force—an arrow from the region of the Holston River north of the Virginia line to Sycamore Shoals; an arrow from the region between the Watauga and Nolichucky Rivers to Sycamore Shoals; a compound arrow having a stem from each of the two counties, Burke and Rutherford, swinging west of the route line to Sycamore Shoals; a similar double-stemmed arrow from Wilkes and Surry Counties to the route line at Quaker Meadows; a similar double-stemmed arrow from Lincoln County, N. C., and swinging up east of Kings Mountain from South Carolina joining at Flint Hill and extending to the route line at Cowpens. Most of the locations used in defining these map details may be found in Landers' map (70th Cong., 1st sess., H. Doc. No. 328) (26).

2. LABEL—describing the assembling of the force, to be lettered on the chart at the left of the map, with lines extending from each text description to the corresponding arrow. The text is as follows, and refers to the arrows in the same order as given above (27):

THE GATHERING OF THE "MOUNTAIN MEN"

400 Virginians under Campbell
240 frontiersmen under Shelby
240 frontiersmen under Sevier
160 refugees under McDowell
350 men under Cleveland and Winston
400 men under Williams, Hill, and Lacey

3. LABEL—outlining the story of the march, to be lettered on the chart at the right of the map, to read (28):

THE MARCH OF THE "MOUNTAIN MEN"

September 25—Assembled at Sycamore Shoals on the Watauga River.
September 26—Began the march.
September 27—Reached the crest of the Alleghenies. Two deserters escaped to warn Ferguson.
September 29—Crossed the Blue Ridge.
October 2—In camp south of the Catawba. Campbell chosen to command the whole force.
October 4—Approaching Gilbert Town, learned Ferguson was retreating.
October 5—Leaving behind the more exhausted men, about 750 pushed ahead.
October 6—At the Cowpens. 910 of the strongest men, best rifles, and fastest horses chosen for the final dash.
October 7—After riding all night, overtook Ferugson encamped on Kings Mountain.

4. KEY LABEL—centered below the map, with larger lettering to make it more prominent than labels 2 and 3, to read (29):

The "mountain men" rode through 12 days of hardship to answer Ferguson's threat. Nearly half their force was left exhausted along the way. It took endurance, courage, confidence in themselves, and a strong purpose to hunt down their enemy. The frontier bred such men.

5. PORTRAITS—across the bottom of the chart are to be mounted photographic copies of portraits of several of the Whig leaders, each about 4 inches high by 3 inches wide. The name should be lettered at the top of each. The following leaders are to be shown—Campbell, Shelby, and Sevier. If it proves impossible to find a portrait of Campbell, only two will be used, with the Campbell coat of arms and plaid between them (30).

COLOR SUGGESTIONS—This chart will not be lighted, so should have good contrast between the background and lettering. Colors in the map should not attempt to compete with the mural or pictures in IV B.

EXHIBIT V.—DIORAMA—THE BATTLE OF KINGS MOUNTAIN

PURPOSE—to picture realistically the nature of fighting in this battle so that one may visualize the action while on the battlefield.

CASE—a standard diorama case with floor area for the group 6 feet wide by 4 feet deep, the opening 28 inches high by a width suiting the composition of the scene (approximately 42 inches).

LOCATION—the diorama case is to be installed behind the furred wall at the rear of the museum room, its opening approximately 42 inches from the left wall and 46 inches above the floor.

CONTENTS

1. DIORAMA—a scene typical of this battle. The tactics of the two armies at Kings Mountain were fairly simple and markedly distinct. It is believed, therefore, that one scene can illustrate the fundamental characteristics of both. The American plan of attack was to surround the mountain spur and advance up all sides, depending on rifle fire to break the enemy's resistance. The men were ordered to "give them Indian play," using cover when necessary and firing aimed shots at will. The British defense relied on the power of the bayonet charge against raw troops, which had been demonstrated repeatedly in this war. The provincial regulars charged down the mountain, probably holding their volley until the end of the advance, with their retirement covered by the militia rifles on the summit. The decisive strength of the assualt lay in the fact that the frontiersmen retreated reluctantly before the British charges, but only until their force was spent. They did not break and run, but followed the regulars back up the mountain. The British delivered charge after charge, but found little substance to attack effectively, and they could not cover all sides of the mountain at once.

The diorama is to show one of the British charges. A single modeled figure of a frontiersman is to dominate the foreground. Facing uphill to the left of the group, his knee resting on a fallen log, he is taking careful aim at the advancing British. Beyond him others are firing, or running down the mountain, or reloading behind trees. A mounted officer waves his sword. In the foreground, also, two red-coated provincials are modeled. With fixed bayonets they are converging on the rifleman. They are so near that he will have to turn and run after firing his shot or be bayoneted. In the background the British line, led by a mounted officer, advances at a steady walk down the mountain, the regularity of the line rather broken by the trees. In the background at the left the open crest of the ridge may be visible with the line of Tory riflemen at work.

The setting is the steep slope of the Kings Mountain spur. The ground slopes down from left to right at an angle of 30 to 40 degrees. It is heavily wooded with large trees—oaks in dominance, but also tulip, beech, maple, hickory, gum, and a few pines. There is some underbrush where fallen trees have left an opening, but little under the trees. Laurel may occupy the openings. Occasional low rounded outcrops of schist jut out at an angle here and there among the trees, but not conspicuously. Only a few trees have started to change color. The time is about 3:30 in the afternoon, the sky cleared after a rain. The ground under the trees is still wet. The sun is at the back of the group, perhaps casting rays in the powder smoke. If any distant view can be seen through the trees, it will reveal low wooded ridges (31).

2. TITLE LABEL—lettered directly on the sloping lower sill of the shadow box, to read: THE BATTLE OF KINGS MOUNTAIN.

3. KEY LABEL—to be mounted in a simple aluminum label frame, with inside dimensions 18 inches high by 15 inches wide, against the furred wall 9 inches to the left of the diorama opening and with its lower edge 51 inches above the floor, to read (32):

THE BATTLE OF KINGS MOUNTAIN

Ferguson had been retreating slowly toward the main British army at Charlotte, but the day before the battle he had pitched camp on this spur of Kings Mountain to wait for the American attack. He felt it was a strong position from which "all the rebels out of hell" could not drive him.

It was 3 o'clock in the afternoon of October 7. In four columns the "mountain men" were hastily surrounding the ridge. Now they swept up the slopes, yelling madly and firing their deadly rifles as fast as they could reload. They were met by the steady advance of British bayonets. Most undrilled troops would have broken and run, but not the "mountain men." Firing from rock or tree, they fell back before the bayonets. Then, when the British line started back to its position, they swarmed up again on its heels. Repeated British charges failed to drive them off, and at last they gained the crest.

In only an hour the fight was over. At 4 o'clock the gallant Ferguson was dead, half his regulars were killed or wounded, and the beaten Loyalists surrendered.

The margins of this large label are to be ornamented with a few line sketches of men in action—e. g., Ferguson with his silver whistle, an officer with falling horse, men loading their rifles, etc.

Note.—An alternative scene of dramatic possibility would be Ferguson's death. Although the occurrence is the subject of controversy, there probably is enough consistency to permit construction of a diorama if this subject is preferred.

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EXHIBIT VI.—ARMS OF THE "MOUNTAIN MEN"

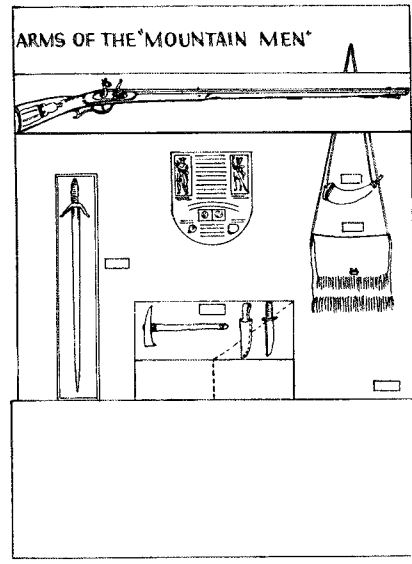

EXHIBIT 6

PURPOSE—to exhibit the types of weapons carried by the mountain men as an aid to understanding the action. This case also will support the emphasis placed on the mountain men.

CASE—standard aluminum-framed wall case, exhibit section 5 feet high by 5 feet wide by 1½ feet deep, base 2 feet high.

LOCATION—on the left wall of the museum, 2 feet from the furred wall at the far end.

CONTENTS

1. TITLE LABEL—cut-out letters, approximately 2 inches high, mounted on the back panel of the case about 4 inches below the top and to the left of the center (to balance with the straps of the pouch and powder horn decribed below), to read: ARMS OF THE "MOUNTAIN MEN".

2. KENTUCKY RIFLE—a specimen mounted on a panel, 9 inches wide and extending the full width of the case, placed 10½ inches below the top and 1 inch out from the back of the case. The barrel of the gun is to be horizontal, with muzzle at the right.

2a. SPECIMEN LABEL—a complex chart 14 inches high by 12 inches wide, with the lower edge curving (straight sides 9 inches), centered below the

rifle panel. The principal text is to be lettered in the central section of the chart as follows (33):

KENTUCKY RIFLE

The Battle of Kings Mountain was won by the Kentucky rifles of the "mountain men." These famous guns—developed on the American frontier—were nearly as accurate at short distances as the best modern rifles. They could be loaded quicker and used less powder and lead than ordinary guns of that period.

At the left of this text a colored sketch, 6 inches high, of a frontiersman pouring a charge of powder into the barrel of his rifle, and at the right a second sketch showing the frontiersman ramming down the ball. Under the former is to be lettered POURING IN THE POWDER.

The right hand sketch is to be similarly labeled RAMMING DOWN THE BALL.

In the curved lower section of the chart below the main text is to be centered the following items:

2 diagrams of the muzzle of a Kentucky rifle placed side by side. In the left hand one a ball is to be shown slightly smaller than the bore, in the one on the right a tight fitting patch-wrapped ball is to be shown. A ball is to be mounted below and a little to the left of the diagrams. A patch is to be mounted below and a little to the right of the diagrams. A title label for this unit is to arch over the two diagrams, to read:

THE "SECRET" OF THE KENTUCKY RIFLE

The ball and patch are to be labeled beneath each, respectively "Bullet" and "Patch." Between the ball and patch and below the two diagrams is to be lettered the following explanatory text:

The bullet was slightly smaller than the barrel. Wrapping it in a patch of greased linen or leather made it fit tightly, but it still could be pushed in easily with the ramrod. In other muzzle-loading rifles the unwrapped bullet had to be hammered into the barrel.

At the left of this unit below the sketch of the frontiersman charging his rifle is to be mounted a vial of black powder (simulated), labeled beneath "Powder." Opposite it at the right of the chart is to be mounted a gun flint, labeled immediately below with the name, "Flint."

3. SHOT POUCH—a specimen suspended from a peg near the top of the case so placed that the bag will hang about 16 inches below the rifle panel and about 4 inches from the right side of the case. The shoulder strap will pass behind the rifle panel.

3a. SPECIMEN LABEL—not larger than 2 by 5 inches, mounted on the background just above the pouch, to read (34):

SHOT POUCH

The rifle bullets were carried in this bag. The small size of the balls permitted a man to carry a good supply for long wilderness journeys.

4. POWDER HORN—a specimen suspended from the same peg as the shot pouch and hanging in its natural place just above the bag.

4a. SPECIMEN LABEL—not larger than 2 by 5 inches, mounted on the background just above the powder horn, to read (34):

POWDER HORN

The gunpowder was carried in a homemade horn. Sometimes a second powder horn was used for fine grained priming powder.

5. CLAYMORE—a specimen mounted vertically on a panel, the panel to extend up from the floor of the case to a point about 6 inches below the rifle panel, standing about 6 inches from the left side of the case.

5a. SPECIMEN LABEL—not larger than 2 by 5 inches, mounted on the background just to the right of the sword panel, to read (35):

CLAYMORE

Some of the officers had swords. This is a Scotch claymore such as Colonel Campbell is said to have used in the battle.

6. TOMAHAWK—a specimen mounted on the left half of the sloping top of a display block resting on the floor of the case. The block is to be 24 inches wide by 12 inches deep by 15 inches high at the back and 6 inches at the front, and is to be centered on the floor of the case.

7. SHEATH KNIFE AND SHEATH—specimens mounted on the right half of the sloping top of the display block just described.

6–7a. SPECIMEN LABEL—not larger than 2 by 5 inches, mounted on the top of the display block between the tomahawk and the knife, to read (36):

TOMAHAWK AND SHEATH KNIFE

The "mountain men" probably carried these typical frontier side-arms. They were used very little in this battle, however.

8. SPECIMEN LABEL—not larger than 2 by 5 inches, mounted on the background below and to the right of the shot pouch, to read (37):

COLOR

The background of this case is butternut color, and the panels are of buckskin. Many of the mountain fighters wore these colors.

COLOR SUGGESTIONS—It is recommended that the case background be dyed a butternut brown, with actual or simulated buckskin used for the panels and the top of the display block, with the exception of the sword panel which should be covered with the Campbell plaid.

EXHIBIT VII.—THE RESULTS OF KINGS MOUNTAIN

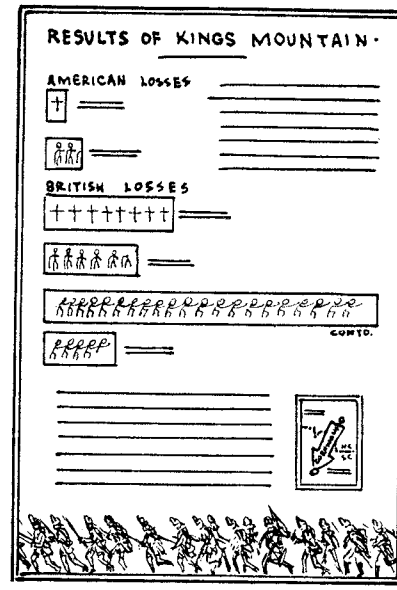

EXHIBIT 7

PURPOSE—to present in graphic form the significant results of this battle, including both its immediate outcome and more far-reaching effects.

CASE—this exhibit is a wall chart requiring no special case. A shielded tube light at the top attached directly to the wall will provide light for the exhibit.

LOCATION—on the left wall of the museum, its right edge 15 inches from the case for Exhibit VI and its top 7 feet above the floor.

CONTENTS—a chart 3 feet high by 2 feet wide containing the following items:

1. TITLE LABEL—in ¾-inch cut-out letters at the top of the chart, to read: RESULTS OF KINGS MOUNTAIN.

2. KEY LABEL—a general statement on the immediate outcome, to be lettered directly on the chart below the title label and to the right of the graph showing losses, to read (38):

The American victory was complete. The "mountain men" captured or wiped out the entire British force of brave, well-armed and well-led fighters.

3. THREE-DIMENSIONAL BAR GRAPH to show the losses on both sides. Each

bar is to be 2 inches high by the length given below, and is to begin 1½ inches from the left side of the chart. The two bars for American losses are to be blue and the remaining for British losses red. Cut-out symbols in white are to be superimposed on the colored bars. The bars are to be spaced 1 inch apart with an additional 1½ inches for a heading between the American and British series (½-inch between the two lines of the last bar). Above the first bar in blue cutout ½-inch letters is to be the heading —AMERICAN LOSSES. Between the second blue and first red bars is to be the heading in red cut-out ½-inch letters—BRITISH LOSSES. The bars are to be as follows, beginning about 5 inches below the top of the chart, with the statement of actual figures as given below lettered at the end of each bar (39):

AMERICAN LOSSES

1-inch blue bar containing one white cut-out cross—28 killed.

2¼-inch blue bar containing two and a fraction formalized white cut-outs representing wounded men (one crutch and arm in sling, e. g.)—62 wounded.

BRITISH LOSSES

8-inch red bar containing eight white crosses—225 killed.

5¾-inch red bar containing five and three-quarters symbols of wounded men—163 wounded.

21-inch red bar containing 21 formalized cut-outs representing prisoners (e. g., linked hands but not in lock step) with "Continued" below its right end in small letters.

4½-inch red bar containing four and a half prisoner symbols continuing previous line—716 prisoners.

4. KEY LABEL—a general statement concerning the effects of the victory on the southern Tories and on the British campaign, to be lettered directly on the chart 2 inches below the bar graph, 2½ inches from the left side of the chart, and 1½ inches to the left of the map described below, to read (40):

The destruction of Ferguson put a sudden stop to Tory enthusiasm in the Carolinas. Even more important, it forced Cornwallis to retreat from North Carolina. When he began his invasion again, the Continental Army was in the field to meet him.

5. MAP—a simple map about 6 inches high by 4 inches wide, placed on the chart 6½ inches from the bottom and 2½ inches from the right side. The background of the map is to be solid color rectangle. On this are to be shown and named Charlotte, N. C., Winnsboro, S. C., Kings Mountain, and the North Carolina-South Carolina boundary. A cut-out arrow extending from Charlotte to Winnsboro is to be labeled "Cornwallis."

6. SILHOUETTE—at the bottom of the chart is to be mounted a decorative cut-out silhouette of a column of British regulars in retreat (not a rout or hasty retreat, but strategic withdrawal). The strip is to be about 4 inches high and extend entirely across the chart below the second key label and the map.

COLOR SUGGESTIONS—It is recommended that the ground color of this chart be yellow to correspond with those on the opposite wall. The general label lettering, map rectangle, and silhouette should be in contrast—blue, chocolate brown, or deep wine red.

EXHIBIT VIII.—MAJOR PATRICK FERGUSON

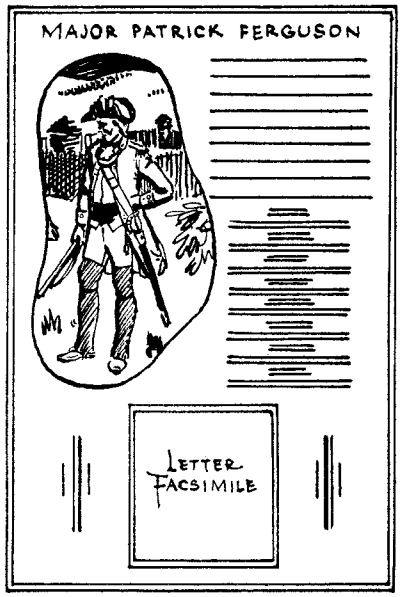

EXHIBIT 8

PURPOSE—to sketch the career of Ferguson, who was the British commander at Kings Mountain and the most important officer killed there. Park visitors show considerable interest in Ferguson and many of them visit his grave.

CASE—this exhibit is a wall chart requiring no special case. A shielded tube light attached directly to the wall at the top of the chart will illuminate the exhibit.

LOCATION—on the left wall of the museum to the right of the fire door (the exact position will depend on the size and placement of this door) with the top 7 feet above the floor.

CONTENTS—a chart 3 feet high by 2 feet wide, with the following components:

1. TITLE LABEL—in ¾-inch cut-out letters at the top of the chart, to read: MAJOR PATRICK FERGUSON.

2. PORTRAIT—a full length portrait of Ferguson, about 18 inches tall, showing him in the uniform of a captain of the 70th Regiment (authorities of the American Military Institute feel that it is unlikely that Ferguson ever wore the uniform of the 71st Regiment to which he was transferred in

October 1779). The figure is to be painted against a scenic background, the whole to form a cut-out plaque which is to be mounted on the left side of the chart 12 inches above the bottom (41).

3. KEY LABEL—the right half of the chart is to bear the following outline of Ferguson's career (42):

Patrick Ferguson was a good soldier—brave, intelligent, energetic, and humane. He entered the army as an officer when only 14 years old, and served in Germany, France, the West Indies, and America. During the Revolution Ferguson commanded small detachments of picked infantrymen with special success. He died fighting for king and country at the age of 37.

1758–1762—officer in Scots Greys.
1768–1779—captain in 70th Regiment.
1776—invented Ferguson rifle.
1777—severely wounded at Brandywine.
1778—defeated famous Pulaski Legion in surprise attack.
1779–1780—major in 71st Regiment.
1780—Inspector-General of Loyal Militia in South Carolina.
1780—killed in action at Kings Mountain.

4. PHOTOGRAPH—a photographic copy of the letter written by Ferguson to Tenpenny on October 6, 1780. This is to be mounted beneath a mat at the bottom of the chart. The precise lay-out of the entire chart will depend on the size of this item, which cannot be determined until later. Care should be taken to provide enough light on this letter to make it legible.

4a. SPECIMEN LABEL—lettered immediately above the facsimile, to read (43): ONE OF THE LAST LETTERS FERGUSON EVER WROTE.

COLOR SUGGESTIONS—It is recommended that the background of this chart be yellow to correspond with the preceding, and that the lettering and mat for the photograph be the same contrasting color as used in the preceding chart.

EXHIBIT IX.—THE FERGUSON RIFLE

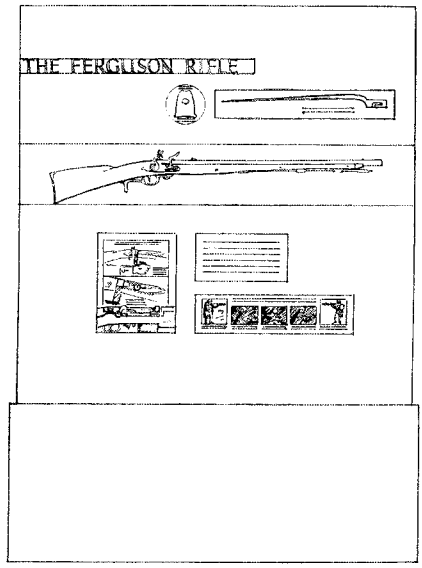

EXHIBIT 9

PURPOSE—to exhibit the rare and interesting specimen of a Ferguson rifle which the National Park Service owns, and which is of the type closely associated with this battle.

CASE—standard aluminum-framed wall case, exhibit section 5 feet high by 5 feet wide by 1½ feet deep, base 2 feet high. A single shelf, 6 inches deep and extending the width of the case, is to be installed 30 inches above the floor of the case, and a sloping panel is to extend from the front edge of the shelf to the front of the case floor.

LOCATION—on the front wall of the museum to the left of the entrance.

CONTENTS

1. TITLE LABEL—cut-out letters approximately 2 inches high, mounted upon a colored strip 2 by 36 inches placed flush with the left side of the case background 8 inches below the top to read: THE FERGUSON RIFLE.

2. A FERGUSON RIFLE mounted on the shelf with barrel horizontal and muzzle to the right. The gun is to be borne by upright supports from the shelf rather than be attached to the background. The surface of the shelf and a panel 9 inches high rising behind it are to be covered in a rich, colored fabric to emphasize this specimen.

3. KEY LABEL—about 7 inches high by 14 inches wide, mounted on the sloping panel 4 inches below the shelf and 19 inches from the right side of the panel, to read (44):

THE FERGUSON RIFLE

Patrick Ferguson, the best shot in the British army, invented a rifle in 1776 that loaded at the breech. It was the first breech-loader carried by the troops of any country. The Provincial Regulars are believed to have used this splendid weapon at Kings Mountain. The rifle was ahead of its time and was discarded after his death. It is now rare.

4. ENLARGED MODEL OF THE REAR SIGHT OF A FERGUSON RIFLE mounted against a 6-inch circle of the same color as the shelf and panel in a position permitting the visitor to sight through it. The center of the circle is to be about 6 inches above the shelf and 25 inches from the left side of the case. The model is to be about 4 inches high.

4a. SPECIMEN LABEL—fitted in the lower chord of the colored circle, corresponding with it in color and lettered in white, to read (45):

REAR SIGHT

(Enlarged model)

The sliding mechanism which permitted aiming for any distance made the Ferguson rifle exceptionally accurate.

5. A BRITISH BAYONET of the Revolutionary War period mounted on a colored strip, 4 inches high by 27 inches wide, of the same color as the shelf and panel placed about 4 inches above the shelf and 3 inches from the right side of the case.

6. CHART, 15 inches high by 12 inches wide, set into the sloping panel in a vertical position with its top flush with the panel about 4 inches below the shelf and its left side 12 inches from the left side of the case. The chart is to contain two diagrams showing the breech mechanism of the Ferguson rifle in cut-away section viewed from the right side and sloping down a little to the right of the chart. In the upper diagram the breech plug is to be lowered about one-third, with a hand turning the trigger guard. The lower diagram is to have the breech plug completely lowered, the ball in position and the powder being poured in. The labeling of the chart is to be as follows:

A title above the first diagram, to read: BREECH MECHANISM OF THE FERGUSON RIFLE.

Below the first diagram: Breech plug lowered by one turn of the trigger guard.

Below the second diagram: Compare this with the breech mechanism of the modern bolt-action rifle below.

A 12-inch section of a modern bolt-action rifle including the breech mechanism is to be built into the floor of the niche formed by setting the chart into the sloping panel.

7. CHART, 6 inches high by 24 inches wide, mounted on the sloping panel 2 inches below the key label and 9 inches from the right side of the case. It is to contain a series of five colored sketches of a soldier operating a Ferguson rifle. The first figure on the left is to be standing in the act of firing toward the right; the next three are to be advancing toward the right and respectively opening breech, loading and firing; the fifth figure, facing left, is to be loading in a heavy rain. The figures are to wear the red and black uniforms of the 70th Regiment. The labeling is to be as follows (46):

Centered above the series of sketches: Performance of the Ferguson rifle.

Below the first sketch: 6 shots a minute.

Below the three center sketches: 4 shots a minute while advancing.

Below the last sketch: Efficient in any weather.

COLOR SUGGESTIONS—It is recommended that this case have a buff background with the shelf and panel for the rifle, the two circles, the title label, and a border on chart 6 in the red of the British uniform coats, and the key label and two charts in a darker buff.

EXHIBIT X.—THE KINGS MOUNTAIN BATTLEFIELD

PURPOSE—to provide a general view of the terrain involved in this engagement for reference in the museum and particularly for lecture use when weather conditions are unfavorable.

CASE—the relief map is to be mounted on a base 30 inches high, with a seat 18 inches high by 15 inches wide surrounding it. A spotlight from the ceiling should be considered for lighting this exhibit.

LOCATION—centered on the main axis of the room about 6 feet from the entrance.

CONTENTS—a relief model of the Kings Mountain battlefield 4 feet square, with a horizontal scale of 1 inch to 100 feet and a vertical scale of 1 inch to 50 feet. The map is to include the Kings Mountain spur, Indian Knob, Hambright's Gap, and the "Hitching Grounds." On the map are to be shown the American troop positions at the foot of the mountain by blue bars, and the British by a red bar along the crest and a cluster of red triangles on the northeast end of the ridge. The Colonial road and trail system is to be clearly traced in black the two Indian trails being dotted, and the present main park road system with the museum site marked is to be indicated lightly in brown. The brook at the north end of the mountain should be shown. The "Hitching Grounds" and museum are to be so labeled. The American route from the west edge of the map to the troop positions is to be shown by broken blue lines ending in arrows. In the lower left corner of the map the following legend is to be lettered, with appropriate symbols inserted (47):

THE KINGS MOUNTAIN BATTLEFIELD

Route of American Advance (broken blue line).
American Positions at the Start of the Battle (blue bar).
British Camp (red triangles).
British Line at the Start of the Battle (red bar).
Colonial Road (black line).
Indian Trails (dotted black line).
Present Park Road (brown line).
Scale: Horizontal 1 inch=100 feet; vertical 1 inch=50 feet.

COLOR SUGGESTIONS—The surface of the map should not be treated to show vegetation, but left as simple as possible to emphasize topography. It should be a solid light color such as buff.

Note.—The mold should be retained for casting a duplicate to be used in an orientation exhibit out on the mountain.

EXHIBITS XI AND XII.—KINGS MOUNTAIN SOLDIERS

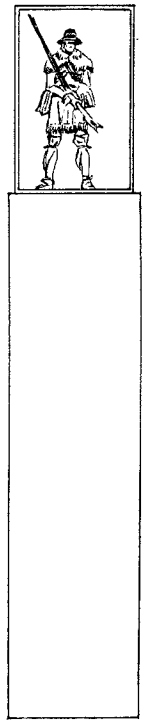

EXHIBIT 11

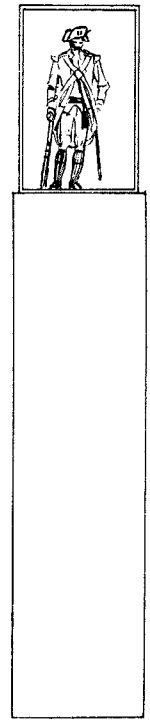

EXHIBIT 12

PURPOSE—to increase the general effectiveness of the museum by the use of a potent device which at the same time will contribute to the visual impression that the visitor should carry onto the battlefield.

CASE—two simple pedestal cases, with the bases 12 by 12 by 48 inches high, and glass tops 11 by 11 by 17 inches high. Lighting for these pedestals is to be from bulbs set in the base which will light the glass top (vitrine) through a ground glass plate set in the top of the pedestal.

LOCATION—these exhibits can be moved readily to fit unforeseen or changing conditions in the museum, but at the outset Exhibit XI will stand between Exhibit III and the furred wall, and Exhibit XII will be between Exhibit VI and the furred wall.

CONTENTS

EXHIBIT XI—a modeled figure of a frontiersman in buckskin with his Kentucky rifle and accouterments. The figure is to be between 12 and

15 inches high and finished in natural color. At the foot of the figure is to be placed a small label, 2 by 5 inches, to read (48):

A "MOUNTAIN MAN"

The frontiersmen living along the headwaters of the Tennessee were not regular soldiers, but they were experienced fighters defending their homes.

Uniforms portrayed in the museum are based on data supplied through the courtesy of the American Military Institute.

EXHIBIT XII—a modeled figure of a captain in the King's American Regiment, with sword and accouterments. The figure is to correspond in size to that in Exhibit XI and be finished in full color. At the foot of the figure is to be placed a small label, 2 by 5 inches, to read (49):

A PROVINCIAL REGULAR

Provincial regulars were American Tories enlisted in the British Army. This is a captain in the King's American Regiment from New York.

Uniforms portrayed in the museum are based on data supplied through the courtesy of the American Military Institute.

EXHIBIT XIII.—FLAGS

PURPOSE—to display three flags as a decorative focal point of the museum and for their symbolic value.

CASE—no case will be used, but a base must be provided to hold one vertical staff and a slanting staff at either side. The flags should be spotlighted from a point on the ceiling near the center of the room.

LOCATION—centered against the furred wall opposite the museum entrance.

CONTENTS

1. AMERICAN FLAG hanging from a vertical staff 6 feet 9 inches high. The diagonal dimension of the flag should be between 5 and 6 feet.

2. AMERICAN FLAG of 1780 hanging from a slanting staff 6 feet 3 inches long at the right of the vertical staff. The diagonal dimension should be between 4 and 5 feet (50).

3. BRITISH FLAG of 1780 hanging from a slanting staff 6 feet 3 inches long at the left of the vertical staff. The diagonal dimension should be between 4 and 5 feet (51).

REFERENCES

MUSEUM EXHIBIT PLAN KINGS MOUNTAIN NATIONAL MILITARY PARK

(1) LANDERS, page 5.—"Upon completion of their plans, the amphibious expedition under Clinton and Arbuthnot sailed from its base, New York, December 26, 1779. Charleston Harbor was occupied, siege laid to the city, and on the 12th of May General Lincoln surrendered the town and its garrison."

"Cornwallis commanded in the field, and on May 17 had a force . . . which Clinton believed would be sufficient, when augmented by militia, to subjugate South Carolina and continue the campaign into North Carolina."

Page 4.—"In commenting on the internecine warfare carried on without cessation, General Greene wrote on the 23rd of May 1781, . . . 'The animosity between the Whigs and Tories of this State renders their situation truly deplorable. There is not a day passes but there are more or less who fall a sacrifice to this savage disposition. The Whigs seem determined to extirpate the Tories and the Tories the Whigs. Some thousands have fallen in this way in this quarter, and the evil rages with more violence than ever. If a stop can not be put to these massacres, the country will be depopulated in a few months more, as neither Whig nor Tory can live'."

ROOSEVELT, page 134.—"The British leaders . . . held almost unchecked sway throughout the Carolinas and Georgia; and looking northward they made ready for the conquest of Virginia . . . The northern portion of North Carolina was still in possession of the remainder of Gates' army, but they could have been brushed aside without an effort."

(2) WHITTON, page 319.—See map of Cornwallis campaign opposite.

Page 260.—Clinton sent three columns into the interior after taking Charleston. A chain of posts was established from Ninety Six through Camden to Georgetown.

FISHER, volume 2, page 231.—Georgia was invaded and conquered by the British from Florida in the winter of 1778.

FORTESCUE, volume 3, page 310.—three columns sent out from Charleston, Cornwallis moving up the north bank of the Santee to Camden with 2,500 men between May 18 and early June.

Page 332.—Cornwallis moved from Camden to Charlotte arriving September 22nd. Ferguson moved north from Ninety Six as the third column in this advance.

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DRAPER, page 68.—After Charleston Clinton sent Cornwallis to Camden "while Colonel Ferguson . . . marched from Nelson's Ferry . . . thence on to Little River and Ninety Six, where they arrived on the twenty-second of June." "His orders were to have watch-care over the extended district of country from the Wateree to the Saluda, well nigh a hundred miles."

(3) MACKENZIE, page 57.—"Ferguson had directions to advance on the left flank of the main army."

Page 65.—"He was therefore charged with the measure of supporting, and at the same time disciplining, the numerous bodies of Loyalists with which the interior districts of the Carolinas abounded, . . ."

DRAPER, page 75.—"To coerce the Whigs to submission, and embody the Tories, and train them for war, Ferguson kept moving about the country . . ."

(4) DRAPER, page 73.—"He would sit down for hours, and converse with the country people on the state of public affairs, and point out to them, from his view, the ruinous effects of . . . disloyalty . . . This condescension on his part was regarded as wonderful in a King's officer, and very naturally went far to secure the respect and obedience of all who came within the sphere of his almost magic influence."

(5) DRAPER, page 73.—"The younger men were thoroughly drilled by Colonel Ferguson and his subordinates in military tactics, and fitted for active service."

Page 237.—". . . he had provided each with a long knife, made by the blacksmiths of the country, the butt end of the handle of which was fitted the proper size to insert snugly in the muzzle of the rifle with a shoulder or button two inches or more from the end, so that it could be used as an effective substitute for a bayonet."

(6) ROOSEVELT, page 125.—"Their activity and energy was such that the opposing commanders seemed for the time being quite unable to cope with them, and the American detachments were routed and scattered in quick succession."

Page 126.—"Ferguson, on the contrary, while quite as valiant and successful a commander (as Tarleton), showed a generous heart, and treated the inhabitants of the country fairly well. He was especially incensed at any outrage upon women, punishing the offender with the utmost severity, and as far as possible he spared his conquered foes."

Page 128.—"Ferguson himself hung some men; and though he did his best to spare the country people, there was much plundering and murdering by his militia."

DRAPER, page 77.—"The horses of Ferguson's men were turned loose in any fields of grain that might be most convenient. Foraging parties brought in cattle . . . or wantonly shot them down in the woods and left them . . . so that Ferguson had an excellent opportunity to . . . support his men by pillaging the people."

Page 488 (Allaire's Diary).—"This day Colonel Ferguson got the rear guard in order to do his King and country justice, by protecting friends, and widows, and destroying Rebel property; also to collect live stock for the use of the army, all of which we effect as we go, by destroying furniture, breaking windows, etc . . ." His diary for Ferguson's operations on the frontier gives no instances of burning or hanging, although they often quartered at rebel plantations.

Page 72.—" 'We come not,' declared Ferguson, 'to make war on women and children, but to relieve their distresses.' "

(7) DRAPER, pages 499–510.—Route traced from Allaire's Diary. United States Geological Survey—maps of the States of South and North Carolina.

MOUZON.—Map of the Carolinas in 1775

(8) DRAPER, page 169.—"But a circumstance transpired that tended to arouse them from their ease and sense of security. When Ferguson took post at Gilbert Town, in the early part of September, remembering how the mountain men had annoyed him and his detachments on the Pacolet, at Thicketty Fort, near Wofford's iron works, and at Musgrove's, he parolled Samuel Philips, a distant relative of Colonel Isaac Shelby, whom he had taken prisoner—perhaps one of the wounded left at Wofford's or Musgrove's, now recovered—with a verbal message to the officers on the Western waters of Watauga, Nolachucky, and Holston, that 'if they did not desist from their opposition to the British arms, he would march his army over the mountains, hang their leaders, and lay their country waste with fire and sword.' "

Page 522 (The Official Report.)—"On receiving intelligence that Major Ferguson had advanced as high up as Gilbert Town, in Rutherford County, and threatened to cross the mountains to the western waters . . ."

Page 541 (Shelby's narrative).—"Whilst there he discharged a patriot, who had been taken prisoner, on his parole, and directed him to tell Col.

Shelby, (who had become obnoxious to the British and Tories from the affair at Musgrove's Mill,) that if Shelby did not surrender, he (Ferguson) would come over the mountains, and put him to death, and burn his whole County."

Page 547 (Gen. Graham's account).—"Although Col. Ferguson failed to overtake the detachment of mountain men alluded to, he took two of them prisoners, who had become separated from their comrades. In a day or two, he paroled them, and enjoined them to inform the officers on the western waters, that if they did not desist from their opposition to the British arms, and take protection, under his standard that he would march his army over the mountains, hang their leaders, and lay the country waste with fire and sword."

ROOSEVELT, page 135.—"Ferguson had pushed his victories to the foot of the Smoky and Yellow Mountains. Here he learned, perhaps for the first time, that there were a few small settlements beyond the high ranges he saw in his front; and he heard that some of these backwoods mountaineers had already borne arms against him, and were now harboring men who had fled from before his advance. By a prisoner whom he had taken he at once sent them warning to cease their hostilities, and threatened that if they did not desist he would march across the mountains, hang their leaders, put their fighting men to the sword, and waste their settlements with fire."

ADAMS, R., page 352.—"Extract of a letter from Colo. Lord Rawdon to Major General Leslie October 24, 1780 'A numerous Army now appeared on the Frontier drawn from Nolochucke & other Settlements beyond the Mountains, whose very names had been unknown to us' (Clinton footnote)."

See also the text of Ferguson's letter to Dr. Tenpenny, which lists his supposed adversaries on October 6 and includes none of the real over-mountain settlers (op. cit., p. 349).

(9) AMERICAN MILITARY INSTITUTE.—The costumes and uniforms for this museum are to be based on sketches, notes, and other information supplied by the American Military Institute which has several students of military costume at work on the problem.

See reference 5 for makeshift bayonet, also Draper, p. 547.

(10) AMERICAN MILITARY INSTITUTE.—*See* reference 9.

(11) AMERICAN MILITARY INSTITUTE.—*See* reference 9.

(12) AMERICAN MILITARY INSTITUTE.—*See* reference 9.

(13) TARLETON, page 159.—"And, in order to keep alive the British interest in North Carolina, Major Ferguson's corps of rangers, and about one thousand loyal militia, were advanced to the western borders, to hold communication with the inhabitants of Tryon county till the King's troops under Earl Cornwallis were in condition to advance."

MACKENZIE, page 57.—"Ferguson had directions to advance on the left flank of the main army. His force consisted of about one hundred and fifty men from the provincial corps, in whom perfect confidence might on all occasions be placed, and from one to two thousand militia, a fluctuating body."

DRAPER, page 523 (The Official Report).—"It appears from their own provision returns for that day, found in their camp, that their whole force consisted of eleven hundred and twenty-five men; . . ."

(14) DRAPER, page 237.—"Ferguson's Provincials—or Rangers, as Tarleton terms them—were not a permanent corps, but made up for special service, from other Provincial bodies—the King's American Regiment, raised in and around New York, the Queen's Rangers, and the New Jersey Volunteers." N. B. Simcoe, *Journal of the Operations of the Queens Rangers*, mentions no detachments to Ferguson. Major Dunlap of the Rangers was with Ferguson earlier, but not at Kings Mountain, *see* Draper, page 158.

LANDERS, page 2.—"His command consisted of about 125 picked officers and men, taken from several regular battalions raised in New York and New Jersey, and formed into a temporary Provincial Corps."

MACKENZIE, page 66.—mentions Captain Depeister of the King's American Regiment, Captain Taylor of the New Jersey Volunteers, and Lieutenant Allair of the Loyal American Regiment.

Page 64.—"In the year 1780 he was appointed to a command formed of detachments selected from the Provincial corps, . . ."

FERGUSON, page 77.—Ferguson's special command at Charleston was a corps of 300 men called the American Volunteers formed of Loyalists from New York and the Jerseys.

(15) PITKIN, page 2.—"The new immigration of Germans and Scotch-Irish, landing principally in Pennsylvania, had found the best lands along the coast taken up. They had also found that even lands somewhat farther inland were subject to quit-rents. They consequently drifted in the easiest direction southwest along the foot of the Alleghenies, in the Piedmont and in the trough of the valleys between the Alleghenies and the South Moun-

tain-Blue Ridge chain. This movement took them through south-central Pennsylvania, across Maryland and Virginia into the Carolinas. All along this route they met and mingled with the various older colonial stocks pushing west from the coast . . ." Dr. Pitkin reviewed the specifications for this map.

ADAMS, J., pages 171, 172, 173.—". . . the Palatinate, which had been the most fertile province of all, became a desert . . . To this was added in the latter part of the century religious persecution . . . In the north of Ireland, at the beginning of the eighteenth century, there was almost as much bitterness and hopelessness as in Germany . . . To complete the misfortunes of the unfortunate Scotch Presbyterians, under the Test Act of 1704 they had been made almost outlaws . . . It was from such sources as these that was derived the enormous immigration into the colonies during the first three quarters of the eighteenth century."

Page 177.—". . . Philadelphia, the main port of entry, . . ."

Page 190.—"The opening of the Shenandoah Valley in Virginia was immediately followed by an influx of Scotch as it had been by Germans."

Page 112.—". . . many of the families of older settlers, whose lands were worn out, . . . were crossing over to North Carolina. . . ."

Page 7.—"The revocation of the Edict of Nantes in France in 1685 at once caused a vast exodus from that country of the Huguenots, many hundreds of whom found their way to the American colonies through England . . ."

DRAPER, pages 378–380.—The Campbell family moved from Scotland to northern Ireland about 1600. William Campbell's grandfather moved to America, settling in Pennsylvania, then moving to western Virginia. His father lived in Augusta County, Virginia. William Campbell moved out to the Holston Valley frontier.

Page 411.—Isaac Shelby's grandfather came to Maryland from Wales, settling near the frontier. His father was a noted Indian fighter. The family moved to the Holston Valley in 1771.

Page 418–420.—John Sevier's grandfather fled from Paris to London. His father immigrated to America, settling in the upper Shenandoah. He moved to the Watauga region.

(16) *See* reference 15. Dr. Pitkin checked this label text.

(17) SHERER AND BOYLAN, page 66.—"As can be imagined, pioneer women did a great deal of spinning with the fingers and the hand spindle

because it was not always possible for a spinning wheel to be brought into the wilderness."

(18) MERCER, page 4.—The American ax "began to appear in New England and the Middle States. The comparatively short-bitted, heavy-polled tool, here illustrated by old farm axes and Revolutionary campsite specimens, had become well-established before 1776— . . ."

Page 7.—"These axes are of typical American construction, as developed in the American Colonies before about 1750; of a type unknown, except by importation, in other parts of the world."

(19) ROOSEVELT, pages 134, 135.

(20) DRAPER, page 170.—"In a few days, Shelby went some forty miles to a horse race, near the present village of Jonesboro, to see Colonel Sevier . . . to inform him of Ferguson's threatening message . . ."

ROOSEVELT, page 136.—"Shelby was the first to hear the news. He at once rode down to Sevier's home on the Nolichucky . . . At Sevier's log house there was feasting and merry-making, for he had given a barbecue, and a great horse race was to be run, while the backwoods champions tried their skill as marksmen and wrestlers. In the midst of the merry-making Shelby appeared, hot with hard riding . . ."

DRAPER, page 541 (Shelby's narrative).—"With this object in view, he went to a horse race near where Jonesborough has since been built, to see Sevier and others."

(21) DRAPER, page 176.—"Early on the twenty-sixth of September, the little army was ready to take up its line of march over mountains and through forests, and the Rev. Samuel Doak, the pioneer clergyman of the Watauga settlements, being present, invoked, before their departure, the Divine protection and guidance, accompanied with a few stirring remarks befitting the occasion, closing with the Bible quotation 'The sword of the Lord and of Gideon,' . . ."

ROOSEVELT, page 140.—"Rev. Samuel Doak. Draper, 176. A tradition, but probably truthful, being based on the statements of Sevier and Shelby's soldiers in their old age. It is the kind of an incident that tradition will often faithfully preserve."

(22) DRAPER, page 177.—"The next day we ascended the mountain; . . . 'they found the sides and top of the mountain covered with snow, shoe-mouth deep; and on the summit there were about a hundred acres of

beautiful tableland,'. . ." (quoted from Robert Campbell's diary, see page 535, but note that date is probably wrong).

(23) DRAPER, page 221.—"The whole night was spent in making a selection of the fittest men, horses, and equipments for a forced march." (Refers to October 5 at the ford of Green River.)

ROOSEVELT, page 151.—"The officers went round, picking out the best men, the best rifles, and the best horses. Shortly after nine o'clock the choice had been made, and nine hundred and ten picked riflemen, well mounted, rode out of the circle of flickering firelight, and began their night journey." (Refers to October 6 at the Cowpens.)

(24) DRAPER, page 229.—"As they reached the river, it was about sunrise . . . Though the river was deep, it was remarked that not a solitary soldier met with a ducking. . . . The officers rode at a slow gait in front of their men. . . . The rain continued to fall so heavily . . . The men could only keep their guns dry by wrapping their bags, blankets, and hunting shirts around the locks. . . ." (*See* Sharp's narrative, p. 555.)

(25) DRAPER, page 245.—"At length the several corps started for the scene of conflict, marching two men deep, led on by their gallant officers."

Page 543 (Shelby's narrative).—"When the patriots came near the mountain they halted, tied all their loose baggage to their saddles, fastened their horses, and left them under charge of a few men, and then prepared for an immediate attack. About three o'clock the patriot force was led to the attack in four columns. . . ."

(26) LANDERS, facing page 44.—Rough sketch map shows the route as described in his text, pages 21–27.

Pages 20, 21.—"Reference has been made to the retirement of Col. Charles McDowell from his home, with his band of soldiers and refugees. He reached the shelter of the backwaters with a force of 160 men from Burke and Rutherford Counties. To this rendezvous on the Sycamore Flats, bordering the Watauga, about 2½ miles southwest of the present town of Elizabethton, Col. Arthur Campbell sent his brother-in-law, Col. William Campbell, with 200 militia from Washington County, Va. Later he led to the same place an additional force of 200 men who joined the first group . . . Shelby, at the head of 240 men from Sullivan County and Sevier, with an equal number from Washington County, N. C., joined at the designated meeting point . . ."

Page 23.—"Here (Quaker Meadows) the marching column of 1,040 men was joined by Colonel Cleveland with the men from Wilkes and Major Winston with the men from Surry, 350 in all, . . ."

Page 26.—"At the Cowpens Col. James Williams, of South Carolina, with 400 men, joined. This new party was made up largely of groups of Sumter's men from South Carolina, under Colonels Hill and Lacey, of men from Lincoln County under Graham, Hambright, and Chronicle, and a small number embodied by Colonel Williams in North Carolina."

ROOSEVELT, page 145.—". . . for at this time several small guerilla bands of North and South Carolina whigs were encamped at Flint Hill."

(27) DRAPER, page 522 (The Official Report).—". . . Col. William Campbell, with four hundred men. . . . Shelby, with two hundred and forty . . . Sevier, with two hundred and forty men. . . . McDowell, with one hundred and sixty men. . . . Col. Cleveland, . . . with three hundred and fifty men . . . Col. Williams, with four hundred men . . ."

(28) DRAPER, page 522 (The Official Report).—". . . assembled at Watauga, on the 25th of September, . . ."

Page 535 (Robert Campbell notes).—". . . rendezvoused at the Sycamore Flats, on Watauga, . . ."

Page 522.—"We began our march on the 26th . . ."

Page 177.—"The next morning, Wednesday, the twenty-seventh . . ." Campbell's diary says the twenty-sixth was the date of crossing the Alleghenies, but Draper states in footnote, pages 176, 177—"It is only by concluding that they camped at the celebrated 'Resting Place,' on the night of the 26th, that we can reconcile Campbell's diary and the traditions of the oldest and best informed people along the route, as to the other camping places till they reached the Catawba . . ." The 'Resting Place' was west of the mountains.

Page 177.—"Two of Sevier's men, James Crawford and Samuel Chambers, here deserted. . . ."

Page 537 (Robert Campbell).—Col. Ferguson had notice of their approach by a deserter that left the army on Yellow Mountain, . . ."

Page 180.—"On Friday, the twenty-ninth, the patriot army pursued its winding way up the valley of Grassy Creek to its head, some eight or nine miles, when they passed through Gillespie's Gap in the Blue Ridge; . . ."

Pages 186, 187, 188.—The appointment of Campbell is fully recounted as taken from Shelby's narrative (p. 541, 542). Draper gives the date as the

second, while the force remained in camp because of stormy weather. Landers, page 25, gives the date as October 1.

Page 197.—"They learned this day (Oct. 4) from Jonathan Hampton that Ferguson had retreated from Gilbert Town; . . ."

Page 221.—"They reached the ford of Green river on the evening of the fifth of October. . . . The whole night was spent in making a selection of the fittest men, horses, and equipments for a forced march, and successful attack on the enemy. The number chosen was about seven hundred; . . ." The additional 50 were footmen who pushed ahead fast enough to reach the battle. (*See* Roosevelt, p. 150.)

Page 522 (The Official Report).—"By a council of the principal officers, it was then thought advisable to pursue the enemy with nine hundred of the best horsemen, . . ." The figure 910 is based on Shelby's early narratives particularly. (*See* footnotes in Draper, p. 227, and Roosevelt, p. 151.)

Page 523 (The Official Report).—". . . and, marching all night, came up with the enemy about three o'clock P. M. of the 7th, who lay encamped on the top of King's Mountain, . . ."

(29) Roosevelt, page 150.—"Their whole army was so jaded that the leaders knew they could not possibly urge it on fast enough to overtake Ferguson, . . . In consequence they determined to take . . . the least tired . . ."

Draper, page 551 (Lenoir's narrative).—". . . without any aid from public stores, of clothing, arms, ammunition, or any article of camp equipage, not having a single tent or baggage wagon amongst them, . . ." (*See* also Sharp's narrative, p. 557, 558.)

(30) Draper, facing page 174.—Portrait of Sevier.

Facing page 252.—Portrait of Shelby.

No portrait of Campbell has been located so far. Earlier pictures of the other two should be sought.

(31) (The Proposed Typical Scene).

Landers, page 30.—". . . Campbell's and Shelby's men almost reached the enemy lines, but here they were met by Ferguson's Provincial Corps, and at the point of the bayonet driven down the mountain. Their officers bravely rallied them, however, and under cover of rocks and trees the enemy fire was returned. The Provincials now in turn fell back before the sure marksmanship of the mountain men, and were pursued to the top of the

crest, where a second time they resorted to the bayonet . . ." Fighting described on pages 29–31.

ROOSEVELT, page 166.—". . . while he in person led his regulars and such of the loyalist companies as were furnished with the hunting-knife bayonets. . . . At three o'clock in the afternoon the firing began, . . ."

Page 167.—"He ordered them to raise the Indian war-whoop, which they did with a will. . . . They then rushed upwards and began to fire each on his own account; . . . Ferguson's men . . . Then charged, cheering lustily . . . The mountain was covered with smoke and flame, . . . Ferguson's troops advanced steadily, their officers riding at their head, with their swords flashing; and the mountaineers, who had no bayonets, could not withstand the shock."

Page 168.—"No sooner had the British charge spent itself than . . . they were all climbing the hill again, going from tree to tree, and shooting at the soldiers on the summit."

DRAPER, especially pages 250–252 for description of the fighting. (*See* also Shelby's narrative, p. 543.)

(31) (ALTERNATIVE SCENE OF FERGUSON'S DEATH).

LANDERS, page 31.—"It was evident that nothing could be done to better the situation and snatch victory from defeat, and Ferguson determined to cut his way through the band of fire and escape. He, with several of his officers, made this desperate move, but was shot from his horse and killed instantly."

ROOSEVELT, page 169.—"Ferguson, conspicuous from his hunting shirt, rode hither and thither with reckless bravery, his sword in his left hand—for he had never entirely regained the use of his wounded right—while he made his presence known by the shrill, ear-piercing notes of a silver whistle which he always carried."

Page 170.—"Ferguson dashed from point to point, to repel the attacks of his foes, which were made with ever-increasing fury. Two horses were killed under him; but he continued to lead the charging parties; slashing and hewing with his sword until it was broken off at the hilt. At last, as he rode full speed against a part of Sevier's men, who had almost gained the hill crest, he became a fair mark for the vengeful back-woods riflemen. Several of them fired together and he fell suddenly from his horse, pierced by half a dozen bullets almost at the same instant. The gallant British leader was dead, while his foot yet hung in the stirrup."

Page 171.—"There is no ground whatever for the statement that Ferguson

was trying to escape when shot; nor was there any attempt at a charge of horsemen, made in due form."

DRAPER, page 276.—"Driven to desperation, Ferguson endeavored to make his escape, accompanied by two Loyalist Colonels, all mounted, who charged on that part of the line which they thought was most vulnerable. . . . As soon as Ferguson reached the Whig front, he fell; . . ."

Page 287.—"'He had,' says Doctor Ferguson, 'two horses killed under him, while he remained untouched himself; but he afterwards received a number of wounds, of which, it is said, any one was mortal, and dropping from his horse, expired, while his foot yet hung in the stirrup.' "

Pages 290, 291.—"Most of the accounts represent that the British Colonel was killed outright." Draper then goes on to develop the view that he did not die at once, but that Shelby rode up and talked to him, after which "The life of this restless British leader soon ebbed away."

Page 543 (Shelby's narrative).—". . . and rushed out from his men, sword in hand, and cut away until he broke his sword, and was shot down."

Page 550 (Graham's account).—"Even after being wounded, he fought on with courage."

Page 556 (Sharp's narrative).—". . . and Ferguson seeing that all was lost, determined not to survive the disgrace; he broke his sword, and spurred his horse into the thickest of our ranks, and fell covered with wounds, . . ."

(32) ROOSEVELT, pages 156, 157.—"He deemed the position one of great strength, as indeed it would have been, if assailed in the ordinary European fashion; . . ."

Pages 172, 173.—"The British regulars had lost half their number; . . . When the Holston and Watauga men gained the crest the loyalists broke and fled to the east end of the mountain, . . . The fighting had lasted an hour; all hope was gone; and De Peyster hoisted a white flag."

DRAPER, page 217.—". . . that he would select his ground, and boldly meet them; that he defied God Almighty himself and all the Rebels out o h—l to overcome him; . . ."

LANDERS, page 23.—"The following day Ferguson began his withdrawal from the vicinity of the mountains." A detailed account of the route of retreat follows.

Page 25.—". . . and taking up a position which was most favorable for defense, and remaining there for 24 hours before the enemy came in sight, Ferguson acted with deliberation and with full intent to engage in battle, did the enemy take the initiative."

Page 31.—"The battle lasted an hour and five minutes."

(33) METSCHL, page 271.—"Famous instances of the execution of which these rifles were capable were the battle of King's Mountain. . . . In America it was early discovered—by whom is unknown—that by making the bullet slightly smaller than the bore and wrapping it in a small piece of greased linen or thin leather, known as a 'patch', it could be rammed down upon the powder with ease, while the covering . . . fitted the bore sufficiently tightly . . . and received the revolving effect of the grooves. . . . As to their accuracy it may be said that at a distance of twenty yards a favorite target used in competitive matches was the head of a tack, at sixty to one hundred yards the head of a turkey. . . ."

Page 270.—"But their greatest novelty and the principal factor in their success and popularity lay in the method of their loading. In . . . the common rifles of Europe . . . the practice being to force a tightly fitting lead ball . . . requiring a heavy iron ramrod and a mallet."

Page 270.—"The ammunition for it must be as small in amount used at a shot as should be consistent with efficiency, that he might carry a considerable amount on his person; . . ."

(34) METSCHL, page 271.—"The user of one of these rifles commonly carried on his person a bullet pouch and powder horn, not infrequently . . . two of the latter, one for a finer grained 'priming powder' . . ."

(35) DRAPER, page 257.—"The 'red-haired Campbell—the Claymore of Argyle gleaming in his hand . . .' "

(36) ROOSEVELT, page 140.—"Every man carried a small-bore rifle, a tomahawk, and a scalping-knife."

DRAPER, page 262.—"Bowen enraged, . . . snatched his tomahawk from his belt . . ."

(37) LEFFERTS, page 11.—"The hunting shirt was made of deer leather, linen, or homespun, dyed in various colors . . ."

SHERER and BOYLAN, page 63.—"Early settlers made various shades of brown dye from walnut hulls. . . ."

(38) LANDERS, page 32.—"A defeat so overwhelming as that suffered by Ferguson's command is rare in warfare."

ADAMS, R., page 350 (quoted from the Clinton papers).—". . . after a sharp Contest (in which that valuable Officer & several of his Men lost their lives) they carried off the whole party, . . ."

ROOSEVELT, page 174.—"Almost the entire British and tory force was killed or captured; the only men who escaped were the few who got through the American lines by adopting the whig badges."

Page 177.—". . . they had not only defeated but captured an equal number of well-armed, well-led, resolute men, in a strong position."

(39) DRAPER, pages 523, 524 (The Official Report).—The report gives 28 killed and 62 wounded for the Americans; 225 killed, 163 wounded and left on the field, and 716 prisoners for the British. These figures are admittedly not exact—e. g., Shelby's losses were not tabulated in the official report as found in the Gates MSS. (Roosevelt, p. 175)—but they are the ones customarily used in the park, and more reliable than any other known. (*See* Draper, p. 301.)

(40) ROOSEVELT, page 177.—"The loyalists of the Carolinas were utterly cast down, and never recovered from the blow; and its immediate effect was to cause Cornwallis to retreat from North Carolina, abandoning his first invasion of that State."

ADAMS, R., pages 351, 352 (from the Clinton papers).—"When Lord Cornwallis first heard of the Misfortune & the Effect it was likely to have on South Carolina he suddenly abandoned the Post at Charlottetown and returned with his whole Force to that Province. But the Precipitancy with which this retrograde movement was made contributed (I fear not a little) to make the Revolt more general and to increase the Despondency of the Kings Friends; especially in North Carolina, where the Loyalists, whom his Lordship's Presence had encouraged to shew themselves, being exposed to Persecution and Ruin by his Retreat, threw away for ever after all *their Confidence of support from the Kings Army.*" (*See also* Landers, p. 34 for a quotation from Tarleton's *History.*)

(41) AMERICAN MILITARY INSTITUTE.—They are supplying information on the uniform of a captain in the 70th Regiment. It is their considered opinion that Ferguson never wore the uniform of the 71st Regiment. (*See also* Lefferts for the uniform of the 70th Regiment.)

FERGUSON, pages 81, 82.—"He was not favored, however, with a commanding personal presence. He was of middle stature, slender make, possessing a serious countenance; . . ."

Page 96.—Ferguson was said to be the best uniformed man on the mountain. (*See* this reference for a portrait.)

WOOD and GABRIEL, page 237.—Portrait bust pictured.

(42) METCHL, page 91.—"At the early age of fourteen he was commissioned an officer in the Royal North British Dragoons, also known as the 'Scots Greys,' and saw service in Germany and France. . . . Next he became a member of an expedition . . . in the West Indies. . . . During the American revolution, he was . . . at the battle of Brandywine. . . . It was in this battle that Ferguson was severely wounded . . . at Little Egg Harbor, New Jersey, where his riflemen . . . routed the famous 'Pulaski Legion' . . ."

Page 92.—"He was next commissioned Inspector-General of Loyal Militia . . . of South Carolina, . . ."

DRAPER, page 48.—"No man, of his rank and years, ever attained more military distinction in his day than Patrick Ferguson."

MACKENZIE, page 63.—"Thus fell Major Patrick Ferguson, a gentleman whose virtues and accomplishments were universally admired."

STEDMAN, page 220.—"Major Ferguson, whose zeal in the service of his king and country was equal to his other great qualities as an officer, . . ."

DRAPER, page 510 (Allaire's diary).—"We lost in this action, Maj. Ferguson, of the Seventy-first regiment, a man much attached to his King and country, well informed in the art of war; he was brave and humane . . ."

ROOSEVELT, pages 124, 125.—". . . he was of literally dauntless courage, of hopeful, eager temper, and remarkably fertile in shifts and expedients. . . . It would be difficult to imagine a better partisan leader. . . ."

FORD, page 69.—Patrick Ferguson: Captain 70th, 1 Sept. 1768; Major, 71st, 25 Oct. 1779.

(43) ADAMS, R., page 348.—"The next day, seeing he was about to be attacked, Ferguson wrote once more to Cornwallis, . . ." but in his letter to the Museum Division, January 26, 1940, Adams refers to the Tenpenny letter as follows: "I suspect that was the last letter Pat Ferguson ever wrote."

(44) METSCHL, page 89.—". . . this rifle was invented by Major Patrick Ferguson, . . . It was the first breech-loader used by the troops of any country. . . . A patent was granted to Ferguson for his invention on December 2, 1776."

Page 92.—"With the death of Ferguson, the rifles of his invention with which probably a hundred and fifty to two hundred of his men were armed, also disappeared; . . ." Six specimens are listed on page 93.

ROOSEVELT, page 124.—". . . and the best marksman with both pistol and rifle in the British army."

DRAPER, page 50.—"He was regarded as the best rifle shot in the British army, if not the best marksman living—excepting, possibly . . . Hangar (who claimed it for himself 20 years later) . . . The British writers, including several who knew whereof they wrote, unite in ascribing this high character to Ferguson's skill in the use of his improved rifle."

FERGUSON, page 81.—"To a corps of . . . 100 picked men . . . armed with his rifles. . . ."

DEPEYSTER, page 405.—"Provincial regulars (armed with his rifles)."

FARROW, pages 630, 631.—"Some of these rifles were used in the battle of Kings Mountain."

SAWYER, page 138.—Says that Ferguson lost his life at Kings Mountain for lack of his rifles.

(45) METSCHL, page 90.—". . . and into this elevated sight a sliding sight is let in, which, by being gradually pulled out in proportion to the distance of the object, may be adjusted to all manner of distances, . . ."

(46) METSCHL, pages 90, 91.—"Notwithstanding a heavy rain and high wind, he fired during the space of four or five minutes at the rate of four shots per minute, at a target two hundred yards distance. He next fired six shots in one minute, and also fired (while advancing at the rate of four miles an hour) four times in a minute. . . . He only missed the target three times during the whole course of the experiments."

(47) YOUNG, page 140.—Data for this map are to be found in Diagram 14 particularly, which precedes page 140 of Young's report. National Park Service topographical surveys are available for much of the area.

(48) AMERICAN MILITARY INSTITUTE.—*See* reference 9.

(49) AMERICAN MILITARY INSTITUTE.—*See* reference 9.

LANDERS, page 2.—"The troops commanded by Ferguson were Americans, or persons who had come to the Provinces prior to the Revolution . . . taken from several regular battalions raised in New York and New Jersey, and formed into a temporary Provincial Corps."

(50) CONFERENCE WITH MR. BELOTE, *Curator of History, U. S. National Museum.*—In 1780 the official American flag had 13 stripes with 13 stars in a circle. This was the military flag from 1777 to 1783. It was derived from the British merchant marine flag (union field in red flag), which was much commoner in the colonies than the Union Jack. The American

flag resembled the merchant flag in being oblong. The Grand Union, combining the union field with the stripes, was in official use only for about 18 months, earlier in the war.

DRAPER, page 495 (Allaire's diary).—". . . took possession of Charleston, and soon leveled the thirteen stripes to the dust, and displayed the British standard on their ramparts."

(51) CONFERENCE WITH MR. BELOTE.—The regular British flag (1606–1801) was the blue Union Jack with the cross of St. George and of St. Andrew. This flag was square, not oblong.

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