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SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 72, NUMBER 15

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1921

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(PUBLICATION 2669)



CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION

1922

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(SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 72, NUMBER 15 [v. 74, no. 5; v. 76, no. 10])

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SMITHSONIAN INSTITUTION
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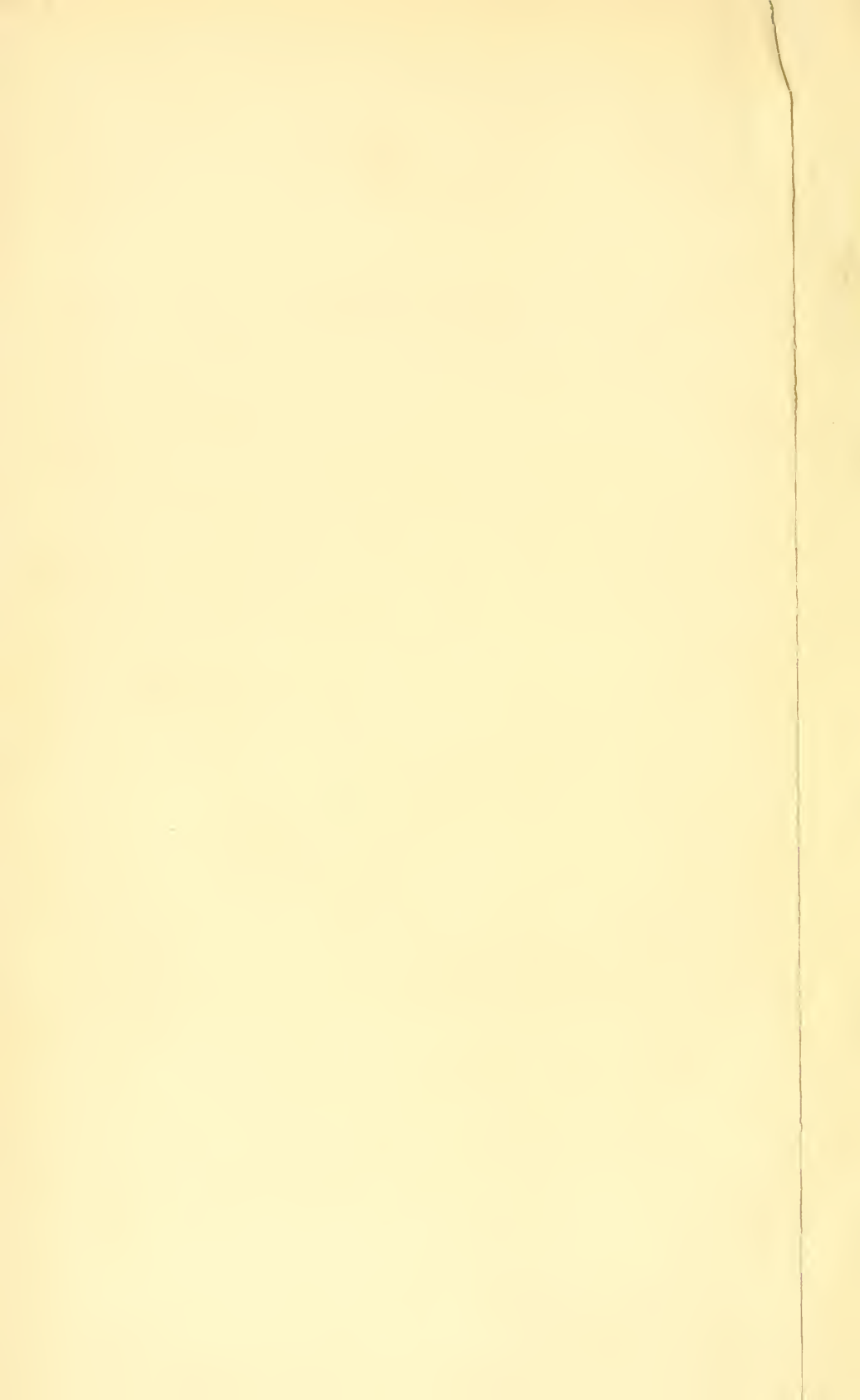


CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1922 [- 1924]

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EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1921

INTRODUCTION

The exploration and field-work conducted by the Smithsonian Institution is one of the means employed for the "increase and diffusion of knowledge," the purpose of the Institution as stipulated in the will of James Smithson, its founder. Attention is directed whenever possible to regions which have previously been imperfectly explored from a scientific point of view, and during the seventy-five years of its existence, the Institution's field parties have been able to make notable additions to existing knowledge as well as to provide vast collections of biological, zoological, and anthropological material for the exhibition and study series of the United States National Museum, a branch of the Institution.

During the past year, the effectiveness of the Institution's limited funds for this work has been so reduced by the prevailing high costs that it was not possible to take part in as many expeditions as is customary. The more important of those which did take the field are briefly described in the present pamphlet, which serves as an announcement of the results obtained, many of the expeditions being later treated more fully in the various series of publications under the direction of the Institution. The photographs here reproduced were for the most part taken by the field-workers themselves.

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

The geological work by Secretary Charles D. Walcott in the Canadian Rockies was in continuation of that of the field seasons of 1919, 1920, for the purpose of securing data on the pre-Devonian strata of the Sawback range in Ranger Brook Canyon, and a reconnaissance of the pre-Devonian formations to the northwest as far as the headwaters of the North Fork of the Saskatchewan River, Alberta.

The season was an unusually cold and stormy one. The party started with a pack train from Banff, June 30, and returned September 30. During this period there were 35 stormy days, 28 cloudy and cold days (20° to 45°) and more or less snow fell on 20 days in August and



FIG. 1.—Panoramic view from south side of Saskatchewan River looking west up the river toward Mounts Outram (10,670') and Forbes (12,102'); Glacier Lake canyon, and on right across the North Fork, Survey Peak and unnamed mountains to the north.
Locality: The view is from a point about 47 miles (75.2 km.) northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1921.)



FIG. 2.—Looking south down Baker Creek with upturned Upper Cambrian limestones of the Sawback Range on the left (east); the Ten Peaks in distance across Bow Valley, and Baker Mountain on the right.
Locality: The camera was on a low ridge directly east of Baker Lake 8.5 miles (13.6 km.) in an air line northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)



FIG. 3.—Up
Locality: Southeast s



FIG. 4.—
Locality: The



FIG. 3.—Upturned Devonian, Ordovician, and Cambrian strata southwest of Badger Pass, at head of Cascade Creek and northeast of canyon of Johnson Creek.
Locality: Southeast side of canyon leading up from Johnson Creek to Badger Pass in Sawback Range. Position of camera about ten miles in air line east of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1921.)



FIG. 4.—Thompson Pass on Continental Divide. Mountain on south (left) Mt. Rice (10,745'), and on north (right) Mt. Bryce (11,000') and glaciers.
Locality: Thompson Pass about 63 miles (101.3 km.) northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1921.)



FIG. 5.—Mt. Douglass (11,015') from the north, with Black Douglass on the left and White Douglass on the right. Devonian limestones form upper cliffs, with Ordovician and Cambrian limestones on lower eastern slopes. *Locality*: View taken from the north side of the head of Red Deer River about 10.5 miles (16.8 km.) northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)



FIG. 6.—Thrust fault on north end of Oyster Mountain along which a thick bed of Upper Cambrian limestone has been forced from the southwest (right hand) against a mass of thin bedded and shaly limestones of Devonian or Ordovician age so as to crumple and distort the latter.

Locality: View taken from the north side of the head of Red Deer River about 10.5 miles (16.8 km.) northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)

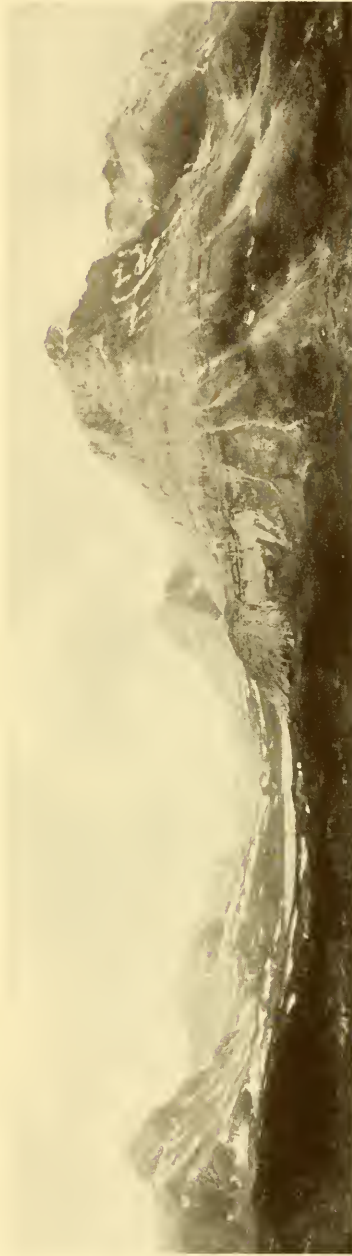


FIG. 7.—Panoramic view looking west over Baker Lake. On the left Baker Mountain (7,230') and on right Fossil Mountain (9,655'). Back of Fossil Mountain, Ptarmigan Peak (10,060') and across from it (left) Fort Mountain (9,510').
Locality: The camera was on a low ridge directly east of Baker Lake 8.5 miles (13.6 km.) in an air line northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1921.)

September. While on the trail 30 camps were made, but owing to weather conditions and to the fact that the snow remained on the slopes and cliffs above timber line, a relatively small amount of productive work was accomplished.

The section studied near the head of Ranger Brook Canyon of the Sawback Range about 12 miles (19.3 km.) northwest of Banff, was from the base of the Devonian limestones down through the post-Cambrian (Ozarkian) Mons formation and the subjacent Lyell and Sullivan¹ formations of the Upper Cambrian.



FIG. 8.—Camp on the lower eastern slope of Fossil Mountain looking north toward the head of Red Deer River.

The character of the formations is indicated by figures 2 and 3, which show the southwesterly slope of the highly inclined beds (45° to 70°) and the saw-tooth-like effect caused by the unequal rate of erosion of the massive bands of limestone and the softer, more friable sandy and clay shales. Towards the northwest end of the Sawback range at the Red Deer River the Black and White Douglass mountains stand high above the surrounding ridges. (Fig. 5.) Oyster Mountain

¹ See Exploration pamphlet for 1919, Smithsonian Misc. Coll., Vol. 72, No. 1, 1920, p. 15.



FIG. 9.—Looking north from below Baker Lake to the headwaters of Red Deer River. Mrs. Walcott is pointing to an eagle soaring high above the valley.

(fig. 6) has been cut out by erosion from the limestones between Douglass and Fossil mountains, and figure 6 illustrates the crumpling of shaly limestones by thrusting of a series of massive limestone strata against them during the period of displacement of the great series of formations of this part of the Cordilleran ranges.

Fossil Mountain, named from the presence of Devonian corals, is about 9 miles (14.4 km.) northeast of Lake Louise Station and faces Baker Creek Pass on the east. It has a good section of Devonian and



FIG. 10.—Wild flower camp on northwest side of Johnson Creek Pass.
(Mrs. Mary V. Walcott, 1921.)

pre-Devonian rocks on its eastern slope. There is a fine outlook from camp at the east foot of the mountain.

The broad U-shaped valley (fig. 9) between Fossil and Oyster mountains has been eroded in the shale and thin bedded limestones that pass beneath Fossil Mountain; this formation is one of those in the Sawback Range that is readily worn away, with the result that the agencies of erosion followed by the glaciers have made a valley altogether disproportionate to the present erosion agencies, water, frost and snow.

At a camp in the heart of the Sawback Range on a tributary of Baker Creek leading up to Johnson Pass there was a wonderful

exhibit of wild flowers in bloom. Mrs. Walcott counted 82 species within a short distance of the tents. A spring-fed pond supplied camp water; dead pines and spruce, firewood; and a grass covered snow-slide slope, abundant feed for the horses.

The moss pink (fig. 11) and the beautiful *Dryas octopetala* were very abundant, but heavy frosts in August killed nearly all the plants and few of the flowers went to seed.

On our way north we crossed over Pipestone Pass and down the Siffleur River. Clearwater River heads in glacial gravels on the east side of the Siffleur about two miles north of Pipestone Pass. Figure 13 is a view looking west through the Clearwater Pass and across to the high cliffs on the western side of Siffleur Canyon.

Twenty-five miles further to the northwest at the point where the south branch (Mistaya Creek), the middle branch (Howse River), and the north branch unite to form the Saskatchewan River, there are some beautiful and instructive views of the surrounding mountains. Figure 1 (frontispiece) is a fine view of the head of the river, with Howse River in the left background and the North Fork beyond the island on the right. The Mount Forbes massif on the left is a superb mountain mass and in the distant center is Division Mountain at the head of Glacier Lake Canyon which we visited in 1919; on the right Survey Peak and beyond two unnamed points. The Glacier Lake section of the pre-Devonian and Upper Cambrian formations was studied on the northern slopes of the Mount Forbes massif as illustrated by figure 1 (frontispiece) of the Smithsonian exploration pamphlet for 1919,¹ and the rugged cliffs and peak of Mount Forbes are shown by text figure 14 of the present number.

Twelve miles northeast of Mount Forbes the cliffs of Mount Murchison (fig. 15) rise high above the dark forested slopes and present a view of the Devonian and pre-Devonian formations that is unequalled in all this region of peaks, cliffs and broad canyon valleys.

Opposite Mount Murchison on the north side of the Saskatchewan, Mount Wilson (fig. 16) presents another section of the pre-Devonian formations, the upper end of which is a massive white quartzite formed of the sands of the beaches over which the Devonian Sea deposited thick layers of calcareous sediments abounding in the remains of corals and various invertebrates of the time. On the west, Mount Wilson rises directly above the North Fork of the Saskatchewan which here flows through a narrow picturesque inner canyon (fig. 17).

¹ Smithsonian Misc. Coll., Vol. 72, No. 1.



FIG. 11.—Moss pink in Johnson Creek Pass.



FIG. 12.—*Dryas octopetala* below Johnson Creek Pass.



FIG. 13.—Looking westward up through the head of Clearwater River Canyon across Siffleur River Canyon to the high cliffs of Middle Cambrian rocks, which are about 2 miles (3.2 km.) north of Pipestone Pass. *Locality:* The divide at the head of Clearwater River Canyon is about 21 miles (33.6 km.) in an air line north 12° west of the Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1920.)



FIG. 14.—Mount Forbes as seen from the north, looking across the lower end of Glacier Lake Canyon Valley. The locality is from the upper slope of Survey Peak above Glacier Lake, about 48 miles (76.8 km.) northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1919.)



FIG. 15.—Mount Murchison (11,500') from the north side of the Saskatchewan River. The view is from a point about 47 miles (75.2 km.) northwest from Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)



FIG. 16.—Mount Wilson from the south. The summit cliffs on the right are formed of the Mount Wilson quartzite capped by dark Devonian limestone.

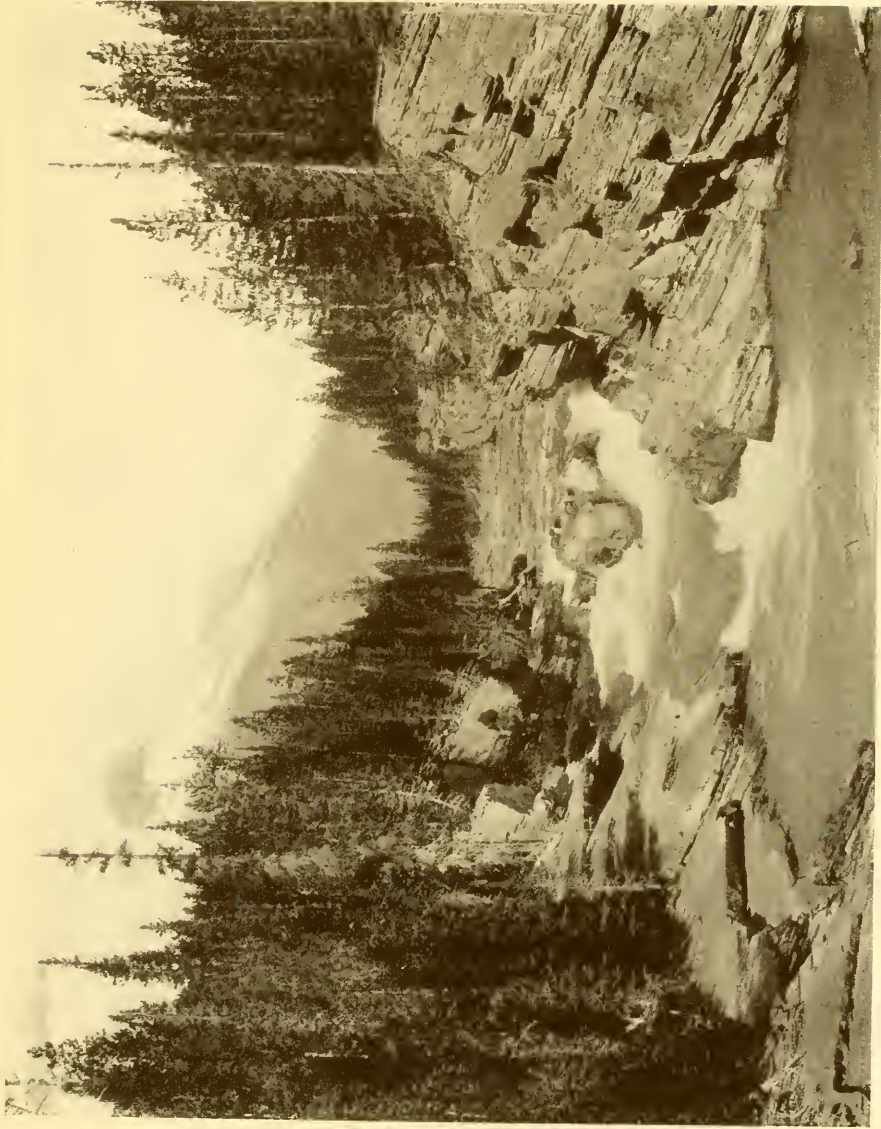


FIG. 17.—Falls of the North Fork of the Saskatchewan River about one mile (1.6 km.) above where the North Fork unites with the Middle Fork (Howse River). The rocks are Upper Cambrian shaly limestones dipping east toward Mount Wilson.

Locality: About 48.5 miles (78 km.) northwest from Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)



FIG. 18.—Quartzite cliffs at the summit of the north ridge of Mount Wilson. The cliffs are capped by dark Devonian limestones very much as are those of the southeast side of the mountain, as shown by fig. 16.
Locality: View taken from the river flats of the North Fork about 7 miles (11.2 km.) north of the Saskatchewan River and 55 miles (88.4 km.) northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada.

The trail up the North Fork follows the bed of the river most of the way to its head beneath Wilcox Pass. The same is true of the trail up the west branch called Alexandra River, and its northwest extension named Castleguard River, by the Interprovincial survey of the boundary between Alberta and British Columbia. Near the union of Castleguard and Alexandra Rivers there is a fine view of the peaks along the Continental Divide and Alexandra glacier. On one of the



FIG. 19.—Mount Wilson and glacier from the southeast, with the eastern section of the broad syncline, of which Mount Wilson is the western section, on the right.

Locality: View taken from south shore of Saskatchewan River about two miles (3.2 km.) east of Mistaya Creek and 47 miles (75.2 km.) northwest from Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mrs. Mary V. Walcott, 1921.)

misty days of early September a photograph of Alexandra glacier, Queens Peak, and Mount Alexandra was taken from the river bed and is reproduced as figure 20.

Castleguard River heads in a deep, rather broad canyon at the foot of the Castleguard glacier. Thompson Pass is on the southwest and high barrier ridges on the northeast. On the summit of the latter great terraced buttes occur with narrow side facing the line of drainage (fig. 21). These outlying buttes are formed of the alternating hard



FIG. 20.—View of Alexandra glacier with Mount Alexandra (11,215') in distance on the north (right), Queens Peak (10,990') immediately to right of glacier, Mount Donai (10,230') on left of glacier; all on Continental Divide. The gravelly bed of the flood plain of Alexandra River in the foreground.
Locality: Near head of Alexandra River, a tributary of the North Fork of the Saskatchewan River. Mount Alexandra is about 59 miles (94.8 km.) in an air line northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (Mr. and Mrs. C. D. Walcott, 1921.)



FIG. 21.—Terraced buttes back from the northeastern branch of the Castleguard River. They all have one or more small glaciers on their lower slopes, which are at about 8,000 feet (2,438 m.) elevation.
Locality: Near head of Castleguard River, 5 miles (8.04 km.) northeast of Thompson Pass, which is about 63 miles (101.3 km.) northwest of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1921.)



FIG. 22.—Waiting for the pack horses to be brought up to receive camera boxes, dunnage bags, blanket rolls, tent, and small impedimenta.



FIG. 23.—Horses foraging through the snow.

and soft bands of limestone and shale of the Sullivan¹ formation, and they form a somewhat unique topographic feature, and are the top of the world at this point.

Thompson Pass is one of the scenic features of the Continental Divide when viewed from the high Alpine valley on the northeast side of Castleguard Canyon. The Pass is low (6,511' or 1,984 m.), and bold high ridges lead up to mountain summits on either side (fig. 4). A view taken on a misting day shows Watchman Lake (6,050' or



FIG. 24.—A snowy morning on upper Pipestone River.

1,844 m.) and above it Cinema Lake (6,400' or 1,950 m.) on the northeast slope of the Pass. On the south Watchman Peak (8,674' or 2,634 m.) which lies in front of Mount Rice (10,745' or 3,275 m.) and on the right Mount Bryce (11,000' or 3,352 m.) and Bryce glacier, which is at the head of the middle branch of Castleguard River. The Castleguard glaciers flow down from Mount Castleguard (10,090' or 3,075 m.), which is a fine peak a few miles northeast of Mount Bryce. Figure 4 is a fine illustration of a misting day along the Continental Divide. We were camped for a week on the south side of the Alpine

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

upland in the foreground, and on each day numerous squalls of fine snow or frozen mist would sweep over from Thompson Pass or Bryce glacier.

I do not know the origin of the names of Rice and Bryce, but it is probable that the mountains were named in honor of Sir Cecil Arthur Spring-Rice and Lord James Bryce.

As the result of unfavorable weather not more than one-third of the work planned was completed when the late September snow drove us back to the railroad. The morning we broke camp to go to Lake Louise Station the horses were pawing away the snow to get at the grass beneath (fig. 23), and the snow was very beautiful on the trees and along the stream below camp (fig. 24). The trail was obscured by it and to make matters more complicated, snow driven by a strong east wind beat into our faces during the seven hours march. The next day the sun came out and the storms were forgotten except for the wonderful snow scenes along the trail down the Pipestone River.

The Commissioner of the Canadian National Parks, Hon. J. B. Harkin, and the members of the Parks Service in the field, from Superintendent to Park Warden, were most helpful, and the same is true of the officials and employees of the Canadian Pacific Railway.

PALEONTOLOGICAL FIELD-WORK IN THE UNITED STATES

Field-work by the Department of Geology of the U. S. National Museum during 1921 was carried on by three members of the Division of Invertebrate and Vertebrate Paleontology.

Dr. R. S. Bassler, Curator of the Division of Paleontology, in cooperation with the Geological Survey of Tennessee spent the month of July in field-work in the Central Basin of that State, where he was occupied in collecting geologic material and in mapping and studying the economic resources of the Franklin quadrangle in Williamson County, south of Nashville. This area of about 250 square miles is of economic interest, on account of phosphate and oil shale possibilities. It is also classic ground for the paleontologist because of the numerous outcrops of Ordovician and later Paleozoic formations which afford a wealth of fossils. During the course of the mapping, Dr. Bassler was able to collect a considerable number of these fossils needed in the museum study series and was also fortunate in securing several large exhibits illustrating various geological phenomena. Among the latter is a large mass of limestone composed entirely of the dismembered calices and columns of a large species of crinoid or sea lily in which the individual fragments are perfectly



FIG. 25.—Contorted and cross bedded phosphate rock, Franklin, Tenn. (Photograph by Bassler.)



FIG. 26.—Massive limestone with an intercalated coral reef, near Franklin, Tenn. (Photograph by Bassler.)

preserved and admirably illustrate the formation of a limestone through the accumulation of this type of animal remains. Material was also secured, both for the exhibition and study series, illustrating the origin of the phosphate beds of the locality through the removal from a phosphatic limestone of the easily soluble calcium carbonate by the leaching power of surface waters. Such material is represented in figure 25 showing a rock outcrop where a porous limestone is overlaid by the contorted and crossbedded rock which upon such leaching gives rise to the phosphate.

Among the interesting stratigraphic results secured was one showing the efficacy of coral reefs of the Ordovician in rock formation. The massive limestone about fifteen feet thick shown in figure 26 represents a middle Ordovician formation here containing but a single reef but within a distance of ten miles the number of intercalated coral reefs has so increased that the formation attains a thickness of over 250 feet.

An ancient Indian village near Brentwood, Tennessee, was visited during this trip in the interest of the Bureau of Ethnology. The object of the visit, namely the determination of the length of time since the village was deserted, proved to be, however, outside of the domain of geology.

Upon the completion of this work Dr. Bassler proceeded to Springfield, Illinois, where with the permission of Dr. A. R. Crook, Chief of the Museum, he prepared casts of the type specimens of invertebrate fossils contained in the Illinois State Museum collections. The aim in this work is to make the national collections of invertebrate fossils as complete as possible in its representation of type specimens, a work which was further advanced in the early part of January by a visit to the Walker Museum of the University of Chicago, where the casting of all the Paleozoic species which had remained unfinished on the occasion of a former trip was completed.

Through the courtesy of Mr. E. J. Armstrong, of Erie, Pennsylvania, Dr. Bassler was enabled to visit all the classical Silurian and Devonian localities in northwestern Pennsylvania and western New York during the latter half of September. The object of this trip was to obtain a field knowledge of the detailed geology and to collect carefully selected sets of fossils illustrating the numerous formations of this region. This work was successful and the many large collections of Devonian fossils in the museum hitherto lacking exact stratigraphic data can now be determined and arranged in the detail necessary to-day.

In April, Mr. C. W. Gilmore, the Associate Curator of Vertebrate Paleontology was authorized to undertake a trip into New Mexico, "for the purpose of making collections of geological material for the National Museum and determining the advisability of preserving certain lands in northern New Mexico for national monumental purposes." Mr. Gilmore was obliged to report that:

Since the many square miles of "bad lands" surrounding the reserved area are equally fossiliferous and in places present much more favorable territory for the recovery of fossil remains than any observed within the boundaries of the monument, and also since the greater part of these surrounding areas lie within Pueblo Grants over which federal control has been relinquished, there would be no advantage in retaining governmental control of so small a part of the area as is represented in the proposed monument.

Mr. Gilmore did, however, find a contiguous fossiliferous area in the Santa Clara Pueblo Grant and secured for the museum a well-preserved skull and other bones of a small rhinoceros, and in an adjoining Pojoaque Pueblo area remains of an extinct camel. The most promising area for collecting would appear to lie within land grants over which the government has at present no control.

In January, this same year, Mr. J. W. Gidley, Assistant Curator in this Division, was authorized in cooperation with the United States Geological Survey to conduct field explorations in the San Pedro and Sulphur Springs Valleys of southern Arizona and on the completion of this work to visit the La Brea asphalt deposits of southern California and from there go to Agate, in Nebraska, for the purpose of securing other exhibition material. The work in Arizona was eminently successful, Mr. Gidley shipping some 24 boxes having an aggregate weight of 5,000 pounds. The bulk of this collection, he reports represents "a practically new Pliocene fauna containing about 60 vertebrate species, most of which are mammalian."

In detail Mr. Gidley reports essentially as follows:

"The geological structure of the San Pedro Valley will be published in detail by Doctor Bryan of the United States Geological Survey. It, however, may be noted here that this beautiful desert valley, now drained by the Rio San Pedro (which, rising near the Mexican border, runs nearly north-northwest, emptying into the Gila River, more than a hundred miles away), narrows and deepens as it runs northward from Benson leaving relatively small and scattered areas of sedimentary deposits which may contain fossil vertebrate remains. Most of our work, therefore, was confined to the upper valley, which forms a rather wide basin bounded on the east by the Dragoon mountains, on the west by the Whetstone Range, and on the south by the Tomb-

stone mountains, and extends northward a few miles below the town of Benson.

" Erosional exposures in this general region are quite extensive, but time and funds being limited the work done on this expedition was confined entirely to two promising localities of relatively small area, previously located by Doctor Bryan. One of these is situated on the west side of the valley, about two or three miles due south of



FIG. 27.—General view of fossil bearing exposure at Curtis Ranch locality, looking across the San Pedro Valley. Partly excavated bones of *Glyptodon* in foreground. (Photograph by Gidley.)

Benson, the other on the east side, at the head of a large 'wash' three miles east of the Curtis ranch which is situated on the state road about 14 miles south-southeast of Benson and an equal distance northwest of Tombstone. The latter locality occupied the greater part of my time and yielded by far the greater amount of material, although the number of species later collected in the Benson locality, slightly exceeded those found here.

" Among the larger, and, from the museum standpoint, more important specimens secured at this locality are included parts of two skeletons of a new species of mastodon, and parts of three skeletons of a large armored edentate, *Glyptotherium*, which when restored should make a striking exhibition piece.

“ Other material obtained here consists of remains representing a wide variety of species which include a large and a smaller species of camel, the latter apparently closely related to the South American guanaco; two or three species of horses, a species of deer; a small extinct antelope of the *Merycodus* type; a carnivore related to the dog-wolf group but more primitive in some respects than any of the living forms; several new species of the rodent group, but all belong-



FIG. 28.—Portion of the carapace or bony skin covering of a Glyptodon, partially excavated. Curtis Ranch locality. (Photograph by Gidley.)

ing to modern genera; two species of land turtles, and a species of bird not yet determined.

“ At the close of this work, which had nearly exhausted the original allotment for field expenses, an additional sum was granted, whereby it was possible to proceed with a desired investigation planned for earlier, in the Sulphur Springs Valley near Willcox.

“ I arrived at Willcox on the 15th of March. As found on a previous visit the conditions were not such as would inspire enthusiasm over the prospects of a good collecting-field. The surrounding country stretched away for miles in every direction almost as level as a floor, with no erosional exposures; and had not recent fossil remains already

been discovered through the digging of a shallow well in the vicinity no one would have suspected their presence here. Several years earlier fossil bones had also been found at nearly the same depth (about 9 feet) in another well, now filled in, which had been dug at a distance of about 250 feet from the present open one. It was thus assumed that the fossil-bearing gravel deposit was of rather wide extent, and that by making a long stripping with plow and scrapers, a considerable area of "pay gravel" might be uncovered and worked at comparatively small expense. The spot chosen as being most promising was naturally that between the two wells.

"At Willcox, the services were procured of a reliable man with teams, plow and scrapers and this work was put into execution. Thanks are here due Mr. Harris, a local real estate agent, who lent valuable aid in this connection. I was also indebted to this gentleman for permission to put through the project, for the locality worked was on deeded land which he had in charge.

"As the stripping progressed, it became evident that the strata, or layers, of deposits passed through did not conform to the section exposed in the abandoned well. Hence, on reaching the 7-foot level three prospect holes, about 15 feet apart, were put down to a depth of about 6 feet, or 4 feet lower than the top of the gravel deposit in the well. In none of these holes was there any sand or gravel encountered thus proving that the gravel exposed in the well was part of an ancient stream channel of limited lateral extent. This discovery of course caused a complete abandonment of the trench excavation work, and the remainder of our time was spent in 'mining' the gravel from the sides of the well as far as was considered safe to do so. In this way several good fossil horse teeth were procured.

"From Willcox, I went by way of Tucson to Feldman, arriving there about noon of the 29th of March, where I was joined by Dr. Bryan. Feldman is a ranch and post office in the lower valley of the San Pedro, about 90 miles north-northwest of Benson and about 10 miles above the junction of the San Pedro with the Gila. The valley here is very much narrowed and deepened, the river bed being nearly 2,000 feet lower than at the Curtis ranch. The gradient of the streams and 'washes' emptying into the San Pedro in this vicinity is very steep and benches and divides rise quite abruptly on either side. Erosional exposures one might expect to find here under these conditions are very much reduced by a heavy covering of gravel of relatively recent age. But paleontological evidence for confirming the age of this part of the valley was so much desired, a special effort



FIG. 20.—Base of skull of mastodon with tusks in position, partially excavated. Curtis Ranch locality. (Photograph by Gidley.)



FIG. 30.—Searching for small mammal jaws in excavation made in collecting one of the mastodon skeletons. Curtis Ranch locality. (Photograph by Gidley.)

to procure it was considered worth while. However, the few days spent here met with little success, and owing to the great inconvenience of continuing it further without more complete field equipment, the project was abandoned. On the morning of April 2, we left Feldman, returning to Benson via Tucson, and the next morning began a systematic search for fossils at a locality about two to three miles south of the town. During our earlier stay at the Curtis ranch we had made one short visit to this locality, the material obtained then suggesting a slight difference in age, or phase, between these deposits and those of the Curtis locality. The material obtained at this place is fragmentary and abounds mostly in remains of mammals of small size, intermixed with which were bones of birds of several species sufficiently well preserved for their determination, and a new species of box turtle. Here remains of thirty-four species of vertebrates were recovered. This collection, together with the material obtained at the Curtis ranch locality, in which 26 species are represented, makes up a very considerable fauna which should not only do much toward definitely determining the age of the beds of the San Pedro Valley, but will also throw valuable added light on the at present very little-known animal life of the upper Pliocene of America."

From Arizona, Mr. Gidley proceeded to Los Angeles, California, where he passed a week studying the museum of the southern branch of the University of California and in examining the well-known asphalt bone deposits of the Rancho la Brea. From Los Angeles, he proceeded on the 16th of April to Agate, Nebraska, prepared to carry out a second detail of field-work mentioned above. He was unfortunate here in encountering bad weather, but succeeded in securing for the museum a block of the bone-bearing sandstone some $3\frac{1}{2}$ by $5\frac{1}{2}$ feet and 14 inches in thickness. This was shipped to the museum and preparation for exhibition is now under way.

ASTROPHYSICAL FIELD-WORK IN ARIZONA AND IN CHILE

As stated in last year's Exploration pamphlet,¹ the solar radiation work of the Smithsonian Astrophysical Observatory was removed from Mount Wilson, California, to Mount Harqua Hala, Arizona, in September, 1920, in order to observe under better sky conditions, and in a more favorable place for continuing the observing the whole year round. Under the charge of Dr. C. G. Abbot the work was

¹ Smithsonian Misc. Coll., Vol. 72, No. 6.

established and continued at Mount Harqua Hala until January 20, 1921, when it was taken in charge by Mr. L. B. Aldrich. He remained until May 20, 1921, when he was relieved by Mr. A. F. Moore, formerly director of the Smithsonian private observing station at Calama and Montezuma, Chile. Under Mr. Moore's charge, the work has been continued steadily at Mount Harqua Hala, with the assistance of Mr. F. A. Greeley.

The Smithsonian Institution maintains from the income of the Hodgkins fund a similar station at Mount Montezuma, near Calama, Chile, under the direction of Mr. L. H. Abbot assisted by Mr. P. E. Greeley. From this Chilean station daily telegrams are forwarded to Buenos Aires, Argentina, giving the observed value of the solar constant of radiation for the day. These data are employed regularly by the Argentine Weather Bureau for weather-forecasting purposes.

While the Smithsonian Institution is not yet in position to champion the use of statistics of solar variation for meteorological forecasts, the great interest which its studies of solar variability have aroused here and abroad seems clearly to warrant the continued maintenance of the Arizona and Chile solar stations under the best possible observing conditions for several years, until a satisfactory basis for a test of the solar variability as a weather-forecasting element has been laid.

The present year has unluckily proved unfortunate at both stations. At Mount Harqua Hala the spring months were very hazy, the summer and autumn months unusually cloudy, with almost unprecedentedly heavy rainfall. At Montezuma the cloudiness of the earlier months was quite unprecedented. During August and September a disarrangement of the apparatus caused apparently by earthquake, combined with illness of the director, led to the loss of many observing days.

In October, Dr. Abbot began an inspection trip to Montezuma, arriving at the station on November 15, and remaining until December 14. During this interval of 30 days, the observers fortunately were able to determine the solar radiation on 26 days, and generally with three or four closely agreeing determinations per day. All of the apparatus was readjusted and improved to the most perfect state of fitness. Many of the results in these conditions proved of a higher grade than ever before observed. In fact it would be hard to conceive of anything which could add now to the excellence of the Montezuma station and outfit.

The accompanying illustrations show the desolate, rainless character of the region; figure 31 shows the mountain top with the observ-



FIG. 31.—Summit of Mount Montezuma. Observing cave near the top.



FIG. 32.—Garage, Shop and Dwelling, Mount Montezuma.

ing cave; figure 32, the group of buildings comprising the observer's quarters, the shop and the garage; and figure 33 the entrance to the observing cave with such observing apparatus as is employed outside during observations of the solar constant.

It is possible to drive the automobile on high gear clear to the observer's quarters which are situated at the head of a cañon sheltered on the west by a rise of several hundred feet from the strong west winds of afternoon. There is almost invariably practically complete



FIG. 33.—Pyranometer, coelostat, pyrheliometers and theodolite with L. H. Abbot, Director at Mount Montezuma.

absence of wind for several hours after sunrise, a thing highly favorable to morning work.

The observing cave near the top of the mountain is less than 10 minutes walk from the observer's quarters. It is only necessary to go up twice a day, once to observe, and again at 8.30 P. M. to signal the observed value to Calama, whence it is telegraphed to Buenos Aires.

BOTANICAL EXPEDITION TO THE ORIENT

During the summer and fall, 1921, Dr. A. S. Hitchcock, systematic agrostologist of the Department of Agriculture and custodian of the section of grasses of the Division of Plants in the U. S. National

Museum, visited the Orient for the purpose of collecting and studying the grasses, especially the bamboos. He left Washington April 25 and returned December 23, visiting the Philippines, Japan, China, and Indo China. Six days were spent at Honolulu on the way over. Collections were made at the following places: *Philippines*, Manila, Los Baños, Baguio; *Japan*, Keelung (Formosa), Yokohama, Tokio, Nikko, Lake Hakone, Mount Fuji, Kyoto, Nagasaki; *China*, Shang-



FIG. 34.—A peasant's hut near Gotemba, Japan. The roofs of the building are thatched with coarse grass. The bundles are for firewood.

hai, Nanking, Kuling, Hongkong, Canton, Wampoa, Yingtak, Shiu-chow, Lohfau Mountain, Macao, Island of Hainan, Pakhoi; *Indo-China*, Haiphong, Hanoi, Vinh, Hue, Tourane.

The countries were visited in the order named so that collections might be made at the most favorable season for grasses.

Collecting in the vicinity of Manila is not very satisfactory as the native flora has been largely replaced by introduced species. From Los Baños, the seat of the Agricultural College, a trip was made to the summit of Mount Makeling about 3,500 feet high. This mountain is of especial interest to botanists as it is the most accessible region for the virgin forest, most of which has disappeared from the vicinity of Manila. On this mountain was met one of the worst pests of the eastern tropics, the leeches. At upper altitudes in the rain

forest these vile worms are found in countless numbers. They attach themselves to the skin and suck the blood with great avidity and constant vigilance is necessary to prevent serious damage.

Japan is not very favorable for the collecting of grasses as it is mostly a forested region and there is comparatively little open country. The bamboos were of interest as there are many species. In the Lake Hakone region the hills were covered for miles with a single



FIG. 35.—Hills near Lake Hakone, Japan. The vegetation on the distant slopes is almost exclusively a single species of bamboo (*Arundinaria chino*), 4 to 8 feet high.

species of bamboo (*Arundinaria chino*), 4 to 8 feet high, often to the exclusion of everything else.

China on the other hand was very rich in grasses. One of the surprises of the trip was to find so much open grass land in a country that is said to be very thickly populated. The cities of China are very much crowded and the valley lands are intensively cultivated, but the hills are unoccupied and almost unused. This is in striking contrast to our own western regions where, except in National Forests and other protected areas, the grass lands are extensively grazed. The basic reason for this condition in China appears to be the risk from bandits. The valley lands can be protected but the hills are open to the attack of robbers.

China was entered at Shanghai, a large comparatively modern city, much under the influence of foreigners. Here is the only American post office outside of the United States or its possessions. Mail can be sent from here under frank or with United States postage stamps. The two other places visited in central China were Nanking and Kuling. At the former city is the University of Nanking, a flourishing missionary institution, which extended many courtesies to Doctor



FIG. 36.—A street scene in Shanghai.

Hitchcock. Nanking is a thoroughly Chinese city showing little foreign influence. Like most Chinese cities it is surrounded by a high wall, this one being 32 miles in length and 30 to 50 feet high. Kuling is a resort on a mountain south of the treaty port Kiu Kiang, where the missionaries and other foreigners of central China congregate during the summer.

During the visit of Doctor Hitchcock the Yangtse River was in flood and the rice fields of the valley were covered with water. The unfortunate peasants were in the water up to their waists or even to their shoulders cutting the rice and placing it in small circular



FIG. 37.—A typical valley at Nanking, China, showing intensive cultivation. There is a fish pond in the left foreground. The hills on each side of the valley are covered with grass, much of which will be cut and used for fuel.



FIG. 38.—A ricksha party just after passing out through one of the main gates of Nanking China. The city wall is about 50 feet high.



FIG. 39.—The Yangtze Valley above Nanking in flood. View from a river steamer.



FIG. 40.—Slender pieces of split bamboo drying in the sun. From these joss sticks are to be made.

boats. The bundles were supported on the ends of crossed poles on the dikes to hold them out of the water to dry.



FIG. 41.—A clump of bamboo, Canton, China. A common ornamental plant.

The gateway to south China is Hongkong, a very mountainous island owned by the British, the peak being 1,800 feet high. There is here a botanic garden and a herbarium. Canton lies up the river west of Hongkong about 80 miles. Opposite Canton on the island of Honam is the Canton Christian College, where Doctor Hitchcock

made his headquarters. Excursions were made to Yingtak and Shichow on the North River north of Canton, to Lohfau Mountain east of Canton and north of Sheklung, to Wampoia 10 miles east of Canton, where the Wilkes Expedition made collections, and to Macao, a Portuguese possession 40 miles from Hongkong and the oldest foreign settlement in this region.

A more extended trip was made in company with Mr. McClure of the Canton Christian College, to Indo-China and the Island of



FIG. 42.—A street scene in Yingtak, on the North River, about 80 miles north of Canton. The bundles of stalks are to be used for firewood.

Hainan. Going from Hongkong to Haiphong, a stop was made at Pakhoi on the southern coast of Kwantung Province. Here forty-six species of grasses were obtained in a few hours on the sandy areas and rocky hills. Haiphong is the port of Tongking. Indo-China is a French Colony (officially French Indo-China), consisting of five divisions, Tongking, Annam, Cambodia, Cochin-China, and Laos. The objective in Indo-China was Hue, the capital of Annam. Loureiro, a Portuguese botanist, resided here and published in 1790 a flora of Cochin-China and it was to determine the identity of many of

his grasses that this interesting city was visited. To reach Hue one goes by rail to Hanoi and then south to Vinh, the present terminus of the railroad that is to be built to Hue and ultimately to Saigon. Beyond Vinh one goes by auto-bus over good roads about 175 miles. A trip was made to Tourane on the coast, connected with Hue by railroad.

On the return trip from Haiphong to Honkkong, a stop was made in Hainan, landing at Hoihow on the north coast. Hainan is a seldom-visited island about 180 miles long, belonging to China.



FIG. 43.—A wayside shrine at Yingtak, China. These shrines are common but, like the present one, often suffer from neglect.

Through the kindness of Doctor McCandliss, a missionary in charge of a hospital at Hoihow, we were able to penetrate to the interior of the island as far as Kachek where there is a branch missionary station. The journey was made by boat on the river the first day and on foot the second and third days. From Kachek a trip was made up the river into the foothills of the Five-finger Mountains. Traveling in Hainan as in many other parts of China is chiefly by chair carried by two coolies.

Traveling in China is mostly by rather primitive methods. Modern steamers ply along the coast and on the larger rivers and there are a few railroads. The sampan, a small partly covered boat propelled by

oars, is common in the harbors. In the cities where the roads are wide enough the ricksha (jinrikisha) is used. This is a two-wheeled cart, mostly now with pneumatic tires, drawn by a coolie, and holding



FIG. 44.—A sampan at Shiuchow. This is the common type of small boat used on the rivers of south China. The bamboo pole is used to push the boat in shallow water. Oars are used in deeper water.

one person. In the narrow streets of the cities where there is not room for rickshas, and on the country trails or paths, chairs are commonly used. These are covered seats supported by two poles and carried by two coolies. Long journeys in them are far from com-

fortable. In the part of China visited animals are little used for transportation of any kind. Freight is carried on land by manpower, one man with a pole supporting two weights, two men with



FIG. 45.—A specimen of the traveler's tree, growing in the botanical garden at Hué, the capital of Annam, French Indo-China. The plant is a native of Madagascar.

a pole supporting one weight, heavy loads on rude wheelbarrows, in the cities heavy loads, as much as a ton, on carts pulled and pushed by several men.

One of the curious sights to one visiting China for the first time is the enormous number of graves distributed at random over the

country. Thousands of little mounds are to be seen on every hand, some hemispherical and grass-covered, some more elaborate, with stones or masonry.

The agriculture of China is intensive and in some ways much in advance of ours. The rice fields show usually a perfect even stand, and the amount per acre is the maximum. It represents a large amount of labor as every stalk is set out and harvested by hand.

The botanical results of the trip were very satisfactory, a large and valuable collection of grasses having been made.

BIOLOGICAL EXPLORATION IN THE DOMINICAN REPUBLIC

In November, 1920, Dr. W. L. Abbott revisited the Dominican Republic, working in both the Samaná Peninsula and the region lying between Sánchez (at the head of Samaná Bay) and Puerto Plata, on the north coast. Already familiar with much of this territory, he was able to investigate a number of new and very interesting localities. Two weeks was spent at Sánchez; three weeks in the vicinity of Samaná, a town on the south coast of the Samaná Peninsula about 20 miles east of Sánchez, and on the mountain known as Pílon d'Azúcar; seven weeks at several stations along the railroad connecting Sánchez and Puerto Plata, among which were Villa Riva, Pimentel, Cotuy, Mao, and Navarrete; two weeks in the easternmost portion of the peninsula, in visiting Las Cacaos, Rojo Cabo, and Cape Samaná; one week on the south coast of Samaná Bay in the vicinity of San Gabriel; and one week in the region of Old Heart River, in the north-central part of the peninsula.

Contrasting with the remaining part of Hispaniola, the population of the Samaná Peninsula is chiefly English-speaking, due to the fact that Samaná was settled by a colony of Philadelphia negroes under President Boyer of Haiti in 1820-22. The region is well watered and has a luxuriant vegetation, and provisions are plentiful and relatively cheap. The hills extending north to the coast from Pílon d'Azúcar are covered with unbroken forests.

The Yuna River forms a vast swamp, which occupies the entire region at the head of Samaná Bay and extends along the railroad for a distance of 12 miles. West of this swamp region, in the vicinity of Villa Riva, Pimentel, and Cotuy, are vast stretches of grassy savannah. The soil is fertile, and the inhabitants are industrious and prosperous. Beyond this region the land, except along the streams, becomes arid and the towns, such as Guaybin, Navarrete, and Mao, are small, poorly provisioned, and lacking in enterprise.



FIG. 46.—View down Río Mao from schist outcrop near Bulla; cliffs of conglomerate in the distance.



FIG. 47.—View along the Río Mao, near Cercado de Mao.

Numerous caves provide an interesting feature on the south coast of Samaná Bay, one of them comprising nearly the whole interior of San Gabriel Isle. A cave at the mouth of Naranjita River contained a quantity of Indian bones and pottery.

A collection of about 4,000 plants was procured, representing 1,460 numbers. Of these about 20 per cent are ferns, one being an interesting new species of *Anemia*.

The birds obtained by Doctor Abbott on this visit totaled thirty-one skins, with a few skeletons and eggs, chiefly representing species not previously collected by him. Of particular interest is a whip-poor-will



FIG. 48.—Harbor of Puerto Plata, looking north from Monte Isabel de Torres.

(*Antrostomus*), closely related to a species found in Cuba, but not hitherto recorded from Santo Domingo. On the natural grassy plains on the north side of the island he secured several specimens each of the local form of the grasshopper sparrow (*Ammodramus savannarum intricatus*), and of the stone-plover or thick-knee (*Oedinenus dominicensis*), both new to the museum collections. The thick-knee belongs to a family of birds resembling overgrown plovers, and is related to them. It occurs in the West Indies only in Santo Domingo, but allied forms are found in suitable localities in Central and South America. The family is chiefly an Old World one, and for the most part tropical in distribution. The Santo Domingo species is well-known to the natives, under the name "boukera," and tame individuals

are often kept about the houses for the purpose of ridding the premises of insects and spiders.

In addition many land shells and a considerable quantity of ethnological material were secured. Doctor Abbott left New York about the middle of December, 1921, on another expedition to the island, but thus far no information or material has been received from him.

EXPERIMENTS IN HEREDITY

Progress in the experiments in heredity conducted under the joint auspices of the Smithsonian and Carnegie Institutions by the writer, Dr. Paul Bartsch of the U. S. National Museum, have from time to time been published in this pamphlet and in the Year Book of the Carnegie Institution. A summary of the results attained up to 1920 was published as "Experiments in the Breeding of Cerions" in 1920, volume 14 of the Department of Marine Biology of the Carnegie Institution, pp. 3-55, pls. 1-59.

The reported loss of the Cerion colonies introduced into the Tortugas which were said to have been wiped out by the hurricane of September, 1919, made it necessary to revisit the Bahamas to secure additional breeding material for the heredity experiments. Accordingly, passage was secured at Miami on the power schooner "Tecoma" for Nassau, New Providence, on May 18, and there the services of the power boat "Standard J" were secured for a trip to Andros.

The desired adolescent specimens of *Cerion viaregis* were obtained along King's Road, Bastian Point, South Bight, Andros, with considerable difficulty because the agricultural efforts on the part of the local population have shifted to the ground that was occupied by the Cerion colonies during our 1912 visit.

The colony of *Cerion casablancae* has met with even greater misfortune, for sheep and pigs have been introduced into the region occupied by this species, and the larger vegetation has been cut down in order to furnish more opportune habitat for grass culture. These new environmental conditions promise well to exterminate this colony. The necessary material for the experiments was secured with great difficulty.

A trip was next made through South Bight to the western end of Andros and then back to the eastern shore through Middle Bight. On this journey many stops were made and Cerions were gathered in large numbers. The localities from which they were taken were carefully listed so that it will be possible to go back to the same spot in

the future and gather material for comparison with that now resting in the National Museum.

There were several points of interest as far as the physical features of the locality visited were concerned. In 1912 the waters of the western end of South Bight were of a creamy consistency and the land areas adjacent low flats, mud cracked, with flakes of oolitic rock. On the present visit South Bight was found to be a perfectly clear stretch of water with well-packed bottom with an abundant growth of aquatic plants, while the land adjacent gave the impression of moss covered flats. The green element, however, was due to blue-green algae, which appear to serve as a binding factor.

The trip was enlivened by an iguana hunt, which resulted in the securing of several of these large lizards which are now in the collection of our Zoological Park.

Returning to Nassau, five days were spent exploring the cays off the northwestern shore of New Providence and the adjacent mainland. Here large collections of *Cerions* were made, the location of each colony being carefully noted, so that these likewise may serve as a check series for comparison with future generations produced in place.

On June 3 Dr. Bartsch returned to Miami and on the following day set sail for the Tortugas, stopping to examine the various plantings along the Florida keys.

It was a pleasure to find that the hybrid colony on Newfound Harbor Key, around which the greatest interest centers just now, had escaped being wiped out by the hurricane. Evidently the rain preceding the hurricane had caused the *Cerions* to take to the ground, as they are wont to do for foraging purposes under such circumstances, and the dense mats of grass here had kept them from being swept away by the floods that had passed over them, a most fortunate state of affairs. A large number of dead specimens were nevertheless found, which have been placed in the National Museum for record.

Incidentally, it may be stated that another almost fledged young great white heron was discovered on White Heron Key, the island that furnished the specimen that was shipped to the Zoological Park two years ago. The present specimen, which is probably a younger brother or sister of the former sending, was also transmitted by parcel post to the Zoo, where it arrived in good condition.

In "Experiments in the Breeding of *Cerions*," there are given on page 46 detailed measurements of 100 specimens representing the check series of *Cerion crassilabris* from Balena Point, near Guanico

Bay, Porto Rico, which were planted on Loggerhead Key in 1915. These were figured on plates 48 to 50. On page 47 measurements were given and on plate 51 figures of 36 adult shells of the first Florida grown generation which were gathered in January, 1919. This year a much larger series of first generation material was found, and 200 of such specimens were measured.

The summaries of these measurements show that no appreciable changes in measurements have taken place in the first generation of Florida grown *Cerion crassilabris*. The measurements in size all fall within the limits of variation, as denoted in the check series, excepting one, *i. e.*, a single specimen which was found among the 200 of the first Florida grown generation that had a diameter 0.2 mm. less than any in the check series. There is no doubt that one could find an individual giving such a measurement among the specimens on the native heath of this species, for the check series was not a selected one, but a hundred specimens taken at random.

COMPARISON OF MEASUREMENTS OF FIRST FLORIDA GROWN CERION
CRASSILABRIS WITH THE CHECK SERIES

		No. whorls	Altitude	Greatest diameter
Average	{ Check series	9.55	22.13	12.41
	{ First generation	9.13	22.36	11.89
Greatest diameter.....	{ Check series	10.5	27.5	13.9
	{ First generation	10.4	25.7	13.2
Least diameter.....	{ Check series	8.5	19.0	10.6
	{ First generation	8.6	19.6	10.4

It is interesting, therefore, to note that so far as the first generation of this Porto Rican *Cerion* is concerned, it is in complete agreement with the facts adduced from the two Bahaman species.

The hurricane of 1919 destroyed the cages in which had been placed a specimen of each of two species, in order to determine their ability to hybridize, and to note the results of such crosses as might be observed from such selected individuals.

A new set of cages was therefore prepared. Eleven groups of these cages consist of four compartments, each a cubic yard in size. The septa between compartments are double wire walls to prevent possible mating through the meshes of the fine Monel metal wire screen. In each of these cages there were placed a *Hymenocallis* plant, some grass and dead wood rubbish, in other words, habitat conditions which were found to be favored by *Cerions* at the Tortugas. Then two half-grown specimens, one of *Cerion viaregis* and one of *Cerion incanum* from Key West, were placed in each of the forty-four

compartments. These cages are securely anchored, and every precaution has been taken to make sure that the mollusks will be confined within them, and that no extraneous individuals can find entrance. The cages are arranged as shown in the following diagram, and a better idea of them may be formed from the photograph (fig. 50).

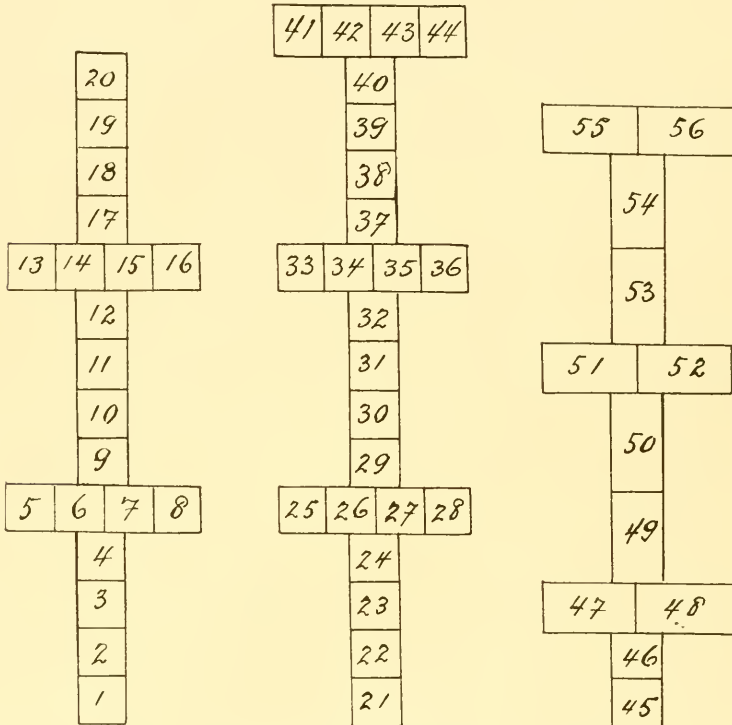


FIG. 49.—Diagram showing arrangement of cages.

Cages No. 45 and No. 46 are of the same size as those last mentioned. In cage 45 were placed 183 young of *Cerion incanum* from Key West, in order to determine what percentage of these will reach maturity. In cage 46 was placed an abnormal specimen of *Cerion viaregis*. This had a spiral keel, which may be the result of an injury, although Doctor Bartsch was unable to discover any sign of it. With it was also placed a normal specimen of *Cerion viaregis* in order to determine if this character might be transmitted to offspring.

In addition to these, five groups of cages were made which have the same size as the four unit cages, but they have only one partition in

the middle, thus making them 3 by 6 feet, and 3 feet high. In these there were placed the following combinations:

- No. 47, 25 each of *Cerion incanum* and *Cerion viaregis*.
 No. 48, 25 each of *Cerion incanum* and *Cerion casablancae*.
 No. 49, 25 each of *Cerion incanum* and *Cerion urva*.
 No. 50, 25 each of *Cerion incanum* and *Cerion crassilabris*.



FIG. 50.—A portion of the monel metal wire cages used in *Cerion* breeding experiments.

- No. 51, 25 each of *Cerion viaregis* and *Cerion urva*.
 No. 52, 25 each of *Cerion viaregis* and *Cerion crassilabris*.
 No. 53, 25 each of *Cerion casablancae* and *Cerion urva*.
 No. 54, 25 each of *Cerion casablancae* and *Cerion crassilabris*.
 No. 55, 25 each of *Cerion urva* and *Cerion crassilabris*.

In cage 56 there were placed 203 young of various sizes of the huge new form collected in Middle Bight, Andros, which Doctor Bartsch has called *Cerion mayori*.

Two additional species were introduced this year on Loggerhead Key, one *Cerion mayori*, as above stated, and the second, *Cerion incanum*, as also stated above, but of this species a large colony was

also placed about the water tower at the northern end of the island, in order to have additional material if it should be needed for breeding purposes in the future.

While at the Tortugas a careful bird census was made, as usual. By the use of a blind, a series of photographs of the beautiful roseate tern, nesting here abundantly, was secured. The accompanying illustration shows one of these birds together with an unhatched egg and a babe.

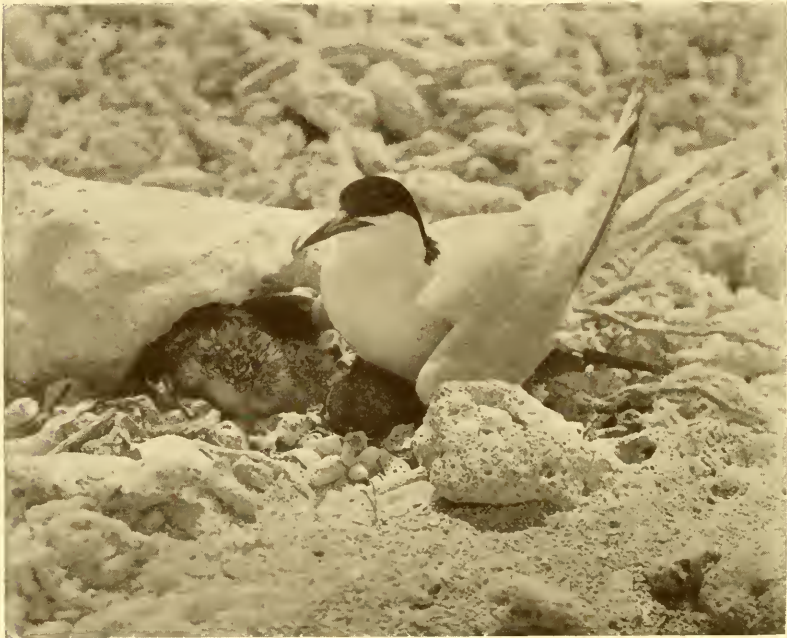


FIG. 51.—Roseate tern, young, and egg. Bush Key, Tortugas, Fla.

ENTOMOLOGICAL EXPEDITION TO ALASKA

In May, 1921, Dr. J. M. Aldrich, Associate Curator of Insects, U. S. National Museum, was detailed to collect insects in Alaska, especially in the interior. The museum had very little material from Alaska, except from the coast region. The government railroad, extending from the southern coast north to Fairbanks, was nearing completion, and offered opportunity for travel not heretofore existing. It appeared also that the completion of the railroad would probably lead to an increase of population which would create greater interest in the insects of the region.

Doctor Aldrich left Seattle May 30. The steamship made some stops for unloading freight, enabling him to collect one day at Skagway and one day at Valdez. The coast region is fairly familiar to tourists, with its innumerable islands, steep shore-line, snow-capped mountains and numerous glaciers (figs. 52-56). Seward was reached on June 9. The government railroad begins at this point and close connections were made with a waiting train. The railroad passes over rugged mountains in the Kenai peninsula close to several large glaciers; it then descends to sea-level at Turnagain Arm, keeping near the shore line to Anchorage. This was the first collecting point which might be considered to represent the fauna of the interior. Although



FIG. 52.—Cannery near Juneau, Alaska.

it is on tide-water it is behind the coast range and has the dry climate characteristic of the interior. The town is on a level glacial plain, several miles wide, covered with a light forest and having a thin soil upon quite recently deposited gravel. The forest is composed of spruce, aspen, birch, alder and willow. After several days collecting here the journey northward was resumed. Steel had been laid as far as Hurricane, 285 miles from Seward. On arriving here Doctor Aldrich was furnished a horse by the Alaskan Engineering Commission and rode along the right-of-way for 85 miles across Broad Pass and down the Nenana River to Healy, which was at the time the terminus of the rails laid southward from Nenana on the Tanana River. Only casual collecting was done until Healy was reached, but here it was necessary to wait several days for baggage to be brought from Hurricane by wagon. This proved to be a very good collecting

point as it is at the mouth of the canyon on the edge of the Yukon Valley, thus combining to some extent the mountain and plain fauna. After five days here, Doctor Aldrich went north on the railroad to Nenana, collected there for only part of a day and continued the following day on the narrow gauge line, recently acquired by the government, to Fairbanks, his destination. It had been intended to spend



FIG. 53.—North side Lynn Canal near Skagway, Alaska.



FIG. 54.—Glacier on Lynn Canal, Alaska.

most of the collecting time in the vicinity of Fairbanks, but the trip had taken much longer than expected, so he stayed only a week at this point.

The Tanana Valley at Fairbanks is typical of the Yukon Valley in general, as far as the species of insects are concerned. Although it is within about 100 miles of the Arctic Circle, it has a fairly hot summer on account of the extremely long period of sunshine in the day. Some farms are developed and the government experiment station has been demonstrating for many years that the usual garden

vegetables of the northern states as well as some cereals can be grown. The aspect of the light forest is much like parts of northern Minnesota and the regions about Lake Superior generally: the insects collected



FIG. 55.—Port Althorp, Alaska (merely a cannery).



FIG. 56.—Looking north from Tannel Station, Alaska. Valley filled with glacial gravel in part very recent.

were mostly species occurring in the region named and eastward to the Adirondacks and New England.

A return trip was made along the same route, with stops at Healy and at some of the construction camps on the unfinished part of the



FIG. 57.—A good insect collecting ground on Ship Creek, near Anchorage, Alaska.



FIG. 58.—Homesteader's cabin near Anchorage, Alaska.



FIG. 59.—Outskirts of Anchorage. Log houses make up almost the whole town, and are the usual thing in Alaska.



FIG. 60.—Outskirts of Anchorage, Alaska. Half-cleared land.

road. The bad condition of the wagon road along the right-of-way south of Healy had reduced wagon travel to a very low stage. The only wagons using the road were those of the Alaskan Engineering



FIG. 61.—Spruce forest on Chulitna River near Mount McKinley.



FIG. 62.—Hurricane, a construction camp on the government railroad 285 miles north from Seward, Alaska.

Commission, carrying supplies to the camps. As each wagon turned back on unloading, and only a few were in use at the time, considerable delay was encountered in getting baggage moved from Healy to

Hurricane. This delay could have been used to good advantage for collecting except for the fact that the weather became cloudy and windy and very unfavorable. Doctor Aldrich, after several days delay, went on to Anchorage and spent a few more days collecting there while awaiting his baggage. Here the weather was again favorable so that the result was very good. Resuming his journey Doctor Aldrich went to Seward with the intention of spending at least ten days in getting a collection of the insects of the humid coast region. The weather, however, gradually became more rainy, greatly limiting the result and finally making it expedient to take the boat from Seward about a week after arrival.



FIG. 63.—Middle fork of Chulitna, a little south of Broad Pass. Corduroy bridge of the Alaskan Engineering Commission.

The expedition resulted in the accession of about 10,000 specimens of Alaska insects, nearly all from the interior region. As far as they have been studied up to the present time they indicate three somewhat distinct faunal regions in the territory covered.

First, the maritime fauna consisting of the insects living upon the seashore and depending upon the ocean for necessary conditions of existence. Insects of this group extend down the coast, in many cases as far as the State of Washington and some even so far as San Francisco; while it is presumed that they would also be found more or less in the Asiatic side of Bering Sea.

The second element is that of the humid mountain region along the coast; a considerable part of this fauna extends to Puget Sound,



FIG. 64.—Contractors' cabins on the line of the government railroad near Broad Pass, Alaska.



FIG. 65.—Looking northward down the Nenana, Alaska. Unfinished government railroad in foreground and down left side.

Mount Rainier, and in less degree, to other mountains of the Pacific northwest. The relation of this element to the Asiatic fauna is very little known.

The third element of the Alaska fauna, as far as observed, is that of the dry interior and especially of the Yukon Valley, which has many elements in common with Northern Minnesota, Wisconsin and Michigan, Ontario, the Adirondack Mountains of New York and the White Mountains of New Hampshire. Many of the insects of this group also occur in the Rocky Mountains of Colorado and no doubt further exploration will show that they occur in other mountains of the western United States. Those which represent a more northern



FIG. 66.—Town of Healy in the lignite belt on the Nenana River, Alaska.

range also reappear in Labrador collections, and presumably extend across North America although we have no collections from intermediate points. This element contains many species known from Finland and the Scandinavian Peninsula in Europe, presumably extending in their distribution across Russia and Siberia.

In most orders of insects Alaska has a comparatively large fauna. There are very numerous species of the two-winged flies, or Diptera; and from Doctor Aldrich's long experience with this group he naturally paid especial attention to collecting in this order. Bumble bees and wasps are conspicuous insects everywhere on flowers; and in the absence of darkness bumble bees were observed to work as late as 10.30 at night in Fairbanks. Grasshoppers were strikingly scarce, only two species being found and in all but half a dozen specimens.

Mosquitoes in the interior are exceedingly abundant, as is well known. Especial attention was given to them in collecting, and two species previously undescribed were among the material brought back. It appears, however, that the most troublesome species are the same ones which occur in somewhat less numbers in the Pacific northwest in occasional favorable localities. Horse flies are very numerous in the region at Fairbanks where they are commonly called moose flies since the moose is more common than the horse.



FIG. 67.—Construction camp at Nenana Bridge, north of Healy, Alaska.

The common house fly was not found at any point in Alaska. Continuous attention was given to this matter, and collections were made at the garbage dumps in Anchorage and Seward; while at Ketchikan, the southernmost town in Alaska, grocery stores, restaurants and a cannery were carefully examined early in August without finding any of the flies. Other garbage-feeding flies were studied at every possible point and one new species of blow-fly was collected. The absence of several scavenger flies which are common in the United States was noted.

The exploration of Alaska, especially the interior, from an entomological point of view is important in itself and also forms a link in the study of a much broader problem—that of the entire Holarctic fauna which extends almost continuously around the globe in the vicinity of

the Arctic Circle. It is a matter of great scientific interest to determine how much of this northern fauna is the same in the new world as in the old, and also to determine how much of the fauna further south,



FIG. 68.—Fairbanks, Alaska, and adjacent country from top of a building.



FIG. 69.—Looking up the Cheva River eastward from Fairbanks, Alaska. Some farms cleared and cultivated on the slopes of the distant hill.

as for instance in the United States, has been derived from this northern region. It is hoped that opportunity will arise to carry this exploration much farther not only in Alaska, where as yet merely a beginning has been made, but also in other northern regions as for instance Labrador, Greenland and Siberia.

ARCHEOLOGICAL FIELD-WORK ON THE MESA VERDE
NATIONAL PARK

During May and June, 1921, Dr. J. Walter Fewkes, Chief of the Bureau of American Ethnology, continued his archeological work of former years on the Mesa Verde National Park, Colorado, the brief season's field-work being financed with a small allotment from the Bureau of American Ethnology.

The site chosen for field operations was the Mummy Lake cluster of mounds, a typical prehistoric southwestern village situated $4\frac{1}{2}$ miles north of Spruce-tree Camp. One of the mounds in this village, excavated in 1916, is now known as Far View House. The surface contours of the remaining mounds differ somewhat, indicating that the buildings hidden in them have different forms, but excavations are necessary to determine the use of these buildings. It has long been known that some of the prehistoric pueblos of our southwest had rooms called kivas for religious purposes, but only within the last year has it been recognized that there was sometimes added to these kivas a complex of rooms, also for ceremonial purposes. Several of these specialized religious structures have already been described, but there remain many other mysterious mounds beckoning the archeologist for excavation and accurate identification. How many different types of buildings designed solely for ceremonials there are in our southwest, time will reveal.

The word house (*ki*, Hopi) is applied in prehistoric cliff-dwellers' nomenclature to a compact collection of inhabited rooms, secular and religious (fig. 70). A pueblo is such a communal dwelling; but a group of uninhabited rooms, each and all constructed for ceremonial purposes, should bear another name. The discovery of Sun Temple introduced archeologists to a type of southwestern buildings not intended for habitations, but for a specific communal purpose supposed to be religious. Fire Temple, on the Mesa Verde, is also regarded as such a specialized building and is likewise believed to have had a religious use. Similarly, Cedar-tree Tower and Far View Tower were not habitations but communal buildings with a religious function. The "Lower House" at Yucca House National Monument, the "Great Kiva" at Aztec, and similar great kivas situated in the Chaco Canyon and elsewhere on tributaries of the San Juan River morphologically belong to this type. All these may be called temples. There are many large buildings never inhabited but now in ruins scattered over the southwest, the use of which is doubtful. Among these are



FIG. 70.—Sun Temple and Cliff Palace: from Sun Point, Mesa Verde National Park. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Railroad.)

the so-called fire houses or "houses" of the Hopi fire people and the twin mounds conspicuous on the mesa top above Sikyatki, which may on excavation be found to have been devoted solely to religious purposes.



FIG. 71.—Far View Tower and Kiva, partially excavated. Mesa Verde National Park. (Photograph by Fewkes.)

This specialization in the San Juan Valley of buildings showing functional differentiation in structure is indicative of a high cultural development. It is instructive to find that it is confined to prehistoric stages of development and is most abundant in areas where sedentary inhabitants had disappeared before the advent of Europeans.

The plan of the work of the Bureau on the Mesa Verde National Park in 1921 was to investigate a conspicuous and centrally placed mound not far from Far View House. The indications are that this was an ancient necropolis of the Mummy Lake Village, combining subterranean rooms or kivas with a large cemetery situated on the southern side of a high tower. Unfortunately, this cemetery had been rifled several years ago by vandals; but the many fragments of pottery found on the surface betray features important in cultural comparisons.

Far View Tower was relatively an ancient building; its architectural form is characteristic and its pottery decidedly archaic as compared with that of the golden epoch of geometric decoration from Cliff Palace or Spruce-tree House. We may never know in what century this tower was built, but its construction can be referred to an older epoch than the great cliff dwellings of the park, which were probably inhabited as late as 1300 A. D. The refuse heaps of cliff houses have so little depth that a stratification or superposition of pottery shards is too small to afford satisfactory evidence of long occupancy. In historic refuse heaps of pueblos now inhabited they are thicker and the stratification method has proved advantageous; but nothing that was not already known has been added to our knowledge of the sequence of prehistoric pottery of cliff houses by this method of study. No Mesa Verde refuse mound has yet shown any difference in the character of pottery found on its surface and at its base. The pottery fragments of mounds containing relics of earth lodges are as a rule cruder than others. The pottery from the cemetery or necropolis of Far View Tower is rudely decorated ware, while that from Far View House is finer, but not as well made as that from Spruce-tree House. It is probably older than the pottery from Far View House, but both are more ancient than the pottery from Spruce-tree House.

Far View Tower (fig. 71), like Cedar-tree Tower, has one and possibly more subterranean rooms or kivas on the south side, but the latter lacks the large cemetery. The use to which Far View Tower was put and the significance of the relation of the accompanying kivas to it were probably not very different from those at Cedar-tree Tower, discovered last year (1920). Evidently the complex was devoted to some archaic cult, like fire worship.

In addition to the work above mentioned, Doctor Fewkes also excavated Painted Kiva House, a small prehistoric cliff dwelling situated on the Mesa Verde a short distance north of Cedar-tree Tower, under the rim of the west side of Soda Canyon. This ruin was excavated and described by Baron Nordenskiöld, who called it Ruin 9. It contains remains of two well-made kivas of the regular

circular Mesa Verde type and of several granaries and living rooms. The approaches to it from the mesa rim are very precipitous and it was necessary to construct four ladders and otherwise improve the trail to enable visitors to see it.

On the walls of one of its two kivas there survives a very good example of decorated plastering. As shown in the accompanying illustration (fig. 72) there is a dado or lower part of the kiva wall which is painted red, and on its upper edge there are arranged at intervals clusters of triangular symbols (three in number) around which extends a row of dots. The Hopi identify these triangles as



FIG. 72.—Interior of kiva, showing mural decoration, niches, and pilaster. Painted Kiva House, Mesa Verde National Park. (Photograph by Fewkes.)

symbols of butterflies. They are of common occurrence on the walls of several kivas and survive in certain secular rooms of the cliff dwellers. These triangles with surrounding dots occur constantly on the oldest cliff-dweller pottery, as shown in the accompanying figures. The ventilator shaft is represented in the painted kiva by a tortuous passage, extending under walls and opening some distance from the room. It is spacious enough to serve as an entrance into the ceremonial chamber. Although Baron Nordenskiöld made extensive excavations in Painted Kiva House and devoted several pages of his memoir to a description of it and the specimens he found there, many objects (fig. 73) remained in rear chambers which were found in 1921.

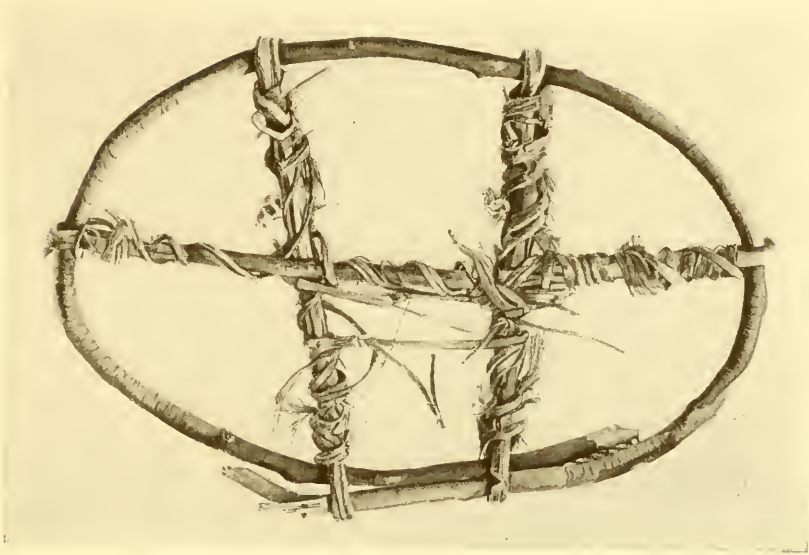


FIG. 73.—Snowshoe frame. Painted Kiva House, Mesa Verde National Park.
Size: $14\frac{1}{2}$ inches by $9\frac{1}{2}$ inches. (Drawn by Mrs. George Mullett.)

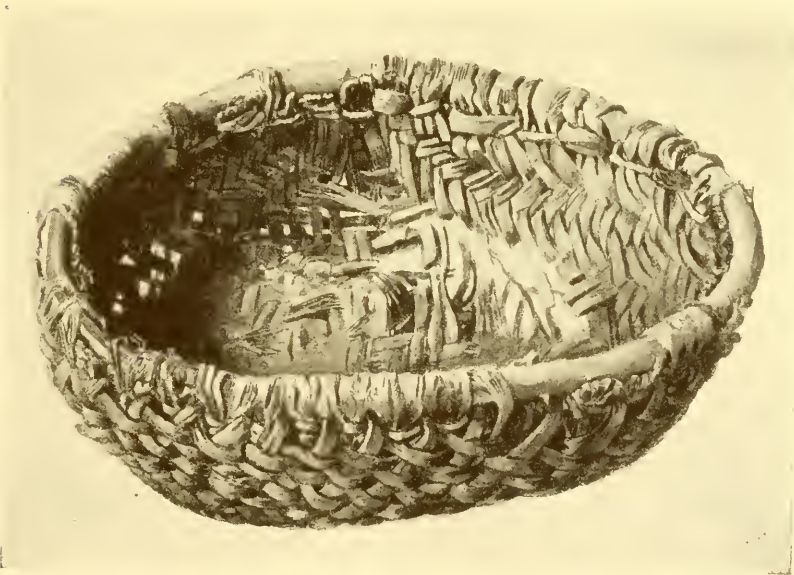


FIG. 74.—Rim basket. Painted Kiva House, Mesa Verde National Park.
Size: $15\frac{1}{4}$ inches. (Drawn by Mrs. George Mullett.)

Among the instructive specimens collected in Painted Kiva House should be mentioned a rim basket (fig. 74) and a woven headstrap of yucca fiber. The unique object shown in figure 75 reminds one



FIG. 75.—Unidentified object. Painted Kiva House, Mesa Verde National Park. Size: $5\frac{3}{4}$ inches long. (Photograph by De Lancey Gill.)

of Navaho "*bugaboos*," sometimes found farther down the San Juan but not yet recorded from Mesa Verde. In a rear room which gave every evidence of having been a granary or bin for storage there were found numerous ears of corn with kernels entire, beans, and squash seeds. The belief is widespread that cliff-dweller seed corn when

planted will germinate, but all experiments in that direction have failed. There is no hope that any greater success will reward experiments made with corn from this granary. In the centuries that have elapsed since the mesa was deserted, corn seed left behind has lost its vitality.

The walls of a ruin called Mummy House, situated almost directly under Sun Temple, are among the most carefully constructed on the park. This ruin has one kiva which was cleaned out but not repaired. A mummy (now in the Mesa Verde Park Museum) was found in this ruin several years ago. Above it is Willow-tree House, practically inaccessible. Ladders were put in place connecting the trail up the canyon with Mummy House. A typical form of cliff house called Oak-tree House, before and after repair, is shown in figures 76 and 77.

One of the important ruins on the Mesa Verde, called Step House by Nordenskiöld, is situated in a cave 5 miles west of Spruce-tree Camp. It presents to the archeologist one of the most instructive problems on the Mesa, and should be put in shape for visitors. In the floor of this cave, which has been considerably dug over by Nordenskiöld and others, there was material bearing on a most interesting chronological problem, viz., the age of the cliff houses; for the artifacts in this place represent two different epochs in the cultural history of the pure pueblo-cliff-dwelling type. Out of the floor of the cave there projects the edges of upright slabs of stone showing the existence of cists like those in Earth Lodge A. These suggest the slab-house culture; but at the other end is a building in the highest form of horizontal masonry. The probability is that the former is the older construction or that it was built by the most ancient people of the park, who lived and were buried in that end of the cave, designated by Nordenskiöld a cemetery. Here we have evidences, both architectural and ceramic, of former earth lodges or fragile walled buildings of the prepuebloan or archaic culture. The original dwelling built by people when they moved into Step House Cave was an earth lodge, and the dwelling with horizontal masonry and kivas, at the other end of the cavern, was a later development. The pottery of the former is more archaic than that of the latter. Figure 78 illustrates the most highly developed Mesa Verde pottery. We have, in other words, indications of two distinct stages of development in Step House Cave—one the earth lodge and the other the pure pueblo or kiva style; the former or earth construction situated at one end of the cave, the latter stage at the other. This evidence of two stages of



FIG. 76.—Oak-tree House, before repair. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Railroad.)



FIG. 77.—Middle room of Oak-tree House, repaired. (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Railroad.)

development in the same cave is derived from both ceramic and architectural studies. The indications are that after the earth-lodge condition was outgrown the floor of the cave where the evidence occurs was used as a cemetery, and the survivors constructed their new homes at the other end of the cave in the form of cliff houses. Although no satisfactory scheme of the chronological sequence of different types of Mesa Verde pottery has been worked out, it is most important to pay some attention to its bearing on the age of the above-mentioned buildings.

The mortuary pottery (fig. 79) from the Far View Tower cemetery belongs to a primitive type quite unlike any yet recorded from Mesa Verde cliff dwellings. The most exceptional features are the numerous varieties of coiled, corrugated, undecorated ware. Figure 80, restored from a fragment, and figure 81 show one of these exceptional bowls. A similar bowl with a blackened inner surface occurs elsewhere in the southwest, as on the Little Colorado, but has never been described from the Mesa Verde. A comparison of ceramic objects from the cemetery of Far View Tower (fig. 82) indicates it belongs to an ancient type related to Earth Lodge A, described in the explorations pamphlet for 1919.¹ Attempts have been made to show an architectural evolution from an earth lodge with roof and walls of logs and mud into buildings constructed of well-laid horizontal stone masonry. There is a chronological development in technique, form and decoration of pottery from the simple to the complex, but those who have studied cliff-house pottery have not yet succeeded in arranging the different kinds in chronological sequence.

Each ceramic area in our southwest has its distinct facies. Mesa Verde pottery excels all others in its geometrical decoration. Conventionalized designs and life figures on it are few in number and crude in execution, but linear designs are abundant and varied. In the prehistoric Hopi pottery, where there are few life figures and the majority of designs are geometric or highly conventionalized, there is nothing showing successive steps in the development of designs. In those ruins where geometric figures (fig. 83) predominate there is little to show their evolution. The pottery from the Mimbres Valley, New Mexico, decorated with both fine geometric and realistic figures, gives us no clue to evolution of different typical naturalistic designs. Apparently the three types, geometric, conventional, and realistic, are distinct from their very origin and it is difficult to prove that one type

¹ Smithsonian Misc. Coll., Vol. 72, No. 1.



FIG. 78.—Mug; black on white ware. Fire Temple House, Mesa Verde National Park. Size: 4 by 4 inches. (Photograph by De Lancey Gill.)



FIG. 79.—Archaic black on white ware; coarse decoration, Far View House Village. Necropolis, Mesa Verde National Park. Size: $5\frac{1}{4}$ inches.



FIG. 80.—Bowl; indented corrugated ware with black interior, Far View House Village. Necropolis, Mesa Verde National Park. Size: $4\frac{1}{2}$ by $2\frac{1}{8}$ inches. (Repaired by W. H. Egberts.)

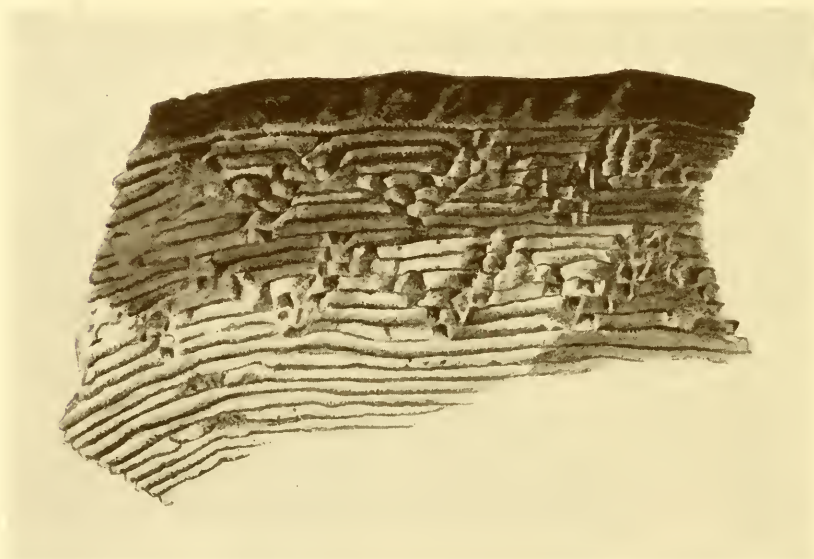


FIG. 81.—Detail of indented corrugated bowl, figure 80, Far View House Village. Necropolis, Mesa Verde National Park. (Drawn by Mrs. George Mullett.)

preceded another in evolution. For the present, then, our knowledge of sequence of types of pottery is largely derived from descriptions and not generalizations. But our archeological method permits us to determine the main features of a stage of culture among the Indians of which little is historically known. For instance, previous to the year 1915 we were ignorant of the manners and customs of the people



FIG. 82.—Archaic black and white ware, coarse decoration, Far View House Village, Necropolis, Mesa Verde National Park. Size: $3\frac{1}{2}$ by 3 inches. (Photograph by De Lancey Gill.)

who inhabited the Mimbres Valley, New Mexico. Documentary history is silent about them. Through archeological studies data are being brought to light year by year by which our knowledge of these Indians is greatly advanced. Pictures on ancient pottery often impart more information than written descriptions and are most important in the study of lost races. During the last few years Mr. E. D. Osborn, of Deming, New Mexico, has from time to time sent to the bureau many unique photographs of mortuary bowls (figs. 84-86), some of

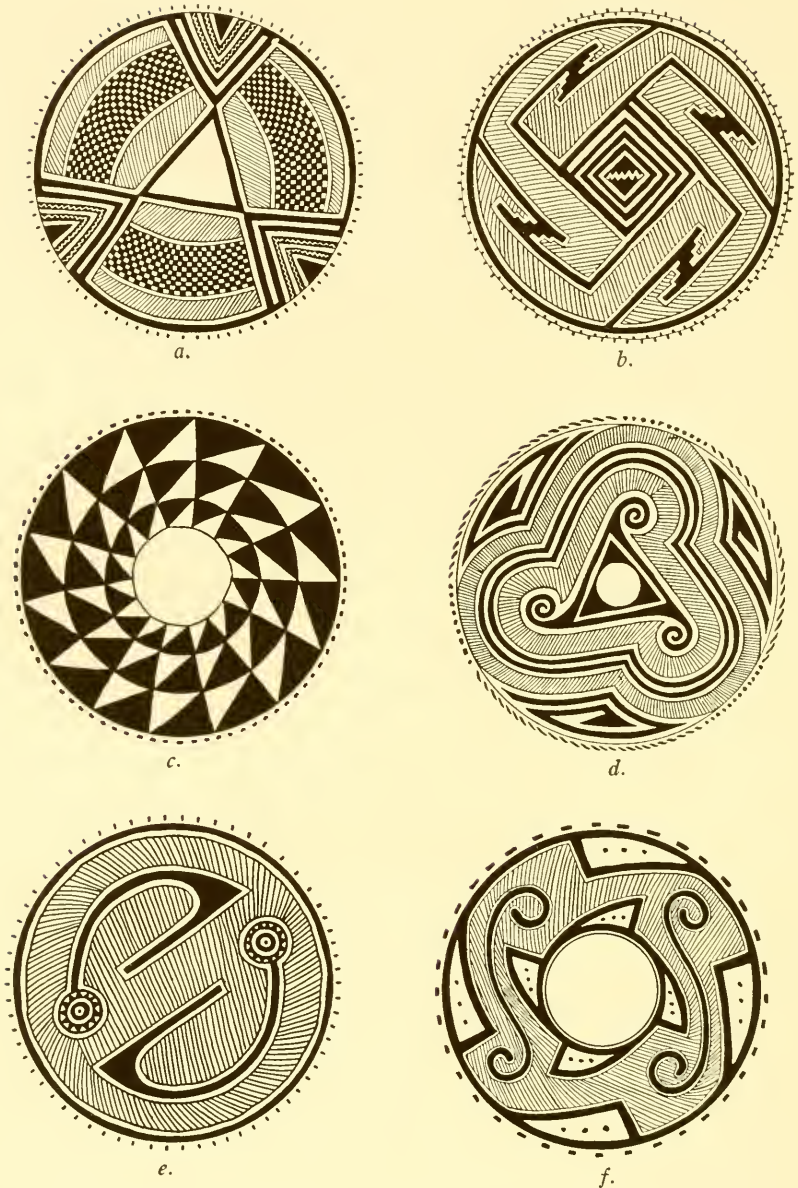
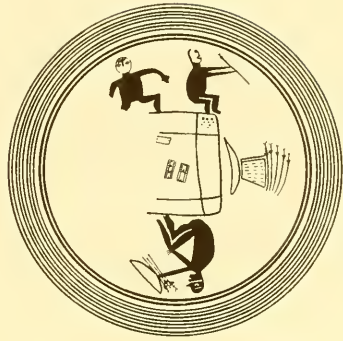


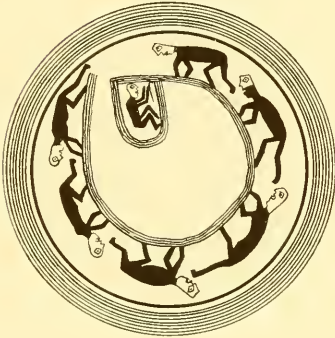
FIG. 83.—Decorated pottery from Mesa Verde National Park. *a*, triangular geometric design; *b*, hatched and terraced line; *c*, black triangles in concentric series; *d*, central triangle with curved lines at angles; *e*, unknown geometric design; *f*, S-shaped design. (Drawn from photograph, by Mrs George Mullett.)



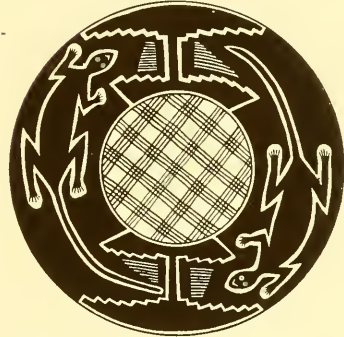
a.



b.



c.



d.



e.



f.

FIG. 84.—Decorated pottery from Mimbres Valley, New Mexico, Osborn Collection. a, bird trap; b, gambling game; c, emergence of man from lower world; d, white outline on black ground; e, two fishes; f, two negative pictures of fishes. (Drawn from photograph, by Mrs. George Mullett.)



FIG. 85.—Decorated pottery from Mimbres Valley, New Mexico, Osborn Collection. *a.*, unknown bird, from back, with outstretched wings; *b.*, feathers used in geometric decoration; *c.*, three-headed turkey; *d.*, parrot, head often repeated as club-shaped design on Casas Grandes pottery; *e.*, humming birds and flowers; *f.*, unidentified flowers. (Drawn from photograph, by Mrs. George Mullett.)

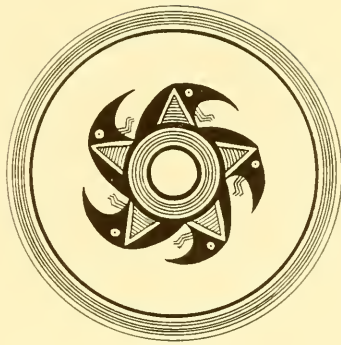
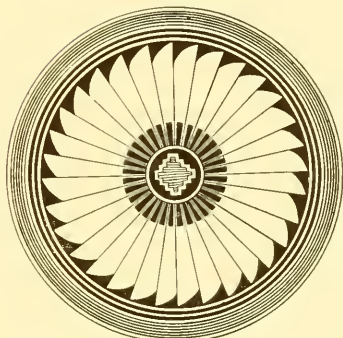
*a.**b.**c.**d.**e.**f.*

FIG. 86.—Decorated pottery from Mimbres Valley, New Mexico, Osborn Collection. *a*, unknown fish with feathered horn; *b*, animal heads like swastika; *c*, sun with four tail feathers; *d*, geometric ornaments; *e*, geometric ornaments; *f*, geometric ornaments. (Drawn from photograph, by Mrs. George Mullett.)

which are decorated with well-made pictures showing hitherto unknown features of prehistoric life in that valley. Similar pictures have been reproduced in former reports, but several specimens lately discovered are the most instructive yet found. References to a few of these close this account.

The food bowl (fig. 84*a*) apparently represents a hunter snaring birds. He carries three nooses in his hand and in three of the snares that are set are birds, while a fourth is empty. On the opposite side of the bowl there are two other birds that possibly have been captured earlier.

Figure 84*b* represents a prehistoric game of "stick dice." In this design three of the "canes" or dice are represented in a rectangular enclosure around which are seated the players. The stakes are arrows shown in a receptacle deposited above the picture.

Two fishes shown in figure 84*c* call to mind the unusual method of representing certain life figures, men, birds, and other animals, on other pieces of pottery. The background of the two fishes of figure 84*f* is black, the bodies white; a negative picture common on ware from Casas Grandes, Mexico, and peculiar to the inland basin in which the Mimbres lies. The upper beak and eye of the head of the well-drawn parrot is shown in figure 85*d*. This conventionalized head often occurs without the body of a bird or any realistic likeness to a parrot in the decoration of pottery from Casas Grandes and it is interesting to note in this connection that Mr. Osborn claims to have found a mound a few miles from Deming, New Mexico, in which the pottery is practically the same as the well-known Casas Grandes ware.

The body of the animal represented in figure 86*a* is serpentine, but the shape of the head and the possession of fins suggest a water monster. The horn with a cluster of feathers occurs in a similar painting without fins, and may be a representation of the Horned or Plumed Serpent.

As is true of decorations on prehistoric Hopi ware, the feather is sometimes used as a decorative element. The identification of the use of this motive was made by a comparison of the undoubted bird with outstretched wings and well-marked symbolic wing feathers shown in figure 85*a*, and the existence of four clusters of a like design in figure 85*b*. A study of over a hundred decorations, realistic, conventional and geometrical, taken from Mimbres pottery indicates that this lost people of southern New Mexico had reached a very high stage of ceramic decoration. There is evidence that this art was somewhat influenced from outside but mainly developed where it was

found. It is one of several localized culture areas related to but not necessarily belonging to the pueblo with which it has affinity. It is most closely affiliated with that of Casas Grandes and the southern part of the plateau in which it lies. The environment of this plateau is Mexican, climatically speaking, and the culture will probably be found to correspond. While superior to the Casas Grandes and all other prehistoric Indian pottery in variety and the accuracy with which human and animal figures are drawn, it shares enough with it to hold a place in the same group.

ARCHEOLOGICAL COLLECTING IN THE DOMINICAN REPUBLIC

While engaged in a biological exploration of this republic in 1921 and previous years, Dr. W. L. Abbott of Philadelphia incidentally made a collection of aboriginal Indian antiquities on the north coast, especially around Samaná Bay and the region between it and Puerto Plata, as well as in other parts of the island. No systematic excavations were attempted; the majority of the specimens were either purchased or otherwise obtained. The localities where individual specimens were said to have been found are mentioned in the legends under the illustrations. This accession contains many specimens, one or two of which merit special notice, even if it anticipates a final report.

There is in this collection an exceptionally good water jar of unique form upon the neck of which are incised rude figures of animal or human heads. The body of this jar (fig. 87), instead of being round is roughly four-sided, its base flat, neck constructed bottle shaped. Another bowl (fig. 88), spherical in form, is also unique and the incised figure covers much of the upper surface.

In the collections of every West Indian archeologist there are specimens of burnt clay heads called "zemis" (idols) by the natives. These objects are not idols but broken handles of bowls, portions of which sometimes adhere to them. As broken specimens they teach very little, but if the jar from which they were broken be restored they become instructive. The results of Mr. Egbert's clever reconstruction of the bowls to which three of the handles belong are shown in figure 89, *a*, *b*, and *c*.

The decoration of Santo Domingo pottery, like that from prehistoric Porto Rico, as a rule is limited to handles or lugs of bowls and vases. These heads are attached to the rims of jars or bowls and give us a means of classification. They fall naturally into three distinct types: First, and most common (fig. 89*a*), those where the handles are opposite each other, the handle represented as looking into the bowl;

second, a less common type, those with handle faces looking outward; and third (fig. 89c), rarest of all, those with human or animal heads attached to the rim by the back of the head or lying along the rim



FIG. 87.—Unique vase. Cueva de Roma, Dominican Republic. Size: $8\frac{3}{4}$ inches. U. S. Nat. Mus. No. 316445.

of the bowl with their axis parallel to it. Santo Domingo pottery as a rule is a coarse biscuit ware, its surface waterworn but smooth, apparently sometimes formerly covered with a red slip, showing, however, no evidence of a glaze. Although in bolder relief than that made by the prehistoric potters who preceded the Carib in the Lesser

Antilles, the ceramics of the aborigines of the Greater Antilles are more closely related to the work of the Huastecs of Mexico than to that of the aborigines of South America.

There are in the Abbott collection representatives of all types of those Antillean idols characterized as three-pointed stones: one (figs. 90 and 91) with head on the anterior point; another (fig. 92), a second type characterized by a head on the side of the cone; a third



FIG. 88.—Globular bowl of thin ware. Locality, Yaqui del Norte, Dominican Republic. Size: $5\frac{3}{4}$ inches. U. S. Nat. Mus. No. 293016.

type has the cone modified into a head; and lastly one smooth, undecorated specimen, referred to a fourth type. The specimen represented in figure 93 belongs to the first type and has on each side of the base of the cone two shallow circular pits; each of these pits represents a joint of the fore and hind limbs, both of which are cut in relief on the side. Although similar pairs of pits are known on several specimens and accompanying forelegs or arms sometimes appear in relief, no specimen with two pits both having relief representations of limbs has been recorded.

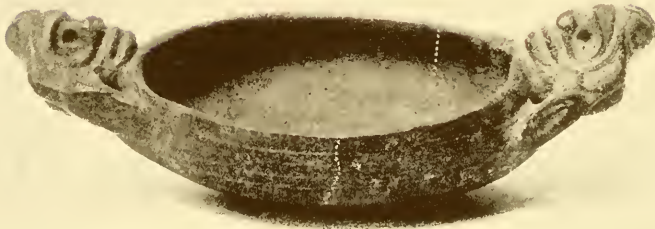
*a.**b.**c.*

FIG. 80.—Restored pottery from shards collected in the Dominican Republic, by Dr. W. L. Abbott. Restoration by W. H. Egberts. *a*, food bowl with effigies on rim, facing inward; *b*, effigy bowl with handles in form of heads, facing upward; *c*, food bowl, handles in form of heads transversely placed on rim. Size: *a*, $9\frac{1}{2}$ inches; *b*, $6\frac{1}{4}$ inches; *c*, $16\frac{3}{4}$ inches. U. S. Nat. Mus. No. 316454.

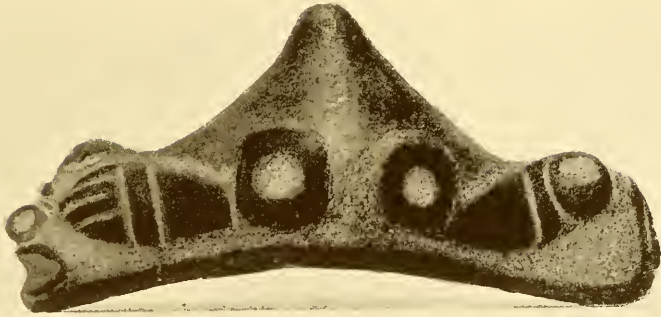


FIG. 90.—Three-pointed stone of first type, from side. Constanza, Dominican Republic. Size, $5\frac{3}{4}$ inches x $2\frac{1}{2}$ inches. U. S. Nat. Mus. No. 309536.

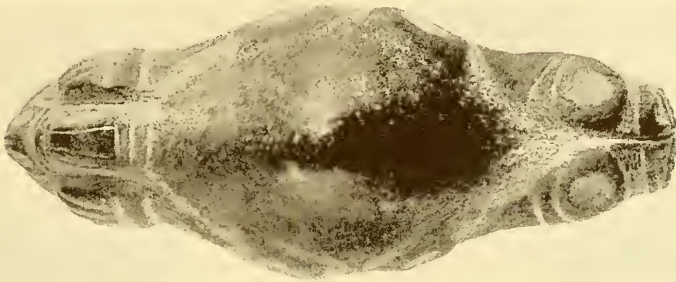


FIG. 91.—Same three-pointed stone from above.



FIG. 92.—Three-pointed stone of second type, from side. Constanza, Dominican Republic. Size: $2\frac{1}{2}$ inches x $1\frac{1}{2}$ inches. U. S. Nat. Mus. No. 309537.

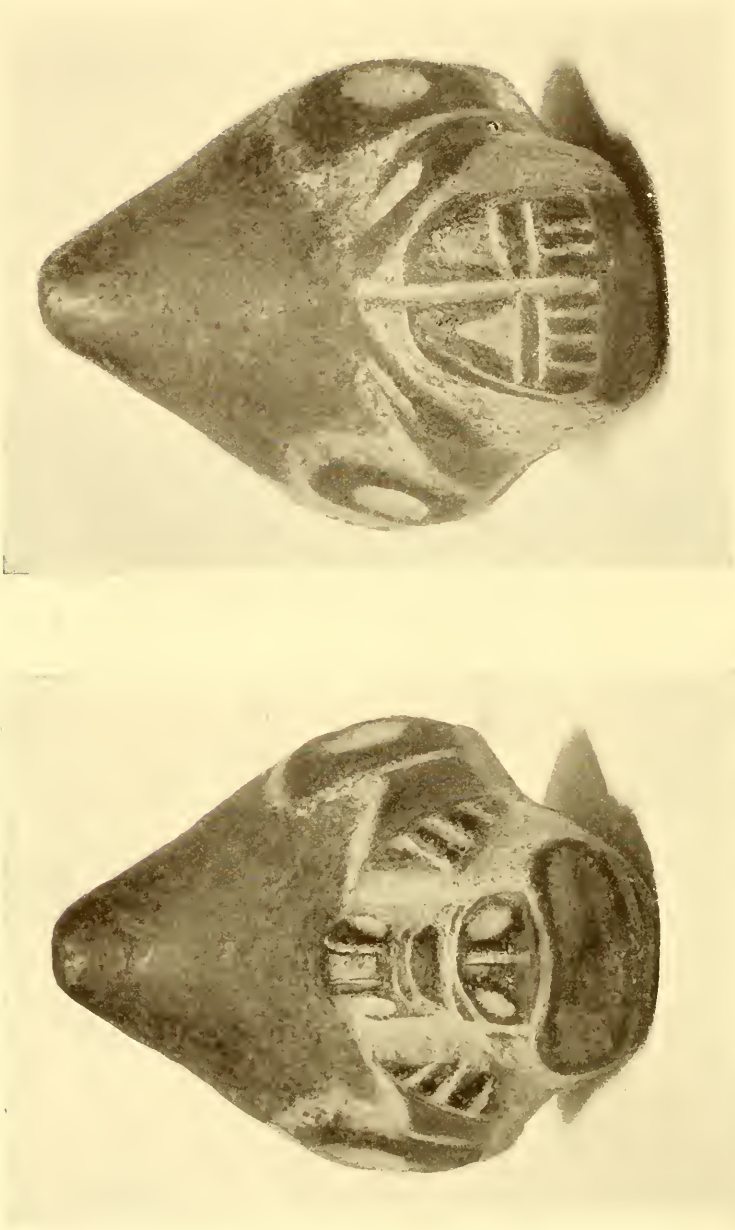
*b.**a.*

FIG. 93.—Front and rear views of three-pointed stone of first type, whose side and top are shown in figs. 90 and 91.
a., front; *b.*, rear.

There are only seven known specimens of three-pointed stones of the second group, and the U. S. National Museum now has five of these, one of which we owe to Doctor Abbott.

He has also added to the museum collection the three especially fine Antillean amulets shown in figure 94. The form of one—that figured in the middle—is unique. These objects are supposed to have been



FIG. 94.—Three marble amulets. Locality, Guayubin, Yaqui River, Dominican Republic. *a*, $2\frac{7}{8}$ inches, U. S. Nat. Mus. No. 316448; *b*, $4\frac{1}{4}$ inches, No. 316446; *c*, $2\frac{1}{8}$ inches, No. 316447.

used as fetishes and to have been tied to the foreheads of warriors when they went into battle, as described by Gomara and other early writers.

The cylindrical object of clay with incised figure shown in figure 95 belongs to a type concerning the use of which there has been considerable discussion. These specimens have been identified as rollers for stamping pottery with the design incised on their surfaces; but if

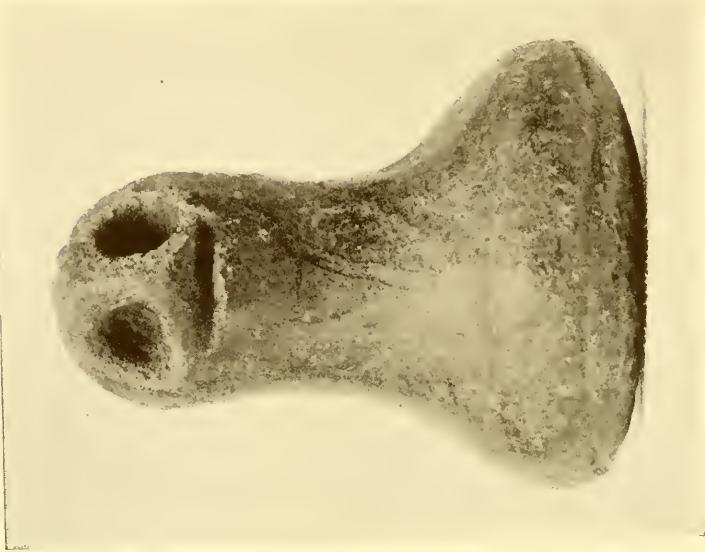


FIG. 97.—Stamp made of pottery, for marking fabrics or imprinting design on the body. Dominican Republic. Size: $2\frac{1}{2}$ inches. U. S. Nat. Mus. No. 309507.

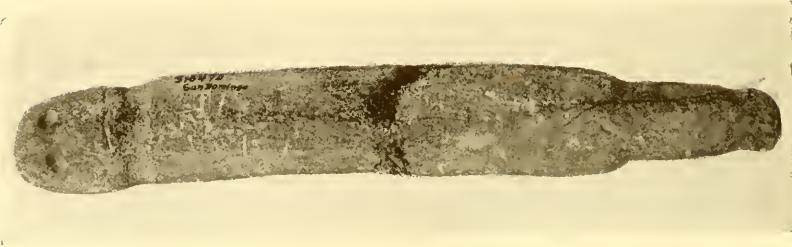


FIG. 96.—Stone baton. Collected by Col. G. C. Thorpe. Size: $16\frac{3}{8}$ inches. U. S. Nat. Mus. No. 316475.



FIG. 95.—Cylindrical stamp for imprinting pigment markings. Constanza. Size: $2\frac{3}{4}$ inches. U. S. Nat. Mus. No. 309559.

we judge from the similar objects of aborigines of Venezuela they were more probably used for stamping fabrics or even for printing certain totemistic or other designs on the face or body.

There is in the Abbott collection an artificially worked stone (fig. 96), about a foot in length, which appears to have been used as a



FIG. 98.—Stone Cassava grinder. Yaqui del Norte, Jarabacoa. Size: $12\frac{3}{4}$ inches x $19\frac{1}{2}$ inches. U. S. Nat. Mus. No. 292998.

baton, possibly a badge of office. One end bears incised designs representing eyes and mouth suggesting a human head.

Figure 97 resembles outwardly a pestle, but a closer examination shows that it is made of clay, a material impossible for an effective grinding implement. It has many pits on the under surface (shown in the figure) which suggests that it was functionally like the cylinder above mentioned used for imprinting paint patterns on the human body or woven fabrics.

One of several flat stone objects collected by Doctor Abbott having extensions, two "handles" on the rim, is shown in figure 98. In shape and especially in the form and position of the handles these stone implements resemble graters—generally of wood—specimens of which are still in use in Haiti. Stone graters are novelties and those collected by Doctor Abbott are the first of this material added to the museum. It is probable that the surface of this stone was formerly covered with some kind of matrix in which were set sharp stones arranged in an ornamental design that has now completely disappeared, leaving no trace of its former presence.

All the above-mentioned specimens are referred to the Tainan or most advanced neolithic culture of the West Indies, that originated and flourished in the Haiti-Santo Domingo and Porto Rico areas in prehistoric times. The three-pointed idols, stone collars, elbow stones, and characteristic pottery separate the Porto Rico Tainan from that of Jamaica, eastern Cuba, and the Bahamas, which belong to another closely related culture that may be called Cuban Tainan.

The pottery of the aborigines of the Lesser Antilles belongs to an allied prehistoric Tainan culture that was submerged by the Caribs, who inhabited these islands when discovered by Europeans, at the close of the 15th century. The fine addition that Doctor Abbott has made to our West Indian collection all belongs to the true Tainan culture which reached its highest development in Española and Porto Rico.

The archeological specimens from the West Indies presented to the museum by Doctor Abbott are very valuable and as time goes on will be more and more appreciated by students of the history of man in the Antilles.

ARCHEOLOGICAL RECONNAISSANCE OF THE CAHOKIA AND RELATED MOUND GROUPS

David I. Bushnell, Jr., collaborator of the Bureau of American Ethnology, conducted during 1921 a reconnaissance of the remarkable mound groups in the vicinity of the great Cahokia Mound. The information secured at this time, added to notes made during frequent visits in the past, has been used in preparing the following sketch of the interesting region.

It is quite evident that long before Père Marquette discovered and passed the mouth of the Missouri, during his journey down the Mississippi early in the summer of 1673, the region immediately below the confluence of the two great streams had been an important center, a gathering place, of the native inhabitants of the

valley. Mound groups, village sites, and burial places remain to indicate the presence of a numerous people before the coming of Europeans, and the innumerable objects of native origin encountered

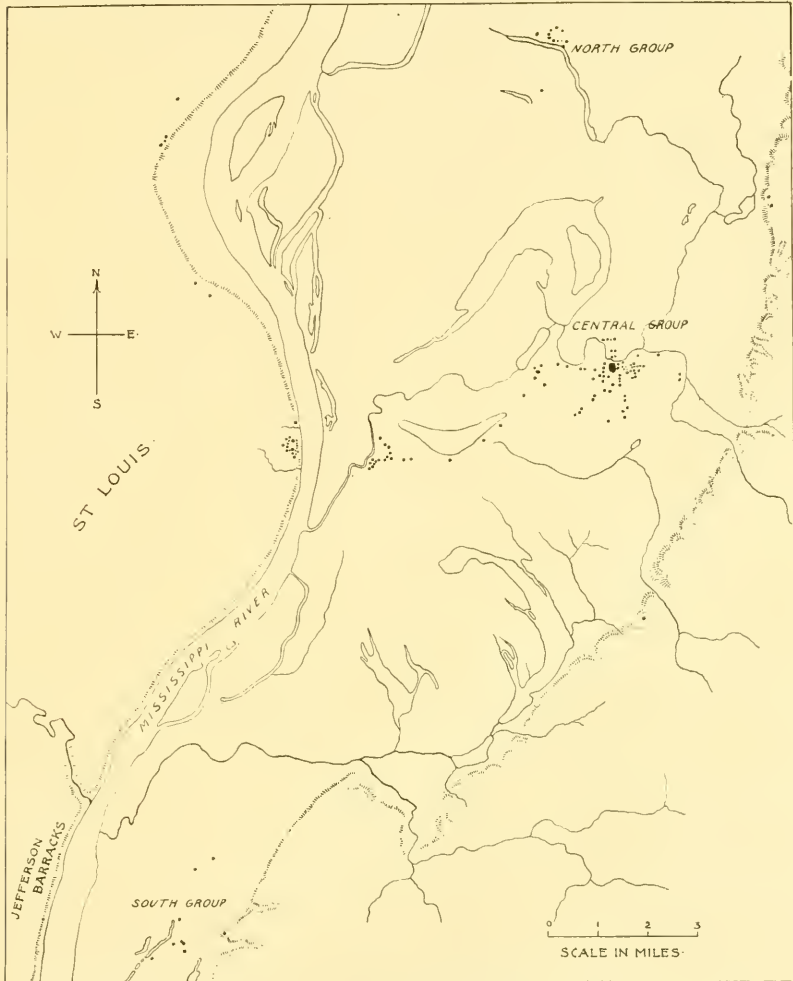


FIG. 99.—Map showing location of mound groups.

in the region bear evidence of their skill in working the available materials.

Immediately below the mouth of the Missouri, on the left or Illinois bank of the Mississippi, the river bluffs become more distant from the stream and consequently the lowlands are in some places 6 or 8 miles in width from east to west. Shallow lakes covered much

of the surface and some parts were heavily timbered. As indicated on the accompanying map, figure 99, four mound groups stood in the lowlands east of the Mississippi and a fifth was on the opposite bank, land now covered by the city of St. Louis. And as is shown on the map the five groups were placed with a certain degree of order to one another, with the great mound, Cahokia, rising near the center of the area.

But who were the builders of the mounds, the most important groups in the Mississippi Valley? The question may never be definitely answered although it is more than probable they should be attributed to a tribe or tribes known in historic times but who may have become greatly reduced in numbers and relative importance before the coming of the French. Evidently the historic Algonquian tribes did not reach the eastern bank of the Mississippi until about the beginning of the seventeenth century, and it is doubtful if others of this linguistic family had preceded them. Siouan tribes when moving from the eastward may have traversed the region, but there is no reason whatsoever to attribute the great mound groups which form the subject of this sketch to either the Algonquian or Siouan tribes. The works were probably raised by a southern tribe, a southern people who at some time before the arrival of the Algonquian tribes, or the migration of the Siouan tribes from the eastward, occupied the region, later to move elsewhere, possibly to return southward. These may have been the ancient Natchez, the Chickasaw, or some other Muskogean tribe of whom we possess no historic record; however, a careful examination of the mode of construction and the contents of one or more of the mounds may enable us to arrive at some conclusions regarding their origin.

The great Cahokia Mound which rises from the level alluvial plain near the center of the area, is somewhat less than 6 miles east of the Mississippi and 10 miles east of south of the mouth of the Missouri. It is a truncated pyramid, of rectangular form, with a broad terrace extending from the south side which continues in a graded way or approach. The sides of the work face the cardinal points, as do those of the lesser rectangular mounds of the group. Its maximum elevation is about 100 feet. Its extreme length including the approach is 1,080 feet, and its width from east to west is 710 feet. The base covers an area of approximately 16 acres. Viewed from the east, as in figure 100, it appears quite regular in outline and is clearly defined from base to summit. A small conical mound formerly stood on the

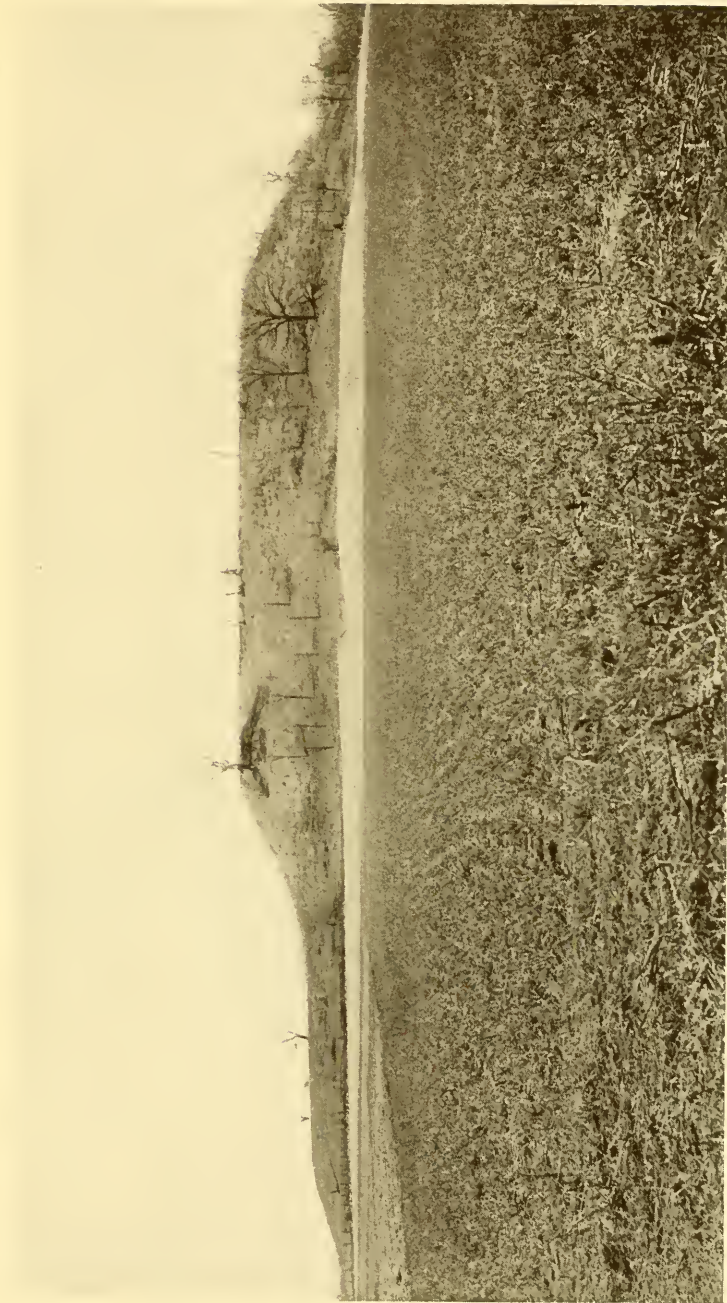


FIG. 100.—Cahokia. The eastern side, with the graded approach on the south.

upper plateau near the southeastern corner but it was removed many years ago. The northwestern portion of the great mound is deeply gullied and very irregular in contour: it is a question whether this part of the structure was ever completed.

Cahokia is the largest earthwork in the United States and one of the most remarkable monuments left by the native tribes. Fortunately it remains in its original condition, practically untouched since the coming of Europeans, and in this condition it should be preserved. With each succeeding generation, as the lesser mounds and other earthworks disappear by reason of the cultivation of the soil or the requirement of the land for other purposes, this great terraced work is destined to become of greater popular interest and immediate steps should be taken to make certain its preservation.

The several groups, as indicated on the map, may now be described in detail.

NORTH GROUP

Eleven mounds constitute this group which stands on the north side of Long Lake, near the station of Mitchell. They are about three and one-half miles east of the Mississippi, nearly midway across the lowlands and some seven miles west of north of Cahokia. When the group was surveyed March 13, 1900, it was not possible to determine the original shape of several of the mounds. The land had been cultivated for many years and this, with the constant washing and wearing away of the surface, had caused the works to assume an entirely different appearance from their original condition.

The largest mound of this group stood apart and to the west of the main cluster. It was practically destroyed years ago at the time of the construction of two railroads which pass through it, but parts of the work may now be traced between and on either side of the tracks. Many remarkable objects of stone and copper were recovered during the destruction of the structure.

As is shown on the map the large mound stood to the west. The mound nearest it on the east, as determined by the survey of 1900, was 1,200 feet distant and at that time had a maximum elevation of 9.3 feet above the plain, and was of circular form with a diameter of approximately 237 feet. Eastward from this mound are other units of the group. The highest mound of the group at that time measured 10.4 feet, but undoubtedly the large work to the west was originally much higher than any now standing.

South of the lake, away from the main group, is a single, isolated mound. Others may have stood within the area, all traces of which have disappeared.

CENTRAL OR CAHOKIA GROUP

Surrounding the great Cahokia Mound, which has already been briefly described, were many lesser works, about seventy in number, some of which were more than 40 feet in height. Some were rectangular, others were circular and although at first glance they appear to have been placed without definite order, nevertheless it is quite evident that in several instances they were so arranged as to create inclosed areas, thus conforming with the position of the mounds of the three lesser groups to the north, west, and south of the central cluster.

Unfortunately the large majority of the mounds east and west of the great central structure have been much reduced and modified by the plow, while several have been practically destroyed and a slight rise is all that remains to indicate their position. The inclosure formed of the smaller mounds on the east is clearly defined and gives the impression of having been intentionally planned and arranged, but for what purpose may never be determined. And although many of the lesser mounds have thus lost their original form and appearance, Cahokia remains the most important and impressive native work in the Valley of the Mississippi. As the great mound now stands it should be preserved: to permit its destruction would be a calamity, an irreparable loss to future generations.

The rectangular work immediately southwest of Cahokia was occupied from 1810 until 1813 by a small body of Trappist monks, during which time their garden was on the southern terrace of the great mound. According to the survey of 1875-1876 from which all measurements now given are derived, this lesser mound was 25 feet in height, its base line from north to south was 180 feet and from east to west 200 feet. Just south of this is a small circular work. A short distance east of south of the latter stands a conical mound which rises 44 feet above the plain, having a diameter at base of 150 feet. Immediately east of this is a rather irregular mound 46 feet in height, and possibly other units of this remarkable cluster were even higher and more extensive than these. A rectangular mound southeast of the preceding was, according to the survey mentioned, 40 feet in height, with its base extending 300 feet from north to south and 250 feet from east to west. This reference to several of the lesser works



FIG. 101.—Airplane photograph showing Cahokia in upper right center. Mounds to the south and southwest are also defined, likewise the country northward. Camera pointed west of north.



FIG. 102.—Airplane photograph showing Cahokia in the upper left corner. The rectangular mound in the center of the picture, just south of Cahokia, rises 46 feet above the original surface. A light snow covers the ground.



FIG. 103.—Airplane photograph showing mound north of Cahokia, partly removed. Camera pointed west.

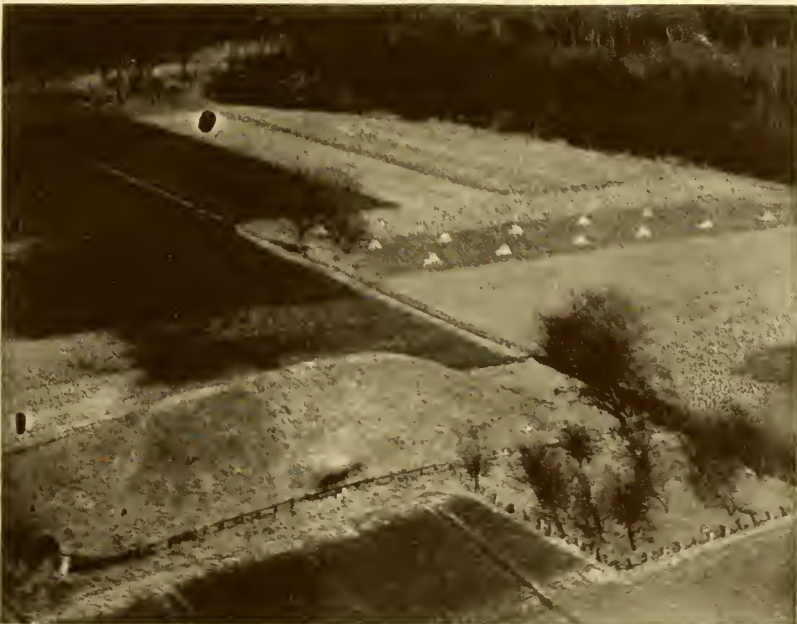


FIG. 104.—Airplane photograph showing mound about $1\frac{1}{2}$ miles west of Cahokia. One of the most perfect of the group, and probably quite similar in appearance to the large mound of the St. Louis group which was removed in 1869. Camera pointed northeast.

will serve to convey an idea of the magnitude of the group as a whole; the most important prehistoric site in the entire valley.

It is of interest to be able to reproduce at this time four aerial pictures of units of the Cahokia group, and these are believed to be the first photographs of American mounds or earthworks to be taken from the air. The negatives, with others, were made during the winter of 1921 and 1922 by Lieut. Harold R. Wells and Lieut. Ashley C. McKinley, stationed at Scott Field, Belleville, Illinois, under instructions of Major Frank M. Kennedy.

Unfortunately, weather conditions during the winter were not favorable for aerial photography, and although many attempts were made ground haze and smoke interfered greatly with the work. As Major Kennedy wrote in part February 6, 1922, after mentioning the mines and factories in the vicinity of the mounds: "These activities produce a large amount of smoke which seems to settle near the ground and form a blanket two or three hundred feet thick." Nevertheless the four pictures are shown to record the first attempt to photograph mounds from an airplane.

On the summit of the bluffs northeast of Cahokia, as indicated on the map, are two mounds of great interest which command a wide view of the lowlands extending to the Mississippi, and beyond. Both are of conical form and rise 30 feet or more above the original surface. One, as it appears from the foot of the bluff, is shown in figure 105.

A view of the bluffs, with the beginning of the lowlands which slope westward to the bank of the Mississippi, is reproduced in figure 106. This is looking northward from a point southeast of Cahokia.

Extending from the main group which surrounded the great mound, in a direction south of west and following a slight ridge, is a chain of works which terminated in an irregular group of smaller mounds near the bank of the Mississippi. It is to be regretted that all units of this group have now disappeared.

WEST OR ST. LOUIS GROUP

There formerly stood on the right, or west bank of the Mississippi, on the summit of the high bluff within the limits of the present city of St. Louis, an interesting group of mounds, twenty-seven or more in number. All have now disappeared but fortunately their positions were indicated on early maps of the city.

One of the earliest as well as most detailed descriptions of the mounds was that prepared by members of the Long Expedition, more than a century ago. At that time they stood north of the settled



FIG. 105.—Conical mound on summit of the bluff northeast of Cahokia.



FIG. 106.—Looking northward from near the road leading to Belleville, showing the eastern border of the lowlands which extend westward to the Mississippi.



FIG. 107.—St. Louis from the Illinois bank of the Mississippi, 1840. Showing the large mound in the northern part of the city.

portion of the town and were in their primitive condition, but soon the settlement was to extend northward and the mounds were destined to be leveled. A view of St. Louis from the east, taken from the Illinois bank of the Mississippi during the year 1840, is reproduced in figure 107. Far to the north of the principal structures of the town, on the extreme right of the picture, stands the large detached mound. The main group was below, probably near the middle of the picture.

The large isolated work was more than 1,400 feet north of the main cluster which formed an inclosure, thus conforming with the arrangement of the mounds on the opposite side of the river. This most important work was of oval form, with the maximum diameter of its base, from north to south, 319 feet, and from east to west 158 feet. The dimensions of the summit plateau were 139 feet and 11 feet. Height 34 feet. On the eastern side, facing the river, was a terrace resembling that on the south side of Cahokia, which was 79 feet from east to west and probably extended the entire length of the structure.

At the time of the destruction of the great mound in the year 1869 a most remarkable cavity was discovered within it. This was a burial chamber which could be traced for a distance of 70 feet and part had previously been removed. It had probably been constructed of logs over which the mass of earth had been deposited and shaped. Within were encountered human remains in the last stages of decay, and associated with these were vast quantities of shell beads and other objects. This was truly a remarkable structure and one which should have been preserved, but unfortunately it shared the fate of the lesser mounds of the group, all traces of which have now disappeared.

SOUTH GROUP

The southern part of the American Bottom—a name long applied to the lowlands occupied by the ancient works mentioned in this sketch—across the Mississippi from Jefferson Barracks, becomes quite narrow, the bluffs approach the river and are, in some places, a scant mile from the low marshy ground which was formerly covered with water the greater part of the year. But the land extending along the foot of the bluffs at this point was evidently at one time occupied by a village of some importance which stood in the midst of a group of mounds. This may be designated the south group and in some respects resembles the north or Mitchell group, already described.

The site was visited by the writer during the latter part of October, 1921, at which time a plan of the group was made, this now being included on the general map. As is indicated there are now seven

mounds standing on the lowland and one, a large conical structure, on the bluff to the east. It is said that until a few years ago, at the time of the construction of several railroad embankments, five mounds extended in a row southward from the one now remaining nearest the bluffs, consequently these, together with the five now remaining, formed an inclosure quite similar to the north group. Northward from the main cluster or inclosure, are two detached mounds, both large and prominent. The group as a whole and as it originally stood, must have been as interesting and imposing as either the north or



FIG. 108.—Village site and mounds at Bixby, with bluffs beyond.

west groups as already described, and all were probably of equal importance to their builders.

Unfortunately, the majority of the remaining units of the group have been greatly reduced and modified by the plow and consequently it is not possible to determine their original size or form. However, it is evident the second mound from the south, on the west near the Mississippi, was rectangular and quite large. It appears to have been oriented with its sides facing the cardinal points, as were the units of the other groups, including the great mound. At the present time it is worn down by long-continued cultivation and now measures about 12 feet in height, with a diameter of 200 feet. A photograph looking eastward from the summit of this work is reproduced in figure 108.

This is a view over the plain once occupied by a native village and shows the bluffs in the distance. Fragmentary pottery and objects of stone are now found scattered over the intervening ground.

As has been mentioned, and as is shown on the map, a conical mound stands on the bluff just east of the main group. It is not on the highest point, not on the summit, but on a commanding spot visible from miles away, north and south, and from far westward across the Mississippi. It is on the bluff in the exact middle of figure 108, and a closer view, taken from the south, is shown in figure 109. This resembles the two mounds on the bluffs northeast of Cahokia and is of equal interest.



FIG. 109.—Conical mound on bluff east of Bixby.

No other area of equal size in the entire valley of the Mississippi appears to have been of so great importance to the native tribes as that mentioned in this sketch. Here they reared their greatest monument, Cahokia, and surrounded it with many lesser works. The several distinct clusters should be considered units of a greater group, in which the massive terraced work stood as the central structure. This was the gathering place of a numerous people, but when or whence they came can never be known. Now, two and one-half centuries after the region was first entered by the French, at which time Illinois tribes were occupying small villages near the banks of the Mississippi, the majority of the ancient mounds have disappeared, but Cahokia remains and it should ever stand. It must be saved as have the pyramids of Egypt; a monument of another race whose origin is shrouded in mystery.

ARCHEOLOGICAL INVESTIGATIONS AT PUEBLO BONITO,
NEW MEXICO

Mr. Neil M. Judd, curator of American archeology, U. S. National Museum, began work during the year on a five-year archeological project undertaken by the National Geographic Society, mentioned in the Smithsonian Exploration Pamphlet for 1920,¹ centering about Pueblo Bonito, one of the largest and most important prehistoric ruins in the United States. Mr. Judd left Washington for New Mexico on May 1 and shortly thereafter began operations in the



FIG. 110.—Pueblo Bonito, from the northwest, showing the vast accumulations of fallen wall material and wind-blown sand which cover the ruin. The present height of the north wall is indicated by the three figures in the left center. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

great ruin; his staff consisted of seven assistants with Navaho and Zuñi Indians employed for the actual work of excavation.

The first few weeks were largely devoted to development of a water supply sufficient for the expedition camp, to transporting equipment and provisions from the railroad, 62 miles distant, and to removal of several hundred tons of fallen wall material and wind-blown sand which had accumulated in that section of the ruin selected for the season's explorations. Following these preliminaries attention was

¹ Smithsonian Misc. Coll., Vol. 72, No. 6.

directed, respectively, to the central and southeastern portions of the pueblo. The central wing was considered of prime importance since it included the Great Kiva, the civil and religious heart of Pueblo Bonito; the southeastern quarter was chosen because its masonry, apparently the most recent of all in the village, suggested that antiquities found in this area would illustrate the very apex of cultural advancement by the ancient Bonitians, thus forming an index for subsequent discoveries.



FIG. 111.—Zuñi workmen pointing out features of the masonry in Pueblo Bonito, which is far superior to that in their own village. The skill exhibited by the ancient artisans was a source of constant admiration to these modern Pueblos. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

Altogether, fifty secular rooms and five kivas were excavated during the summer. In addition, a number of dwellings previously opened were cleared of their individual accumulations of wind-deposited sand and other débris. An outstanding result of this work was identification of three distinct types of masonry, each illustrating the dominant construction method at a given period during occupancy of the village. It is, of course, still too early to designate the factors which brought about these various styles in building, just as any present effort to trace the ground area formerly occupied by each of the three types



FIG. 112.—Central portion of Pueblo Bonito, from the south, showing the north cliffs of Chaco Canyon towering above the ruin. Some of the rooms were so large that the initial work of excavation could be done directly with teams. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)



FIG. 113.—An excavated kiva in Pueblo Bonito, showing the low encircling bench and, above this, the roofing timbers which overlap above the pilasters. At the left will be seen the decayed fragments of upright hewn planks which stood between the dome-shaped roof and the circular wall of the chamber. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)



FIG. 114.—Excavating the Great Kiva. The block of masonry in the middle is the fireplace; that in the lower right, an inter-pillar compartment. The piles of stone at the top consist of blocks retained for repair of the ancient walls. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

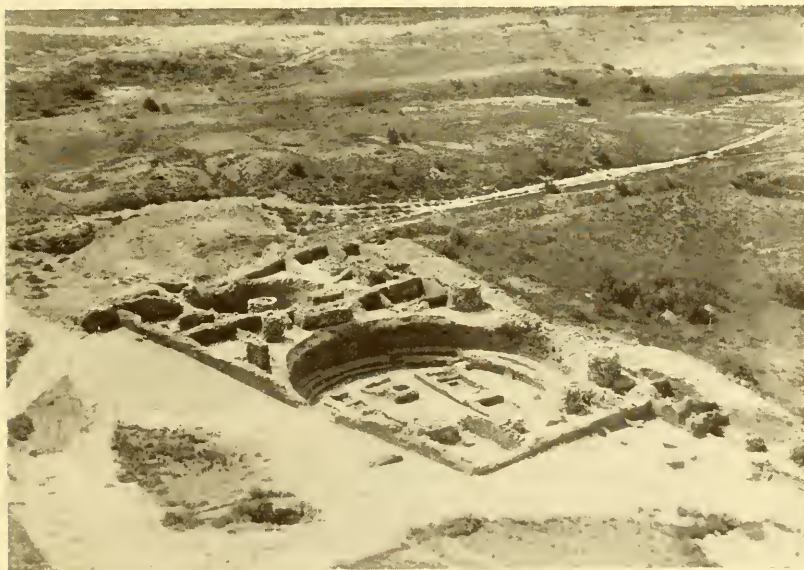


FIG. 115.—The Great Kiva and its surrounding rooms, as seen from the cliffs north of Pueblo Bonito. This remarkable structure is 52 feet in diameter; it was the largest and most important ceremonial room in the village. A trench for stratigraphical examination of the west refuse mound will be noted at the upper left center. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

would be premature. Dwellings were razed and replaced by other structures as Pueblo Bonito grew in size and population.

Those walls which appear to have formed the nucleus of the village are crude and irregular; the rooms they inclose are relatively small and low of ceiling. In contrast to these, walls of the second type exhibit an infinite amount of patience and attention to detail. They consist of rather large uniform blocks of friable sandstone, dressed on the face only, laid in adobe mud and chinked with innumerable small, thin chips. Equally marked in its variation from that in the oldest houses is the masonry of the third type mentioned. In this, uniformly thin tablets of laminate sandstone were utilized with a minimum of adobe and little or no chinking. Larger blocks were frequently laid in bands both for the decorative effect produced and as bonds to hold the masonry veneer to the earthy core of the wall. Beneath the floors of a large number of the rooms excavated during 1921 were found the razed walls of older structures in which a different style of construction prevailed.

These principal variations in masonry may represent merely local developments—the will of ascendant influences in Pueblo Bonito—but it seems more reasonable to believe that each came in upon a wave of immigration from other regions. Among the collections made during the summer are specimens of pottery characteristic of the Mesa Verde cliff-dwellings in Colorado, of the prehistoric ruins in the Kayenta and Gila River districts of Arizona and of the Rio San Francisco, New Mexico. The very number of these objects would indicate not that they had been introduced through intertribal commerce but rather that their makers had come to dwell at Pueblo Bonito, bringing with them their own distinctive arts and industries. On the other hand, it is manifest that the prehistoric Bonitians maintained an active trade with other primitive folk at a great distance from their terraced village in Chaco Canyon. The quantity of Pacific coast shell—used for beads, pendants and other ornaments—copper bells from central Mexico and especially skeletons of the great macaw (*Ara macao*), furnish abundant proof that adventurers from Pueblo Bonito or friendly traders from distant valleys braved the rigors of open desert travel long before the Spanish conquistadores introduced the horse and other beasts of burden.

The circular kivas in Pueblo Bonito, as elsewhere, were both council chambers where clan representatives met for consultation and religious sanctuaries in which secret ceremonies were enacted and preparations made for public rituals to be held in the open courts of the



FIG. 116.—Repairing third-story walls in Pueblo Bonito. Some of these high walls had been so weakened by vandalism and the elements that their repair was necessary before excavation could safely be undertaken beneath. The work will serve, also, to preserve the present height of the walls for many years to come. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)



FIG. 117.—Repaired walls of the third type of masonry, showing occasional bands of thicker blocks inserted for strength and decorative effect. Corner doorways are not uncommon in Pueblo Bonito; they provided a direct means of communication between neighboring dwellings occupied by members of the same family or clan. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 118.—A Zuni Indian in an ancient Bonitian doorway. The excellence of the masonry and the trueness of the corners are well illustrated in this picture: a typical lintel of pine poles will be noted at the top. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)



FIG. 119.—A trench 20 feet deep was cut in the west refuse mound in order to obtain chronological data. Potsherds deposited during the early occupancy of Pueblo Bonito were quite different from those found near the surface of the mound. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

village. These important structures were constructed both below the level of the plazas and among the living rooms, in which latter case the surrounding walls were so arranged as to simulate the required subterranean position. In certain features of construction and equipment, however, Bonitian kivas—judging from the five already excavated—differ from those heretofore examined in other sections of



FIG. 120.—Pueblo Bonito as seen from the north wall of Chaco Canyon. The ruin is semicircular in shape and covers more than three acres of ground. Its dwellings were terraced upward from two inner courts; its outer wall was unbroken except for small, elevated ventilators. Excavations thus far have disclosed but one entrance, that from the south. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

the Southwest. The ventilator shaft is connected with a manhole in the room through a hidden tunnel; sub-floor chambers are sometimes, but not always, present; the primary roof supports or pilasters have been so specialized as to lose their original stability and to take on a new function, that of depositories for ceremonial offerings.

The Great Kiva possesses several noteworthy features not found in the lesser structures of its kind. It is a room of exceptional size,

being 52 feet (15.85 m.) in diameter with a ceiling formerly 11 feet (3.35 m.) high. The central portion of its flat roof was supported by four masonry pillars each of which had a separate foundation of low grade, soft coal. On the east and west sides of the chamber, between the pillars, were built-in receptacles, probably for containing ceremonial paraphernalia. A fire box with protective screen stood at the



FIG. 121.—A naïve example of Bonitian engineering. In an obvious attempt to hold up a huge section of cliff which threatened to topple upon their village, the ancients placed pine props under the weathered section and covered these with a great terraced mass of masonry. The north wall of Pueblo Bonito stands at the left. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

south side and, opposite this, a flight of narrow steps led to an elevated room in which a central block of masonry represented the "altar."

Excavation of the kivas and secular rooms in Pueblo Bonito is contributing in large measure to our knowledge of the prehistoric sedentary peoples of the Southwest. Chronological data from the vast accumulations which comprise the adjacent refuse mounds is expected to illustrate not only the character and extent of local cultural development but to serve also as a medium of correlation between the ancient Bonitians and other aboriginal peoples of the south-

western United States. Through such data it is hoped ultimately to arrive at the approximate age of this famous center of pre-Columbian civilization.

The National Geographic Society proposes, as an essential feature of its Pueblo Bonito Expedition, to conduct dependent researches which will seek to determine the ancient source of water supply; the agricultural possibilities of Chaco Canyon in prehistoric times; the rapidity of subsequent sedimentation; the age and probable source of the large timbers used in roofing the dwellings of Pueblo Bonito, and the geophysical changes, if any, brought about since abandonment of the great ruin. These are lines of investigation which may result in information of far-reaching significance and yet they have been generally neglected, heretofore, in connection with archeological explorations.

ARCHEOLOGICAL FIELD-WORK IN SOUTH DAKOTA AND MISSOURI

In the fall of 1921 Mr. W. E. Myer, a voluntary collaborator of the Bureau of American Ethnology, investigated sites in South Dakota and western Missouri, known to have been occupied by the Omahas and Osages in early historic times, after they had come in contact with the whites but before they had been changed thereby to any considerable extent.

Especial attention was paid to any resemblance to the ancient cultures found in the valleys of the Ohio, Cumberland, and Tennessee rivers. This line of research was suggested by certain traditions of both the Omahas and Osages, as well as some of the other branches of the great Siouan linguistic family, that they had at one time lived east of the Mississippi River, on the Ohio, and elsewhere, and after many wanderings, stopping here and there for years, finally reached their present sites in South Dakota and western Missouri.

THE OMAHA SITES

Mr. Francis La Flesche reported that the traditions of his people, the Omahas, stated that they had occupied two important villages on what the Omahas call "The Big Bend of the Xe," at some time in the seventeenth or eighteenth century. These traditions also told of many important events while the Omahas dwelt on these two sites.

Aided by these traditions, Mr. Myer was enabled to locate these two ancient villages. He found one of these on the Big Sioux River, at its junction with Split Rock River, designated Split Rock site in this report.

He found the other site where the Rock Island Railroad now crosses the Big Sioux River, about 10 miles southeast of Sioux Falls. It is designated here the Rock Island site.

ROCK ISLAND SITE

Sometime in the seventeenth century the Omaha and Poncas removed from the Pipestone regions in Minnesota and finally, after some further wanderings, built a fortified town on the Big Sioux River at the Rock Island site. While living in this fortified Rock Island site they were attacked and defeated by an enemy, most probably the Dakotas, and finally forced to leave the region. Before leaving, they buried their dead from this fight in a mound on this site. This burial tradition was confirmed by excavations made by Mr. A. G. Risty and Mr. F. W. Pettigrew, who report finding a considerable amount of human bones in one of the mounds. Some glass beads and small copper bells of white man's make were also found in one of the mounds on this site. There is evidence that this site was occupied somewhere between 1700 and 1725.

SPLIT ROCK SITE

After leaving the Rock Island site, the Omahas and Poncas roved without long permanent settlements for several years, but finally returned to their beloved Xe and built a permanent village at Split Rock site on "The Big Bend" at the junction of the Big Sioux and Split Rock rivers.

The month of October, 1921, was spent exploring this Split Rock site. Many interesting relics of the Omahas were here unearthed, which throw new light on the life of these people before they had been very much changed by contact with the whites.

There is a group of 30 mounds on the ridge between the two rivers marking the site of that portion of the old town occupied by the Omahas. On a hill one-half mile to the east was a group of ten more mounds, occupied by the Poncas before they split away from the Omahas at this old town.

On the tall ridge $1\frac{1}{2}$ miles to the west, by following the clues furnished by the traditions, three low mounds were discovered. These were said by the traditions to have been on the site of the lookouts for the main village. These lookout mounds command a view, ranging from 6 to 15 miles, on all sides. The mounds on this Split Rock site appear to have nearly all been used for burial.

The exploration of mound No. 1 showed that the Indians had selected for its site the summit of a beautiful little knoll on the edge of the steep bluff-like bank of Split Rock River. In the soil of this summit they dug a shallow pit, about 12 feet by 6 feet, and 2 feet deep. In this shallow pit bones belonging to five bodies had been placed. Several of these bodies appeared to have been buried after decay of the flesh. One body appeared to have been buried in the flesh, closely flexed, and this human bundle placed in the pit. The position of the



FIG. 122.—A portion of the layer of human bones on floor of charnel pit.

skeleton of a horse with a crushed frontal bone showed that when this body-bundle had been placed in the pit, a large horse, about seven years of age, had been led to the knoll and there killed, on the edge of the pit, by the side of this body-bundle. Then, over all these, a low, round-topped mound, 60 feet across base and $5\frac{1}{2}$ feet in height, had been raised.

Mound No. 2, the largest mound of the group, was near the center of the village. It was round-topped, 110 feet across base, and 10 feet high. This mound proved to be of considerable importance. In beginning its construction, a rectangular charnel pit, 12 feet by 14 feet, and 2 feet deep, had been dug in the surface of the soil near the center of the town. This empty pit was then thoroughly coated with a white layer, about $\frac{1}{8}$ inch in thickness. This white coating was made from calcined bones.

The bottom and sides of this white pit were then probably covered with soft furs. This is indicated by a thin black layer of animal matter next to the white coating.

On the floor of this fur-lined pit, bones representing about 50 human beings had been laid. These bones had been brought from elsewhere after the decay of flesh. The bones presented the appearance of belonging to bodies which had either been left unburied, as on some battle field, or of belonging to scaffold burials. This solid layer of compressed broken and decayed human bones entirely covered the floor of the charnel pit to a depth of from 2 inches to 6 inches.

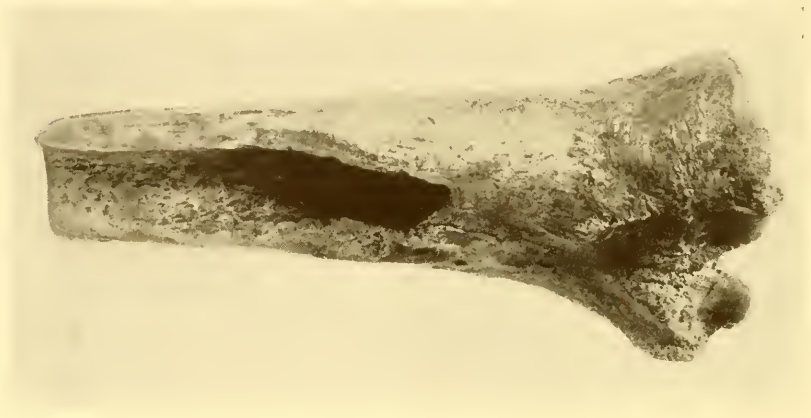


FIG. 123.—Bone flesher.

Portions of this layer of human bones, before it had been disturbed, are shown in figure 122.

On top of this solid mass of human bones traces of the thin fur layer were also found. Over this soft, warm fur covering a layer of bark was laid, and over this bark earth had been spread to a depth of from 3 to 6 inches. This layer of earth was then smoothed and pressed down, and on this surface a white coating, similar to that on the bottom and sides, had been spread. Thus, these human bones, enclosed in their layer of warm furs, were completely incased by this white layer, very much as the filling of a pie is enclosed by the crust. Only one small, cylindrical copper bead was found with all this mass of bones.

On the exterior of this communal charnel pit, on all four sides, the separate burials of several adults and two small children were found. With these outer burials were found several objects. Amongst these was the bone flesher shown in figure 123. With a compact bundle of

bones belonging to two adults was a small pile of 30 circular ornaments of shell like those shown in figure 124. These ornaments had probably been attached to some garment in the original temporary burial and removed from the decayed garment when placed with the bones in this new burial.



FIG. 124.—Shell ornaments.

No object of white man's manufacture was found on this site. There is evidence that this site was occupied by the Omahas somewhere between 1725 and 1775.

The Omahas and their kindred, the Poncas, lived together at this Split Rock site. It was here that some of the most important events in the history of the Omahas and Poncas took place. While living here the long hostilities between the still united Omahas and Poncas and their old enemies, the Cheyennes and Arikaras, were ended by

a peace which was concluded with great ceremony at this Omaha-Ponca town. At the urgent request of the Arikara the sacred chant and dance of the calumet was used to cement this great peace pact. In this manner the Omahas and Poncas for the first time came into contact with this the most profoundly binding and sacred ceremony known to savage man.

At this site the age-long association between the kindred Omahas and Poncas was broken. The tradition does not give the cause of their separation; but for some reason the Poncas, after having lived with the Omahas through their long slow wanderings in the regions east of the Mississippi and through the lower and middle reaches of the Missouri Valley, left their kindred and formed a separate tribe.

It was at this site that the Omahas first came to possess the white man's horse, which was to play such an important part in the later Omaha life. The tradition tells that neither the Poncas nor the Omahas had possessed horses until after their separation at this site. The finding of the skeleton of a horse in a mound on this site is one of the many evidences which confirm this tradition that the Omahas remained at this site after the Poncas split away, and shows the Omahas were still living here when they first obtained horses.

OSAGE SITES

In Vernon and Bates counties, western Missouri, near the junction of the Osage and Marmiton rivers, Mr. Myer found several sites known to have been occupied by the Osage Indians in early historic times, shortly after they had come in contact with the whites.

Two of these early historic Osage sites, the village of the Grand Osage and the Little Osage village, were probably located. These were visited by Zebulon Pike in his journey of exploration in 1806.

The site of the village of the Grand Osage was at the junction of the Marmiton and Little Osage rivers, in Vernon County.

The probable site of the Little Osage village of Pike was at the Perry and MacMahan coal mine, about 2 miles northwest of the village of the Grand Osage. Old settlers stated that decayed lodge poles were still standing and many other signs of Indian occupancy were to be seen at this Little Osage site as late as 1840. The present appearance of this site is shown in figure 125.

A considerable collection of surface finds from this site shows no objects of white man's manufacture; but local tradition says fragments of brass kettles, old gun barrels, early bullets, and other objects of white man's manufacture have been found here.



FIG. 125.—Site of Pike's Little Osage Village.



FIG. 126.—Halley's Bluff.

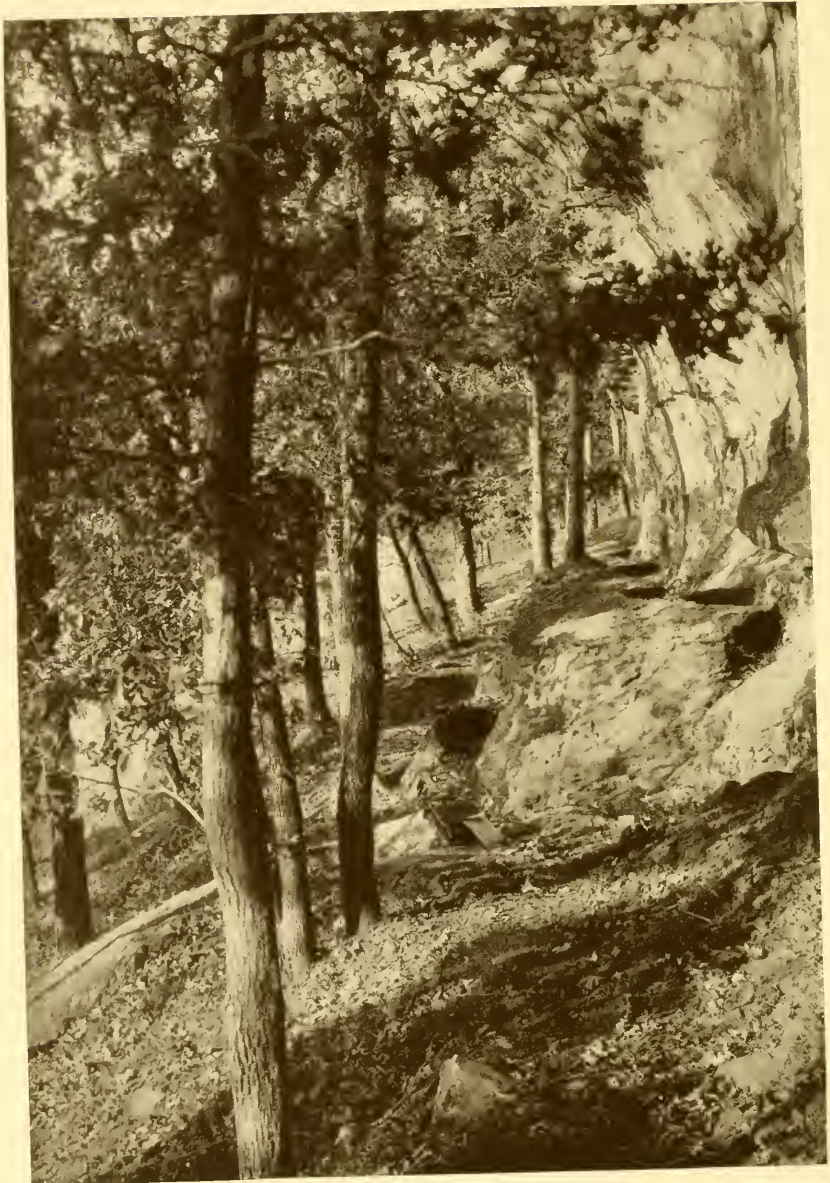


FIG. 127.—Site of cache pits at base of Halley's Bluff.

Two of these surface finds throw light on the extent of aboriginal barter. One of these is a broken obsidian implement. The nearest source of this material is probably in the Rocky Mountains, some 1,000 miles to the west. Another is a shard of Mesa Verde pottery, the nearest source of which is in the Mesa Verde culture region around the southwestern corner of Colorado, about 800 miles to the west.

The largest Osage village in Vernon County is at what is still known as Old Town, on Old Town creek, about $3\frac{1}{2}$ miles south of Pike's village of the Grand Osage. This site covers about 40 acres and is the best known of any of the Osage sites. It has yielded a large amount of iron axes, gun barrels, gun locks, fragments of brass kettles, glass beads, and other articles of early white manufacture. Along with these large quantities of shell beads, flint arrow heads, broken pipes, and other objects of purely aboriginal origin were found. Old Town culture furnishes an excellent example of Indian culture in the days of early contact with the whites.

The most picturesque Indian site in this Osage region is Halley's Bluff on the Osage River, about $1\frac{1}{2}$ miles down stream from where the Marmiton and Marais des Cygnes unite to form the Osage River. A photograph of a portion of this bluff is shown in figure 126. There is evidence showing occupancy of this bluff by Indians long before the coming of the white man and probably before the coming of the Osages.

The long summit of the bluff shows many small, low heaps of stones and other Indian signs. The sheltered spaces at the foot of the overhanging cliffs were out of reach of the highest waters and were sheltered in large degree from the winds and rains. Here, in these dry, sheltered spaces, these ancient people lived and worked. They dug about 20 cache pits at present about 5 feet in depth, in the moderately soft red sandstone.

FIELD-WORK ON THE KIOWA, PUEBLO, AND CALIFORNIA INDIANS

At the end of July Mr. J. P. Harrington, ethnologist, proceeded to California to continue his studies of the Indians of the Chumashan area of that state. Place-names, material culture, and sociology, all these branches being closely related to language, were especially investigated and all obtainable data recorded. By rare good fortune several dozen old ceremonial songs were obtained on the phonograph, with full notes and translation where possible, these songs having not been in use since the middle of the past century. The songs were

accompanied by the beating of the split-stick, and the rendition, while not what might be desired, will doubtless be adequate for transcription. They belong to several distinct cycles. Interesting comparisons were drawn between the California Indian culture and that of the southwest. The sweathouse is certainly the same as the kiva. The Cali-



FIG. 128.—Aged Mission Indian informant. (Photograph by Harrington.)

fornia phratries correspond to the dual division of the Pueblos. The dancers who represent demons are the Pueblo katchinas. These resemblances also extend to many minor features.

Nor was the linguistic side of the work neglected, ethnology and linguistics, and in fact archeology, of necessity going hand in hand in this difficult field. This linguistic work is of the greatest importance since it furnishes material for comparison with all the related languages.

Mr. Harrington's field studies reveal the fact that the language of the Kiowa, who are now settled in Oklahoma but formerly had eastern Montana as their habitat, is closely and genetically related to that of the Taos and other Tanoan tribes of New Mexico, which have typical Pueblo culture. Thus, the interesting fact is established that the Taos speak a dialect of Kiowa just as the Hopi, farther west, speak a divergent Shoshonean. These studies also make it clear that Keres and Zuñi are related to each other genetically, and furthermore to Tano-Kiowan and Shoshonean, the languages all having a common origin.

ARCHEOLOGICAL FIELD-WORK ON THE SUSQUEHANNA RIVER, PENNSYLVANIA

In July, 1921, Mr. John L. Baer, Acting Curator of American Archeology of the United States National Museum, examined for



FIG. 129.—Petroglyphs, Bald Friars, Md.



FIG. 130.—Petroglyphs on Miles Island, Susquehanna River, Pa., near Mason-Dixon Line.

the Bureau of American Ethnology a number of instructive pictographs at Bald Friars and Miles Island in the Susquehanna River.

These occur about one-fourth the distance between Bald Friars Station and Conowingo Station, on the Columbia and Port Deposit Railroad.

All the rocks upon which petroglyphs are found seem to have been polished before the petroglyphs were cut in them. The top surfaces of most of the rocks bearing petroglyphs were marked with cups and circular grooves, some of which were concentric. Some of the rocks were fractured destroying the continuity of pictures that originally existed. Upon one large rock broken from its original position possibly by ice are carved two slender fishes headed up-stream. The rock upon which they were found suggests a good stand for shad fishing with a net.

On a group of low rocks to the northwest of Miles Island is a peculiar arrangement of figures. On one side of a tectiform rock are two concentric circles with radiating spokes, a cup, and two semi-circular concentric grooves, while on the ridge and extending down on the opposite side of the roof-like rock is a figure that might represent an animal.

During the same trip, Mr. Baer spent several days on Mount Johnson Island, Susquehanna River, and on the near-by flats below



FIG. 131.—Petroglyphs on Miles Island, Susquehanna River, Pa., near Mason-Dixon Line.



FIG. 132.—Petroglyphs, Bald Friars, Md.

Peach Bottom, Lancaster Co., Pa., seeking further evidences of the bannerstone workshop in which he has been interested for a number of years. He brought back with him a number of broken and unfinished slate bannerstones, flint pecking stones, polishing stones and other utensils showing evidences of a considerable sized workshop on the island. A synoptic series from this workshop showing the different stages in the manufacture of the bannerstone has been placed on exhibit in the Pennsylvania case in the American Archeological collection of the National Museum.

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 74, NUMBER 5

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
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(PUBLICATION 2711)

CITY OF WASHINGTON
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My. Tychin

Trifid Glacier

Mount St. Bride (10,871 - 3,311.7 m.)

Cyclone Mt.

Lake Douglas

Pinckney Ridge



FIG. 1.—Looking north down Douglas Creek across Red Deer River canyon to the high ridges of Cyclone Mountain and Mount Drummond. Mount St. Bride is capped with Devonian limestone with Ordovician and Ozarkian limestone in the cliffs below. View taken from east side of Douglas Canyon, 13.5 miles (21.6 km.) north-northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta, Canada. (C. D. Walcott, 1922.)



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, 2,739 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.)

Overlook Point

Halstead Pass



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

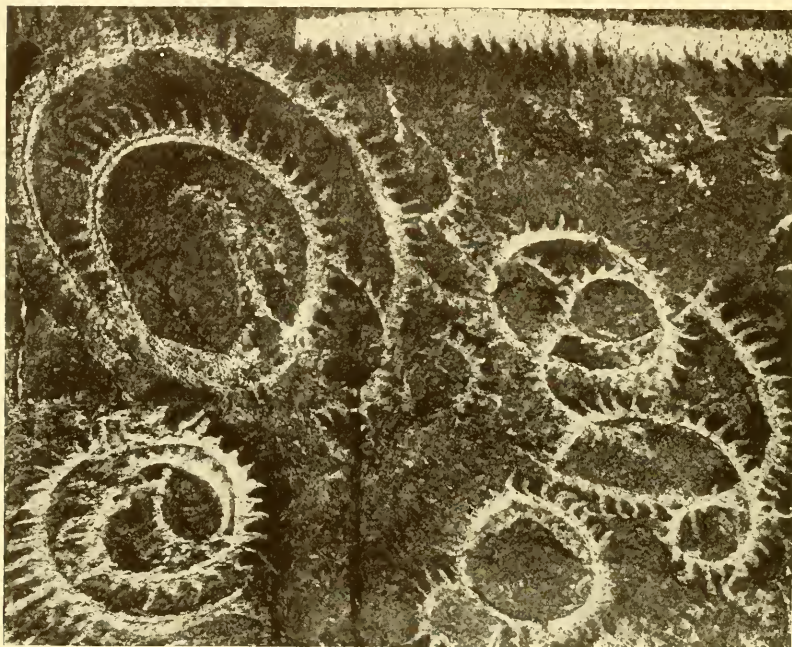


FIG. 10.—Graptolites that flourished on the muddy bed of the sea in Silurian time. The coiled form *Monograptus convolutus* Hisinger is found both in Europe and America. The straight form is very abundant in some of the partings of the shale.

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. 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.)

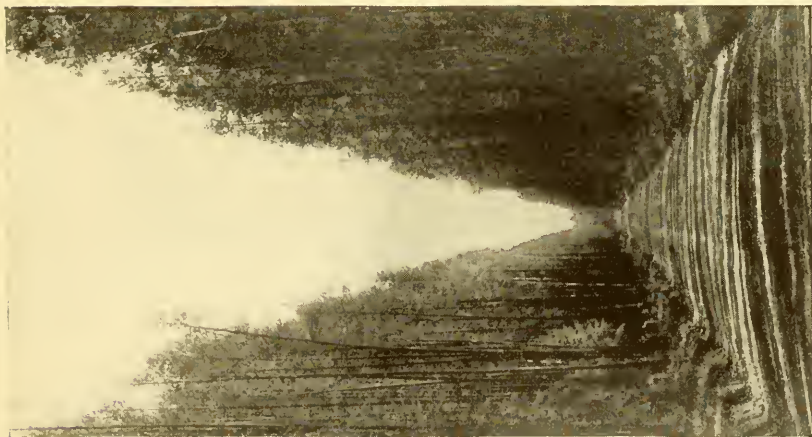


FIG. 20.—Looking south through the forest on a tangent of the Banff-Windermere motor road.

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



FIG. 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.)

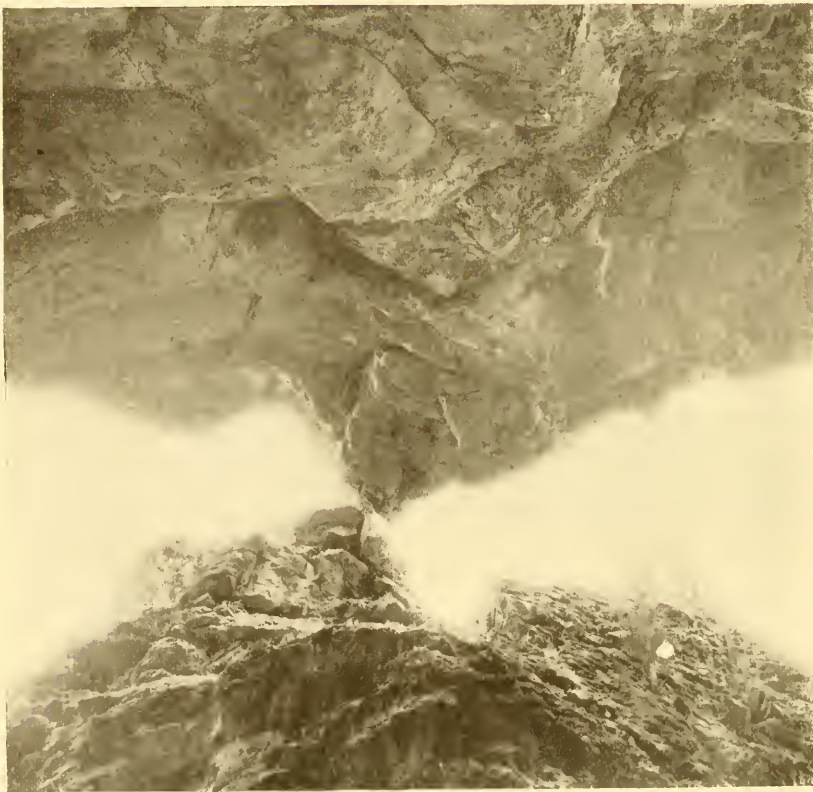


FIG. 22.—A view of the sky from the Banff-Windermere motor road near the entrance to the canyon from the Columbia River Valley. See figure 21.



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 *Zigadenas* 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 Bap-
tie, 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

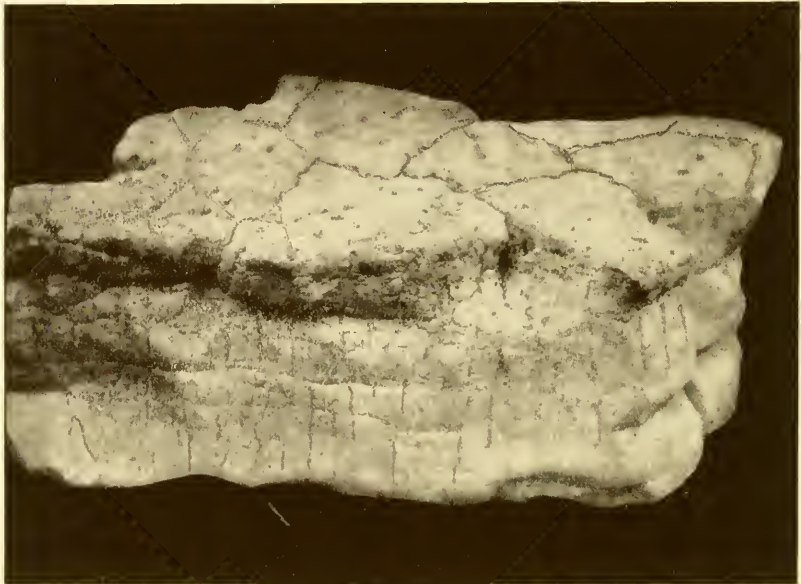


FIG. 31.—Stratum of dove limestone showing sun-cracked upper surface and penetrating worm tubes, indicative of shallow water origin. (Photograph by Bassler.)

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 dioxide 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 Wandalian, 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 scaplane, 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 repopled 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 noddy tern in this region. The noddy 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 noddy 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 noddy 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 Cavinás 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.

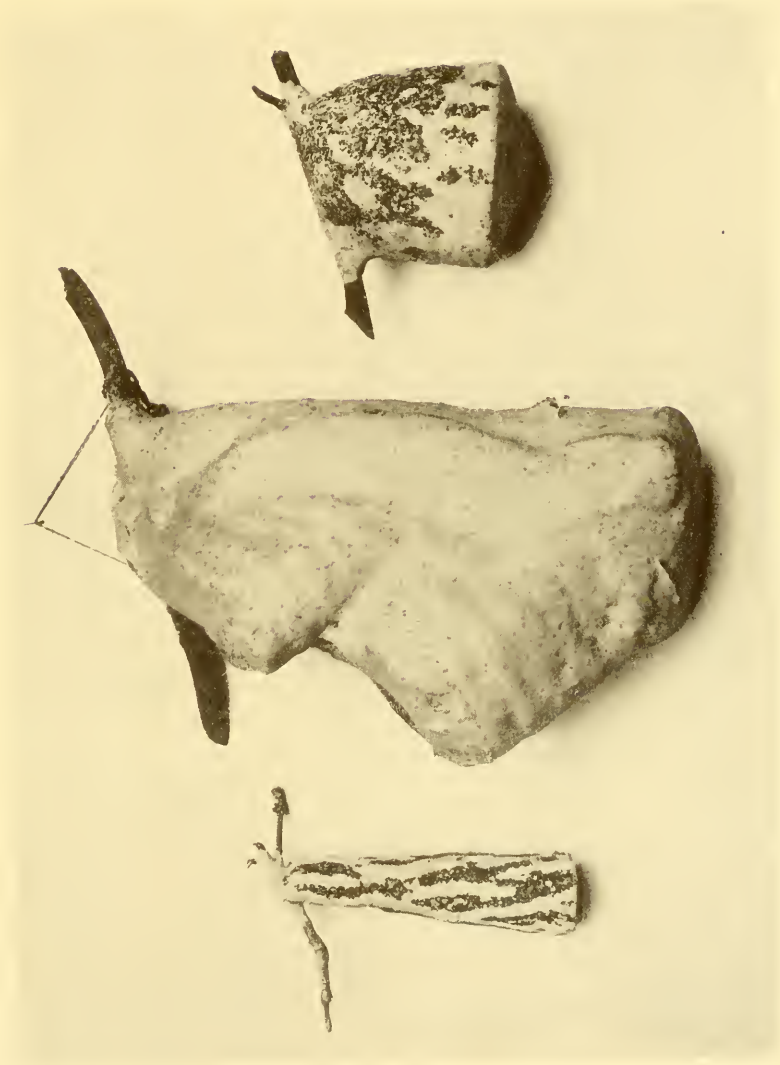


FIG. 61.—Wasp nests made of carton or paper-like substance, Rio Beni, Bolivia.
Suspended from branch of tree over water.

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-

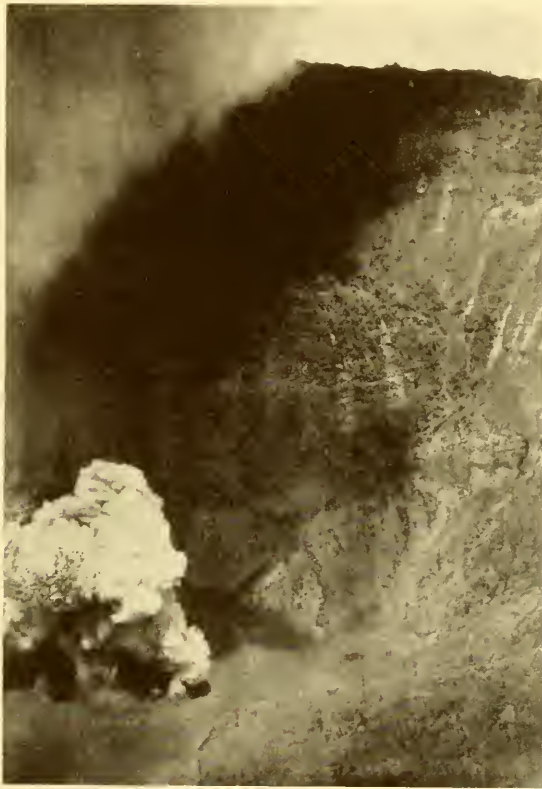


FIG. 64.—Eruption from the secondary crater of the volcano of San Salvador in 1917. (Photograph by Dr. V. M. Huezo.)

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. Huevo.)

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.

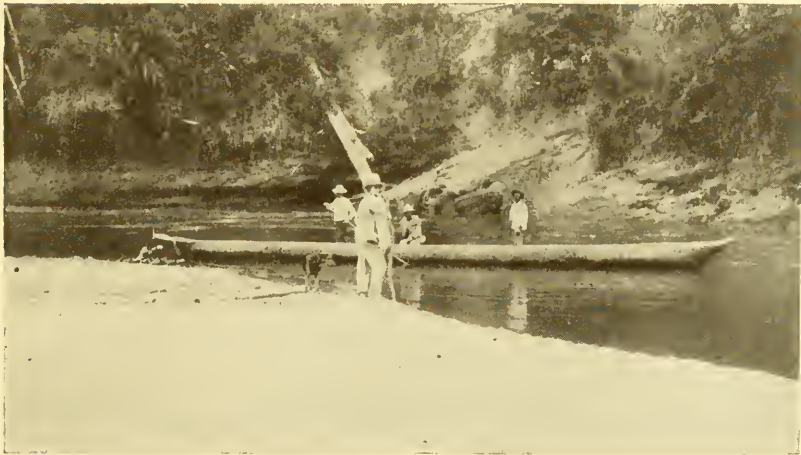


FIG. 76.—Crossing the Vieja River, a tributary of the Cauca, Colombia. As there is no bridge at this point, cargo must be removed from the mules and transported in native dug-out canoes.



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 espletias, 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 Lamarek 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 Ariège, 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 *viguers*, 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 $4\frac{1}{4}$ 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. 99.—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 passages 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

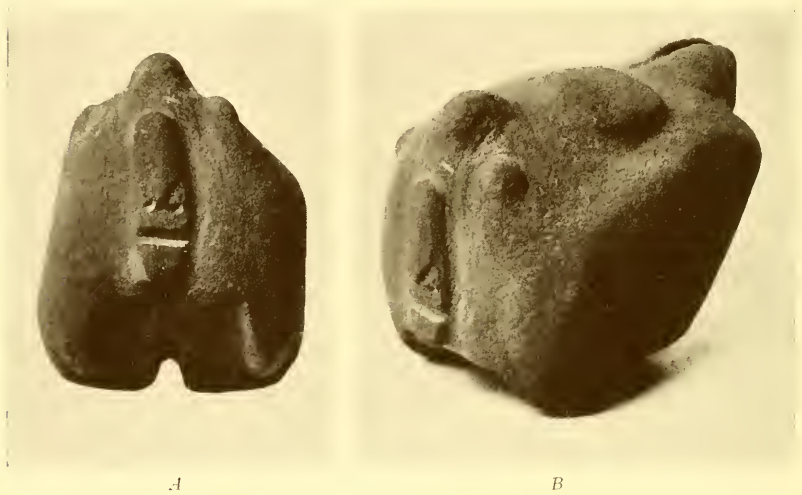


FIG. 98.—Stone idol of a bird. Views from front *A*, and one-half lateral *B*.
Pipe Shrine House. Size: $4\frac{1}{4} \times 2\frac{1}{4} \times 2\frac{3}{4}$ inches.

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.—Cist 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 *sipapû* 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.)

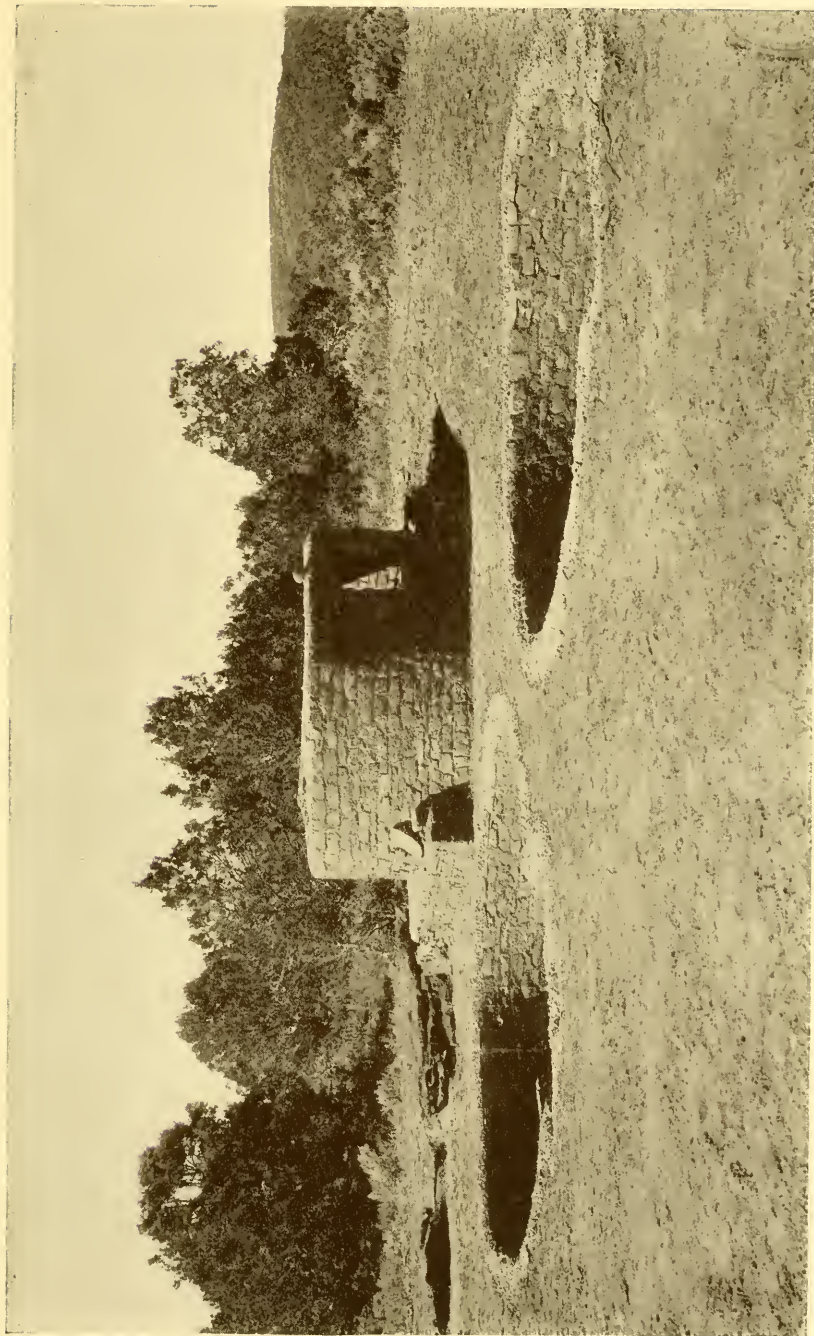


FIG. 103.—Far View Tower, looking north, showing tops of two kivas. Doorway in shadow; object above doorway germ idol or "corn mound." (Photograph by Geo. L. Beam. Courtesy Denver and Rio Grande Western Railroad.)



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

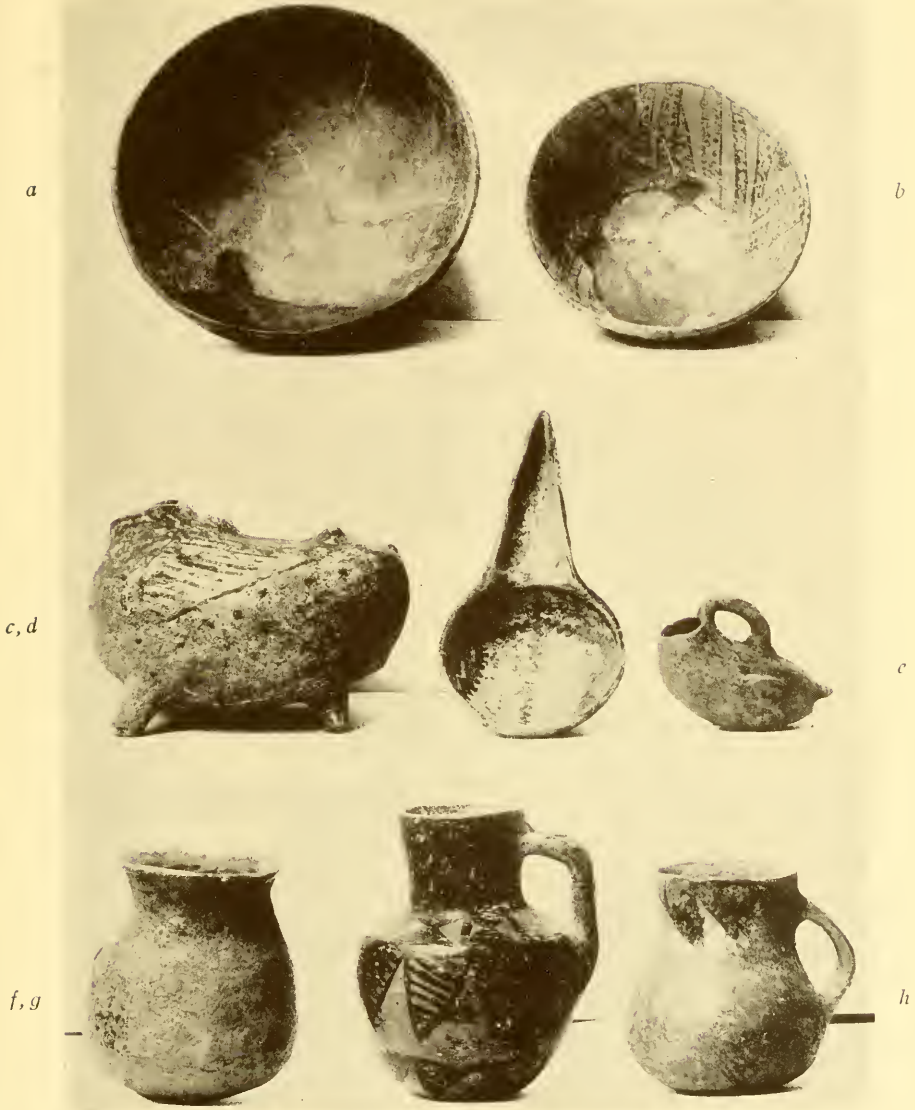


FIG. 107.—Pottery from cemetery of Pipe Shrine House: *a*, Red food bowl; *b*, Coiled brown ware, archaic decoration; *c*, Effigy jar, black on white; *d*, Ladle, black on white; *e*, Effigy jar, black on white; *f*, Vase, rough ware; *g*, Mug, gray with glossy black figures; *h*, Mug, gray with black 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 1⅞", 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

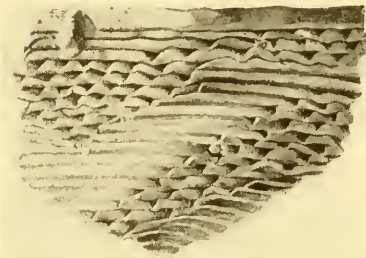


FIG. 109.—Fragment of corrugated pottery. One-third natural size. (Drawing by Mrs. George Mullett.)

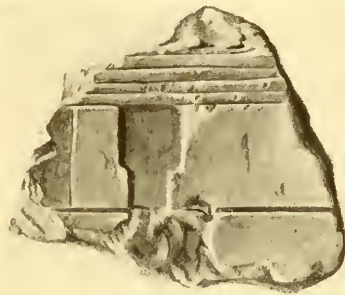


FIG. 110.—Stone with carved T-doorway in intaglio. (Drawing by Mrs. George Mullett.) Size: $5\frac{1}{8} \times 5 \times 3\frac{3}{4}$ inches.

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

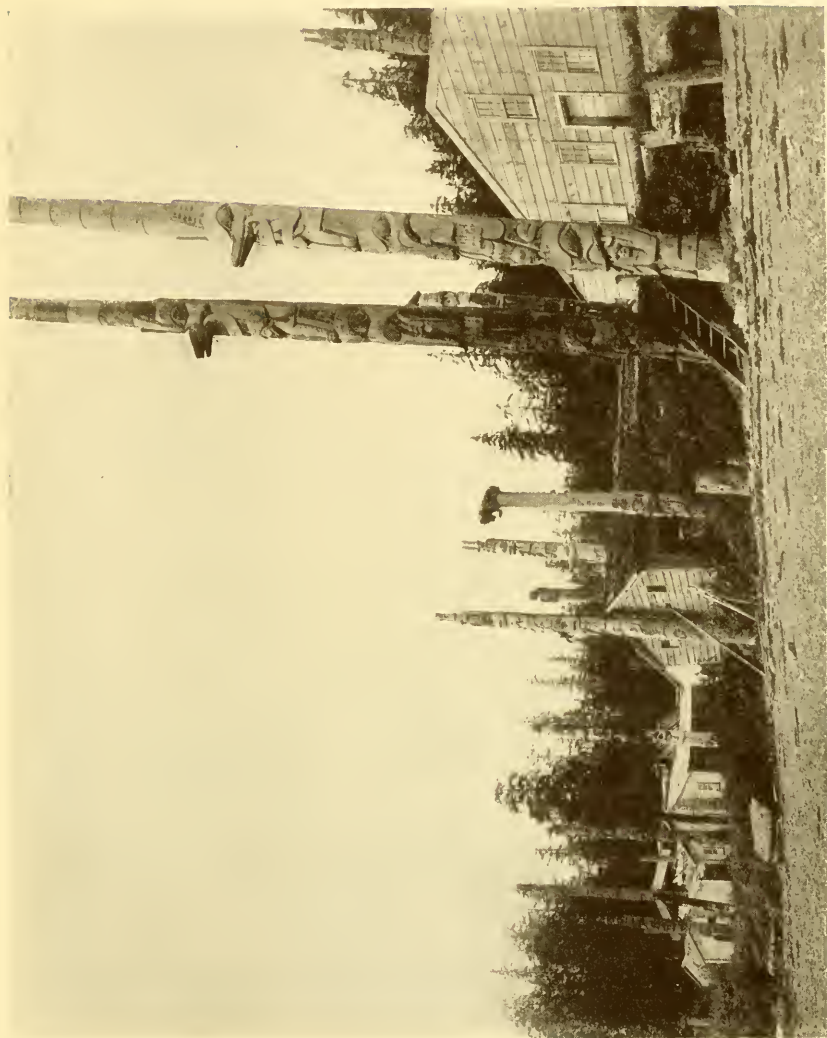


FIG. 118.—A photograph of Kasaan Village made by Lieutenant Emmons, about 1885. The poles in the foreground show the crests of Chief Skowl.

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-hon. (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.

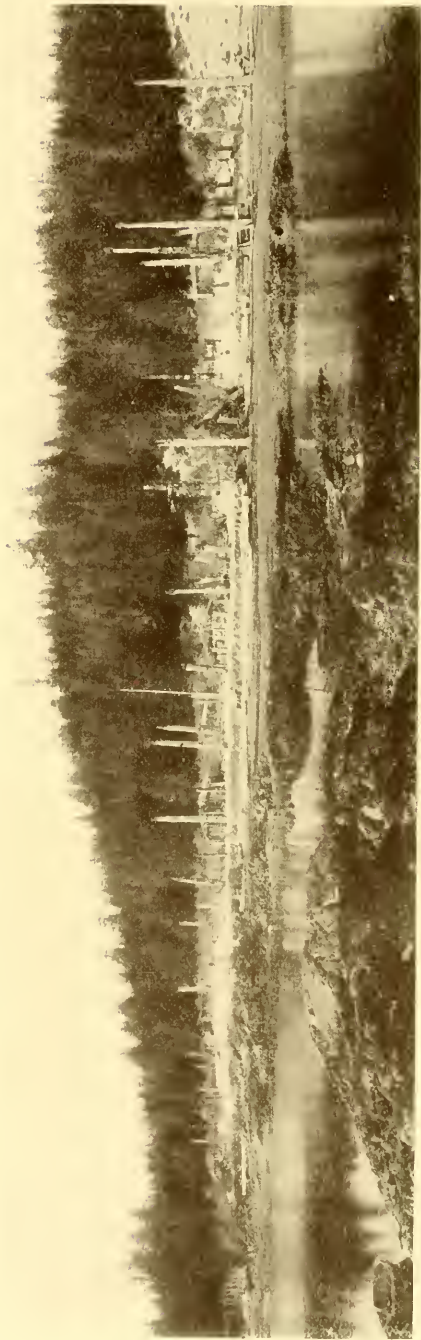


FIG. 125.—Panorama of Kasan Village, Alaska, as it was in 1922. (Photograph by Julius Sternberg, for the Smithsonian Institution.) Compare this with a photograph of the same village, made about 1885 (fig. 118, above).

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.

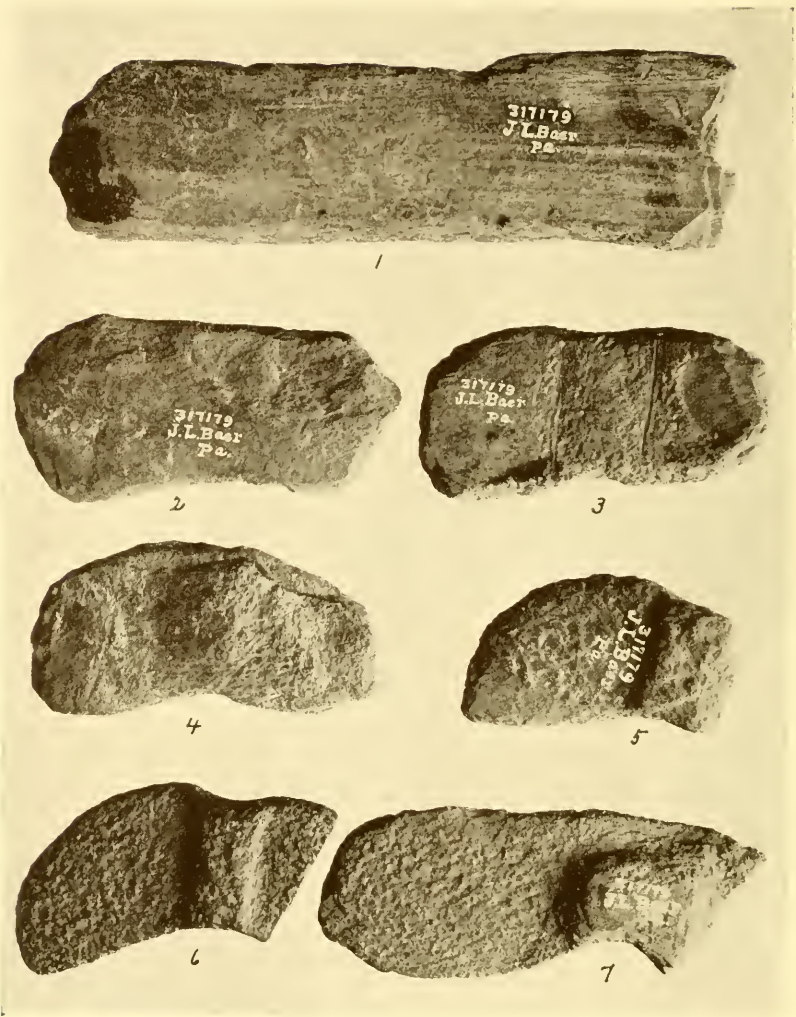


FIG. 137.—A series of unfinished banner stones.

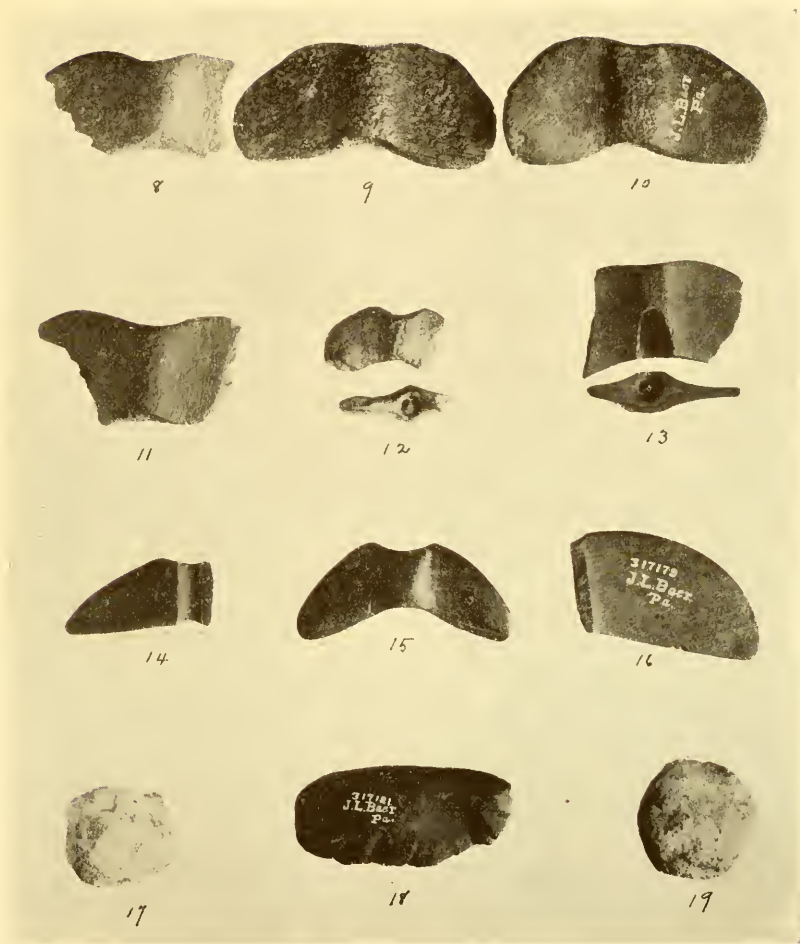


FIG. 138.—Banner stones in series, and shaping tools.

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. 130.—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

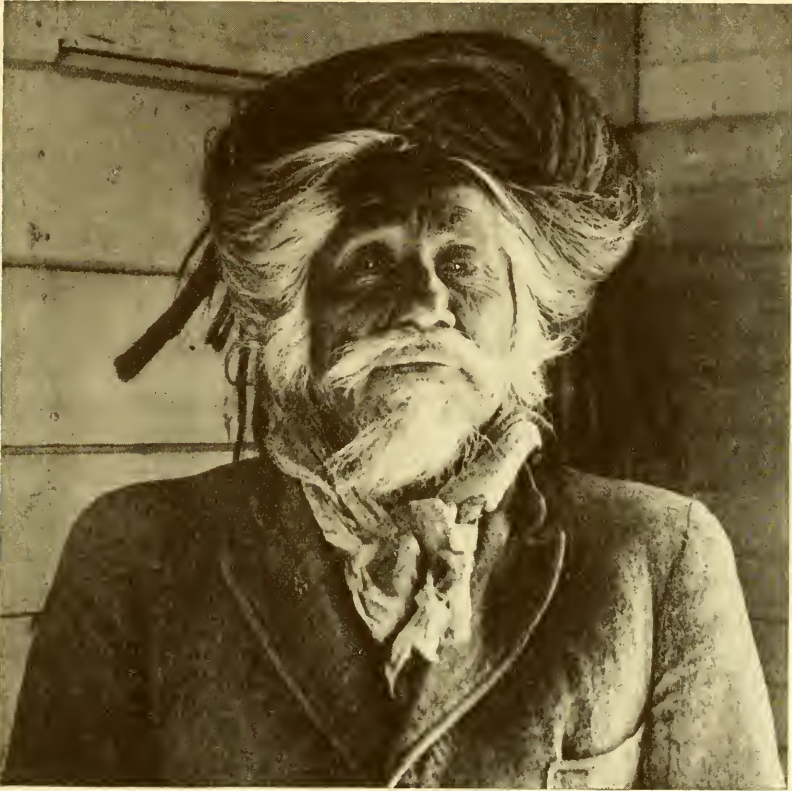


FIG. 141.—Kachora, a Yuma. His long hair is wound like a turban around his head. (Photograph by Miss Densmore.)

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.

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 76, NUMBER 10

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1923



(PUBLICATION 2752)

CITY OF WASHINGTON
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EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1923

INTRODUCTION

The field expeditions sent out by the Institution or cooperated in by the members of its scientific staff during the calendar year 1923 are here briefly described and illustrated. The scientific results of many of them will be presented later in the various series of publications under the direction of the Institution; the bulletins and proceedings of the United States National Museum and the bulletins and reports of the Bureau of American Ethnology. That part of the Institution's income from its small endowment of slightly over one million dollars, which is available after defraying administrative costs, does not permit of extensive field operations, but every effort is made to send out or cooperate in as many expeditions as possible with the means at hand. This scientific exploration forms an important part of the Institution's work in the "increase of knowledge," and by means of it much valuable information has been gathered and disseminated and the collections of the United States National Museum have been greatly enriched.

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

During the summer and early fall of 1923 Secretary Charles D. Walcott carried on geological field-work in the Canadian Rockies of Alberta and British Columbia, in continuation of the previous year's work in the main range and the western minor ranges that form the great eastern wall of the Columbia River Valley from Golden south to Kootenay River. His object was to secure data on the Pre-Devonian strata from the Clearwater River southeast to the Bow Valley and along the eastern side of the Columbia River Valley.

The field season was a favorable one for geological work up to the middle of September, despite the intense heat, as the nights were invariably cool and restful.

It was found that the Mons formation which was discovered on the headwaters of the Saskatchewan River at Glacier Lake, extended southwesterly on the western side of the Continental Divide in British

Columbia to the southern end of the Stanford Range between the Kootenay River and Columbia Lake, which is at the head of the great Columbia River, which here flows northwesterly in what is popularly known as the Rocky Mountain Trench.

The valley of the Columbia was found to be largely underlain by the limestones and shales of the Mons formation of the Ozarkian system, and the strata have been greatly upturned, faulted and folded prior to the great pre-glacial period of erosion that cut out the Rocky Mountain Trench for several hundred miles in a north-northwest and south-southeast direction.

The Mons formation is upwards of 3,800 feet in thickness in the Beaverfoot-Brisco-Stanford Range on the eastern side of the Columbia River Valley, and contains four well-developed fossil faunas that indicate its position to be between the Upper Cambrian and the Ordovician systems of this and other portions of the continent (fig. 5).

A great development of Lower Ordovician was discovered near the head of Sinclair Canyon, and cliffs of massive Upper Cambrian limestones were recognized at several localities beneath the Mons formation. Collections were made of corals and other fossils from the Silurian limestones that occur above the Ordovician shales.

This is a wonderful region for the geologist to work in as the numerous canyons and mountain ridges give access to many of the formations from base to summit. Beneath the great series of limestones, shales and sandstones there are 16,000 feet or more of older stratified rocks that form the main range of the Rockies which are so wonderfully exposed along the line of the Canadian Pacific Railway from Banff westward over the Continental Divide to the central portions of the beautiful Kicking Horse Canyon east of Golden.

It was intended to review some of the work of 1921-22 north of Lake Louise near Baker Lake, but a heavy snow storm drove the party back to the railway on the 18th of September, just after a day of taking photographs. The coming of the storm was indicated by the presence of large numbers of mountain sheep and goat in the upper limits of the forest, as well as the presence of black and grizzly bear lower down on the mountain slopes, and wisps of vapor trailing to leeward from the mountain peaks. When the mists and clouds broke away four days later, a thick mantle of snow covered the ridges and peaks well down into the forest covered slopes. A few of the photographs taken near Baker Lake are illustrated by figures 1, 2, and 3.

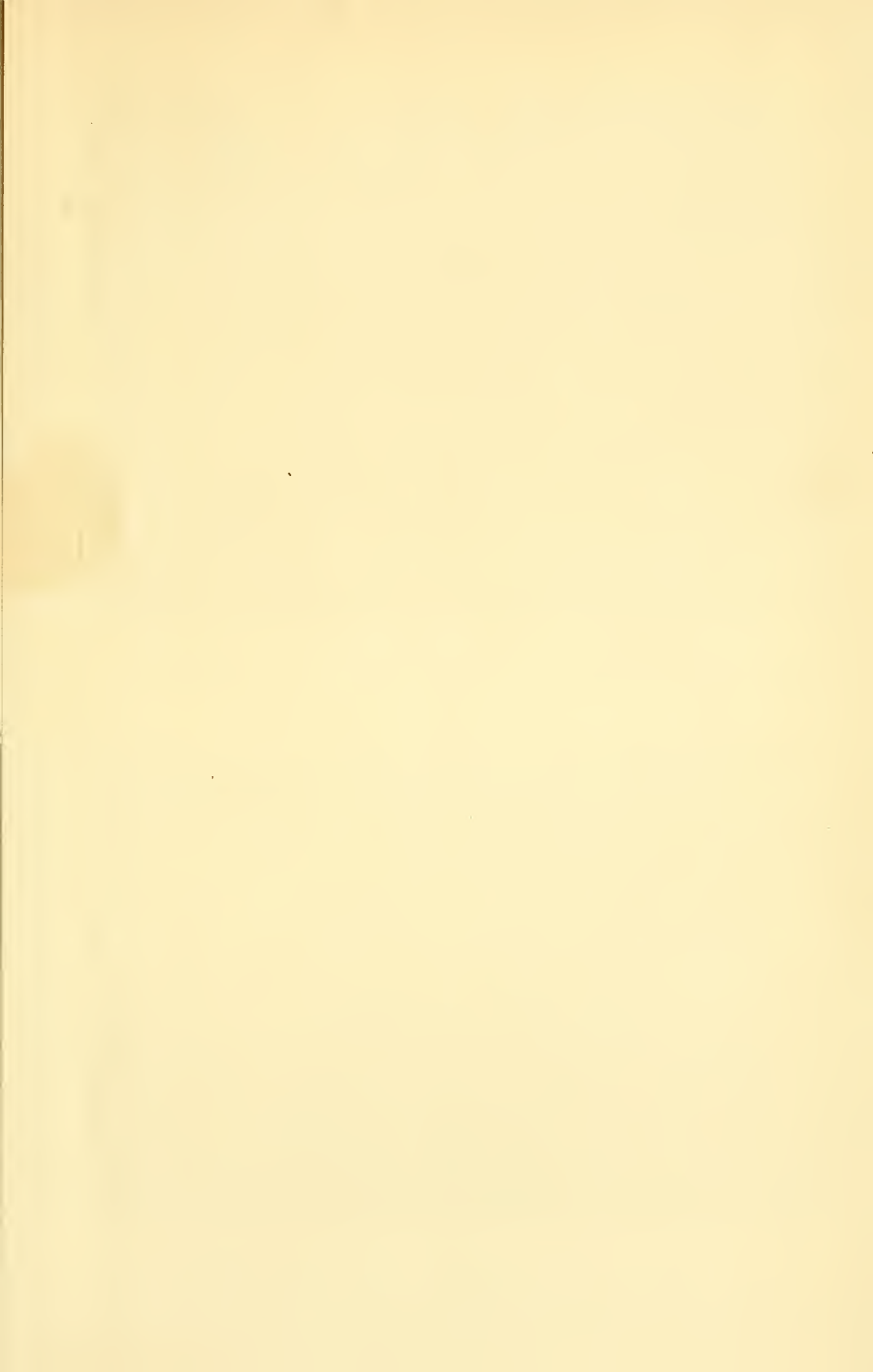




FIG. 1.—Lake of the Hanging Glaciers. This represents a typical valley glacier that terminates in a lake where the ice front calves or breaks off and floats away in the form of ice floes or miniature icebergs. The main glacier is fed by the snow and ice that fall from the small surrounding glaciers that cling to the slopes of the surrounding mountains. This is a beautiful glacial view just at timber line in one of the wildest spots in the mountains west of Lake Windermere in the Columbia River Valley, British Columbia. (Walcott, 1923.)

Redoubt Mountain
(9,510')

Ptarmigan Peak
(10,060')

Baker Lake
(7,321')

Fossil Mountain
(9,655')



FIG. 2.—A mountain view northeast of Lake Louise Station on the Canadian Pacific Railway. Baker Lake (7,321 feet, 2231.4 m.) at the foot of Fossil Mountain (9,655 feet, 2942.8 m.); Ptarmigan Peak (10,060 feet, 3066.2 m.) in the distant center; Redoubt Mountain (9,510 feet, 2898.6 m.) on the left in the distance, and the slope of Brachiopod Mountain on the extreme left. All in the Province of Alberta.

The Lower Cambrian and Pre-Cambrian rocks of Ptarmigan Peak have been thrust eastward and now lie above the much later Devonian rocks of Fossil Mountain. The crest of Fossil Mountain is a syncline or basin of limestone caused by the pressure of the rocks from the westward. (Walcott, 1923.)



FIG. 3.—Upturned Ozarkian and Cambrian strata in northwest section of Sawback Range, northeast of Lake Louise Station on the Canadian Pacific Railway, Alberta. This is a fine geologic section and a Rocky Mountain home of the wild goat, black and grizzly bear, and on the lower slopes elk and deer. (Walcott, 1923.)

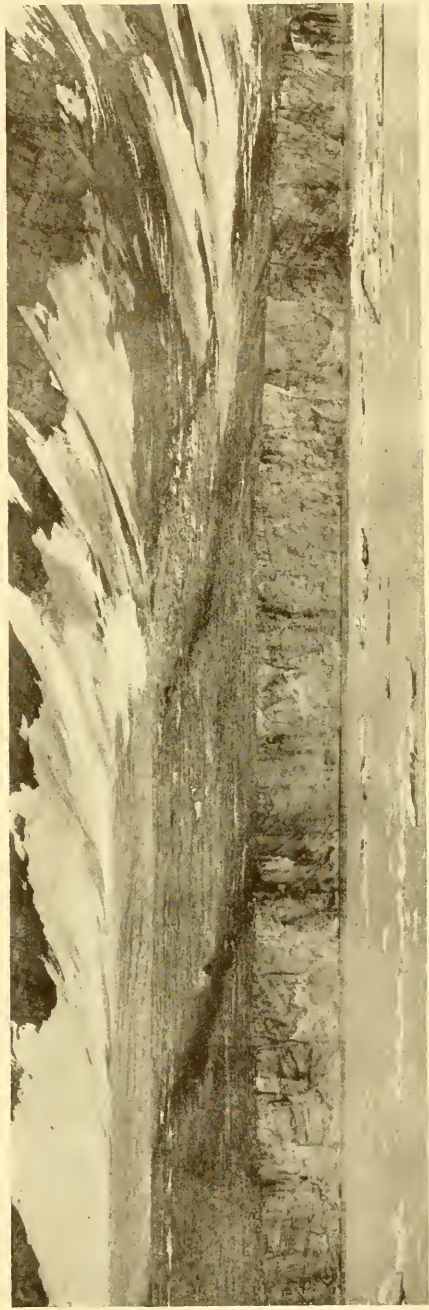


FIG. 4.—Ice front of the valley glacier of the Lake of the Hanging Glaciers, showing the moraines above and on the front the curvature of the layers of ice between the moraines. Locality same as figure 1. (Walcott, 1923.)

A side trip was made in August from the Lake Windermere area west up Horsethief Canyon to the Lake of the Hanging Glaciers (figs. 1 and 4). Passing through Wilmer the temperature was above 90° ; two days later the snow flakes were sifting down on the tent in the early morning at the camp just below the foot of Starbird Glacier. Climbing up 2,000 feet on a slippery trail, we spent a day at the Lake of the Hanging Glaciers, and were so fortunate as to have a little sunshine in the intervals between snow squalls and whirling clouds of mist. Some of the photographs reproduced here



FIG. 5.—Looking across Columbia River Valley to the west face of Stanford Range between Stoddart Canyon (on right) and Dry-Creek Canyon (on left). At the mouth of Stoddart Canyon the Upper Cambrian Lysell limestones (L.) form a low cliff, and to the left of the canyon foothills of Mons shales and limestones (M.) abut against the cliffs of Silurian limestones, Brisco (Br.) and Beaverfoot (B.). The strike of the Mons and the Silurian strata is indicated by short lines, and the position of the fault between the Mons and the Brisco limestones by a dotted line. A second block of the Mons with Silurian further up Stoddart Canyon is indicated by the letters M., Br. The Red Wall fault and breccia are shown on the face of the high cliffs to the left, which are a short distance south of Sinclair Canyon. (Walcott, 1923.)

give a very imperfect idea of this beautiful lake hidden away in an old glacial cirque which now has a normal glacier fed by the falling ice and snow of the smaller glaciers clinging to the cliffs above. To be fully appreciated both this lake and the Starbird glacier must be visited for a few days.

As a whole the season was a successful one, both from its geologic results and the sketches and photographs of mountain wild flowers obtained by Mrs. Walcott, who sketched in water colors 30 species of wild flowers or their fruit that were new to her collection, a portion



FIG. 6.—Lake Louise, Alberta, after a September snow squall. A reflection of Mounts Victoria and Lefroy from the mirror of the lake. (Mrs. Mary V. Walcott, 1923.)



FIG. 7.—Starbird Glacier at the head of Horseshief Canyon. Purcell Range, about 40 miles (64.3 km.) west of Lake Windermere, British Columbia. (Mrs. Mary V. Walcott, 1923.)



FIG. 8.—A great cluster of 75 blossoms of the Lady Slipper (*Cypripedium parviflorum* Salisb.). Seven miles east of Lake Windermere in the Stanford Range, British Columbia. (Mrs. Mary V. Walcott, 1923.)



FIG. 9.—Labrador Tea (*Ledum groenlandicum* Oeder), which has a range of many thousands of square miles. This particular group of blossoms was from Sinclair Canyon, Brisco-Stanford Range, British Columbia. (Mrs. Mary V. Walcott, 1923.)

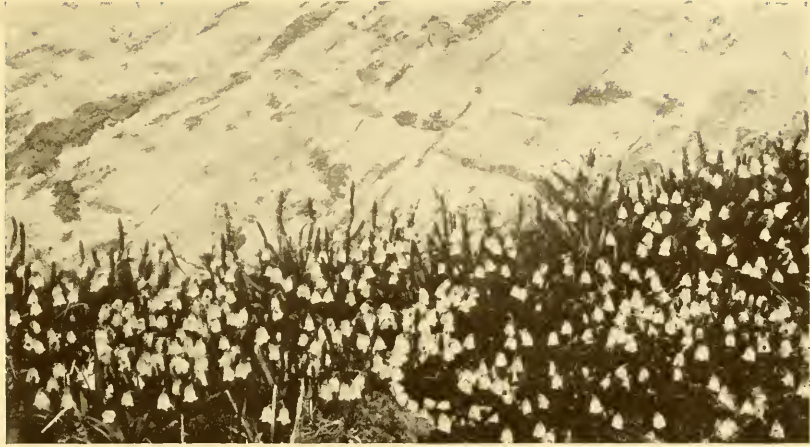


FIG. 10.—Bell heather (*Cassiope mertensiana* (Bong.) Don) which carpets large areas in the Canadian Rockies. From Lake of the Hanging Glaciers, British Columbia. (Mrs. Mary V. Walcott, 1923.)



FIG. 11.—Grizzly bear camp up among groves of Lyell's Larch. Southeast of Baker Lake and northeast of Lake Louise, on the Canadian Pacific Railway, Alberta. (Mrs. Mary V. Walcott, 1923.)

of which is exhibited in the main hall of the Smithsonian Institution building. Three of the photographs of wild flowers as growing are reproduced by figures 8, 9, and 10.

During most of the field season the party consisted of Secretary and Mrs Walcott, Dr. Edwin Kirk of the U. S. Geological Survey, Arthur Brown, Paul J. Stevens, packer, and William Harrison, camp assistant.

The Commissioner of the Canadian National Parks, Hon. J. B. Harkin, and the members of the Parks Service in the field, and the officials and employees of the Canadian Pacific Railway, were all most courteous and helpful.

GEOLOGICAL FIELD-WORK IN THE OHIO VALLEY

The field-work for 1923 of Dr. R. S. Bassler, curator of paleontology, United States National Museum, was limited to three regions of the Ohio Valley, namely, the Central Basin of Tennessee, the Knobstone area of southern Kentucky and the Niagaran plain of southwestern Ohio. The stratigraphic and paleontologic studies in the Central Basin of Tennessee, commenced two summers ago, were continued this year in cooperation with the Geological Survey of Tennessee. In previous field-work the geology of the western side of the Central Basin, particularly an area of about 250 square miles just south of Nashville, was studied and mapped. This season's work was concentrated upon the Hollow Springs quadrangle, an area of similar size located on the opposite side of the Central Basin and upon the adjacent Highland Rim. This Highland Rim, a plain area underlaid by very gently undulating strata, is a possible source of oil, so that State Geologist Wilbur A. Nelson suggested that in addition to the usual stratigraphic studies, a structural contour map be made of the quadrangle for use in locating oil areas. Therefore during the geologic mapping special attention was paid to the accurate determination of the top of the Chattanooga black shale, a widespread oil shale formation separating the Mississippian limestones above from the Ordovician limestone below. Sufficient observations were obtained to make it possible to draw on the map the structural contours or lines of equal elevation of the oil shale, thereby revealing the slight undulations of the strata. Several anticlines of interest as possible oil reservoirs were discovered by this method. The stratigraphic sequence in this region proved to be quite different from the western side of the Central Basin for here the middle Ordovician, Cannon limestone as shown in figure 12 is overlaid directly by the early Mississippian Chat-



FIG. 12.—View of Middle Ordovician-Mississippian unconformity near Hollow Springs, Tennessee, showing the undulating line of contact between the Cannon limestone (C) and the Chattanooga black shale (B). (Photograph by Bassler.)



FIG. 13.—View of Highland Rim in east central Tennessee, dissected by Central Basin stream. (Photograph by Bassler.)



FIG. 14.—Falls of Duck River near Manchester, Tennessee. (Photograph by Bassler.)



FIG. 15.—Portion of Stone Fort mound near Manchester, Tennessee, an Indian earthwork built largely of black shale. (Photograph by Bassler.)

tanooga black shale, all of the upper Ordovician, Silurian and Devonian strata thus being absent.

The Highland Rim in this part of Tennessee is dissected by many streams which carve out narrow rocky valleys opening into the Central Basin. This in turn gives rise to many rock outcrops and consequent opportunities for collecting fossils. Such areas, although very rough in nature, contain beautiful scenery, as shown in figure 13. The Highland Rim is as a rule a monotonous plain, but interesting scenery upon it is sometimes developed along the streams where erosion has been sufficient to cut through the hard silicious limestone into the softer underlying black shale. In such cases, as shown in figure 14, waterfalls of considerable size are developed. This particular outcrop is also of archeological interest in that the blocks of black slate shown at the base of the falls furnished part of the material with which the Indians built extensive mounds along the river banks. A portion of these mounds known as the Stone Fort is shown in figure 15.

In company with State Geologist Nelson and the late Mr. W. E. Myer, Dr. Bassler visited the Indian earthworks along the Harpeth River west of Nashville in order to study a blue-clay stratum outcropping in the mounds. Elsewhere in Tennessee this blue clay contains mammals of Pleistocene age but here it was underlaid by strata holding human remains. Therefore at first glance it seemed that definite results as to the age of early man in America had been discovered but upon a little investigation it became evident that the Indians had transported this clay from some distance and packed it down into the flat layers resembling geological strata.

The geologic work in Kentucky was financed by Mr. Frank Springer and consisted of quarrying operations in an area of crinoid-bearing strata. Although some specimens were discovered this season, the main object of the work was to uncover the fossiliferous strata so that weathering during the coming year would reveal the crinoids now hidden in the débris.

In southwestern Ohio, in connection with the packing of the Austin collection of fossil invertebrates for shipment to the Museum, Dr. Bassler, through the courtesy of Dr. George M. Austin the donor of this collection, was enabled to study the geology of the Niagaran plain and surrounding areas from which Dr. Austin had secured his specimens. In this way a first hand knowledge of the region was obtained which is now proving very useful in the study and arrangement of the specimens in final Museum form.

EXPEDITION TO THE DINOSAUR NATIONAL MONUMENT, UTAH

The department of geology of the United States National Museum has long been desirous of obtaining a mountable skeleton of one of the large sauropodous dinosaurs to be utilized as a central feature in the main hall devoted to the exhibit of fossil vertebrates. In the latter part of 1922, the opportunity for securing such a skeleton was presented when the Carnegie Museum of Pittsburgh abandoned opera-



FIG. 16.—Sign on the Victory Highway near Jensen, Utah, directing visitors to the Dinosaur National Monument. Erected by the Vernal Chamber of Commerce. (Photograph by C. W. Gilmore.)

tions at the Dinosaur National Monument in northeastern Utah. In the course of their final excavating, the Carnegie collectors uncovered two partially articulated skeletons of *Diplodocus*, which were left *in situ*, since a sufficient amount of such material had already been secured. When this fact and the intention of the Carnegie Museum to cease operations in the region were communicated to the officials of the Smithsonian Institution, plans were formulated for taking up the work, and in May, 1923, Mr. C. W. Gilmore, curator of vertebrate paleontology, was detailed to take charge of such operations as were necessary to secure a mountable skeleton of one of these huge reptiles.



FIG. 17.—View of the quarry at the Dinosaur National Monument. The slope in the center foreground was excavated for dinosaur remains by the Carnegie Museum. The dump may be seen in the lower left hand corner. (Photograph by Earl Douglass.)



FIG. 18.—General view of the region surrounding the Dinosaur National Monument with Green River at right. The arrow indicates the location of the quarry. (Photograph by Earl Douglass.)

The fossil deposit in the Vernal Valley, near Jensen, Utah, now known as the Dinosaur National Monument (see figs. 16, 17, and 18), was discovered by Mr. Earl Douglass in 1909, and has been worked continuously by the Carnegie Museum since that time. The material secured there—some 300 tons—is greater in quantity and finer in quality than the sum of all that has been obtained hitherto in America. The fossil bones are found here in a thick, cross bedded sandstone of variable hardness that is tilted up to an angle of 60° , as is clearly indicated in the accompanying illustrations.



FIG. 19.—View showing the steeply inclined plane of the fossil bearing sandstone, with blocks of fossils being boxed preparatory to shipping. (Photograph by Earl Douglass.)

Mr. Gilmore arrived at the quarry on May 15. A preliminary survey showed that the two skeletons uncovered by the Carnegie collectors had been partially worked out in relief, as illustrated in figures 20 and 21. These are here referred to as No. 355 and No. 340. It was at once decided that No. 355 (see fig. 21), although lacking much of the neck and some other parts, would form the basis of a mountable skeleton, its value being materially increased by its articulated condition, while the preserved parts of No. 340 would serve admirably to replace the missing bones of No. 355.

Regular work in the quarry was begun on May 24 and proceeded continuously up to August 8. The employment of three men with ex-



FIG. 20.—General view of the skeletons of *Diplodocus* collected by the National Museum. Men are working on specimen No. 355 at the right, and No. 340 is shown near the floor of the quarry to the left. The large plastered blocks on the ledge are portions of the neck of No. 340. (Photograph by Arthur Coggeshall.)



FIG. 21.—Photograph showing a more detailed view of specimen No. 355 as it was uncovered by Carnegie Museum collectors. The squares, 4 feet across, are painted on the rock to assist in properly mapping the bones. (Photograph by Arthur Coggeshall.)

perience in this field, together with the assistance of Mr. Norman H. Boss of the Museum's paleontological force, who joined the expedition on June 5, were largely responsible for the successful outcome of the operations.

The work of quarrying these often fragile bones from the ledge of rock without doing irreparable damage is a slow and tedious operation, involving the skill of both the stone cutter and the miner. Further difficulty is encountered in handling by primitive methods the immense blocks of rock enclosing the bones, with the subsequent arduous work of boxing and transportation. The largest block quarried, containing the sacrum with attached hip bones, weighed nearly 6,000 pounds when ready for shipment. The transportation of the boxes to the railroad involved a haul by teams of 150 miles across country and over a range of mountains 9,100 feet above sea level. However, 34 large boxes having a combined weight of over 25 tons were safely transported.

The expedition resulted in the acquisition of sufficient material for a good skeletal mount of *Diplodocus* which, it is estimated, will exceed 80 feet in length with a height at the hips of 14 feet.

COLLECTING FOSSIL FOOTPRINTS IN VIRGINIA

In September Mr. Charles W. Gilmore, curator of vertebrate paleontology, United States National Museum, visited the farm of Mr. F. C. Littleton, near Aldie, Loudoun County, Virginia, for the purpose of investigating the reported discovery of fossil footprints. In excavations made by Mr. Littleton in the red Triassic shale in quest of flagstone, numerous footprints were to be observed. These occur in four distinct horizons in a vertical distance of perhaps 100 feet. In two instances at least prints were found in successive layers. Three-toed imprints predominate though they vary in size from a length of three to fourteen inches. A few tracks were noticed having four toes, evidently terminated with wide, flat unguals. All of these are probably of dinosaurian origin, but a few small 4- or 5-toed tracks with traces of sharp claws perhaps pertain to some other group.

While as a whole the tracks bear a striking similarity to those from the Trias of the Connecticut Valley, a critical study and comparison of them would be most interesting. They are of further interest as being the first footprints to have been found in the State of Virginia.

Through the courtesy of Mr. Littleton, Mr. Gilmore again visited the locality and with the assistance of Mr. N. H. Boss collected a fine slab, two by twelve feet, on which were the imprints of a 3-toed



FIG. 22.—Slab of footprints from the Triassic shales, near Aldie, Virginia. Presented to the National Museum by Mr. F. C. Littleton.

dinosaur. This slab shows that the animal had a stride of 56 inches. This specimen which weighed in the neighborhood of 1,500 pounds makes a most important and interesting addition to the collection of fossil footprints now on exhibition. A few separate tracks were also secured at the same time.



FIG. 23.—General view of the place where footprints were found on the President Monroe farm near Aldie, Virginia. (Photograph by C. W. Gilmore.)

PALEONTOLOGIC RECONNAISSANCE IN THE GREAT BASIN

Dr. Charles E. Resser, associate curator of paleontology, United States National Museum, was detailed by Secretary Walcott to spend the months of August and September, 1923, in reconnaissance stratigraphic and paleontologic work in the Great Basin Ranges of Nevada and Utah. This work was planned primarily to obtain information and collections of Cambrian fossils to further the work of Dr. Walcott in his monographic studies of the Cambrian and allied formations. As the region to be studied was so extensive and lacking ordinary means of travel, a Ford truck was purchased in advance at Elko, Nevada, the starting point of the trip (fig. 24).

Mr. M. C. Flohr of Washington, D. C., accompanied Dr. Resser and ably assisted about the camp and in making the collections. Dr. Murray



FIG. 24.—Delayed in irrigation ditch, south of Egan Canyon, Nevada, showing difficulties encountered in exploration work. (Photograph by Resser.)



FIG. 25.—Lamoille Creek and Canyon, in the Ruby Range, the most rugged and picturesque in Nevada. (Photograph by Resser.)

O. Hayes, professor of Geology at Brigham Young University, Provo, Utah, joined the party for a week's work near the end of the season in the Wasatch and Bear Lake Mountains.

Passing by the beautiful Ruby Range (fig. 25) the party proceeded to Eureka, Nevada, where the first two weeks were spent in this region made classic by Dr. Walcott's monograph of 1886. Large collections were secured here supplementing those made by Dr. Walcott in the early days when the district was densely populated and the producer of great quantities of silver and gold. Now it is largely abandoned like the other older mining districts, but more knowledge of the geology is necessary because at the present time several large mining companies are making an intensive search to find any ore bodies that may lie beyond the older workings.

A rapid survey was then made of the Schell Creek, Egan and Snake Ranges in eastern Nevada, all typical Basin Ranges where Cambrian beds are brought to the surface at many places. A most excellent and important section was found in Patterson Canyon, 50 miles south of Ely in the Schell Creek Range, but as it is eight miles by very steep road from the nearest water and 50 miles from the nearest gasoline station, through a wide desert (fig. 26), only one trip could be made to it from the spring at the Geyser Ranch.

A large collection of Cambrian fossils was secured along the Lincoln Highway just west of the summit on Schellbourne Pass. Thousands of tourists pass this way each season, for the party was joined in its camps along this highway invariably by numerous other parties representing every type of American citizen.

In the drier portions of the world the universal and absolute control exercised by water on the position of man's habitation and manner of living is the more apparent. In the Great Basin one finds no dwellings except where water can be secured and the size of the unit of dwellings is determined altogether by the amount of water. Thus one may find a single individual at a small spring, a small ranch at the end of a small stream and a large ranch or groups of ranches where the stream carries more water. The copper ores from the Ruth-Kimberley District must be carried 30 miles across Steptoe Valley to the concentrators and smelters at McGill, situated on Duck Creek, the largest stream in this region. To conserve the water supply the ranches formerly depending on this stream have been abandoned and the water is piped to the plant to avoid the loss in the natural stream bed. The higher ranges catch the greater amount of snow and rain and so the denser populations are located along their foot.



FIG. 26.—Typical desert view along Overland Trail in Steptoe Valley, Nevada, showing flood water after a storm. (Photograph by Resser.)



FIG. 27.—Early morning picture of the Smithsonian camp in Blacksmith Fork Canyon, known for the excellent section studied here by Dr. Walcott. (Photograph by Resser.)

The last two weeks were spent in a brief study of certain sections in the Wasatch and Bear Lake Mountains in Utah. These ranges form the western edge of the great Rocky Mountains and offer many complicated problems in structure and stratigraphy. These mountains are higher and consequently catch a heavier rainfall. The well-watered strip, which is the rich agricultural district of Utah, is the result. Cache Valley in the northern part of the state, between two ranges, is densely peopled in its many farming communities and is a region of great beauty. Numerous canyons have been cut by the larger streams around this valley and among them is the Blacksmith Fork Canyon studied some years ago by Dr. Walcott (see fig. 27), with results which proved so interesting that further collections were desirable.

FIELD-WORK OF THE ASTROPHYSICAL OBSERVATORY

In 1918, the Astrophysical Observatory began to undertake the daily measurement of the variation of the sun. The late Secretary Langley used often to express his prevision that the study of the sun's heat, the losses which it suffers in passing through our atmosphere, the variations which it may be subject to, would at length serve to forecast the changes of weather and climate which are so important for the agriculturist, and which in some parts of the world even lead occasionally to periods of disastrous famine. He used to speak of Joseph's seven years of plenty and seven years of famine, in this connection, and of the possibility that in the future the student of the sun might be in a position to emulate that ancient prophet.

Langley's dream received some support when the Smithsonian Astrophysical Observatory discovered the substantial variability of the sun, and confirmed this discovery by its expeditions to Africa. The influence of the solar variation on the weather was studied by Mr. Clayton, at that time chief forecaster of the Argentine Meteorological Service, and he seemed to find that the sun's variations produced notable influence on the weather conditions of Argentina, and, indeed, of the rest of the world. The results of these preliminary studies of Mr. Clayton were published in the Smithsonian Miscellaneous Collections, Vol. 68, No. 3, and Vol. 71, No. 3.

Our previous investigations had been restricted to the summer and autumn seasons which are notably cloudless at our observing station on Mt. Wilson, Cal. These results appeared so encouraging that it seemed incumbent on us to make the necessary observations of the sun throughout the entire year for a number of years, in order to make

a groundwork for further studies of the relation of the variation of the sun to the variation of the weather. As is well known, solar observations of this kind require the highest degree of cloudlessness and uniformity of sky. After many inquiries, it was decided to occupy a station near the city of Calama, on the edge of the Nitrate Desert of Chile. This station was first set up in July, 1918, and continued until July, 1920, when, by the advice and financial assistance of Mr. John A. Roebeling, it was removed to the top of Mt. Montezuma, about ten miles south of the former location and high above the dust and smoke which had hindered to some extent the observations near Calama.

At the same time, also, by Mr. Roebeling's assistance, the apparatus which had hitherto been used on Mt. Wilson, Cal., was transferred to the top of Mt. Harqua Hala, Ariz., selected after a long meteorological investigation conducted through the kindness of the Director of the United States Weather Bureau. This station was first occupied in October, 1920, and both stations have reported continuously from their establishment until the present time.

The method of solar observation invented by Langley and developed by the Astrophysical Observatory requires a continuous uniform transparency of the sky for several hours, either in the early morning or the late afternoon. It also requires about twenty-five hours of measurement and computing for each day of observation. In 1919, a brief empirical method, based upon this longer and fundamental method, was devised and applied first at Calama and later at Harqua Hala and Montezuma. In 1922, a still further abbreviation of the methods of computing was devised and was introduced at both stations in the spring of 1923. According to this newest method, the required observations for determination of the intensity of the sun's heat as it is outside the atmosphere can be secured in less than fifteen minutes, and the results can be computed in less than an hour, so that it is now possible and usual to make daily five independent determinations at each station of the intensity of the solar heat as it is outside the atmosphere, reduce these observations by one or two o'clock in the afternoon, and, again by Mr. Roebeling's financial assistance, communicate them by telegraph, from the stations at Harqua Hala and Montezuma, to the Smithsonian Institution at Washington where they are received early on the following morning. If it were essential, the matter might be still further accelerated, so that telegraphic reports from these distant observing stations could be had on the afternoon of the same day of the observation.

Now that five independent determinations are usually made daily at each station, the mean results are very accurate. A comparison has been made of the daily determinations at the two stations over the period January to October, inclusive, 1923. It proves that a half of one per cent is the average daily difference between the indications of the solar heat as it is outside the atmosphere, determined at these two stations many thousands of miles apart, one in the Northern, the other in the Southern Hemisphere, one at an altitude of 5,000 feet, the other at 9,000 feet.

The two stations join in indicating the march of the solar heat up and down, and within the past year the fluctuations have ranged over about 4 per cent. During the years 1914 to 1921, the results had run generally at a level of about 1.95 calories per square centimeter per minute. Beginning in 1921, a notable downward march began, and by September, 1922, the monthly mean values were ranging at about 1.91. This lower level continued, with minor fluctuations, for a number of months, and the lowest values were reached in February and March, 1922. After that, there was a gradual increase until in September and early October, 1923, the values had come to an average level of about 1.93. Still more recently, there has begun a slump, so that at latest advices, up to February 1, 1924, the solar heat outside the atmosphere is running at approximately 1.92 calories. It will be of great interest, after two or three years of this steady investigation of the solar radiation, to compare the results with meteorological conditions.

The reader might think it obvious that if the solar radiation falls the temperature would fall also. Nothing so simple as this occurs. For the earth's surface is so complex that its deserts, its mountains, its oceans, and other features, with the circulation of the atmosphere, modify extremely the effects of the solar heat. It is easy to see, for instance, that inasmuch as a quarter of the sun's heat is absorbed in the atmosphere itself, and as the atmosphere has but a trifling capacity for heat compared with the solid earth or the ocean, that its temperature must be almost immediately affected by solar variations, far more directly than the temperature of the ocean or the temperature of the land. But since the atmosphere is in some regions hazy, humid, and cloudy, in other regions dry and transparent, the quantity of solar heat absorbed must vary very much from place to place. So the changes in the solar heat must produce very different temperature effects in the atmosphere in a cloudless desert region at high altitude



FIG. 28.—The Windmill of the Montezuma Station.



FIG. 29.—The Montezuma, Chile, Solar Observing Station. Living quarters below, observatory in a cave at the top of the mountain.

than they would at a cloudy, humid, hazy region where the air is contaminated, perhaps by the smoke of a great city.

The consequence is that air expansion, due to the increased temperature accompanying increase of solar radiation, takes place in much larger proportion in the humid, hazy regions than it does in the cloudless, clear ones, and so the air must flow from the regions of the former condition to those of the latter. This produces changes in barometric pressures which in turn produce the winds and cyclonic movements which are so familiar. With the changes of season and other variable conditions, the regions which are sources of these cyclonic disturbances move about from place to place. This alters the direction of the winds, and, as is well known, the temperature depends intimately on the prevailing winds at every locality. This may explain why it is that we are not to expect at every station and at every time of the year colder weather when the solar radiation is lower. We may have exactly the reverse, depending on these secondary effects. Consequently the study of the dependence of weather on solar radiation must be very long continued and thorough before it will be possible to hazard predictions based upon the variation of the sun, or even to know for certain that the variations of the sun are of importance for our forecasters. The Smithsonian Institution, however, having developed the methods of measurement of the solar heat, seems in duty bound to continue these careful determinations of it long enough to furnish a first rate groundwork of data from which meteorologists can determine these interesting relations.

Notable improvements have been made at both stations through the enthusiastic work of the directors, Mr. L. B. Aldrich at Montezuma and Mr. A. F. Moore at Harqua Hala. One of the most striking of these is the introduction at Montezuma of a windmill, situated at the very top of the mountain, and furnishing sufficient power to produce electric lights and to charge the storage batteries used about the dwelling-house and the observing station. Some additions have been made to the living quarters at each station in order to add to the comfort of the observers and their families. The accompanying illustrations show the Montezuma station with the windmill as now installed. Readers may compare these with previous illustrations of former Exploration Pamphlets.

An expedition was made by Dr. Abbot to the station on Mt. Wilson, formerly occupied for the measurements of the solar heat, but now reserved for occasional occupation for the study of problems requiring good, cloudless observing conditions not found in Washington. Three

investigations were proposed: 1, Further study of the use of the sun's heat for cooking purposes, first reported in the Exploration Pamphlet of 1920; 2, the study of the effects of ozone in the earth's atmosphere; 3, a repetition, with improved apparatus, of the measurements of the heat of the spectra of the brighter stars, first attempted in 1922, in the focus of the 100-inch telescope of the Carnegie Observatory on Mt. Wilson.

Some progress was made with the solar cooker, and oven temperatures up to 175° C. were reached. At this high temperature, the oil circulating system sprung leaks and soaked the insulating material which, thereby becoming combustible, spontaneously took fire. So the experiments had to be discontinued. It is proposed to rebuild the solar cooking apparatus for further experiments another year.

The measurements of ozone in the atmosphere have very interesting aspects. The French observers, Fabry and Buisson, have worked out photographic methods of determining the quantities of ozone. This gas, formed by the action of ultra-violet sun rays upon oxygen, occurs very high up in the atmosphere and is scarcely found in appreciable quantities at the earth's surface. The measurements of Fabry and Buisson indicate that the quantity existing in the higher atmosphere, although small, is sufficient to produce notable absorption, indeed extinction, of the extreme ultra-violet sun rays, and the quantity seems to vary from day to day through a range of even as much as 20 per cent. These variations in the atmospheric ozone would not be of importance meteorologically if the effects were restricted to the ultra-violet regions. For the quantity of solar rays there is small and, besides, the extinction of them by the ozone is always so complete that variations are insignificant. However, in the far distant infra-red spectrum region there is a strong absorption band of ozone exactly where the earth itself sends out rays to space. Those are rays which, cooling the earth, maintain the balance of temperature dependent on the equality of the rays which the earth sends out and those which it receives from the sun.

By comparison of the results of Fabry and Buisson with variations of the sun reported from our stations, it seems likely that there is a dependence of the quantity of atmospheric ozone on the intensity of the sun's heat. If so, we have here an indirect influence on the earth's temperature, depending upon the variations of this infra-red ozone band, for it falls precisely in the only region of the infra-red where otherwise the atmosphere is transparent to the earth's rays. Apparatus was set up at Mt. Wilson for the study of this question, but time did

not permit of the actual program of ozone measurements being started this year, so that it is postponed for another season.

By the kind assistance of Dr. E. F. Nichols, of the Nela Research Laboratories in Cleveland, and his colleague, Dr. Tear, a radiometer, an instrument similar in principle to the blackened vanes which revolve in the glass bulb in the optician's show window, was employed for the measurements of the heat of the spectra of ten of the brighter stars. It proved possible to measure them very easily and very accur-

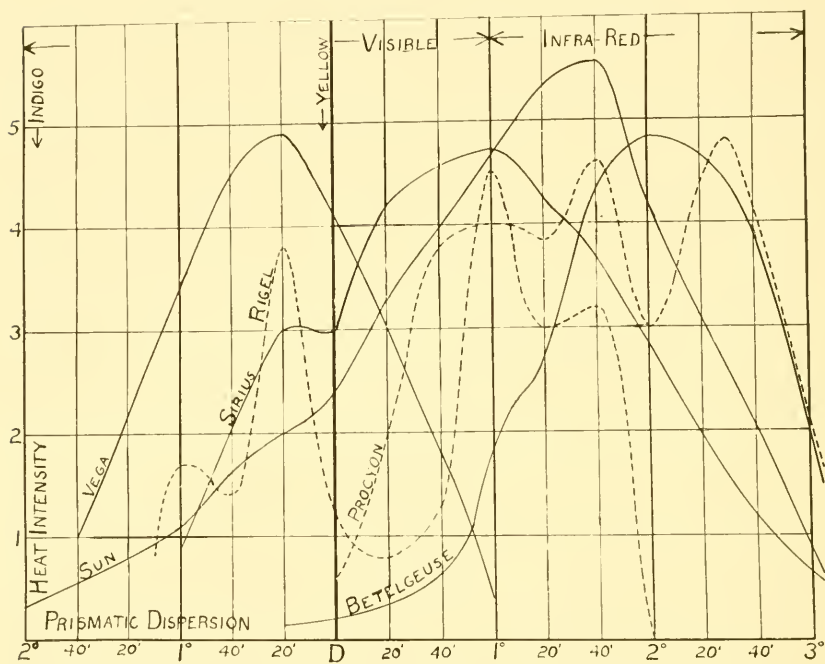


FIG. 30.—Observed Prismatic Energy Spectrum Curves of the Sun and Stars.

ately with this instrument. Indications observed were all about the same magnitude as those which were obtained last year with the bolometer, but owing to the great simplicity and consequent steadiness of the radiometer, the accuracy obtained this year was very much superior to that which was attained last year. The results secured were of very high interest to all astronomers who have seen them. It looks as if this method of studying the stars would prove of much value.

It is possible, in this way, by comparison with the sun, to determine the intensity of star heat nearly as accurately as we can determine the

intensity of solar heat. From rough preliminary computations it appears, for instance, that the radiation sent by the bright star Aldebaran, if collected over a *square mile*, would produce 1 calory of heat per minute, whereas the sun's radiation collected over a surface of 1 *square centimeter*, that is to say about three-eighths of an inch on a side, amounts to 1.94 calories per square centimeter per minute.

It is also possible, in this manner, to determine the diameters of some of the stars, providing their distance from the earth is known. In the case of the star Aldebaran, preliminary computations give the diameter as 58,000,000 miles.

Still more interesting are the opportunities offered by the method for estimating the temperatures of the stars. In the case of Aldebaran,

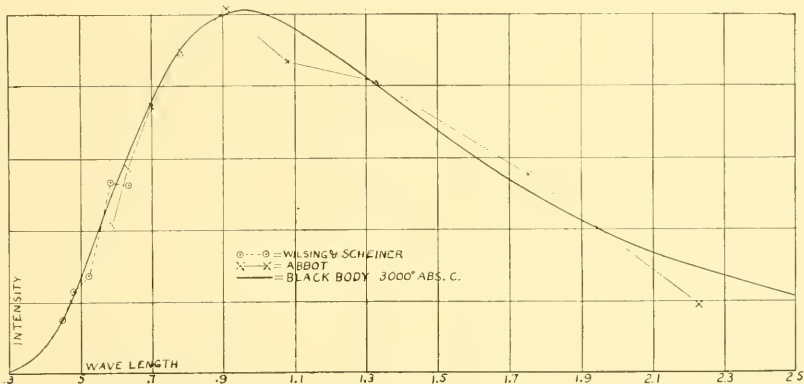


FIG. 31.—The energy spectrum of Aldebaran, as reduced to wave-length scale, and compared to the perfect radiator at 3000° Absolute Centigrade.

the distribution of heat in the spectrum between wave-lengths 0.4 and 2.0 microns, that is to say between a point in the violet and a point far beyond the end of the visible red, fits almost precisely upon the curve of the radiation of the perfect radiator or “absolutely black body” of $3,000^{\circ}$ Absolute Centigrade. The fit is, indeed, startlingly close, so that one has no hesitation in assigning to the star Aldebaran the temperature $3,000^{\circ}$ Absolute Centigrade. In the case of other stars, including our sun, the fit is less exact, so that one can only give moderately approximate estimates of their temperatures, but the accurate determination of the distribution of the stellar heat in the spectrum cannot but lead to advances in our knowledge of the physical constitution of the stars.

The accompanying figure 30 shows the results as originally observed on the prismatic spectrum of the sun and the stars Rigel,

Sirius, Procyon, and Betelgeuse. Figure 31 shows the corrected results in the spectrum of Aldebaran as reduced to the normal wavelength scale and compared with the energy of the perfect radiator or "absolutely black body" at 3,000°.

BIOLOGICAL EXPLORATIONS IN THE YANG-TZE VALLEY, CHINA

On December 15, 1922, Mr. Charles M. Hoy sailed for China to collect vertebrates for the Smithsonian Institution in the region of the Yang-tze Valley. As in previous years his work was made possible by the generosity of Dr. William L. Abbott of Philadelphia. Much delay was experienced in clearing the collecting outfit at the custom house in Shanghai. Consequently it was impossible to begin serious field-work until May 17 when the supplies at last reached Huping College, Yochow City, Hunan. Work was carried on in this general district until June 24, when Hoy wrote as follows:

I am enclosing my official report on the Yochow district, also pages from my catalogues covering all specimens collected to date. I have finished up, for the time being, my work in this district and expect to start, in a few days for Kiangsi. I would have been away before this only my headman stepped on a bamboo spike and poisoned his foot. He has been in the local hospital for over a week but will be discharged tomorrow. When it comes to exasperating delays, this trip seems to be ridden by a sure enough jinx. First one thing then another comes up but I am hoping that the finish will be better than the start. I suppose that you have been reading, in the papers, about the unsettled state of affairs here in China. Things are going from bad to worse and there is, now, practically no central Government. The various Provinces are ruled by their Military Governors who recognize no power but their own and as this power is, generally, not very strong, the lawless element has taken full advantage of the situation. Bandits are everywhere overrunning the country and very little is being done to check them. Even those bandits that derailed a train, in Shantung, and captured twenty-six foreigners and over three hundred natives, whom they held for ransom, have gone unpunished. In fact you might say that they were rewarded, for they were enrolled, *en masse*, into the army! Such things just tend to make the bandits, in other parts, all the bolder. Last week a Catholic priest was kidnapped from near Hankow and he is now being held for ransom which is fixed at \$1,000,000 (Mex.) or sixteen thousand rifles. Travel, anywhere through China, is, of a consequence, not without a certain amount of danger, but I am going ahead with all my plans and trust to luck in getting through. If I am caught, all that I ask is that nobody ransom me. I don't believe in encouraging the blighters. There was a bit of a scare thrown into the community here, in the disappearance of two of the American professors, last night. At first it was thought that they had fallen into the hands of bandits but it appears that they were out in a canoe when a storm blew up and nothing has been heard of them since. We have searched all day but found nothing but the two paddles and the hat of one of the men. Nothing has been heard of

either the men or the canoe but the supposition is that they were drowned. However, there is still the chance of their having been blown out into the current and carried away clinging to the overturned canoe. Thirty boats have been dragging the lake, all day, without success. The paddles came ashore near the spot where the men had last been seen. That spot is one of the most dangerous promontories in the Tung Ting Lake and, annually many boats are wrecked there. (Since writing this the bodies of both men have been recovered.) I have everything ready for my start, except the shipping of the specimens to the United States. My porters arrived today, ten of them, and a right hefty looking bunch they are. They have contracted to carry a minimum load of one hundred pounds at a maximum rate of thirty miles a day, for the magnificent wages of two dollars (U. S. currency) per month, plus their food. Everything in my outfit seems satisfactory with the exception of the auxiliary shells. They seem to be loaded too heavy for about one in every twenty explodes. As a general rule when that happens, the base of the shell is blown off as neatly as if it had been filed. I have several times been temporarily blinded by the powder that blew back through the locking mechanism. The country around Yochow is very well differentiated as to topography, containing mountains, rolling hills, plains and swamp lands. Fully half of the land is not under cultivation and is covered with a dense growth of scrub bamboo, buffalo grass and reeds. Here and there areas of scattered forest growth, mostly pine and other conifers, are met with but as these for the most part have been planted and are not allowed to grow to any great size, they do not support any strictly forest forms of mammals. The district, up to a few years ago, teemed with a great variety of mammal life but floods, droughts, fires and the great increase in hunters have created such havoc that certain species seem to have been exterminated while most of the others have become very scarce. Prices of skins have risen several hundred per cent in the last few years and this fact is mainly responsible for the increase of hunters, for if a man gets only four or five skins a month, he is making far more money than if he worked for wages. Work in the Yochow District has been closed for the present with a total of 169 mammals, representing nineteen species, and 84 birds.

On July 2 Hoy left Huping for a trip through Hunan and Kiangsi. His field books have not yet been received, consequently no detailed account of his route can now be given. He finally arrived at Kuling, Kiangsi, the summer hill resort for foreigners in the Yang-tze Valley. Many interesting specimens were obtained, though no part of the collection has yet reached Washington. About this trip Hoy writes from Kuling, under date of August 12, 1923:

The day after writing my last letter to you, from Iningchow [never received], I had a bad fall and badly wrenched my back. For about a week I was scarcely able to crawl about. Just when my back was getting so I could straighten up I had another accident and shot myself through the left leg with the Colt 45 automatic. The accident was due to a "hang fire." The gun did not go off when the hammer struck and so I lowered the gun to eject the shell when the shell exploded. The bullet struck me on the inside of the leg



FIG. 32.—A typical Chinese farmhouse in the Yochow district, China.
(Photograph by Hoy.)



FIG. 33.—Native cheek gum, Yochow district, China. (Photograph by Hoy.)

four inches above the ankle, just missed the big tendon, and came out on the other side just half an inch above the ankle bone. Luckily no bones or important sinews and blood vessels were struck and so the wound although rather painful is not serious. As soon as the accident happened I applied first aid and struck out ahead of my stuff for this place and a doctor. The wound is healing nicely but the doctor says that it may be several months before I get full use of my foot and that I will most likely have a slight permanent limp. However,



FIG. 34.—A widow's arch, Yochow district, China. (Photograph by Hoy.)

I am hoping that it won't interfere with my collecting, but even if I won't be able to do much walking myself I have one man who is a crack shot with the shot gun and another that is fair with the rifle, so I ought to be able to get specimens anyhow. My trip down from Iningchow was rather uneventful except for the above accidents. We were under military guard all the way from there to Kuikiang. The country, it seems, is full of disbanded Northern soldiers who have driven out the natives and occupied their farms. Consequently it is dangerous for even natives to travel through that region. The final explanation given me, as to the reason of the escort, was that it was feared that my

guns and ammunition might fall into their hands. We were fired on once, in the night, but aside from a lot of shouting and that one shot, nothing happened. We could never learn who fired the shot but the way things turned out I am convinced that we were mistaken for bandits and the shot was fired to scare



FIG. 35.—Water deer, Yochow district, China. (Photograph by Hoy.)

us off. Owing to the accidents, I have not been able to secure any specimens since the writing of my last letter. My outfit has not yet arrived owing to the heavy rains but as soon as it gets here I plan to send my men out collecting so I will be able to get specimens notwithstanding the fact that I am confined to the house.

The wound was not a subject of serious anxiety. Other conditions, however, soon appeared. These and their subsequent course are described by Dr. W. E. Hoy, Jr., Department of Biology, Presbyterian College of South Carolina, in two letters dated October 14 and 18:

Sometime between the 8th and 12th of August Charles was carried up the mountain to Kuling, suffering from a gunshot wound in the leg. Kuling, as you probably know, is the summer resort for foreigners in the Yank-tze valley. The wound was caused by the accidental discharge of his revolver. The bullet made a clean wound between the tibia and the fibula. No anxiety was felt for his condition. My mother was on the mountain at the time and took care of him. In the next few days my brother developed severe abdominal pains and an attending physician pronounced it appendicitis. He was operated on immediately. This was about the 17th. The operation was a long affair. The appendix could not be found for several hours. The surgeons stated that the appendix was gangrenous and bound down by multiple adhesions. They expressed it as the worst case they had ever operated on. Just after I had written to you the beginning of the week I received further letters from home. My mother stated that Charles had had severe hemorrhages and that he lapsed into coma on the sixth of September. That evening at six o'clock he ceased breathing.

MOLLUSCAN STUDIES ABOUT THE FLORIDA KEYS, BAHAMAS, AND WEST INDIES

The experiments in heredity which are being conducted by Dr. Paul Bartsch, curator, Division of Mollusks, United States National Museum, under the joint auspices of the Smithsonian and Carnegie Institutions required the addition of several elements to render these studies as comprehensive as possible. For that reason transportation was secured on May 1, 1923, on the naval transport *Henderson* sailing from Hampton Roads for Porto Rico. This made possible a number of stops; *viz.*, Guantanamo Bay, Cuba; Port au Prince and Cape Haitian, Haiti; Porto Plata, San Domingo City, San Pedro Macoris, San Domingo; and San Juan, Porto Rico, in all of which places series of minute shells were gathered.

In Porto Rico Governor H. M. Towner was good enough to place an automobile at Dr. Bartsch's disposal, to carry him and his collecting outfit to Guanica Bay at the southwestern end of the island. This gave him an opportunity to see the lay of the land and to understand the zoo-geographic features which govern and underly the distribution of the molluscan fauna. It also showed what a beautiful island Porto Rico really is, and how it has been almost completely bent to human use, with results that in most places very little of the original flora,



FIG. 36.—Upper: A San Salvador mocking bird enjoying a drink from a bird bath made of half a watermelon rind.

Lower: A hand of the junior member of the party, showing the effects of the innumerable bites of the sand fly (*Culicoides furcens* Poey), resulting in an endless number of tiny tumid areas. The lizard on the hand was the pet and mascot of the party.



FIG. 37.—Upper: Columbus Bay, San Salvador, in which it is believed the ships of Columbus came to anchor, upon his discovery of America.

Lower: Columbus Point, San Salvador, showing the monument erected by the Chicago Herald in commemoration of Columbus' discovery of America.



FIG. 38.—Upper: A view of the splendid roads which are being built around and across the island of San Salvador.
Lower: A view of the landing in Lake Isabella, showing the type of boat used in lake travel.

and therefore fauna, remains. Frequent stops were made, where suitable places presented themselves, and bags of leaf mould, rich in minute land mollusks, were secured. Thanks to a letter from the governor to Mr. French T. Maxwell, Vice President of the Guanica Central, Dr. Bartsch had splendid quarters assigned to him, and he was granted every facility and assistance to make his week's stay at this end of the island thoroughly available for intensive work. With the aid of a launch owned by Mr. Thompson he was able to comb the south coast from Balena Point to the western extremity of the island, as well as the off-lying islands, for Cerions and other land mollusks, a large series of which was secured.

The return trip was made by the railway that skirts the western and northern shores of the island to San Juan, whence the naval transport *Kittery* carried Dr. Bartsch back to Hampton Roads, arriving on May 27.

This expedition resulted in the securing of about 15,000 land, fresh water and marine mollusks, 48 bats, 1 lizard, some ectoparasites, a collection of ants, and 3 fungi.

A second expedition to the island of San Salvador was undertaken on August 9, at which time Dr. Bartsch and his son left New York on the army transport *St. Mihiel*. They were landed at Cockburn Town on August 12, and spent two trying weeks on San Salvador in intensive collecting. The work was made particularly arduous by the presence of countless numbers of little sand flies, which made it difficult to attend to anything but these little pests in the day time, and absolutely forced one under a cloth screen after sunset. There was only one night when it was possible to collect night flying insects without wearing a superabundance of clothes, gloves securely tied at the wrists, leggins and a cloth head net, but in spite of these trials the island was thoroughly searched for Cerions, and quite a number of new species were secured, but unfortunately not the one that was particularly sought, which group is not represented on the island. Large series of other land mollusks, as well as marine and fresh-water species, were gathered and as many insects and birds as time would permit.

It is interesting to compare present conditions with those described by Columbus in his journal. Not a trace of Indian blood was apparent. The black population consisted of about 700 souls. It was a rather homogeneous, tall, splendid type, actively engaged in pursuits of one kind or another, chief among which is the growing of sisal. Thanks to our Eighteenth Amendment, funds have been steadily pouring into



FIG. 39.—Upper: A native house of San Salvador. These are practically all built of coral limestone and usually thatched with palm. Lower: A group of native boys. The native population of San Salvador is black, practically unmixed, and of splendid physique.

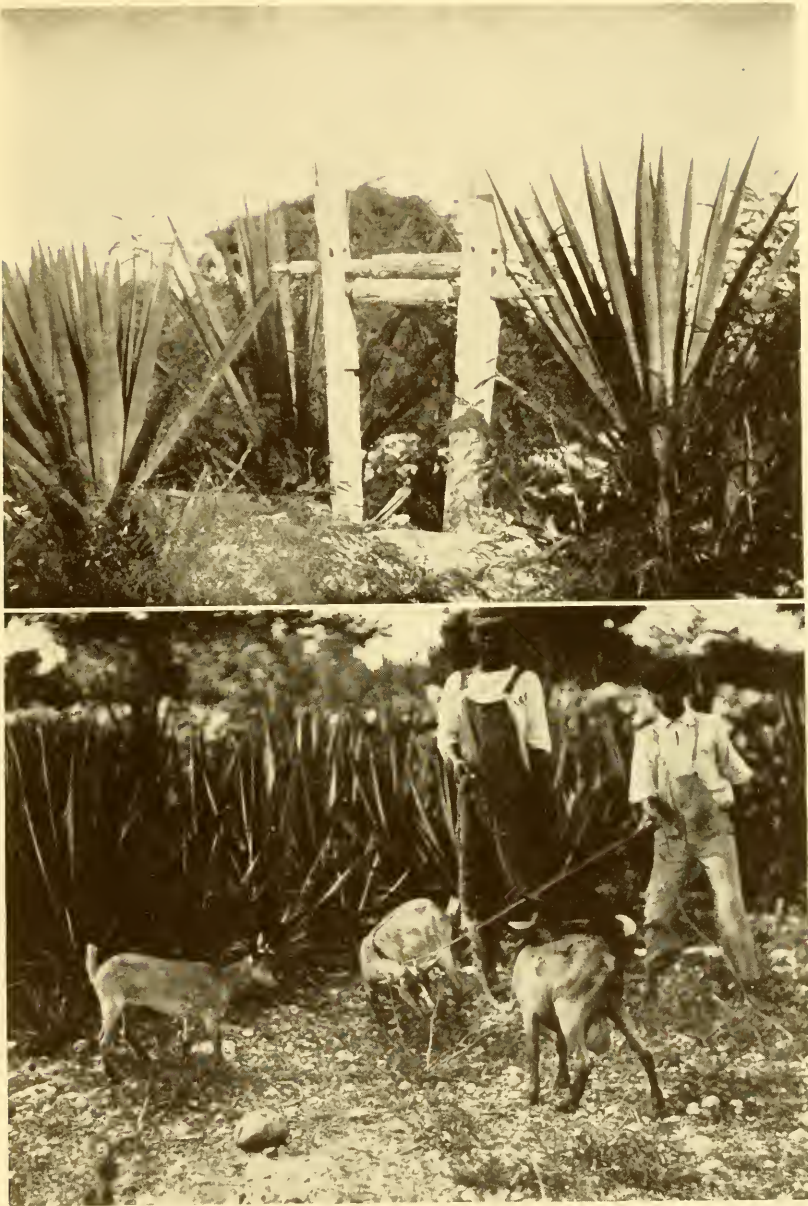


FIG. 40.—Upper: A sisal field with a primitive sugar mill. Sisal forms the greatest export element of San Salvador. Its fiber is largely used in the making of rope.

Lower: The greatest element in the milk and meat supply of the island.



FIG. 41.—A habitat picture of *Cerion coloni* new species, a member of the group used for our experiments in heredity. This species was taken at the base of the Columbus Monument, San Salvador.

the treasury of the Bahamas as import and export duties on wet goods, and this is making it possible for these islands to enjoy a financial uplift which is manifesting itself in the building of splendid roads. The island of San Salvador, for example, is rapidly acquiring an automobile road which will shortly completely encircle it, although there is not a single machine there at the present time, transportation being effected almost exclusively by human carriers, or horseback.

There are two huge lagoons within the island, the larger eastern one of which I have named Lake Ferdinand, and the smaller western one Lake Isabella. These lagoons are supersaline and communicate with the sea by long underground channels. They contain a remarkably modified molluscan fauna characteristic of such places.

The visit to San Salvador resulted in the gathering of approximately 25,000 specimens of mammals, birds, reptiles, batrachians, fish, mollusks, insects and plants.

After two weeks the U. S. Naval transport *Kittery* stopped and carried the expedition to Guantanamo Bay, Cuba. From there the party proceeded to Havana by rail, thence by P. & O. boat to Key West. Here Dr. Bartsch was met by Mr. Mills, the chief engineer of the Marine Biological Laboratory of the Carnegie Institution, and carried by the launch *Valcella* to the Tortugas, where a study was made of the Cerion colonies previously placed here. Here, likewise, Dr. Bartsch tried out a new submarine moving-picture camera, with which he secured several hundred feet of excellent films showing marine organisms in their native habitat in depths varying from 10 to 20 feet.

On the return trip the various keys containing Cerion colonies were examined, and the specimens studied. On Newfound Harbor Key 150 Cerions from the hybrid colony were gathered for anatomic study in the laboratories at Washington. The dissections of these specimens are showing some wonderful results.

The *Valcella* reached Miami September 9, where Dr. Bartsch took train for Washington.

In addition to the specimens secured, careful notes were taken of the birds observed in the various regions visited.

BOTANICAL EXPLORATION IN THE DOMINICAN REPUBLIC

In continuation of botanical exploration conducted in Hispaniola for several years past, Dr. W. L. Abbott, for many years a generous patron of the Smithsonian Institution, revisited the Dominican Republic in February and March, 1923, giving particular attention to the



FIG. 42.—Tree ferns (*Cyathea arborea*), on the road to Seybo. Perhaps the most graceful of all tree ferns. Unlike most, it commonly grows in open sunny situations at low altitudes and is often planted about houses.



FIG. 43.—Harbor and town of Samaná.



FIG. 44.—A typical house near Jovero. The roof is formed of the sheathing leaf-bases of the royal palm (*Roystonea*).



FIG. 46.—Trunk of a Santo Domingan "red-wood" tree (*Guarea trichilioides*), with numerous epiphytes, chiefly aroids and a freely branched pendent cactus (*Rhipsalis cassutha*).

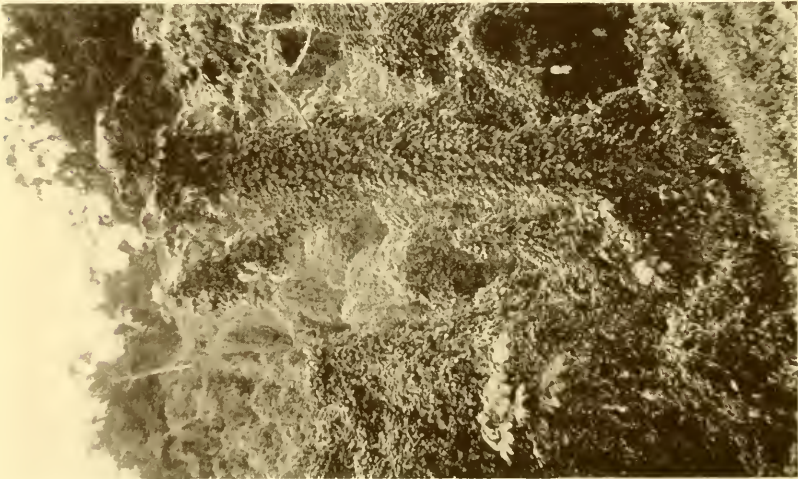


FIG. 45.—View of forest injured by hurricane of September, 1921. The broken and uprooted trees are densely overgrown with vines and creepers, which flourish in open situations.

southern coast of Samaná Bay in the eastern part of the Republic. Field-work was carried on in the vicinity of Jovero, Liali, and Las Cañitas, all located in this region.

Jovero is a small town 21 miles southeast of Samaná, near the river Lajaguá and on the road running south to Seybo. Supplies are obtainable in small quantities from the several shops which the town affords and good water is obtained from the river, a factor of considerable importance in some of the coastal regions of Hispaniola. The principal product of this district is cacao.

Six miles south of Jovero is a small clearing with three houses, called Liali. From this point as headquarters Doctor Abbott was able to reach the summit of the Cordillera Central in this vicinity at an altitude of about 490 meters. He found the slopes very steep and for the most part covered by virgin forests. Much of the forest of the upper slopes is composed of a low tree called "mahoe" and scattered royal palms. It may be interesting to note that this locality was the last stronghold of the patriots, held in defense against the American Occupation for five years. This situation had hitherto prevented Doctor Abbott's plan of exploration locally. Peace was, however, made in June, 1922, and the chiefs were given positions in the Dominican Government; consequently the region was quite safe during his present visit.

Las Cañitas is a small village farther west on the south shore of Samaná Bay near the mouth of the Río Catalina and about 12 miles distant from Samaná. Supplies are scarce here and mosquitoes plentiful, especially in the lowlands.

The collections made consist of over 500 plants, a large percentage of which are ferns. The flowering plants prove to be of great interest, and many of them if not new are at least not represented in the United States National Herbarium.

Doctor Abbott returned to the Dominican Republic in November, and at the present time is exploring in the eastern peninsula of the Republic.

BOTANICAL EXPLORATION IN PANAMA AND CENTRAL AMERICA

In May, 1923, Dr. William R. Maxon, associate curator of plants in the United States National Museum, was detailed to accompany a party from the Department of Agriculture, engaged under the direction of Dr. O. F. Cook in investigating rubber resources in Panama

and Central America. In company with Mr. A. D. Harvey he sailed for Panama May 15, being joined there shortly after by other members of the party. Mr. Harvey and Mr. A. D. Valentine served as assistants in Panama and during a short trip in western Nicaragua, and the former also during a fortnight spent in Costa Rica the latter part of July. Travel and incidental expenses were borne by the Department of Agriculture. Unfortunately rains interfered seriously with field-work in both Panama and Nicaragua; nevertheless a general



FIG. 47.—A new clearing in dense lowland jungle near Frijoles, Canal Zone, for banana plantation.

botanical collection of about 4,500 specimens was made, representing more than 2,000 collection numbers apportioned about equally among the three countries visited.

Aside from two days given to collecting in the interesting Juan Diaz region east of Panama City, work in Panama was mostly confined to the Canal Zone, being conducted chiefly from headquarters on the Pacific side, at Balboa, with the courteous assistance of the Panama Canal authorities. Of particular interest were trips to Barro Colorado, a large wooded island in Gatun Lake opposite Frijoles.



FIG. 49.—View from the biological station. The "stub" in the foreground is one of the innumerable dead trunks occupying the shallow parts of the lake.



FIG. 48.—Biological station at edge of virgin forest, Barro Colorado Island, Gatun Lake, Canal Zone. Large collections of insects have been made from this headquarters.

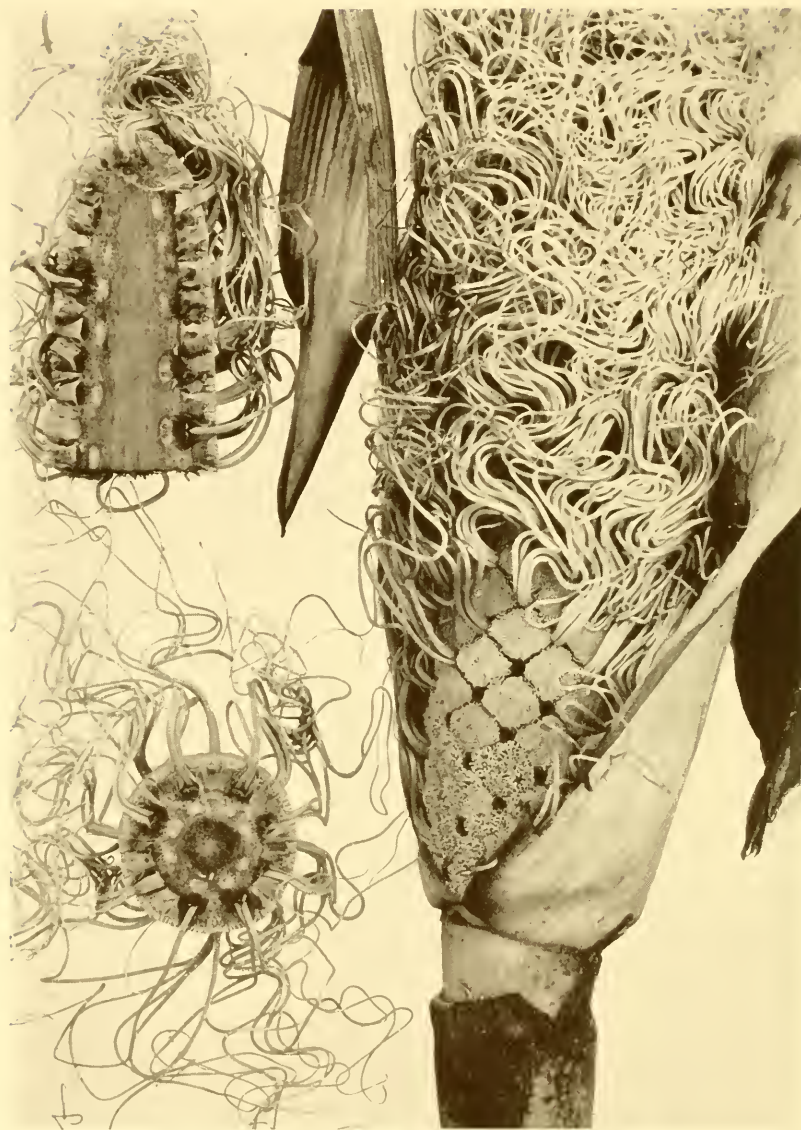


FIG. 50.—Inflorescence of the Ippi-appa "palm" (*Carludovica*), which is not a palm but a member of the family Cyclanthaceae. From the palm-like leaves of this plant most of the cheaper "Panama" hats are made. (Slightly reduced.)

recently set aside as a wild reserve upon representation of the Institute for Research in Tropical America; the virgin forest region at the headwaters of the Rio Chinilla, above Monte Lirio; and the Fort Sherman Military Reservation, which includes the famous old Spanish stronghold, Fort San Lorenzo, at the mouth of the Chagres. All these localities are forested and are rich in palms, and special attention was directed to obtaining material in this difficult group. With the steady clearing of leased land for planting bananas the original forest in the Canal Zone is rapidly disappearing, and with it its characteristic palm associations. These can hardly appear in abandoned cut-over areas for a long time to come, and will therefore have to be sought shortly in unexplored territory adjacent to the Zone. Owing to the killing of thousands of huge trees by flooding in forming Gatun Lake the natural habitat of many rare and peculiar orchids has been destroyed also, and it may be doubted if some of these species will ever be found elsewhere in the region. Fortunately they are largely represented in the truly remarkable collection of living orchids amassed by Mr. C. W. Powell at his home in Balboa as the result of many years of painstaking search in the Canal Zone region and western Panama.

About three weeks was spent in Nicaragua, wholly in the region west of Lake Nicaragua and mainly working from Managua, the capital, which lies picturesquely at a low elevation 90 miles inland from the Pacific coast, flanked by numerous volcanoes. Except for the volcanoes and the low range called the Sierra, given over to coffee production, western Nicaragua is low and almost entirely cleared of forest. Cane and grazing are the main industries. The soil is largely a rich black loam of volcanic origin, and supports a luxuriant growth of tall grasses, the arborescent vegetation being mainly confined to roadsides and abandoned "potrero." The most interesting trips were to the region of Casa Colorada in the Sierra, and to Mombacho and Santiago volcanoes. The material collected indicates a rich flora for the higher mountain slopes, one that would amply repay extended exploration. Returning to Corinto, a day was given to collecting avocados at Chinandega, a locality famous for this fruit throughout the Republic. Notwithstanding the remarkable diversity and excellence of the varieties that are here locally abundant, these seem to have attracted no attention on the part of growers in other countries.

From Corinto Dr. Maxon proceeded by steamer to Puntarenas, the Pacific port of Costa Rica, a little town chiefly notable for its heat, cleanness, and manufacture of tortoise-shell articles. The ascent by



FIG. 51.—Beach and low coastal hills, San Juan del Sur, western Nicaragua.



FIG. 52.—Momotombo Volcano, as seen from the railroad on the way to Managua.



FIG. 54.—A small coffee tree in full flower, vicinity of Cartago, Costa Rica.

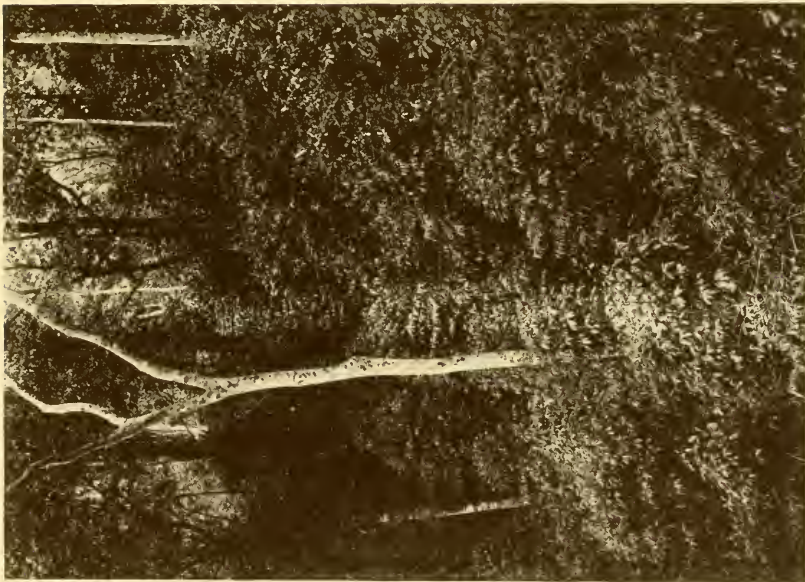


FIG. 53.—Coffee growing under shade, vicinity of Juan Vinas, Costa Rica.



FIG. 55.—Partially cleared area in the humid forest region of the Atlantic coastal plain; Río Honda, Costa Rica.



FIG. 56.—A banana plantation in the Zent District, eastern Costa Rica, near sea level.

rail from this point in the semi-arid coastal plain to the capital, San José, lying at an altitude of 1,140 meters in the cool *meseta central*, is through a region remarkably diverse as to physiography. From San José three principal trips were made: First, to La Palma, a classical botanical locality on the cloud-drenched southwestern slopes of Irazú volcano; next to Santa Clara, in the mountains a few leagues south of Cartago; then to Vara Blanca, lying high up in an almost unexplored region between the volcanoes Poás and Barba. Special attention was here given to ferns and orchids, both groups being



FIG. 57.—Street scene in Puntarenas, the Pacific port of Costa Rica.

extremely abundant both as to species and individuals, and many new and interesting species in these and other groups were collected. The flora of the upper slopes of the interior mountain region appears well-nigh inexhaustible and will long be a most profitable field for botanical exploration.

STUDIES ON EARLY MAN IN EUROPE

During the summer and early autumn of 1923, Dr. Aleš Hrdlička, curator of the division of physical anthropology, United States National Museum, spent three and a half months in revisiting the numerous important sites of early man in western and central Europe, and the institutions in which the skeletal remains of ancient

man and the fossil European apes are preserved. Acting at the same time as Director of the American School in France for Prehistoric Studies, Dr. Hrdlička was accompanied on his trip by a number of graduate American students to whom the sites and specimens were demonstrated.

One of the principal objects of the trip was the securing of accurate measurements of the teeth, particularly the lower molars, of the larger fossil apes and early man by one observer, a strictly defined method, and accurate instruments; while a second important object was the taking of photographs of the various sites of early man of which good photographic views were not yet available.

The work began with a re-examination of the Piltdown jaw and skulls which are in the care of Professor Smith Woodward in the British Museum of Natural History, London.¹ The Rhodesian, Boskop, Gibraltar and other early remains in London were also seen once more, and then a day was spent in company with Professor Smith Woodward in a visit to the interesting site where the Piltdown remains were uncovered and where further search was to be resumed during this summer. The results, so far as the Piltdown remains are concerned, were merely to accentuate the conviction that the lower jaw and the skulls do not belong together.

The next visit was to the important Ipswich Museum and to the archeological sites in the vicinity, including that of Foxhall, under the guidance of Mr. Guy Maynard, the Curator of the Museum. A trip to Cromer, kindly arranged by Mr. J. Reid Moir, was undertaken on the following day, to examine the famous "Cromer forest beds." Here Mr. Savin showed the party his invaluable paleontological collections from the Cromer forest beds, and under the guidance of Professor Barnes of Oxford the cliffs bearing worked stones were examined, together with the beach accumulations containing many chipped flints, and also a large private collection of what are supposed to be Tertiary implements. It is in the sites about Ipswich, particularly at Foxhall and also on the beach at Cromer, that worked stones of Tertiary man are believed to have been recovered; but after seeing conditions and noting the divergent views of men who are giving close attention to this subject it was felt that a definite answer to this weighty question is not as yet possible.

¹ Grateful acknowledgments for aid rendered on this trip are due to all those mentioned in this report. Their assistance in giving first hand reviews of the knowledge concerning individual specimens and sites, with personal conduct in many instances to the latter, was of the greatest value.

On the following day the party arrived at Jersey and were met by Professor Marett under whose guidance were seen the originals of *Homo brecladensis*, the local archeological collections and the cave of St. Brelade, where work still continues. This site has already given upwards of 20,000 chipped stones of the Mousterian and Aurignacian cultural periods.

Upon his arrival at the British Museum of Natural History, Dr. Hrdlička found awaiting him in care of Professor Smith Woodward a cordial invitation from Professor Eugene Dubois of Haarlem, Holland, to visit him and see the famous remains of the Pithecanthropus as well as the other Java remains in his possession, which for many years were inaccessible. This so far unique privilege, made possible by the fact that Dr. Dubois has at last completed his studies on the precious objects, was taken full advantage of on July 15, Dr. Dubois demonstrating personally and without reserve all the specimens. The remains of, or those attributed to, the Pithecanthropus consist of the now thoroughly cleansed skull-cap, a femur and three teeth, two molars and one premolar. Besides these there is from another locality a piece of a strange primitive lower jaw, and also two skulls with many parts of the skeletons of a later, though yet rather primitive, type of man from consolidated calcareous deposits in still another part of the island.

The examination of the originals belonging to the Pithecanthropus find was in many respects a revelation. It was seen that none of the casts now in various institutions are accurate, and that the same is true of the so far published illustrations, above all those of the teeth and femur. The originals are even more important than held hitherto. The new brain cast shows an organ very close to human. The femur is without question human. When the detailed study of all these specimens is published, which Dr. Dubois expects to occur before the end of the winter, the specimens, though all controversial points may not be settled, will assume even a weightier place in science than they have had up to the present.

In connection with the visit to Haarlem a stop was made in Amsterdam for the purpose of visiting the classic Vrolijk Museum, together with the valuable more recent anthropological collections of Professor Louis Bolk, which include a series of the deformed skulls from the Zuyder Zee showing a type that is identical with that of several skulls from the Delaware Valley which at one time were supposed to be very ancient (Bull. 33, Bureau of American Ethnology). The Museum is now directed by Professor Bolk, and in his absence, due

to illness, the collections were demonstrated to the party by his two able assistants.

The next visit was to the two museums at Brussels which contain valuable collections relating to early man, namely, the National Museum and the Cinquantenaire. Both these very profitable visits were made under the guidance and with all possible assistance of Professor A. Rutot, who also arranged an excursion to the but little-



FIG. 58.—Gravel beds yielding ancient paleolithic stone implements in the Low Somme Terrace at Montier, suburb of Amiens. Most of the stones showing work of man are found in the very lowest layers of the gravel, as seen in the pit at the right. (Photograph by A. H., July, 1923.)

known cave of Spy and to the equally little-known paleolithic caves of the Lesse Valley.

The next stopping point was Liège, for the re-examination of the Spy skeletons. In company with Professor Charles Fraipont, Dr. Hrdlička visited the house of Professor Maxime Lohest where the precious specimens had been hidden during the war and where they are temporarily preserved to-day. A visit was also paid with Professor Fraipont to the rich prehistoric collections of M. Hamal-Nandain and a participation in the excavations of an early Neolithic site was ar-

ranged for the next day, but this was made impossible by rainy weather. Instead of this a very stimulating trip was taken along the archeologically important Meuse Valley from Namur to the French boundary.

Upon entering France the first visit paid was that to the St. Acheul and Montier quarries about Amiens. These gravel and sand deposits are still being worked and they are still yielding Acheulean and Chellean and possibly other ancient implements; but since the death of M. Commont, no one is watching the work and the implements recovered by the workmen are being sold by them to tourists or anyone who cares for them. From Amiens a visit was made to Abbeville, where similar conditions were found to exist.

The next stage was Paris, with a visit to the Laboratoire d'Anthropologie (Professor Manouvrier) and to the Institut de Paléontologie humaine; after which Dr. Hrdlička with all the students proceeded to Bordeaux where they attended (Dr. Hrdlička as a foreign guest) the meeting of the Association Française pour l'Avancement des Sciences. The meeting of the anthropological section of the association was almost entirely devoted to man's prehistory in France and Northern Africa and was very interesting, particularly in its discussions. In connection with the meeting an examination was made of the prehistoric collections in the Bordeaux Museum and of the rich private collections of Dr. Lalanne; while excursions were made to various other collections and prehistoric sites (Bourg, cave Pêre-non-Pêre, valley of the Vezère).

On the return trip from Bordeaux, a stop was made at St. Germain where, under the guidance of M. Hubert, the Curator, the richest prehistoric museum of France was examined. This museum belongs to the government. It is located in a large, ancient palace and contains vast prehistoric collections, including most of the precious objects relating to the arts of ancient man that have so far been discovered in France.

The continuation of the journey led to Germany, to the cities of Tübingen, Stuttgart, Frankfurt, Heidelberg, Weimar and Berlin, in the institutions of which are preserved highly valuable remains both of early man and fossil European anthropoid apes, all of which, together with most of the sites from which they were derived, were re-examined. In addition, the occasion was utilized for participating in the Congress of the German Anthropologists at Tübingen. Many favors were received from them and from the paleontologists, particularly from Professors Schmidt and Henig in Tübingen, Martin Schmidt in



FIG. 59.—The Mauer site from a distance. The heaps in front are refuse from the quarry. (Photograph by A. H.)



FIG. 60.—Part of the Mauer sand and gravel quarry as it appears today. (Photograph by A. H.)

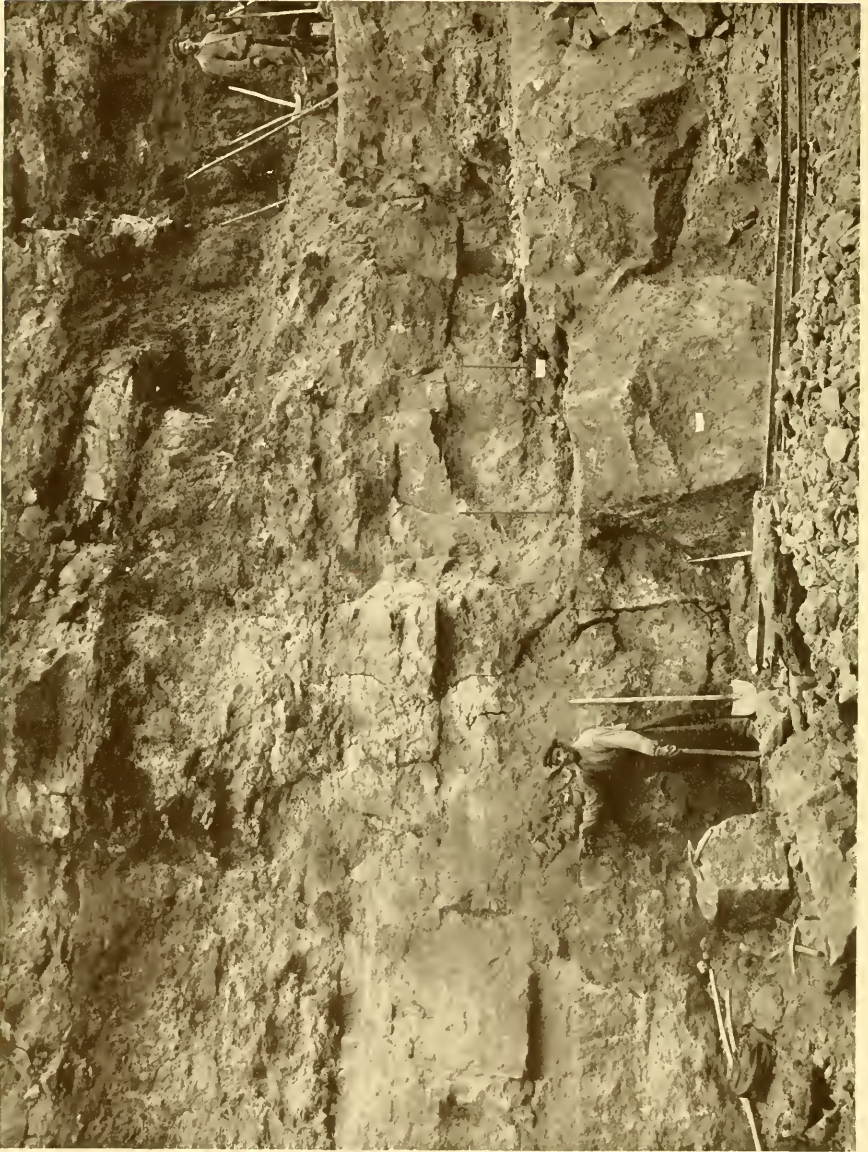


FIG. 61.—The Ehringsdorf or Kaempfe's Travertine Quarry. View of place where first human lower jaw was found.



FIG. 62.—The Ehringsdorf Quarry from a greater distance. First fossil human jaw found at place marked by white spot where the two men stand.

Stuttgart, Wegner in Frankfort, Salomon and his first assistant in Heidelberg, Schuchart in Berlin and Herr Lindig in Weimar.

From Germany the trip led to Bohemia where, to facilitate the work, a special representative of the Ministry of Foreign Affairs, Dr. Novák, together with Professor Matiegka, gave personal guidance to various museums as well as to the great ossuary at Mělník and especially to that at Sedlec, where many thousands of crania and bones from the time of the Hussites are tastefully arranged in the form of a most impressive, spacious subterranean chapel. Under the same guidance visits were paid to the great Moravian caves which have yielded and probably still contain remains of early man as well as those of the cave bear (six complete skeletons) and Quaternary beaver (upwards of 20 finely preserved skulls with many bones); to the Provincial Museum at Brno which harbors the valuable remains of the Přeborní mammoth hunters, and to the monastery of Mendel, still full of reminders of the student-monk, including his library and garden. A number of interesting details were learned about Mendel from the excellent abbot of the monastery, among them the fact that Mendel was a Moravian and spoke both the languages (Czech and German) of the country.

The following stage of the journey was to Vienna, where the rich prehistoric and anthropologic collections of the former Hoff-Museum were examined under the guidance of Professor Szombathy.

From Vienna Dr. Hrdlička with some of his students proceeded to Zagreb in Croatia, where in company with Professor Gorjanovič-Kramberger they re-examined the very valuable Krapina remains and visited the locality where they were discovered. This is situated at the head of the very beautiful but little-known Krapinica Valley, and indications were seen that there may be additional sites of ancient man in the vicinity of the original discovery.

From Zagreb the journey led over northern Italy to Lyons where the collections of the University were examined in company with Professor Mayet; this was followed by an excursion under the guidance of Professors Arcelin and Mayet to the prehistoric site of Solutré. Here existed some 15,000 years ago a large paleolithic settlement, the duration as well as the size of which may be seen from the fact that its refuse accumulations are estimated to contain, aside from implements and other objects, the bones of approximately 200,000 late Quaternary horses. New explorations have just recommenced at this site, and they led within three days of the visit to the recovery of no less than five prehistoric Solutrean or Upper Aurignacian skeletons, some in a very good state of preservation.

From Solutré the road led to Les Eyzies, in the valley of the Vézère (Dordogne), which is probably archeologically the richest as well as one of the most picturesque regions of the world. Here under the guidance of Abbé Breuil and M. Peyrony, were visited the sites of Le Moustier, La Madeleine, La Ferrassie, Laugerie Haute and Basse and others of importance, as well as numerous caves showing graven, painted, or sculptured prehistoric animals. Here was also examined the very promising new local museum which is under the



FIG. 63.—Part of excavations at La Quina, Charente, France. (Photograph by Dr. G. G. MacCurdy.)

direction of M. Peyrony and which was officially opened a short time subsequently.

After 10 days spent in the district of Les Eyzies the journey was prolonged southward to Toulouse where, with Count Begouen the local museum with its rich Cartailhac and Begouen collections was examined and from which an excursion was made to a vast cave with splendidly preserved paintings of ancient animals in the Pyrenees.

The last portions of the journey included an eight days' stay with Dr. Henri Martin at La Quina, becoming acquainted with its already important museum and assisting in the excavations; this was supplemented by visits to the prehistoric collections of the museums at

Perigueux, Angoulême and Gueret. Then followed a return to Paris and a final trip to Havre where the very interesting and but little-known prehistoric collections from the maritime district of Havre were examined in the local museum.

The trip resulted in an overwhelming sense of the greatness as well as scientific importance of the field of early man in western and central Europe, and in a keen appreciation of the opportunities for cooperation in this field by American students.

ARCHEOLOGICAL INVESTIGATIONS IN SOUTH DAKOTA

Mr. M. W. Stirling, assistant curator of the division of ethnology, U. S. National Museum, spent the month of June, 1923, in the examination of old village sites on the Missouri River. The region investigated was the 12-mile strip between Grand River and Elk Creek, South Dakota. Much of the success of the exploration was due to the able cooperation of Mr. E. S. Petersen of Mobridge, South Dakota.

During the eighteenth and up to the middle of the nineteenth centuries, the upper Missouri River was the scene of a very considerable shifting of native populations. On the one hand there was a south to north movement and a possible reverse tendency; on the other hand a general east to west movement in which such tribes as the Cheyenne, Sutaro, Arapaho, and others, figured. These tribes before leaving the Missouri River for the nomadic life of the plains were, according to tradition, a sedentary agricultural people, living in earth-lodge villages like those of the Arikara, Mandan, and Hidatsa. The Grand River formed the western pathway for these migrations, and we find the point of intersection of these tribal movements in the vicinity of the junction of the Grand River with the Missouri. To establish the identity of the numerous sites in this region is a complex but interesting task.

In all, 10 of these old villages were visited and excavations carried on in four. Three of these, on the west bank of the Missouri, were identified as Arikara; one being the historic upper village of the Arikara visited by Lewis and Clark in 1804 and later by Brackenridge and Bradbury in 1811. The others were all prehistoric, but from the presence of a few objects of European origin found in each, obviously of post-Columbian age. The fourth site excavated is on the east bank near the town of Mobridge and seems most likely to have been Cheyenne.

There is a close similarity existing between the material culture remains of all of the upper Missouri tribes. Because of this fact,



FIG. 64.—Two specimens of old Arikara pottery showing incised and cord marked designs.



FIG. 65.—Gorgets and balls of Catlinite, and a polished chalcedony pendant.
Arikara.

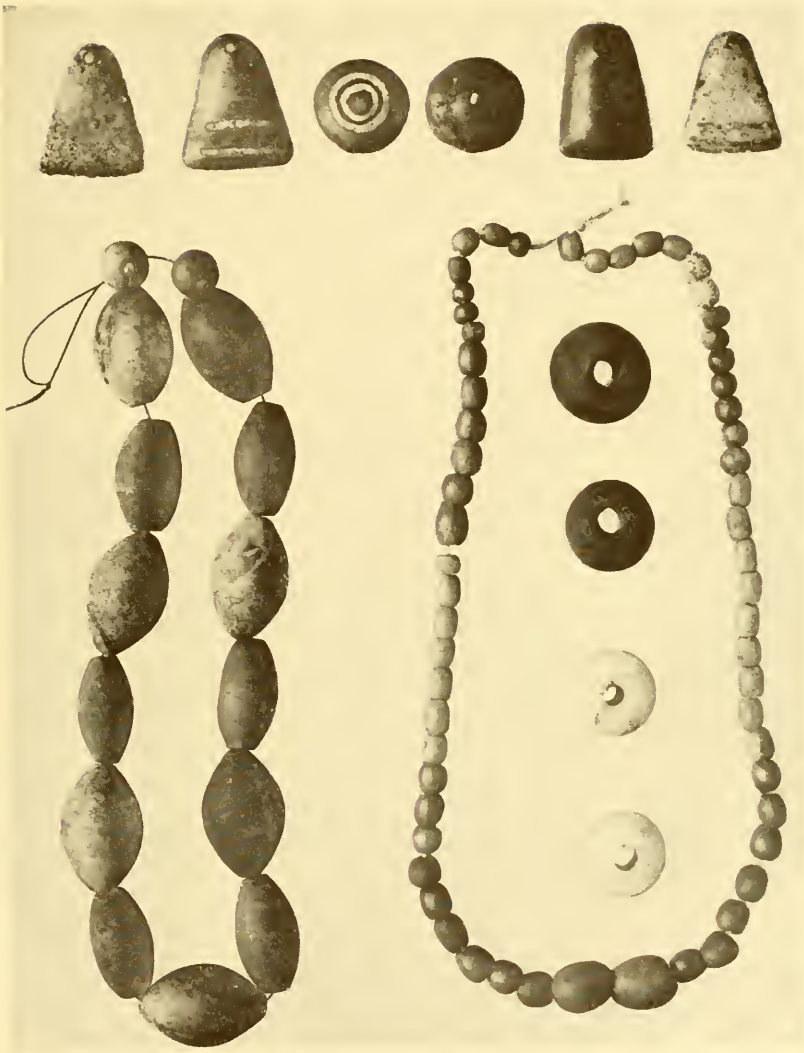


FIG. 66.—Glass beads and ornaments of native manufacture. Arikara.



FIG. 67.—Shell beads and ornaments. Arikara.

pottery, ornaments, and implements do not serve as a safe means of distinction between the several tribes. Any differences which existed were nullified by the constant intercommunication and intermarriage between members of the neighboring villages. It is also doubtful whether much can be deduced from the arrangement of the lodges in the villages.

The physical type of the region is likewise quite uniform, with the result that the skeletal remains of the inhabitants themselves tell but little. The best means of distinguishing between the occupants of the various villages is in the manner of disposal of the dead. The Mandan, the Hidatsa, and the Cheyenne practised exposure of the dead on scaffolds with usually secondary burial of the bones. The Arikara and the Arapaho buried the dead directly.

Excavations in the four sites which were worked were carried on in the refuse mounds, cache pits, house rings, and cemeteries. An extensive archeological collection was made consisting of pottery, implements and ornaments of bone and stone, and a good many objects of European manufacture from the historic Arikara site. An interesting discovery was a number of glass beads, pendants, and other ornaments of native manufacture. This art, the origin of which is a mystery, was described as practised by the Mandan and Arikara by Lewis and Clark in 1804, but examples of it in collections have been extremely rare.

A large collection of skeletal material was made, representing 110 individuals, filling an important gap which has heretofore existed in the collection of the division of physical anthropology.

The region has by no means been exhausted, and a number of sites yet remain to be positively identified.

ARCHEOLOGICAL INVESTIGATIONS AT PUEBLO BONITO. NEW MEXICO

During the spring and summer months of 1923, Mr. Neil M. Judd, curator of American archeology, United States National Museum, continued his investigation of prehistoric Pueblo Bonito¹ under the auspices of the National Geographic Society. As heretofore, Mr. Judd's staff consisted of several trained assistants; 27 Navaho and Zuñi Indians were employed for the actual work of excavation.

During the explorations of 1921 and 1922, the expedition devoted its efforts primarily to excavating the eastern portion of Pueblo Bonito. In this area is to be found the finest type of prehistoric

¹ Smithsonian Misc. Coll., Vol. 72, Nos. 6 and 15; Vol. 74, No. 5.

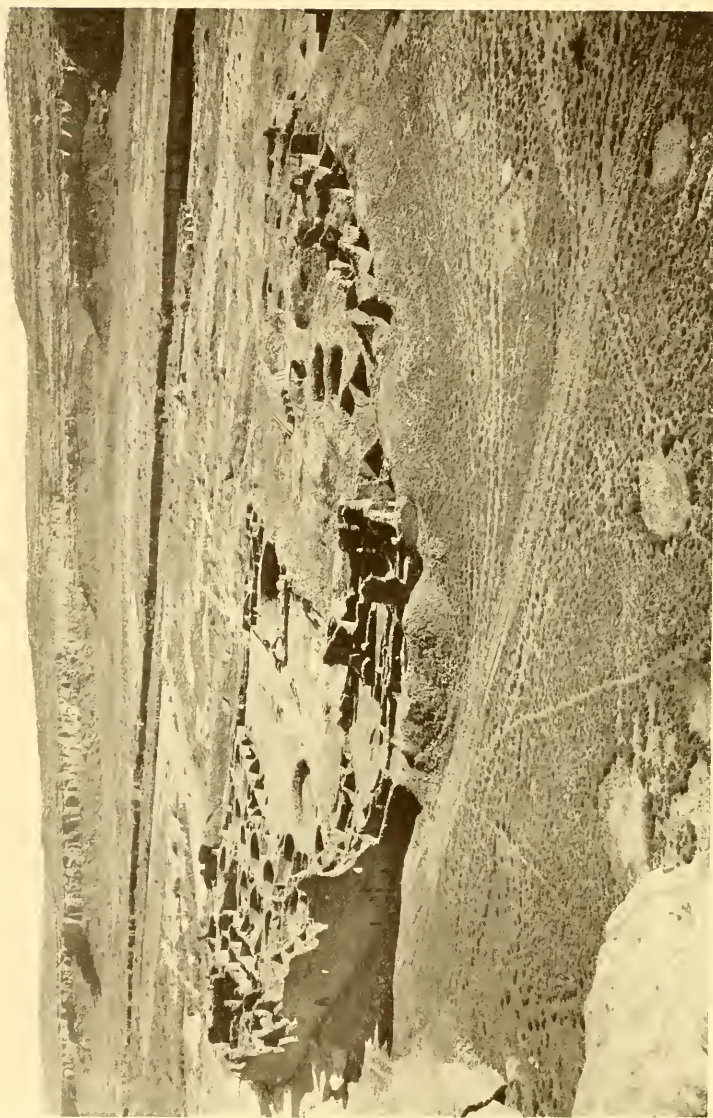


FIG. 68.—At the close of the 1923 season a view of Pueblo Bonito from the north cliff of Chaco Canyon revealed the extent of the National Geographic Society's explorations. The size of this historic village may be gauged by comparison with the five figures on the edge of the circular room in the middle of the picture. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)

masonry north of Mexico; it is that last erected at Pueblo Bonito and overlies the partially razed walls of other equally distinct types of construction. The secular rooms and the circular kivas, or ceremonial chambers, associated with them formed a group of structures occupied by one of the immigrant groups which added greatly to the original population of Pueblo Bonito and helped to spread the fame of this remarkable village throughout a large portion of ancient America. Excavations during the two years mentioned established the fact that this eastern portion of Pueblo Bonito, although comprising the largest and finest rooms in the entire village, was deserted at some time prior to final abandonment of the community.

The explorations of 1923 centered in the northern section of the ruin. Much of the expedition's efforts this year were devoted to removal of the vast accumulations of debris and blown sand which covered the fallen walls. It was in this particular section that the Hyde Exploring Expedition made its remarkable discoveries during the years 1896 to 1899. Conforming to a custom of the time, these early explorers threw the refuse from each room into that last excavated. Prehistoric habitations were not then regarded as objects of instruction in connection with the pre-history of our country and no concerted effort was made to support insecure walls, or to leave excavated ruins in a condition that would invite popular attention.

In removing the accumulations of earth and stone from the northern portion of Pueblo Bonito the National Geographic Society's Expedition of 1923 exposed three new kivas or ceremonial chambers and 26 previously uncharted and unexplored dwellings and storage rooms. A few of these structures had been destroyed by fire during or following the time of occupancy. In them and in other neighboring rooms a considerable collection of cultural material was recovered and has been forwarded to the United States National Museum.

In addition to the investigations pursued within the walls of Pueblo Bonito proper, search was made in the adjacent areas for further evidence of building operations. Enormous piles of blown sand and fallen masonry were removed from the outer east and northeast walls of the great ruin—débris which heretofore has completely concealed the first-story walls of the ruin. In removing this débris a veritable network of foundation walls was disclosed. These foundations connect directly with similar walls exposed beneath the floors of rooms excavated during 1921 and 1922; although obviously prepared as supports for heavy structures it is equally certain that these foundations were never utilized subsequent to their preparation. Plans for the con-



FIG. 60.—The roof of a Pueblo Bonito council chamber was a very complicated affair. Beginning on eight or ten low masonry supports, pairs of logs lay close to the kiva wall; above these were other poles laid in threes, fours, etc., until a neat vault, flat on top, covered the room. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)



FIG. 70.—Beneath a vast accumulation of earth, sand, and stone on the north and northeast sides of Pueblo Bonito were a number of foundation walls which had been prepared for contemplated additions to the village. Some of these walls are shown at the lower left. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

struction of the later dwellings were altered and the Pueblo Bonito of to-day affords evidence of the extent of these alterations.

After the northern group of habitations had been examined, the east court was cleared of débris to a point corresponding with its last



FIG. 71.—Extensive repairs have been made to strengthen the shattered walls of prehistoric Pueblo Bonito and preserve its masonry for future generations. Four stories are evident in this particular view. (Photograph by Neil M. Judd. Courtesy of the National Geographic Society.)

level of occupancy. Earlier levels were disclosed beneath the latest one and the exploratory trenches also exposed the partially razed walls of several abandoned kivas. The depth of these now hidden structures furnishes abundant proof of the antiquity of Pueblo Bonito and the length of the period during which it was occupied.



FIG. 72.—This view of work in progress on the west side of Pueblo del Arroyo illustrates the extent to which fallen masonry and blown sand will accumulate. (Photograph by O. C. Havens, Courtesy of the National Geographic Society.)



FIG. 73.—The outer southwest corner of Pueblo del Arroyo during the course of excavation. In this section, nine rooms, previously unsuspected, were discovered. (Photograph by O. C. Havens, Courtesy of the National Geographic Society.)

As opportunity permitted during the exploration of Pueblo Bonito, attention was also directed to a neighboring ruin, Pueblo del Arroyo. Excavations in this latter village were under the immediate supervision of Mr. Judd's chief assistant, Mr. Karl Ruppert, of the University of Arizona State Museum.

This first season's exploration in Pueblo del Arroyo resulted in the complete excavation of one kiva and 20 living rooms. One of the latter is 58 feet long but its original length, before certain partitions were constructed, had been almost twice as great. In addition to the excavations within the walls of Pueblo del Arroyo itself an accumulation of débris was removed from the south and west sides of the ruin. In this débris nine small rooms were unexpectedly discovered—rooms which formed no part of the original ground plan of the pueblo.

Several unique specimens of pottery were recovered during the initial explorations in Pueblo del Arroyo and the success of this past season increases the belief that this particular ruin possesses much that will add to the scientific importance of current studies in Pueblo Bonito. Pueblo del Arroyo appears to have been designed and erected as a unit; it lacks the many intricate problems created by successive waves of immigration so evident in Pueblo Bonito. The 1923 explorations in Pueblo Bonito and Pueblo del Arroyo were conducted at a cost of more than \$18,700. The success with which this expedition has been rewarded during the past three years warrants the belief that the National Geographic Society will continue its explorations during the next two years at an estimated cost of \$15,000 annually. This is in conformity with the Society's program as adopted by its research committee in 1921.

EXPLORATIONS IN SAN JUAN COUNTY, UTAH

Bordering the Rio Colorado in Utah are vast areas which, owing chiefly to their inaccessibility and barrenness, have thus far escaped thorough examination by men of science. Certain portions of these areas, indeed, have never been visited by white men. To investigate one such district, that lying immediately east of the Colorado and north of the San Juan rivers, and to determine whether further, more detailed researches therein were desirable, the National Geographic Society, in cooperation with the Smithsonian Institution, organized a small reconnaissance party for explorations during the months of October and November; Mr. Neil M. Judd, curator of American Archeology, United States National Museum, was designated leader of this expedition.

Fortified with all the information obtainable, most of which was later found to be useless, Mr. Judd proceeded to Kayenta, Arizona, upon conclusion of his annual explorations for the Society in Pueblo Bonito. At Kayenta, the limit of automobile transportation, saddle and pack mules were obtained for the prospective journey. Besides Mr. Judd the party consisted of John Wetherill, guide, E. L. Wisherd, photographer for the National Geographic Society, George B. Martin of Denver and Julian Edmonson of McElmo, Colorado, assistants. Two Navaho Indians who professed to know something of the region to be visited failed, in turn, to appear as the time for departure approached.

It had been planned to swim the Rio San Juan at the mouth of Piute Canyon but the river, being still in flood, forced a long eastward detour that cost the expedition several days' time and brought it to the Clay Hill divide by way of Grand Gulch. Further delay was experienced at this point in recovering a quantity of grain and provisions which Indians had failed to deliver, on a previously designated date, at the Clay Hill Crossing.

Having gained the west slopes of the Clay Hills, seven of the 12 pack mules were pastured in a secluded cove at the head of Lake Canyon and those supplies actually required for the return journey were cached nearby. With fewer animals and equipment to care for and with only a week's rations, more rapid progress could be made and a proportionately larger area traversed in the limited time available for actual exploration.

From this base camp the party continued in a northwesterly direction to the Rio Colorado at Hall's Crossing, thence along the river edge into Moki Canyon. The latter, because of its name, had been chosen as one of the objectives of the expedition, under the belief that numerous remains of prehistoric habitations would be found in its deeper recesses.

Moki Canyon had been represented as about five miles long and enterable, on foot only, at its mouth and extreme head. Mr. Judd not only led his pack train into the narrow gorge, but he advanced with it 18 miles or about two-thirds the total length, over quicksands and rock ledges that added frequent barriers and not a little danger to the expedition.

Signs indicative of former Indian trails were noted at intervals throughout that portion of the canyon traversed and on one of these, after having directed the other members of the party to return to the Lake Canyon cache, Mr. Judd and his guide climbed the north wall of Moki Canyon in order to ascertain the location and characteristics of



FIG. 74.—The Clay Hills extend southward to the Rio San Juan as an unscalable barrier of red and gray shale, overtopped by sheer walls of pink sandstone. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)



FIG. 75.—When Moki Canyon cut its tortuous course, massive caves were formed at every angle and in these caves prehistoric peoples sought refuge from the elements and from their tribal enemies. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)



FIG. 76.—The expedition's pack train crossing the sandstone ridges that reach out from the base of Navaho Mountain, en route to the Rainbow Natural Bridge. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)



FIG. 77.—The Rainbow Natural Bridge, one of the most majestic and inspiring spectacles in the United States, rises to a height of 300 feet yet it is dwarfed by the sheer red walls of the canyon which shelters it. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)

what is more recently known as Knowles Canyon. They had with them at this time only their saddle animals and one pack mule, but to afford some understanding of the topography of the entire region traversed by the expedition it may be noted that, in leaving Moki Canyon, Messrs. Judd and Wetherill progressed only 15 miles in six hours' time and then, at dark, found themselves less than 2 miles from their last previous camp.

With the party reunited at its Lake Canyon cache the return trip to Kayenta was begun. Although handicapped by rain and dense fog



FIG. 78.—Thin fingers of pink and red sandstone tower above the yellow floor of Monument Valley pointing the height of the rock mesas that once covered northern Arizona. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)

which for three days almost obscured the dim Indian trail they were following, members of the expedition finally crossed the Rio San Juan immediately north of Navaho Mountain and thence visited the Rainbow Natural Bridge. Mr. Judd, as assistant to Dean Byron Cummings, was a member of the party which discovered this great stone arch on August 14, 1909.

The results of these recent explorations north of the Rio San Juan in Utah indicate the desirability of further, more extended archeological investigations; it is felt that the botanical and biological sciences would profit to a less degree. Animal and plant life in this region,

according to Mr. Judd's observations, are neither plentiful nor greatly diversified, at least in the fall season. Such prehistoric habitations as were visited are small, crudely constructed affairs which suggest temporary occupation by small, migratory bands or family groups. Traces of a people older than the cliff-dwellers were observed in several localities; further research should afford a clearer conception of the cultural development of these two distinct types of cave folk and, at the same time, disclose their relationship to other prehistoric tribes of the great plateau country.

Several unavoidable factors, however, will tend to limit and restrict exploration of the uninhabited area north of the Rio San Juan. Water is at a premium except in the deeper canyons where seeps and intermittent streams may usually be found; "tanks," or natural reservoirs, do not occur on the broad sandy mesas separating the canyons. All supplies must be transported at least 200 miles by pack mules and quicksand in the narrow gorges is certain to prove troublesome except during the late fall and winter months.

ARCHEOLOGICAL FIELD-WORK IN NEW MEXICO

In May and June, 1923, Dr. J. Walter Fewkes, chief of the Bureau of American Ethnology, continued his field studies of ceramic decorations characteristic of the Mimbres Valley, New Mexico. The wonderful picture pottery of this region strikes the attention on account of the geographical position of the valley between Mexico and the pueblo region, and promises to shed light on prehistoric migrations of the southwestern Indians.

The Mimbres Valley is comparatively limited in extent and its pottery is being rapidly collected and sold as curiosities. In order to prevent the complete loss to science of this material and to give it a permanent home for future students, Dr. Fewkes obtained by purchase about a hundred specimens and added them to the collections of the National Museum. The designs on these are as a rule different from those already recorded. The Mimbres picture pottery (fig. 79) was made by a people that disappeared in prehistoric times without leaving a documentary trace of language or culture. Archeology is the only guide to its characterization. The pictures on these specimens are reproduced in Smithsonian Miscellaneous Collections, Vol. 76, No. 8, and in the present publication only a few general conclusions are considered.

Copper deposits in the Mimbres Mountains first attracted attention of the Spaniards to this area. Considerable quantities of this and other

ores were mined here in early days by the Mexicans and shipped to Chihuahua; but the distance of the market and the interference of hostile Apaches rendered transportation rather hazardous. At the time of the survey of the boundary between Mexico and the United States, in 1854, the production of metal had practically ceased from the upper end of the Mimbres, which lower down was raided by hostiles and had become a dark and bloody ground. The Apaches were



FIG. 79.—Restoration of the parrot food bowl from the Mimbres Valley, New Mexico. (Painted by Mrs. George Mullett.)

embittered against the white people by atrocities they had suffered, and the toll of death of both races was large. From the year 1860 to 1864 considerable mining was done there by Americans, but the infamous killing of the Chief Mangas Colorado led to a general rising of all of the Indians seeking revenge, and for several years no white man entered or crossed this valley except with the greatest danger to his life. Hundreds of travelers were killed in Cook's Pass and the settlers in the valley were in continual danger. The Indians found in

the Mimbres were known as Mimbrenos Apaches. Shortly after the whites came into the neighborhood the town, Pinos Altos, became a center of mining industry, but existence there was precarious on account of hostile Indians who fought a battle within its limits. Little now remains of the old Santa Rita settlement. One of the bastions of this ancient fort is now used as the fuse house. The region of the old Santa Rita mine (fig. 80) has now changed so much that ancient landmarks are difficult to discover. The mountains over it are bare but not without interest. A standing rock called the Kneeling Nun, which rises to the east of the present copper company's building near the point of a high mountain, is said to commemorate an accident



FIG. 80.—Santa Rita Mine, New Mexico. (Photograph by Fewkes.)

in which a large number of miners lost their lives. This "Kneeling Nun" is supposed to be praying for the souls of the deceased men.

Whatever population existed in the Mimbres Valley in prehistoric times disappeared as a distinct people, probably having been absorbed into bands of Apaches, the so-called Mimbrenos Apaches, now settled at San Carlos and other reservations.¹ It would be an interesting and important inquiry to study their legends in order, if possible, to determine any survival of the ancient people that may still exist. When Bartlett visited the valley in 1854 no villages of the original prehistoric population existed, although he speaks of ruins here and there and comments on fragments of pottery.

¹The oldest inhabitants were probably the Mansos or Gorritas, so-called because they wore little caps, one of which is figured on a food bowl.



FIG. 81.—Design on the interior of a food bowl from the Mimbres Valley, New Mexico. U. S. National Museum.



FIG. 82.—Two specimens of Casas Grandes pottery found at Black Mountain ruin near Deming, New Mexico. U. S. National Museum.

It has been shown in former publications that the pottery (fig. 81) of the Mimbres resembles that of Casas Grandes in the adjoining State of Chihuahua, Mexico. There is no doubt that there was intercourse between the two peoples, for whole pieces of the brilliant



FIG. 83.—Food bowl with Gila Valley decoration found at Black Mountain ruin near Deming, New Mexico. U. S. National Museum.

Chihuahua pottery (fig. 82) were obtained in a ruin at Black Mountain, about six miles from Deming. In the same ruin there was found typical pottery from the Gila Valley (fig. 83), and the conclusion seems legitimate that this ruin was inhabited by an intrusive people contemporary with the ancient Mimbres settlements.

The so-called City of Rocks is situated near Faywood Hot Springs, which was cleared out some 15 years ago. The construction of the famous Hot Springs Hotel rendered it desirable to excavate the accumulated mud, and in removing it, a large number of votive offerings came to light. These consisted mainly of arrowheads, pipes, spear points, stone clubs, and various other objects. The spring was evidently a sacred shrine where offerings were thrown many years ago

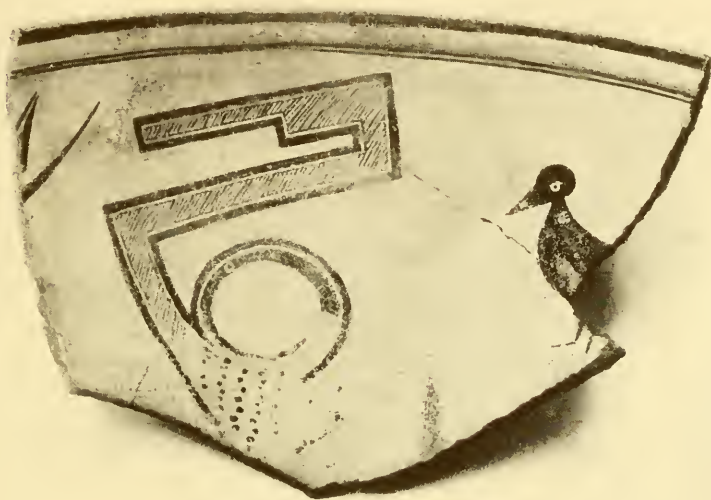


FIG. 84.—Fragment of ancient Zuni pottery, Canyon del Muerto, Arizona, collected by Dr. W. H. Spinks. U. S. National Museum.

by the aborigines as sacrifices. Happily some of these specimens are now preserved in private hands; others are scattered through the valley. Among these objects are tubes called "cloud blowers," types of pipes that have been elsewhere described.

In May Dr. Fewkes visited Pinos Altos, on the divide separating the headwaters of the Gila and those of the Mimbres Valley. Near it is a large ruin situated on top of Montezuma Hill. This ruin, which from its position offers many problems for investigation, is one of the most important on account of the mixed character and decoration of the

pottery. Its pottery may be decorated with designs from all the three ceramic areas here mentioned. In the high country north of Pinos Altos occurs the so-called Tularosa ware whose decoration connects pottery designs from the Mimbres with the pure pueblo. We must await more specimens from this region before we can determine the extent and meaning of the relation.

A beautiful fragment of ancient Zuñi ware (fig. 84) has been presented to the Bureau by Dr. W. H. Spinks, by whom it was found in a ruin in Canyon del Muerto. It bears a bird head and neck and the typical geometric design that occurs so frequently in modern Zuñi ware. In texture and color, however, this ancient example differs from



FIG. 85.—Boy Scouts watching progress of excavations, Weeden Mound, Florida.

the modern Zuñi and in these respects is more closely related to the brilliant yellow ware of Sikyatki, a well-known ruin of the Hopi. This is the first time that ceramic evidence has been adduced to show the relation of a Canyon del Muerto ruin to modern Zuñi.

ARCHEOLOGICAL FIELD-WORK IN FLORIDA

In November, 1923, the chief of the Bureau of American Ethnology made a preliminary trip to the southwestern coast of Florida. Although several archeologists, Cushing, Moore, Hrdlička, and others, have investigated this region, many unsolved problems are still awaiting solution, as known facts are too scanty for accurate generalizations. The archeology of this region has especial attractions to the

chief of the Bureau on account of certain West Indian affinities of its prehistoric inhabitants. Through the kindness of Mr. E. M. Elliott, of St. Petersburg, he was able to make a short preliminary visit in anticipation of more intensive work which will naturally follow.

The prehistoric human inhabitants of the southern part of Florida were, from the nature of their environment, low in culture. Their

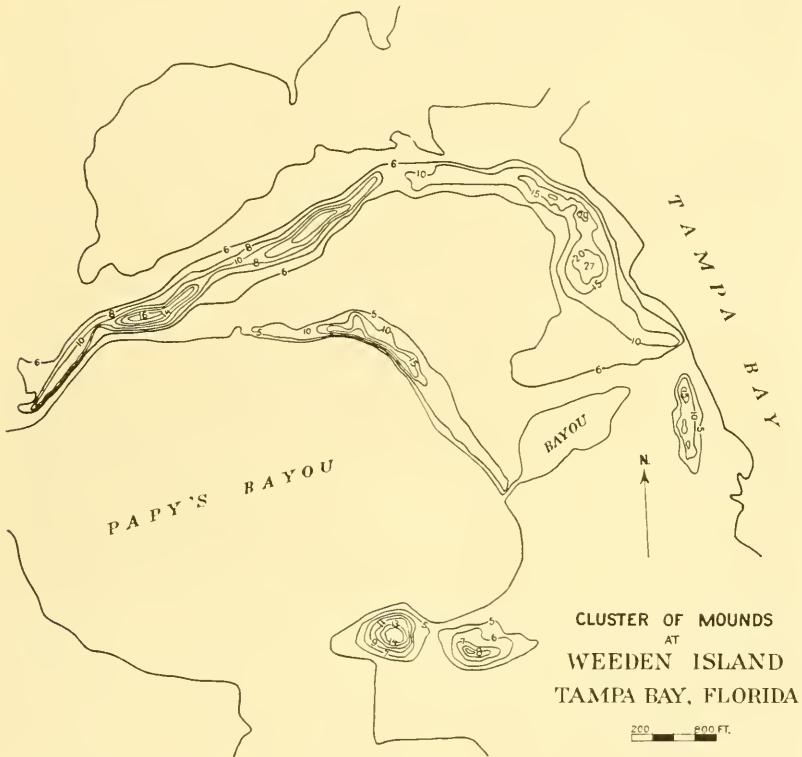


FIG. 86.

surroundings presented only scanty possibilities for a high development, and judging from data available not only was their material culture low, but they also owed little to outside influences. The visit was intended as a reconnaissance in which some of the numerous shell heaps and other remains of the culture antecedent to the coming of the white were inspected (figs. 85 and 86). The northern part of Florida has been well investigated but the Ten Thousand Islands are almost virgin soil for the archeologist. Caxambas, Key Marco, Horr's



FIG. 87.

A. Entrance of the canal to Shell Mound near Porpoise Point.

B. Landing place at Porpoise Point Settlement.

C. Mangrove jungle near canal at Porpoise Point Settlement.

D. Live oak on mound at Weeden's Island.

(Photographs by Fewkes.)



FIG. 88.

A. Typical shell-heap on Ten Thousand Islands, Florida.

B. Large tree on periphery of Weeden's Mound.

C. Inhabitants of Porpoise Point in front of their new schoolhouse.

D. Old house at Porpoise Point.

(Photographs by Fewkes.)

Island, Porpoise Point, Lostman's Key, and Choskoloski River have many little-known shell heaps. The keys near Caxambas appear to have been the center or the sites of a considerable population, judging from the number of these mounds.

This word with a different orthography, *cacimbas*, occurs in the Isle of Pines, Cuba, where 20 or 30 objects called *Cacimbas de los Indios* were examined by Dr. Fewkes several years ago. The word occurs on the mainland of South America and is interpreted as a "pipe." Cuban *cacimbas* are large vase-like objects buried in the earth and ample enough to contain a child. These vases are associated with low mounds showing effects of fire, and are supposed by some writers to be receptacles for turpentine or pitch with which the ancients pitched their canoes. Naturally it would be interesting to know why the name is applied to this region in Florida. Was the "Arawak Colony" in this neighborhood?

Several shell implements (fig. 92) were found at Horr's Island, near Caxambas, among which was a perforated circular disk of stone, called an anchor by the owner. It was smooth on one face and rough on the opposite, suggesting a quern or mill for grinding or bruising roots or corn, similar to those elsewhere described from Haiti and Porto Rico. The particular interest attached to this object which was one of many other specimens is that it is one of the few implements from the Ten Thousand Islands that substantiates the historical accounts that the Indians in southern Florida ground food into meal.

There are only a few modern settlements in the Ten Thousand Islands scattered along the southwestern coast of Florida, the most extensive of which, at Porpoise Point, consists of several houses and about 50 people, all related or belonging to one social unit or clan (fig. 88c, d). At this isolated community a school house has been erected for the natives by Mr. Elliott, and Mr. Little, who will serve as their school master, was carried to them on this trip. The oldest man of the settlement claims to be a Choctaw Indian; he is very old, and although there is some doubt of his ancestry, his descendants are mixed bloods. Life is very simple in this primitive place and the houses are mounted on piles like pile dwellings.

One of the most interesting clusters of shell heaps (fig. 88a) visited in Florida is situated near Porpoise Point. The shell heaps near this settlement are rarely visited or at least seldom described by archeologists, probably because it is hidden by a dense jungle of mangroves and approached by a narrow channel cut through this forest, and navigable only at half or full tide. The difficult entrance



FIG. 89.—Airplane view of pseudo-atolls near Weeden Island, Florida. (Photograph by Burgert Bros., Tampa, Florida.)

to this passageway is concealed as one approaches from the gulf, and appears to be artificial. The concealed entrance extends to a clearing in the forest, which is the site of the cluster of mounds on which now grow cocoanut palms, alligator pears, citrus fruits, bananas, and cultivated plants. The approach to one of the elevated shell heaps in this secret area is shown in the accompanying figure (fig. 87*a*). This area is the farm of the Porpoise Point settlement and would well repay archeological study. Several interesting shell implements were picked up on the surface and shallow excavations revealed a unique perforated bivalve fossil shell of unknown use. The whole collection thus far made is very large, and the work of Dr. Fewkes' assistant, Mr. M. W. Stirling of the U. S. National Museum, has attracted wide attention.

*Profile of Excavation in Shell Mound on Weeden Island
November 22, 1923.*

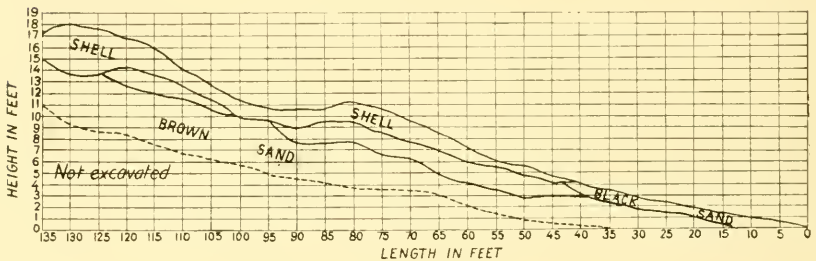


FIG. 90.

The site of Mr. Cushing's explorations at Marco was examined with great interest under the guidance of an old resident of Marco who remembered the valuable objects found there 28 years ago. The site is now much changed, the lagoon, from the muck of which so much was taken, is only a few hundred feet from the hotel; but the depression in which the most of the objects were found has been filled with shells leveled from nearby mounds in construction of a road, and the locality does not offer great inducements for future exploration.

Although it is hardly possible on such a slight acquaintance with Florida archeology to properly choose the most desirable sites for future work it would seem that the least known were those on the Ten Thousand Islands, especially from Caxambas southward. The Tampa Bay shell heaps, especially the cluster on Weeden's Island (fig. 91), about six miles from St. Petersburg, present many practical

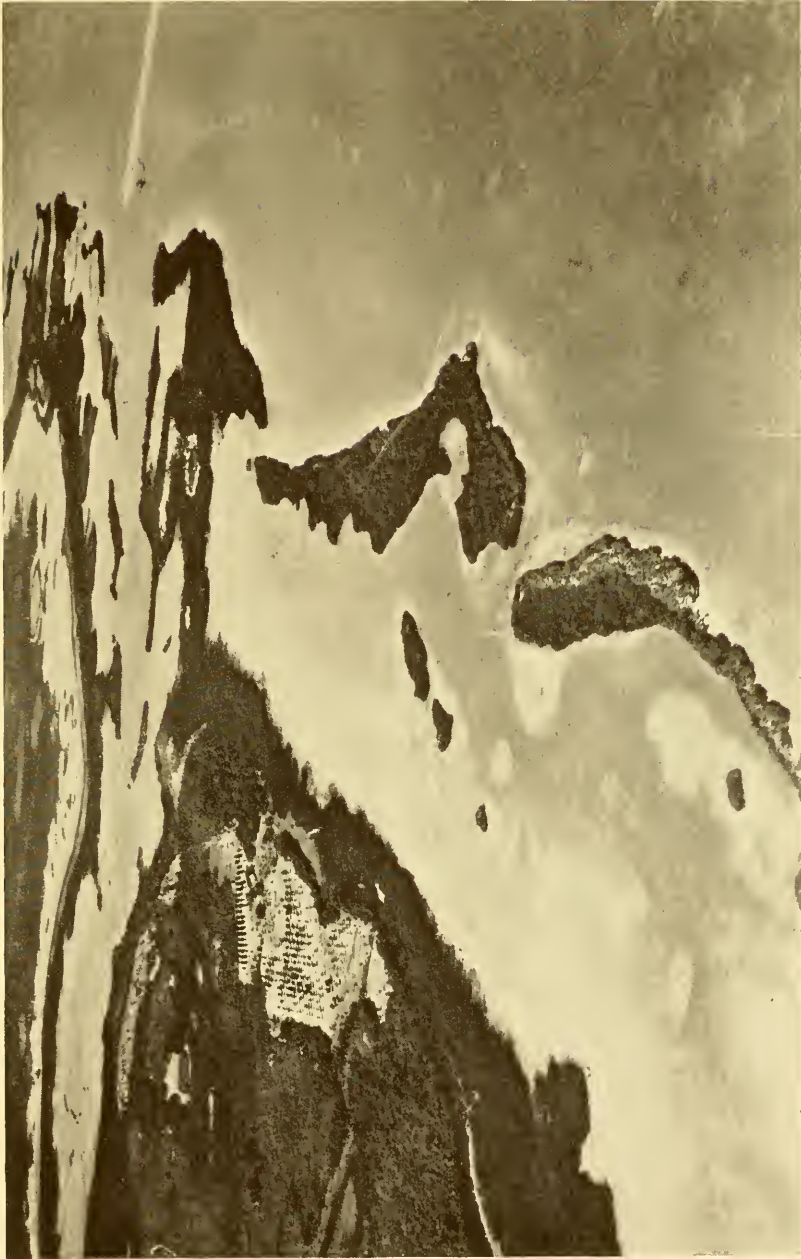


FIG. 91.—Airplane photograph of shell-heaps on Weeden's Island, Tampa Bay, Florida. Weeden Mound shown in middle of the picture. (Photograph by Burgert Bros., Tampa, Florida.)

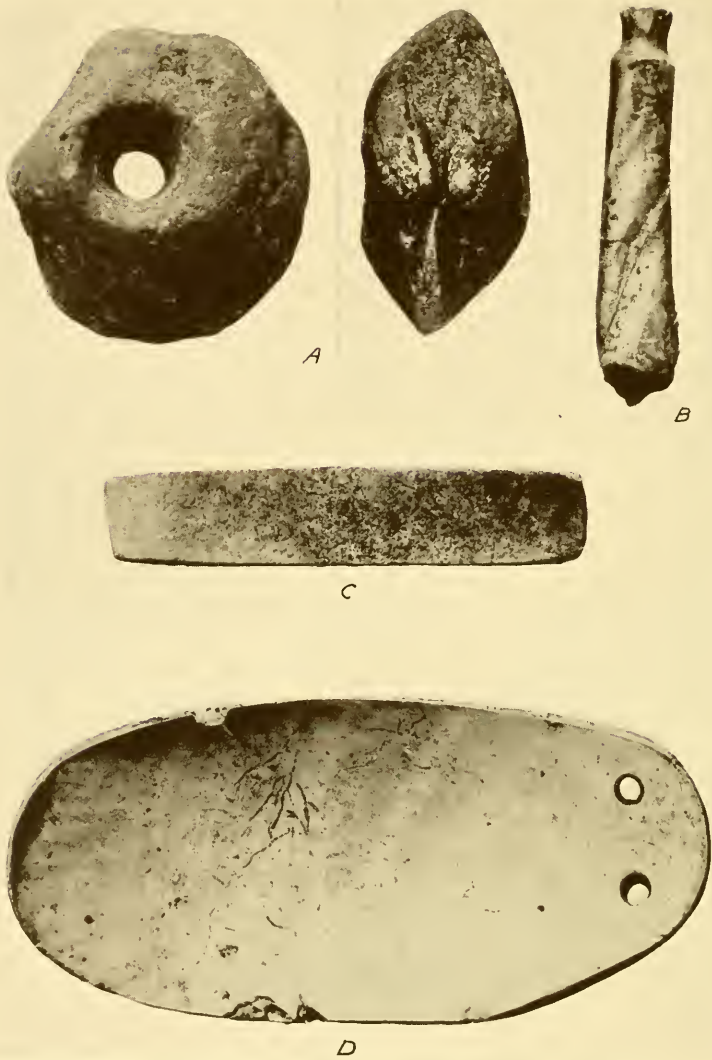


FIG. 92.—Shell objects from southwestern Florida.
A. Perforated fossil bivalve shell.
B. Shell pendant.
C. Unknown shell implement.
D. Shell gorget.
(U. S. National Museum.)



FIG. 93.—Frontal amulets from Mayaguez, Porto Rico, loaned to the U. S. National Museum by Mr. D. W. May.

Center, frontal amulet of shell.

Upper left, frontal amulet of indurated clay.

Upper right, frontal amulet of quartz.

Lower figures, frontal amulets of Falcure mineral.

advantages and a beginning was made on that island. A deep trench (fig. 90) was dug into the main mound in order to determine its character and stratification. It is believed to be a domiciliary mound or, since it is the largest in the cluster, that on which the chief's house was probably erected. Dr. Weeden's claim that De Soto and Narvaz landed on this mound seems probable, and if so we can identify it as the Calusa town, Ucita, which according to Bourne "stood near the beach, upon a very high mount made by hand for defense; at the other end of the town was a temple, on the roof of which perched a wooden fowl with gilded eyes."

The archeological problems of the southern part of Florida are complex and require more field-work than has yet been devoted to them. We have on the southwestern Florida keys many heaps of shell indicating several types, as eating places, domiciliary mounds, and

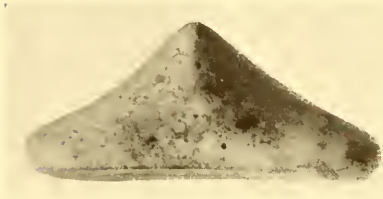


FIG. 94.—Three-pointed stone of the fourth type, Mayaguez, Porto Rico. Loaned to the U. S. National Museum by Mr. D. W. May.

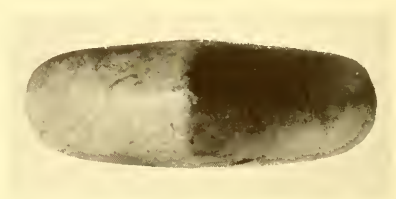


FIG. 95.—Apical view of figure 94.

mounds of observation and defense. At the time of the discovery we learn from historical documents that a tribe of Indians called Calusa inhabited these keys and the names of certain towns of this tribe are recorded, but our knowledge of the ethnology, language and customs of the Calusa is scanty. Did the Calusa build the shell heaps or were they an intrusive people? Did the shell heap people come from the Antilles or were they Muskhogean? Archeology dealing with material culture can contribute to an answer to this question.

In the accompanying figure (fig. 93) are shown specimens of true Antillean amulets lately loaned to the United States National Museum by Mr. D. W. May, from Mayaguez on the west coast of Porto Rico. The central figure is a unique carved shell amulet with lateral wings different from any previously described. The other four amulets figured are likewise new. The three-pointed stone belongs to the fourth type, or that characterized by absence of head and legs but with a curved longitudinal depression on the base.

ETHNOLOGICAL STUDIES IN MAINE, CANADA, AND LABRADOR

Dr. Truman Michelson, ethnologist in the Bureau of American Ethnology, left Washington towards the close of May for a reconnaissance trip among the Algonquian tribes of northeastern United States and the adjacent parts of Canada including the Labrador peninsula. The Penobscot Indians of Maine remember their ethnology and folk-lore very well; but their language is dying. Practically none of the younger generation speak it; so it is only a matter of time before it is extinct. The native arts and industries are still kept up. In sharp contrast with them are the Malecites of "Indian Village," about 14 miles from Fredericton, New Brunswick, Canada. Everyone, even small children, speak the language; yet English is understood and spoken also. In their own homes, however, the Indian language is practically the only one in use. Their native arts and industries are still practiced. It was a rare treat to see them pound ash and then draw out the long splints which are used in basketry. The folk-lore is still remembered, but their ethnology properly speaking is nearly gone. It should be noted that as Penobscot, Malecite, and Micmac have a partially developed dual, in contrast to the Central Algonquian languages, it is plausible to consider this grammatical feature as due to Esquimauan influence.

Dr. Michelson left Sydney, Nova Scotia, June 19, and arrived at Port-aux-Basques, Newfoundland, the next day. From there he went to St. Johns by rail. While in St. Johns he took the cranial measurements of four Beothuk skulls in the local museum. These, of course, are too few in number to guide us regarding the racial affinities of the Beothuks, beyond their general American Indian one. Yet it may be worth noting that three of the skulls were mesocephalic (two nearly dolichocephalic) and one (a female) brachycephalic. It may be further noted that one skull (that of a male) had an unusually heavy supra-orbital ridge. Dr. Michelson left St. Johns on June 25 for Rigolet, Labrador, on the S. S. *Sagona*. The passage was rather severe for the season of the year, but this was more than recompensed for by the sight of so many ice-bergs. At Wesleyville the trip was livened by the ship striking rocks, fortunately without damage. It will be remembered that the *Portia* earlier in the season was fast on the rocks. And at Lord Arm, Dr. Michelson's steamer found the *Ranger* standing by *Scal*, whose propeller had been broken off by ice. The *Sagona* arrived at Rigolet, Labrador, July 3. The next day Dr. Michelson left in a motor boat for the Northwest River. The weather was rough and



FIG. 96.—Iceberg off the coast of Labrador. (Photograph by Michelson.)



FIG. 97.—Indians at the Northwest River, Labrador. (Photograph by Michelson.)

the first attempt was unsuccessful, but towards night-fall the weather moderated, and the Northwest River was reached early the next day. Dr. Michelson lodged at a Hudson Bay Company post during his stay at the Northwest River. The very best thanks are due to officials of the Hudson Bay Company at Rigolet and the Northwest River, as well as those of the Revillon Frères at the Northwest River, for their uniform courtesy and endeavor to make the expedition a success.



FIG. 98.—Indian making canoes at Northwest River, Labrador. (Photograph by Michelson.)

At the Northwest River there were some Indians from Davis Inlet, and at least one Nascapi from Ungava. Dr. Michelson took the physical measurements of a few, and made linguistic and ethnological notes. It follows that Nascapi is really not a distinct Algonquian language; it is the same as the Indian language spoken at Davis Inlet, and is merely a Montagnais dialect, differing only in a few details. From work done previously by others as well as by Dr. Michelson it is clear that the Indian languages at the Northwest River, Davis Inlet, and Ungava (*i. e.*, Nascapi) distinctly form a unit as opposed to the

Montagnais of Lake St. John, Mistassini, the "Cree" of Rupert's House, and the "Cree" of the East Main River. It should be mentioned that the folk-lore and mythology is much nearer that of the Central Algonquian than hitherto supposed. Dr. Michelson was informed that west of the Nascapi are some Indians whose language they cannot understand. Obviously these cannot be Eskimo or Montagnais; for the Nascapi know that the Eskimo and Montagnais differ but slightly from their own language. But who these Indians



FIG. 99.—Indian carrying a canoe at Northwest River, Labrador. (Photograph by Michelson.)

are is at present quite unknown. Later on Dr. Michelson was informed by William Cabot, Esq., of Boston, Mass., who has done a great deal of exploring in Labrador, that he had heard the same thing.

Dr. Michelson left the Northwest River July 21 for Rigolet and arrived there without adventure. He proceeded to Turnavik and from thence to St. Johns, Newfoundland. On the trip Dr. Michelson was able to take the physical measurements of a few Eskimos; up to that time he had taken only the measurements of a few mixed-blood Eskimos who are common on the Labrador coast and who constitute an important element of the so-called "Liveyeres." St. Johns was



FIG. 100.—Fox Indians, Tama, Iowa.
(Photograph by Michelson.)



FIG. 101.—Wigwam, Tama, Iowa. (Photograph by Michelson.)

reached on July 31, and on the same day Dr. Michelson left for Port-aux-Basques by rail. The train was wrecked at almost the center of the island, five cars leaving the track which was torn up for at least 50 yards and probably more. After a delay of more than 24 hours he reached Port-aux-Basques, taking the S. S. *Kyle* that night for North Sydney, Nova Scotia, which he reached early the next morning. From there he proceeded by rail to Tama, Iowa, to renew his researches among the Fox Indians. When not far from Chicago this train was also wrecked, but not badly. At Tama, Dr. Michelson finished a memoir on the Ceremonial Runners of the Fox Indians as far as practical in the field; he also gathered other ethnological data, and returned to Washington September 22.

ETHNOLOGY OF THE OSAGE INDIANS

Mr. Francis LaFlesche, of the Bureau of American Ethnology, spent a part of May and all of the month of June, 1923, among the Osage Indians. The purpose of the visit was to gather information relating to the fruits of plants, cultivated and uncultivated, which the Osage people learned to use for their sustenance before contact with the European races.

It was learned from Wa-no'-she-zhiⁿ-ga, better known as Fred Lookout, and his wife Mo'-ci-tse-xi (figs. 102, 103), and from other members of the tribe, that the Indian corn, or maize, which was known to many of the Indian tribes before the coming of the "whites," still forms a large part of the daily subsistence of the people, that they have over 20 different ways of preparing it for eating. As among other Indian tribes who cultivate the soil, the corn is a sacred food to the Osage, and it figures prominently in their ancient tribal rites and ceremonies. Green corn partly boiled or roasted on the cob, the grains removed from the cob and dried in the sun for use at all seasons, is liked much better by these Indians than the canned corn of the white man. Corn thus prepared for preservation is called, "u'-hoⁿ-ça-gi," and the woman who wishes to give a dinner to her friends never fails to have it on her table. A description of the Indian way of planting and cultivating the Indian corn was also given by Wa-no'-she-zhiⁿ-ga and his wife.

Many of the Osage Indians continue to use as food the roots of a number of wild plants, principally those of the *Nelumbo lutca*, commonly known as "water chinkapin" (fig. 105). The root of this plant, the native name of which is tse'-wa-the, has an important place



FIG. 104.—String of dried roots of *Achimbe lutea* (water chinkapin) used for food.

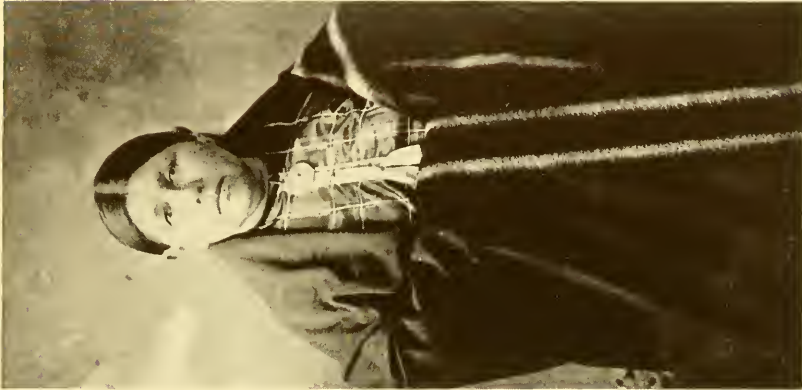


FIG. 103.—Mrs. Lookout, who gave information on the various ways of cooking maize.



FIG. 102.—Mr. Fred Lookout, who gave information on plants used for food by Osage Indians.

among the food plants upon which the people depended for their daily sustenance. In recognition of the great value of this natural product of the soil, the ancient No^{n'}-ho^{n'}-zhi^{n'}-ga (learned men) made special mention of it as a sacred plant in the tribal rites which they formulated and transmitted to the successive generations.

The root of the water chinkapin was gathered in large quantities and dried for winter use. The outer skin was scraped away from the



FIG. 105.—View of the growing *Nelumbo lutea* (water chinkapin).

long armlike roots, which were then cut into one- or two-inch pieces, strung together (fig. 104) with thongs and hung up to dry in the sun on racks erected for the purpose. The root is eaten raw when fresh, and it is also cooked for immediate use. The nuts are also eaten when fresh and taste somewhat like chestnuts. The nuts are also dried and stored for winter use.

The çta-i^{n'}-ge (persimmon) is a fruit that is gathered in large quantities for winter use. In preparing the fruit for preservation the

seeds are first separated from the pulp with a rude screen made of small saplings. The pulp of the fruit is then moulded into cakes, put on wooden paddles and held over live coals to bake. After baking the cakes are dried in the sun and stored. The persimmon cakes thus prepared resemble chocolate cakes. A specimen which was furnished by Moⁿ-çi-tse-xi is now in the National Museum. The process of preparing the persimmon for preservation is called Çta-iⁿ-ge ga-xe, making çta-iⁿ-ge. In the autumn the people go out in groups and camp in the woods to gather persimmons for preserving.

Wa-toⁿ, the squash, was also cultivated by the Osage. They always raised a sufficient quantity to last till the next season. The pulp of the fruit, after removing the seeds and the skin, is cut into long strips which are hung up for a time to partly dry in the sun, after which they are taken down to be braided or woven into a mat-like shape and hung up for the final drying. When thoroughly dried these woven pieces are packed away in raw hide cases for winter use. The smaller pieces left over are strung together on strips of bark to be dried in the sun and stored. The squash was also counted as a sacred food and was given special mention in the ancient tribal rites.

A number of other wild plants afforded the Osage plenty of food, but the corn, squash, water chinkapin and persimmon are valued most because they never fail to yield a dependable supply of food.

ARCHEOLOGICAL WORK IN CALIFORNIA

During the past summer the Bureau of American Ethnology has been engaged in cooperative work in California with the Museum of the American Indian (Heye Foundation). At the request of Mr. Heye, Mr. John P. Harrington, ethnologist of the Bureau, was detailed to take charge of the exploration of the site of the principal rancheria of the Santa Barbara Indians, which is called the Burton Mound. Several years ago efforts were made to obtain permission to excavate this site, but when the Potter Hotel was erected on it in 1901 all hope was given up, and it was supposed that the opportunity for opening this mound had vanished; but this hotel was burned a few years ago, and the opportunity to excavate the site was obtained by Mr. Heye from the Ambassador Hotel Corporation. The excavations under the direction of Mr. Harrington for the Heye Museum and the Bureau of American Ethnology were begun early in May, 1923, and the first day's work located the position of the cemetery on the slope leading to the beach.



FIG. 106.—Collection of soapstone and sandstone bowls taken from Burton Mound cemetery. Left to right: G. W. Bayley, Professor D. B. Rogers, John P. Harrington. (Photograph arranged by J. P. Harrington.)



FIG. 107.—Santa Barbara beach, looking east from Castle Rock Bluff. The cove this side of the further wharf is the former puerto de cayucos or canoe landing place of the Indians in front of Burton Mound. (Photograph by J. P. Harrington.)

Several hundred human skeletons and a valuable collection of mortuary and other objects were found, among which was a fragment of a canoe made of soapstone, stone utensils and implements, mortars, pestles, beads, daggers, pottery, and other articles. By arrangement with the Heye Museum the report of this important discovery will be published by the Bureau of American Ethnology and a collection of duplicates of objects obtained will be deposited in the U. S. National Museum. The collection is the finest illustrating the culture of the Santa Barbara Indians that has been made in many years.

ARCHEOLOGICAL FIELD-WORK IN TENNESSEE

Mr. William Edward Myer, special archeologist, Bureau of American Ethnology, spent May and June, 1923, exploring the remains of a great prehistoric Indian town in Cheatham County, Tennessee. These remains are known as the Great Mound Group on account of the great central mound. Some interesting scientific problems were revealed by his excavations at this old town on the Harpeth River near Kingston Springs. Through the kindness of Mr. Wilbur Nelson, State Geologist of Tennessee, Mr. Crawford C. Anderson made a survey of the group. His maps are shown in figures 108 and 109. Through the efforts of Lieutenant Norman McEwen, of the 136th Air Squadron, Tennessee National Guard, aeroplane photographs were secured.

The remains of this ancient town or towns are found in two adjoining bends of the Harpeth, about a mile apart, and cover about 500 acres. The two sections of the town or two separate towns had each been protected by its own line of defenses, consisting in part of perpendicular bluffs and the remainder of palisaded walls.

GREAT MOUND DIVISION OF THE GROUP

In the upstream bend of the Great Mound division of the town he found a bold projecting hill which had been artificially shaped from base to summit. The original rounded summit had been leveled until a great plaza or public square, about 1,000 feet in length and 500 feet in breadth, had been formed. This plaza is indicated by *P* on figures 110 and 111. At the northeast corner of this plaza, at the brow of the tall terraced hill and overlooking the adjoining region for several miles, the Great Mound had been erected. It is denoted by *M* on figures 110 and 111. Along the eastern edge of this plaza two smaller mounds had been built. Three wide terraces had been formed along

the northern side of this hill. Very faint traces of them can be seen at *T, T, T*, figure 111.

The Great Mound division of this ancient town was protected on the water side by the perpendicular cliffs of the Harpeth River. On the land side it was defended by an earthen embankment or breastworks surmounted by a wooden wall from which at intervals semi-circular wooden towers projected. These earthen breastworks, which had formerly supported this wooden wall, were still to be found in the undisturbed woodlands where they yet extend about $1\frac{1}{4}$ miles, and there is evidence that they originally ran much farther. Wooden palisades, consisting of small tree-trunks, had been driven into the ground side by side and wedged together and the soil thrown against

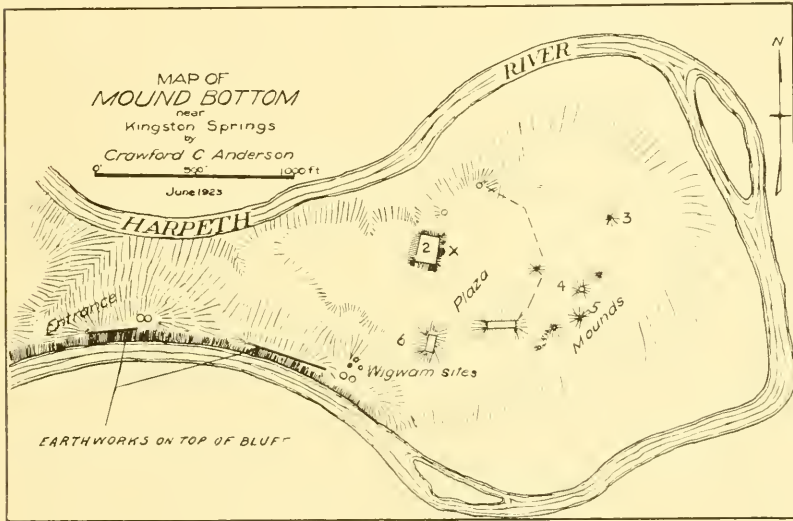


FIG. 109.

them until they were by this means firmly imbedded in these earthen embankments or breastworks. These palisades, bound closely together and strongly braced, formed a wooden wall which had been plastered on the outside in order to make scaling by an enemy difficult. Earthen bastions projecting beyond this line of wall at intervals of about 150 yards were still to be found. These had formerly supported semi-circular wooden towers. The enemy advancing to attack was therefore subjected to fire from the defenders through port-holes along the main wall and also to a flanking fire from the warriors in the towers on these bastions. Faint traces of some of the timbers of these



FIG. 110.—Great Mound, in Great Mound Group.

palisades and wooden towers were found in the soil of these embankments.

This prehistoric town is notable for the artistic ability displayed by the ancient man who planned the beautiful, terraced, bold central hill with its fine plaza surmounted by towering Great Mound. No other remains of ancient man have been found in our southeastern



FIG. 111.—Aeroplane view of northern side of central hill, showing Great Mound, M, Plaza, P, faint traces of terraces at T, T, T. (Photograph by Lieut. Norman McEwen.)

United States which approach this Great Mound Group in an artistic sense. On the other hand, the pottery and the stone artifacts are somewhat ruder than those of the adjoining region. The remains of about 15 mounds of various sizes were found on this site.

While this great central mound topping the bold terraced hill formed the most striking feature of this ancient town, there were within the walls four other eminences whose summits had likewise been leveled

into plazas. All these plazas yielded traces of earth lodges and other evidences of former buildings. On the edges of the terraces were the earth lodges of the common people. See map, figure 108. The larger mounds had probably supported important public buildings and the lodges of leading personages.

All the buildings unearthed appeared to have been destroyed by fire. A line of wall-post holes and fragments of the charred poles used for wall posts in the large building, *A*, can be seen in figure 112.

Under the fallen-in walls of this building the charred remains of woven cane-matting wall hangings were found and carefully preserved. The woven design could still be discerned.



FIG. 112.—Wall post holes and fragments of charred wall posts of building *A*, Great Mound Group.

There is some evidence that this group of important buildings around five separate plazas and in different parts of the town very probably indicates that the population was made up of what had once been four or five separate groups of kindred peoples. These groups had probably formerly been autonomous. Here in their later home each group had gathered around their own public square in their own section of the town and thus preserved at least some of their old ceremonials and held together in some fashion their old organizations.

It is impossible to determine even approximately the number of inhabitants, but the large number of the buildings and the long extent of the walls to be manned required a population of several thousand.

MOUND BOTTOM DIVISION OF GREAT MOUND GROUP

Figure 109 shows a map of the Mound Bottom division of the Great Mound Group. This portion of the remains covers nearly all of the lower river bend which is called Mound Bottom by the local people. The accounts of the early white visitors to the region indicate that a line of walls with towers every 40 paces at one time extended around the edge of this river bottom. If so, all trace has disappeared under long cultivation. A curious line of earthen embankments was found on the narrow neck of bluffs through which entrance was gained to the ancient town. These embankments do not appear to have been portions of fortifications.

A photograph of a portion of Mound Bottom is shown in figure 113. Numbers 2, 4, 5, and 6 are large mounds. Number 1 is a wide artificial



FIG. 113.—Mound Bottom. Harpeth River, two miles below mouth of Dog Creek, Cheatham Co., Tennessee.

earthen platform adjoining mound number 2. Number 7 is a cemetery containing stone-slab graves.

It is not as yet possible to determine the age of these remains. Beyond all question the town had been destroyed long before the coming of the whites. In like manner the Indians living in this section when the whites arrived stated their ancestors had also found these vestiges of some unknown people lying silent and deserted along this beautiful river when they came into this region.

DENNY MOUND

Later in the summer of 1923 Mr. Myer explored a small mound on the Denny farm at Goodlettsville, Sumner County, Tennessee, which proved to be of unusual importance, in that it yielded relics which showed it to belong to a culture quite different from that of much of

the surrounding region in the valley of the Cumberland in middle Tennessee.

Several of the potsherds found in this mound were decorated with fabric impressions which throw new light on the clothing of some of the southern mound-builder women and reveal important differences between some of the customs of the builders of the Denny mound and those of ancient man in the adjoining states.

The burial customs, pottery fragments, pipes, implements of bone and antler, copper ornaments, and other artifacts brought to light in this excavation were of great interest as they furnished intertwining clues which led to tracing out a cultural relationship between many widely scattered important ancient sites occupied by prehistoric man in the upper valleys of the Tennessee River in eastern Tennessee, northwestern North Carolina, the Shenandoah Valley, the upper valleys of the Potomac, the valleys of the New and the Kanawha, the central and lower Scioto valley, a site in the suburbs of Cincinnati, certain sites in the southern peninsula of Michigan, and in southern Wisconsin and elsewhere in our central northern states.

Probably the most interesting contributions to knowledge brought to light by the exploration of the Denny mound were the clues which led to determining what modern Indians are the descendants of the ancient mound-builders who erected this old Tennessee mound. A study of the material cultures aided by the scanty written records and traditions regarding the localities where cultures have been found somewhat similar to that of the Denny mound brings out the fact that the little outlying settlement of ancient people who lived at the Denny mound belonged to a culture group whose remains are found at various points in eastern Tennessee, northwestern North Carolina, southwestern Virginia, Shenandoah Valley, the upper Potomac valleys, the valley of the Kanawha, southern and central Ohio, southern Wisconsin, the southern peninsula of Michigan, and possibly in other sections. This culture group appears to have belonged to the Algonquian stock. The many interlocking evidences render it probable that the Denny mound and some of the other culturally related sites here mentioned were at some time occupied by the Shawnees or people closely akin to them.

REMAINS IN LINCOLN AND MOORE COUNTIES, TENNESSEE

Mr. Myer also visited Lincoln and Moore Counties, in the southern part of Tennessee, where he studied several ancient sites and surveyed and mapped a large and hitherto undescribed mound group on Elk

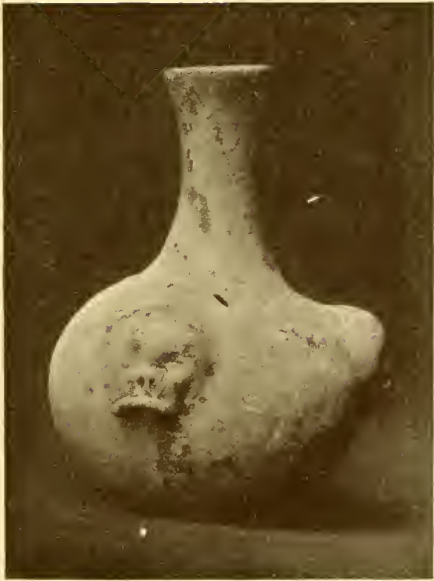


FIG. 114.—Vase from Lincoln County, Tennessee.

River, in the southern corner of Moore County at the point where Moore, Lincoln, and Franklin counties corner. This group of large mounds, plazas, and traces of ancient wigwam sites covers a large bottom on Elk River. Its accompanying cemetery is found on a tall bluff overlooking the site. These remains of some important ancient mound-builder town have never been explored. It has been named the R. H. Gray group in recognition of Mr. R. H. Gray's services to archeology in seeking out and accurately recording for the Bureau of American Ethnology 74 ancient Indian sites in Lincoln County where formerly only two had been reported. Through the kindness of Mr. E. C. Brossard, of Fayetteville, some unusual relics were secured from an ancient site in Lincoln County, on Swan Creek near its junction with Elk River. One of these, a long-necked vase decorated with three unique heads, is shown in figure 114.



FIG. 115.—Boat-shaped object from Lincoln County, Tennessee.

An exact duplicate of this vase in material, size, shape, and heads was found in the suburbs of Nashville, Tennessee, several years since. These very striking heads probably are connected with some ancient tradition or religious rite of these prehistoric men in Tennessee.

A fine boat-shaped object from the same Swan Creek site is shown in figure 115.

LINK GROUP

Mr. Myer also visited Humphreys County, Tennessee, and studied and mapped the Link group of mounds on Duck River, some six miles southwest of Waverly. This is the site where the famous cache of fine, long, chipped flint ceremonial blades and chipped flint implements now in the Missouri Historical Society collection was found. He secured some new information in regard to this important group and the surrounding region.

FIELD STUDIES OF INDIAN MUSIC

In July, 1923, Miss Frances Densmore went to Neah Bay, Washington, to continue her study of Indian music for the Bureau of American Ethnology. The purpose of the trip was to record the songs of Pacific Coast Indians for comparison with the songs of desert and plains tribes. The Makah were selected for this comparison as they are particularly efficient in the catching of whale and seal. The result fully justified the undertaking. Proof of the effect of environment and occupation on Indian song was obtained, together with descriptions of musical customs not found in tribes previously studied. The



FIG. 116.—Neah Bay village, Olympic Mts. in distance. (Photograph by Miss Densmore.)

resultant material comprised phonographic records of 103 songs, more than 200 pages of manuscript notes, 26 specimens of plants with descriptions of their use, 5 portraits of singers and numerous photographs of the locality. A considerable number of specimens relating to the material were obtained, and several specimens which the owners refused to sell were photographed with their permission.

Neah Bay is on the Strait of Juan de Fuca and lies within a few miles of the end of Cape Flattery. Across the Strait can be seen the mountains of Vancouver Island while back of the village rise the Olympic mountains (fig. 116). Communication between Neah Bay and the outer world is entirely by water. Long ago, the Spaniards

came here, built a dock and "surveyed the place." An informant said this took place in the time of his grandfather's grandfather. The Indians were friendly to the Spaniards until they molested the women, when they drove them away. A trace of Spanish influence was found in the statement that the earth revolves once every day, but the Makah added that "the earth is a flat disk, supported by something underneath but resting on the surface of the water." One edge was said to be a little lower than the other, so that in revolving it dips below the water, this causing high and low tides. Further evidence of Spanish influence lay in the description of an armor made of narrow wooden slats, worn in war by the early Makah. The next white visitors were "Boston men" concerning whom it was said "they dug large deep holes and buried a great many bottles to prove they discovered Neah Bay."

Four tribes of Indians are under Neah Bay Agency, the largest number being the Makah who comprise 414 persons. They frequently exchange visits with the Indians on Vancouver Island but did not mention the tribes living on Puget Sound. A clear distinction was made between Makah songs and those of the British Columbia Indians; it was said, however, that many of the Makah songs had "B. C. words." No explanation was given for this usage. The words of the gaming songs were in the "Chinook jargon." Many songs were in a "dream language."

As an outstanding peculiarity of Makah music we note the custom of pounding on planks instead of drums. Timber was easily obtained and the material for a drum head could be obtained only by hunting in the mountains. The planks were "shag," made by splitting a log with a wedge, and the short sticks used for pounding were of the same crude manufacture. The Thunderbird dance was performed on the flat roof of a house and as an accompaniment for that dance a plank was placed on the ground near each side of the house, the company sitting beside these planks, facing the house, and pounding as they sang. A somewhat similar arrangement was used at a social gathering on the beach, attended by the writer (fig. 117). The planks are raised a few inches above the ground, giving space for resonance. Drums appear to have been used by individuals. Mrs. Long Tom (fig. 118) declined to sell her drum, saying "it was so much company for her in the long winter evenings." Certain songs were accompanied only by handclapping, and certain dances had no songs, being accompanied only by pounding on the planks.

Throughout the general culture of the Makah is seen the influence of the "caste system" and the keeping of slaves. Many acts were permitted only to the "first families" and forbidden to the "lower classes." In former times a prominent Makah owned at least 12 slaves usually obtained from other tribes in exchange for the various products that resulted from his successful whaling. These products included whale meat, oil, blubber, and bone. The possession of slaves affected the position of women, as they were relieved of much arduous labor. This enabled them to spend more time on their personal appearance and to enter more fully into an enjoyment of their children. A



FIG. 117.—Makah singing on beach. Pacific Ocean in distance. (Photograph by Miss Densmore.)

woman who was careful of her appearance washed her hair and massaged her face and body every day. Men as well as women rubbed their bodies with cedar bark fiber or with fine hemlock branches, the men following this with prayers for physical strength. Occasionally the women also desired great strength.

Two ideals were noted in this tribe, personal beauty in the women and physical strength in the men, and we find also a certain grace in social intercourse. For instance, each person at a feast was expected to sing a "gratitude song" before his or her departure and there were many songs, sung at social gatherings, in which men and women expressed an admiration for each other. A charming custom was that of "lullaby singing" by the older women which was always followed



FIG. 118.—Mrs. Long Tom. (Photograph by Miss Densmore.)



FIG. 119.—Mrs. Wilson Parker. (Photograph by Miss Densmore.)



FIG. 120.—Mrs. Sarah Guy. (Photograph by Miss Densmore.)

by gifts supposed to be bestowed by the infant. There were songs for boys and for girls. Frequently the words were supposed to be those of the child. Thus a lullaby for a baby girl contains the words

“The only reason I cannot gather more berries
Is that so many other babies are bothering me.”

The following lullaby is addressed to a boy,

“What a nice basket full of snipes you are carrying.
You got them at Tcatcatiks.”

The singer of this song would expect to be rewarded with a feast of snipes. Several of the lullabies were recorded by Mrs. Wilson Parker (fig. 119), whose head shows a deformation observed frequently among the Makah.

The wedding customs were elaborate, including mock and genuine feats of strength as well as dramatic performances of various sorts. An instance of the latter was the presentation of what might be termed a “model” of an island, given by a man to the girl who married his son. A song concerning this action was recorded by Mrs. Sarah Guy (fig. 120) and contains these words,

“My island home is ready,
There are many ducks around it.”

The most characteristic songs and legends of the Makah are those connected with whale catching. In these songs we find tones prolonged to the length of four or more counts in slow tempo, suggesting the “*ahoy*,” or call across the water, which is used among sea-faring people of other races. In addition to these very long tones the whaling songs contain short rhythmic units, crisp and decided, like the motion of the paddles in the water. The intervals and compass of these melodies is rather small. Mr. James Guy (fig. 121), who recorded whaling songs, said they were sung “in time with the paddles” and that between renditions the men held their paddles upright and gave a long wail or moan, imitating the sound made by a wounded whale.

The prominence, power and wealth of a Makah depended on his success in catching whales. One or two whales was the average catch for a man in a season but sometimes a man caught four or five. In that event he was able to give an oil potlatch, at which about 500 gallons of whale oil were given away. Not only was the oil taken home by the guests but buckets of it were poured over the women relatives of the host who danced at the potlatch. The host even showed his lavish intention by pouring a large quantity of oil on the fire. In the songs of the oil potlatch a captured whale is supposed to be speaking.



FIG. 121.—Mr. James Guy. (Photograph by Miss Densmore.)



FIG. 122.—Young Doctor. (Photograph by Miss Densmore.)

Among the songs peculiar to this tribe was one learned from the frogs, another concerning the story of an encounter between a man and a shark, and another concerning a mysterious creature of the sea called by a term meaning "lightning belt of the thunderbird." Concerning one song it was said, "In old times the people believed that the singing of this song would bring rain." Three "echo songs," with prolonged tones, were recorded by Young Doctor (fig. 122) who said he heard them in a dream, sung by men in a canoe on a very calm day. Young Doctor was an excellent singer, a proficient, industrious worker in wood and whale bone and formerly treated the sick, using a rattle of shells strung on thin whale bone.

Other subjects studied were war, contests of strength, and the ordinary potlatch, with its songs of invitation, welcome and feasting.

The following incident is of interest, in connection with the study of Indian music. Miss Densmore played for Young Doctor the phonograph record of a Yuma song. He listened attentively and then said, "That sounds like a song calling on the southwest wind and asking for rain. It is calling for a soft wind, not a strong wind." He was interested to learn that the song came from a desert country where the desire for rain is often in the minds of the people, and the song belonged to the Kurok, or Memorial ceremony of the Yuma. The words of this song were in an obsolete language, unknown to the man who recorded it.

Two phases of singing by the Makah women deserve special mention. It was said to be the custom with all old songs that a man sang the introduction, then a certain woman pronounced the words, after which all sang the song. This woman acted as a sort of precentor, and her action was not unlike that of "lining out the words." The second interesting phase of singing by the women was the use of a high drone, or sustained tone, while the other singers gave the melody. It was said "the Makah women sometimes do this if they are not sure of a song and are asked to help with the singing, but the Quileute women do it a great deal, calling it the 'metal pitch' because it is like a piece of metal which can give only one pitch." Miss Densmore heard and noted this high drone in the singing of Papago women in southern Arizona, where it seemed to be regarded as an ornamentation to the music. A high drone is said to characterize the singing in "some parts of European Russia and all over the eastern Caucasus, in the wild recesses of the mountains where the native music has not felt the modifying influence of European culture." Its presence in these localities in the United States, and not in tribes living farther from

the Pacific coast, is of peculiar interest. There has been no opportunity for investigating the possible use of the high drone by California tribes.

After leaving Neah Bay Miss Densmore went to Prince Rupert, B. C., where she interviewed some members of the Tsimshian tribe and learned that their old songs are remembered by at least one member of the tribe. No attempt was made to record songs in British Columbia, but there seems an important opportunity for musical work in that region.

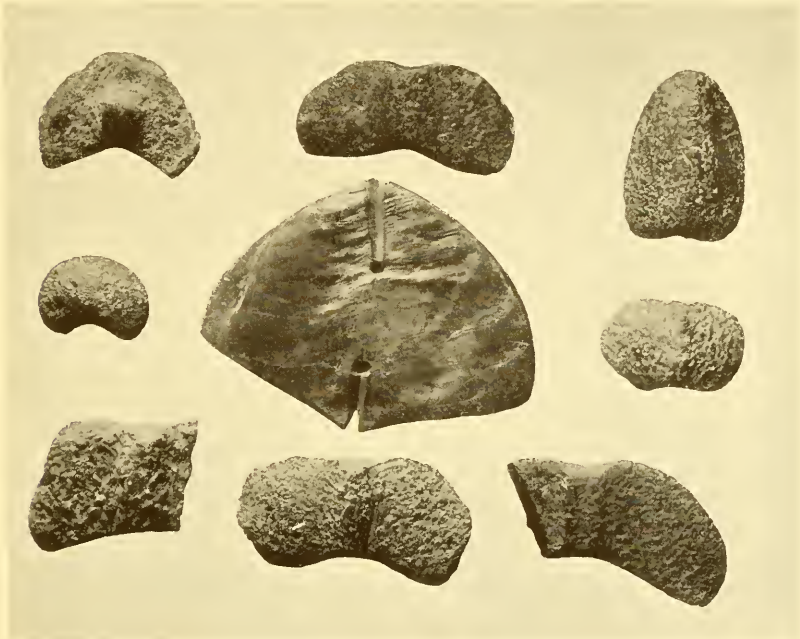


FIG. 123.—Unfinished banner stones, showing different stages of workmanship on various types found in eastern Pennsylvania.

BANNERSTONE INVESTIGATIONS IN PENNSYLVANIA

John L. Baer, special archeologist for the Bureau of American Ethnology, spent three months in eastern Pennsylvania studying bannerstones and the method of their manufacture. Four more aboriginal workshops, where bannerstones were made, were located; two along the Susquehanna and two along the Delaware. None of these, however, was as large as the one formerly reported on Mt. Johnson Island in the Susquehanna River. At each of these workshops the bannerstones were made either after different patterns or of a

different material. By learning the sources of the various types of these ceremonial objects Mr. Baer hopes to discover some of the prehistoric migrations of certain tribes of the American Indians. Many interesting specimens of bannerstones were located in small private collections in Pennsylvania. In one town there are nearly a dozen which were found within a radius of 10 miles. Unless this section of the country was specially favored, bannerstones must have been much more numerous than has heretofore been supposed.

Numerous reports of a cache of rhyolite blades, ranging from 20 to 150 per cache, attracted Mr. Baer's attention to the source of material in the South Mountains west of Gettysburg, Pennsylvania. These prehistoric rhyolite quarries were discovered and described by Prof. W. H. Holmes a number of years ago. Recently a trench for a pipe-line was dug over the side of the mountain, which exposed chips and reject blades of rhyolite and trap hammers for a distance of half a mile. The bushels of rejects scattered along this narrow path are indications of the magnitude of this prehistoric workshop, which was as broad as it was long.

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