

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 74, NUMBER 5

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1922



(PUBLICATION 2711)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1923

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

CONTENTS

	PAGE
Introduction	I
Geological Explorations in the Canadian Rockies (Dr. Charles D. Walcott)	I
Paleontological Field-Work in the United States (Dr. R. S. Bassler)....	24
Astrophysical Field-Work in California, Arizona, and Chile (Dr. C. G. Abbot)	27
Expedition to Examine the North Pacific Fur Seal Islands (Dr. Leonard Stejneger)	30
Explorations in Australia and China (Mr. Charles M. Hoy).....	41
Biological Explorations in Southeastern China (Mr. A. de C. Sowerby)..	42
Heredity Experiments in the Tortugas (Dr. Paul Bartsch).....	45
Collecting Trip to Jamaica (Mr. John B. Henderson).....	54
The Mulford Biological Exploration (Dr. W. M. Mann).....	54
Botanical Exploration of the Dominican Republic (Dr. W. L. Abbott)..	62
Botanical Exploration in Central America (Mr. Paul C. Standley).....	63
Botanical Exploration in Colombia (Mr. Ellsworth P. Killip).....	70
Visit to European Herbaria (Mrs. Agnes Chase).....	80
Recent Discoveries of Ancient Man in Europe (Dr. Aleš Hrdlička).....	82
Meeting of International Congress of Americanists in Brazil (Drs. Hough and Hrdlička)	85
Exploration of the Paleolithic Regions of France and Spain (Mr. M. W. Stirling)	87
Archeological Field-Work on the Mesa Verde National Park, Colorado (Dr. J. Walter Fewkes)	89
Observations Among the Ancient Indian Monuments of Southeastern Alaska (Dr. T. T. Waterman).....	115
Archeological Investigations at Pueblo Bonito (Mr. Neil M. Judd).....	134
Investigation of Prehistoric Quarries and Workshops in Pennsylvania (Mr. John L. Baer)	143
Investigations Among the Algonquian Indians (Dr. Truman Michelson)..	146
Field-Work Among the Yuma, Cocopa and Yaqui Indians (Miss Frances Densmore)	147

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1922

INTRODUCTION

The present pamphlet, describing briefly the various explorations and field expeditions initiated, or cooperated in by the Smithsonian Institution and its branches, serves as an announcement of the results obtained, many of the investigations being later described more fully in other publications of the Institution. The collections resulting from many of these expeditions are shown to the public in the National Museum.

Scientific exploration has always been an important phase of the Institution's work in the "increase and diffusion of knowledge" and during the 76 years of its existence practically every part of the globe has been visited by Smithsonian field parties and our knowledge of the regions increased. There will always be important work in the nature of scientific exploration to be done, and had the Institution the means at its command, more extended investigations of great value to science and interest to the layman could be undertaken.

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

Secretary Charles D. Walcott continued explorations in the Canadian Rockies for evidence bearing on the pre-Devonian formations north of Bow Valley, Alberta, and south along the new Banff-Windermere motor road, which passes from the Bow Valley over Vermilion Pass and down the Vermilion River Canyon to the Kootenay River and thence over Sinclair Pass to the broad Columbia River Valley north of Lake Windermere in British Columbia.

The first half of the season was unfavorable owing to dense forest fire smoke and inefficient trail men, but the latter part of August and all of September fine weather and capable men enabled the party to push the work vigorously. A fine section of pre-Devonian strata was studied and measured in the upper part of Douglas Lake Canyon Valley, and many fine photographs taken (figs. 3-12). This beautiful valley is only 12 to 15 miles (19.3 to 24 km.) in a direct line east and northeast of Lake Louise Station on the Canadian Pacific Railway,



Left to right: (top) down; (middle) down; (bottom) down; (right) down. View taken from the side of Dangle Creek, looking down the high ridge of the range. Mount St. Helens is visible in the distance. View taken from the side of Dangle Creek, looking down the high ridge of the range. Mount St. Helens is visible in the distance. View taken from the side of Dangle Creek, looking down the high ridge of the range. Mount St. Helens is visible in the distance.



Mount Douglas

Oyster Mt.

Fossil Mt.

FIG. 2.—Looking south from Overlook view above camp at head of Red Deer River. On the left the snow clad summit of Mount Douglas (10,615 feet, 3,018 m.), and just back of it Mount St. Bride (10,875 feet, 3,314.7 m.) with its snow fields and small glacier. To right of horses Oyster Mountain (9,100 feet, 2,730 m.) with Fossil Mountain (9,655 feet, 2,896 m.) on the right.

Locality: South side of Red Deer River about 10.5 miles (16.8 km.) northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1922.)



FIG. 3.—Great cliffs of the sentinel mountains Douglas (10,615 feet, 3,018 m.) and St. Bride (10,875 feet, 3,262 m.) overlooking Douglas Lake and its broad canyon valley. The north side of these mountains is shown in figure 2.
Locality: View taken from above timber line on east side of Douglas canyon valley nearly opposite Mount St. Bride, looking west and northwest, 13.5 miles (21.6 km.) north-northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1922.)

Bonnet Glacier

Trifid Glacier



FIG. 4.—Profile view of Bonnet and Trifid glaciers and great cliffs from Lake Gwendolyn.
Locality: View from outlet of Lake Gwendolyn in upper part of Douglas canyon about 12.5 miles (20 km.) east in air line from Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1922.)



FIG. 5.—Panoramic view of Bonnet glacier and ice fall with a great lateral moraine from which the ice has retreated in very recent times. A much older moraine is shown on the left. View taken from summit of an ancient moraine. (See figs. 4 and 6.)
Locality: Same as figure 4. (C. D. Walcott, 1922.)

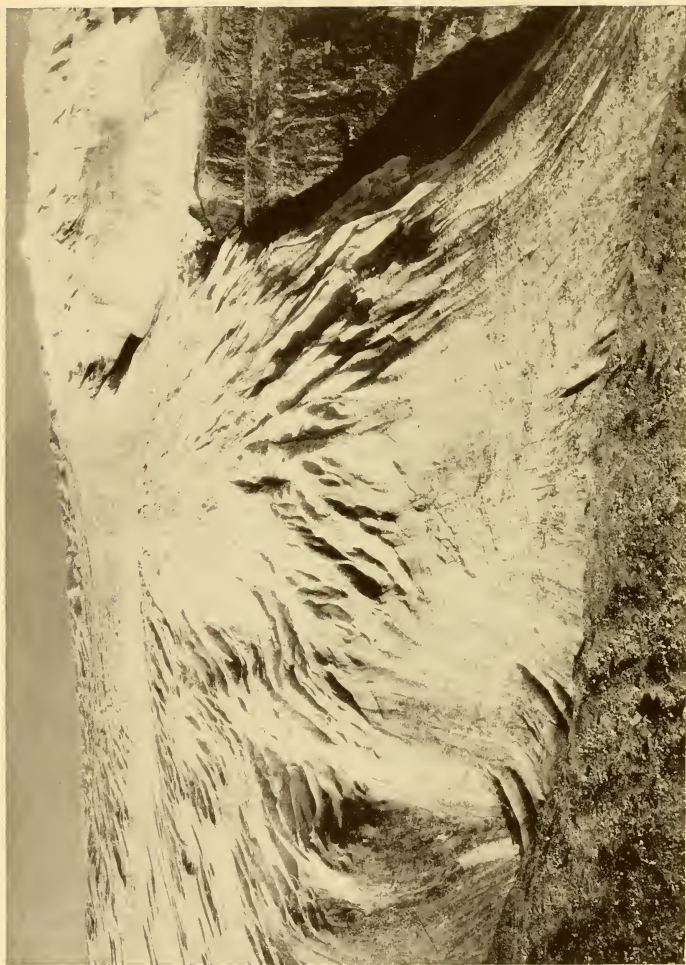


FIG. 6.—Lower ice fall of Bonnet glacier with radial series of crevasse and above, on right, columnar crystallization on a great scale. (See figs. 4 and 5.)
Locality: Same as figure 4. (Mr. and Mrs. C. D. Walcott, 1922.)

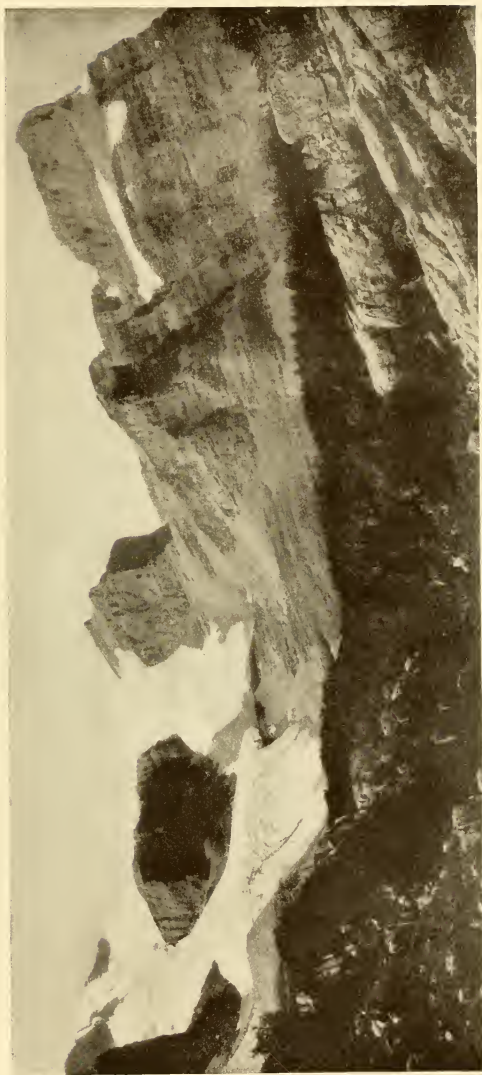


FIG. 7.—Cliffs south of Mount St. Bride (10,875 feet, 3,262 m.) with two branches of Trifid glacier. The cliffs are formed of Devonian limestones above with the Mons formation (Ozarkian) below.
Locality: Same as figure 3. (Mr. and Mrs. C. D. Walcott, 1922.)

but as far as known it had not been visited, except by trappers long ago, until the summer of 1921 when Walter D. Wilcox and A. L. Castle camped in it and photographed some of its more striking features. Wilcox called it the "Valley of the Hidden Lakes,"¹ but for geologic description and reference "Douglas Canyon" is more simple.

Mount Douglas (10,615 ft., 3,018 m., figs. 2 and 3) towers for 4,500 feet (1,371.60 m.) above the canyon bottom, and Lake Douglas



FIG. 8.—Lake Gwendolyn, the gem of the upland valley, with Bonnet glacier and the northwest cliffs of Bonnet Mountain.

Locality: The lake is about 12.5 miles (20 km.) east-northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada, and 7,500 feet (2,250 m.) above sea level. (Mr. and Mrs. C. D. Walcott, 1922.)

(fig. 1) fills the ancient pre-glacial channel for two miles or more. This superb canyon valley with its forests, lakes, glaciers and mountain walls and peaks (figs. 1, 3-10) should be opened up to the mountain tourist who has the energy to ride along a fine Rocky Mountains Park trail (fig. 12) from Lake Louise Station up the Pipestone and Little Pipestone rivers to the upper section of the Red Deer River, or from the Station by the way of Lakes Ptarmigan and Baker to the Red Deer camp and thence to Douglas Lake and Canyon Valley.

¹ Bull. Geog. Soc. Philadelphia, Vol. XX, 1921.



FIG. 9.—Gwendolyn glacier and Overlook point at the head of the eastern upland of Douglas canyon valley. This fine view shows the tongues of Gwendolyn glacier on the slope east of the lake seen in figure 8.

Locality: Same as figure 8. (Mr. and Mrs. C. D. Walcott, 1922.)

Halstead Pass

Overlook Point



FIG. 10.—Lake Gwendolyn and glacier with moraine above. Halstead Pass, on the left, is at the head of the Panther River drainage, and Cascade divide is above a branch of Cascade River. (See fig. 7.)
Locality: Same as figure 7. (C. D. Walcott, 1922.)

The trail into Douglas Lake from the Red Deer River is not cut out for three miles, but 10 pack horses were led through the forest on a mountain slope without difficulty. This part of the trail should be opened up by the Rocky Mountains Park service and made part of the Pipestone-Red Deer-Ptarmigan circuit.



FIG. 11.—Limestone rock fall from mountain side on right of picture. The horses and riders indicate the size of the blocks.

Locality: Douglas Lake canyon about 1.5 miles (2.4 km.) above Lake Douglas and about 13 miles (20.8 km.) east-northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1922.)

Game is abundant. The party saw 144 mountain goats, many black tail deer, and marmots on the Alpine slopes of Douglas Canyon (figs. 7 and 10), and at the head of the Red Deer-Pipestone divide, mountain sheep.

The measured geologic section was from the base of the Devonian above Lake Gwendolyn across the canyon to the deep cirque below Halstead Pass where the great Lyell limestone forms the crest of

the ridge. (See fig. 10.) The section includes the Ozarkian Mons formation down to the Lyell formation of the Upper Cambrian.¹

A short visit was made to Glacier, B. C., where Mrs. Walcott measured the recession of Illecillewaet glacier, which she began to record in 1887. The recession the past four years has been at the rate of 112.5 feet (34.29 m.) per year, and all of the lower rock slopes are now free from ice. (See figs. 13 and 14.)



FIG. 12.—Rocky Mountains Park trail on north side of head of Red Deer River, en route from Lake Louise to Douglas Lake canyon.

Locality: Same as figure 2.

On our way south from the Bow Valley no stops were made for photography or geologic study until camp was made on the Kootenay River about six miles (9.6 km.) below the mouth of the Vermilion River. The Kootenay Valley is deep and broad, with the high ridges of the Mitchell Range on the east and the Brisco Range on the west. (Figs. 15 and 16.) In places the old river terraces extend for miles along the river with a varying width. This greatly facilitated the

¹ Explorations and Field-work of the Smithsonian Institution in 1919, p. 15. Smithsonian Misc. Coll., Vol. 72, No. 1, 1920.



FIG. 13.—Photograph of Illecillewaet glacier taken in 1898, for comparison with one taken 24 years later in August, 1922. In this photograph the bare space between the glacier and the dark bushes represents the recession of the ice between 1887 and 1898.

Locality: Two miles (3.2 km.) south of Glacier House, British Columbia, Canada. (George and William Vaux, 1898.)



FIG. 14.—Remnant of Illecillewaet glacier photographed in August, 1922.
Locality: Same as figure 13. (Mrs. C. D. Walcott, 1922.)



FIG. 15.—Looking eastward across Kootenay River from the Banff-Windermere motor road, to the Vermilion range. The "gap" of the Vermilion River is on the right.
Locality: Same as figure 16.



FIG. 16.—Panoramic view looking east and south across Kootenay River toward Mitchell Range, from the Banff-Windermere motor road, about 8 miles (12.8 km.) below Kootenay crossing, British Columbia, Canada. (C. D. Walcott, 1922.)

building of the motor road, as long, level and straight sections were readily surveyed and fine gravel was at hand for surfacing the road bed.



FIG. 17.—Illustrating a thrust fault. The bedded limestones have been dragged and bent upward on the west (left) side of fault, the plane of which slopes northeast at about 45° . The thin layers of limestone above the thick strong layer which slid over the limestones beneath are broken and crowded against the massive bed on the upper side of the fault.

Locality: North side of the Banff-Windermere motor road about one-half mile (.8 km.) below Radium Hot Springs, Sinclair Canyon, British Columbia, Canada. (Mr. and Mrs. C. D. Walcott, 1922.)

Note face in upper left corner.

A view in the forest section of the Kootenay Valley is shown by figure 20, and a more difficult section for road building by figures

15 and 16. The motor road is a fine public work and opens up for pleasure and business direct connection through the main ranges of the Rockies between the Bow and Columbia River valleys.

The limestones and shales of both ranges are upturned and sheared and faulted so as to make it very difficult, without detailed areal maps and unlimited time, to work out the structure and the complete stratigraphic succession of the various formations. (See fig. 17.)



FIG. 18.—West slope of Stanford range south of Sinclair Pass, with white quartzite band at base of Silurian limestones. About six miles (9.6 km.) above Radium Hot Springs, British Columbia, Canada. (Mr. and Mrs. C. D. Walcott, 1922.)

The Silurian limestones, with their fossil coral beds above the white quartzite of the Richmond transgression (see fig. 18) were found in the upper portion of Sinclair Canyon, and not far away black shales full of Silurian graptolites (fig. 19). Lower down the canyon thin bedded gray limestones yielded fossils of the Mons¹ formation not unlike those so abundant at the head of Clearwater Canyon, 73 miles (117.4 km.) to the north, and Glacier Lake, 94.6 miles (152.21 km.)

¹ Smithsonian Misc. Coll., Vol. 72, No. 1, p. 15, 1920.

north. It is evident that in the ancient and narrow Cordilleran Sea that extended from the Arctic Ocean 2,000 miles (3,218 km.) or more south between the coast ranges of the time and the uplands of the central portion of the North American continent, there was a similarity of Lower Paleozoic marine life along the shores and in its shallow waters. Evidences of this and of strong currents and persistent wave action occur all the way from central Nevada to Mount

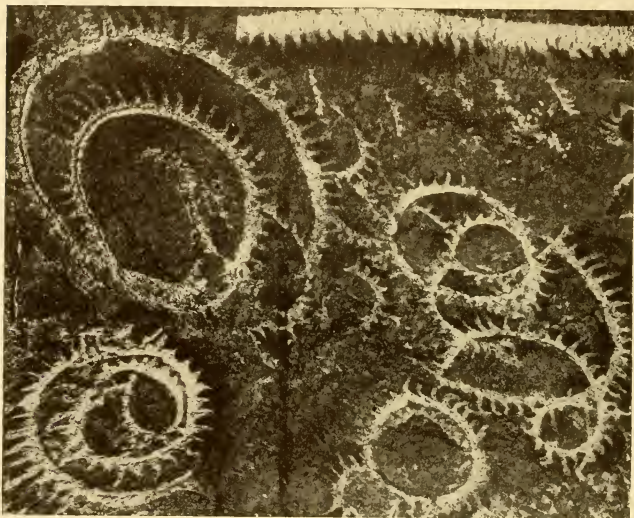


FIG. 19.—Graptolites that flourished on the muddy bed of the sea in Silurian time. The coiled form *Monograptus convolutus* Hisinger is found both in Europe and America. The straight form is very abundant in some of the partings of the shale.

Locality: Sinclair Canyon about 3.25 miles (5.2 km.) above Radium Hot Springs, in cliff on south side of Banff-Windermere motor road, British Columbia, Canada.

Robson in British Columbia. The record of the marine life and deposits of mud and sand is most complete, and it has been great sport running down the various clues that have been encountered from time to time.

The lower Sinclair Canyon opens out into the Columbia River Valley through a narrow canyon eroded in the upturned and faulted limestones. Some conception of the character of the canyon may be obtained from figures 21-23.

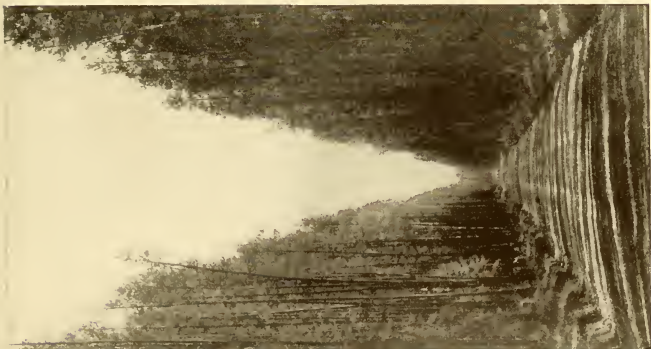


FIG. 20.—Looking south through the forest on a tangent of the Banff-Windermere motor road.

Locality: About 9 miles (14.4 km.) below Kootenay River Crossing, British Columbia, Canada. (Mr. and Mrs. C. D. Walcott, 1922.)



FIG. 21.—Looking westward through narrow entrance to Sinclair Canyon on Banff-Windermere motor road. Brisco Range, British Columbia, Canada. See figures 22, 23. (Mr. and Mrs. C. D. Walcott, 1922.)



FIG. 23.—Looking westward near sunset towards the Selkirk Mountains through west entrance to Sinclair Canyon on the Banff-Windermere motor road, Brisco Range, British Columbia, Canada.
Profile of lion's head near top of cliff on left side, profile of ape's head on right side. (Mr. and Mrs. C. D. Walcott, 1922.)

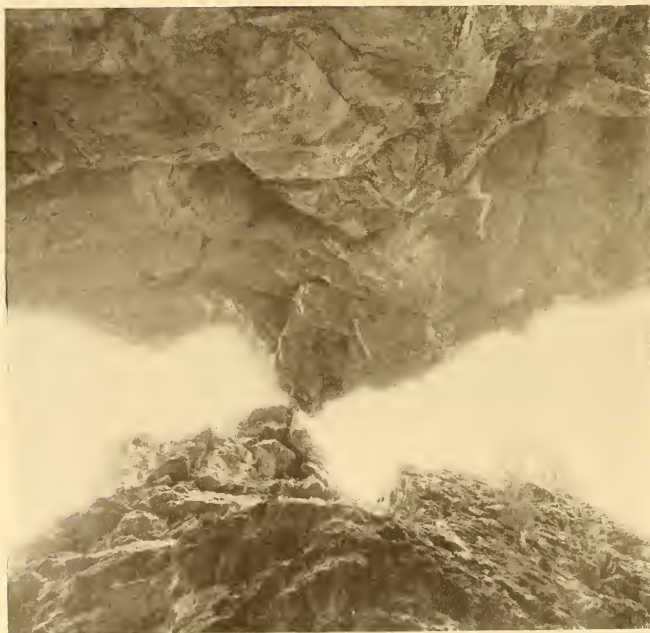


FIG. 22.—A view of the sky from the Banff-Windermere motor road near the entrance to the canyon from the Columbia River Valley. See figure 21.



FIG. 24.—A beautiful cluster of white saxifrage in a sheltered spot among limestone boulders.

Locality: South branch of the headwaters of Clearwater River, 22 miles (35.2 km.) north of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mrs. C. D. Walcott, 1922.)



FIG. 25.—A group of white heather, *Bryanthus*, growing on limestone soil.

Locality: Near head of Red Deer River 10.5 miles (16.8 km.) northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mrs. C. D. Walcott, 1922.)



FIG. 26.—Purple gentian growing on a south slope of a limestone ridge at about 7,000 feet (2,100 m.) elevation.

Locality: Same as figure 25. (Mrs. C. D. Walcott, 1922.)



FIG. 27.—A fine plant of *Zigadenes* growing on a slope of limestone débris.

Locality: Same as figure 25. (Mrs. C. D. Walcott, 1922.)



FIG. 28.—Mrs. Walcott sketching a wild flower in water colors on a frosty morning in camp. The camp fire kept the open tent warm and comfortable.

Locality: Vermilion River canyon between the Banff-Windermere motor road and the river, British Columbia, Canada. (C. D. Walcott, 1922.)



FIG. 29.—Getting acquainted with a young broncho. Baby Nancy and her mistress at Hillsdale camp, Bow Valley, Alberta, Canada. (C. D. Walcott, 1922.)

The living evidence of the heat developed by the upturning and compression of the strata under the eastward thrust of the massive Selkirk Mountains is that of Radium Hot Springs in Sinclair Canyon, and Fairmont Hot Springs, 15 miles (24 km.) or more to the south.

During the summer Mrs. Walcott sketched in water colors 24 species of wild flowers, or their fruit, that were new to her collection now on exhibition in the great hall of the Smithsonian building. Some of her photographs of wild flowers are shown by figures 24-27, and sketching in camp by figure 28.

The party at the end of the season camped on the eastern side of the Columbia River Valley at Radium Hot Springs postoffice, where the veteran prospector, John A. McCullough, has made his home for many years. He and Mrs. McCullough were most courteous and obliging to the party which then consisted of the Secretary and Mrs. Walcott, Arthur Brown, Paul J. Stevens, packer, and William Baptie, camp assistant.

Familiar scenes in connection with the life on the trail are illustrated by figure 29.

The Commissioner of the Canadian National Parks, Hon. J. B. Harkin, and the members of the Parks service in the field, especially Chief Inspector Sibbald and Chief Game Warden John R. Warren, were most helpful, also the officials and employees of the Canadian Pacific Railway.

PALEONTOLOGICAL FIELD-WORK IN THE UNITED STATES

Dr. R. S. Bassler, curator, division of paleontology, U. S. National Museum, working in collaboration with the State Survey, was in the field six weeks in June and July, in a continuation of stratigraphic and paleontologic studies begun a year earlier in the Central Basin of Tennessee. This work is so extensive that a number of seasons of field-work will be necessary for its completion. In 1921 the study and mapping of the Franklin quadrangle, an area of about 250 square miles, just south of Nashville, was well advanced but so many new stratigraphic problems arose that the State Geologist, Mr. Wilbur A. Nelson, suggested the field season of 1922 be devoted to the further study of the Franklin quadrangle and to stratigraphic studies in contiguous areas. Accordingly, the mapping of the Franklin quadrangle was completed and data secured for the preparation of a geological report upon the area, to be published by the State. Stratigraphic studies were then undertaken in the adjacent contiguous

areas and some of the classic geologic sections of Central Tennessee were visited and studied in detail. Dr. E. O. Ulrich, associate in paleontology in the National Museum, joined in this work on account of his life-long interest in the stratigraphy of Central Tennessee, and with the aid of his assistant, Mr. R. D. Mesler of the U. S. Geological Survey, numerous detailed sections and about a ton of carefully selected fossils were secured for the National Museum.

The classic section at Nashville, Tennessee, in which the proper delimitation of the formations has long been in dispute, was studied



FIG. 30.—Section at Nashville, Tennessee, illustrating sequence of Ordovician formations. (Photograph by Bassler.)

with especial care and ample collections of fossils were secured to verify the stratigraphic results.

The deep sea origin of all limestones has long been taught in spite of the trend of evidence that many limestone formations were laid down in shallow seas. The shallow water origin of limestone is well illustrated in the section of Ordovician strata exposed near the blind asylum at Nashville which has been studied by several generations of geologists. At the base of this section, as shown in figure 30, is the Hermitage formation which was evidently formed along

ancient shore lines because it is composed of beach worn fragments of shells and other fossils. Above this comes the Bigby limestone, the source of much of the Tennessee brown phosphate and which also is made up almost entirely of the comminuted remains of fossils. Next is the Dove limestone, an almost pure, dove-colored, lithographic-like limestone which shows its shallow water origin in the worm tubes penetrating it and its sun-cracked upper surface. A slab of this limestone a foot thick, as shown in figure 31 and now on

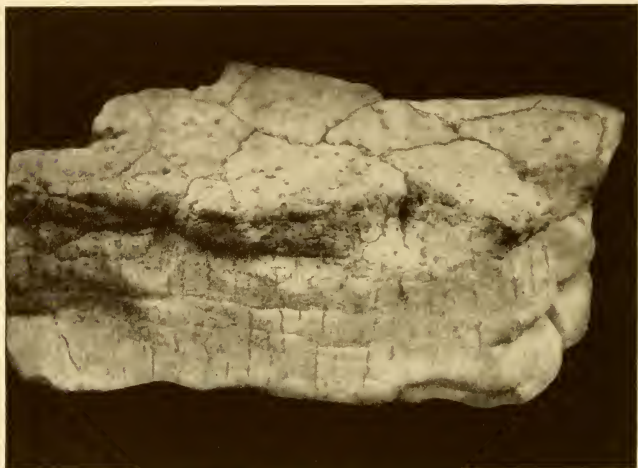


FIG. 31.—Stratum of dove limestone showing sun-cracked upper surface and penetrating worm tubes, indicative of shallow water origin. (Photograph by Bassler.)

exhibition in the National Museum, well illustrates the polygonal upper surface and the penetrating worm tubes, both features indicative of the origin of the rock on old mud flats which were periodically above water and thus became sun cracked. The succeeding Ward limestone is of the more typical blue variety but here the rock is filled with millions of fossil shells which under the influence of weathering are changed to silica and are left free in great numbers in the soil. This section is only a portion of the entire geological sequence at Nashville but it well illustrates the various types of limestone outcropping throughout the Central Basin.

ASTROPHYSICAL FIELD-WORK IN CALIFORNIA, ARIZONA,
AND CHILE

The Astrophysical Observatory of the Institution did some notable work at Mount Wilson on the spectra of the sun and stars. Some discrepancy had appeared between the work of 1920 and the early work of the observatory prior to 1910 on the distribution of energy in the sun's spectrum as it is outside the atmosphere. It appeared necessary to go over this ground again, as the result is used in everyday work at the two field stations in Chile and Arizona, in computing the solar constant of radiation, so the work was repeated by Messrs. Abbot and Aldrich with as much variety in conditions as was possible. The results of the different experiments were in close accord, and in accord with the work of 1920, so that the new determination is now going into effect in the computations in Arizona and Chile.

At the invitation of Director Hale, of the Mount Wilson Observatory, Messrs. Abbot and Aldrich employed the great hundred-inch telescope there in connection with a special vacuum bolometer and galvanometer designed and constructed at Washington in order to measure the heat in the spectrum of the brighter stars. In other words, they attempted to investigate the distribution of radiation in the stellar spectra with the bolometer as they have long done with regard to the spectrum of the sun. When one thinks of taking the light of a star, which looks like a firefly up in the sky, separating it out into a long spectrum, and observing the heat in the different parts of the spectrum, it seems a practical impossibility. Nevertheless, the observers succeeded in doing this for ten of the brighter stars, and they also observed the sun's spectrum with the same apparatus. In this way it was possible to represent the distribution of radiant energy in the different types of stars from the bluest to the reddest ones, and to know the displacement of the maximum of energy from shorter to longer wave-lengths as the color of the stars tended more and more towards the red.

The outlook for further investigations of this kind is hopeful, and it will have a notable value in the estimation of the temperatures of the stars and the study of stellar evolution.

The two field stations at Mount Harqua Hala, Arizona, and Mount Montezuma, Chile, are continued in operation. The station on Mount Harqua Hala, under the direction of Mr. Moore, has been much improved during the year. Owing to the driving rains and high winds, it proved necessary to sheathe the adobe building there with galva-

nized iron. At the same time all cracks for the entrance of wind, snow, and noxious insects and animals were closed. A small building was erected to house the tools and electrical appliances used for charging storage batteries and other purposes, and in this was arranged a shower bath ingeniously contrived to give a continuous shower as long as desired with only about a gallon of water. Cement water reservoirs for collecting and preserving the rain and snow water from the roofs have been constructed, with a total storage



FIG. 32.—Mount Harqua Hala Solar Observing Station, Arizona.

capacity of about two thousand gallons. A small porch was attached to the dwelling quarters and the rooms have been neatly painted and curtained. A "listening in" wireless outfit has been erected, and a so-called "Kelvinator" or sulphur dioxid refrigerating device for keeping provisions and cooling water for drinking purposes has been installed.

The observatory owns a Ford truck which is kept in a small garage built at the foot of the trail, and weekly mail and supply service is maintained from Wenden to the mountain top. A telephone line is just being erected to connect from Wenden to the observing station.

The cost of these various improvements, which have made living on the mountain very much more comfortable, has been borne by funds provided for the purpose by Mr. John A. Roebling, of New Jersey, to whom the Institution is greatly indebted for his generous interest in its solar radiation program.

A notable case of fluctuation in the solar radiation has recently been reported from the Arizona station. A fall of 5 per cent in the solar heat occurred, beginning about the 15th of October and



FIG. 33.—Mount Harqua Hala and garage at foot, Arizona.

reaching its minimum on the 21st, and then quickly recovering to the normal by the 25th. By inquiry at the U. S. Naval Observatory, it is learned that a very notable new group of sun spots was formed, the first indications appearing about the 17th of October and the group reaching great dimensions by the 21st when it neared the limb of the sun and shortly disappeared over the edge, due to the solar rotation. This occurrence is nearly parallel to that of March, 1920, when a similar great drop in the solar heat occurred and a very extraordinary sun-spot group passed over the sun.

EXPEDITION TO EXAMINE THE NORTH PACIFIC FUR SEAL ISLANDS

The Department of Commerce wishing to obtain exact information as to the status of the fur seal herd on the Russian seal islands, situated off the coast of Kamchatka and known as the Komandorski or Commander Islands, with special reference to the effect of the treaty of 1911 entered into by the United States, Russia, Japan and Great Britain for the protection of the fur seals in the North Pacific Ocean, requested the detail of the head curator of biology of the Museum, Dr. Leonhard Stejneger, to accompany an expedition to Alaska and adjacent regions during the summer of 1922. The expedition, under the immediate leadership of Assistant Secretary of Commerce C. H. Houston, was primarily organized for the purpose of studying the conditions of the fisheries of Alaska as well as the other economic and commercial problems of that territory in so far as they are included in the activities of the Department of Commerce. Among others it included Mr. W. T. Bower, Bureau of Fisheries, Assistant in charge of Alaska, and Dr. Alfred H. Brooks, U. S. Geological Survey, in charge of Alaskan Geology. Capt. C. E. Lindquist was engaged as special assistant to Dr. Stejneger.

The expedition left Seattle, Washington, in the U. S. Coast Guard Cutter *Mojave*, Lieut. Comm. H. G. Hamlet commanding, on June 20, 1922, and proceeded by the inside passage to southern Alaska, making short stops at various places for inspection of canneries, hatcheries, factories, mines, etc. At Juneau, an excursion to Mendenhall glacier was undertaken. On June 27, Cape St. Elias, the "land-fall" of Bering in 1741, was rounded, and the *Mojave* stopped at Cordova, the principal town in Prince William Sound. From here Mr. Huston and a small party went overland to Fairbanks, returning by the recently opened Central Alaska Railroad to Seward, where they again boarded the *Mojave* on July 4. The stay of the cutter at Cordova was taken advantage of by Stejneger and Lindquist to arrange a visit to Kayak Island. The Russian commander, Vitus Bering, in May, 1741, left Petropaulski, Kamchatka, on board the *St. Peter* under orders to sail eastward until discovering America. After a stormy voyage a cape with high land beyond was clearly made out on July 16, old style, and on July 20 the *St. Peter* came to anchor off an island which is now known as Kayak Island. Steller, who accompanied the expedition as a naturalist, was only allowed to go with the crew sent ashore in a boat to fill the empty water casks at a small creek on the western shore of the island. Accompanied by



FIG. 34.—U. S. C. G. C. *Mojave* in Dutch Harbor, Alaska. (Photograph by L. Stejneger.)



FIG. 35.—Steller's landing place, Kayak Island, Alaska. (Photograph by L. Stejneger.)

his cossack, he explored as much of the island as he could during the short stay of about 6 hours, collecting plants, birds and other natural history objects. This was the first landing of a scientific man in Alaska for the purpose of making observations and collections.

The principal object of the trip to Kayak Island was to verify Steller's description, to locate the place where he made his celebrated landing and where the water was obtained, and to make such collections of natural history objects as circumstances would allow. Passage for the 50-mile trip to Katalla was secured on the motor boat *Pioneer*. Leaving Cordova at 2 a. m. on June 29, it did not reach Katalla until 9.30 p. m. owing to its grounding at ebb tide on the extensive mudflats at the mouth of Copper River. Another motor boat was hired at Katalla, but it was not possible to leave until the following day, so that Kayak Island was not reached until 6.15 p. m. A landing was effected at the mouth of a creek which, from Steller's description, can be none other than the one at which Bering's crew took in water. Owing to the fast failing daylight, the party at once set out along the beach in the direction of the mainland for the distant hill described by Steller, but came to an abrupt halt after a laborious walk of about two miles along the bouldery beach at a comparatively recent fall of huge blocks of conglomerate rock among which the ocean waves were breaking so furiously as to stop further progress. The remaining few moments before darkness set in were utilized in collecting a few plants accessible along the beach at the foot of the precipitous cliffs which prevented access into the interior of the island. Returning, Cordova was reached at 4 p. m.

The fair weather which had favored the expedition hitherto changed to fog and rain after leaving Seward. Passing through Shelikof Strait opposite Katmai, a glimpse was had of the mountains on Kodiak Island still white, as if covered with snow, from the ash deposited during the eruption of the Katmai volcano in 1912. The passage through Unimak Pass was successfully accomplished in spite of the heavy fog on July 10, and the *Mojave* anchored off the Akutan Whaling Station which was visited. Two finback whales were stripped of their blubber during the inspection. Arriving at Unalaska at 3.30 p. m. the outfit and baggage of Stejneger and Lindquist were at once transferred to the U. S. Coast Guard Cutter *Algonquin* which was lying ready to take Secretary Huston and Mr. Bower to the Pribilof Islands for an inspection of the fur seal rookeries there, leaving Unalaska the same evening.



FIG. 36.—Whaling station, Akutan, Alaska. (Photograph by L. Stejneger.)



FIG. 37.—Carcass of fin back whale, whaling station, Akutan, Alaska.
(Photograph by L. Stejneger.)

The visit to the Pribilofs was favored with cool cloudy weather which showed up the rookeries to the best advantage. The increase in the number of seals on the beaches, a result of the elimination of pelagic sealing by the treaty of 1911 between the United States, Great Britain, Japan and Russia, was very remarkable, notwithstanding the handicap of the excessive increase of superfluous and therefore disturbing young males due to unfortunate legislation which stopped land killing for five years following the signing of the treaty. By drastic measures the proper numerical ratio between the sexes has almost been accomplished by now, and a complete restitution of the fur seal herd to its former maximum is confidently predicted for the not distant future, if pelagic sealing is not resumed. An improved method in stripping the skin from the body of the dead seal and subsequent cleaning of the skin was being tried out for the first time on an extensive scale and was shown to be a great improvement on the old method. Greatly improved methods were also observed in the handling of the blue foxes. The air of prosperity and progressiveness pervading the whole establishment as compared with conditions 25 years ago was very notable, bearing testimony to the efficiency of the management of the islands by the Bureau of Fisheries.

The *Algonquin* with Stejneger and Lindquist on board returned to Unalaska to fill up with fuel oil preparatory to the trip to the Commander Islands, a distance of approximately 1,100 miles. At Dutch Harbor, while the vessel was taking in oil, the opportunity was taken advantage of to examine the small group of Sitka spruce planted there nearly 100 years ago by the Russian Admiral Lütke while visiting the island in the corvette *Seniavin*. A fire during the summer of 1896 came very near destroying the stand, but timely aid saved most of the trees. The little isolated grove, the only one west of Kodiak Island, showed the effects of the fire. There are now 15 trees left, all looking healthy, the foliage being dense and dark, and the lower branches sweeping the ground. The south side of the trees was covered with blossoms and last year's cones, but no seedlings were seen anywhere. Among the large trees, however, there were a couple of saplings about 10 feet high, which had been smothered to death, but which show that fertile seeds have been produced occasionally. The largest tree was measured and found to be 8 feet in circumference 3 feet from the ground. About a foot higher it divides into three distinct trunks.

The Commander or Komandorski Islands were reached on July 24. These islands form the most western group of the Aleutian Chain.



FIG. 38.—Wharf at Unalaska. (Photograph by L. Stejneger.)



FIG. 39.—Dutch Harbor, Alaska, U. S. C. G. C. *Algonquin* taking in oil.
(Photograph by L. Stejneger.)

It consists of the two islands, Bering and Copper, situated about 100 miles east of Kamchatka. They belong to Russia and at the time of the visit were controlled by the Vladivostock government under Miliukof. The conditions of the inhabitants were found to be better than expected. Perfect order was maintained, no foreign traders or disturbers were present, and the people, though reduced both in number and resources, were not starving thanks to the abundance of fish and the cargo of necessities which had been sent them in exchange for the furs of the past season. They were lacking, however, in clothing, shoes and fuel. The party on the *Algonquin* was received with open arms, especially as the officers and crew of the



FIG. 40.—Grove of Sitka spruce, Dutch Harbor, Alaska. (Photograph by L. Stejneger.)

cutter supplemented the scanty stores of the communities with generous donations of necessities and a few luxuries. Immediately after landing the baggage and outfit of the expedition, the *Algonquin* left for Unalaska.

The first important business was the examination of the only remaining fur seal rookery on Bering Island. The South Rookery had long since ceased to exist, and the great North Rookery, one of the most important on the islands had been greatly reduced. The actual state of affairs was found to be much worse than anticipated. At his last visit to this rookery which he had studied and mapped in 1882, 1883, 1895, 1896 and 1897, Stejneger had estimated the number of breeding seals located there to be about 30,000. On July 28, 1922.



FIG. 41.—Preobrazhenski village, Copper Island. (Photograph by L. Stejneger.)



FIG. 42.—Nikolski village, Bering Island. (Photograph by L. Stejneger.)

there were scarcely 2,000 left. Regular killing had been stopped and for the present the Komandorski seal herd is non-productive.

The weather which had been stormy and foggy now settled down to a continuous fog and rain which interfered greatly both with observations and collecting. The latter was confined mostly to insects and plants. An interesting addition to the flora of the Commander group was the finding of *Cypripedium guttatum*, apparently confined to a single locality on Bering Island on a hillside south of the great swamp back of the Nikolski village.

On August 8, the first clear day for weeks, the *Mojave* arrived and after staying a couple of hours proceeded with the completed



FIG. 43.—Harbor of Petropaulski, Kamchatka. (Photograph by L. Stejneger.)

party to Petropaulski, the capital of Kamchatka. The delay had been caused by the necessity of the *Mojave* returning from Anadir to Unalaska for fuel oil.

At Petropaulski the town was found to be in the possession of the "whites," *i. e.*, the officials of the Vladivostock government supported by an "army" of about 50 men, while the "reds," *i. e.*, the portion of the male population recognizing the authority of the Far Eastern Republic, were holding the hills about four miles out. Two days were spent here examining into the conditions and gathering statistics of various kinds. A member of the Swedish Scientific Kamchatka Expedition which has been collecting natural history objects for the National Museum in Stockholm for a couple of years, Dr. René

Malaise, a well-known entomologist, was met here and some of his interesting collections were examined.

The next objective of the *Mojave* expedition was an inspection of the Japanese fur seal island off the eastern coast of Sakhalin in Okhotsk Sea, usually known as Robben Island.

On August 13, the *Mojave* passed the Kuril chain through Amphitrite Strait but on account of fog did not anchor off Robben Island until the 15th in the evening. The party was there met by three Japanese officials of the Karafuto provincial government who with the greatest liberality placed all the desired information and statistics at the disposition of the American investigators. Robben Island is



FIG. 44.—Robben Island, Okhotsk Sea. Part of fur-seal rookery. Breeding place of innumerable murre. (Photograph by L. Stejneger.)

a small, elongated, flat-topped rock, nowhere higher than 50 feet, only 1,200 feet long and less than 120 feet wide, surrounded by a narrow gravelly beach 30 to 120 feet wide, on which the rookery is located. A couple of low houses for the sealing crew, which is stationed here during the summer season, are located on the western slope. When Stejneger visited and photographed the rookery in 1896 the seals occupied a small spot on the east side. Since the Japanese took over the island from the Russians in 1905, the number of fur seals has gradually increased until now the animals not only occupy the entire eastern beach but are extending the rookery at both ends on to the west side of the island. The Japanese have closely followed the methods employed in managing the American seal herd on the Pribilof Islands, and the result has been equally gratifying. The history of the sealing

industry on this rock is most instructive as it proves in the most convincing manner that "protection does protect." After examining and photographing the rookery the party was entertained by the Japanese Commissioners with refreshments in a large tent erected for the occasion.

From Robben Island the *Mojave* proceeded to Hakodate, Japan, where additional important information relating to the Russian fur seal islands was obtained from Mr. Koltanovski of Vladivostock, who was on his way to the Commander Islands with a staff of assistants to assume charge of the fisheries there during the coming winter. In



FIG. 45.—Members of the expedition at Robben Island. (Photograph by L. Stejneger.)

1. E. Takamuku, Chief of Fisheries Section, Karafuto Government.
2. W. T. Bower, U. S. Bureau of Fisheries.
3. C. H. Huston, Assistant Secretary of Commerce.
4. L. Stejneger, U. S. National Museum.
5. S. Okamoto, Otomari, Karafuto.
6. K. Fujita, Karafuto Middle School.
7. C. E. Lindquist, Oakland, Calif.
8. A. H. Brooks, U. S. Geological Survey.

Yokohama, the next stopping place, an interview with Col. Sokolnikof, who had been administrator of the Russian fur seal islands for ten years, was productive of valuable information, as was also a visit to the Imperial Fisheries Bureau in Tokyo, thanks to the kind assistance of Prof. K. Kishinouye of the Imperial University. Mr. K. Ishino, the fur seal expert of the bureau, was kind enough to allow inspection of a series of photographs which he had taken during the

trip to the Commander Islands in 1915 and 1916. An interesting excursion was also undertaken to the Biological Station at Misaki, but as the season had not opened yet, only the buildings and the apparatus of the station could be examined.

Messrs. Stejneger and Lindquist having now completed the task of inspecting the fur seal rookeries, left the *Mojave* in Yokohama and took passage in the *President Jefferson* sailing for Seattle, Washington, on September 2. Dr. Alfred H. Brooks returned in the same steamer.

EXPLORATIONS IN AUSTRALIA AND CHINA

Through the generosity of Dr. W. L. Abbott, Mr. Charles M. Hoy continued his work of collecting specimens of the very interesting fauna of Australia. The work was terminated during the winter and Mr. Hoy returned to the United States in May, 1922. The results of this expedition are of especial value for two reasons: First, the Australian fauna has heretofore been but scantily represented in the National Museum, and, second, the remarkable fauna of that continent is being rapidly exterminated over large areas. The specimens received during the year bring the total up to 1,179 mammals, including series of skeletal and embryological material; 928 birds, with 41 additional examples in alcohol, and smaller collections of reptiles, amphibians, insects, marine specimens, etc. The accompanying photograph (fig. 46) shows part of an exhibition case in the National Museum with mounted specimens mostly from the Hoy collection.

This expedition has been so important that the main features of its history may now be appropriately recapitulated. Doctor Abbott arranged early in 1919 to send Mr. Hoy to Australia. Departure from San Francisco took place early in May and collecting was begun at Wandanian, New South Wales, on June 19. From this time until the middle of January, 1922 Mr. Hoy was constantly in the field. The regions visited were as follows: New South Wales (June to December, 1919), South Australia, including Kangaroo Island (December, 1919, to the end of March, 1920), West Australia (May to September, 1920), Northern Territory (October to end of November, 1920), New South Wales (January and February, 1921), Tasmania (April to June, 1921), northern Queensland (July, 1921, to January, 1922). As the main object of the expedition was not to visit the unexplored portions of Australia but rather to secure material from regions where settlement of the country is producing rapid

change in the fauna, travel was of the ordinary kind, by boat, rail and wagon road. Tent life was an important element in the living conditions, and at times it was rendered difficult by the heavy rains which in some districts broke a long-continued drought just at the time of Mr. Hoy's arrival. Detailed accounts of the work, with photographs of many of the animals collected, and with passages from Mr. Hoy's letters have been published in previous numbers of this series of Exploration pamphlets (Smithsonian Misc. Coll., vol. 72, No. 1, pp. 28-32; vol. 72, No. 6, pp. 39-43).



FIG. 46.—Part of exhibition case in National Museum showing some of the kangaroos collected by Mr. Hoy in Australia.

Dr. Abbott's unfailing interest in the national collections is shown by the fact that he has now arranged to send Hoy to China for the purpose of obtaining vertebrates from certain especially important localities in the Yang-tze valley, a region with which Hoy has been familiar for many years. Departure for the field took place on December 15, 1922.

GERRIT S. MILLER, JR.

BIOLOGICAL EXPLORATIONS IN SOUTHEASTERN CHINA

In the summer of 1921 Mr. A. de C. Sowerby returned to China to continue the work of exploration interrupted by the war. This work, which is made possible by the generosity of Mr. Robert S. Clark of New York, will now be carried on in the region south of the Yangtze, and the zoological results will come to the National

Museum. While it is too soon for any full report on the explorations in which Mr. Sowerby is engaged, the following passages from a letter dated December 1, 1921, give some idea of the conditions under which the work is being done.

IN THE INTERIOR OF FUKIEN PROVINCE,

S. E. CHINA, December 1, 1921.

Here I am over 200 miles from the coast up a tributary of the Min River, right at the back of beyond of the province, as you might say. I couldn't sit idle in Shanghai, so I decided to have a shot at this province. I took steamer to Foochow and was very fortunate in meeting a young American named Carroll, engaged in the lumber business, who was on his way to the very spot I had decided to visit, and he offered me the hospitality of his boat—an adapted river-boat, shallow draft, but comfortable—and his pleasant company. Naturally I accepted, and so here I am. We went away up a side stream, too small for boat traffic—to a spot in the back hills—or mountains, about 5,000 feet—where his company is opening up a forest, and there we camped a week, scouring the whole neighborhood, and having a few good hard tries for serows. Though we failed to get anything big, I did pretty well with small mammals. Next we came back to the main stream, where I am camped, while he has gone on up stream to transact some business. He expects to return here to-morrow or the next day, when we will go down stream to a place where a couple of tigers have been killing a lot of people, and see if we can't get a shot at them. Then on back to Foochow, whence I shall return to Shanghai for Christmas. After that I have fixed up with a party to go up the Yangtze as far as Wuhu, then inland to a place called Ning-kuo-fu, taking in some forested country on the way in the hopes of getting some *Cervus kopschii*, across the divide into Chekiang Province and down some stream to Hangchow. The other fellows are out for sport pure and simple, but I shall have time to do some collecting. So you see I am panning out pretty well. I shall come back to this province again as soon as possible, as it is simply full of stuff. The only trouble is that the cover is so dense that trapping and shooting are extremely difficult. I already have a collection of 94 mammals—including 14 species—some interesting birds, fish, frogs, etc. The rats are a puzzle. As far as I can make out I have five different species of *Epimys*.

I have met Caldwell, the man who saw the famous "Blue tiger," and he tells me it was of such a color that he thought it was a chinaman in his blue coat in the brush. But he had a good enough view of the

animal to be perfectly certain of what it was. And the only reason why he did not shoot it was that it was just above two boys who were working in a field, and had he shot it it must have fallen on top of them. Indeed, it was actually stalking them when he saw it. Yen-ping-fu is a wonderful animal centre. Caldwell got a tufted muntjac and a leopard just back of his compound, and wild cats, palm-civets and what not actually in it.

This is very, very beautiful country. I have never seen anything quite like it. The whole country is hilly and mountainous, and covered with heavy underbrush, and woods of spruce, pine, and deciduous trees. The rivers and streams are clear as crystal, studded with rock, and exquisitely beautiful. The underbrush is a terror to get through by reason of its denseness and the sword-grass that occurs everywhere and cuts like a razor. I like the people, and find them very friendly. At this moment I am camped in the local temple of a small village, my things spread all over the place. I am the centre of interest for the whole countryside. People come and burn incense and *chin chin joss*, and then stop to look at me and have a good chin wag. It doesn't seem to worry them that I have dead rats on the altar. And the small boys bring me in rats, and mice, and shrews, and bats. Truly they are a most remarkable people. And there have been ever so many cases of murdered missionaries in the province in bygone days. I don't believe these people are pure Chinese. Some of them have most remarkably bushman-like faces. They say that there are real aborigines in the province, and the natives call them dog-faced men

By the way, there was a tiger reported here this afternoon! One man came in and said he saw it take a chicken. And there isn't any door to this temple. What would you do under the circumstances? All the tigers in this province are man-eaters! I have made plans to try conclusions with this particular fellow to-morrow—but he may assume the offensive first. Don't think me an alarmist. I'm not. I'm merely telling you the cold truth about things. The other day when we were on our way up here we pulled up for the night beside a village. And all along the shore were the fresh tracks of two tigers. There was a lovely stretch of white sand, and it was bright moonlight, and so I kept the cabin window open and my rifle handy . . . and I'll swear I woke up every 20 minutes and had a look out of the window. Next day we heard that 15 people had been killed by tigers in the neighborhood during the past month or so.

HEREDITY EXPERIMENTS IN THE TORTUGAS

Dr. Paul Bartsch, curator, division of mollusks in the Museum, has continued his heredity studies, for which mollusks of the genus *Cerion* are used as a basis. He visited the various colonies transplanted to the Florida Keys from the Bahamas, Curacao, and Porto Rico and made a careful study of the new generations which have arrived since last year. He reports a loss of all the material which was placed in cages last year for the purpose of studying the crossing products of selected pairs. A little experimenting led him to believe that this loss was due to the fact that the fine screen Monel wire used for the cages, which not only covered the sides but also tops of these structures, prevented dew formation on the vegetation in the inside of the cages and thus inhibited the moisture required by these organisms. A heavy dew forms at the Tortugas during the night, the time during which *Cerions* are actively foraging for food, which is largely gained by plowing immediately below the surface for fungal mycelial threads. It is more than likely that the lack of dew also prevented the proper formation of mycelia in the area enclosed by the wire meshes and the *Cerions* may therefore not only have been famished for want of water, but likewise starved.

Dr. Bartsch believes that these were the controlling factors for he found that by placing a piece of Monel wire over a board at some little distance from the board and leaving a portion of the same board uncovered, the part over which the wire was stretched was found dry in the morning, while the uncovered portion was duly covered with moisture. To overcome this all the tops of the cages were removed and a narrow fringe of wire, turned down at the distal edge, was placed around each to prevent the *Cerions* from escaping. The cages were then stocked with the same elements used a year ago.

Two additional cages were built. The sides and top of one were covered with paraffine treated cheesecloth and in the other the sides only were covered with this material. In these, specimens were placed in order to make sure that the contentions expressed above were the active factors in the killing off of last year's material, and that the attaching of the *Cerions* to the wire mesh of the sides of the cages, which become decidedly warm when the sun shines upon them, was not responsible.

The Newfound Harbor hybrid colony was found flourishing. A lot of dead specimens was brought to Washington for record.

Two new mixed colonies were established, consisting of 500 Florida grown specimens of *Cerion viaregis* Bartsch taken from Colony E,

Loggerhead Key, and 500 *Cerion incanum* Binney from Key West. It is hoped that these two colonies will reproduce the conditions existing in the hybrid colony on Newfound Harbor Key. It was deemed wise to establish these colonies so that in the event a fire should sweep over the Newfound Harbor colonies the experiments might be continued in these additional places. The first of these colonies was placed on the east end of Man Key in a small, low meadow, which suggested the conditions in which the hybrid colony on Newfound Harbor Key is existing. The other colony was established on the north end of the little key east of Man Key, which may be called Boy Key.

Five hundred each of *Cerion viaregis*, *Cerion casablancae* and *Cerion incanum* were sent to Dr. Montague Cooke at Honolulu for colonization in the Hawaiian Islands.

Thanks to the good offices of the Navy Department, Dr. Bartsch was granted the use of a seaplane for a week. This was under the command of Lieut. Noel Davis and Lieut. L. F. Noble. By means of this plane Dr. Bartsch was able to fly at low altitude over all the keys between Miami, and the Tortugas and West Cape Sable and the eastern fringe of islands. During past years he had spent as much time as was available in the exploration of the Florida Keys, for the native *Cerion incanum* in order to establish the present extent of the colonies and to note what variation might exist in the members thereof. These colonies are usually found in the grassy plots on the inside of the keys and frequently in small grassy plots, which are difficult to discover as one approaches these mangrove fringed islands by water. To discover such colonies has usually meant cutting through the mangrove fringe to reach the interior, and there was danger of missing the smaller grassy plots. Flying over these keys made it easily possible to see all favorable places and to mark them on the charts. This will now permit a direct attack upon the places in question and determine positively the extent of existing colonies. Dr. Bartsch feels that at least a year of solid work was saved by the four days during which these explorations were made, to say nothing about saving an endless amount of punishment by mosquitoes which usually infest these mangrove fringed islands.

This aerial survey of the Bay of Florida also adduced the fact that the milky condition of that stretch of water which has obtained for some time and was probably responsible for the killing off of the greatest part of the marine flora and fauna of the region, has subsided, a state of affairs also noted in the Bahamas last year. It was found that the water was clear everywhere and that the channels as



FIG. 47.—A great white heron at Newfound Harbor Key. This is the younger brother or sister of the two now in the National Zoological Park, sent there by Dr. Bartsch in 1920 and 1921.

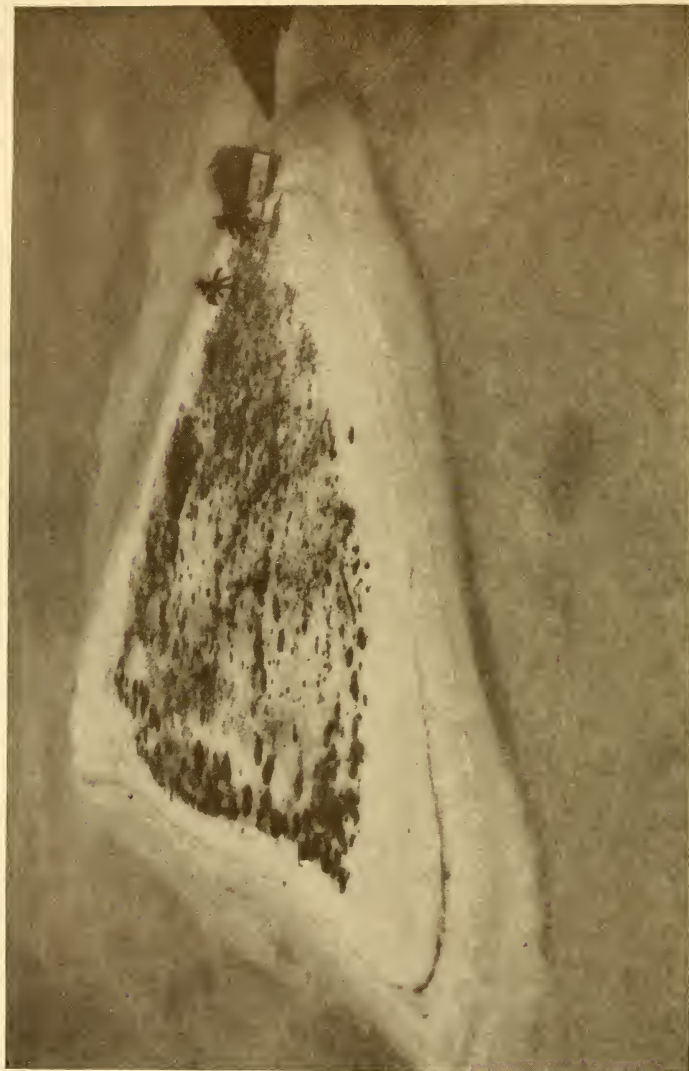


FIG. 48.—A photograph of Bird Key taken from the seaplane, showing the warden's house before removal and the scanty remnants of vegetation.



FIG. 49.—Upper figure showing the wave undermined condition of the warden's house on Bird Key before removal. Middle figure, the new location of the warden's house in the midst of the tern colony. Lower figure, Mr. Bethel, the warden, and his home in the new location.

well as the shallow flats were being repeopled by plants and animals. It will be interesting to note what, if any, change in the flora or fauna may ensue; that is, to what extent an additional West Indian element may be injected into the lower Florida reaches. The partial stamping out of the old fauna without serious physiographic or oceanographic changes in the region as far as physical features are apparently concerned is a rather interesting phenomenon and the re-establishment of a new flora and fauna will be equally noteworthy.

As heretofore, careful notes on the birds observed on the various keys visited were kept. One of the remarkable things resulting from the use of the seaplane was the finding of several colonies of the great white heron (*Ardea occidentalis*) which in previous years had been found breeding singly in the mangrove bushes. Two colonies of at least fifty each were found and several other colonies of lesser number. A photograph of a young of this year is shown in figure 47.

During Dr. Bartsch's stay at the Tortugas, the Navy Department, at the request of the U. S. Biological Survey, moved the warden's house on Bird Key. This necessitated the removal of a large number of eggs of the breeding terns which were on the point of hatching. Dr. Bartsch staked out the place to be invaded and removed all these eggs, giving the terns breeding in the area adjacent to the marked place each an additional egg, which all the birds accepted without protest. In this way, 2,420 foster parents were established and it is hoped many young sooty terns saved. Of the nests destroyed, only eight contained two eggs. All the others had one only. Figure 48 shows a photograph taken of Bird Key from the seaplane, by Dr. Bartsch, and figure 49 shows the old and new location of the warden's house.

There were but seven nests of the noddly tern in this region. The noddly tern on Bird Key is disappearing rapidly. Dr. Bartsch does not believe that there are 800 birds there at the present time. This is largely due to the fact that the vegetation was destroyed almost wholly by a hurricane a few years ago, and no serious efforts have been made to replace it. Unless some relief is found in this matter, both the sooty and noddly will undoubtedly become decidedly diminished in numbers because the young birds will not find the shade essential to their protection. It is again suggested, as heretofore, that a row of Australian pines and coconut trees be planted all around Bird Key, preferably alternately, and that the pines be kept topped so that they will become bushy and furnish a nesting site for the noddies. These trees grow very rapidly and should, in a very little while, furnish adequate home sites for the noddly tern. At the present time



FIG. 50.—Near view of two noddies on their tree nests, on Bird Key, taken five years ago.



FIG. 51.—This illustration shows transition stages from the tree breeding habit to the sand breeding stage depicted on the next plate. The upper figure shows a nest of dead twigs placed on the ground. The middle figure shows a number of nests placed among débris and rubbish on the site of the blown down house, while the lower figure shows an egg placed on a board.



FIG. 52.—The upper figure showing the noddy terns breeding on the bare flooring, the major remaining portion of the structure of the blown down house. The middle picture shows a noddy and her egg on the bare sand, and the lower figure shows another pair in a similar location.

the noddy terns, which are tree and bush building birds, are making their homes in clumps of grass wherever these are available, or on old boards or even in bare sand. Their habits in the last 10 years have changed on this key almost completely, resulting in the shrinking of the colony from about 4,000 birds, as estimated by Dr. Watson, to about 800, Dr. Bartsch's estimate, at present. Figures 50, 51, and 52 show the changes that have taken place. The photograph of figure 50 was taken five years ago; the other two this year.

Another interesting observation made on birds was the large number of thrushes found, chiefly on Garden Key. These included the veery, the olive back, the hermit, Alice's and Bicnell's thrush, all rather emaciated. Evidently the place did not furnish adequate food for them. It was interesting to see these birds mingle with the colony of exceedingly active white rumped sand pipers, which frequented the outer sandy beach of Garden Key, and to watch them chase sand fleas on the beach for food.

COLLECTING TRIP TO JAMAICA

In February, 1922, Mr. John B. Henderson, a Regent of the Smithsonian Institution, desiring living specimens of Antillean Zonitid and Thysanophoroid landshells for anatomical study in connection with a monograph on these groups in preparation, proceeded to Jamaica to collect them. He made trips to Bog Walk on the Rio Cobre River, to Holly Mount on the summit of Mount Diablo, to Momague and to Brownstown in the Province of St. Anns. From the latter point he proceeded to St. Acre to complete for the Museum its series of fossil land shells occurring there in a Pleistocene deposit. From Brownstown he continued along the north coast to St. Anns Bay, collecting at numerous stations. A final trip was made to Morant Bay along the southeast coast. Although the time spent in the island was only a fortnight, the results were most satisfactory. About 40 species of land mollusks were expanded and preserved for study and as many more were collected for their shells only. Mr. Henderson also visited Panama for the purpose of learning the possibilities of obtaining suitable craft from the Canal Zone authorities for contemplated future dredging operations at Colon and Panama.

THE MULFORD BIOLOGICAL EXPLORATION

The National Museum has received the zoological material, other than reptiles, batrachians and fishes, collected by the Mulford Biological Exploration of the Amazon Basin, an expedition financed by

the H. K. Mulford Co. of Philadelphia. The party consisted of Dr. H. H. Rusby, of the College of Pharmacy of Columbia University, director and botanist, W. M. Mann, assistant custodian of hymenoptera, National Museum, assistant director, N. E. Pearson of the University of Indiana, ichthyologist, O. E. White of the Brooklyn Botanic Garden, botanist, G. Schultz McCarty and two Bolivian students, Manuel Lopez and Martin Cardenas, who were detailed by



FIG. 53.—Start of mule train, La Paz, Bolivia.
(Photograph by N. E. Pearson.)

the Bolivian Government to study entomology and botany with the expedition members, and was accompanied by Mr. Gordan MacCreagh and J. Duval Brown, moving picture photographers, representing the Amazon Film Company.

The expedition left New York on June 1, 1921, and proceeded to Arica, Chile, and from there to La Paz, Bolivia, where arrangements were made for transportation across the mountains. At Pongo

de Quime (Alt. 11,500 ft.) above the timber line, a stop was made for several days and considerable zoological material gathered. From here to Espia the journey was by mule train. Espia is a spot at the junction of the Megilla and La Paz rivers which form the Rio Bopi. In August it was exceedingly dry and not very productive of specimens.



FIG. 54.—Nest of Hoatzin, Little Rio Negro, Bolivia.
(Photograph by Mann.)

Mositana Indians at their village down the river built balsas or rafts and towed them up to where the party waited and the members floated down the Bopi into the Rio Beni and to Huachi, a small settlement, and remained in this vicinity for over a month, with several excursions to nearby regions, as Covendo where the mission is located, and up the Cochabamba River to Santa Helena, a locality visited



FIG. 55.—Loading a balsa, Rio Bopi, Bolivia. (Photograph by N. E. Pearson.)



FIG. 56.—Camp of Balseros (raft men), Mositana Indians, Rio Bopi, Bolivia. (Photograph by N. E. Pearson.)



FIG. 57.—Young tapir, Rio Beni, Bolivia. (Photograph by N. E. Pearson.)



FIG. 58.—Mositana Indian girl at loom, Covendo, Bolivia. (Photograph by Mann.)

rarely by the Indians on hunting trips. This hilly, forested country was rich in animal life and large collections were made.

From Huachi the Beni was descended to Rurrenabaque, a short distance above the head of navigation on the Rio Beni, and over three months spent in this vicinity, with side trips across the pampa to Lake Rocagua, and to Tumupasa, a small village situated at the very edge of the Amazon Valley, and to Ixiamas, an isolated pampa region beyond Tumupasa.

Dr. Rusby, director of the expedition was compelled to return to the United States from Rurrenabaque, because of bad health. The



FIG. 59.—Church music, Ixiamas, Bolivia. (Photograph by Mann.)

party under Dr. Mann then went down river to Riberalta and afterward returned as far as the Little Rio Negro, where they spent several days collecting, and making short trips in the vicinity of Cavinass and up the Rio Madidi. In the region near the Lower Madidi several villages of Gorai Indians were visited and a small lot of ethnological material gathered.

A final stop was made at Ivon, at the mouth of the river of that name. Then the party proceeded to Cachuela Esperanza and from there to the Madeira-Mamore Railroad in Brazil where steamer was taken for Manaus and to New York.

The collection of living animals made by Dr. Mann on this expedition reached the National Zoological Park on April 15, 1922. In



FIG. 60.—Wasp nest made of clay, Rio Beni, Bolivia. Suspended from branch of tree over water.

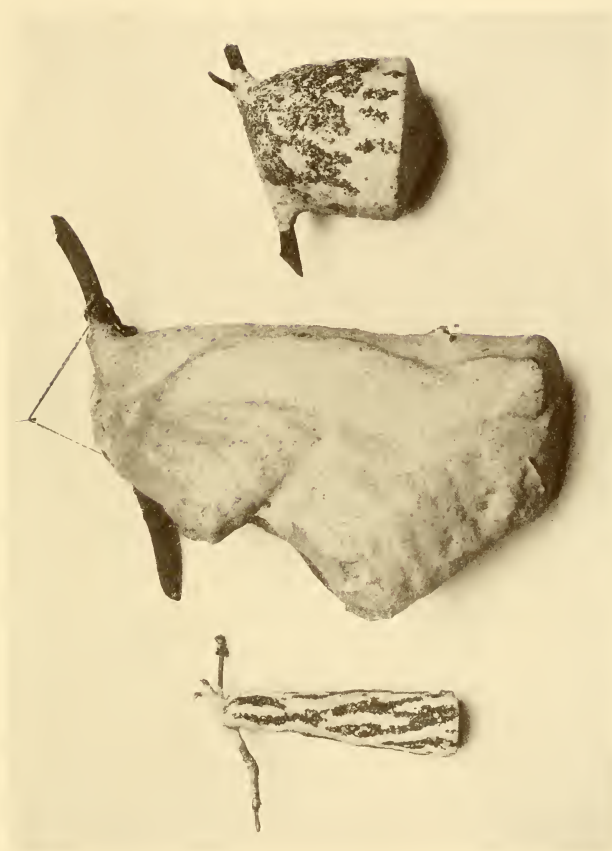


FIG. 61.—Wasp nests made of carton or paper-like substance, Rio Beni, Bolivia.
Suspended from branch of tree over water.

addition to a few specimens lost from the effects of the journey the collection included 15 mammals, 50 birds, and 17 reptiles that arrived in perfect condition. Among these are a number of very rare species never before exhibited in the Zoological Park. The red-faced spider monkey, black-headed woolly monkey, pale capuchin, choliba screech owl, Bolivian penelope, short-tailed parrot, Maximilian's parrot, blue-headed parrot, Cassin's macaw, golden-crowned paroquet, Weddell's paroquet, orange-crowned paroquet, and golden-winged paroquet are new to the collection. These and other rarities are mostly from Rio Beni, Bolivia, and the upper Rio Madeira, Brazil, localities from which animals seldom find their way into collections. Of special interest also are such rare birds as the festive parrot, Amazonian cacique, and white-backed trumpeter, and a number of reptiles. Very few collections containing so many rare species in such perfect condition have ever been received at the National Zoological Park.

The collection of insects secured by Dr. Mann was one of the largest single accessions ever received in the Division of Insects of the National Museum, estimated at 100,000 specimens. Only a small part has yet been examined. Some rare wasps' nests, made of carton and clay, were brought back in perfect condition. Ants received especial attention, and many biological observations were made upon them.

BOTANICAL EXPLORATION OF THE DOMINICAN REPUBLIC

Dr. W. L. Abbott spent the winter and spring of 1922 in further botanical exploration of the Dominican Republic, and was able not only to rework much of the region about Samaná Bay, but to make a thorough investigation of the entire southern portion of the Province of Barahona, as well as the cordillera north of San Francisco de Macorís. In the Province of Barahona he visited Barahona City, Paradis, Trujín, Enriquillo (Petit Trou), Los Patos, Polo, Maniel Viejo, and Cabral. The first four are small villages on or near the seacoast, south of Barahona City. The land here is for the most part low, rocky, and semiarid, except in the immediate vicinity of occasional springs and streams, but rises rapidly toward the interior to the Bahoruco Mountains. As the rock is limestone, caves and underground streams are frequent. One cave in particular, situated near Los Patos, is regarded by Dr. Abbott as promising valuable results to the ethnologist. Trujín, the most southern station reached on this trip, is on a large salt lagoon. Herman's coffee plantation, about 1,500 feet above Paradis, is of interest as being the source of earlier botanical collections by von Tuerckheim and by Fuertes.

Polo, a small settlement in the mountain region west of Barahona City, is situated on the edge of a long flat valley about one mile wide, evidently at one time the bottom of a lake. Just east of this village the Loma de Cielo rises to a height of 4,200 feet, while four miles northeast of Polo the Loma la Haut reaches an elevation of 4,500 feet. The former is covered with wet forests, while the timber of the latter is rather poor, having suffered from both the hurricane of 1905 and numerous recent forest fires. Forest fires have almost entirely destroyed the pine forests about Maniel Viejo, south of Polo, leaving nothing but dry scrubby thickets and bare slopes.

Exploration in the region of San Francisco de Macoris was confined to the vicinity of Lo Bracito, a small village on the southern slopes of Quita Espuela. These slopes are covered by humid thickets and forests, having, in fact, a reputation of being one of the wettest spots in the Dominican Republic and consequently affording a flora rich in ferns and mosses.

A collection of over 3,000 plants was procured, nearly 50 per cent of which are cryptogams. Many of the flowering plants collected represent shrubs and timber trees that are likely to prove of great interest.

Although the results of this expedition were chiefly botanical, Dr. Abbott collected also in other branches of natural history, his collections including specimens of mammals, birds, reptiles, fish, land shells, insects, and earthworms, as well as a small assortment of archeological material.

BOTANICAL EXPLORATION IN CENTRAL AMERICA

Botanical exploration in Central America during 1921 and 1922 was made possible by the cooperation of the Gray Herbarium of Harvard University, the New York Botanical Garden, Mr. Oakes Ames, the U. S. Department of Agriculture, and the National Museum. It was undertaken in order to obtain material for use in the preparation of a flora of Central America and Panama, which is now under way. Mr. Paul C. Standley left Washington in December, 1921, going by way of New Orleans to Guatemala, and directly to the Republic of Salvador.

Salvador, although the smallest of the Central American republics, has been the least known botanically, and previously hardly any collecting had been done there. With the fullest assistance of the Salvadorean Department of Agriculture, especially that furnished by Dr. Salvador Calderón, it was possible to make extensive collections



FIG. 62.—Scene near San Salvador, the Cerro de San Jacinto in the distance.
The hills are composed wholly of volcanic ash.



FIG. 63.—Amate or wild fig tree (*Ficus* sp.) in San Salvador.

of plants in widely separated localities, covering nearly all parts of the country. All except three of the 14 departments were visited, and collecting was carried on in most of them. Five months were spent in the work, and 4,600 numbers, represented by about 15,000 specimens of plants, were obtained. The central and western parts of the country are densely populated and intensively cultivated, the moun-

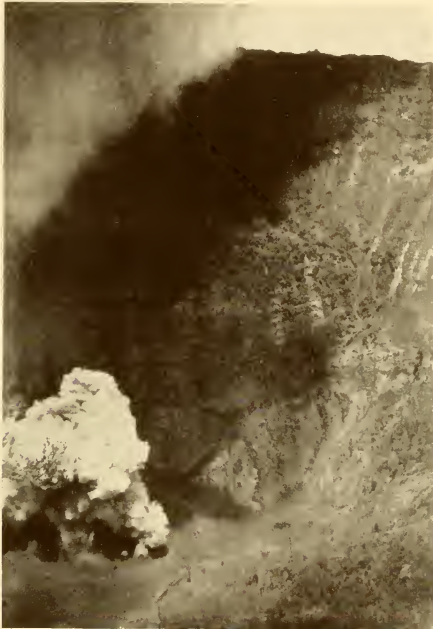


FIG. 64.—Eruption from the secondary crater of the volcano of San Salvador in 1917. (Photograph by Dr. V. M. Huezo.)

tains being given over to the culture of coffee, which is often planted up to the very summits of the highest volcanoes. On this account, most of the natural vegetation has been destroyed, and conditions are not so favorable for botanical work as in the other Central American countries. There are forests still remaining on some of the volcanoes, and in the mountain chain known as the Sierra de Apaneca, which lies close to the Guatemalan frontier, and here it is possible

to get some idea of the former state of the vegetation. In eastern Salvador there are extensive areas still uncultivated, but this land lies at a low altitude, where the flora is less interesting than at higher elevations. The highest mountains, it should be noted, are much lower than those of the neighboring countries, the largest of the Salvadorean volcanoes attaining an elevation of less than 2,500 meters. All the mountains are of comparatively recent volcanic origin,



FIG. 65.—Giant Ceiba tree in the city of San Salvador.

and several of the volcanoes are still active, an eruption of the volcano of San Salvador having wrecked the capital in 1917.

It is expected that there will be prepared for publication in Salvador a list of the species of plants obtained by this expedition, including also those collected by the Salvadorean Department of Agriculture, which is actively engaged in botanical exploration. Thus far only a small part of the collections has been studied critically, but it is already evident that a considerable number of undescribed plants is

contained in them, besides many that are rare and little known. The flora of Salvador is essentially like that of the Pacific slope of Guatemala (which likewise has been but imperfectly investigated), but it is of great interest to find here many species that heretofore have not been known to extend north of Costa Rica and Panama.

Particular attention was devoted to securing the vernacular names employed in Salvador, and many hundreds were obtained. A part



FIG. 66.—Gathering Salvadorean balsam in forests of the Balsam Coast. (Photograph by Dr. V. H. Huezo.)

of the country was occupied before the Spanish conquest by people who spoke a dialect of the Nahuatl language, the idiom spoken also by the inhabitants of the Valley of Mexico, although not or scarcely known in the intervening territory of Guatemala. A large part of the names now used here for plants are of Nahuatl origin, some of them being the same as those employed in Mexico, while others are quite different. Besides these philological notes, much information

was secured regarding economic applications of the plants of the country. Salvador is especially rich in valuable cabinet woods, a remarkably large number of plants with fruits or other parts that are edible occur, and hundreds, probably, of the native plants are employed by the country people because of real or supposed medicinal properties. The most interesting of all the native plants is the balsam



FIG. 67.—Basaltic formation in the Department of La Libertad, Salvador.

tree (*Toluifera percirac*), from whose sap is secured the article known as Salvadorean balsam or sometimes, erroneously, as balsam of Peru, because of the former belief that it came from Peru. Although this tree is widely distributed in tropical America, the balsam is gathered almost exclusively in Salvador, and in a limited portion of the country, known as the Balsam Coast. Other noteworthy trees are the giant ceibas and the *amates* (*Ficus* spp.) or wild figs, which are sometimes called the "national tree" of Salvador. They are



FIG. 68.—Coconut trees in a Salvadorean finca.



FIG. 69.—Coast of Salvador, in the Department of La Libertad. The rocks are mostly of recent volcanic origin. (Photograph by Dr. V. M. Huezo.)

common and characteristic features of the landscape, and almost every country dwelling has its particular *amate* tree.

Mr. Standley left Salvador early in May and proceeded to the north coast of Guatemala, where superior facilities for work were furnished through the kindness of the United Fruit Company. About three weeks were spent at Quiriguá, a locality long famous archeologically because of the ruins of an ancient Mayan city which are located here. Over a thousand numbers of plants were collected, chiefly trees and shrubs, many of them of great interest. The most conspicuous feature of the vegetation of this part of Guatemala is the enormous plantations of bananas which are grown to supply the markets of the United States. Adjoining these plantations are boundless areas of swamp and hilly woodland which remain in their natural condition. Especially noteworthy are the "pine ridges," low hills covered with scattering pine trees and occasional groups of the cohune palm. The vegetation on these hills is strikingly like that of the Everglades region of southern Florida, and the whole country looks about as Florida might if it were crumpled up into hills, instead of being almost perfectly level.

After leaving Quiriguá, about a week was spent in collecting at Puerto Barrios, on the north coast of Guatemala. The land here is nearly all swampy, but at this time of the year (early June), at the end of the dry season, it was possible to walk about in the swamps and gather plants that at other seasons of the year are inaccessible.

Altogether six months were spent in Salvador and Guatemala, and a collection of over 6,000 numbers of plants was obtained, which will add materially to previous knowledge concerning the Central American flora. The data concerning distribution and the notes upon vernacular names and economic applications will contribute greatly to the completeness of the flora of Central America which it is proposed to publish.

BOTANICAL EXPLORATION IN COLOMBIA

Between the months of April and October, 1922, Dr. Francis W. Pennell, curator of the herbarium of the Philadelphia Academy of Natural Sciences, and Ellsworth P. Killip, of the Division of Plants, National Museum, carried on botanical exploration in the Republic of Colombia. The expedition was organized by the New York Botanical Garden, the Gray Herbarium of Harvard University, the Philadelphia Academy of Natural Sciences, and the National Museum as part of a general plan, adopted in 1918, for botanical research in northern South America. Financial assistance was given also by Mr. Oakes



FIG. 70.—Arid valley of the Dagua River, Colombia. The transition from a luxuriant rain-forest to this dry "pocket" is very abrupt. (Photograph by T. E. Hazen.)



FIG. 71.—View to the north from La Cumbre, in the Western Cordillera, Colombia. The wooded valleys are filled with orchids. (Photograph by T. E. Hazen.)

Ames. Mrs. Pennell accompanied her husband, returning in July, and Dr. Tracy E. Hazen, of the Biological Department of Columbia University, was a member of the party from July to September, giving special attention to photography.



FIG. 72.—Dense forest at La Cumbre, Colombia. Plants of the Tropical Zone here mingle with the subtropical vegetation.

The Republic of Colombia occupies the northwestern corner of the continent of South America, facing both the Caribbean Sea and the Pacific Ocean. The Andes Mountain chain, extending northward in practically a single range from its origin in southern Chile, divides

at the southern boundary of Colombia into three branches, known as the Western, Central, and Eastern cordilleras. Between the Western and the Central cordilleras lies the valley of the Cauca River; between the Central and the Eastern, the Magdalena River. On the present trip it was possible to visit only the Western and Central cordilleras, the Cauca Valley, the city of Bogotá in the Eastern Cordillera, and one or two localities on the Pacific slope. The expedition entered the country at Buenaventura, the principal seaport on the Pacific, and at once established headquarters at the village of La Cumbre, in the Western Cordillera, for the purpose of studying the vegetation of the central part of this range. Descending to the



FIG. 73.—View from the summit of the Western Cordillera toward the Pacific slope, Colombia. The peaks are more angular than noted in other regions.

city of Cali the party proceeded up the Cauca Valley to Popayán, the southern portions of both the Central and the Western cordilleras being explored from this point. Subsequently trips were made to Salento, in the northern part of the Central range, and to Ibagué and Bogotá, material being collected at historic localities along the Quindiu Trail. Dr. Pennell sailed from the north coast, after exploring the northern portion of the Western Cordillera. Dr. Hazen and Mr. Killip returning by way of Buenaventura and the Panama Canal. Approximately 7,200 numbers were collected, sufficient material being secured to make nearly equal sets for each of the institutions associated in the expedition. Particular attention was paid to orchids, a group in which Mr. Ames is especially interested. To dry these specimens

required the use of artificial heat, the plants being put between driers and corrugated boards, bound tightly in packages, and placed over a charcoal-burning heater.

As might be expected from its physiography, the vegetation of Colombia is extremely diverse. Within a few miles may occur a luxuriant tropical flora, the more open woods of the temperate zone, and the low alpine growth familiar on our American mountain tops. Again, as in the Dagua Valley, one may ride through a dense rain-forest, filled with ferns, mosses, and aroids, to emerge suddenly in an arid, desert-like region where cacti and acacias are the conspicuous plants.



FIG. 74.—Crest of the Western Cordillera at El Derrumbo, 9,500 feet altitude, Colombia. Here occurs the stunted growth of the temperate zone.

Since Colombia lies between the first and eleventh parallels, the development of its vegetation is little influenced by latitude. The controlling factors are altitude and precipitation, the rainfall ranging from 400 inches a year to almost perpetual dryness. Four zones of plant life may be recognized, the limits being approximately as follows: Tropical, from sea-level to 5,000 feet; Subtropical, from 5,000 to 9,000 feet; Temperate, from 9,000 to 12,000 feet; Páramo, above 12,000 feet. The tropical forests are very dense; giant-leaved aroids, bromeliads, and heliconias are most abundant; everywhere are palms and bamboos. In the subtropical forests orchids become more common, many of them being of great beauty; tree trunks are densely



FIG. 75.—Raft-building on the Cauca River, Colombia. The ever-present bamboos and palms supply the material needed.



FIG. 76.—Crossing the Vieja River, a tributary of the Cauca, Colombia. As there is no bridge at this point, cargo must be removed from the mules and transported in native dug-out canoes.



FIG. 77.—Village of Salento, in the Central Cordillera, Colombia. Through this town passes the historic Quindiu Trail, reaching from Cartago to Ibagué.



FIG. 78.—Upper valley of the Quindiu River, Colombia. The forest land is being cleared out for pasture. (Photograph by T. E. Hazen.)

covered with mosses, hepaticae, and ferns. In this zone occasionally occur oak forests, recalling vividly our northern woods, and blackberries are to be found. The Temperate Zone is a region of small-leaved, usually dwarfed trees, of blueberries and other ericaceous shrubs, and of open hillsides, where geraniums and Andean genera of the rose family are numerous. The Páramo is the bleak open country between timberline and the snows. Here flourish densely woolly espeletias, bizarre senecios, and many other brilliantly flowered herbaceous plants.

Travel in Colombia is by railroad, by boat, and by horse or mule. Railroad construction has necessarily been slow, no road having yet been built over the Central Cordillera, while only a single line crosses the Western Range. In the Cauca Valley construction is being pushed, though only a small portion of the line has been completed. Boat travel is fairly satisfactory, and the scenery along many of the streams is very picturesque. The Cauca, navigable for good-sized steamers between Cali and Puerto Caldas, winds its way down a broad valley, in the main keeping to the western side, the banks lined with palms and bamboos. On one hand are the hills of the Western Cordillera; on the other, the higher mountains of the Central range. But to the botanist travel by horse or mule, though slower, is far preferable, since it affords opportunity to collect thoroughly in specially favorable places. So inadequately known is the flora of Colombia that even along the regular routes of travel many species are found that are either new, unrepresented in American herbaria, or known only from specimens preserved in European collections.

The Colombians are of Spanish descent and are mostly well educated, many of them having studied in American and European universities. Even among the lower classes illiteracy was rarely met with. The Indians, found chiefly in the mountainous regions of the interior, seem to be peaceful and industrious. No "wild savages" were seen, although members of the expedition reached remote corners of the country. Indian women delight in gay colors, a blue waist and a scarlet dress being a particularly favorite combination; the men dress more somberly and more scantily, often wearing merely a black smock reaching barely to their knees. The negroes are confined mainly to the coastal strips and to the warmer parts of the main valleys.

Perhaps the most lasting impression one brings back from Colombia is that of the unaffected friendliness of the people. Everyone, from



FIG. 79.—Upper valley of the Quindiu River, Colombia. Part of the forest has been supplanted by pastures. The palm is *Ceroxylon andicola*, or a closely related species.



FIG. 80.—Páramo above Bogotá, Colombia. From this lake arises one of the important tributaries of the Orinoco River.

the highest official to the lowliest peon, showed marked courtesy and hospitality to the members of the expedition. Customs officials made entrance into the country easy; railroad men were most helpful in



FIG. 81.—Apparatus for drying specimens. The bundle of plants rests upon two poles. From this, cloth is draped about the charcoal-burning heater, being lined with woven wire to prevent its being blown into the fire.

every way; landowners continually were placing their haciendas at the disposal of the party. Much of the success of the expedition was due to this universal spirit of friendly cooperation.

VISIT TO EUROPEAN HERBARIA

Mrs. Agnes Chase, assistant custodian of the Grass Herbarium, National Museum, visited several of the larger herbaria in Europe during 1922 for the purpose of studying the grass collections. Five weeks were spent in Vienna. The herbarium of Professor Eduard Hackel, whose work on the genera of grasses in Engler & Prantl's *Pflanzenfamilien* is the accepted one in current use, is deposited in the Naturhistorisches Staatsmuseum, Vienna. Professor Hackel has described about 1,200 species from all parts of the world, probably half of them from South America. The types of all but about 50 were found. Most of the missing types were found later in the herbaria whence he had borrowed material. Besides this collection, of greatest importance to American agrostology, the Vienna herbarium was found to contain many American types of Weddell, Philippi, Doell, and Mez, as well as classic collections such as Lechler's plants of Chile, D'Orbigny's from the Andes, Mandon's from Bolivia, and Spruce's from the Amazon, upon which many species are based.

A visit was made to Prof. Hackel at Attersee in western Austria, and important but unrecorded items in the recent history of agrostology were secured.

In Munich were found the types of Nees's *Flora Brasiliensis*, a few of Doell's and several of Mez's. At the Museo e Laboratorio di Botanica in Florence, Italy, types of Poiret, Poiteau, and Bosc were studied. Poiret was the author of the grasses in the supplement to Lamarck's *Encyclopedia*. His descriptions, like Lamarck's, are indefinite. It was necessary to see his plants to be certain of his species. Poiteau botanized in Santo Domingo in the latter part of the 18th century, and made a brief visit to the United States. Bosc was a friend of Michaux, and came to Charleston in 1798, where Michaux had established a propagating garden. During the next two years he collected in the Carolinas. In Pisa there is a small but very important collection, that of Joseph Raddi, whose *Agrostografia Brasiliensis*, published in 1823, is the earliest work devoted to South American grasses. These were collected by Raddi himself in 1817-18. The *Agrostografia* contains 64 species of grasses, of which 33 are described as new. A number of these had never been identified. The specimens were found to be unusually ample and well preserved, and photographs were obtained of them. (Fig. 82.)

Ten days were spent at the Delessert Herbarium at Geneva. This herbarium contains, besides full series of the more recent collections, several old herbaria. Of great importance to the agrostologist is

the herbarium of Palisot de Beauvois, whose small volume "Essai d'une nouvelle Agrostographie," published in 1812, has caused much trouble for the agrostologist, because of his misunderstanding of the structure of grasses. An examination of his specimens, fragmentary though they are, cleared up many difficulties. At Delessert a number



FIG. 82.—*Raddia brasiliensis*, named by Bertoloni for Joseph Raddi in a preliminary paper. Raddi himself referred the species to *Olyra* and gave it a new species name. It is recognized today as *Raddia brasiliensis*.

of grasses collected by Rafinesque in the United States were also found. Types of Nees, Schrader, Kunth, Willdenow, Sprengel, Link, Pilger, and Mez were studied at the herbarium of the Botanical Garden, Berlin.

Visits were made to the Rijks Herbarium at Leiden, and to the herbarium of the Jardin Botanique d'État at Brussels.

Two very profitable weeks were spent at the herbarium of the Paris Museum. In this institution the Lamarck Herbarium and that of Michaux are segregated. Dr. A. S. Hitchcock had studied these collections in 1907. Mrs. Chase made drawings and took some additional photographs. The Paris Herbarium is exceedingly rich in early American collections, such as those of Humboldt and Bonpland, Poiteau, Gaudichaud, Bourgeau, and D'Urville. The Fournier Herbarium, the basis of Fournier's Mexicanas Plantas, was of very great interest.

An important early paper on American species of *Paspalum* was by LeConte, 1820, an American of French descent. His herbarium is deposited in the Academy of Sciences, Philadelphia. When the collection there was studied a few years ago some of his species were not represented. Dr. Asa Gray, in a biographical note on LeConte, states that LeConte took his collection with him on a visit to France and that he was very generous in allowing his friends to have specimens. It was a great satisfaction to find the missing LeConte specimens in the Paris Herbarium.

Two weeks were spent in London, studying the grasses in the Kew Herbarium and in the herbarium of the British Museum. Both of these herbaria contain much that is of greatest importance to American agrostology.

Botanizing in herbaria does not afford the same pleasure as does botanizing in the field, but it is not without its thrills of discovery. Current concepts of several species were found to be erroneous; that is, our ideas were those of later authors instead of those of the original ones.

RECENT DISCOVERIES OF ANCIENT MAN IN EUROPE

Under a grant from the Joseph Henry Fund of the National Academy of Sciences, and upon the conclusion of his work as chairman of the American Delegation to the XX International Congress of Americanists at Rio de Janeiro, Dr. Aleš Hrdlička proceeded to Europe to examine the more recent discoveries of skeletal remains of early man and several of the most important sites where these discoveries have been made.

In this quest Dr. Hrdlička visited Spain, France, Germany, Moravia and England. The important specimens studied included the jaw of Bañolas in Spain; the La Quina site and specimens in southern France; the La Ferrassie skeletons, now beautifully restored, in Paris; the Obercassel finds in Bonn; the Ehringsdorf discoveries and site

at Weimar and at Ehringsdorf; the Taubach site near a village of that name, with the specimens at Jena; and the principal Předmost skeletons now preserved in the Provincial Museum at Brno, as well as the site of these important discoveries at Předmost (in northern Moravia) itself. In addition to these, thanks to the courtesy of Dr.



FIG. 83.—Side view of the reconstructed La Quina skull.

Smith Woodward, Dr. Hrdlička was enabled to submit to a thorough study the Piltdown remains at the British Museum of Natural History, and to see there the originals of the Boskop skull as well as the highly interesting Rhodesian skull and parts of skeleton, from South Africa. He was finally once more able to see, at the Royal College of Surgeons, London, the originals of the Galley Hill and Ipswich skeletal remains.



FIG. 84.—Top view of a cast of the intracranial cavity of the La Quina skull, showing the shape of the brain. The brain, compared with modern specimens, is small and especially low.

The examination of the specimens and the visits to the sites where most of them were discovered, produced a deep impression on the one hand of the growing importance as well as complexity of the whole subject, and on the other of the vast amount of the deposits in western and central Europe bearing remains of early man and giving great promise for the future. It was also once more forcibly impressed upon the mind of the observer how much more satisfactory is the handling of the original specimens than of even the best made casts.

So far as the scientific results of the trip are concerned, Dr. Hrdlička feels confident that he was able to reach a definite conclusion and position as to the human nature of the Piltdown jaw; to satisfy himself on the more or less intermediary nature, between Neanderthal and the present type of man, of the Obercassel, the Předmost and some other crania; and to see the admirable restorations of both the La Ferrassie and the very important La Quina discoveries, the latter including the highly interesting and, so far as ancient remains of man are concerned, unique specimen of a well-preserved skull of a child.

Plaster casts of nearly all the important specimens not yet represented in the U. S. National Museum were obtained for the Institution.

MEETING OF INTERNATIONAL CONGRESS OF AMERICANISTS IN BRAZIL

The twentieth meeting of the International Congress of Americanists at Rio de Janeiro, Brazil, was attended by Dr. Walter Hough and Dr. Aleš Hrdlička, who were delegated by the Department of State and the Smithsonian Institution. Through the aid of the Carnegie Endowment for International Peace means were supplied for the journey of these delegates. A successful meeting of the Congress is reported, the effect of which on the promotion of anthropological science in Brazil is believed by the delegates to be important. While there was not time to travel in Brazil more than in the environs of Rio, it was interesting to view the resources of the capital as an index to the progress of the country. In this center there is a historical department, a national library, a national museum, fine arts institution, botanic garden, athletic club, and all the activities relating to engineering, sanitation, commerce, etc., reflecting modern conditions. There is seen a tendency at present to lay more stress on historical researches than on science, but the nucleus is here to be developed in such a way as the future affords. In some lines science is being adequately treated as in General Rondon's work among the Indians,

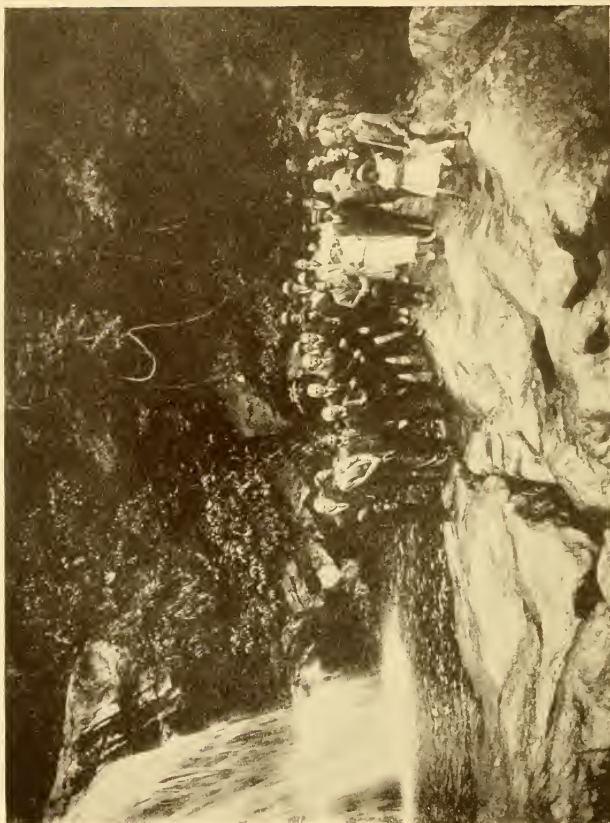


FIG. 85.—Members of the International Congress of Americanists at Cascatinha on road to Tijuca, September, 1922. Rio de Janeiro, Brazil.

which has resulted in the gathering of important collections and in the publication of valuable ethnological studies, especially by General Rondon's assistant, Dr. E. Roquette-Pinto.

EXPLORATION OF THE PALEOLITHIC REGIONS OF FRANCE AND SPAIN

During the month of September, 1922, Mr. M. W. Stirling, aid in the Division of Ethnology, National Museum, in the company of Mr. P. J. Patton, a student in the University of Paris, explored the paleolithic regions of southern France and northern Spain. All of the important sites where remains of ancient man have been discovered were visited, and in addition a great many caves unknown to science were entered.

The idea has become prevalent in America that this region has been practically exhausted archeologically. Although the previous existence of paleolithic man in this locality has been known for half a century, it may be truly said that the work of exploration has hardly begun.

The habitations of the Stone Age are closely linked with the limestone formation which overlies large areas in this part of Europe. These may be said to fall into two classes, *i. e.*, rock shelters and caverns. The former are undercuts in the limestone, made by the rivers during the early Pleistocene or late Pliocene. A general elevation of the land has caused the streams to deepen their channels, thus leaving the undercuts well above the surface of the water. These were utilized as dwelling places by paleolithic man and in many instances were artificially modified. There are literally miles of relic bearing deposits of this class that have not yet been touched. The possibilities in this field are very great.

The caverns of the Dordogne region are for the most part comparatively small, while those in the department of Ariège are immense caves of a most spectacular nature. Of the former class are the grottoes of Font du Gaume, Combarelles, La Mouthe, Marsoulas, Montesquieu, and others. Of the latter class are the immense caves in the neighborhood of Foix, as for example, Salignac, Ussat, and Niaux. The tunnel of Mas d'Azil is the remnant of such a cave.

Many of these caverns have become blocked with sediment owing to the fact that they frequently slope downward from the entrance. Messrs. Stirling and Patton entered at least a dozen such caves which had become sealed at varying distances from their mouths. The opening of such caves has heretofore been left almost entirely to chance. Scientific endeavor at this work should produce most



FIG. 86.—Pal, a typical village of Andorre, showing slate roofs and stone construction of houses. Note the terraces on the bare rock hillside back of the village. Every foot of soil is made available for cultivation.



FIG. 87.—An old bridge in Andorre. The verdure in this scene is exceptional. Andorre as a whole is practically treeless.

fruitful results. The sealing of these caves has been a fortunate accident of nature, since the contents are by this means preserved intact.

Of the regions visited, that in the neighborhood of Altamira, in Spain, and Ussat, in France, give most promise of rich returns to the archeologist.

A few days were spent in the republic of Andorre. This little semi-independent state contains much of interest to the ethnologist. Here one finds medieval customs and usages still functioning in the same manner that they did in the middle ages.

Located in the rugged mountains between the Spanish province of Lerida and the French department of Ariege, it is very difficult of access. Preserved from innovations by rival jealous potentates as well as by the conservative temper of its inhabitants, it has kept its medieval institutions almost intact. The administration of minor matters of justice and legislation is in the hands of local councils chosen from the heads of families in each of the six parishes into which the state is divided. The central government is vested in two *viguiers*, one nominated by France and the other by the Bishop of Urgel in Spain. Serious crimes and important cases in dispute are brought before them for judgment. There being no written laws, their decisions are given according to their consciences, and are final.

The population is entirely self-sufficient, and each family is an independent unit, raising their own produce, grinding their own meal, and making their own clothing. The primitive nature of their farming and household implements and utensils make an interesting study.

ARCHEOLOGICAL FIELD-WORK ON THE MESA VERDE NATIONAL PARK, COLORADO

In the year 1922, from May to August, inclusive, Dr. J. Walter Fewkes, chief of the Bureau of American Ethnology, continued his archeological investigations, begun 15 years ago, on ruins of the Mesa Verde National Park, Colorado. The brief season's work was financed with small allotments from the Bureau of American Ethnology and the National Park Service. He had for assistants Messrs. W. C. McKern and J. H. Carter, who contributed much to the success of the summer's work. The site of the field operations was the so-called Mummy Lake village, better named the Far View group of mounds (fig. 88) through which runs the government road to Mancos. The group is situated about $4\frac{1}{2}$ miles north of Spruce-tree Camp, contains 16 large stone buildings, many indicated by mounds of stone, sand, and a luxurious growth of sage brush. The three of



FIG. 88.—Mound in Far View House Group, before excavation. Situated at Far View Junction, Mesa Verde National Park, Colorado. A few sage bushes have been removed, but otherwise no change. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)



FIG. 89.—Pipe Shrine House looking south from Far View House, Mesa Verde National Park, Colorado. (Photograph by Geo. L. Beam, Courtesy Denver and Rio Grande Western Railroad.)

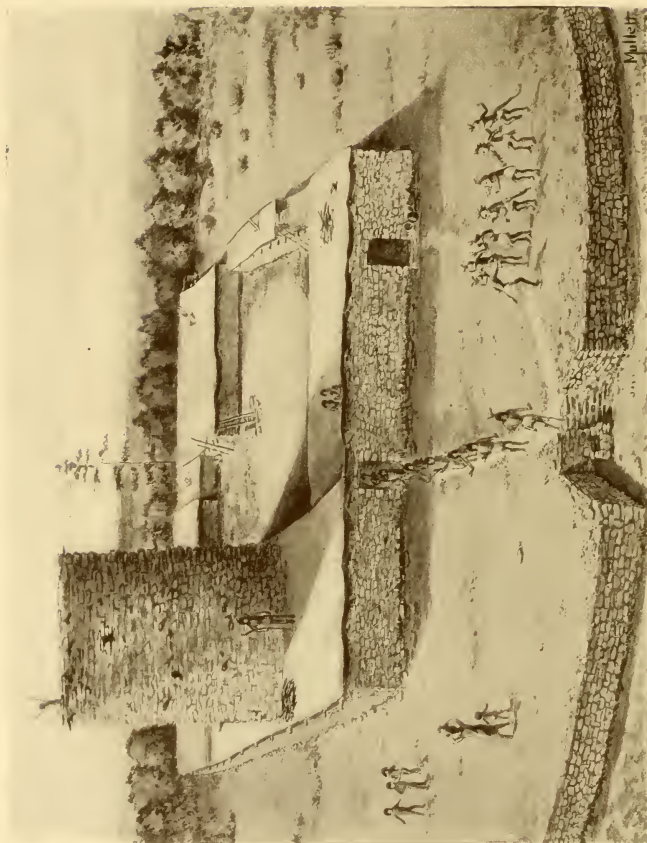


FIG. 90.—Restoration of Pipe Shrine House, Mesa Verde National Park, Colorado. Made from data collected during field-work in 1922 by the Bureau of American Ethnology of the Smithsonian Institution. View from the south showing priests carrying offerings to the shrine of the mountain lion in the recess of the retaining wall and a line of dancers personating bird gods.

these which have thus far been excavated belong to different types; but it is desirable to examine and repair them all in order to discover other types. Indian corn, the national food of the cliff-dwellers, should be again planted in this area so that the future student or tourist could behold a Mesa Verde village in approximately the same environment as in prehistoric times. The first of the mounds was excavated by the Bureau of American Ethnology in 1916, and was called Far View House, and the particular mound chosen for excavation in 1922 lies about 100 feet to the south of it (fig. 89) or on the southern edge of the sage-brush area.



FIG. 91.—Distant view of Pipe Shrine House. This view shows the whole north wall and the east wall foreshortened. The group of men at extreme left are looking at skeleton in cemetery. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

The only noticeable characters of the mound when work began were a saucer-like central depression, and an elevated rim, which led Dr. Fewkes to suspect a buried subterranean kiva surrounded by a series of rooms above ground. The mound was covered by a dense growth of vegetation. No walls were seen when this was removed, and much accumulated sand, earth, and stone had to be removed before any masonry was visible. Complete excavation revealed a remarkable building or pueblo (figs. 89, 91) presenting to archeologists several new problems for solution.

The large depression turned out to indicate a central kiva (fig. 92) quite unlike that of any other on the Mesa Verde National Park. This room has no central fireplace; no ventilator or deflector to dis-



FIG. 92.—Interior view of kiva of Pipe Shrine House, looking north, showing shrine where pipes were found on floor. The ruin in the distance is Far View House. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

tribute fresh air; but in place of these a segment of the floor was separated from the remainder by a low curved ridge of clay. This area was a fireplace, as indicated by the large quantity of ashes and burnt wood it contained, and many artifacts mixed with the ashes showed that it served also as a shrine. Among other objects in it were



FIG. 93.—Several pipes from shrine on the floor of the kiva of Pipe Shrine House. Reduced a little less than one-half.

a full dozen decorated tobacco pipes made of clay, some blackened by use, others showing no signs that they had ever been smoked. Several of these are figured in the accompanying illustration. There were fetishes, a small black and white decorated bowl, chipped flint stone knives of fine technique, and other objects. For many years it had been suspected, that the ancient inhabitants of the Mesa Verde cliff dwellings were smokers, but these pipes (figs. 93, 94) are the

first objective evidence we have to prove it, and the fact that these objects were found in the shrine of a sacred room would indicate that they were smoked ceremonially, as is customary in modern pueblo rites. Evidently the priests when engaged in a ceremonial smoke sat about this shrine and after smoking threw their pipes as offerings into the fireplace. Probably as with the Hopi every great



FIG. 94.—Pipes and other objects in shrine, as found. In addition to pipes many other objects were found, among which may be mentioned small black and white bowl, flint knives, idols, and "septarian nodule." (Photograph by J. W. Fewkes.)

ceremony opened and closed with the formal smoking rite at this shrine, and one can in imagination see the priests as they blew whiffs of smoke to the cardinal points to bring rain.

The discovery of pipes for ceremonial smoking in a Mesa Verde kiva is a significant one, indicating that the ancient priests of the

plateau, like the Hopi, smoked ceremonially. Moreover the forms of the prehistoric pipes (fig. 93) thus used differ materially from those of modern pueblos, in size and shape, although a few formerly used by the Hopi have much in common with them.

The walls of the kiva show structural variations from a standard Mesa Verde kiva. There were eight instead of six small mural pilasters, an addition of two to the usual number; evidently the roof of this subterranean chamber was vaulted and as its size was large it needed more than the regulation number of supports for the roof



FIG. 95.—Interior of Pipe Shrine House looking southwest across the central kiva. (Photograph by W. R. Rowland, Durango, Colorado.)

beams. Although the means of entrance to the room is unknown there was probably a hatchway in the roof, but no sign of a ladder was discovered and no vertical logs to support rafters were seen.

The stones and plastering of the inner walls of the kiva indicate everywhere a great conflagration; the beams of the roof had completely disappeared, and the color of the adobe covering of the walls was a bright brick-red. The kiva measured about 24 feet in diameter and was about the same depth. Its roof served as the floor of a court surrounded by one-storied rooms. There was no large banquette on its south side (fig. 95) as almost universally occurs in a regular Mesa Verde kiva. A conspicuous slab of rock set in the

floor near the rim of the shrine was possibly reserved for an idol or the altar during ceremonies.

Midway in the length of the west side of the ruin there remain foundations of a circular tower whose wall once rose, like a minaret, several feet above the roofs of surrounding rooms. The altitude of this tower was no doubt formerly sufficient for a wide outlook, and its top, rising above the cedars, served as the elevation from which the sun priests watched the sun's position on the horizon at sunrise and sunset. It was perhaps built as an observatory for determining time for planting and other agricultural events, and may likewise have been used in certain solar rites.



FIG. 96.—Storage jars in place as found in northeast corner room of Pipe Shrine House. Four of these made of corrugated and one smooth white ware with black decoration. (Photograph by J. W. Fewkes.)

The chambers surrounding the central kiva do not appear adapted for habitations; several were more likely used for storage of food, or for other secular purposes. In a room situated on the northeast angle several pottery vessels were found arranged in a row (fig. 96). It would appear that the site of the kiva was dug out by the ancients before these rooms were built, and that the rooms forming the north side were built later than the others and constructed of poorer masonry than those of the south side, where the masonry compares very well with the best on the Mesa. The east rooms are well made and resemble those of Sun Temple. There are two entrances or passageways through the south side, midway between which on the outer surface there is set in the wall a large stone with a spiral incised figure

supposed to represent the plumed snake; and near the southwest corner there are smaller mural designs representing two snakes.

The presence of shrines outside Pipe Shrine House is significant as the first of their kind ever found on the Mesa. On the northeast corner of the ruin there is a small square enclosure with walls on three sides, one of which is the wall of the northeast side of the ruin. Reset in the north wall of this enclosure is a stone, found a little distance away, bearing an incised circle or sun symbol; and within the shrine were found several waterworn stones; also an iron meteorite, a fossil nautiloid, and many stone concretions and waterworn



FIG. 97.—Mountain Lion Shrine, or Shrine of the South. Stairway constructed by aborigines. Square enclosure is shrine as found. South wall of Pipe Shrine House shown above. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

stones. A stone slab found nearby bears on its surface an incised circle, the symbolic representation of the sun, indicating the presence of a sun shrine nearby. Waterworn stones, by a confusion of cause and effect, are supposed to be efficacious in rain-producing.

South of Pipe Shrine House the ground slopes gradually (fig. 97), the earth being held back by a retaining wall. Aboriginal stone steps lead down to an enclosure which was a shrine, rectangular in shape, built in a recess of the retaining wall opposite the western doorway on the south side of the ruin. Within this shrine were a number of waterworn stones sufficient to fill a cement-bag, surrounding a large crudely fashioned fragment of a stone idol of the mountain lion. Al-

though the head and forelegs were broken from the body the hindlegs were intact: a long search for the broken anterior end of the idol was a disappointment. The indentations on the surface due to chipping were plainly seen; and the tail was especially well made, resting along the dorsal line. This position of the tail is, in fact, what led the writer to identify the rude image as a representation of the mountain lion, for among the Hopi a picture of the puma painted on the north side of the warrior chamber has a similarly placed tail. The Hopi priests say that a Mountain Lion clan formerly inhabited the same cliff dwellings in the north as the Snake people. The position of



FIG. 98.—Stone idol of a bird. Views from front *A*, and one-half lateral *B*. Pipe Shrine House. Size: $4\frac{1}{4} \times 2\frac{1}{4} \times 2\frac{3}{4}$ inches.

this shrine and the accompanying idol would indicate that the puma was the guardian of the south while at Walpi this animal is associated with the north. Among the Hopi, the mountain lion is also the guardian of cultivated fields.

Lest, in the future, vandals loot this shrine, it was protected by a wire netting set in cement spread on top of the walls, but the contents were left as originally found. South of the mountain-lion shrine, about 20 feet distant, was another enclosure, also a shrine, containing many waterworn stones, but its idol or guardian animal had disappeared. This receptacle was likewise protected by a wire net. Although it had no beast-god image; several stone idols (fig. 98) were found in the adjacent dump around Pipe Shrine House—evi-

dently belonging to other cardinal points—but no other shrines were discovered.

The heads of two stone idols, homeless or without a shrine, were picked up outside the walls of Pipe Shrine House, on rock piles between the retaining wall and the south side of the ruin. One of these (fig. 99) is thought to represent the head of a mountain sheep, another a serpent, and a third (fig. 98) a bird. The instructive thing about these idols, next to their crude technique, is the fact that stone images rarely occur on the Mesa Verde, few similar stone idols or images having previously been reported from ruins on this plateau. Their crude form reminds one of pueblo idols.



FIG. 99.—Stone idol of a mountain sheep. Pipe Shrine House. Size: 3 x 5 x 6 in.

An aboriginal cemetery, ransacked of its mortuary contents years ago by vandals, was found near the southeast corner of Pipe Shrine House. The human skeletons found in this cemetery show the dead were buried as a rule in an extended position. In cave burials the bodies were flexed or in a seated posture. The accompanying pottery contained food and drink for the deceased. On the western fringe of this graveyard Dr. Fewkes discovered about a dozen human skeletons that had escaped desecration, one or two of which were buried only a few inches below the surface; the deepest grave was shallow, not more than three feet deep. All the skeletons that were found were well preserved, considering their antiquity, and had been buried in an extended position on a hard clay bed. They lay on their backs at full length with legs crossed and heads oriented to the east,

generally accompanied by mortuary vessels of burnt clay and other objects. Several whole pieces of typical Mesa Verde pottery were taken out of the soil of this and another cemetery southeast of Far View House. These vessels once contained food and water, the spirit of which was thought to be suitable food for the spirit of the defunct. One of these skeletons (fig. 100) was as fresh as if buried a few years ago and the bones were so well preserved that they were left *in situ*. Every bone of one skeleton remains where it was found and was not raised from the position in which it was interred over 500 years ago. Walls of a stone vault (fig. 100) were constructed around the skeleton, reaching to the surface of the ground, and to a wooden frame firmly set in cement was nailed a wire netting, above which one of the workmen constructed a waterproof wooden roof hung on hinges. By raising this roof the visitor may now behold the skeletal remains of a man about 45 years old, 5 feet 6 inches tall, as he was laid out in his grave centuries ago. Visitors called him a mummy; his flesh had not dried as is sometimes the case with the cliff-dwellers, but turned into a brownish dust. So far as known this is the first time care has been taken to preserve a skeleton of a Pueblo in its aboriginal burial place so that it may be seen by visitors. It shows the environment of the defunct and satisfactorily answers the question whether the cliff-dwellers were pygmies.

In a refuse heap a short distance east of the sun shrine of Pipe Shrine House were found a hundred worn-out grinding stones and metates with many stones once used for pecking, all evidently thrown in a heap when they were no longer needed.

The grading of the area about Pipe Shrine House was a work of considerable magnitude, as the surface was very irregular and overgrown with vegetation. The soil, earth and stones fallen from the rooms had raised mounds of considerable magnitude around the ruin.

Pipe Shrine House appears to have served as a ceremonial building rather than a habitation—a kind of temple, originally constructed for the accommodation of the inhabitants of the neighboring Far View House. The tower was probably devoted to the worship of Father Sun and other celestials; the kiva to that of Mother Earth and terrestrial supernaturals.

In the thick cedars south of Far View House there were two mounds, one of which (fig. 101) was completely excavated by Dr. Fewkes, who found in it a fine central kiva surrounded by low walls of rooms, the whole probably being the house of one clan, for which the name, One Clan House, seems appropriate. It was probably the



FIG. 100.—Cyst constructed around skeleton in cemetery southeast of Pipe Shrine House, and two partial skeletons. The rock walls were built around the skeletons by Dr. Fewkes. (Photograph by Geo. L. Beam. Courtesy of Denver and Rio Grande Western Railroad.)



FIG. 101.—One Clan House, looking north. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

residence of a single social unit having a men's room or kiva in the center of the women's rooms or those used for grinding and storage of corn, sleeping, cooking, and other purposes.

The kiva (fig. 102) of this ruin is typical of a cliff-house sanctuary. Its architecture is normal, the floor being cut down a short distance into the solid rock and covered with a white earthy deposit. The roof was supported on six pilasters between each pair of which there is a banquette, that on the south side being larger than the others. In the floor there is a circular fire pit, near which is a deflector facing a ventilator. There is also a large *sîpâpû* or ceremonial opening in the floor. The surface of the north banquette has its ledge lowered to a level below that of the others, and in the wall above it is a recess that served, no doubt, for the idol. A slab of stone formerly used to close this recess lay on the kiva floor below it. A structural peculiarity was observed in the wall of One Clan House. As a rule kiva walls are built of horizontal masonry, but here the walls above the banquettes were made of upright stone slabs.

A well-worn trail, probably originally made by Indians, connects Far View House, Pipe Shrine House, and One Clan House with Spruce-tree House. Since the Indians abandoned the Mesa this trail has been deepened by stock seeking water and by herdsmen; it was also formerly used by all early tourists who visited the ruin on horseback before the construction of roads.

An important result of the archeological work of the Bureau of American Ethnology at the Mesa Verde the past summer, 1922, is new information on the use of towers revealed by the excavation and repair of Far View Tower. This building (fig. 103) is situated north of Far View House, about midway between it and "Mummy Lake," and when work began on it no walls were visible; the site was covered with sage bushes, and fallen stones strewn over the surface had raised a mound a few feet high, which is now a fine circular tower surrounded by low walled basal rooms. Three kivas were revealed on the south side where formerly no evidences of their existence appeared. Two of these (figs. 104, 105) were completely excavated and a third showed evidences of a secondary occupation. After this kiva had been used for a time, no one knows how long, it was filled with debris and fallen stones on which new walls were built by subsequent occupants. The masonry of the rooms they built is much inferior to that of their predecessors, the original builders of the kivas, and probably contemporaneous with the low walls east and north of the tower.



FIG. 102.—Kiva of One Clan House, from the north. Showing two pilasters, ledge on banquette for altar, conical corn fetish, sipapu and mortar. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

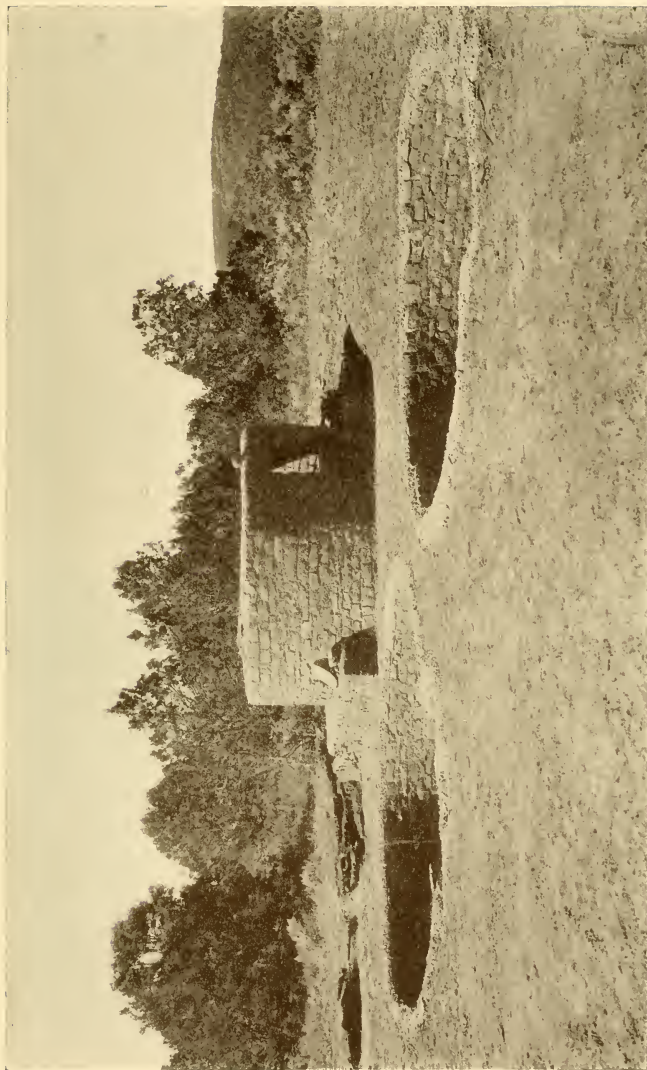


FIG. 103.—Far View Tower, looking north, showing tops of two kivas. Doorway in shadow: object above doorway germ idol or "corn mound." (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)



FIG. 104.—Kiva A, Far View Tower, looking south, showing ventilator opening and large banquette. (Photograph by W. R. Rowland, Durango, Colorado.)



FIG. 105.—Kiva B, Far View Tower. (Photograph by W. R. Rowland, Durango, Colorado.)

The main object in excavating Far View Tower was to discover the use of these buildings, many of which occur on the Mesa Verde and still more in the canyons and tablelands west of the park. These structures are commonly supposed to have been used to detect enemies approaching the settlements. This was one of their functions; they were undoubtedly constructed to enable the observer to see or signal a long distance. Nordenskiöld suggested that Cedar Tree Tower had a religious character, which appears feasible. It is believed that one of their uses, perhaps the main one, was to observe the position of the sun on the horizon and thus to determine the seasons of the year by noting the corresponding points of sunrise and sunset. The sun priests of the early cliff dwelling determined the time of planting and other necessary calendar data for the agriculturists in the same way as the Hopi who use the following method: The line of the horizon silhouetted against the sky between the rising of the sun at the summer and winter solstices is divided into a number of parts each corresponding to a ceremony or other important event.¹ The point of sunset at the winter solstice is likewise used for the same purpose. Having determined in this way that the time for planting has come, the sun priest informs the speaker chief who makes the announcement standing on the highest roof of the pueblo. These towers were not only lookouts from which by horizontal sun observations the seasons were determined, but likewise sun houses or chambers where certain sun rites were performed. There is a room dedicated to sun ceremonies connected with the Great Serpent worship among the modern Hopi; and it is instructive to note that incised spiral designs representing the great snake frequently occur on stones of which towers are built. These towers may be square, circular, or D-shaped in form; may have one or many chambers; and may be accompanied with kivas or destitute of the same. Commonly the rising or the setting sun illuminates their summits. Sun Temple, on the Mesa Verde, may be regarded as a complicated tower with many chambers but in function practically the same as that of a simple one-chamber tower. The complex of rooms at Far View Tower should be looked upon as an architectural unit, composed of a tower, probably when in use as high as the tops of the neighboring cedars; three subterranean ceremonial rooms, circular in form and similar to cliff-house kivas; and a cemetery situated on the south. The rooms for habitation surrounding the tower do

¹ It would be very instructive in this connection to determine by excavation whether the two towers known as Küküchomo, on the East Mesa of the Hopi, were used for the same purpose as those at Mesa Verde.

not belong to this complex but indicate a secondary occupation; their masonry is crude; their number shows that the population was insignificant. The few people who occupied them came later than those who erected and used the tower.

There remain several large mounds in the Mummy Lake area awaiting excavation: some of these cover pueblos or houses of many clans, others small one-clan houses. The superficial appearance of these mounds seems to indicate types somewhat different from any yet described. One of the most unusual is a mound lying a few



FIG. 106.—Megalithic House. Mainly distinguished by walls made of huge stones on edge. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)

hundred feet north of Mummy Lake, near the government road. When discovered nothing appeared above ground except a row of large unworked stones set on edge, forming one wall of a small room. On excavation walls of other rooms appeared, one of which was paved with flat stones. The ruin had a single subterranean kiva, of regulation shape and size, the walls characterized by large stones. This ruin, called Megalithic House (fig. 106), belongs to a type which there is every reason to suspect is represented elsewhere on the Mesa. Cyclopean walls similar to those of Megalithic House have been previously reported from the bluff overlooking the junction of the Yellow Jacket and McElmo Canyons, and at various places in the

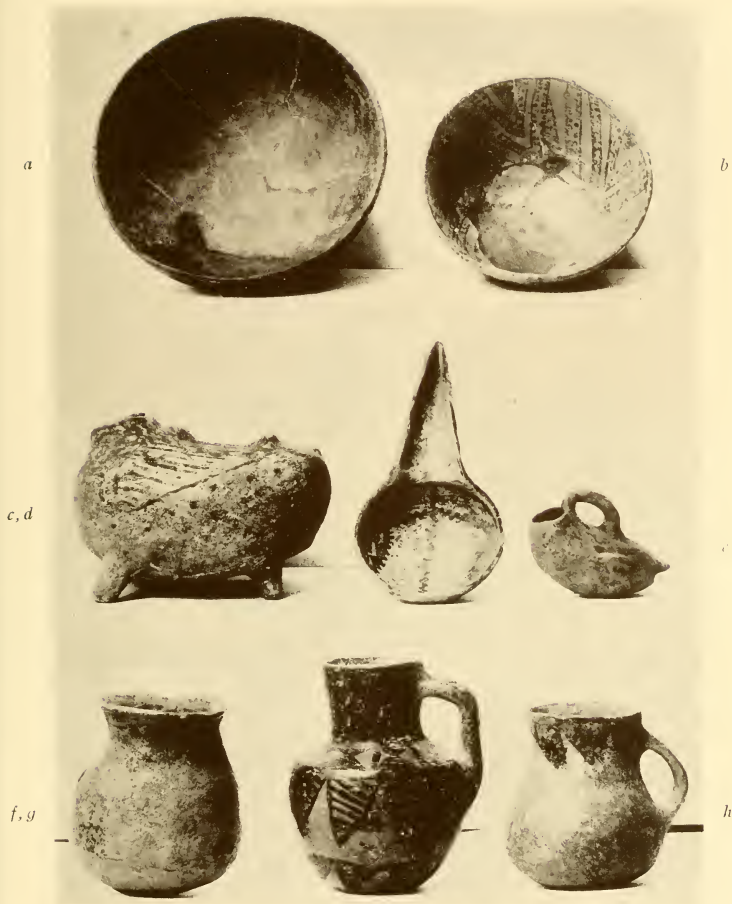


FIG. 107.—Pottery from cemetery of Pipe Shrine House: *a*, Red food bowl; *b*, Coiled brown ware, archaic decoration; *c*, Effigy jar, black on white; *d*, Ladle, black on white; *e*, Effigy jar, black on white; *f*, Vase, rough ware; *g*, Mug, gray with glossy black figures; *h*, Mug, gray with black decoration.
a, Diameter 11", height 4"; *b*, diameter 6½", height 3"; *c*, height 4¼", length 6", width 4"; *d*, diameter 3½", handle 3½" long; *e*, length 3¼", height 1¾", width 2"; *f*, height 3¾"; *g*, height 4½"; *h*, height 4½".

San Juan Valley. In some instances the walls are made of much larger stones, but always vertically placed.

An examination of the numerous artifacts or small objects like stone implements, pottery (fig. 107), and the like, that were collected in the excavation of the rooms above mentioned, impresses one with the unique character of several, and the differences of the ceramics from those of Spruce-tree House and Cliff Palace. We find characteristic cliff-house forms of indented and corrugated ware differ from those of Far View Tower which more closely resemble those found at Pipe Shrine House; other forms do not occur in cliff houses. Many specimens of apparently coiled ware were decorated with stamps, one



FIG. 108.—Stone with parallel grooves, possibly used as a pottery stamp. Pipe Shrine House. Size: $2\frac{3}{4} \times 2\frac{3}{4} \times 5$ inches.

of which is shown in figure 108. Among pottery types may be mentioned: *a*, food bowls with shiny black interiors and small grooves with corrugations on their exteriors; *b*, pottery showing coils (fig. 109) on their exteriors and painted designs on their interiors. The black and white ware is coarse and the designs used in decoration are simple and not very artistic. Representations of a few of these archaic types appear in the accompanying figures. The excavations at Far View House, Pipe Shrine House, and other surface pueblos show that there are several divisions of corrugated ware which should be considered. We should not rely wholly on geography in a comparative study of ceramics in the Southwest; age may also be considered. It is probable that types of architecture have changed

since man settled on Mesa Verde, and that pottery also has changed seems probable, but direct observations regarding that change are necessary. Take for instance the type known as effigy jars and vases. No clay effigies of men or animals had been recorded from Mesa Verde before the present year. Jars representing birds, quadrupeds, and a clay representation of the foot of a human effigy were excavated at Pipe Shrine House. A more archaic pottery distinguished by black figures on white ware is not the same as the black on white ware found in cliff dwellings, which would appear to indicate that the pottery from the cemetery of Pipe Shrine House was earlier than that of Spruce-tree House, and yet we find at the former locality pottery fragments equal in technique and almost identical in

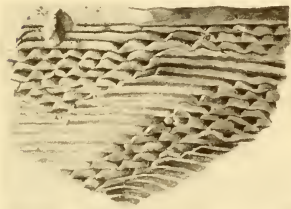


FIG. 109.—Fragment of corrugated pottery. One-third natural size. (Drawing by Mrs. George Mullett.)

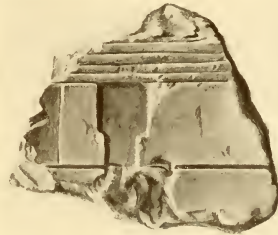


FIG. 110.—Stone with carved T-doorway in intaglio. (Drawing by Mrs. George Mullett.) Size: $5\frac{1}{8} \times 5 \times 3\frac{3}{4}$ inches.

ornament with the best taken from the latest cliff houses on the park. There is evidence from the character of the pottery that some of the Mesa Verde pueblos were inhabited later than Cliff Palace, rendering it easy to accept the theory that the Mesa Verde caves became so crowded with buildings that their inhabitants were compelled to move out and, having constructed pueblos, to settle on the mesa tops near their farms.

Several objects, some of which are of doubtful use, were found near Pipe Shrine House. One of these is the stone shown in figure 110, on which is engraved a T-doorway and roof beams, a specimen which, so far as known, is unique. A bare mention of the various forms of stone weapons and mortars and pestles, implements, pottery objects, bone needles, scrapers and the like would



FIG. 111.—Fossil shell used as an arrow polisher. Pipe Shrine House. Size: $2\frac{3}{4} \times 1\frac{3}{4} \times 1\frac{3}{8}$ inches.



FIG. 112.—Cool Spring House on Cajon Mesa, Hovenweep National Monument. (Photograph by J. W. Fewkes.)

enlarge this report to undue proportions. An implement hitherto undescribed (fig. 111) is made of a fossil bivalve shell with two grooves for arrow polishing. This object is ornamental as the outer surface of the shell valves give it an artistic look.

In order to protect them from the weather, the tops of the walls of rooms in Pipe Shrine House, One Clan House, Far View Tower and the kivas of the same were covered with a cement grout. The walls of Far View House were treated in the same way and it is to be hoped that these ruins will not need additional protection from the elements for several years to come.

At the close of his season's work on the Mesa Verde National Park, Dr. Fewkes visited Cool Spring House (fig. 112), a large undescribed ruin on Cajon Mesa, in Utah, about 10 miles west of the junction of McElmo and Yellow Jacket canyons. Cool Spring House, like Cannon Ball Ruin, is situated about the head of a canyon and consists of several more or less isolated rooms. It takes its name from a fine spring below the mesa rim. This ruin is situated so far from white settlers that its walls are at present in no danger of being mutilated, but there is danger that the neighboring towers will soon be torn down, if not protected. As it is proposed that Cool Spring House be added to the towers in Square Tower Canyon and Holly Canyon to form the proposed Hovenweep National Monument, it would be most unfortunate if these three groups of ruins should be allowed to be destroyed by vandals.

OBSERVATIONS AMONG THE ANCIENT INDIAN MONUMENTS OF SOUTHEASTERN ALASKA

In the spring of 1922, the Bureau of American Ethnology dispatched a special investigator, Dr. T. T. Waterman, to examine the remains of native villages in southeastern Alaska. A number of these interesting old settlements were scrutinized, in the company of native informants. There is much of interest in and about these old-time villages, though signs of Indian occupancy are rapidly vanishing. The principal objects of remark are the totem-poles, for which this part of America is celebrated. Every village site shows a number of these columns, though some have fallen, some have been cut down with axes, and some have been hauled away bodily as curiosities, sometimes to distant cities. In spite of the fact that they are carved out of nothing more enduring than wood (usually yellow cedar) some of them are of such tremendous size and solidity that they have stood for many generations. Here and there on the old village-sites,

there still may be seen among the poles the framework of one of the old-time Indian houses.

The area in which totem-poles were originally in use was very definitely limited. Nowadays small replicas are being cut for sale



FIG. 113.—A fine example of totemic art, from the Alaskan town of Howkan (central pole). Striking features of totemic art are, (1) the love of complexity, and (2) the fact that the whole pole is an artistic *unit*. A figure merges into the ones above it and below it in the most clever way. This is well shown in the splendid column in the center. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

out of all sorts of wood, and stone, by all sorts of people, many of whom have not the faintest notion of how to do it properly. Originally, poles were not set up anywhere south of Frazer River. The Indians of Puget Sound, for example, never heard of these columns until late years. The Indians of the east coast of Vancouver Island

had totemic columns, but the custom had never spread to the island's western side. To the northward, totem-poles were carved by all the tribes as far north as the Chilkat (a Tlingit group living not far from Haines, Alaska). The Indians to the north and west of them,



FIG. 114.—The degeneration of totemic art under civilized influences. It would be a pity to discuss this wretched thing, except to note that the clever joining of one figure to the next is completely forgotten. The carvings show (at the bottom) the Sun, above that two Beavers, and, at the top, an Eagle. The house behind it is called "Eagle-leg house." The house-posts represent the legs and feet of the eagle. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

however, knew nothing of such columns. Beyond these lived the Eskimo and Aleut, to whom the whole matter is absolutely foreign. The whole idea of art from which the totem-pole rose, was limited strictly to the coast region.

It is safe to say that totem-poles are peculiar. As a matter of fact they represent a very highly developed, and very highly perfected, art. For many generations the Indians hereabouts were developing a special "knack," and special ideas, and the matter has gone so far that other people (even some civilized artists) seem to have a hard time even in copying their handiwork.

In looking over these monuments, one is impressed by the fact that there has been a gradual change in artistic style even on the part of the Indians themselves. Unfortunately, this change is in the wrong direction. The older monuments are much more interesting, and are better executed, than the later ones. In other words, the Indians themselves are forgetting their art. This matter is worth illustrating by photographs (figs. 113, 114). Monuments carved within the last 40 years look (usually) rather staring and stiff, compared to the ones executed previously. With the increasing decay of the old landmarks, a unique style of work bids fair to pass as completely out of existence as though it had never been.

This art consists almost solely in the representation of animals. In the second place, the carvings refer almost always to the parts which these animals played as actors in certain interesting old myths. The carving is meaningless, unless one understands the allusions. Personal experiences are sometimes portrayed. This matter, also, can be very simply illustrated. In the third place, in making a representation of an animal the Indian has special stylistic devices. He puts in what he knows should be there (including at times things not visible at all). Finally, he often simplifies and distorts (according to certain definite rules), in the interest of getting in what he regards as important. He actually loves artistic complexity. All of these tendencies prevent us from readily appreciating what is in many cases a genuine artistic masterpiece. These points may well be explained separately.

The significance of the poles can scarcely be understood without taking into consideration the form of society which these Indians had developed. All of the tribes of the Northwest Coast are divided into what are usually called "clans." This word is borrowed from the Scotch, and is a very poor term to describe the social groups of the Northwest Coast Indians, for here each group looks upon itself as related by blood to some particular animal. A tremendous mass of ideas and usages has grown up, involving kinship, rules of marriage, property, religious ceremonies, and descent, all centered about these



FIG. 116.—The lower part of an old totem-pole, showing the old style conventionalized way of representing the Bear. The smaller figure is a carving from the corner of the house, representing the killer-whale. (Photograph by Julius Sternberg, for the Smithsonian Institution.)



FIG. 115.—A late carving, representing a Bear; more realistic than the former, but not half as interesting. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

animal crests. To the Indian of this region, the most important thing in life is his animal crest or "totem." All his ideas and ambitions center about this hereditary animal progenitor and protector, the similitude of which he carves on all his utensils, paints on his house-front, tattoos on his arms and chest, paints on his face, and represents on his memorial column. Curiously enough (from our particular point of view) these people reckon kinship through the mother only. This has some curious consequences. A man (to mention one consequence) sets up a memorial column, not for his father, but for his mother's relatives, particularly her brother. Conversely, if a collector wishes to buy a pole for preservation, he ought logically to arrange matters, not with a dead chief's son, but with the dead chief's nephews; for a son has (according to the native idea) no connection with his father. It is to a maternal uncle that a boy or young man looks for guidance and counsel, and it to his maternal uncle's memory that he owes respect and veneration. It is from this uncle only that he inherits property. A boy's whole position in society, his rank, his outlook, his standing, and his prospect for a wife, all hinge upon the animal crest which he inherits from his mother's brother. It is clear, therefore, that a "totem-pole" will display to the public view all the animal crests which the Indian possesses, and all those with which his family (*i. e.*, his *maternal* relatives) have been associated in the past.

The importance of these animal crests to the Indian, may be illustrated in an interesting way by the matter of personal names. Many of the names used within a group of kindred, refer to the qualities, or traits, or tricks of behavior, of those animals to which the group looks. Sometimes the names are highly figurative. Sometimes they are so pitilessly literal and Homeric in their directness that they almost disconcert us. Some very famous names, which have been used in certain families for generations, appear in the following list:

NAMES IN THE RAVEN CLAN

"Raven's child."

"Waddling." This refers to the raven's gait when he walks on the ground.

"Treating-each-other-as-dogs." This alludes to the fact that when a raven dies, the other ravens pull the body about, dragging it here and there.

"*Big-doings.*" This refers to the fact that young ravens are noisy, in the nest. The native word means literally a celebration, or fiesta of some sort.

"*Stinking-nation.*" This epithet refers to the fact that the raven's nest has a bad odor.

NAMES IN THE EAGLE CLAN

"*Four-eggs,*" an allusion to the eagle's trait of laying always four eggs in the nest.

"*Tail-dragging,*" because the tail of the eagle drags when he walks.

"*Flying-deliberately.*" The eagle, with his great bulk and enormous wings, flies strongly but deliberately, unlike any of the smaller birds.

The next point to be explained is the matter of mythology. The animals whose likenesses appear in the carvings are the heroes of endless mythical tales. It requires a good deal of erudition therefore to explain some of the carvings on the totem-poles. Only the old Indians can do it. In the first place, the animal may be represented either in human or in animal form, for any animal can take either form, as he pleases. A bear, for example, in his own den, takes off his bear-skin and hangs it up. What looks like a lot of stones or branches is in reality the furniture and property in a fine house; and the bear himself appears there as human as you or I. Conversely, when the Indian artist is carving the likeness of a man, he is occasionally so moved by his feeling for that man's totem or crest, that he introduces features of the crest-animal into the carving. The art is therefore a bit abstruse; and the native sculptor seems in some cases to delight in border-line styles of execution.

The carvings on a given pole, where they refer to the great animal heroes, usually allude to some certain episodes in the myth of that particular animal. For example, a certain family of Raven-people living at the town of Kasaan put up the pole shown in figure 117. It represents part of the legend known as "Raven Travelling." At the top is Raven himself, in human form. Below him is his likeness in bird form (and an impish look it has). Below this again is a fish called the sculpin or bull-head—an excessively ugly and repulsive looking fish.

Bull-head used to be a beautiful fish, the prettiest of all that swam in the sea. Raven when walking along the shore saw Bull-head disporting himself, and called out to him, "Come on shore one moment." Bull-head paid no attention. "Come ashore a moment," said Raven, "you look just like my grandfather." "I know you," said Bull-head,

"you might as well be still. Future generations also will know what kind of a person you are!" Bull-head was thus too smart to come ashore. "Well then," said Raven, "from this time on your head will be big, and your tail will be skinny, and you will be ugly." That is why Bull-head is so ugly to-day.



FIG. 117.—A totem-pole at Kasaan Village, illustrating the myth of the adventures of Raven. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

An illustration of another kind of crest is supplied by the following picture (fig. 119). The carving at the top represents a man in a stove-pipe hat and a frock coat. An old lady belonging to the house in front of which this pole stood, was the first person in the village to encounter a white man. She went to Sitka with some Indians, and there saw a ship with whites in it. The figure representing what she saw was accordingly put on her pole. Below this white man is a

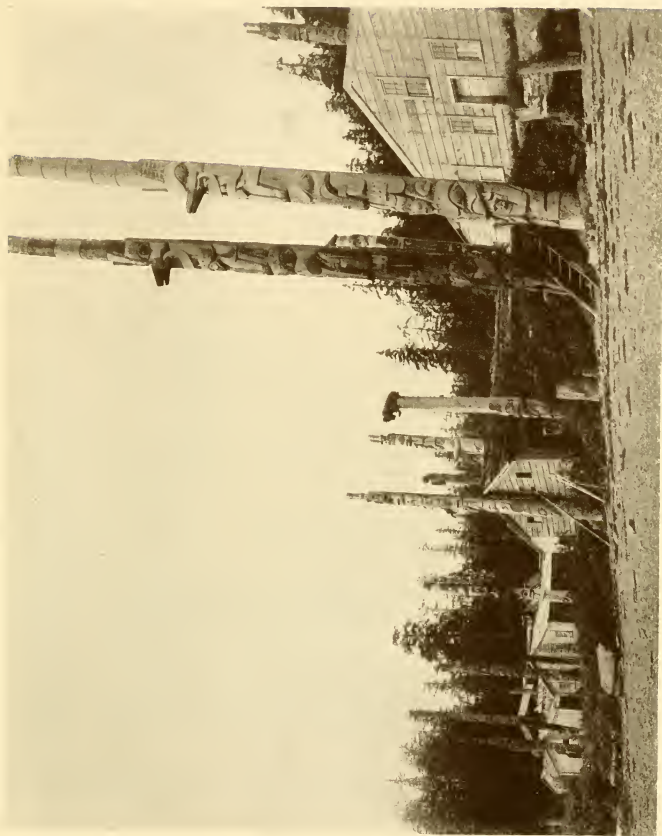


FIG. 118. —A photograph of Kasaan Village made by Lieutenant Emmons, about 1885. The poles in the foreground show the crests of Chief Skowl.

splendid carving of Raven, and below him a figure representing a "sea-lion rock." The supernatural being who lives in the rock is pictured as a great beast, who embraces a sea-lion, the flukes of which are under his chin. Such a rock-being is called "Grandfather-of-the-sea-lions." In this pole, carvings like the carving of the Raven, representing the ancestor of the owner's family, are combined with



FIG. 119.—A pole with a white man as a totem (central pole). An old lady who set up this pole was the first Indian of her group to see the whites, so she took a white man (in a frock coat and a stove-pipe hat) as her crest. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

a carving representing something in the history of the owner's wife, namely, that she was the first person in the village to come in contact with the whites.

A totem-pole represents, really, a certain Indian's claim to fame. His claim may be based either on his own experiences (like a dis-

tinguished conduct medal is, with us) ; or it may be founded on his ancestry, as in the case of a title of nobility or a coat of arms.

The idea that a pole always represents descent is therefore not quite accurate. It is more nearly correct to say that the pole represents the Indian's claim to fame, or the claim of his family, whatever that claim may be based on. Examples of both kinds of carvings are plentifully illustrated in the poles.

A quaint example of a recently-acquired crest is shown in the next photograph (fig. 120). This specimen was described to me as "the best totem-pole in Alaska." As a matter of fact, it is not properly speaking an example of totemic art at all. The owner's wife was an Eagle woman, so the Eagle appears at the top of the pole. The owner himself many years ago, prior to the American occupation of Alaska, became converted to Christianity. The three figures on the body of the pole were copied, along with the scroll designs, from a Bible in the Russian church at Sitka. The bottom one represents, it is said, St. Paul. The pole, while it is not a totemic monument as far as the designs on it are concerned, illustrates how an individual's inner experiences give rise to crests. This man gave a great "potlatch" when he raised the pole, and thus endowed himself with title to these carvings, and made them his own. He was the first of his group to become a Christian.

It will be seen that there are a variety of ways in which carvings come to be on poles. In one case I know of, a chief who belonged to the Raven side, gave a great feast to a rival chief, a man of the Killer-whale persuasion at Wrangell, and made him numerous gifts. This latter chief fell upon evil days (he became a drunken loafer, in fact) and was never able to return these gifts, in their equivalent. The first chief therefore put on his totem-pole his own crest, the Raven, represented as biting the dorsal fin of a Killer-whale. The rival chief resented the affront, but he had lost his property so what could he do?

Some of the larger poles are 50 or 60 feet long. The tree is felled and transported to the village-site, often at great labor. Here it is blocked up, and an artist, hired for the purpose, works out the design. To carve an elaborate pole was often the work of several years. The back side of the pole was hollowed out, to lighten, as much as possible, the labor of erecting it. A large concourse of people assembled for the actual erection of the great column, and to partake of the accompanying feast. Tremendous amounts of property were distributed at such times, by the host and by his relatives, and such an occasion has come to be called a "potlatch." The rank of a family



FIG. 120.—A "totem-pole" with figures copied from an old Russian Bible in the church in Sitka. The owner was the first inhabitant of the village to become a Christian. (Photograph by Bergstresser, Alaska.)

was greatly increased by this means. The size of a pole, and the style of the carvings, like the name assumed by the owner, were correlated to a nicety with the cost of the potlatch and the amount of property disbursed. The noble families were very careful of their dignity. Once a young man who was preparing to take a swim,



FIG. 121.—A pole at the village of Howkan, showing (near the top) a representation of the Czar of Russia who sold Alaska to the U. S. A. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

slipped on a treacherous rock and capsized on this beach. His father at once ordered that a slave be killed, so that nobody would laugh at his son. Slave people, who merely represented objects of value, were often dispatched at potlatches, to add lustre to the occasion, and to show that the owner was so rich that the value of a slave was nothing to him.

In later times, after the first contact with civilization, it became difficult to kill slaves. The custom developed, therefore, of manumitting one or more slaves when a pole was set up. A figure representing the slave who went free, was often carved on the pole. A very finely carved pole in Howkan (fig. 121) has an amusing figure on it. It represents the Czar of Russia who sold Alaska. It shows him with his military uniform, with epaulettes. An Indian made this pole soon after the transfer of Alaska to the United States. Concerning the Czar he said as follows: "We have now got rid of this fellow. We have let him go off about his business. Therefore, I will put him on my pole, in memory of the event."

A certain artistic style has become established in this region, which also tends to prevent the carvings from being readily recognized. Two tendencies especially may be recognized. In the first place, many parts of the animal are suppressed entirely, and selected features only are portrayed. In the second place, the Indian artist feels at liberty to *rearrange* the parts of the animal, to make the design fit the available space. Often the animal is reassembled in an entirely new way, the parts appearing in the most unexpected and incongruous way. These two tendencies have been labelled by Boas the tendency toward *symbolism*, and the tendency toward *distortion*.

Some of the important totem animals are symbolized by the following traits. When one or two of these traits are present, the animal may be readily recognized.

Beaver. This animal is usually represented as sitting up, and gnawing at a stick, which he holds in his forepaws. The great incisor teeth of this rodent are always shown very plainly.

Bear. The bear is usually in a sitting posture, usually holds something between his paws, and usually has something protruding from his jaws (if nothing else, then his tongue).

Eagle. The beak of the eagle curves over at the end, and has a characteristic shape.

"*Thunderbird.*" This bird (which does not appear in the natural histories) makes thunder by clapping his wings, and lightning by winking his eyes. He is carved very much like the eagle, but his beak is larger, and he wears a cloud hat.

Hawk. The carving of the hawk may be distinguished by the fact that the beak curves over, and the point of it touches the mouth or chin.

Shark. The characteristics emphasized in the shark-carvings are rather curious. The animal's gill-slits (a row of openings on either side of the animal's neck) are always shown by crescent-shaped

markings. When the shark is represented in human form, these marks appear on the cheek. The mouth is invariably *curved downward* at the corners, and is often furnished with sharp triangular teeth. The forehead of the shark always rises into a sort of peak.

The principle of dissection is equally useful to the native artist. It may be illustrated not merely in the case of totem-poles, but with many varieties of objects. We may suppose for example that an Indian's totemic crest happens to be the Killer-whale, and that this man is ornamenting a slate bowl with this family crest. The shape of the bowl is settled in advance; that is, being a bowl or dish, it is round. The nature of the design is also a cut-and-dried matter. The man in the nature of the case wishes to represent the Killer, for that is the crest he has inherited from his forebears. He therefore has to make a killer-whale pattern which will exactly fit into a round field. The Indian's artistic ideal is quite different from our own. He feels (apparently) that certain essential traits (or "symbols") of the animal must go in; and that the design when finished must neatly fill up the available space.

The monuments left in Alaska are often in the last stages of neglect and decay. Worse than that, even, many of them are being deliberately destroyed. The Indians themselves, under the influence of the whites, learn to despise these monuments of their past, as being reminders of their state of unregenerate barbarism. One Indian chap, trained in the white man's ways and "educated" perhaps somewhat beyond his intelligence, cut down with an axe a lot of fine old totem-poles, sawed them into sections, and used them in building a sidewalk. (See fig. 122.)

The fate which has for various reasons overtaken these monuments is best indicated by the accompanying photographs. The ruin and decay which has fallen upon all things simply beggars description. No work could be better than to preserve, somewhere in Alaska, at at least one house, with its totem-poles and carvings complete. This would at least serve to illustrate the kind of architecture which these Indians developed. Some of these native houses were of cyclopean proportions, the great beams being 3 and 4 feet in diameter. The older Indians themselves often have toward the whole matter what seems to be an apathetic attitude, but this is misleading. The real inner feeling seems to be that the old times are gone, and that these monuments of the vanished past should, in the nature of things, be allowed also to decay in peace and to vanish quietly from off the face of the earth. It would not be impossible to interest some of the more alert ones in the preservation of at least some of the ancient glories of



FIG. 123.—An outcrop of rock at Howkan, shaped to represent the sea-lion. (Photograph by Julius Sternberg, for the Smithsonian Institution.)



FIG. 122.—Totem-poles sawn into sections to make supports for a sidewalk at the village of Klinkwan. A section of a pole is visible under the sidewalk, to the right. In the background stands an undamaged pole, showing (at the top) Raven carrying the moon. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

this region. In spite of all that has happened, there is much of great interest left, as the pictures show. No poles worthy of the name have been carved for 30 years, and for 20 years before that the art was degenerating. Some of the old columns are in a marvelous condition of preservation considering their age. The decay begins at the top,



FIG. 124.—Interior of an abandoned native house, showing one of the totemic house-posts, portraying the Bear. (Photograph by Julius Sternberg, for the Smithsonian Institution.)

where seeds also take root and sprout. Often when the top figure is gone, the remainder of the carvings are fairly sound. At the town of Tuxekan an observer in 1916 counted 125 poles standing. In 1922, only 50 were left. The information about the poles, also, is disappearing even more rapidly than the poles themselves, for only the old people know or care.



FIG. 125.—Panorama of Kasaaan Village, Alaska, as it was in 1922. (Photograph by Julius Sternberg, for the Smithsonian Institution.) Compare this with a photograph of the same village, made about 1885 (fig. 118, above).

During the time the observer was in the field, a half dozen of the old village-sites were visited. Sketch-maps were prepared, showing the condition of the monuments. Quite extensive notes were taken from native informants, respecting the genealogies of the people who owned the houses, and the symbolism of the poles. A complete list



FIG. 126.—Three Indians of a totem-pole tribe, in native garb.

was made also of the geographical names along the coast from one village to the next. The native geography of extreme southeastern Alaska was therefore rather completely obtained. The number of place-names thus recorded, charted and analyzed, amount to several thousand. There is probably no region in North America where investigations can be carried out with richer results.

ARCHEOLOGICAL INVESTIGATIONS AT PUEBLO BONITO,
NEW MEXICO

During the months of May to September, inclusive, Neil M. Judd, curator of American archeology, U. S. National Museum, continued his investigation of prehistoric Pueblo Bonito, in behalf of the National Geographic Society.¹ As in 1921, Mr. Judd's staff consisted of seven trained assistants with about 20 Navaho and Zuñi Indians employed for the actual work of excavation.



FIG. 127.—Mr. R. P. Anderson, a former captain of engineers, A. E. F., at work on a topographic map of Chaco Canyon. This view, taken from above Pueblo Bonito, affords an excellent idea of the surroundings of the great ruin and the height of the canyon wall. Note the horses and one of the expedition's test pits in the right foreground. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

In these recent explorations, attention was directed especially to the eastern part of the great ruin, a section which includes not only the finest masonry in the whole pueblo but which exhibits other evidence of relatively late construction. This entire section, although apparently erected last, was probably abandoned before the remainder of Pueblo Bonito. Because of this general abandonment, cultural evi-

¹ Smithsonian Misc. Coll., Vol. 72, Nos. 6 and 15.

dence is largely lacking in the several rooms but the information gathered has been sufficient, nevertheless, to afford accurate comparison with that of other sections. It is now certain that Pueblo Bonito is not the result of a single, continuous period of construction, rather, that it took its final form after much building and rebuilding in which substantial homes were razed to make way for others.

A deep trench was cut in the east refuse mound in order to obtain chronological data for use, with similar information gathered in the



FIG. 128.—Part of the excavated northeast section of Pueblo Bonito at the close of the 1922 season. Most of these rooms had been abandoned prior to the general exodus from the village and were utilized as dumping places for refuse by families which continued to dwell nearby. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

west refuse mound during 1921, in tracing the cultural development of Pueblo Bonito and establishing relative dates, if possible, for the several foreign influxes already apparent. As has been previously noted, clans from the Mesa Verde, in Colorado, and from the valley of the Little Colorado River, in Arizona, and elsewhere, came to dwell at Pueblo Bonito at some time after the establishment of the great community house. The expedition seeks to isolate these outside influences and to determine the effect they exerted upon the distinctive local culture.

In addition to the purely archeological phase of the expedition, geophysical investigations were undertaken in an effort to trace climatic or other changes which may have taken place in Chaco Canyon since the occupancy of prehistoric Pueblo Bonito. Three test pits near the ruin, each more than 12 feet in depth, provided stratigraphic sections of the valley fill in addition to that already available in the arroyo. From the evidence disclosed in these pits, and elsewhere, it now appears that Pueblo Bonito was originally constructed on a slight elevation, superficial indications of which have since been entirely obliterated through building up of the level valley floor by means of blown sand and silty deposits washed in from the sides of the canyon. These deposits vary in depth from 2 to 6 feet and frequently contain scattered objects of human origin.

A pre-Pueblo ruin, the existence of which was disclosed only through caving of the arroyo bank, affords further evidence of the human occupancy of Chaco Canyon at a considerable period prior to the erection of Pueblo Bonito and the other major ruins, a similar structure having been excavated by the National Geographic Society's Reconnaissance Expedition of 1920. This ancient habitation consisted of a circular pit 12 feet 9 inches (3.9 m.) in diameter and about 4 feet (1.2 m.) deep, excavated in the former valley floor; its roof was of reeds and earth supported by small poles which reached from the wall of the excavation to upright posts placed just within an encircling bench. A considerable quantity of potsherds, collected both from the debris which filled the pit and from the masses of adobe which had fallen away from the bank, established the period to which the dwelling belongs as "early black-on-white," a culture well known throughout the San Juan drainage. The fact that the floor of this ancient structure lay 12 feet below the present valley surface is evidence not only of the vast amount of silt which has been deposited since occupancy of the room, but carries the promise, also, that other similar lodges may yet be disclosed by excavation or through the gradual erosion of the valley.

A topographical survey of that part of Chaco Canyon adjacent to Pueblo Bonito, completed by the 1922 expedition, affords the first accurate map of the principal portion of the Chaco Canyon National Monument. This survey correctly locates nine of the major ruins and indicates the relative position of most, but not all, of the smaller structures to be found, especially those along the southern side of the canyon.



FIG. 129.—A narrow, elevated passage-way constructed through one Pueblo Bonito room to connect the two adjoining chambers. The lintel poles of the nearer doorway are supported, on the right, by a hewn plank which rests upon an upright pine log partially imbedded in the wall. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 130.—The ceremonial rooms which belong with the characteristic Chaco Canyon culture are all very much alike. This view in Kiva G, at Pueblo Bonito, shows a portion of the encircling bench, one of the pilasters or roof supports and several charred posts which originally formed something of a wainscoting behind the lower ceiling logs. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 131.—Excavating one of Pueblo Bonito's numerous kivas. Mule-drawn dump cars were used in connection with a portable steel track which could be shifted as the explorations progressed. Owing to the depth of some rooms it was necessary to pass the debris upward from one man to another before it reached the track level. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 132.—Many instances of superposition have been disclosed by the excavations at Pueblo Bonito. This particular view shows the disintegrating masonry of a typical Chaco Canyon kiva resting directly upon the partially razed walls of a ceremonial room fundamentally different in construction and representing an entirely distinct culture. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

Altogether, 35 secular rooms and six kivas were excavated in Pueblo Bonito during the past summer. Several of these, following abandonment of the eastern portion of the pueblo, had been utilized as dumping places by the families which still dwelt nearby. Rubbish from wall repairs, floor sweepings containing potsherds and other artifacts, cedar bark and splinters from old wood piles, etc., comprised this debris. The doorways in many of these deserted dwellings had been blocked with stone and mud and the rooms themselves were



FIG. 133.—Part of the excavated area of Pueblo Bonito at the close of the 1922 season, looking southeast across Kiva G (in the foreground). The upper walls in the three kivas shown here have been slightly repaired to prevent rain water from running into the open rooms. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

entirely filled by masonry fallen from the upper stories and by the vast accumulation of blown sand and adobe. Indications of fire were encountered frequently but in most instances the conflagration obviously occurred at a considerable period following the general abandonment inasmuch as blown sand and, sometimes, fallen wall material had accumulated upon the lower floors before the burning of the ceiling structure. From this evidence, it is certain that the fire which destroyed much of the woodwork in the eastern portion of Pueblo Bonito could have contributed in no wise to its desertion. Sections

of charred and other beams have been examined to determine the relative date of cutting and in the hope, also, that a means may yet be discovered for connecting the annual rings in these ancient timbers with those in trees still growing upon the northern New Mexico mesas. Inasmuch as the prehistoric Bonitians left no known calendar or other time record, an effort is to be made to correlate their distinctive chronology with that of our own civilization through over-



FIG. 134.—The high cliff behind Pueblo Bonito affords an exceptional vantage point from which to view the ancient ruin. In this photograph, taken at the close of the 1922 season, the relationship of the secular rooms and kivas is at once apparent. Note the cars and track by which debris was conveyed from the ruin for deposition in the arroyo; also the expedition camp in the upper right-hand corner. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

lapping series of growth rings in living trees, old logs and ancient beams.

Investigations pursued beneath the floors of both dwelling rooms and kivas revealed, as in 1921, the remains of razed walls belonging to an earlier period of construction. The later habitations do not necessarily conform to the outline of those preceding; the masonry

itself is usually, but not always, different in type thus indicating that people with entirely distinct cultural customs reoccupied this section of the pueblo prior to its final abandonment.

Among the artifacts collected during the past two years are specimens and many fragments of mosaic. These, with the number and



FIG. 135.—A circular pre-Pueblo dwelling, 1 mile east of Pueblo Bonito, was cross sectioned by caving of the arroyo bank. Twelve feet of blown sand and water-deposited silt had accumulated upon the floor of the room whose furnishings included a central fireplace (above the Indian) and a semi-circular bench (at upper left). Charred fragments of roofing poles are plainly seen. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

variety of bracelets, pendants and other objects of personal adornment already recovered, tend to confirm the Navaho and other traditions relating to the great wealth of the ancient Bonitians. Pueblo Bonito is still identified among the Indians of northwestern New Mexico as a village where turquoise and rare shells were abundant. The pottery



FIG. 136.—Dwellings in Pueblo Bonito were sometimes razed to permit of the construction of ceremonial chambers. The former ceiling beams shown in this illustration are here used both as braces for the curved wall of a kiva and as supports for a second-story room which was subsequently abandoned as its enclosing walls were still further altered. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

of this ancient community is among the finest in the Southwest, no other prehistoric people within the borders of the United States having surpassed the ancient Bonitians in the beauty of form and decoration of their ceramic artifacts.

INVESTIGATION OF PREHISTORIC QUARRIES AND WORKSHOPS IN PENNSYLVANIA

Mr. John L. Baer, acting curator of American archeology in the U. S. National Museum during the absence of Mr. Neil M. Judd, curator, spent a part of April, 1922, and a number of week ends during the summer, along the Susquehanna River, where he investigated a number of prehistoric quarries and workshops for the Bureau of American Ethnology.

On Mount Johnson Island, one mile above Peach Bottom, Lancaster Co., Pa., he has located a workshop where slate banner stones were made in quantity. These prehistoric objects, figures 137, 138, often of finest workmanship, are peculiar to the eastern part of the United States and their use has led to much speculation among archeologists. During the past few years more than 300 broken and unfinished banner stones have been found here, from which a number of series have been assembled showing all stages of development from the split blocks of slate to finished banner stones. The series illustrated herein has been placed on exhibition in the Pennsylvania case in the Archeological Hall of the U. S. National Museum.

This workshop was conveniently located a short distance up the river from a large vein of slate which crosses the Susquehanna. A high cliff of exposed slate extends to within a few yards of the water's edge on either side of the river.

The large number of specimens broken in the early stages of manufacture, found at the island workshop, and the scattered specimens showing more advanced work, picked up on nearby camp sites, indicate that many of the unfinished banner stones were blocked out and partly pecked at the workshop near the source of material and carried to distant camp sites to be completed there. As there was a famous shad battery on Mount Johnson Island, to which Indians from distant points came for supplies of shad and herring, it is probable that many of the slate banner stones scattered through Pennsylvania and Maryland may have been made, or at least started, at this workshop.

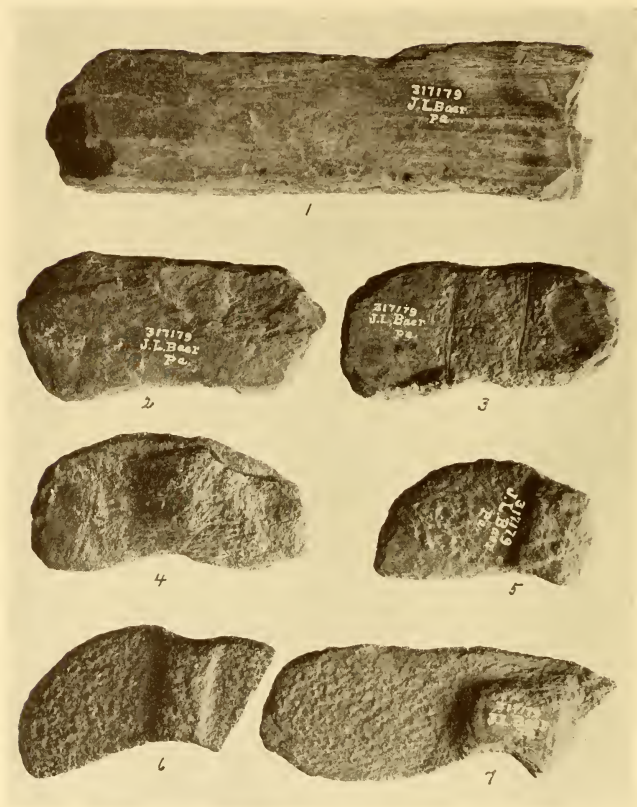


FIG. 137.—A series of unfinished banner stones.

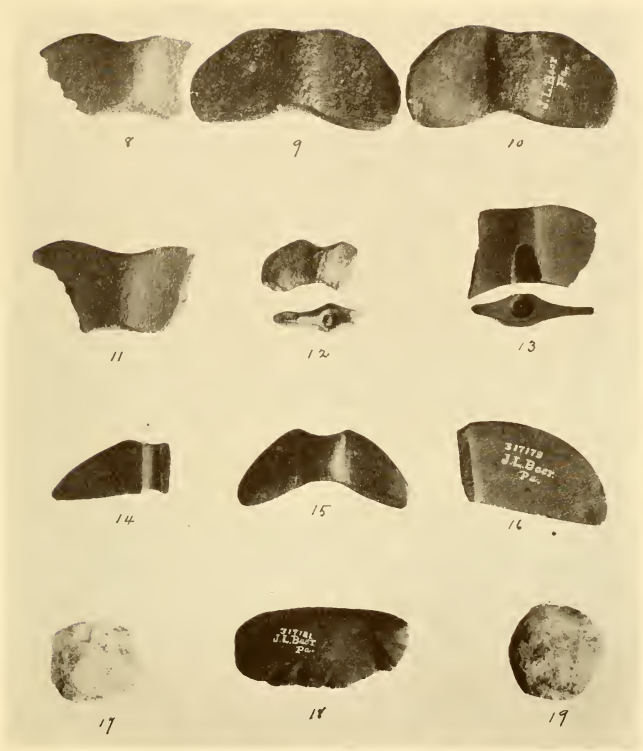


FIG. 138.—Banner stones in series, and shaping tools.

INVESTIGATIONS AMONG THE ALGONQUIAN INDIANS

At the close of May, 1922, Dr. Truman Michelson, of the Bureau of American Ethnology, proceeded to Oklahoma to conduct researches among the Sauk and Kickapoo. The prime object was to secure data on the mortuary customs and beliefs of these tribes. From these data it is now absolutely certain that the mortuary customs and beliefs of not only the Sauk and Kickapoo but also those of the Fox for the



FIG. 139.—Fox winter lodge, at Tama, Iowa.

greater part have been derived from a common source. Towards the end of June, Dr. Michelson went to Tama, Iowa, to renew his work among the Fox Indians. Many texts in the current syllabary were translated, some restored phonetically, fuller data on the mortuary customs and beliefs were obtained as well as new data on the ceremonial attendants and runners.

In August, Dr. Michelson left for Wisconsin, where he spent a week of reconnaissance among the highly conservative Potawatomi,

near Arpin. He then visited the Ojibwa near Reserve, Wisconsin, to obtain some first-hand information on them, and afterwards the Ottawa of the lower Michigan peninsula. It appears that their language and folklore survive with full vigor, but their social organization has rather broken down. Dr. Michelson next visited the Delaware and Munsee of Lower Canada. It is clear that the Delaware and Munsee spoken in Canada are not the same as spoken in the United States; so that the term "Delaware" is really nothing but a catch-all designation of a number of distinct though closely related languages. Finally, Dr. Michelson carried on investigations among



FIG. 140.—Fox matting at Tama, Iowa.

the Montagnais, near Pointe Bleue, P. Q., for a few days. He found that although the language is distinctly closely related to Cree, nevertheless it is decidedly more archaic than has been commonly supposed.

FIELD-WORK AMONG THE YUMA, COCOPA, AND YAQUI INDIANS

Miss Frances Densmore, collaborator of the Bureau of American Ethnology, conducted field-work among the Yuma and Cocopa Indians living near the Mexican border in Arizona, and the Yaqui living near Phoenix, Arizona. Songs of the Mohave were recorded by members of the tribe living on the Yuma reservation, and a Mayo song was obtained from a Yaqui Indian.

The Yuma and Cocopa are the most primitive tribes visited by Miss Densmore and are probably as little affected by civilization as any living in the United States. The Yaqui are still citizens of Mexico though they have lived in Arizona for many years, their little settlement being known as Guadalupe Village. They obtain a scanty living by working for neighboring farmers and their chief pleasure is music, which is heard in the village at all hours of the day. They are governed by a chief and several captains, and seem contented and orderly.

The field-work among the Yuma and Cocopa centered at the Fort Yuma Indian agency, situated on the site of Fort Yuma, in California. An opportunity presented itself to observe their custom of cremating the dead. The body of an Indian who had died in an asylum for the insane was brought to the reservation for cremation. When Miss Densmore went to the cremation ground in the morning the body was seen lying on a cot under a "desert shelter." The relatives were crowded around it, sitting close to it and fondling the hands as they wept. The face of the dead man was covered. The wailing had been in progress all the previous night and the people showed signs of weariness. About 100 people were present, many being old men who sat with tears streaming down their faces while others sobbed convulsively. The cremation took place at about two o'clock in the afternoon. The ceremony was witnessed from the time when the body was lifted for removal to the funeral pyre, until the flames had destroyed it. Clothing and other articles of value were placed with the body or thrown into the fire. The ceremony was given in its most elaborate form, the deceased being accorded the honors of a chief because he had, prior to his mental illness, been one of the two leading singers at cremations. The rattle used in the ceremony is said to be about 250 years old. It is made of the "dew-claws" of the deer, one being added for each cremation in early times. It is now impossible to continue this as the deer are not available.

Information concerning this ceremony was surrounded with the secrecy which envelopes this class of material among all Indian tribes. Many of the ceremonial songs were, however, recorded phonographically by the oldest man who has the right to sing them, and an account of the history of the custom was obtained, together with a description of the *Kurok*, or memorial ceremony which is held every summer. In this ceremony there is a public burning of effigies of the more prominent persons who have died during the year. The dead are never mentioned, this custom being rigidly observed. The

songs of the Kurok, and several cremation songs of the Mohave, which showed interesting differences from those of the Yuma, were recorded.

Miss Densmore's study included war customs, the songs used in treating the sick, those of the maturity ceremony of young girls, those connected with folk tales, and several long cycles of songs sung at



FIG. 141.—Kachora, a Yuma. His long hair is wound like a turban around his head. (Photograph by Miss Densmore.)

tribal dances, or for pleasure without dancing. These songs are interesting, many of them being pure melody without tonality. The words are exceptionally poetic and concern birds, insects and animals, as well as rivers and mountains. The work among the Yuma was aided by Kachora (fig. 141), a prominent member of the tribe.

A trip was made to a Cocopa village in the extreme southwestern portion of Arizona, near the Colorado River and only a few miles

from the Mexican border. In the work of recording songs it was necessary to employ two interpreters, Nelson Rainbow, who translated Cocopa into Yuma, and Luke Homer who translated Yuma into English. In many instances it was necessary for the singer to explain his material to Tehanna (fig. 142) who discussed it with Rain-



FIG. 142.—Frank Tehanna, a Cocopa. (Photograph by Miss Densmore.)

bow, who in turn related it to Homer, after which it was translated into English. Under such conditions it was possible to make only a general study, but much interesting material was obtained. Two of the principal Cocopa singers were Clam and Barley (figs. 143, 144).

The musical instruments of the Yuma and Cocopa are the gourd rattle, the *morache* (rasping sticks), the basket drum beaten with wooden drumming sticks or with bundles of arrow-weed, also a flageo-



FIG. 143.—Clam, a Cocopa. (Photograph by Miss Densmore.)



FIG. 144.—Barley, a Cocopa. (Photograph by Miss Densmore.)

let and a flute, the latter being the first wind instrument blown across the end which has thus far been obtained. Specimens of all these were secured and the playing of the flageolet and flute were recorded by the phonograph. In addition to her musical work, Miss Densmore made a phonograph record of the numbers from 1 to 30 spoken by an aged woman who knows the "old language."

In April, 1922, Miss Densmore visited the Yaqui at Guadalupe Village, about 10 miles distant from Phoenix. She was present at the observances of the week preceding Easter, including the deer dance which was given on Good Friday. Similar, though more primitive, observances were attended at a Yaqui village near Tucson, in April, 1920. The Yaqui observance of Holy Week is a mixture of Roman Catholic influence and native ideas, customs, and dances. The singing is said to be continuous day and night from Good Friday to Easter. There is an evident fanaticism, and a certain hypnotic effect in Yaqui singing which suggests that, under some conditions, the people could work themselves into an irresponsible state of mind by its use. The melodies connected with the religious observance were less distinctly native than those of the deer dance which was performed on the day before Easter by five men, all scantily clad. The leader of the dancers wore a head dress made of the head of a deer and his leg-wrappings were ornamented with hundreds of tiny pouches made of deer hide containing pebbles, forming a series of rattles. Two of the dancers carried rattles made of a flat piece of wood in which were set several small tin disks which vibrated as the rattles were shaken. In this dance they likewise used four half-gourds, of which one was placed hollow side downward on water in a small tub and another was inverted on the ground. These served as drums. The other two were placed on the ground and used as resonators for rasping sticks. A few days later Miss Densmore recorded the deer dance songs, given by an old man who was the leading singer at all the deer dances. She recorded also a deer dance song of the Mayo, living in Mexico.

It was found there are two kinds of music among the Yaqui, one being the native, exemplified in the deer dance, and the other showing a Mexican influence, though the people stoutly asserted that it is Yaqui and "different from Mexican music." The songs of the deer dance are simple, with some characteristics not previously found in Indian music but appearing to be native concepts. These and similar songs are known to only a few of the old men. Songs of the second kind are sung by the younger men and are very pleasing, joyous melodies, usually accompanied by the guitar.

Instrumental music is highly regarded among the Yaqui, a favorite instrument being a short harp of native manufacture, which is played in an almost horizontal position, its base resting on a box in front of the seated player.



FIG. 145.—Manuel Ayala, a Yaqui, playing on flageolet and drum. (Photograph by Miss Densmore)

Among the musicians at the observance of Good Friday was Manuel Ayala who played the drum and the flageolet at the same time, each having its own rhythm (fig. 145). This flageolet had only two sound holes, and was made in two sections which could be taken apart.