

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 72, NUMBER 15

EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1921



(PUBLICATION 2669)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1922

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

CONTENTS

	PAGE
Introduction	I
Geological Explorations in the Canadian Rockies.....	I
Paleontological Field-Work in the United States.....	22
Astrophysical Field-Work in Arizona and in Chile.....	30
Botanical Expedition to the Orient.....	33
Biological Exploration in the Dominican Republic.....	44
Experiments in Heredity	47
Entomological Expedition to Alaska.....	52
Archeological Field-Work on the Mesa Verde National Park.....	64
Archeological Collecting in the Dominican Republic.....	83
Archeological Reconnaissance of the Cahokia and Related Mound Groups.	92
Archeological Investigations at Pueblo Bonito, New Mexico.....	106
Archeological Field-Work in South Dakota and Missouri.....	117
Field-Work on the Kiowa, Pueblo, and California Indians.....	125
Archeological Field-Work on the Susquehanna River, Pennsylvania.....	127



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.)

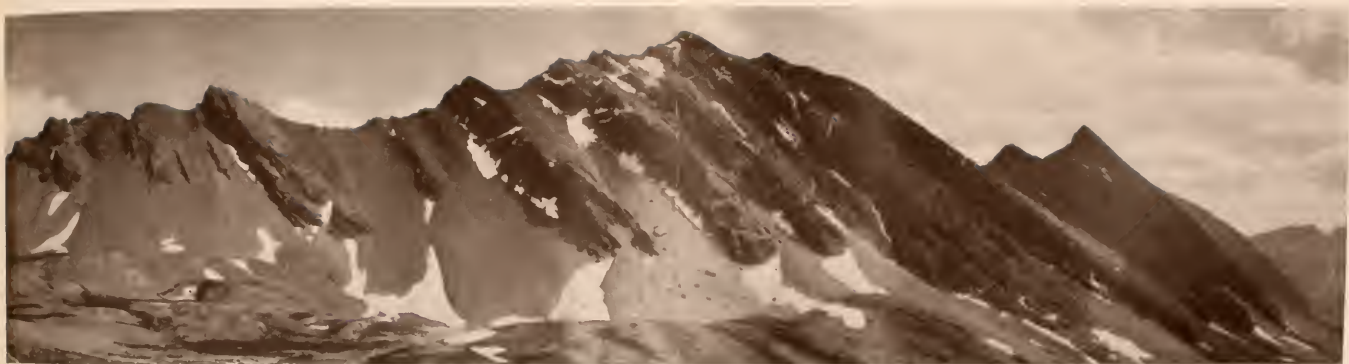


FIG. 3.—Upturned Devonian, Ordovician, and Cambrian strata southwest of Badger Pass, at head of Cascade Creek and northeast of canyon of Johnson Creek.
Locality: Southeast side of canyon leading up from Johnson Creek to Badger Pass in Sawback Range. Position of camera about ten miles in air line east 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 1910, 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 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.)

misting 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 Douai (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, Shiuchow, 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 Yangtse 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 Shiuchow 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-

portable. 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 Yuma 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 (*Oedicnemus 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).

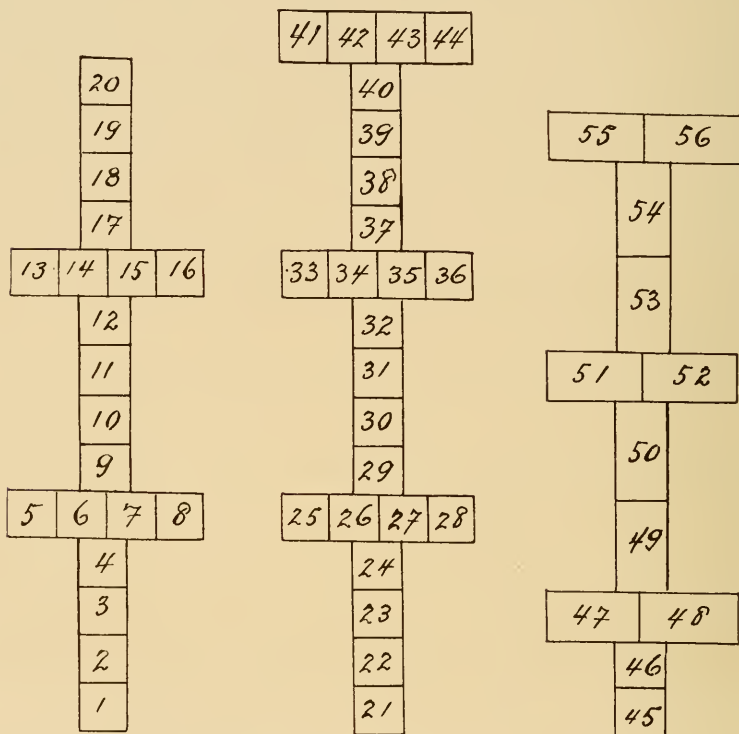


FIG. 49.—Diagram showing arrangement of cages.

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 uva*.

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 uva*.

No. 52, 25 each of *Cerion viaregis* and *Cerion crassilabris*.

No. 53, 25 each of *Cerion casablancae* and *Cerion uva*.

No. 54, 25 each of *Cerion casablancae* and *Cerion crassilabris*.

No. 55, 25 each of *Cerion uva* 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 $4\frac{1}{4}$ 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

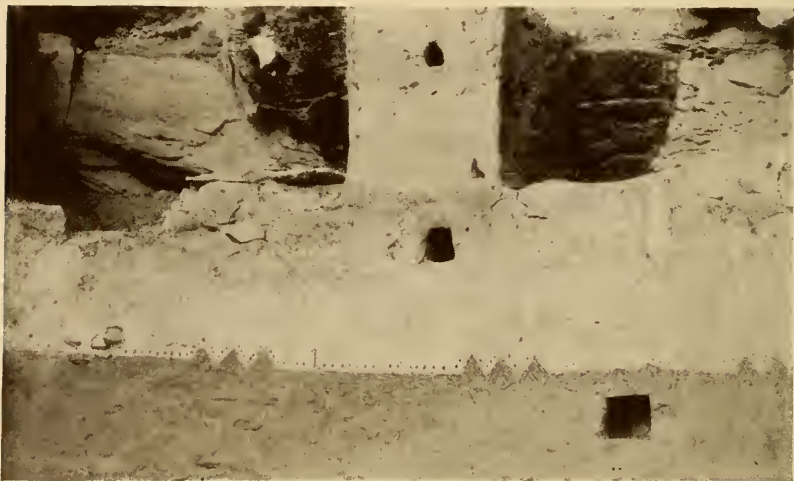


FIG. 72.—Interior of kiva, showing mural decoration, niches, and pilaster. Painted Kiva House, Mesa Verde National Park. (Photograph by Fewkes.)

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.)

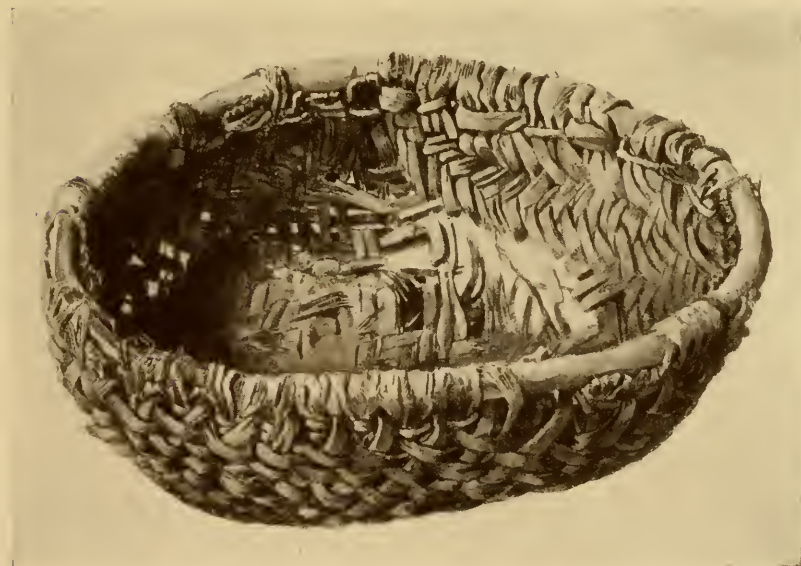


FIG. 74.—Rim basket. Painted Kiva House, Mesa Verde National Park.
Size: $15\frac{1}{4}$ inches. (Drawn by Mrs. George Mullett.)

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

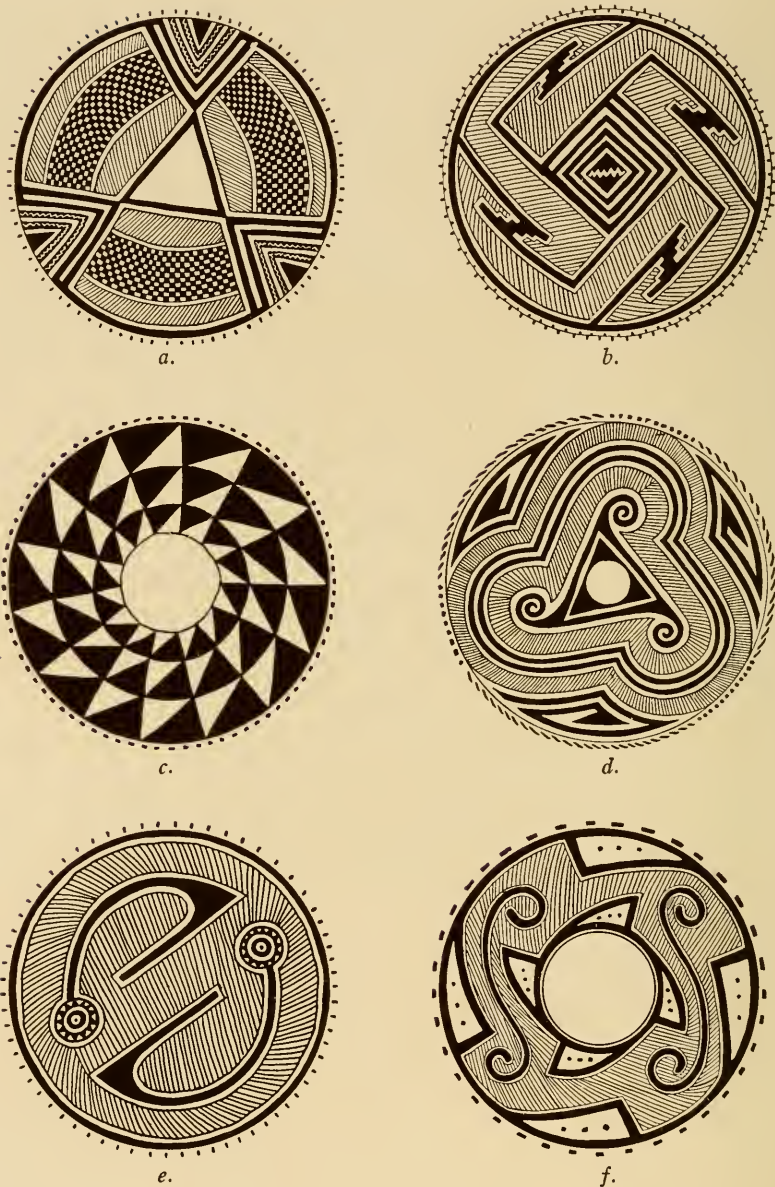
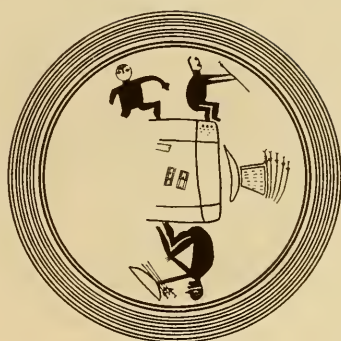


FIG. 83.—Decorated pottery from Mesa Verde National Park. *a*, triangular geometric design; *b*, hatched and terraced line; *c*, black triangles in concentric series; *d*, central triangle with curved lines at angles; *e*, unknown geometric design; *f*, S-shaped design. (Drawn from photograph, by Mrs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

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

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.)



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*e* 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.

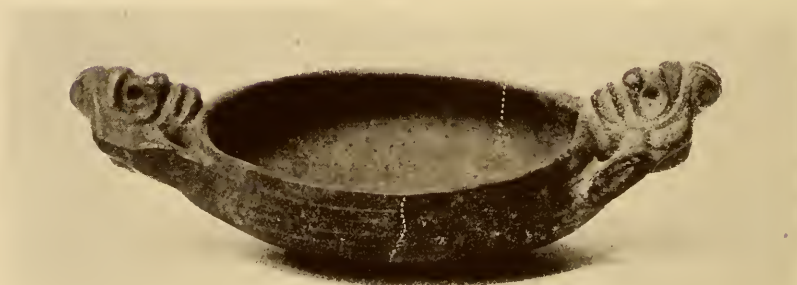
*a.**b.**c.*

FIG. 89.—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*, 9½ inches; *b*, 6¼ inches; *c*, 16¾ 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.

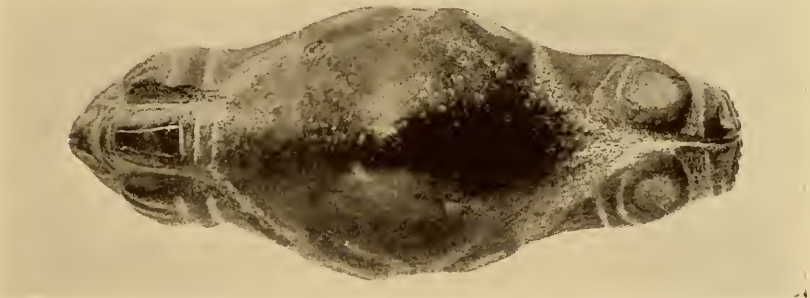


FIG. 91.—Same three-pointed stone from above.



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.



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



a.

b.

c.

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. 309567.

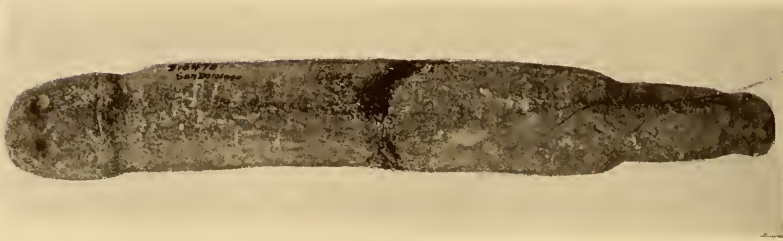


FIG. 96.—Stone baton. Collected by Col. G. C. Thorpe. Size: $16\frac{3}{8}$ inches. U. S. Nat. Mus. No. 316475.



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

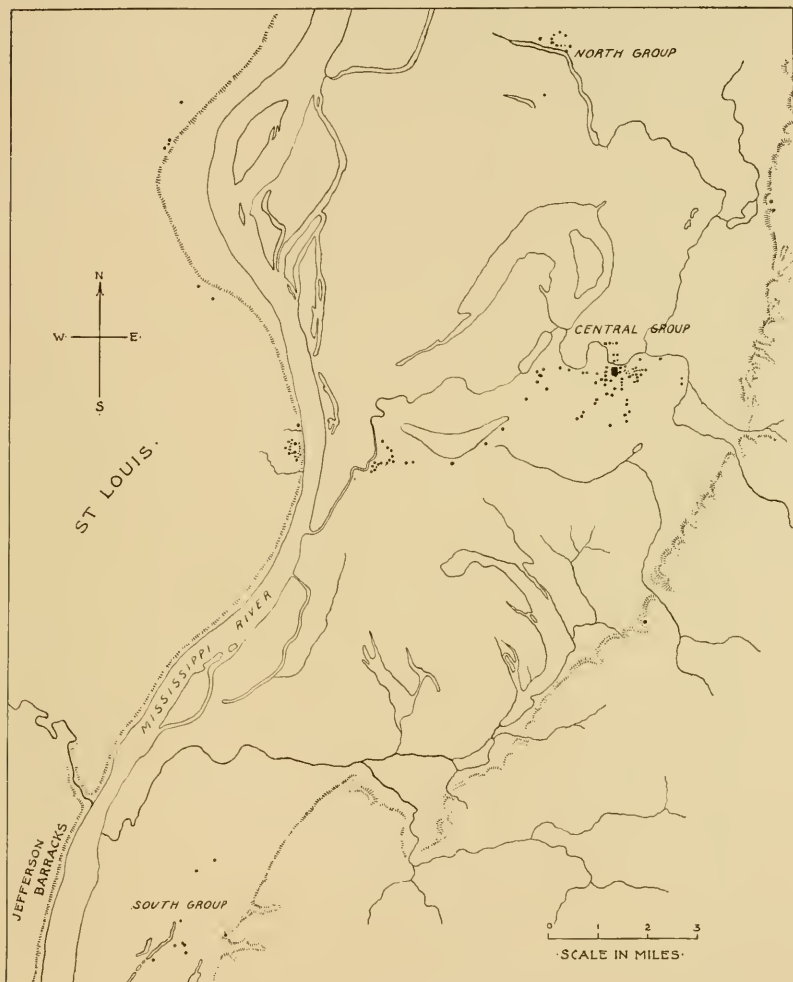


FIG. 99.—Map showing location of mound groups.

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

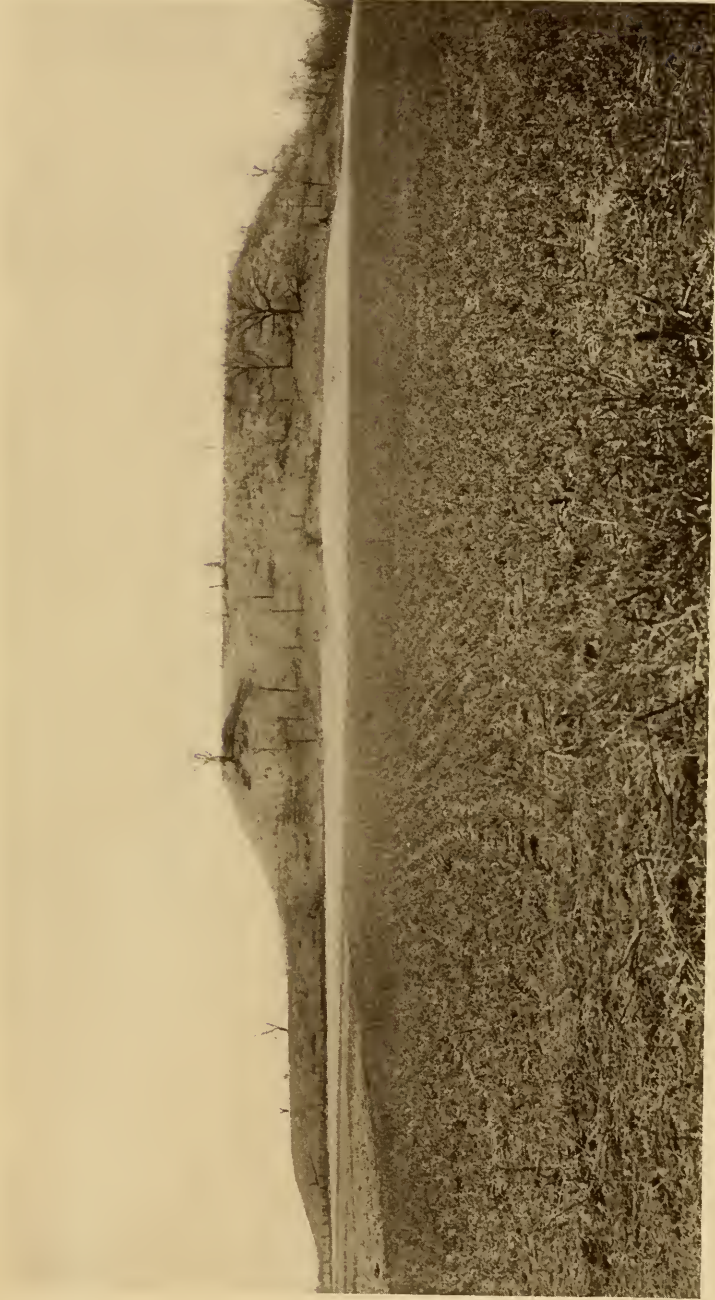


FIG. 100.—Cahokia. The eastern side, with the graded approach on the south.

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. III.—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.)

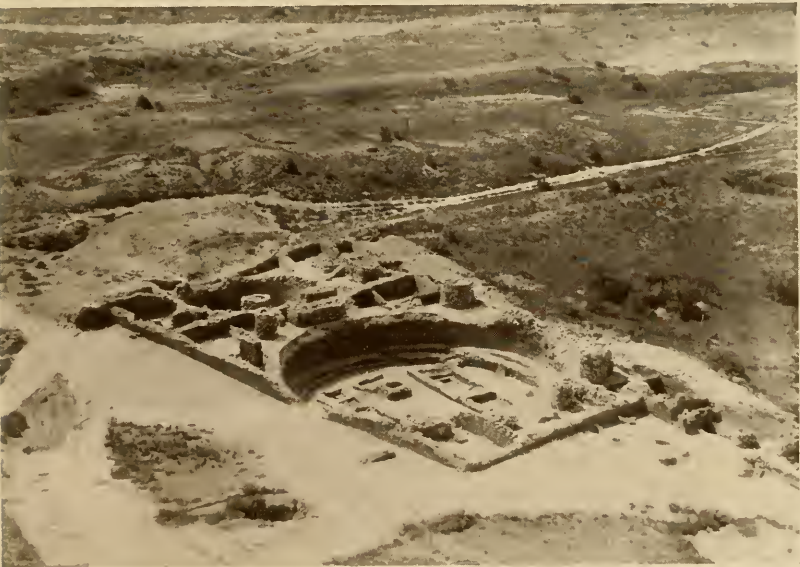


FIG. 115.—The Great Kiva and its surrounding rooms, as seen from the cliffs north of Pueblo Bonito. This remarkable structure is 52 feet in diameter; it was the largest and most important ceremonial room in the village. A trench for stratigraphical examination of the west refuse mound will be noted at 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.

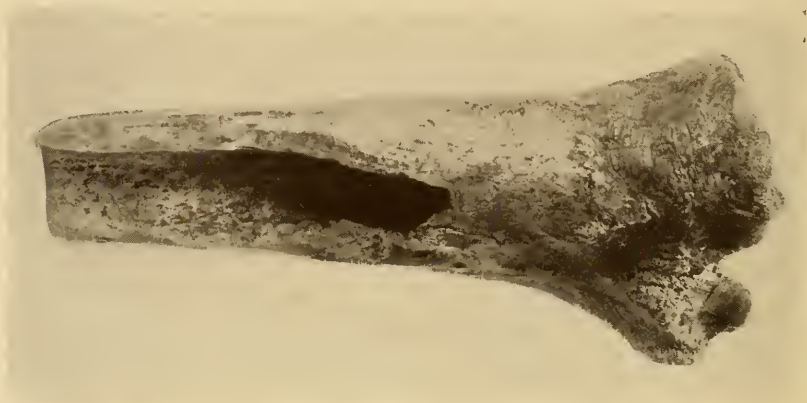


FIG. 123.—Bone flesher.

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-

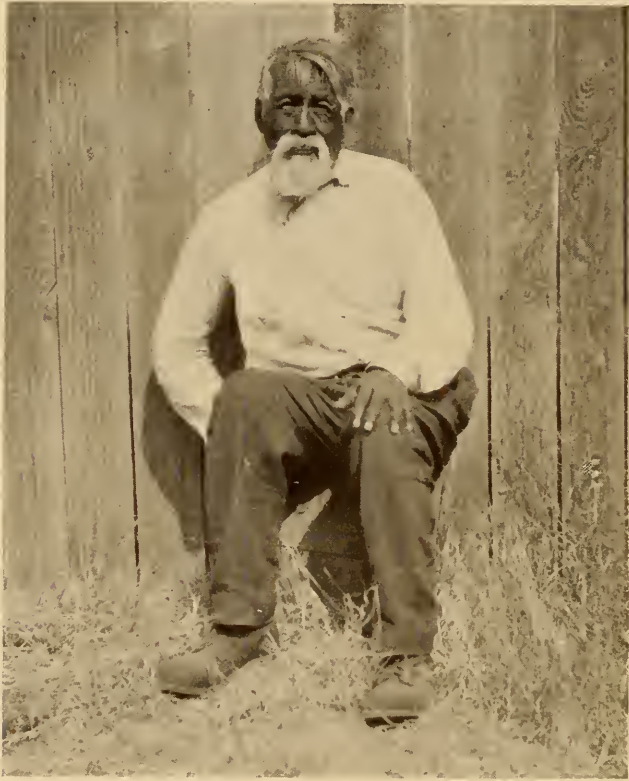


FIG. 128.—Aged Mission Indian informant. (Photograph by Harrington.)

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.