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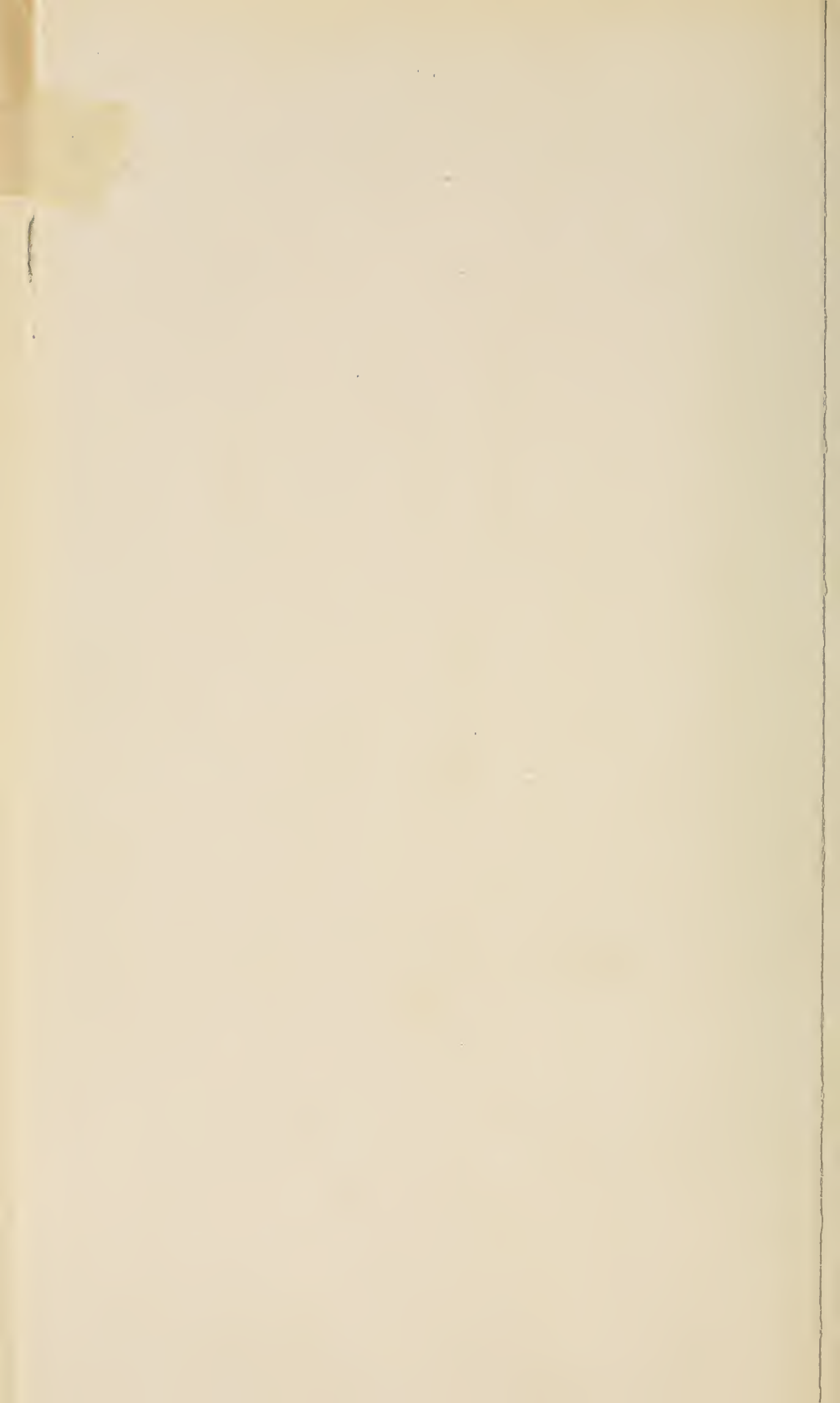
EXPLORATIONS AND FIELD-WORK OF THE
SMITHSONIAN INSTITUTION
IN 1917



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TUMBLING GLACIER AND CLIFFS (6,800 FT.)

MT. GRAY (9,200 FT.), NORTH TOWER (9,100 FT.)

BEAVERFOOT RANGE, WOLVERINE PASS (7,900 FT.)

MT. DRYSDALE (8,400 FT.)

WASHMAWAPTA WALL



Fig. 5. Panoramic view looking west through Wolverine Pass, British Columbia, from a point 8 miles (13 km) east of the Yukon Pass, which is 7 miles southwest of Mount Castle Station, on the Canadian Pacific Railway, Alberta, Canada. Photograph by W. C. C. 1917.

INTRODUCTION

A prominent department of activity throughout the history of the Smithsonian Institution has been the scientific exploration of regions imperfectly known, particularly in North America, although in recent years this work has extended to all parts of the world. These investigations have covered astronomy, anthropology, biology, geology, and in fact all branches of science. Besides extending our knowledge of nature and of man, there has been thus gathered and added to the National Museum collections an enormous mass of material of very great scientific interest and importance.

During the year 1917, the war greatly restricted the operations in foreign lands and the field-work was therefore largely limited to the United States. The accounts recorded herein have been written chiefly by those who have carried on the work.

Under the auspices of the Institution and in co-operation with the U. S. Geological Survey and other departments of the Government, there was carried on a few years ago a most thorough biological and geological survey of the Panama Canal Zone. The results of that important work are now being published in quite voluminous form. Among these publications now in press are "Contributions to the geology and paleontology of the Canal Zone, Panama, and geologically related areas in Central America and the West Indies" prepared under the direction of Thomas Wayland Vaughn, to appear as a National Museum Bulletin; also a comprehensive monograph on the "Mammals of Panama" by Edward A. Goldman. Numerous other works having to do with Smithsonian Explorations during recent years are enumerated in lists of publications issued by the Institution at regular intervals each year.

The geological field-work by Secretary Walcott in the Rocky Mountains during recent years has yielded important additions to our



FIG. 2.—Burgess shale fossil quarry blasted out on the steep slope of the ridge between Mount Wapta and Mount Field at 6,700 feet above sea level and 8 miles by trail from Field, British Columbia.

The fossil-bearing layers are just beneath the surface upon which the men are standing. Photograph by Walcott, 1914.

knowledge concerning the Cambrian and pre-Cambrian formations and has brought to light evidences of life far earlier than heretofore known. The results of much of this work in the field and subsequent

laboratory studies have been described in various Smithsonian publications. Likewise the ethnological researches herein briefly described will later be elaborated in the bulletins and reports of the Bureau of American Ethnology.



FIG. 3.—Undercutting by blasting in order to get at the fossil-bearing bed of rock in the famous Burgess Pass quarry. William Oke and Alex. Mitton drilling, while standing on poles high above the floor of the quarry. Photograph by Walcott, 1917.

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

In continuation of geological work in the Canadian Rockies, Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, was engaged during the summer and early fall of 1917 in field investigations and collecting at the now well-known "Burgess Pass fossil



FIG. 4.—Mrs. Walcott splitting out Middle Cambrian fossils from slabs of shale blasted out of the fossil-bearing bed of the Burgess Pass quarry. Photograph by Walcott, 1917.

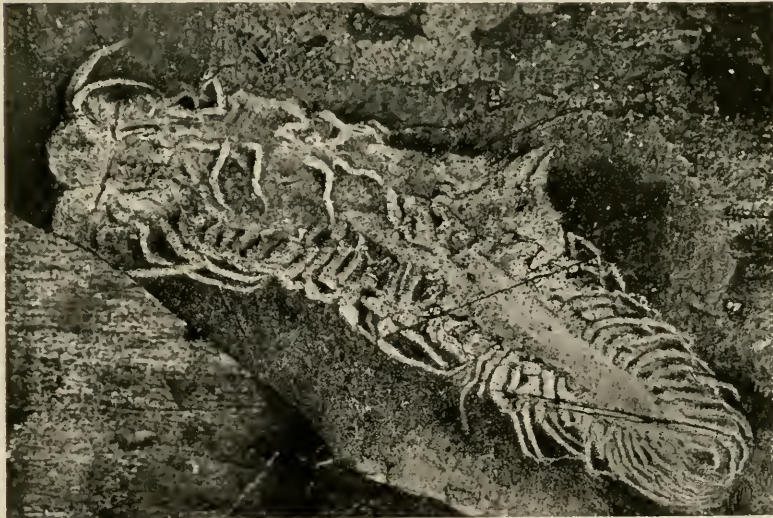


Fig. 5. ($\times 2$.) An elongate creeping holothurian (*Redoubtia polypodia*, new genus and species Walcott) with numerous tube feet and tentacles. This and the forms represented by Figs. 6 and 8 belong to undescribed genera and species and are here illustrated for the first time.

quarry," discovered by him in 1910. Fifty days were spent at the Burgess Pass camp, 3,000 feet above Field, British Columbia, where with the assistance of a miner and assistant, and packer Mitton, a section in the quarry of about 180 square feet was taken out. This practically exhausts a quarry which has given the finest and



FIG. 6.

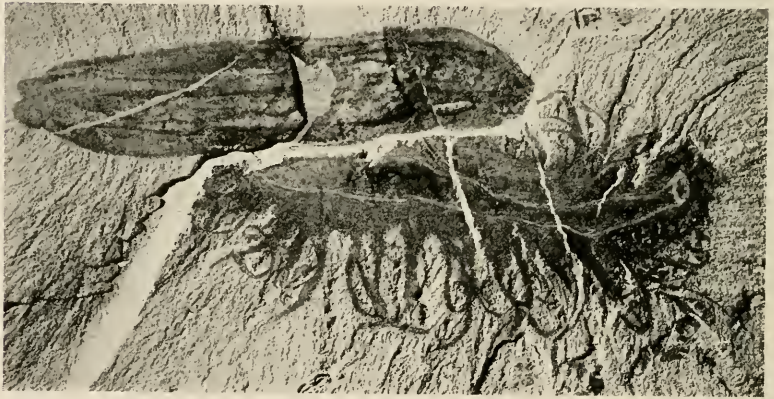


FIG. 7.

FIGS. 6 and 7.—(About two-thirds natural size.) Another and larger holothurian with tube feet. (*Portalia mira*, new genus and species Walcott) that is finely preserved although crushed flat in the shale. An actinian (*Mackenzia costalis*) is lying on the posterior portion of the holothurian.

largest series of Middle Cambrian fossils yet discovered, and the finest invertebrate fossils yet found in any formation. More than one and a half tons of specimens were trimmed out at the quarry with the assistance of Mrs. Walcott and packer Mitton, wrapped in bundles carried by pack horses to camp and thence to the railroad



FIG. 8.—(About four-fifths natural size.) A large, beautifully preserved crustacean (*Helmetia expansa*, new genus and species Walcott) with a thin, semitransparent shell through which parts of the various appendages beneath the body may be seen. The two large eyes are finely shown on the rounded segment of the front of the head.

station at Field, and are now in Washington. Some of the undescribed forms are here illustrated by figures 5 to 8, and the operations of the quarry are shown by figures 2 to 4. Figure 2 shows the quarry just as the party left it in 1913, and figure 3 shows the back wall under which it was necessary to go to obtain fine pieces of the fossil-bearing rock. When the large slabs of hard shale are finally blasted loose they must be carefully split with chisel and hammer (fig. 4)



FIG. 9.—Mrs. Walcott giving Granny, the mountain squirrel, her noon-day lunch at the Burgess Pass fossil quarry. Photograph by Walcott, 1917.

to expose any fossil remains embedded between the laminæ of the compact, siliceous shale. The remarkable thing about the shale is that it preserves animals that were as soft and non-resistant as jelly-fish, worms, and the internal parts of worms and crablike animals. One of these is shown by figure 8. It is a swimming and crawling crab, seven inches long. It had two large eyes in front (shown by

the round white spots), six broad ribs, and a large tail. Branchiæ or gills shine through the thin shell as well as traces of the legs. Another curious form, figure 5, is a soft-bodied holothurian with many flexible podia or false legs. A small, round shell happened to rest on the sea bottom just where the head part of the animal was later pressed down upon it. Another soft-bodied form is *Portalia mira* (figs. 6 and 7), which is related to the sea cucumber or Holothurian which may be seen growing on the sea bed at Catalina Island, California. The shale bed at the quarry suggests that the waters of the ancient Cambrian sea above it swarmed with life just as the ocean does to-day at Catalina Island. But this was long before the



FIG. 10.—Granny, the mountain squirrel. Frequently showers of broken rock and dirt were thrown by the blasting all about the place where Granny was sitting, but she invariably dodged under protecting slabs and appeared soon after as unconcerned as though nothing had happened. Photograph by Walcott, 1917.

advent of fishes on the earth so there were no fish, and no traces of them occur in the fossil bed. The superb preservation of the fossils at the quarry is all the more remarkable when we consider that they have been buried for twenty million years or more and subject to all the vicissitudes that rock materials experience from the time that they are simply hardened mud buried beneath thousands of feet in thickness of layers of mud, sand, and pebbles. Then all were changed by pressure and chemicalization into solid beds of sandstone, slaty shale, and limestone. These were later compressed and elevated into mountain ranges and more or less worn away by

atmospheric agencies. Beside the specimen of *Portalia mira* (fig. 7) there is an imprint of a mud-loving actinian (*Mackenzia costalis*) that closely resembles *Edwardsia*, a living form that usually lives buried in the sand.

"At the quarry," says Mr. Walcott, "we found one of our old friends that led me to write a note on animal behavior. When we were collecting fossils there in 1911, rock squirrels began to come to the quarry we were opening. At lunch time we threw them bits of



FIG. 11.—A summer snowstorm at Burgess Pass camp, 3,000 feet above Field, British Columbia, Canada. Photograph by Walcott, 1917.

bread and crackers, and later carried up nuts to give them. They became very tame, and when we returned the following year (1912) one of them, that we named Granny, because she apparently had two generations of young squirrels that came with her, would run up on our legs and shoulders, and if we did not promptly give her something to eat she would give a sharp chirp to call attention. One rainy day when crouched under a rubber blanket at lunch time, Granny came, and seeing a cake of chocolate lying on my knee made a grab for it, running up my arm and over my shoulder with it so as to jump

to the rocks behind. I made a dash for her, catching her by the end of the tail, which resulted in snapping off the tail about midway. The following year (1913) she was about again as usual, being easily recognized by her stub tail (fig. 10).

"We did not visit the quarry from 1913 until the latter part of July, 1917. Just after a blast had been fired, which was the signal to the squirrels that we were about to eat lunch, we saw two or three of them coming down from the cliffs above. A few minutes later, Granny suddenly appeared at the edge of the quarry. I called her,



FIG. 12.—One of the party who would insist on sleeping beneath the pine trees away from the tent, as seen on the morning of July 27 at Burgess Pass camp. Photograph by Walcott, 1917.

'Granny,' and whistled. She immediately ran across the floor of the quarry, jumped upon my foot and ran up my leg, finally sitting up and begging for something to eat as she had done the years before. There were three strange persons in the quarry, and she would not go near them for several days until she had the opportunity of getting acquainted. The striking feature of this incident is that this mountain squirrel should have remembered through a period of four years, and at once ran and jumped up on me as she had been accustomed to do in the years before.

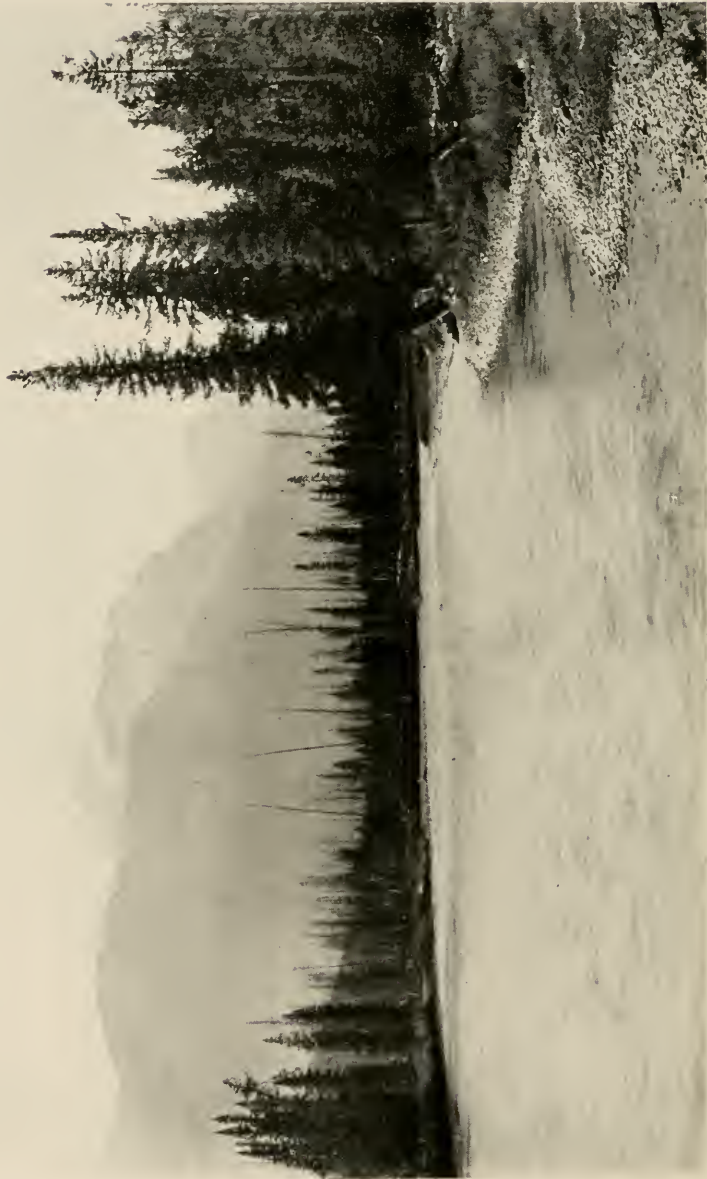


FIG. 13.—Looking up the Bow River from our camp near the Banff-Windermere road bridge a mile west of Mount Castle on the Canadian Pacific Railroad. Photograph by Walcott, 1917.
The high mountain in the center is Mount Temple (11,626 feet), one of the most beautiful mountain masses between Paradise Valley and the Valley of the Ten Peaks.



FIG. 14.—Castle Mountain, the citadel of the Bow Valley, 16 to 18 miles west-northwest of Banff, as seen from the Banff-Windermere automobile road below Vermilion Pass, Alberta, Canada. Photograph by Walcott, 1917.

“ Four other squirrels came, two of which were evidently full grown and a year or more old, and two young ones. As Granny disciplined them all when they became too familiar, we supposed that they were members of her immediate family.

“ After a week or more, Granny became very intimate with Mrs. Walcott and would jump into her lap and onto her shoulders, begging for food. She was entirely fearless, and would cling to a nut or a piece of chocolate and swing in the air until she secured the coveted bit (fig. 9).

“ When the squirrels first came, they were very thin and extremely active. After a month of feeding, Granny became so stout that she had great difficulty in jumping from rock to rock. Chocolate, nuts, bread, and cookies seemed to agree with her, and the day we left the quarry a bountiful supply was placed under the rock ledges, so that they could all take the food to their nests, which were at the base of the cliffs, about 8,000 feet altitude.

“ On July 27, a summer snowstorm buried the quarry, and at camp (figs. 11 and 12) it seemed more like November than July. Sunshine and a dry wind caused the snow to disappear within three days—leaving only very muddy trails and a cold, wet quarry.

“ A few days were taken to verify a geologic section near Lake McArthur, and then the Vermilion River trip was begun. Following down the Bow River, we crossed it near Mount Castle and looked back towards Mount Temple (fig. 13). That night we camped at Vermilion Pass. Some conception of the mountain walls of the upper Vermilion canyon valley may be gained from the view of the west side of Storm Mountain (fig. 15). Lower down the valley on the eastern side near the mouth of Ochre Creek, Syncline Peak (fig. 16) shows remnants of the compression and folding that accompanied the uplift of the mountain massif now cut by erosion into hundreds of mountains, ridges and canyons. In the lower canyon of Tokumm Creek, near Vermilion River, the water passes over a fall into a huge pothole (fig. 17) and then into a narrow, deep canyon where it is often lost to sight in the deep shadows of the overhanging walls. In two places deep potholes were long ago worn in the bed of the stream and, when their enlarging lower portions met, the water poured through the opening and finally the original rim between them was left as a natural bridge above the stream. A very good view of this was secured (fig. 18) by a long time exposure from 60 feet above the water.



FIG. 15.—West face of Storm Mountain (10,300 feet) from the east slope of Mount Whympet, about 2.5 miles (4 km.) below Vermilion Pass. Note the great amphitheater or hanging valley on the right and left of the main summit. Photograph by Walcott, 1917.



FIG. 16.—The north face of Syncline Peak (elevation 8,622 feet), which rises above the broad flat at the junction of Ochre Creek and Vermilion River, 5.5 miles (8.8 km.) southwest of Vermilion Pass. Photograph by Walcott, 1917. The close faulting of the thin Middle Cambrian limestones is beautifully shown by the bare cliffs above timber line.



FIG. 17.—Tokumm Creek and falls at mouth of lower canyon, one-quarter mile above Vermilion River and 3.5 miles (5.6 km.) southwest of Vermilion Pass, British Columbia, Canada. Photograph by Walcott, 1917.

Tokumm River below the falls has worn a narrow, deep canyon, and in places the canyon walls are so close together and so irregular that the stream cannot be seen from above.



FIG. 18.—Looking down into Tokumm Creek canyon below the falls shown in fig. 12. As the result of the wearing of very deep and large potholes in the massive Cambrian limestones the extended lower portions of adjoining potholes have been united, leaving a natural bridge near their upper margin far above the rushing torrent below. Photograph by Walcott, 1917.

“ From the Vermilion River the party followed a new forest ranger trail up Tumbling Brook to a small, beautiful glacier beneath the great, eastward facing cliffs of Gray Peak which is shown in the panoramic view (fig. 1 of this sketch), on the left of the pass between it and Mount Drysdale.

“ Wolverine Pass is a broad, rolling area at about timber line. On its southwest slope the northeast branch of Moose Creek begins, on



FIG. 19.—Bull moose shot for the collections of the United States National Museum. Photograph by Walcott, 1917.

A cow and young were also obtained near by, all on the west side of the Vermilion River, about 9 miles below Vermilion Pass.

the north slope the head waters of Ochre Creek, and on the southeast the drainage is to Tumbling Creek, a branch of Ochre Creek. The views from the upper slopes northeast of the Pass are among the finest in the Canadian Rockies.

“ Mount Drysdale, on the right, rises 2,200 feet above the Pass, and Mount Cambria, on the left, 1,800 feet, the altitude of the Pass being 7,200 feet. Tumbling Glacier, on the left of Mount Gray, is formed from the snows blown over Tumbling Cliffs from the westward. On

the right of Mount Drysdale the eastern side of the great Washmawapta snow field may be seen; in the distance through the Pass the dark Beaverfoot Range, and beyond it in the extreme background the snowy peaks of the gray Selkirk ranges.

"A late September storm drove us back from Wolverine Pass to the Vermilion River where below Ochre Creek a search was made for moose. By a lucky scout on September 30, Vernon Wood located a herd above the Vermilion River, and the next day a great bull (fig. 19), a cow and young were brought down under permit granted by Chief Game Warden Byron Williams of British Columbia.

"There is a fine mountain region between the Continental Divide and the upper Kootenay Valley of British Columbia that still awaits exploration by the geologist and photographer interested in grand views and great series of very old rocks that were formed in the earlier history of the continent."

GEOLOGICAL AND PALEONTOLOGICAL FIELDWORK

But little was accomplished by the National Museum divisions of Economic and Systematic Geology in the way of fieldwork during the season of 1917.

During the latter part of April and early part of May, 1917, Assistant Curator Wherry of the division of Mineralogy, while on private business in the west, was detailed to collect materials for the school duplicate series in sundry easily available localities. This resulted in the acquisition of the lots mentioned below:

Upward of 100 geodes from the well-known locality at Warsaw, Illinois; 100 specimens of wolframite in matrix, 200 pounds of pegmatite carrying cassiterite, and an equal amount of amblygonite, from the region about Keystone, South Dakota; about 150 specimens of zinc and lead minerals and 200 pounds of beautiful chert breccia from the new zinc district at Picher, Oklahoma; and some 300 pounds of hematite with coarse apatite inclusions from Iron Mountain, Missouri.

The division of Invertebrate Paleontology has been enabled to carry out a more extensive series of investigations and collecting trips. Doctor Bassler reports that in company with Assistant Curator Doctor C. E. Resser, he spent ten days in the Frederick and Hagerstown valleys of Maryland with the object of securing for the exhibition series large examples illustrating the various types of conglomerate. Two fine, large masses of the well-known Triassic limestone conglomerate were obtained with little difficulty, but equally

good examples of the siliceous variety were secured only after much hard labor, owing to the ready disintegration of the rock on exposure. Efforts were finally successful, however, and there was also secured a mass of the so-called "edgewise" conglomerate several feet in diameter, which will well illustrate the phenomenon of intraformational conglomerate described a number of years ago by Secretary Walcott. This last was obtained where the steeply dipping lower Ordovician beds outcropped in such a manner that the desired material could be blasted without fracturing. The mass obtained is shown at



FIG. 20.—Steeply dipping Lower Ordovician strata near Hagerstown, Md., composed of "edgewise" conglomerate. Photograph by Bassler.

A in figure 20. Figure 21, about one-sixth natural size, shows this peculiar structure and the reason for the name "edgewise" beds applied to these strata. All of such conglomerates are the result of ancient mud deposits of tidal flats becoming sun cracked when exposed to the air. The dried edges of the sun-cracked areas become tossed about by the wind and the fragments finally accumulate in layers which ultimately are hardened into rock-like conglomerate. Conglomerates usually indicate the base of a formation, but this particular kind may occur at any place within a formation, whence Mr. Walcott applied the specific name "intraformational" to them.

Following the geologic work in the Appalachian Valley in the early summer, Dr. Bassler proceeded to central Kentucky where he spent several weeks in explorations for suitable exhibition specimens covering the general subject of stratigraphic paleontology. It was especially desirable that such phenomena as stratification, the occurrence of fossils, and unconformities should be illustrated in the Museum, and especial efforts were made to secure specimens exhibiting these features. Much discrimination was necessary in the selection of these objects, as it was essential to obtain specimens of such size as to be appreciated by the public and still not too large for



FIG. 21.—Surface of limestone layer A, of fig. 20, one-sixth natural size, showing "edgewise" conglomerate. Photograph by Bassler.

the available space, which is somewhat limited. This difficulty complicated the work, but the selection finally made was extremely satisfactory.

The early Paleozoic coral reef near Louisville, Kentucky, from which a section six by ten feet in dimensions had been quarried and placed on exhibition during the summer of 1916, was revisited and several additional layers of highly fossiliferous shale and limestone were secured. These have now been added in their proper position to the coral reef mount so that this single exhibit now illustrates the subjects of stratification in general, horizontal strata, change of lithology from limestone to shale, the occurrence of fossils in these

types of sediment, and the phenomenon of fossil coral reefs for which the exhibit was primarily planned.

The most valuable result of the summer's work was achieved at Elkins, Kentucky. Here a single limestone slab, six feet long and several feet wide and thick, showing an unconformity distinct enough to be appreciated by the layman, was quarried out and shipped to the Museum without breakage, where it now forms a most instructive



FIG. 22.—Unconformity between Early Black River limestone (white) and Early Trenton strata (dark) at Elkins, Ky. Photograph by Bassler.

exhibit. As shown in figure 22, the outcropping limestone ledge, several feet in thickness, is composed of a distinctly white lower portion and a dark-colored upper part, the head of the hammer marking their line of contact. This line also marks an unusually clear unconformity. Both of these layers are rich in fossils, those of Early Black River (Lowville) age occurring in the lower white rock and those of Early Trenton in the upper dark material. Since at other places in the United States five hundred or more feet of strata of Middle and Late Black River age intervene between these two layers, it is shown

that Kentucky was a land area during the deposition of the Middle and Upper Black River strata, and that the line AB therefore, marks an unconformity of deposition. This is also evidenced by numerous worm burrows extending downward from the top of the white limestone. When the material was in the condition of soft mud and exposed at the surface, the worms burrowed into it as they do in the soil to-day.



FIG. 23.—Phosphate mine of Wallace, Ky., showing occurrence of phosphate rock along joint planes of limestone. Photograph by Bassler.

The phosphate localities near Wallace, Kentucky, were next visited in order to obtain illustrations of the gradual phosphatization of limestone and the types of fossils in phosphatic strata. Here it was discovered that phosphate rock occurs only along the joint planes of the limestone, as shown in figure 23. Surface water passing along these joint planes leaches out the calcium carbonate of the phosphatic limestone, leaving the calcium phosphate content behind, as is well shown in the photograph. The piece of phosphatic limestone at C was removed and shipped to Washington for exhibition. Here also

another large mass of extremely fossiliferous phosphatic limestone was collected to illustrate the types of organisms composing phosphate rock.

In addition to the large exhibition material mentioned above, the geologic work in the Appalachian and Ohio valleys resulted in the securing of many hundreds of rock, mineral, and fossil specimens which were needed to complete certain of the Museum collections.

During the summers of 1916 and 1917, Mr. Frank Springer continued his researches upon the fossil echinoderms of the Ohio Valley with a view to obtaining further material and information for the completion of a monograph upon the Silurian crinoids of that area which he has now in preparation. His assistant, Dr. Herrick E. Wilson, collected in the vicinity of St. Paul and of Madison, in Indiana, proving for the first time the presence in the latter locality of the crinoidal faunas of both the Waldron and the Laurel formations. One object of the present field investigation is to obtain further light on the relations of the Silurian faunas of the Chicago and southern Indiana areas with those of western Tennessee. Mr. Springer acquired by purchase all the echinoderms in the large collection of Mr. John F. Hammell, of Madison, Indiana, which included that made by A. C. Benedict from the Indiana Silurian, containing the types of a considerable number of species. This material has been added to his collection of fossil echinoderms now deposited in the National Museum.

NORTH CAROLINA SOLAR RADIATION OBSERVATORY UNDER THE HODGKINS FUND

War conditions deferred an expedition which was proposed to be sent to Chile to observe the variability of the sun in co-operation with the Mount Wilson station of the Astrophysical Observatory. Preparations for the Chilean expedition had gone so far that the apparatus and supplies needful for several years were boxed for ocean shipment, and the observers, Messrs. A. F. Moore and L. H. Abbot, were engaged to leave for South America in May, 1917. It seemed, however, best to employ the outfit in the United States until a more favorable time should come to carry on observations in Chile.

Desiring to locate as far from Mount Wilson as practicable, so as to avoid simultaneous weather disturbances at the two stations, Director C. G. Abbot of the Astrophysical Observatory, after consideration of Weather Bureau records, fixed upon Hump Mountain in Avery County, North Carolina, as a high station, easy of access,

likely to give nearly 200 days per year favorable to solar radiation work. He went personally to the station, engaged the use of a plot of ground owned by Huff Bros. & Reynolds and the erection of two frame shelters thereon by a local contractor, W. H. Shores. The spot selected is at about 4,800 feet elevation, but at some distance below the top of the Hump, to avoid the tremendous winds which often prevent a strong man from standing on his feet. The houses were boarded within and without the joists, and the air space filled



FIG. 24.—Gorge at Hampton, Tenn., near Hump Mountain, N. C.

with shavings, to make them habitable in winter, for, notwithstanding the low latitude, the thermometer occasionally goes to -15° F. or even colder on the mountain.

The expedition went forward in May, 1917, and the apparatus was set up by Messrs. L. B. Aldrich and A. F. Moore. Observations were begun June 17. Director C. G. Abbot spent several days there early in July, instructing in the reduction of measurements.

Messrs. A. F. Moore and L. H. Abbot carried on the work until the close of 1917, and will continue it until the spring of 1918. The hope entertained for favorable weather has been disappointed.

Cloudiness was nearly continuous until October, and though no doubt this season was exceptionally bad, yet, even in the long stretch of fine weather of October and November, the values obtained were frequently ruined by changes of the atmospheric transparency. It is



FIG. 25.—Observatory and cook-house,
Hump Mountain, N. C.



FIG. 26.—L. H. Abbot observing
sky-radiation.

expected that results of special value will occasionally be obtained in the winter, owing to the low temperature and low humidity then prevailing, but there is no encouragement to continue the observatory for a term of years.

Valuable work has been done with the pyranometer on the brightness of the sky, the quantity of radiation available to vegetation in the forest, and on nocturnal radiation. This work will also go on through the winter, including measurements on snow fields, and the

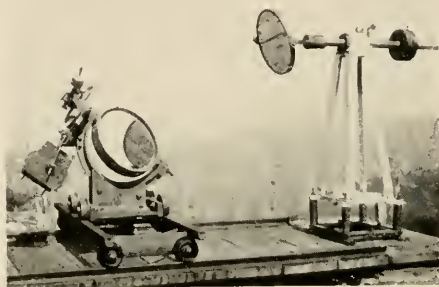


FIG. 27.—The coelostat for reflecting sun-rays.



FIG. 28.—A. F. Moore reducing observations with slide-rule machine.

investigation of certain errors likely to be made in nocturnal radiation work.

It is to be hoped that the expedition will yet be transferred to northern Chile. In that region where rain scarcely ever falls, winds never rise above the gentlest breezes, absolutely cloudless skies pre-

vail for 260 days per year, and skies not more than 1/10 cloudy prevail over 300 days per year, at an elevation above 8,000 feet, with sky of the deepest blue, the conditions are believed to be far the best in the world for the study of the variability of the sun.

It is now known that large fluctuations of the earth's temperature and of barometric pressure, changes of the intensity of terrestrial magnetism, variation of the numbers of sun spots and of the distribution of light over the sun's disk are all closely associated with variations of the intensity of solar radiation. Even our understanding of the variability of the stars is likely to be improved by the study of solar changes. All these and other probable applications of its results enhance the interest and value of the proposed Chilean expedition.

GRASSES OF THE ADIRONDACK AND WHITE MOUNTAINS

During the month of August, 1917, Mr. A. S. Hitchcock, systematic agrostologist in the Department of Agriculture and custodian of the section of grasses of the division of Plants in the U. S. National Museum, visited the Adirondacks in New York and the White Mountains in New Hampshire for the purpose of studying their flora, especially the grasses of the alpine summits. In the Adirondacks his headquarters were at Lake Placid from which point excursions were made to the summits of Whiteface and McIntyre, the highest peaks in the group with the exception of Mt. Marcy. It was impracticable to reach Mt. Marcy without the use of a camp outfit. This peak rises to a height of 5,344 feet but Mt. McIntyre is nearly as high (5,112 feet). Both McIntyre and Whiteface extend above the timber line and support at the summit an alpine flora.

The White Mountains reach a somewhat greater altitude than the Adirondacks, Mt. Washington, the highest peak, being 6,293 feet. In the Mt. Washington group there are several peaks whose summits are above the timber line. The alpine flora of these peaks and of the peaks of the Adirondacks are similar, and include plants that farther north are found at a lower altitude or, in the Arctic regions, even at sea level.

Four days were spent investigating the flora of the peaks. The ascent was commenced at Crystal Cascade on the east side, whence the trail led up Tuckerman Ravine to the summit of Mt. Washington, thence down to Lakes-of-the-Clouds where there is an Appalachian Mountain Club hut for the accommodation of climbers. From here the head of Oakes Gulf was explored. The second day was spent along the trail from Lakes-of-the-Clouds to the Mt. Madison hut,



FIG. 29.—Lake Placid, N. Y. A small lake with a portion of the town in the background among native pines and spruces.



FIG. 30.—In the Adirondack Mountains near Lake Placid, N. Y. Pasture in the foreground, meadow in the middle distance, young growth of spruce in the background, and forest in the distance. The forest is mainly made up of white pine and white spruce with a few larches.



FIG. 31.—In the Adirondack Mountains near Lake Placid, N. Y. White-face Mountain, the high peak in the background, is the third highest peak in the Adirondacks. The summit is above the timber line and supports an alpine flora.



FIG. 32.—In the Adirondack Mountains near Lake Placid, N. Y. The cone-shaped trees are white spruce. A thicket of alder borders the stream.



FIG. 33.—White spruce (*Picea canadensis*). Near Lake Placid, N. Y.



FIG. 34.—White pine (*Pinus strobus*). Lake Placid, N. Y.



FIG. 35.—Larch (*Larix laricina*). Lake Placid, N. Y.



FIG. 36.—Lake Champlain at Plattsburg, N. Y. The marsh grass is the narrow-leaved wild rice (*Zizania aquatica*). The plants rise only a foot or two above the surface of the water. This species is distinctly smaller than the wide-leaved wild rice (*Z. palustris*) found so abundantly in the marshes around Washington.



FIG. 37.—The shore of Lake Champlain at Plattsburg, N. Y. The grass shown in Fig. 38 was found along the shore near here.



FIG. 38.—Wild rye (*Elymus canadensis*), growing along the shore of Lake Champlain near Plattsburg. This is the typical form as described by Linnaeus from specimens grown in his botanical garden at Upsala, the seed having been obtained from Kalm in Canada, possibly in the region of Lake Champlain.



FIG. 39.—White pine forest at the base of the White Mountains near Shelburne, N. H.



FIG. 40.—Dense forest, mixed deciduous and coniferous. At the base of the White Mountains near Shelburne, N. H.



FIG. 41.—Birch forest at the base of the White Mountains near Shelburne, N. H.

going by the way of the Westside and Gulfside trail, which passes near the high peaks of Clay, Jefferson, and Adams. The return trip to Lakes-of-the-Clouds hut was made on the third day, descending 3,000 feet through the Great Gulf by the Buttress trail and ascending again by the Six-Husbands trail to the Alpine Meadow. On the fourth day the descent was made by way of Huntington Ravine over a little used and difficult trail.

There are nine species of grasses that may be considered to be alpine. A few others extend from the lower zones into the alpine region. Most of the alpine species are circumpolar and extend southward in the mountains, one to the high peaks of western North Carolina, and two through the Rocky Mountains even to South America. One species, *Poa lara*, is abundant on the upper cone of Mt. Washington, extending quite to the summit, and comprises almost the only vegetation of this area. This is a European species which is found in North America only in the region of Mt. Washington and on a few of the higher peaks of New England.

The forest flora of the mountains consists mainly of white pine, white spruce, larch, aspen, and white birch. Toward the summits of the peaks the dominant tree is the balsam fir, which near timberline becomes a straggling shrub.

BIOLOGICAL EXPLORATIONS IN CUBA AND HAITI

In recent years Mr. John B. Henderson, a Regent of the Smithsonian Institution, has made numerous collecting trips to the West Indies usually accompanied by some members of the Museum staff, exploring new and little-known localities with special reference to the mollusk fauna.

In 1917, Mr. Henderson and Dr. Paul Bartsch, curator of the division of Marine Invertebrates, spent the month of March exploring the region about the Guantanamo Naval Station in eastern Cuba. This is a semi-arid coastal zone with a complex of hills differing faunally from the more elevated and humid Sierras of the interior. They subjected the region to a process of intensive collecting, securing a large quantity of very interesting land shells, birds, reptiles, plants, fossils, and marine invertebrates. Particularly fine series of the very interesting *Cepolis ovumreguli* and *Polymita versicolor* were secured, which are shown in the accompanying photographs.

Dr. Bartsch also made an exhaustive study of the ship worms (marine boring mollusks) of this region. A report thereon has been published in co-operation with the Corps of Civil Engineers, U. S. Navy.



FIG. 42.—A view on Lake Assuei: a habitat picture of the type locality of Henderson's Rail (*Porzana flaviventris hendersoni* Bartsch).

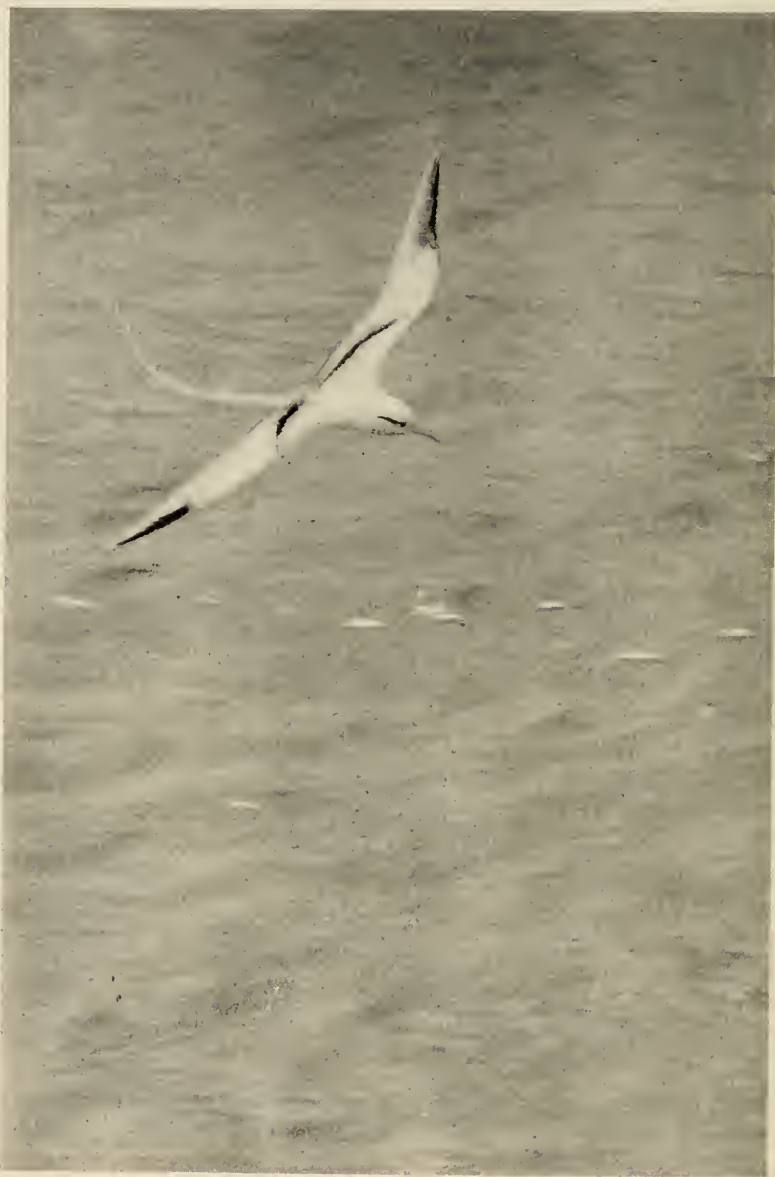


FIG. 43.—A yellow-billed tropic bird (*Phaeton catesbyi* Brandt) sailing from the nesting cliff a little west of Jeremie, Haiti.



FIG. 44.—The Haitian Palm Crow (*Corvus palmarum* Württemberg) seriously objecting to an examination of its nest, in the "Cul-de-Sac" region of Haiti.



FIG. 45.—A picture of the Haitian Burrowing Owl (*Spectyto floridana dominicensis* Cory) which, unlike its Floridian relative, is frequently seen in the trees.



FIG. 46.—The Haitian Lizard Cuckoo (*Saurothera dominicensis* Lafresnaye), an exceedingly important member of the Haitian avifauna.



FIG. 47.—Two Haitian lizards (*Amciva chrysolacma* Cope), which rival the peacock in coloration. These are very abundant along the roadsides where, during the mango season, they feed very largely upon the pulp left clinging to the rejected seeds.



FIG. 48.—A plate of beautiful banded land shell (*Polymita versicolor* Born) from Guantanamo Bay, Cuba.

The month of April was spent in Haiti, where they thoroughly explored the "Cul-de-Sac" region, the north coast of the western peninsula and the coastal range from the "Cul-de-Sac" north as far as San Marc, from which regions very little land mollusk material was represented in the Museum collection. This material was very necessary in order to complete the links in the chain of the distribution of the West Indian land mollusks, a problem which presents many interesting scientific phases, which, when fully examined, will throw much light on zoogeographic distribution. In the "Cul-de-Sac," collecting stations were made about Port au Prince, along the line of the coast north of the city, at Thomazeau and on the shores of Lake Assuei. In the coastal range north of the "Cul-de-Sac," collections were made at numerous points from San Marc to Lake Assuei, the higher elevations being reached at Morne à Cabrits and the mountains back of Trou Caiman. Collections were also made in the hills south of Port au Prince and about Petionville.

On the north coast of the southern peninsula collecting was done at Petit Goave and Miragoane, but more concentrated efforts during a period of two weeks were devoted to the mountains about Jeremie, a region of considerable importance in the study of Antillean zoogeography. With Jeremie as a base, daily collecting excursions were made covering a very considerable area.

A representative series of about 15,000 specimens was secured; also about 1,000 other natural history specimens, including several new birds, some very interesting cacti and other plants and miscellaneous invertebrates, insects, fossil mollusks, fishes, batrachians, bats, and mice.

An extensive series of interesting photographs was also made, many of which will be used in a report on the expedition which the explorers hope to publish in the near future.

A VISIT TO THE CERION COLONIES IN FLORIDA

Through the co-operation of the Carnegie Institution and the U. S. National Museum, Dr. Paul Bartsch was enabled to again visit the Bahama Cerion colonies which he planted in 1912, for the purpose of studying the results attained during the past year. He reports securing a series of adult specimens of the second Florida grown generation which, when compared with those of the first Florida grown generation of the previous year's collections, will furnish the basis of a report showing the effect of the changed environment upon these organisms.

As in previous years, Dr. Bartsch kept a record of the birds observed between Miami and the Tortugas. These notes, as heretofore, have been published in the Year Book of the Carnegie Institution. An especially fine series of photographs of the birds inhabiting the Tortugas was secured and will furnish the basis for an article to be published in the near future in the Annual Report of the Smithsonian Institution.

ANTHROPOLOGICAL STUDIES ON OLD AMERICAN FAMILIES
BY ALEŠ HRDLIČKA

In continuation of his researches on old American families, Doctor Hrdlička, in 1917, made trips to Yale, Virginia, and Harvard Universities. The last two were visited on the occasion of the "Teachers' Course" which brings to these institutions many adult individuals of old American parentage from a large territory. The work was greatly facilitated by the assistance received at Yale from Prof. George Grant MacCurdy; at the University of Virginia from Prof. Robert Bennett Bean; and at Harvard from Prof. K. G. T. Webster. The total number of subjects examined, mainly for pigmentation of hair, and eye and skin color, amounted to over one thousand, all of whom were Americans of at least three generations on both the paternal and maternal sides of the family.

The results which are now being elaborated for a report are of uncommon interest. They show a number of important facts of which we had no previous reliable knowledge. One of these is, in brief, that there is no increase in the proportion or grade of pigmentation as we proceed from New England southward, and no increase in blondness as we proceed northward from the Carolinas and Virginias. Another striking result shows that there are localized peculiarities in pigmentation, especially that of the hair, but that in every case these can be traced to the ancestry rather than to the environmental conditions. The latter nevertheless appear to have been active in general in reducing the total proportions of blondness.

So far as the color of the eyes is concerned there were found unexpectedly, in all the areas, a large proportion of "mixed" colors, in other words eyes in which more or less marked traces of brown co-exist with various shades of blue, green, or grey.

Three cases were encountered in which the color of the two eyes was markedly different. Pure, beautiful blues and browns were few in number.

THE MOUNTAINEERS OF TENNESSEE

During the latter part of July, Doctor Hrdlička made a trip to eastern Tennessee, for the purpose of becoming acquainted with the characteristics of the population of these regions, which in large part is of old American stock but has long existed under disadvantageous environment, remaining as a result backward in education and in other respects.

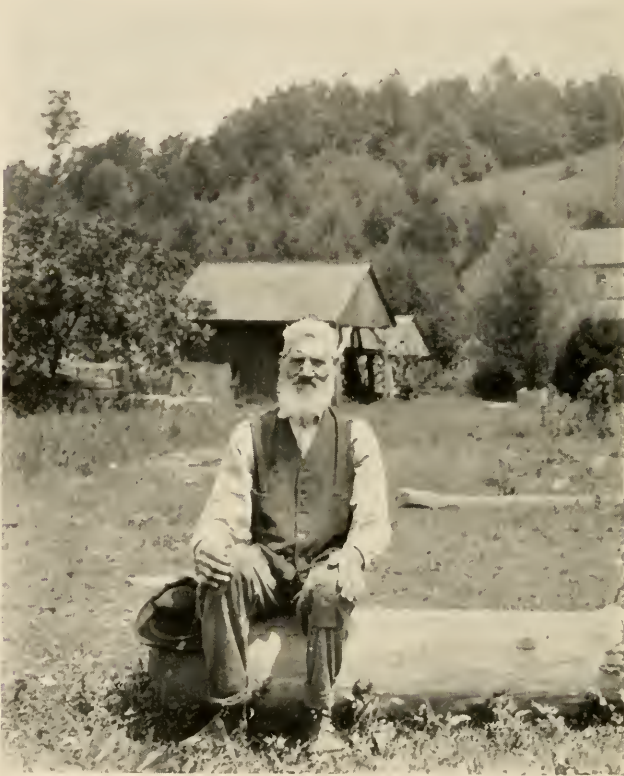


FIG. 49.—Samuel McQueen, 78 years old, mountains of eastern Tennessee.

The work commenced at Bristol, Tenn., extended to Mountain City, and farther on into the hills; and its success was very largely due to the kind offices and direct personal help of an old friend of the Smithsonian Institution, Mr. Samuel L. King of Bristol. For additional help the writer is indebted to Mr. John Caldwell of the same city.

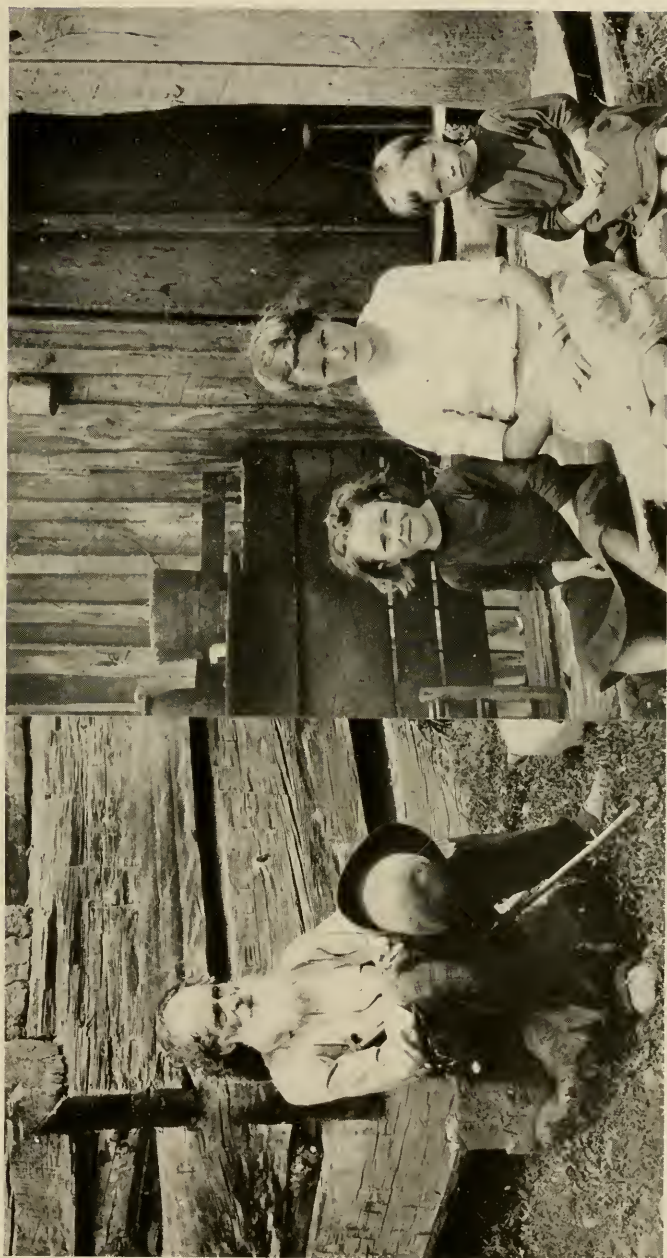


FIG. 50.—Mr. J. H. Henderson, 83 years old, and his latest progeny, Silver Springs region, mountains of eastern Tennessee.

The work extended mainly to the men called for examination by the first draft for the U. S. Army and comprised 150 individuals. Both measurements and observations were taken. Some of the men came from the lower lands of the Bristol district and were kept apart, but a good number represented the real mountaineers.

It is too early to speak of the results of this interesting piece of research, the data not having as yet been properly reduced and



FIG. 51.—Mountaineers of eastern Tennessee. Mr. J. E. Morell, 54 y.; Mrs. M. Eller, 86 y.

analyzed; but it is safe to say that these mountaineers represent no separate type of Americans. In many cases they still show strong indications of their respective pre-American ancestry. Among the men there were seen some fine examples of physique—willowy, clean-cut six-footers; but there were also others of rather feeble mental powers or nervous stability, which conditions, to some extent possibly, are due to hereditary effects of alcoholism, or to defective heredity of other nature.

The families of the mountaineers are remarkable in many cases for their large size and there were seen examples of longevity and virility which it would be hard to find in our cities. One of the accompanying pictures shows the three younger children of Mr. Henderson, 83 years old. They are by his second (or third) wife and his children number 21 in all, a fair proportion of whom are still living.



FIG. 52.—E. Cornett, 24 years old, mountains of eastern Tennessee.

There are all grades of "mountaineers" and no line of demarcation separates them from the people in the lower lands, who are mostly of similar derivation and sometimes of the same families. But as one proceeds into the wilds of the mountains, the population becomes sparser and more backward, the cultivated patches of ground smaller in area, and the habitations poorer, until some of the latter come to resemble the shacks of the southern negro.

The poorer class of mountaineers frequently show characteristics partly due to their backwardness in education and their isolation, and partly perhaps to hook-worm disease or other abnormal conditions. Some of the young men are types of slouchiness, such as would delight the artist; while the women disfigure themselves by chewing snuff and frequently show uncouthness in dress, movements, and behavior. But the people are hospitable and interesting. In the course of a short ride of less than two miles through a sparsely settled gorge, the writer and his local companion had no



FIG. 53.—Mountaineer's shack and patch of corn, eastern Tennessee.

less than four invitations to lunch—in the other places there was no one at home. Their language and intonation are characteristic and quaint, and the people seem to be full of old and local folk-lore, the study of which would probably prove most delightful. Being largely dependent on themselves and their few neighbors they have also many antiquated and strange curative practices which would repay investigation.

Their worst enemies are the isolation, "moonshine" whiskey, and, in not a few cases, undoubtedly a poor heredity. The army draft

will be a God-send to many of the young men, some of whom can not even read or write; but probably few of those who will return will remain mountaineers.

THE VANISHING INDIAN

The progress of miscegenation among many of the Indian tribes has progressed to a degree that is surprising even to those who for



FIG. 54.—Ruth Spoon-Warrior, 73 y., full-blood Shawnee.

many years have been studying the Indian. While the total number of "Indians" as recorded by the census increases from decade to decade, the fact is that this increase is due wholly to that of mixed bloods; the full-bloods of pure strain are in most localities rapidly disappearing and in a considerable proportion of the tribes have become actually extinct or are on the point of extinction.



FIG. 55.—Nancy French (near 70 y.); John Scott (70 y. or slightly over), brother and sister, full-blood Shawnee.

Two remarkable examples of this fact have just been experienced by the writer. For years a growing necessity in American anthropology has been to determine the physical type of the Shawnee, once a large tribe and one of considerable historic importance. No great difficulty was apprehended in this task, as the tribe is still well represented. The most promising part of the tribe was that of the so-called "absentee" Shawnee, on the Shawnee Agency in eastern Oklahoma. They count 569 individuals, quite a few of whom are generally regarded as "full-bloods."



FIG. 56.—On the Shawnee Reservation. From left to right: Creek mixed-blood; Four-Dollars (82 y.), Shawnee with slight admixture of white blood; a half Shawnee half Delaware, with possibly some white blood.

Due to a grant of \$100 from the Committee of One Hundred on Research of the American Association for the Advancement of Science, the writer was able to visit the tribe during the early part of August, 1917. To his great disappointment the task of finding some pure-bloods became exceedingly difficult. Quite a few of the Indians were found to be "full-bloods," but on inquiry into the family history it was generally learned that the subject was a mixture of Shawnee with the Oneida, Delaware, Creeks, or some other tribe. In conclusion, there were found but three individuals

who so far as they or their friends knew were full-blood Shawnee. Two of these were old women and one an old man, all near or over 70 years of age, and two of the three were sister and brother.

The next tribe visited was the Kickapoo, the main body of which to the number of 211 is settled about McLoud, Oklahoma. They were said by the old Shawnee to be practically the same people with themselves, having at some time in the past had but one camp-fire, and it was generally believed that they would show some full-bloods of pure strain. This proved to be a vain hope. On close inquiry all sorts of mixtures were discovered, even among the oldest men and



FIG. 57.—On the Kickapoo Reservation. Children of mixed Indian blood.

women of the tribe, but no pure-bloods. Only one single woman of middle age was believed to be possibly a full Kickapoo, but there was no real certainty. Some visiting Kickapoo from Mexico proved no better than the rest, and no hope was given that any pure strain Kickapoo could be found anywhere else.

Thus two tribes, one of which of considerable importance, may be regarded as lost to science, so far as pure-bloods are concerned. Only a few years ago according to local information there were still a number of old men and women living in both tribes who represented the pure strain. The genuine Indian is rapidly passing away and the work of the anthropologist who endeavors to record the physical type of the various tribes is becoming increasingly difficult.



FIG. 58.—A Kickapoo child in a brush shelter.



FIG. 59.—On the Kickapoo Reservation. Young woman of mixed Indian blood.

EXCAVATIONS AT HAWIKUH, NEW MEXICO

An expedition was organized under the joint auspices of the Bureau of American Ethnology and the Museum of the American Indian, Heye Foundation, of New York City, for the purpose of conducting excavations at the ruined pueblo of Hawikuh, one of the celebrated Seven Cities of Cibola of the sixteenth century, occupied by ancestors of the present Zuñi Indians of western central New Mexico. This research, made possible by the generous aid of Harmon W. Hendricks, Esq., a trustee of the Museum of the Amer-



FIG. 60.—Looking east from Hawikuh across the Ojo Caliente plain. The elongate mound in the foreground is the ruin of the old church built about 1629. Photograph by E. F. Coffin.

ican Indian, was commenced in May, 1917, under the immediate direction of Mr. F. W. Hodge, ethnologist-in-charge of the Bureau, assisted by Mr. Alanson Skinner and Mr. E. F. Coffin of the Museum mentioned.

Both archeologically and historically Hawikuh is one of the most interesting Indian sites in the United States—from an archeological viewpoint by reason of the light the excavations are expected to shed on the primitive culture of the Zuñi people, and historically because of its prominent place in the earliest Spanish annals of the South-

west. It was the first of the Seven Cities of Cibola to be seen by the Franciscan Fray Marcos de Niza, the first white man to enter what is now New Mexico and Arizona, in 1539, and it was the scene of the murder of Estevanico, the negro guide of Fray Marcos. Coronado, who led the most remarkable expedition that ever entered the domain of the United States, stormed the town in 1540, captured it after almost losing his life in the effort, and wrote therefrom his celebrated letter to the Viceroy Mendoza on August 3, in which he set forth the progress of his army and described the customs and



FIG. 61.—The ruins of Hawikuh from the east. The summit of the knoll on which the pueblo was situated is sixty feet above the plain. Photograph by E. F. Coffin.

products of the natives. Hawikuh was visited also by Espejo in 1583, by Oñate in 1598 and 1604, and by other Spanish explorers. In 1629 a Franciscan mission was established there and an adobe church built (fig. 60), but in 1670 the pueblo was raided by the Apache and thenceforth abandoned.

The ruin of Hawikuh is situated on the summit and slopes of a mesa-like elevation (fig. 61), fifteen miles southwest of the present Zuñi pueblo; the entire area covered by the settlement approximates fifteen acres. Excavation was commenced in the western side of a great refuse-heap that covers the slopes, consisting of ashes and



FIG. 62.—Several graves exposed in the Hawikuh cemetery.
Photograph by E. F. Coffin.



FIG. 63.—Uncovering the foundation walls of houses 15 feet beneath the refuse heap of Hawikuh. Ruined walls of the more recent pueblo are seen at the top. Photograph by E. F. Coffin.

other house refuse, the débris of building, sherds of pottery and other rejecta, and drifted sand. In this refuse the dead were buried (fig. 62). Beneath the deposit, at a depth of fifteen feet, the foundation walls of houses, built at two periods earlier than Hawikuh on the summit, were encountered (fig. 63) with burials of those who had occupied them, the graves being in the rooms, under the walls, and outside the houses, but rarely accompanied with pottery vessels or other artifacts such as were generally placed with the dead. The

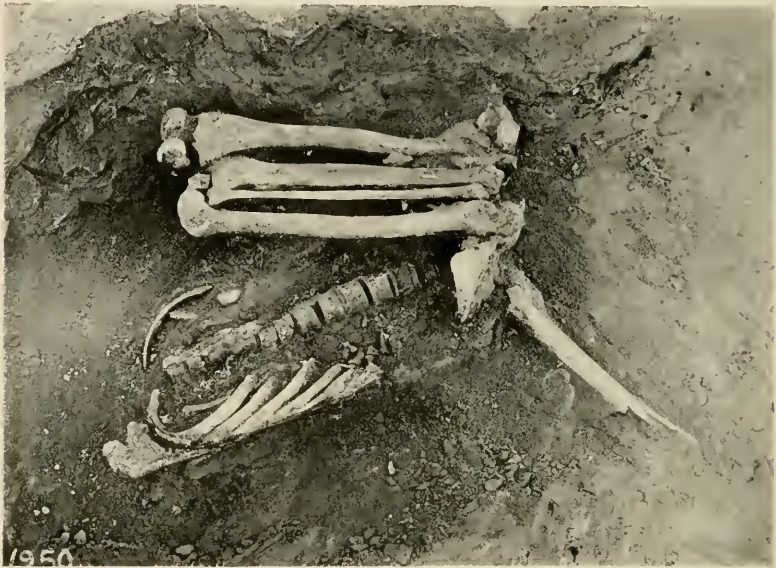


FIG. 64.—Remains of a partly dismembered burial found four feet deep in the refuse, without accompaniment. Photograph by E. F. Coffin.

skeletons in most of these older graves were usually incomplete, as if purposely dismembered at the time of burial (fig. 64); and in one instance the bones almost without exception had been deliberately broken (fig. 65). In addition to these two forms of burial the Zuñis of Hawikuh also cremated some of their dead and deposited the incinerated bones in jars, which were buried with the usual vessels of food and water. Evidently the personal ornaments of the dead were buried with the bodies in these instances, as calcined shell



FIG. 65.—A "pre-Hawikuh" burial almost every bone of which had been deliberately broken. Note the lack of burial accompaniments. Found 6 ft. 4 in. deep in refuse deposit. Photograph by E. F. Coffin.



FIG. 66.—Hawikuh. An extended burial with its accompaniments of pottery vessels, remains of loom beams and other weaving apparatus, fabrics, etc. Photograph by E. F. Coffin.

beads were found with the fragments of burned bones. Early Spanish writers speak of the Zuñi custom of cremating the dead. Above these interments, however, and extending to within a few inches of the surface, were the graves of the later people, those who lived in Hawikuh proper. These dead, unlike the more ancient



FIG. 67.—Hawikuh. The upper part of a skeleton almost completely covered with remains of baskets and corn. Note the prayer-sticks over the pelvis. Photograph by E. F. Coffin.

burials described, were interred usually with the head directed eastwardly, the body fully clothed, and accompanied with such personal belongings as, in the case of women, metates and manos, floor and hair brushes, head-rings used in carrying water jars, mats, baskets, raw material for various manufactures, together with pottery vessels

and quantities of food (corn, squash, piñon nuts, etc.), and articles of adornment such as hair combs and ear pendants of wood beautifully incrustated with turquoise and jet mosaic, shell and turquoise ear ornaments and necklaces, finger-rings, etc.; and in the case of men, bows and arrows, arrowpoints, fetishes, prayer-sticks, ceremonial paraphernalia of various kinds, pipes, and of course earthenware vessels and baskets that had contained food and drink. Examples of these more recent burials are illustrated in figures 66 to 68.



FIG. 68.—Hawikuh. Burial of an aged person, body greatly flexed, with a fine bowl decorated in glaze. Found $6\frac{1}{2}$ feet deep in refuse. Photograph by E. F. Coffin.

The pottery deposited with the dead of these burials consisted of from one to a dozen vessels of various forms and a wide range of decoration, although in some cases there were no such accompaniments at all. Bowls predominated, but there were many fine water jars, duck-shape vessels, and cooking pots of plain and indented ware. Most of the pottery utensils were sacrificed or "killed" by being thrown deliberately into the graves, and sometimes many stones were thrown in on them. The oldest decorated pottery from the site consists of a beautiful rich red or red-orange



FIG. 69.—A skeleton in a kneeling posture.
Photograph by E. F. Coffin.



FIG. 70.—Foundations of houses under the refuse of the western cemetery
of Hawikuh. Photograph by E. F. Coffin.



FIG. 71.—The remains of a grinding bin in a "pre-Hawikuh" house.
Photograph by E. F. Coffin.

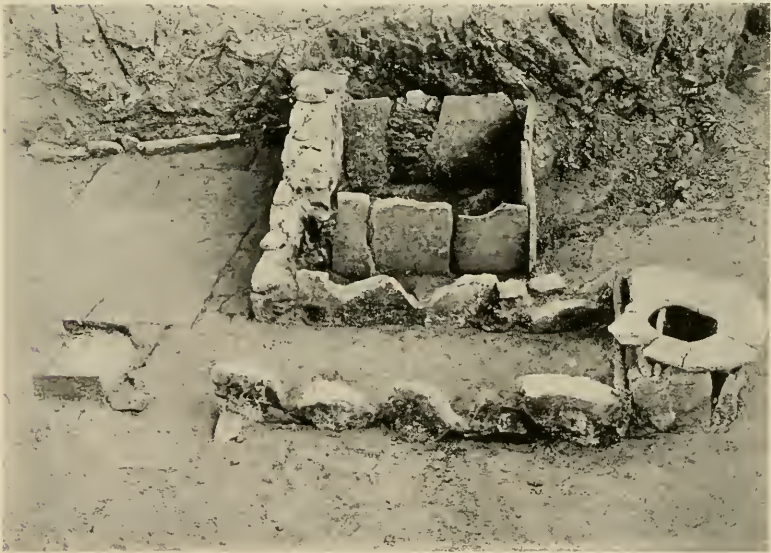


FIG. 72.—A curious structure at the bottom of the refuse, about 15 feet deep. The box-like enclosure, which was once roofed, was probably used for confining rattlesnakes. Photograph by E. F. Coffin.

ware on which was applied geometrical designs in black glaze. The more recent forms are decorated also in glaze, but in green, brown, and red, in addition to black, the glaze, however, was usually poorly applied. Effigy forms in relief are rare, but the eagle, weasel, butterfly, tadpole, and corn plant are among the non-geometric figures employed in ornamenting the vessels by painting. The baskets are chiefly of the woven type, but there is also an example of coiled basketry. Sometimes as many as four baskets were placed or thrown into a grave, almost completely covering the body (fig. 67). The



FIG. 73.—This rock *in situ* was used as a mortar and also for grinding manos and other tools. Photograph by E. F. Coffin.

fabric of the clothing was sufficiently well preserved for identification as cotton, which the Zuñis of Hawikuh probably obtained by trade from the Hopi, who were noted as cultivators of cotton in early times; indeed, early Spanish writers asserted that the people of Cibola did not raise cotton. The dead were often placed on or wrapped in mats, and frequently the grave was lined with cedar or juniper bast, which material served also for torches. Objects of Spanish provenience were encountered frequently—iron nails, a copper buckle, fragments of iron and copper, glass beads, bits of decorated porcelain, bottle-glass, and, at the neck of a child, a Catho-

lic medal or token. Near the floor of one of the houses, eight feet deep, was found half of a pair of scissors. Wooden objects were fairly well preserved, considering the length of time they had been buried, hence it was possible to save batten sticks for weaving, prayer-sticks, bows, arrows, war-clubs, ceremonial objects, loom frames (fig. 66), cane cigarettes, and the like.

Objects of bone are noteworthy because of the fact that so few were found in the graves as compared with the great number recovered from the refuse, no fewer than eighteen hundred being taken



FIG. 74.—The Zuni workmen at Hawikuh. Photograph by E. F. Coffin.

therefrom. These consist of awls, gouges or chisels, needles, pins, whistles, beads of the tubular variety used both as necklaces and for wrist-guards, etc., and ranging from unfinished specimens through the simplest forms to more or less elaborately carved or incised examples.

The masonry of Hawikuh is of stone and is well constructed; indeed the walls are far superior to those of the houses found deep under the refuse (figs. 70 and 71), built before Hawikuh itself, or at least its western part, was erected on the great deposit of debris that covers these more ancient structures. The Zunis raised turkeys, as was shown by the finding of the fragments of an egg-shell con-

taining the bones of the embryo, ceremonially buried with a food bowl, as well as bones of the adult fowl. Eagles were likewise ceremonially buried, and domesticated puppies were given place of interment with the human occupants of Hawikuh. A curious structure of stone slabs on the bottom of the refuse-heap was probably used for imprisoning rattlesnakes (fig. 72). Early Spanish writers mention such a custom at Hawikuh, and one of them states that the rattlesnakes were thus kept in order that their venom might be used for poisoning arrows.

A summary of all the interesting discoveries at Hawikuh is not possible in this brief space, nor is it desirable to offer conjectures respecting the significance of some of the features of the ruin or of various objects found in the course of the season's work, for much remains to be done before the task will approach completion. The excavations were brought to a close late in August and will be continued next season.

ANCIENT PIT DWELLINGS IN NEW MEXICO

Dr. Walter Hough, of the National Museum, spent the month of June, 1917, chiefly in continuation of an investigation on certain remains of ancient pit dwellings near Luna, New Mexico, mentioned in Smithsonian Miscellaneous Collections, Vol. 66, No. 17, 1916 (1917). Excavations were made in various parts of the area with the expectation of finding burials, accompanying skeletons and mortuary objects, but with small results. Sufficient information was secured, however, to give a fair knowledge of the structure of the houses and their arrangement into a village as shown in figure 75. This restoration is a summation of the data acquired through excavation and survey concerning the former aspect of the village. There is no evidence that the great dance pit was stockaded, but it is a reasonable presumption that this great pit, 84 feet in diameter and 10 feet deep, would require an enclosure. Dr. Hough is preparing a report on this interesting find. During the season another site containing about 15 acres was located about seven miles north of Luna, and it is probable that other sites may be found in the general region. The finding of ancient villages of this character is very difficult as they present few surface features by which they may be identified. Of these the shallow concave of a larger pit (dance or assembly pit) is generally the only evidence and this may be obliterated when the site was occupied subsequently by other tribes.

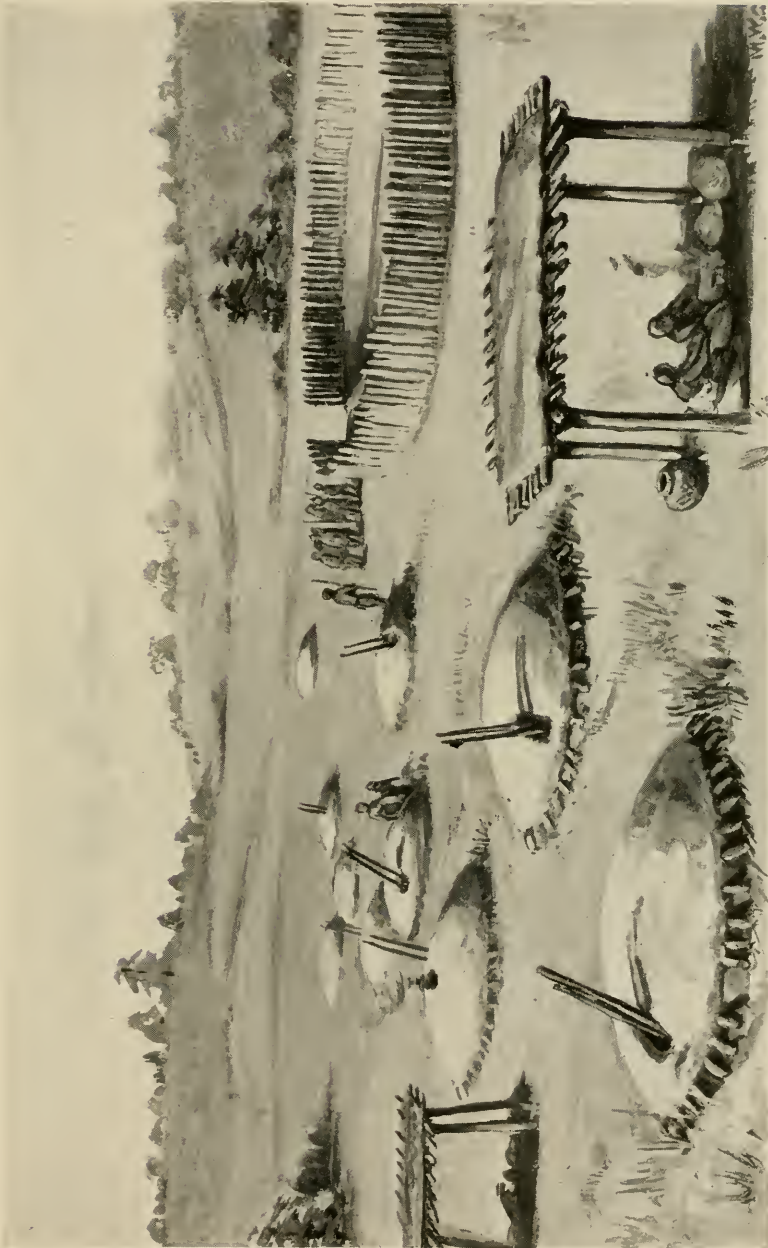


FIG. 75.—Restoration of Ancient Pit-village.

A walled kiva 54 feet square on a small stream running into the San Francisco River from the north was investigated and found to be of the type first discovered by Dr. Hough on the Blue River. On the wall of this kiva grows a huge pine fully matured. It seems rather strange that this kiva has not in its neighborhood any village ruins which would house a population commensurate with the importance of the work or efforts necessary to accomplish its construction.

In the course of the work a number of large ruins were located which appear to be worthy of further examination. The largest of these ruins are in the Fox, Escondido, and Gallo Mountains and seem to show that early migrations were conducted along the watered mountains which stretch eastward from the Escudilla mesa forming the southern boundary of a great arid basin area extending northward from the Rio Grande to the Arizona line. It was observed that the high mountain region presents a ruder culture than obtains at lower elevations in river valleys or basins on the slopes where agriculture produced better returns or where, in the flood plains of rivers having their source in mountains, irrigation is rendered feasible, as in southern Arizona. It was found also that the higher elevations in the mountains did not enforce a hunter life on the inhabitants for hardy varieties of maize could be raised, and thus the mountain culture of the Pueblos presents itself as a ruder phase of the more developed culture of the less elevated lands.

Dr. Hough investigated varieties of maize grown at 7,000, 7,600 and 8,000 feet at Luna, Eagar, and Alpine respectively, and secured samples for the Bureau of Plant Industry of the Department of Agriculture. He also collected a number of very interesting slab mask headdresses used in ceremonies by the White Mountain Apache Indians and other ethnological specimens from this tribe, together with some data on the puberty ceremony and so-called Devil Dance.

The masks, composed of elaborate structures of slats of agave flower stalk decorated with designs in colors and pendants of short rods, etc., are very difficult to obtain. They appear to be related to ceremonial paraphernalia which Dr. Hough obtained from caves in Arizona south of the White Mountain Apache Reservation, described in Bulletin 87, U. S. National Museum (1914).

ARCHEOLOGICAL WORK IN ARIZONA AND UTAH

The Indian Appropriation Act of May 18, 1916, provided \$3,000 for the excavation and repair of the prehistoric cliff-dwellings comprising Navaho National Monument in northern Arizona, the

work to be done under the supervision of the Smithsonian Institution. In March, 1917, Mr. Neil M. Judd, of the United States



FIG. 76.—The main group of dwellings at Betatakin as they appeared late in March. Mountain oak five inches in diameter grew on the debris in the middle portion of the cave.



FIG. 77.—Approximately the same view, after the work of excavation and repair. The long wall in the upper cave may be seen on the ledge above the walls in the middle of the picture.

National Museum, was detailed for this undertaking. He left immediately for Flagstaff, Arizona, engaged a small force of white



FIG. 78.—Restored walls and mealing room, on the sharply sloping cave floor at Betatakin. The original of the wall at the extreme right collapsed after a heavy fall of snow; the front wall of the house at the top fell during a particularly severe thunderstorm, while workmen were engaged below. The three parallel walls are restorations.

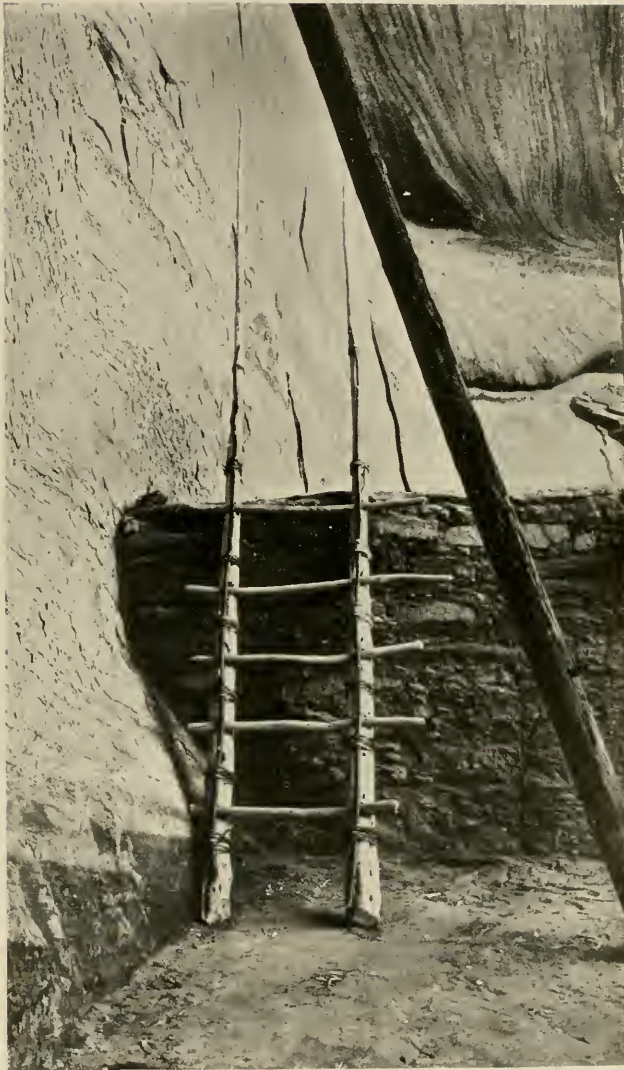


FIG. 79.—One of the ladders placed as a substitute for a series of steps, in this case, cut into the cliff at the left of the wall. The pole in the foreground was used by the ancients in reaching the upper cave from the main village.

laborers, and proceeded northward some 200 miles by trail to Betatakin ruin, an imposing structure which occupies a shallow cave in a branch of Sagie (Laguna) Canyon. Work was inaugurated at Betatakin in preference to one of the other two large pueblos within the boundaries of the monument chiefly for the following reasons: (1) More than one ruin could not be excavated and restored in the time available, from the sum appropriated; (2) Betatakin was, perhaps, in greatest need of repair; and (3) the site was more accessible than the others and furnished abundant water for camp purposes.

Extremely unusual and, oftentimes, discouraging conditions were experienced from the very beginning of the undertaking. Snow, rain, hail, and the severe wind and sand storms so common in the Marsh Pass region, followed each other incessantly, tending to delay and handicap the work in hand. In addition, greater difficulty than that anticipated was experienced in obtaining provisions and in engaging Indians either for work in the ruins or for transportation of supplies. Removal of the cave accumulations had been completed by mid-April, however, and the houses and retaining walls in greatest need of repair or restoration received proper attention before the expedition returned to Flagstaff, late in June.

The accompanying illustrations show the nature of some of the problems encountered at Betatakin and the methods adopted by Mr. Judd in meeting them. In restoring the ancient habitations, every effort was made to preserve the prehistoric atmosphere of the village. Mud mortar similar to that utilized by the original builders was employed in repairing their shattered dwellings and in replacing those house walls which had completely collapsed. In so far as possible, the sandstone blocks and weathered timbers uncovered during the course of the excavations were utilized in the structures as restored. Marks left by the tools of the recent party were carefully erased and imprints of the fingers were intentionally made in the newly laid mortar, the more completely to reproduce the handiwork of the aborigines. Unlike the ancient masonry, however, the new walls appear with joints carefully broken to insure greater strength and durability. The general appearance of the restored dwellings was so far above expectation that this slight distinction between the prehistoric walls and their modern counterparts will prove, in many instances at least, the chief means of distinguishing the latter.

A new trail was made across the talus below the cave, connecting with a series of rude steps which originally formed the principal entrance to the village. These and similar steps in other sections



FIG. 80.—One of several ladders made from the notched trunks of cedar trees and placed in the open courts, as substitutes for series of shallow steps. Similar ladders are still in use among some of the modern pueblo villages of New Mexico and Arizona.

of the cave were enlarged and deepened to furnish secure footing for modern visitors. Ladders were provided as substitutes for steps in



FIG. 81.—Great masses of sandstone had fallen upon the houses at the eastern end of the cave, crushing their walls and oftentimes carrying them over the cliff below. Fragments of standing walls may be seen among the wreckage.



FIG. 82.—Approximately the same view, after the work of excavation and repair. Note the restored retaining wall in the middle foreground. It forms a walk or platform in front of a row of houses whose outer walls were of wattle construction.

other places, especially in open courts where ready access to neighboring housetops is still desired. As noted generally in prehistoric

dwellings of the Southwest, the house roofs at Betatakin were flat and furnished convenient workrooms as well as passages from one



FIG. 83.—A late April snow at Betatakin camp. Snowstorms were of almost weekly occurrence, from the beginning of the work until the last of May.



FIG. 84.—View from the central court, in the great ruin at Paragonah. In the foreground may be seen two fireplaces and charred fragments of three of the posts which supported the roof of a temporary shelter. At this point, seven distinct levels of occupancy were noted in six feet of court accumulations.

section of the pueblo to another. The new ladders, which form connecting links between the several courts, were made of the

notched trunks of cedar trees or from poles to which rundles were tied by willows and withes of squaw bush. Ladders of the second



FIG. 85.—In the foreground may be seen the walls of three superposed dwellings in the great mound at Paragonah. The ancient builders apparently leveled the walls of a house which had collapsed and, without removing the wreckage, built a new structure above the remains of the former.



FIG. 86.—The great mound at Paragonah, as viewed from the north, at the beginning of excavations.

type are frequently found in cliff-dwellings of the San Juan drainage and part of one was exposed by the recent excavations at Betatakin.

After concluding his work in Navaho National Monument, Mr. Judd proceeded to Salt Lake City, as field director of an archeological expedition organized jointly by the University of Utah and the Smithsonian Institution. Excavations were undertaken at Paragonah, in Iron County, where a mound approximately 200 feet square was razed to expose the ancient habitations it covered. The results obtained supplement the previous investigations of Mr. Judd in western Utah, as reported in earlier numbers of this series.¹ A large number of adobe dwellings, arranged in an irregular square, and three kivas or circular ceremonial rooms were uncovered and carefully studied. As observed during the two preceding years,



FIG. 87.—Approximately the same view as fig. 86, after the house walls had been exposed. The walls were made of adobe, built up in irregular layers; the roofs were of poles, covered with willows, grass, and mud. The flat, white areas represent different levels of occupancy.

numerous temporary shelters had been erected by the aborigines in the open courts between their houses; other similar huts were constructed at higher levels as the accumulations of the court increased in depth. An extensive collection of prehistoric artifacts, recovered during the course of the excavations, has been divided between the University of Utah and the Smithsonian Institution.

During his latest work in southwestern Utah, Mr. Judd was assisted by Mr. A. A. Kerr, as representative of the University.

¹ Smithsonian Misc. Coll., Vol. 66, No. 3, 1915, pp. 64-71; Vol. 66, No. 17, 1916, pp. 103-108.

TRIBAL RITES OF OSAGE INDIANS

In the month of January, 1917, Mr. Francis La Flesche of the Bureau of American Ethnology, visited the band of Osage Indians known by the members of the Osage tribe as the Paçugthiⁿ, freely translated, "Those-who-dwelt-on-the-hilltop." Most of these Indians belong to that subdivision of the Hoⁿ'ga tribal division called Wazházhe, a name which the tribe as a whole bears to-day. For religious and ceremonial purposes the Osage tribe is divided into two great parts, one, the Tsi'zhu, representing the sky and the celestial bodies, and the other, the Hoⁿ'ga, representing the earth. The Hoⁿ'ga division is subdivided, one to represent the dry land, the other, called Wazházhe, the water (the seas, lakes and rivers). Each of these divisions and subdivisions has its own version of the great and complex tribal rites by which the people, from an unknown length of time, have been governed, and to which the older people still cling with the old-time reverence and superstitious awe, although these rites are now becoming disintegrated.

The visit of Mr. La Flesche to the "Hilltop" people was principally for the purpose of securing, if possible, a complete version of the tribal rites as practiced by the Wazházhe subdivision, or to secure whatever parts of these rites the members of the Wazházhe might be willing to give. Owing to the conservatism of the members of the Wazházhe subdivision no direct information could be obtained from them concerning their version of the tribal rites. When the men who are versed in the rites were approached on the subject, they simply remarked that the tribal rites are not to be discussed at all times and on every occasion, that the mysteries of the rites are only for those who are duly initiated, and then they become silent or take up for conversation a subject of everyday life. While these "Hilltop" people are consistent in their conservatism, as far as the rites themselves are concerned, they appear not to place as much importance upon the ceremonial paraphernalia, for they have disposed of many sacred objects to curio-hunters or to representatives of museums. The sale of a waxóbe (portable shrine, with its sacred hawk) resulted in a curious and pathetic incident. Five or six years ago a "Hilltop" man transferred his waxóbe (which is always equivalent to an offer of initiation into the tribal rites) to another member of his gens, but retained possession of it, although the transfer was formally accepted and the first fees were paid by the candidate. The keeper of the shrine, after waiting several years and not hearing further from his candidate, yielded to the persistent offers of a

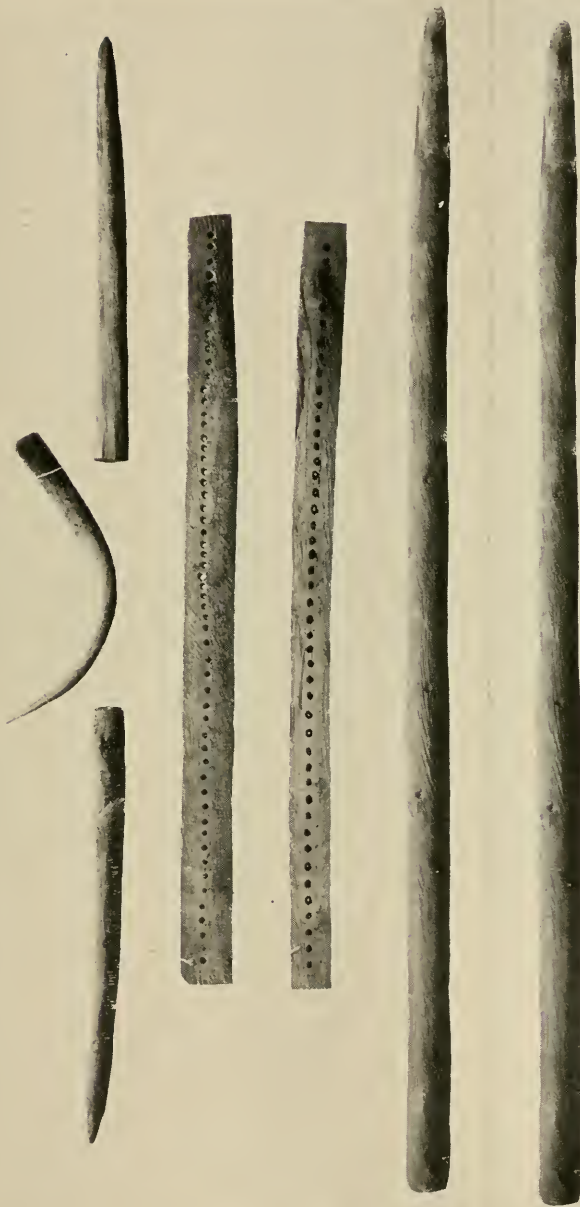


FIG. 88.—Stakes, perforated slats and deer's antler used for the loom and batten when weaving the rush mat and buffalo-hair covering required in making a portable shrine for the sacred hawk.

curio-hunter to purchase it and so parted with the shrine. About two years ago the candidate suddenly demanded that the initiation ceremonies be performed. The Noⁿ'hoⁿzhiⁿga, who had been duly summoned to witness the initiation, assembled, and the ceremonies proceeded in the prescribed manner, but without the waxóbe. At a certain part of the ritual a warrior who had won thirteen war-honors was called on to recount those honors to the sacred hawk in the presence of the assembled Noⁿ'hoⁿzhiⁿga. Kúzhawatse, an aged warrior, and one of the remaining three in the tribe who could count the requisite number of war-honors at the ceremony, was chosen for this coveted honor. At the proper time the old man, gathering up in his hands the thirteen willow saplings which had been placed before him with which to count his honors, arose, thanked the members of the order for the honor conferred upon him, and then addressed the sacred hawk in the following manner: "O, Waxóbe, I rise to speak to you, in words that carry only the truth." Then, suddenly remembering that the waxóbe was not present, he added, "You are not here, but wherever you may be, perhaps in some place on the shores of yonder great water (pointing eastward), however long the distance may be, you will surely hear the words that I shall utter." Then, unmindful of the ill-concealed smiles of the Noⁿ'hoⁿzhiⁿga, he went on, with all the dignity of a warrior, to recount his war-honors, as though the sacred hawk, the emblem of the valor of the Osage warriors, was actually present in its accustomed place.

The results of Mr. La Flesche's efforts to secure from the members of the Wazházhe subdivision, residing with the "Hilltop" band, their version of the tribal rites were disappointing. However, he took advantage of the opportunities that arose for securing other important information relating to the rites. One day there appeared at the Indian house where Mr. La Flesche was staying an old woman who said she had a set of "i'çagthe dapa" ("short-stakes") she wished to dispose of. I'çagthe dapa is the collective name of the stakes, perforated slats and deer's antler (see fig. 88), that are used as loom supports and batten in weaving the rush mats out of which are made the symbolic, portable shrines for the sacred hawks, war symbols, that are distributed among the various gentes of the tribe, and also for the weaving of the buffalo-hair bags that form the outer coverings for the shrines. The old woman said she felt that on account of her age she must soon be departing for the other world and she did not wish to leave the mysterious articles to her

children lest some harm befall them through neglect. She was told that a set had already been obtained from another woman, an official weaver, but that if she would give, with the loom, the *wi'gie* recited at the ceremonial weaving of the rush mat for the making of the shrine Mr. La Flesche would make the purchase. After some reflection the old woman said she was willing to give the *wi'gie*, but asked for time in order to refresh her memory.

In some mysterious way old Kúzhawatse, though nearly stone deaf, heard that Wakoⁿ'dahioⁿbe was about to give away the

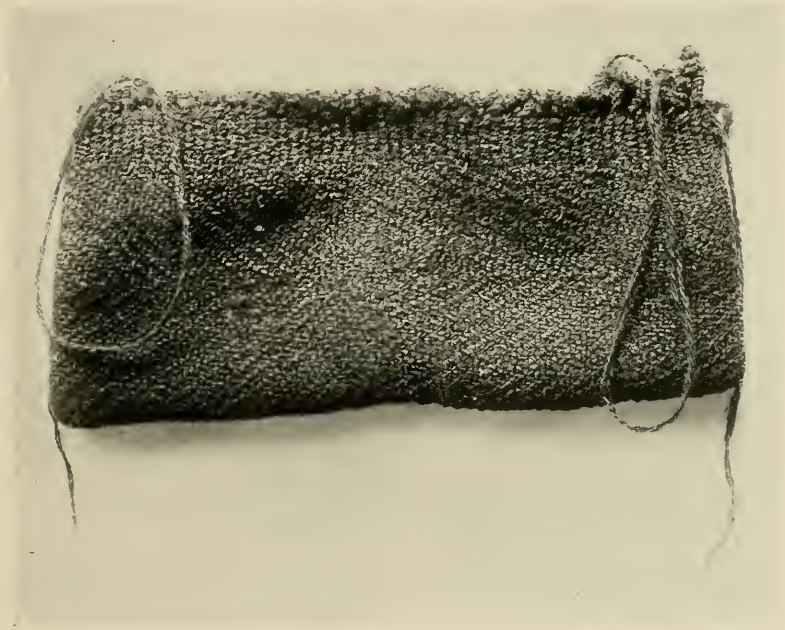


FIG. 89.—Buffalo-hair case that forms the outer covering of the shrine.

sacred loom and the *wi'gie*. He immediately got into an automobile, hastened to the old woman's house where he harangued her in vigorous manner on the sacrilege she was about to commit, and warned her of the *Wáxpegthe*. *Wáxpegthe* is punishment, by supernatural means, that constantly hangs over the head of a *Noⁿ'hoⁿzhiⁿga* and drops on the person the moment an irreverent act is committed. The old woman retorted that the *Wáxpegthe* applied only to the obligations assumed by a candidate for initiation; these obligations she had faithfully fulfilled, consequently she had nothing to fear. Kúzhawatse then, assuming a conciliatory atti-

tude, told her that he would not object to her disposing of the sacred loom, but urged her not to give away the wi'gie, as that act would tend to hasten the disorganization of the Noⁿ'hoⁿzhiⁿga order. The old woman declared that she would dispose of both the loom and the wi'gie, claiming that they were hers by purchase, and emphasized her claim by enumerating to the old man the horses, blankets and other valuable articles she and her husband had paid as fees for her initiation.

Kúzhawatse had assumed the right to interfere with the old woman's action because the wi'gie she had promised to recite belongs to the Wazházhe subdivision, of which he is a prominent member.

On the appointed day Mr. La Flesche appeared with his dictaphone at the old woman's house. Without hesitation she placed before him the "short-stakes" and told of Kúzhawatse's action in the matter. Then, sitting on the floor in front of the machine, she dictated to it the ancient wi'gie, and sang the wailing song, doing this as though she was accustomed to the use of the dictaphone.

The wi'gie and the song she gave filled a gap in the detailed description given by Waxthi'zhi of the ceremonies that were connected with the ceremonial weaving of the portable shrine of the sacred hawk, a hiatus that Mr. La Flesche had almost despaired of filling, as his informant flatly refused to give the wi'gie, consistently adhering to the ancient rule that any part of the rites that exclusively belongs to one of the tribal divisions should not be used by any one belonging to the other divisions without first obtaining permission from the division having ownership.

The set of weaving implements obtained, as stated above, includes seven pieces: four stakes, two perforated slats, and a deer's antler. Two of the stakes are of the length required for the uprights of the loom when it is used to weave the rush mat to be used for making the shrine for the sacred hawk (see fig. 90). The other two are of the length needed as uprights for the loom when the buffalo-hair bag is to be woven (see fig. 89). All four stakes are pointed at one end so as to be planted in the ground and hold the loom steady. The two flat slats are perforated from end to end with small holes, through which are strung and fastened the warp of the piece to be woven. The slats are fastened at right angles to the stakes, one at the top and the other at the bottom, so as to hold taut the threads of the warp.

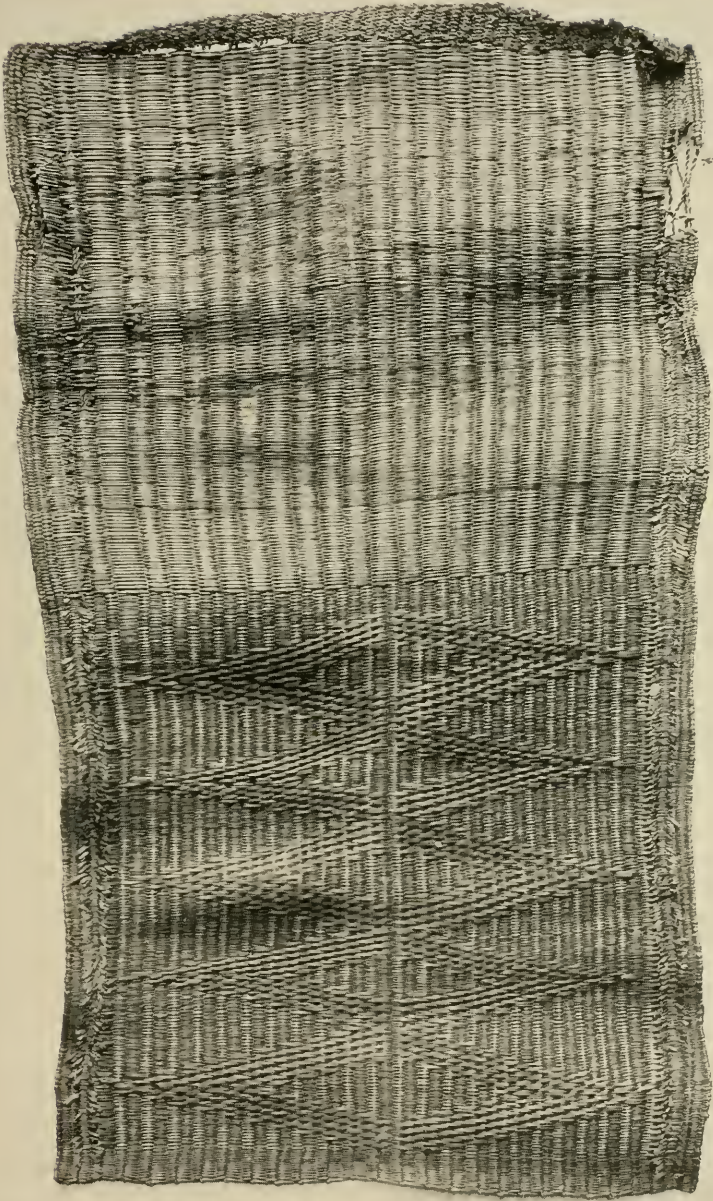


FIG. 90.—Rush mat, with its woven symbolic designs, which forms the portable shrine.

The loom and the batten, after having been ceremonially prepared and consecrated by the Noⁿhoⁿzhiⁿga for the weaving of the symbolic shrine of the sacred hawk, are believed to have become possessed of mythical power that could bring about not only the defeat of the enemies of the tribe, but punish by misfortune any individual member who might treat with irreverence these consecrated articles. The deer's antler used for a batten in the ceremonial weaving is believed to possess greater mystical power than the loom, because it not only symbolizes the sacred arrows of the Wazházhe subdivision, but also the arrows of all the warriors of the tribe.

STUDY OF THE FOX, SAUK AND POTAWATOMI INDIANS

Dr. Truman Michelson, of the Bureau of American Ethnology, left Washington on July 11, for field research among the Foxes near Tama, Iowa. Here he revised the texts pertaining to the White Buffalo Dance, obtained the esoteric meanings of the songs in these texts, and elucidated certain obscure passages. A part of the sociological work of the previous year was duplicated as a check. Lists of ceremonial organizations were made, and the names of the "officers" and the tribal dual divisions of these were secured. It was discovered that at least certain gentes have names for dogs and horses appropriate only to those belonging to members of given gentes; accordingly a number of such names was collected. A list of native terms of fishes and grubs was secured. A number of ceremonies (including the Snake Dance, which is rarely given, and some burials) were witnessed.

Near the close of September Dr. Michelson proceeded to the Missouri Sauks, who are partly in Kansas, partly in Nebraska. It soon became apparent that all who were worthy of ethnologic study had joined the Potawatomi in Kansas. Proceeding among the latter he spent a couple of days working with the Sauks, mainly on sociological matters. It appears that the regulations governing membership in the tribal dual division are not the same as among the Foxes of Iowa; nor are they apparently in absolute agreement with those of the Sauks of Oklahoma. Considering the brief stay with the Potawatomi, work was exceptionally successful. The phonetics of their language are rather complicated, some of the consonants at once recalling similar Delaware ones. A good beginning was made in regard to sociology, though details in many cases must be supplied later. It appears that the tribe is organized in exogamic groups with totemic names, with descent in the male line. The chieftainship

must be in the Bear gens. There were certain relationships of courtesy between gentes; the gentes had definite localizations in certain ceremonies, and had appropriate paints. The regulations regarding membership in the tribal dual division has not been definitely worked out, but it has become quite clear that the dual



FIG. 91.—Ida Poweshiek, mixed Potawatomi and Fox Indian girl of Tama, Iowa.

division was for ceremonial purposes as well as for the ball game. The names of the divisions show clearly that they have been derived from the Sauk, Fox, and Kickapoo. The system of consanguinity is clearly of the Ojibwa type, not that of the Sauk, Fox, and Kickapoo. A number of folk-tales and myths were collected, and it appears that

a fairly large number of European elements have been incorporated. The aboriginal matter definitely proves that two associations must be assumed—an older one with the Ojibwa group, and a later one with the Fox group. Certain plains and plateau elements also occur. The medium or media through which the latter came is as yet unknown. Dr. Michelson returned to Washington October 5.



FIG. 92.—An old Potawatomi man of Kansas.



FIG. 93.—An old Potawatomi woman of Kansas.

STUDIES AMONG THE INDIANS OF CALIFORNIA

Mr. J. P. Harrington, of the Bureau of American Ethnology, spent the period from January 1 to September 30, 1917, in continuing his California studies in the Santa Barbara region of southern California, amassing a large amount of valuable linguistic and other information. Mr. Harrington's time was divided between the Ventureño, Yneseño, Barbareño, and Purismeño dialects, most minute study

being devoted to the Ventureño. A considerably larger amount of the extinct Purismeño was rescued than it had been Mr. Harrington's good fortune to obtain on previous visits. Nearly all of the work was conducted with survivors of the older generation, but



FIG. 94.—Ventura Indian woman.

with the knowledge of this field which Mr. Harrington has acquired it was found possible to secure quite valuable information from some of the younger men, although this information requires to be weighed most carefully. Work in this field requires a thorough

knowledge of Spanish as well as of Indian culture, the two being strangely blent in the informants.

By carefully studying the archeological objects which have been found in the region, it has been possible to obtain an adequate idea



FIG. 95.—Old method of measuring bead money on hand.

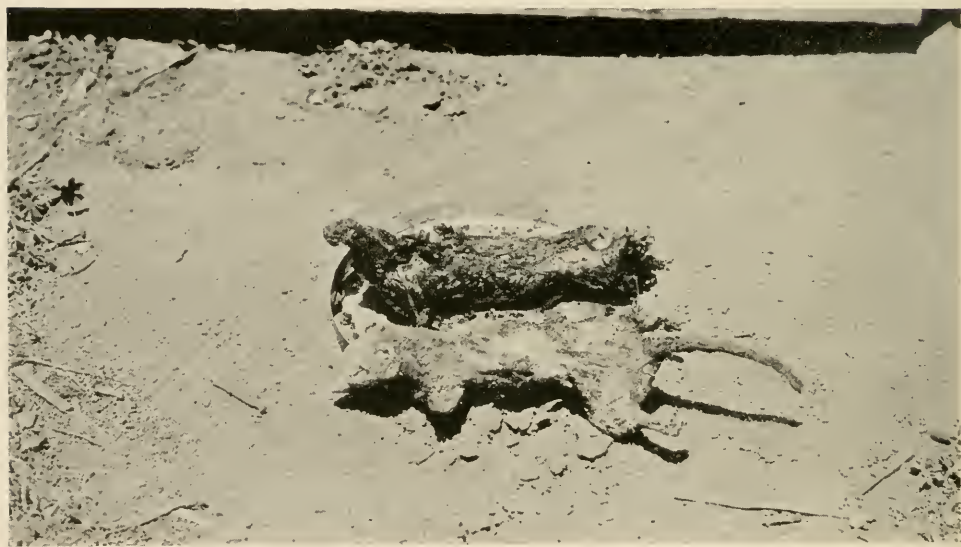


FIG. 96.—California ground squirrels roasted in ashes. One of the few ancient Indian foods which are still popular.

of many of the articles of the vanished material culture. In this way satisfactory information has been obtained on the subjects of personal adornment, archery, basketry, bags, beads and shell money, boats, brushes, buildings, clothing, cradles, deer-headaddresses, dolls, fishing,

food gathering and processes of preparation, hairdressing, mats, measures, musical instruments, regalia, string-making, tobacco and its uses, tools, traps, and other interesting points, although in some cases the informants had never seen the article.

Fortunately it is frequently possible to obtain ethnological information by a more direct method. An old woman was found who still remembered how to measure bead money on the hand, as illustrated by the accompanying photograph (fig. 95), and it is interesting to find Americanized descendants roasting California ground squirrels by the unaltered process of their ancestors (fig. 96).

At the end of September Mr. Harrington returned from the field.

STUDY OF CHIPPEWA MATERIAL CULTURE

During the summer of 1917 Miss Frances Densmore resumed a study of Chippewa material culture begun by her several years ago. This was made possible by the fact that considerable phonographic material had been collected and awaited musical analysis during the coming winter. Returning to the White Earth Reservation, Miss Densmore enlisted the co-operation of many Indians who had assisted in the study of Chippewa music, previously conducted in that locality. The Chippewa tribe has advanced in civilization beyond many other tribes, but there are individuals who neither speak nor understand English and who continue many of the old customs. From such informants a general outline of the old economic life was obtained and several branches were given intensive study.

The ethnobotany of the Chippewa was the subject of special investigation, and an ethnobotanical collection of about 200 plants was obtained, including plants used as medicines, food, dyes, and charms, as well as those used for general utility. With the medicinal plants were collected examples of surgical and medical appliances, and of substances other than vegetal used in remedies. The native names of plants were recorded, together with the portion and amount of a plant used in a remedy, the dosage, the treatment which accompanied its use, and the symptoms for which the remedy was prescribed. The investigation concerned chiefly the use of specifics, but a few combinations of herbs were recorded for comparison with the separate uses of the same herbs. Long life was the greatest desire of the Chippewa, and the attaining of long life formed the principal teaching of the *Mide* or native religion. Two factors were said to contribute to that end, namely, uprightness of life and the

proper use of medicines. Thus the efficient use of herbs was an important province of the *Midewiwin*, or Grand Medicine Society, and the secrets of these herbs were transmitted from one generation



FIG. 97.—Boat in rice-field. Photograph by Miss Densmore.



FIG. 98.—Parching wild rice. Photograph by Miss Densmore.

to another. Miss Densmore's former study of the *Midewiwin* contributed to the present research, as persons who recorded *Mide* songs more than ten years ago were willing to impart information concerning the herbs used in *Mide* remedies.

Food and its preparation formed the interesting subject of an inquiry, which was limited to the period preceding the baking of bread. The principal articles of food at that time were cooked rice and vegetables, fish, meat and game, berries, maple sugar, and beverages made from leaves and twigs. Wooden spoons, bone knives, and a "marrow stick" for scooping marrow from a bone were used within the memory of the older informants, and water was boiled in a vessel made of freshly cut birchbark if a trader's kettle was not available. The manner of securing each class of food was studied. Three rice-camps were visited and photographed, the process including the gathering of the rice, its parching, pounding,

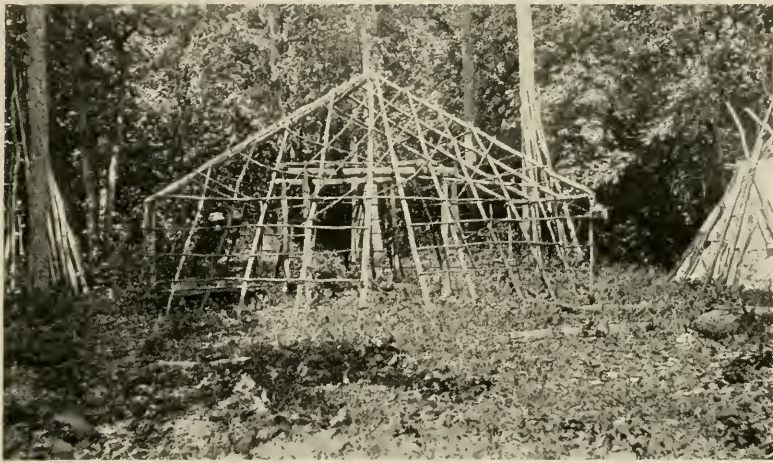


FIG. 99.—Frame of lodge in which maple sap is boiled, and lodge in which sugar-making utensils are stored. Photograph by Miss Densmore.

winnowing, and threshing. A boat was poled through the rice field and the rice gathered by knocking the kernels from the stalk with two short sticks, the kernels falling into the boat (fig. 97). The rice was then parched in an iron kettle over a slow fire, being constantly stirred to prevent scorching (fig. 98). The next phase of the work consisted in pounding the rice in a barrel sunk in the ground, long, heavy poles being used for the purpose. This loosened the husks, which were removed by winnowing in birchbark trays and threshing with the moccasined feet in a shallow receptacle.

The process of taking seines from the water and drying and preparing fish was observed and photographed, and a maple sugar camp was visited, though not seen in actual operation (fig. 99).

Dwellings and their native equipment were given detailed study, the principal types noted by earlier observers being seen and photographed. The reeds and rushes used in weaving mats for the floor and sides of dwellings were collected, together with specimens of the mats and the implements used in their weaving (fig. 100). These mats are still made by the Chippewa, although the use of native



FIG. 100.—Chippewa woman weaving small mat of rushes.
Photograph by Miss Densmore.

dyes for coloring them has been discontinued. The formulæ for many shades of color were, however, obtainable, and rushes, porcupine quills, yarn, and woolen cloth were dyed by Chippewa women as examples of native ability in this art. Numerous specimens of beadwork in geometric designs were collected, the women stating that these designs were employed by them before the floral patterns which are now in general use. The implements used in the handi-

craft of both men and women formed part of the objective material collected for illustrating this report. The making of birchbark



FIG. 101.—Frame on which birchbark canoe is made. Photograph by Miss Densmore.



FIG. 102.—Process of making a birchbark canoe. Photograph by Miss Densmore.

utensils in graceful outlines is rapidly becoming a lost art among the Chippewa, and many examples of this work were obtained.

As the Chippewa were a people living in the woods and beside the water a study of their early life necessarily included the making of a birchbark canoe. For this purpose an old canoe maker was visited and his equipment photographed. Briefly described, the process consisted in molding thick sheets of birchbark upward around a removable flat frame which was held in place by heavy stones (figs. 101, 102). The sheets of bark were sewed together with split roots and fastened to a permanent binding at the top, the seams being calked with spruce or other gum. Hunting and trapping were studied, together with the manner of tanning large and small hides. Games and pastimes were recorded and the implements used in the various games were obtained. Tribal organization received some attention, as well as tribal customs relating to marriage, home life, death, and burial. Not least in importance was the additional information secured concerning the beliefs and customs of the *Midevewin*, and the practice of good and evil charms.

ETHNOLOGIC WORK IN LOUISIANA

The field-work of Dr. John R. Swanton, of the Bureau of American Ethnology, during 1917, was confined to a short expedition to



FIG. 103.—Mixed Houma Indians, Little Barataria Bayou.

Louisiana between May 16 and June 25. In this period three separate investigations were undertaken. The first of these was a visit to the mixed-blood Houma Indians in La Fourche parish and the

eastern part of Terre Bonne. Dr. Swanton was accompanied and his work greatly facilitated by Mr. Ernest Coycault, a creole living in New Orleans and married to one of these Indians. The brother-



FIG. 104.—Cut-off at site of old Houma village, Point au Chien, La.



FIG. 105.—Method of constructing a palmetto roof. Indian house at Point au Chien, Terre Bonne, La.

in-law of Mr. Coycault acted as pilot, guiding Dr. Swanton to all of the more important Indian settlements between New Orleans and Point au Chien where the oldest Houma town in the region is said to have been situated until destroyed by three huge waves from the



FIG. 106.—Mixed Houma Indians (French, German, and Houma), lower Bayou La Fourche, La.

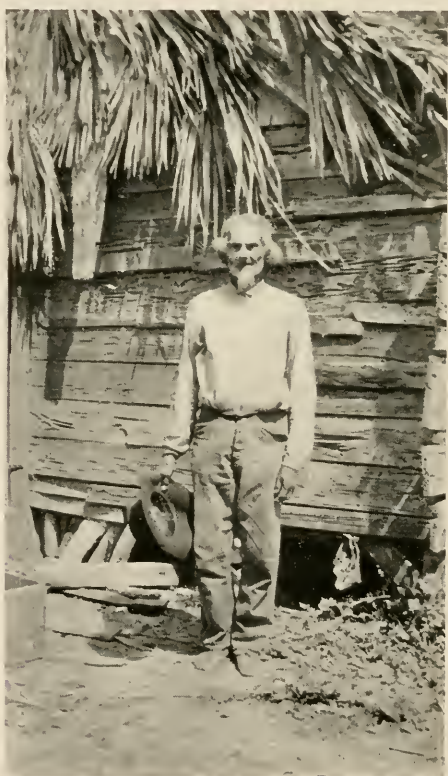


FIG. 107.—Houma man, lower Bayou La Fourche, La. His grandmothers on both sides were Houma, his father's father a German, his mother's father a Frenchman.

Gulf about 1909. A few notes, relating chiefly to the material culture of the people, were made and a number of photographs were taken, but only a single expression in the old Houma language could be secured, and it is evident that the vocabulary obtained in 1907 from an old woman belonging to the western settlements of these Indians is all relating to their language that can now be expected from them.



FIG. 108.—Estelle Sandress, one of the four surviving speakers of Chitimacha.

Before setting out on this trip Dr. Swanton spent a few days in New Orleans examining some of the manuscripts belonging to the Louisiana Historical Society now preserved in the Cabildo, and was able to add several items to his material on the history of the southeastern Indians. His success in this work was much aided by Miss Carrie S. Freret, who has immediate charge of the manuscripts.



FIG. 109.—Chitimacha Indians living near Charenton, La. The man is one of the four surviving speakers of the Chitimacha language. His name is Regist Dardin.



FIG. 110.—Koasati Indians near Kinder, La.

After returning from the Houma Dr. Swanton proceeded to Charenton, La., where he spent a few days revising some of his material on the Chitimacha language with Benjamin Paul, one of the four surviving speakers of this tongue and a man who had assisted him on previous visits. Although it was found that there was little new material to be had, Dr. Swanton secured some gram-



FIG. 111.—Mother of my Koasati interpreter and one of my principal informants.

matical information of great value in fixing the proper position of Chitimacha among the languages of the region.

From Charenton he proceeded to Kinder, in Calcasieu parish, where he remained for about two weeks, recording texts from the Koasati Indians just east of that town. The Koasati language is similar

to Alabama, which Dr. Swanton already studied among the Alabama Indians in Polk county, Texas, but more differences were found between the two than it was supposed existed. He recorded about 150 pages of new text material with interlinear translations, and carefully corrected about 125 pages previously obtained in Texas, but found to be corrupted with Alabama expressions.

ETHNOLOGY OF THE IROQUOIS

On March 2, 1917, Mr. J. N. B. Hewitt resumed his field studies of the League of the Iroquois and of kindred matters relating to the ethnology of the Iroquois, near Brantford, Ontario, Canada. At once he took up the textual and literary criticism of the extensive native texts, chiefly in Mohawk, Onondaga, and Cayuga, relating to the founding and to the structure and the purpose of the League or Federation of the Five Tribes of the Iroquois. This work consists in reading over, grammatically correcting, transposing misplaced parts of texts, annotating obscure passages or obsolescent terms, and, where new information shows the need, expanding the texts with new material. The work is very necessary in view of the fact that much of it was recorded hastily from the dictation of untrained native speakers who did not realize the imperative need of repeating a sentence in the same terms in case it must be repeated.

The difficulty of this task may be measurably realized when it is taken into account that these texts aggregate nearly sixty thousand native words or sentences. It is often necessary to read the words and the immediate context over several times in order to decide upon their tentative final form; this is in addition to the reading of the entire topic or "chapter." An example will suffice. In the Eulogy of the Founders of the League occurs an expression which had been recorded in all previous texts in such manner that it was translated, "The Institution became aged or ancient," or "The Institution has become useless from age." But the correct text, thus found, signifies, "It causes the Institution to become ancient or aged," or "The Institution is being caused thereby to become old or ancient." An important distinction, because it does not state the fact that the League has become old, but rather that the noted causes tend to make it grow ancient or aged. These texts are read over with every well-informed informant in order to elicit a full expression of the informant's knowledge or criticism of the value and correctness of the work of another.

These detailed investigations naturally led to the recording of other corrective or amplifying texts and notes; these amount to over 500 manuscript pages, of which Shaman Joshua Buck supplied more than 240 pages and Emeritus Chief Abram Charles over 260 pages, together on more than forty topics; both these informants recited a ritual for recording.

In addition to this new material in text Mr. Hewitt recorded in English only, three short traditions, about 50 manuscript pages, which though very short are highly significant as they purport to relate events and express ideas and newer conceptions of life and man which, asserting the brotherhood and the fellowship of all men in contradistinction to the ideas of mere tribalism, shaped the principles upon which the League of the Iroquois was built.

Mr. Hewitt also made several important discoveries concerning certain clans of the Iroquois. In brief, the new information shows that three so-called "clans" of this group of tribes do not exist outside of the names which are employed to designate them. It is found that the Onondaga "Ball" clan is in fact a Hawk clan; and that the so-called "Hand" clan of the Cayuga is the Gray Wolf clan; and that the "Potato" clan of the Cayuga and Mohawk (Canadian?) is in fact a (?) Duck clan, or possibly a (?) Wolf clan (the identification is still incomplete). This confusion is due to popular acceptance of a sobriquet as the real name of the clan.

On March 13, Mr. Hewitt was fortunate in being selected as an official delegate from the Council of the Six Nations of Iroquois to represent the Seneca tribe as a celebrant in its behalf in a Condolence and Installation Ceremony held in behalf of the Oneida of Muncietown, Ontario, in which he was required to act a leading part in the rites, necessitating the intoning of an address of comforting in the Onondaga language and also in acting the part of the Seneca chiefs in such a Council of Condolence and Installation. This official recognition gave Mr. Hewitt the rare opportunity of seeing just how such a ceremony is conducted from behind the scenes.

It was Mr. Hewitt's good fortune to obtain a set of wooden masks of the various Wind Gods or Spirits and also two of the Food Gods, eight in all; these Wind Spirits or Gods are held in high repute in the medical circles of these noted tribes.

Mr. Hewitt was also pleased to obtain by purchase the gourd rattle used by the late Chief John Buck, the noted father of his assistant, Mr. Joshua Buck; he also purchased what is reported to be the last cradle-board on the reservation; it has a beautiful beaded belt. He also obtained a fine medicine flute.

PREHISTORIC RUINS IN SOUTHWESTERN COLORADO AND
SOUTHEASTERN UTAH

The country south and southwest of Dolores, Colorado, contains many evidences of a considerable population in prehistoric times. The most striking of these evidences are mounds of stones, remains of well-constructed buildings, the standing walls of which sometimes rise many feet above the surface. Some of these remains are mentioned or described by Newberry, Jackson, Holmes, Morgan, Morley, Moorehead, Prudden, and Kidder, but a still greater number remain unrecorded, although reported by cowboys and sheep herders, who,



FIG. 112.—Lone Pine House, cliff-dwelling near Dolores. Photograph by J. Wirsula.

while paying only casual attention to them, know their sites and something of their superficial characters.

The growing interest in the antiquities of this part of Colorado, especially those of the Mesa Verde National Park, not far distant, has stimulated a desire to investigate other ancient ruins in the neighborhood, and with that end in view Dr. J. Walter Fewkes, ethnologist, devoted several weeks of the autumn of 1917 to an archeological examination of this region. He visited all ruins previously recorded and was able to add several others to the list, without covering more than a part of the extensive territory.

The main object of this work, all too inadequate on account of limited time, was to gather facts bearing on the distribution of prehistoric inhabitants in southwestern Colorado and their cultural rela-



FIG. 113.—Surouaro, situated at the head of Yellow Jacket. Photograph by J. Wirsula.



FIG. 114.—Semicircular tower opposite mouth of Dawson Canyon. Photograph by J. Wirsula.

tionships to those of Mesa Verde, where there is so much in this line to attract tourists and students. Dolores, a station on the Denver and Rio Grande Railroad, was chosen as a convenient point of departure for this preliminary reconnaissance.

Especial attention was paid to a determination of the forms and architectural characteristics of prehistoric buildings. Although no extensive excavations were attempted an examination was made of local collections of pottery and other objects, said to have come from these ruins, as a basis of comparison with similar objects from the Mesa Verde. While collections of these specimens are small they support the conclusion, taught by architectural evidences, that



FIG. 115.—Semicircular tower one mile from Littrell Ranch, Yellow Jacket. Photograph by J. Wirsula.

the life of the inhabitants of the two regions was similar. They uphold the theory that the final abandonment of the region by the aboriginal occupants occurred in prehistoric times or before the Spanish occupation, but they contribute little to definite knowledge of the date of their construction. In the limited time at his disposal Dr. Fewkes confined his studies to typical ruins situated in an area bounded on the west by the Yellow Jacket, formerly known as the Hovenweep Canyon, and its tributaries; on the south by the McElmo; on the north by a line drawn from Dolores to the head of Sandstone Canyon; and on the east by the Montezuma Valley, which extends from Dolores to Aztec Spring Ruin. In this area there occur many types of aboriginal remains, as open sky pueblos like Far View House, single roomed towers, multi-chambered, massive-walled castel-

late buildings, cliff-houses, and other domiciles. In the progress of this work one or two excursions were made into Utah to Cross Canyon west of the Yellow Jacket, where extensive ruins of characteristic type await investigation, but no attempt is made to include the results of these trips in this account. Naturally, since the eastern part of the area considered has been thickly settled by white men for a considerable time the prehistoric ruins in this region are more dilapidated than those on the public domain farther west. There appears, however, to have been a close similarity in the buildings of the eastern and western parts of the area: existing differences being due rather to nature of sites than to cultural causes. The



FIG. 116.—Aztec Springs Ruin. Photograph by J. Wirsula.

western ruins are the better preserved, and can be used to interpret the buried walls of eastern mounds, where little now remains visible except piles of fallen stones, but a satisfactory interpretation must await verification by the uncovering of their walls.

Aside from one or two cliff-dwellings (fig. 112) the ruins near Dolores crown low hills on the left bank of the river, and are much dilapidated. If they are compared with ruins in the Hovenweep it appears that their buried walls had circular D-shaped forms. One of these hill-ruins situated about three miles from town, in plain sight from the Monticello road that practically follows the old Spanish trail, is the ruin referred to in the brief notice that appears in the diary of Fathers Dominguez and Escalante, dated 1776, and is probably the first Colorado ruin mentioned in historical documents.

Another pile of stones (fig. 113), called Surouaro by Professor Newberry, is situated on the same road 14 miles west of Dolores, at Yellow Jacket Springs. According to this author it takes its name from an Indian word meaning desolation, but the name, unknown to ranchmen, is not now appropriate, for modern dry farmers are raising crops in its neighborhood equal to any in Colorado.

There are very extensive ruins all along the rim of Yellow Jacket, the largest of which, nearly opposite Dawson Canyon (fig. 114), is 5 miles south of Surouaro. Its walls, accompanied by a D-shaped tower (fig. 115) perched on a shelf halfway down the canyon, are well preserved and about 15 feet high. There is a similar semi-circular tower a few miles away.



FIG. 117.—Mud Spring Ruin. Photograph by J. Wirsula.

The portion of Montezuma Valley at the mouth of the McElmo is irrigated by water drawn through a tunnel from the Dolores River, the waste flowing down the McElmo. The surface of the valley slopes uniformly southward and is destitute of canyons, but cut by several deep arroyos. In general the ruins of this valley are villages or clusters of mounds one of which is more prominent than the others.

One of the largest and most typical is called Aztec Springs Ruin (fig. 116), described by Holmes many years ago. Its striking feature is the large rectangular mound indicating a block of rooms, or "Upper House," which contained two large, circular, central kivas and one small circular kiva, surrounded by rectangular rooms forming

a compact pueblo of the pure type. The "Lower House" is a rectangular enclosure surrounded on the east, west, and south sides by a low wall and with rows of rooms on the north side, enclosing



FIG. 118.—Goodman Point Ruin. Photograph by J. Wirsula.



FIG. 119.—Blanchard Ruin. Photograph by J. Wirsula.

a circular depression or reservoir. Around the former are several mounds, remains of former blocks of buildings with kivas, the walls of which have fallen.



FIG. 120.—Towers at head of Square Tower Canyon, Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

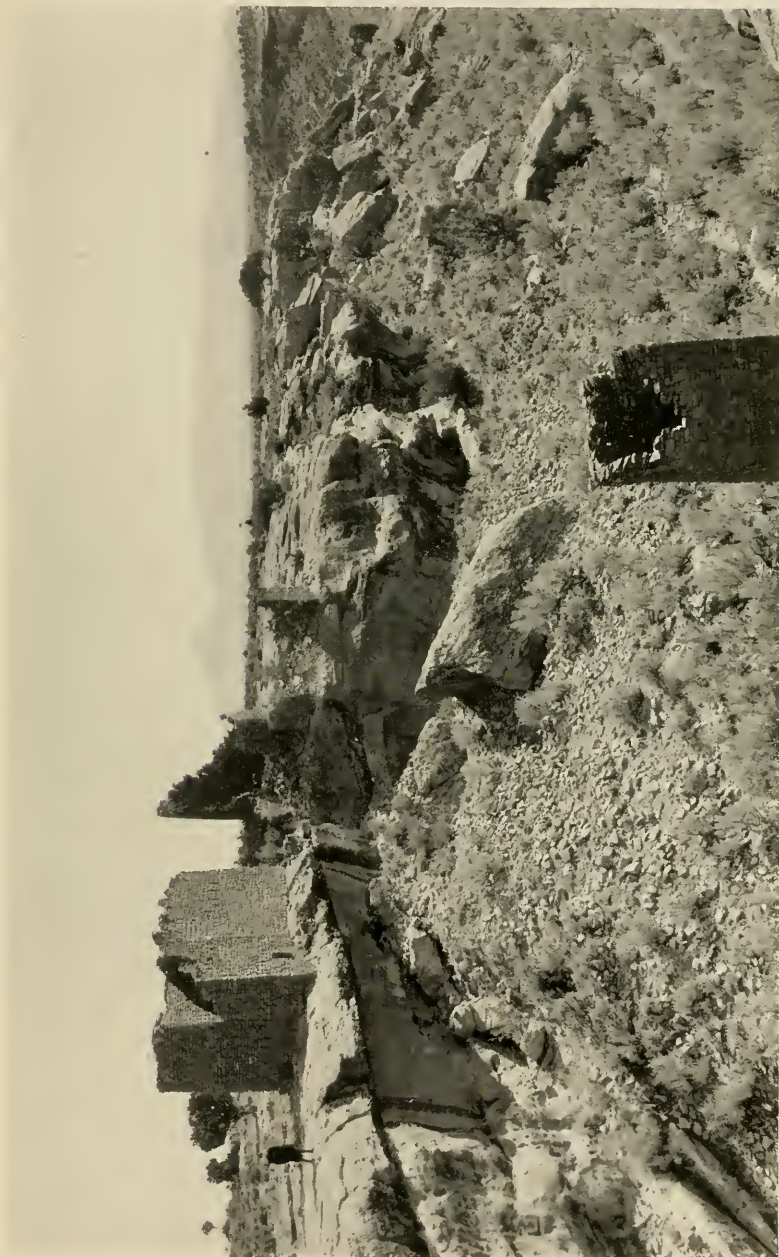


FIG. 121.—Towers at head of Square Tower Canyon. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

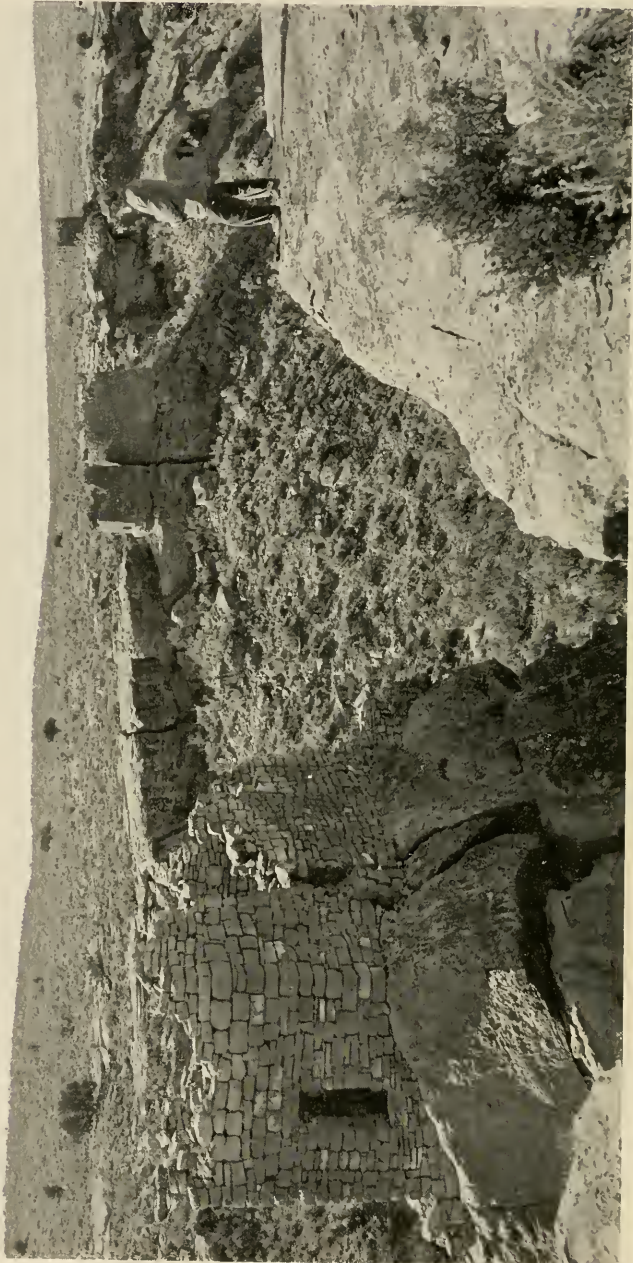


FIG. 122.—Towers in Square Tower Canyon. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

The Mitchell Spring Ruin, situated at Old Town or Toltec, 3 miles south of Cortez, first described by Morgan, resembles in type that mentioned above, and consists of several mounds or remains of rectangular buildings and a tower. One of the smaller of these mounds, excavated by Dr. Prudden, had a central circular kiva surrounded by rooms, constructed like those of Far View House.

The same arrangement of mounds in clusters or villages found at Aztec Springs Ruin and Mitchell Spring Ruin occurs also at Mud Spring Ruin (fig. 117), 7 miles from Cortez, at the head of McElmo Canyon. The mounds are numerous and cover a considerable area. The two largest are separated by a gulch in which lies a spring, as at Aztec Springs Ruin. In one of the largest mounds is the so-called "triple-walled tower" (Holmes) with concentric walls, embedded in rectangular rooms.

There are several other ruins of the clustered mound or village type in the Montezuma Valley, but in many the smaller mounds have disappeared under cultivation of the land. Among these may be mentioned Goodman Point Ruin (fig. 118), and that on the Blanchard Ranch (fig. 119), stones from which were removed to Manitou a few years ago to construct a cliff-house in imitation of Cliff Palace and Sprucetree House. None of the stones used in the construction of the Manitou reproduction came from Mesa Verde.

The Wolley Ranch Ruin, about 10 miles south of Dolores, is a good example of a pure pueblo type of ruin. About all that remains of a former cluster of mounds is the largest, now so overgrown with bushes that architectural details are difficult to observe, but there are evidences that it was a rectangular building with enclosed circular kivas, but without courts or passageways.

In their general features the groups of mounds in the Montezuma Valley resemble the cluster at Mummy Lake, on the Mesa Verde, both in arrangement and in their individual structure, so far as can be judged from the desultory excavations by which walls have been brought to light. Each mound in a cluster has the same structure as the pure type found in Far View House. The top courses of the walls have fallen and filled the rooms with stones and earth. The cemeteries commonly situated east and south of the mounds have nearly all been rifled of their contents. Certain mounds in the cluster may be remains of towers; others of "great houses"; and the same may also be said of different members of the Mummy Lake group.

This same clustering of mounds, characteristic of the Montezuma Valley ruins, occurs also in those situated in the broken country

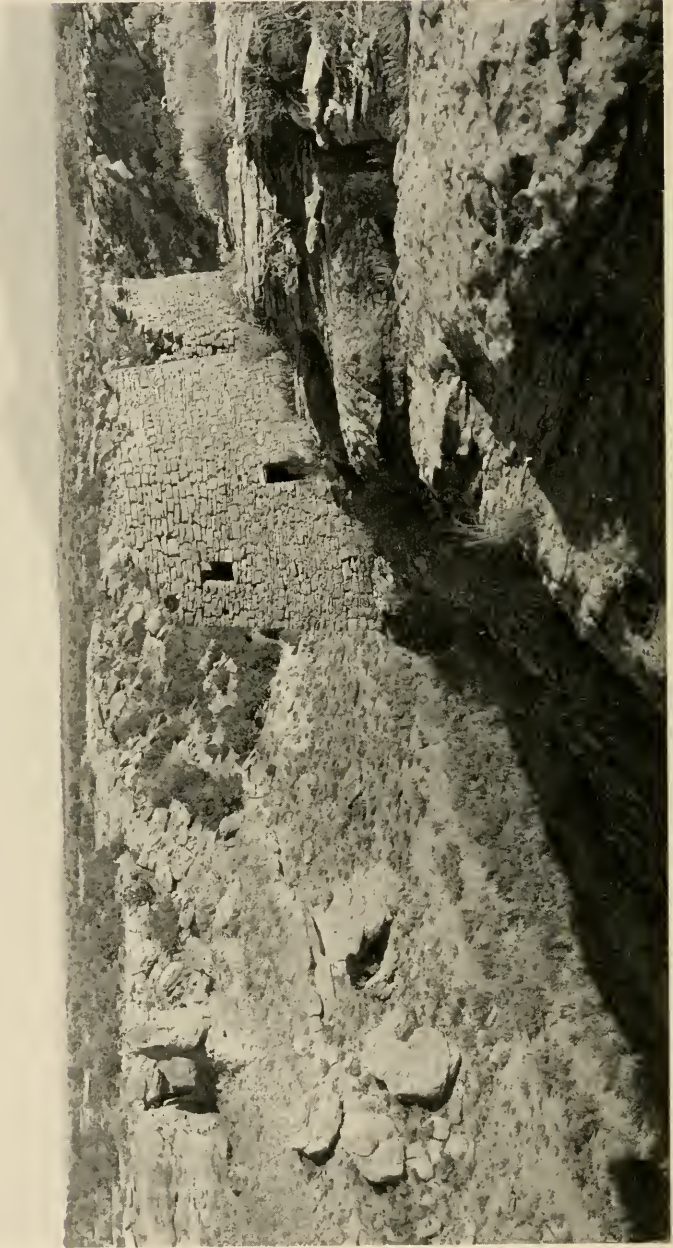


FIG. 123.—Twin Towers, Square Tower group. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

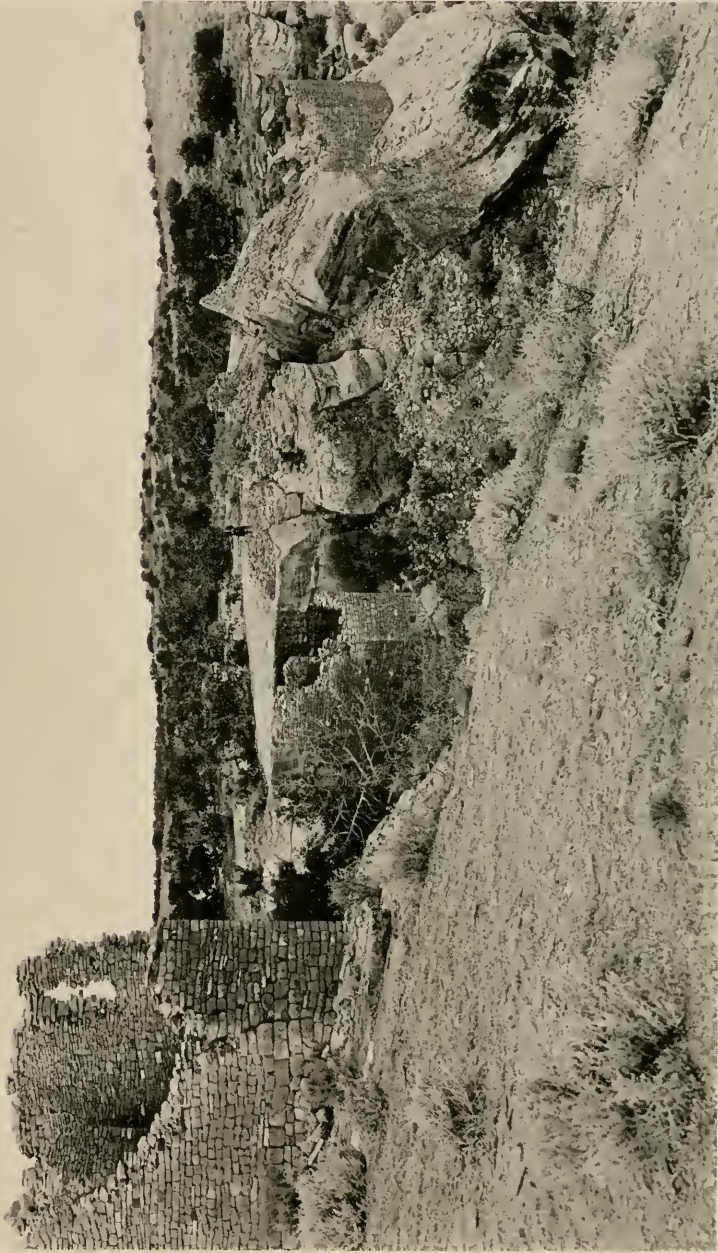


FIG. 124.—Group of Ruins in Holly Canyon. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

cut by the deep canyons that open into the McElmo, west of this valley, although the arrangement of the mounds is modified by configuration of the sites or adjacency of springs. As a rule the mounds

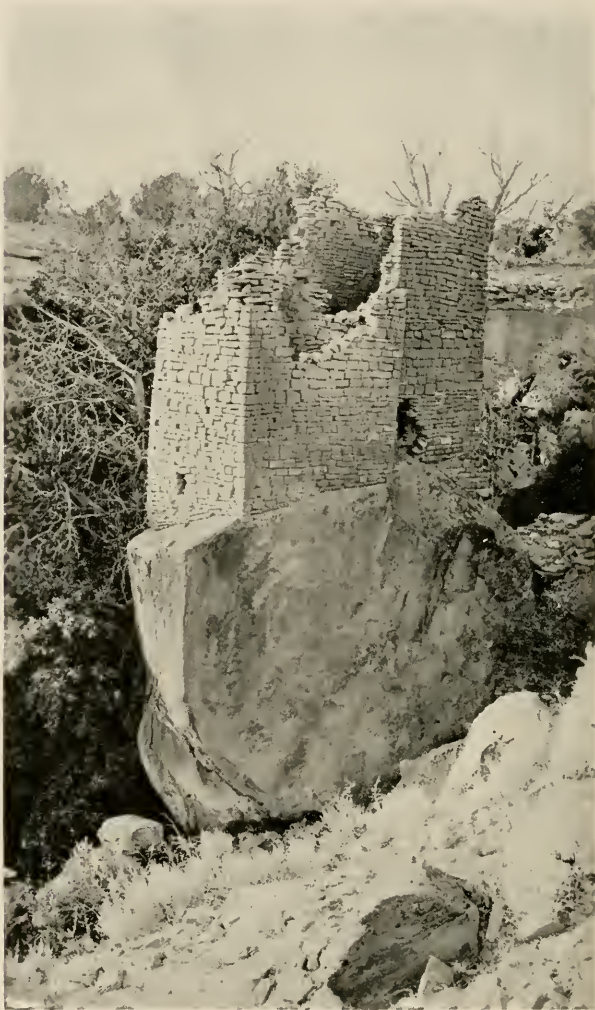


FIG. 125.—Tower in Holly Canyon. Photograph by J. Wirsula.

or clusters in this region either skirt the canyon rims or cluster about their heads. They are generally accompanied with large towers and buildings of the "great house" type (figs. 120 and 121)

situated on points of the mesa rim or perched on fallen angular rocks on the floor of the canyon. It may be mentioned that their walls are constructed of good masonry, which has effectually resisted the erosive power of the elements.



FIG. 126.—Group of ruins in Holly Canyon. Photograph by J. Wirsula.



FIG. 127.—Horseshoe Ruin, Hackberry group. Photograph by J. Wirsula.

The early builders were prone to introduce curved walls in these buildings; they were partial to circular, oval, and D-shaped structures, although square and rectangular buildings are common. They paid little attention to leveling the foundations on which the walls

were constructed, but inequalities in the base were built up with flat stones to the level of the lowest courses. The stones used were of different sizes, well trimmed by means of stone implements. The walls remain fairly stable, notwithstanding the foundations on which they rest are very uneven.

The cliff-dwellings and pueblos of the Mesa Verde National Park belong architecturally to the "pure type," the characteristic of which is a compact pueblo with a circular kiva with mural banquettes and pilasters that formerly supported a vaulted roof, a ventilator with air passage and deflector, and generally a ceremonial floor opening called the *sipapu*. The same type of kiva has been observed in the great consolidated pueblos of the Chaco and the cliff-dwellings in the Chelly Canyon. Dr. Prudden, Dr. Kidder, and Mr. Morley have recorded this type from ruins in Montezuma Valley and the McElmo-Yellow Jacket and Montezuma Canyon regions, and Dr. Fewkes discovered last summer that it occurs in several pueblos of the Hovenweep district. The existence of this form of kiva beyond the limits of the Mesa Verde marks the extension of the prehistoric area it characterizes.

Three groups of large, well-preserved buildings illustrating most of the types of the Yellow Jacket district occur between 40 and 50 miles from Dolores in a limited area which Dr. Fewkes suggests be made by proclamation a National monument, to be known as the Hovenweep National Monument. These groups are as follows: 1. Cluster at the head of Square Tower (Ruin) Canyon (figs. 121, 122 and 123); 2. Holly Canyon group (figs. 124, 125 and 126); 3. Hackberry (branch of Bridge) Canyon cluster (fig. 127). The three regions lie a few miles apart, not far from where the Yellow Jacket empties into the McElmo, near the Utah-Colorado State line. The structure of the well-preserved buildings in these groups enables us to interpret the probable appearance of the buildings, now mounds, in the Montezuma Valley.

In the first-mentioned cluster there are 11 different buildings within a radius of half a mile. One of these, Hovenweep Castle, (fig. 128), has walls that measure 66 feet long and 20 feet high. This building has, in addition to towers and great rooms, two circular kivas on the east end, identical in construction with those of Far View House on the Mesa Verde.

Some of the so-called towers, as figure 130, have single, others multiple, chambers, and are generally two or three stories high. Their shapes are rectangular, circular, semicircular, D-shaped or oval.

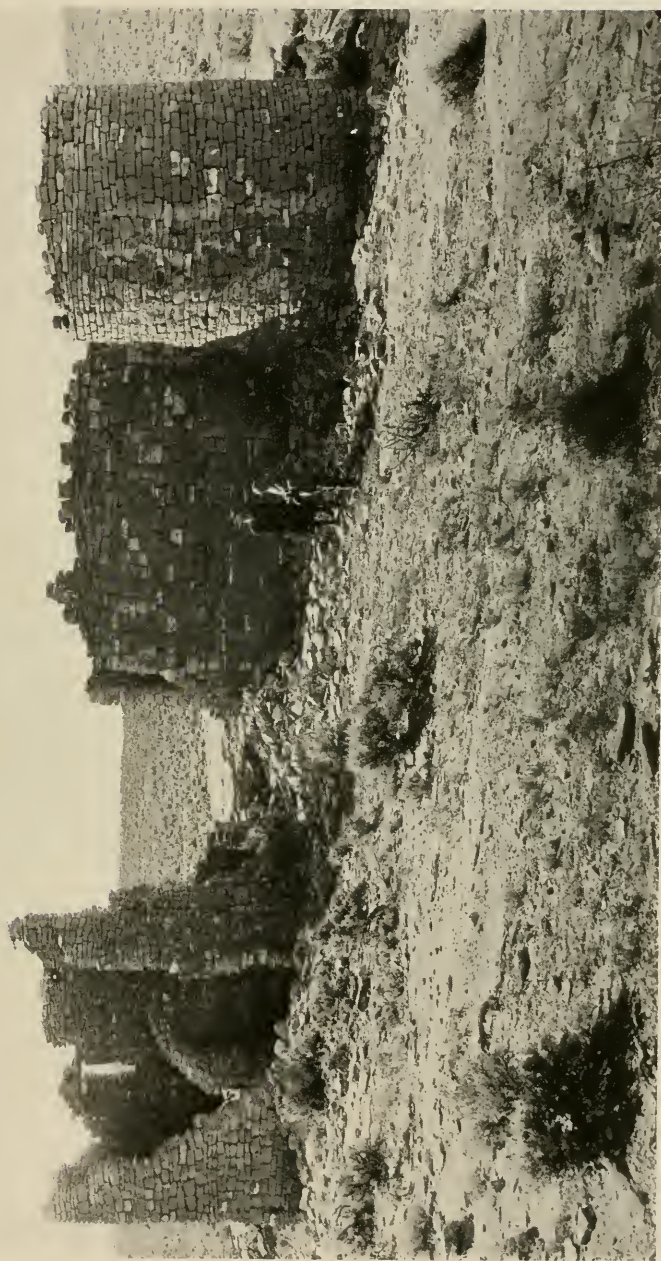


FIG. 128.—Hovenweep Castle. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

One of the most instructive buildings in the Square Tower group (fig. 131) is Unit Type House, a pueblo having a single centrally placed kiva, identical with the kivas of Far View House, compactly surrounded by rectangular rooms, rendering them subterranean and imparting to the ruin a square form (fig. 132). This kiva is characteristic of the pure type of pueblo, whose close likeness to Far View House shows the identity of architectural forms among the prehistoric people of the Mesa Verde and McElmo.



FIG. 129.—Model of Hovenweep Castle.

The cliff-dwellings in Square Tower Canyon are small; one of these was constructed in the eroded cave of a fallen rock, part of which arches over the walls, forming a roof. There is a small chamber in a cave under the two large buildings called the "Twin Towers." The largest cliff-house in this canyon is situated at its head, but unfortunately its walls are now considerably demolished.

Great House, one of the buildings in the Holly Canyon group (figs. 133, 134), about a mile east of Keeley Camp, has the highest walls in these great houses. Five large buildings cluster around

the rim of a spur of this canyon or are perched on angular rocks at its base. Even now, after centuries of wear, they show fine masonry, although some of the mortar between the courses of stones



FIG. 130.—Tower in Holly Canyon. Photograph by J. Wirsula.

has been washed out. There are small cliff-houses in the walls of the canyon below these great houses.

An instructive cluster of ruins in the Hovenweep district is the Hackberry Canyon group situated about 2 miles east of Keeley

Camp, or a mile beyond the cluster on Holly Canyon, above mentioned. One of the members of this group from its shape is called the Horseshoe House. This ruin (fig. 135) has two concentric walls, a curved outer one on the north separated by about 4 feet from an inner circular wall and united to it by two radial partitions forming compartments still well preserved. The height of the outer wall is 12 feet; that of the inner somewhat less.

Several features of this ruin (fig. 135), besides its D-form, recall Sun Temple on the Mesa Verde. Apparently the entrance was on the south, but the walls on this side have fallen, although traces



FIG. 131.—Unit Type House, Square Tower group.
Photograph by J. Wirsula.

still remain of the inner wall. The south wall of the southeast compartment is still erect but does not connect across the south side of the building. Apparently the southwest compartment ended in the same way as the southeast, but as the wall has fallen there is no evidence of a row of rooms across the south side.

There are half-fallen walls of a cliff-dwelling (fig. 136) of considerable size in a cave situated below this building, and upon a neighboring point stands a square tower with high walls and curved corners. Attention may be called to the fact that here, as elsewhere, wherever we find these large buildings on the rim of the canyon there

exist also dugouts or cliff-houses suggesting habitations in the cliffs below.

Several great houses of the Hovenweep belong to a prehistoric type distinct from pueblos, for nothing similar to the multichambered "great house" is found in modern pueblos, although the one-chambered tower may be the same as extramural circular kivas in



FIG. 132.—Model of Unit Type House.

the Rio Grande pueblos. Whether towers are one or many chambered, in form circular, oval, D-shaped, or square buildings, isolated, or united to pueblos, or whether towers and great houses belong to the same type, is not evident. These great houses or so-called towers with several rooms could hardly have the same use as circular or square towers with one room. They do not suggest habitations, and the number of workmen necessary to build them would be

large for them to accommodate. Their general appearance suggests granaries, forts, castles, or some communal use; possibly they were religious buildings. Like certain towers, they are sometimes too shut in by surrounding cliffs to serve as lookouts; they are accompanied by cliff-dwellings which show evidences of habitation. Evidently these large buildings with several rooms without kivas not



FIG. 133.—Great House, Holly Canyon. Photograph by T. G. Lemmon.

only belong to a specialized architectural type but also to a localized one. This type is different from the pure pueblo type, mainly in the absence of terraces and central, circular kivas surrounded by rectangular rooms; it resembles buildings like Casa Grande. When towers are united to a building of the pure pueblo type, as shown in Hovenweep house of the Square Tower (Ruin) Canyon, we have a building made up of two united types, the most complicated form of pueblo architecture.

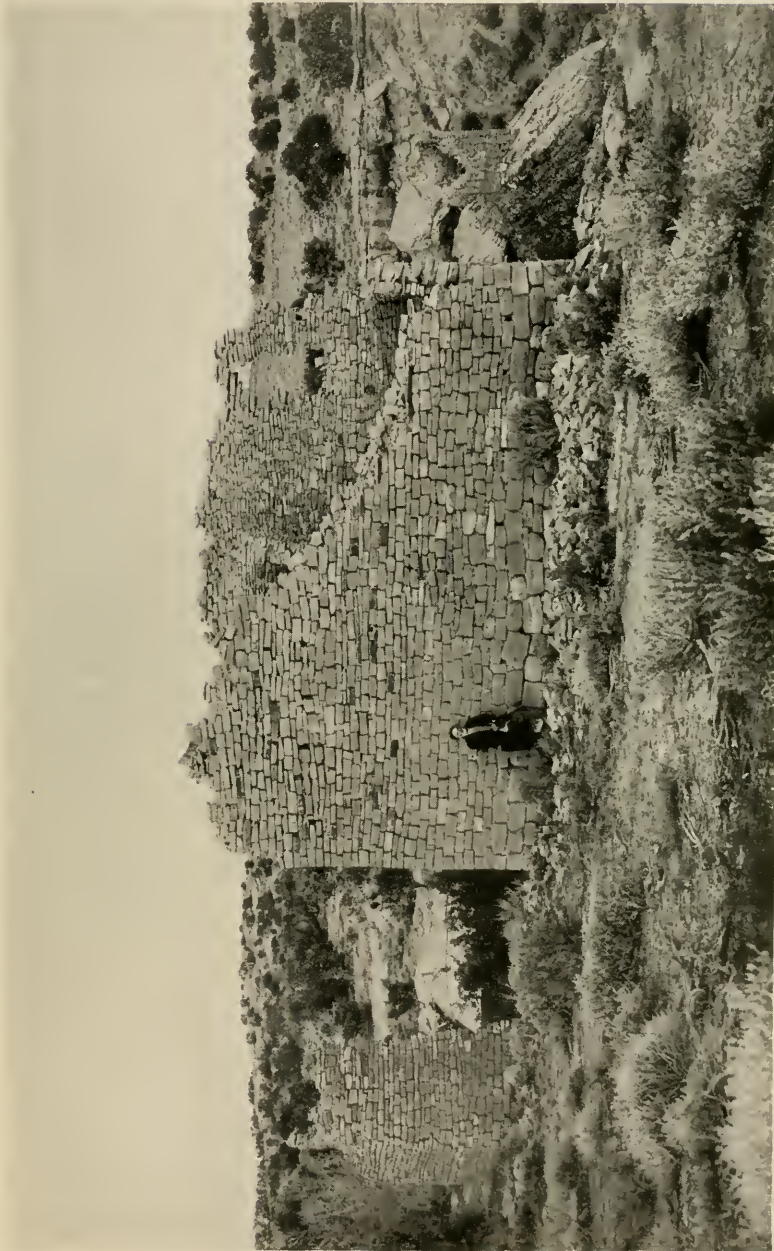


FIG. 134.—Great House, Holly Canyon. Courtesy of Denver and Rio Grande Railroad. Photograph by G. L. Beam.

One feature of many open-sky ruins of the Yellow Jacket which distinguishes them from Mesa Verde ruins is their site. They arise at the heads of canyons or along the rim rock, while as a rule the Mesa Verde pueblos, like Far View House, are situated some distance from the edge of the canyon, like some ruins in the Yellow Jacket series.



FIG. 135.—Model of Horseshoe Ruin.

The simple, isolated towers in the Mesa Verde resemble those of the Hovenweep, but there are many mounds on Mesa Verde awaiting excavation where there was probably a union of towers and pueblos.

The walls of the "great house" type of this region show less wear by the elements than those of the open-sky buildings on the Mesa Verde. As the destruction by atmospheric causes must have been about the same, year by year, in the two regions, it would be natural

to conclude that the Mesa Verde pueblos were deserted earlier than the McElmo, or that the latter were constructed later, either of which suppositions has a bearing on the chronology of the prehistoric culture in the San Juan Valley. By the same reasoning the consolidated villages of pure type like Aztec would be regarded as more modern than the pueblos of the Mesa Verde.

Another feature in the Yellow Jacket Canyon ruin, as compared with the Chaco and other great pueblos situated near the horizon of the pure type in New Mexico, may be significant. Castellate buildings referable to the "great house" type have not been recorded south of



FIG. 136.—Cliff-dwelling, Hackberry group. Photograph by J. Wirsula.

the San Juan; towers are found, but they are less numerous. These types in the San Juan region, each specialized for specific purposes, when contrasted with the uniformity in the architecture of historic pueblos in New Mexico, are likewise significant. The "great house," like the "pure type," is prehistoric; nothing comparable to it has been identified in modern pueblos.

It is pretty generally believed that, in order to support the large population implied by the number and size of these McElmo-Yellow Jacket ruins, their farms on neighboring mesas were formerly better watered. The conclusion is sometimes reached that there has been a climatic change or desiccation that has driven out the aboriginal dry farmer. Attention, however, should be called to the fact that American dry farmers are now successfully cultivating these pre-

historic farms, one source of moisture being now, as in prehistoric times, melting snows. Absence of snow and rain for several consecutive years might have reduced their crops and starved the aboriginal dry farmers, even though a permanent change of climate did not occur.

To utilize their limited water supply the aborigines constructed many reservoirs near their farms to retain snow and rain. These are now indicated by sloping rock surfaces, bare of soil but girt with



FIG. 137.—Prehistoric reservoir, near Hovenweep Ruins.
Photograph by T. G. Lemmon.

vegetation; about the lower edge the natives constructed a low bank of earth to serve as a retaining wall. It is estimated that one of these reservoirs (fig. 137) covers a surface of 4 acres; others are still used by herdsmen, who have somewhat increased the height of the retaining walls, for watering stock.

We find near ruins in this region many examples of enclosures made with slabs of stone set on edge. The use of these structures has not been satisfactorily explained; they have been variously interpreted as graves, crematory cists, and storage places or pits for

roasting corn. The majority show scanty evidences that they were graves, and excavations have yielded few, if any, human bones, although ashes and charcoal are abundant. Similar slabs of stone, possibly a survival of a more archaic method of construction, are often found set upright in horizontal masonry. Some of these uncut stones are large enough to be called megaliths; these also may be regarded as survivals of early methods of construction; in some walls they are used without smaller stones.

The Director of the National Park Service, recognizing the popular and scientific interest in the preservation of the towers in Square Tower (Ruin), Holly, and Hackberry Canyons, as a sequel to the above field work, is endeavoring to have them set aside from the public domain, to be known as the Hovenweep National Monument.