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EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1916

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Every year the Smithsonian Institution initiates or takes part in numerous expeditions to all parts of the world for the purpose of increasing the knowledge in various branches of science. The present pamphlet deals with explorations and field-work in geology, zoology, botany, archeology and ethnology, and astrophysics, during the year 1916, the various accounts being written largely in the words of the investigators themselves.

Friends of the Institution have generously aided this work, particularly during the past few years, through the contribution of funds for specific purposes. Most of the field-work is carried on directly through the branches of the Institution, including the National Museum, the Bureau of American Ethnology, the Astrophysical Observatory, and the National Zoological Park. Wherever funds are not available for specific explorations every opportunity is taken to send representatives of the Institution with such expeditions in order to add to the natural history and archeological collections. The Bureau of Ethnology conducts extensive field-work among the Indians themselves, detailed accounts of which are published in the reports of the Bureau. The Astrophysical Observatory has continued observations in this country and abroad in connection with its work of studying the sun; and the National Zoological Park has cooperated with similar institutions in securing from other countries animals desired for the collections.

These various activities result in valuable additions to scientific knowledge of unexplored and imperfectly known regions, and bring to the collections of the National Museum important material for exhibition and research. Many opportunities for undertaking important field researches and for participating in various expeditions are lost to the Institution every year through lack of sufficient funds.

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

In continuation of work carried on for several years past in the Canadian Rocky Mountains Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, was engaged during the summer

FIG. 1. (Frontispiece.) Assiniboine, as it rises in a gigantic pyramid 4,800 feet (1,463.1 m.) above the surface of Magog Lake, which is about 7,100 feet (2,134 m.) above sea level. Wedgwood Peak (9,930 feet = 3027.4 m.) on the right, and on the left Magog Mountain (9,500 feet = 2896.3 m.) and the great broken eastern ridge that terminates at Wonder Pass, with Naiset (Sunset) Mountain (9,600 feet = 2926.8 m.) in the distance above the glacier. The north spur of Naiset terminates on the left in the dark Naiset Point (9,000 feet = 2743.9 m.), which rises as a succession of great cliffs above the shores of the lake. Photograph by Walcott, 1916.

and early fall of 1916 in field investigations on the Continental Divide forming the boundary between Alberta and British Columbia,

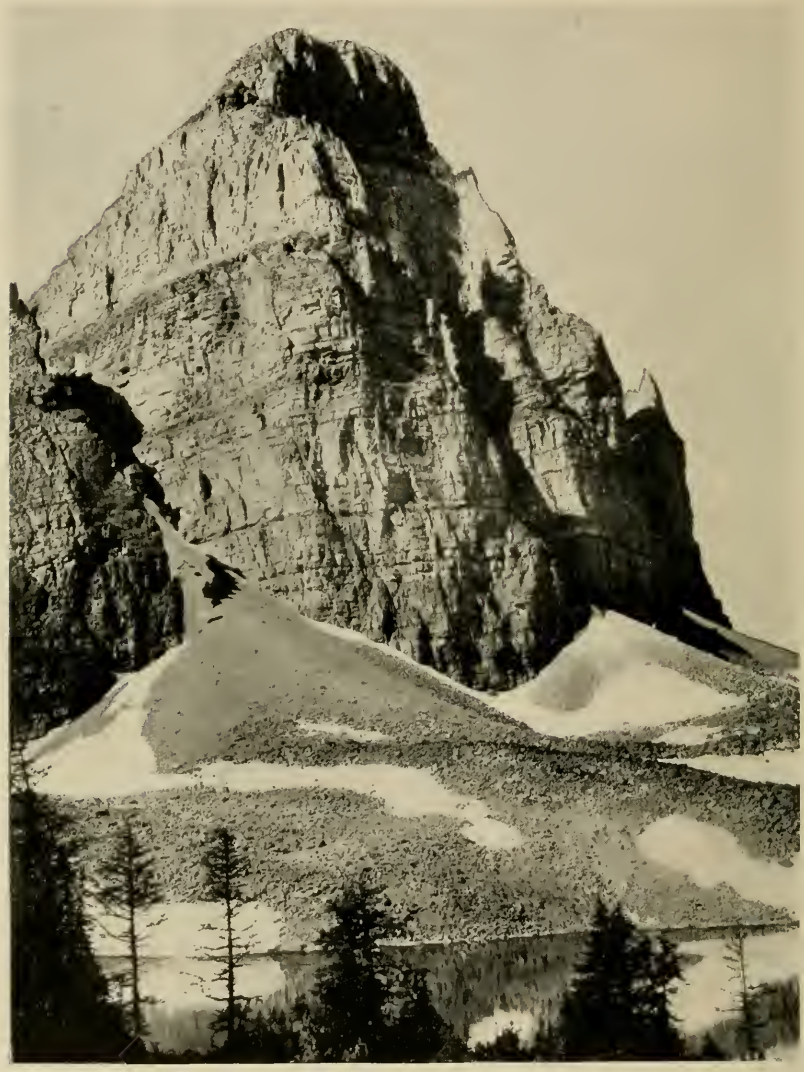

FIG. 2.—Cliffs of massive bedded quartzites at north end of ridge of Wedgwood Peak rising 2,000 feet (609.7 m.) above the small lake in foreground. Note the enormous fans at the base of the cliff, as well as the geological structure of the rock wall above. Photograph by Walcott, 1916.

south of the Canadian Pacific Railway. The very heavy snowfall of the previous winter together with frequent snow and rain squalls

FIG. 3.—Looking southeast toward Wonder Pass; Wonder Mountain rising above pass on left; Naiset Mountain and glacier on right. Many of the trees are fine old specimens of Lyall's larch, found at tree line between 6,500 and 7,500 feet (1,981 and 2,285.9 m.) elevation. Photograph by Walcott, 1916.

FIG. 4.—Mount Assiniboine, the Matterhorn of America, reflected in Sunburst Lake, east of Wedgwood Peak. Around the edges of the melting snow banks anemones, lilies, and other spring flowers bloom in profusion, while on the drier slopes summer flowers carpet the ground. Photograph by Walcott, 1916.

FIG. 5.—The wonderfully eroded front of the Assiniboine massif as seen from the northeast. The line of the great overthrust fault curves through Wonder Pass on left and, crossing beneath the foreground, passes in front of and beneath great

during the summer, had made the conditions unusually favorable for taking photographs, the air being exceptionally pure and clear

FIG. 6.—A magnificent early morning reflection of Mount Assiniboine in Magog Lake. Note the breeze that has just started at the upper end of the lake as shown by the horizontal streak across the water; also the enormous cones of snow at the base of rock cliffs, where ice and snow avalanches have broken from the face of the glacier above to form a second glacier extending down towards the shore line of the lake. Photograph by Walcott, 1916.

during the field season—conditions, however, very unfavorable for geologic investigations.

FIG. 7.—Mount Assiniboine reflected in Sunburst Lake east of Wedgwood Peak. Note the rapidly forming cloud banner which hides the south point of the summit from view. Photograph by Walcott, 1916.

The sections examined and measured extended from the Mount Assiniboine region southwest of Banff, Alberta, northwest to the

FIG. 8.—Mount Assiniboine with its cloud banner lighted by the midday sun and reflected in Sunburst Lake. Photograph by Walcott, 1916.

Kicking Horse Pass, where the Canadian Pacific Railway has bored a double loop through the mountains on the north and south sides of the Pass.

FIG. 9.—Looking down Corral Creek and across the Bow Valley to Mount Temple and several of the "Ten Peaks" from a point near Ptarmigan Pass, 10 to 12 miles (16.1 to 19.3 km.) distant from the Valley of the Ten Peaks. Photograph by Walcott, 1916.

FIG. 10.—Lake Louise (5,670 feet = 1,728.6 m.), the gem of the Canadian Rockies, lying at the foot of the Victoria Glacier and Mount Victoria, which rises 5,685 feet (1,733 m.) above the lake. Mount Fairview, with Mounts Aberdeen and Lefroy, on the left. The view is from a point on the mountain ridge across the Bow Valley about 7 miles (11.2 km.) northeast from the lake. Photograph by Walcott, 1916.

FIG. 11.—Pinnacle Mountain (10,062 feet = 3,067.6 m.) with Sentinel Pass (8,556 feet = 2,608.5 m.) on the left, near the head of Paradise Valley. A passing snow squall has whitened the slopes and old snow banks below the pass. The pinnacles are eroded from the same kind of rock as that forming the massive cliffs of Mount Assiniboine. Photograph by Walcott, 1916.

FIG. 12.—The cliffs of Mount Hungabee at upper end of Paradise Valley, showing expanse of the Horseshoe Glacier. Frequent avalanches of the fresh fallen snow tumbled down the slopes to the fans above the glacier, as the rising sun loosened their hold on the rock ledges. This illustrates very clearly the formation of this type of glacier. Photograph by Walcott, 1916.

A large number of photographs were secured, including a number of panoramic views made on continuous films eight feet in length, a portion of one of which is reproduced in figure 1, the frontispiece.

FIG. 13.—Paradise River in its fall down the massive quartzite steps of the Giants' Stairway. The rocky walls of Mount Lefroy rise in the background. Photograph by Walcott, 1916.

FIG. 14.—Looking north from the slope of Popes Peak over the beautiful emerald green water of Ross Lake and the dark forest to the steep face of Mount Bosworth on the Continental Divide and above Kicking Horse Pass. Mount Hector in the distance. Photograph by Walcott, 1916.

The season's work was undertaken with two principal objects in view: first, to determine if possible the base line of demarcation between the Lower and Middle Cambrian; and second, to locate the

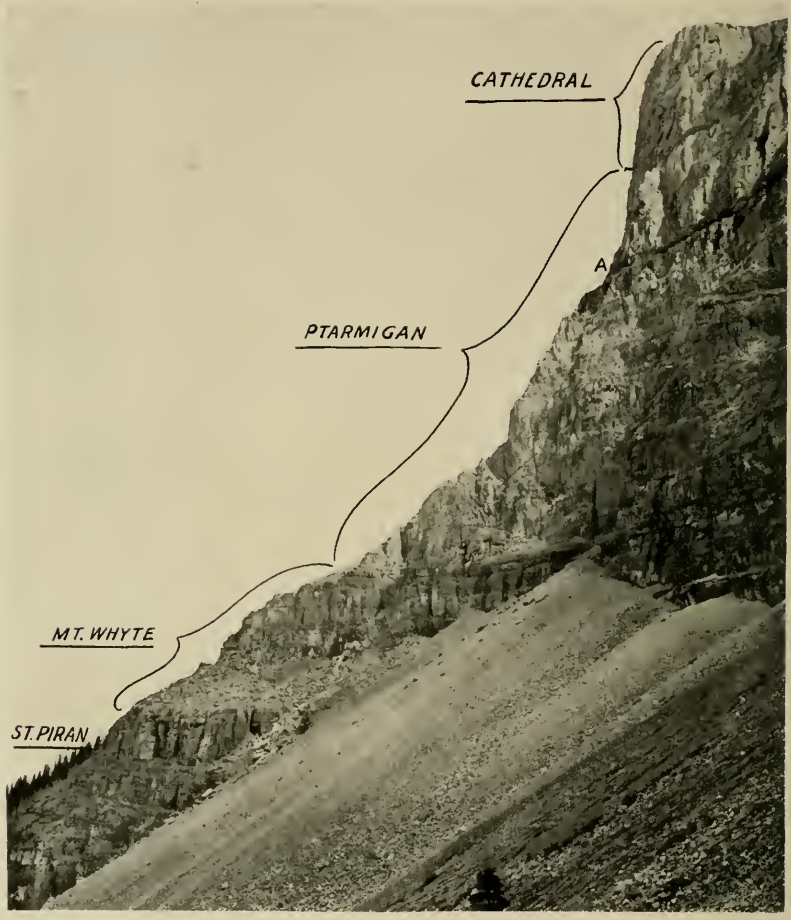

FIG 15.—North profile of ridge above and southeast of Ross Lake, 1 mile (1.6 km.) south of Stephen Station on the Canadian Pacific Railway.

The position of the *Albertella* zone is shown at *A* where the thin band of shale forming the Ross Lake shale member of the Ptarmigan formation may be seen from the Kicking Horse Pass as a dark narrow band.

The relative positions of the Cathedral, Ptarmigan, Mount Whyte, and St. Piran formations are indicated on the plate. Photograph by Walcott, 1916.

exact horizon of a Cambrian subfauna (*Albertella*) that had in its entirety been found only in drift boulders in the Kicking Horse Valley east of Wapta Lake.

FIG. 16.—Panoramic view of Phareo Peak, Scarab Lake, and in the distance Mount Ball. This view well illustrates the cliffs fronting the overthrust fault northwest of Mt. Assiniboine and east of Simpson Pass. Photograph by Walcott, 1916.

FIG. 17.—Alex and Arthur packing up Old Baldy for an early morning start. Photograph by Walcott, 1916.

FIG. 18.—A camp site at last. Where we came down 2,000 feet (609.7 m.) on a blind trail through a wind-fall on "Burnt Timber Hill" in a cold rain. This was one of the reasons why it required three days to reach Assiniboine from Banff. Photograph by Walcott, 1916.

FIG. 19.—Crickett inquiring why the pack train does not start, as she is tired of standing with the heavy pack. Photograph by Walcott, 1916

One of the important incidental results obtained was the discovery at Wonder Pass (fig. 3) of the great overthrust fault by which the basal Cambrian rocks forming the mountains on the west (right) side of the Pass have been thrust eastward over upon the limestones of the Devonian, shown in the slope on the east (left) side of the Pass. The thrust along this fault has carried the rocks forming the main range of the Rockies in this area several miles to the eastward.

FIG. 20.—On the trail to Wonder Pass with a northwest gale to face. The horses always turn their backs to the wind when resting. Photograph by Walcott, 1916.

The fault crosses through Wonder Pass and then curves to the northwest, southeast of Magog Lake, shown in figure 5, to the great cliff forming the northern extension of the Assiniboine massif (fig. 2). During the million or more years that the agencies of erosion had been wearing away the great mass of rocks above the fault, mountain peaks, canyons, and ridges have been carved and polished by frost, snow, and the grinding force of huge glaciers. The glaciers have now retreated to a point near their origin, high up on the mountains,

but they have left behind them basins that are filled by beautiful lakes, such as Magog (fig. 5), Sunburst (fig. 4), and Ross (fig. 14).

The line of demarcation between the Lower and Middle Cambrian was found to be high up in the section on the face of the cliffs at Wonder Pass, and throughout the Assiniboine massif.

While camped on Magog Lake below Mount Assiniboine, some marvelous reflections of the peak in the waters of the lake were seen

FIG. 21.—A noonday rest at Wonder Peak, after climbing up the side of Naiset Mountain. A shelter was made of saddle blankets to break the force of the cold wind. Photograph by Walcott, 1916.

in the quiet of the early morning, and by a fortunate combination of a "clear-cut" day and calm at the lake level, the photographs reproduced in figures 6, 7, and 8 were secured. The changes in the "cloud banners," at the peak, which occur very rapidly, are well shown by figures 7 and 8. These views led us to regard the grand pyramid of Mount Assiniboine as the Matterhorn of America.

Northwest of Banff the broad valley of the Bow has been eroded diagonally back through the massive scarf of the overthrust massif

and thus exposed to erosion the heart of the great arch that had its crest over the region now occupied by Mount Victoria and other peaks of the Bow Range.

FIG. 22.—Standardizing the size of an old trail gang oven beside the trail. Photograph by Walcott, 1916.

A glance into this wonderland is shown by figures 9 and 10, which are views looking south across the Bow Valley into the heart of the Rockies. The illustration of Pinnacle Peak (fig. 11) tells the story of the tremendous power of erosive agencies, where the colossal

quartzites and limestones are shattered and eroded into the most fantastic forms.

West of Pinnacle Peak, at the head of Paradise Valley, Mount

Fig. 23.—Breaking camp and packing up at Mount Assiniboine camp. Photograph by Walcott, 1916.

Hungabee rises in a terraced wall 4,000 feet above the glacier at its foot (fig. 12), while another glimpse of these great cliffs is seen under Mount Lefroy, where the melting snows cascade down as a beautiful brook over the quartzite ledges (fig. 13).

At last, in the cliffs above Ross Lake (fig. 15), the *Albertella* fauna was located in situ, and from the slopes above the lake a panoramic view (fig. 14) was taken of Mount Bosworth, above Kicking Horse Pass on the Continental Divide. Although only 9,083 feet in height, Mount Bosworth exposes in its slopes over 12,000 feet in thickness of bedded rocks that constitute one of the best sections of the Cambrian rocks found in the Canadian Rockies.

FIG. 24.—Waiting for the odds and ends for the last pack at Red Earth Creek camp. The last outfield camp of 1916. Photograph by Walcott, 1916.

Considerable collections of Cambrian fossils were obtained by Secretary and Mrs. Walcott, who accompanied and worked with him throughout the trip, before the storms of late September drove them back to Banff and ended the research for the season.

A few of the incidents of life along the trail are illustrated by figures 17 to 24.

GEOLOGICAL FIELD STUDIES

Dr. George P. Merrill, head curator of geology in the National Museum, devoted several days of the summer vacation period to

visiting the gem and feldspar quarries of Auburn, Topsham, and neighboring areas in Maine. While nothing new was secured, he was able to add interesting material to the exhibit illustrating the character and association of the pegmatite dikes, which is now being installed in the Museum.

In May Dr. Edgar T. Wherry was detailed by the Museum to carry on field studies of certain minerals, rocks, and soils in eastern Pennsylvania. Collections of diffusion rings in shale, of glauberite crystal cavities in shale, of the rare iron silicate chloropal, and of certain soils and the associated rocks, were made. These specimens have been added to the Museum collections, and are being investigated. Articles on the glauberite cavities and on one group of soils have been published.

In June certain gem and mica localities in New Jersey and southeastern Pennsylvania were visited by Dr. Wherry, and Dr. W. T. Schaller of the U. S. Geological Survey. In the course of this trip a number of specimens of minerals were obtained for the Museum collections.

HUNTING GRAPTOLITES IN THE APPALACHIAN VALLEY

The great value of the extinct organisms known as graptolites in determining the age of geological formations which contain few and often no other kinds of fossils, has been proved time and again. During the summer of 1916 Dr. R. S. Bassler and Mr. C. E. Resser, both of the division of paleontology, U. S. National Museum, had occasion to test this particular group of fossils in the course of a study of the Cambrian and Ordovician shale formations of western Maryland. Recent excavations along the Western Maryland Railroad, in the great shale belt just west of Williamsport and extending north and south for hundreds of miles, exposed these rocks to such advantage that it was thought possible enough fossils could be found in them to determine their exact geologic age and structure. However, no fossils of any kind were found after much search. It was then decided that the rocks were either barren of organic life or the cleavage produced in the strata by the great forces resulting in their present folded condition destroyed all traces of fossils.

Finally the fold of black shale shown in figure 25 was observed, and at the point marked X, where the cleavage and the bedding planes coincided, abundant graptolite remains were discovered. The species which were collected proved to be of such typical Trenton forms that there could be no doubt of the Middle Ordovician age of

this particular shale. Limestones known to be much older outcrop so short a distance to the east of this that a great fault or displacement between the two kinds of rocks is clearly indicated.

With these facts in hand, the fault was traced for a distance of thirty miles north and south, thus again showing that the graptolites proved the key to the geologic structure of the region.

FIG. 25.—Fold in Ordovician shale west of Williamsport, Md. Graptolite fauna found at *X*, where cleavage and bedding planes coincide. Photograph by Bassler.

EXPLORATIONS IN THE OHIO VALLEY FOR FOSSIL ALGAE AND CORAL REEFS

Through the extensive studies of the Secretary for several years past, the collections of the National Museum are rich in limestone-forming pre-Cambrian algæ—a low order of water plants that secrete lime or silica. An instructive series of these fossils has been placed on exhibition, but in order to show the geologic occurrence and evolution of this group of plants it was necessary to supplement the pre-Cambrian forms with specimens of more recent age. Accordingly

Dr. R. S. Bassler, curator of paleontology, spent some weeks in the Ohio valley, particularly in the Blue Grass region of Kentucky, in a search for large exhibition specimens, and in a study of their mode of occurrence. He was successful in procuring a number of showy exhibition specimens as well as numerous study collections.

More difficult, however, was the discovery and quarrying of a fossil coral reef suitable for exhibition in the Museum. Coral reefs are known at several horizons in the Paleozoic rocks of the Ohio

FIG. 26.—Strata outcropping along Chenoweth Creek at Jeffersontown, Ky., and containing a coral reef. See text for lettering. Photograph by Bassler.

valley but they are seldom so exposed that an instructive section can be quarried out without injury to the specimens. A great reef of corals outcrops in the strata along the banks of Chenoweth Creek at Jeffersontown, near Louisville, Kentucky, and this was selected to furnish an exhibit for the Museum. A section of the stratified rocks, 6 feet by 10 feet, outlined in the accompanying photograph (fig. 26),

was bodily quarried out of the bank, and these strata with their contained corals were later set up in the exhibition hall of paleontology.

The lowest layer of limestone (A) is composed largely of fossil brachiopod shells. Next above is a layer with scattered corals (B) belonging to a long-tubed species (*Columnaria calicina* Nicholson), probably torn by waves from a nearby coral reef. Overlying this is a limestone stratum (C) largely made of the twiglike stems of stony Bryozoa (Trepostomata).

FIG. 27.—Trenton limestone outcrop near Lexington, Ky., with one stratum containing large heads of coral (X). Photograph by Bassler.

The main reef of corals (D) is chiefly composed of the rounded heads of three species of honey-comb corals, some with radial partitions in the tubes (*Columnaria alveolata* Goldfuss), others without such partitions (*Columnaria vacua* Foerste), and still others with spongy walls (*Calapoccia cribriformis* Nicholson). Large stems of fluted or nodular Hydrozoa (*Beatricea*) are scattered among the honey-comb coral masses.

Horn corals (*Streptelasma rusticum* Billings) are to be seen in both the lower and upper coral beds. The spaces between the lime-

stone layers and also between the heads of coral were filled with clay which contained many other examples of fossil life.

Another coral reef in central Kentucky composed of a single species (*Stromatocerium pustulosum* Safford) was investigated and several massive and complete specimens excavated for exhibition. The smallest of these was several feet in diameter. As shown in the accompanying photograph (fig. 27) these conical coral masses (X) are restricted to a single layer of limestone, on which account they serve excellently in recognizing the bed from place to place. This coral reef occurs in the Trenton limestone and outcrops to advantage around Lexington, Kentucky, although it has been noted at many localities in central Kentucky and central Tennessee.

No expeditions were in the field during the season from the section of vertebrate paleontology. Much valuable material was, however, collected and sent to the Museum by the field parties of the U. S. Geological Survey.

EXAMINATION INTO THE SUBJECT OF SUPPOSEDLY ANCIENT HUMAN REMAINS AT VERO, FLORIDA

On the invitation of Dr. E. H. Sellards, state geologist of Florida, and as his guest, Dr. Hrdlička spent four days in the latter part of October, 1916, at Vero, Florida, where his time was devoted to the study of the site from which certain human bones described by Dr. Sellards were obtained, and to a preliminary examination of the bones themselves.

Laborers were engaged and with their help there was made a clean exposure about 160 feet in length of the geological deposits in close proximity to the localities where the human bones had been discovered. This afforded a comprehensive and enlightening view of the formations involved.

The two human skeletons had been found in the south bank of a recently excavated drainage canal. They occurred, one in fairly close proximity to, and the other within the broad shallow bed of, a small fresh-water stream, now drained by a lateral cut from the canal. The former lay in dark and somewhat indurated sands, the latter for the most part at the base of the muck deposit of the stream bed, and between this and the next older stratum. A few smaller bones which probably belonged to the second skeleton were found at about the same level a short distance from the rest of the remains in an elevation of the lower sandy layer.

The first skeleton lay at a depth of two and a half feet, the second at a depth of two to three and a half feet from the sur-

face. The deposits above the first skeleton consisted partly of somewhat indurated and partly of ordinary sands, overlaid by a layer of marl. The marl when freshly exposed was found to be of the consistency of fresh mortar, but on longer exposure hardened to fairly solid rock. Above skeleton II, there was only muck and irregular sandy patches.

Skeleton No. I is that of a woman probably adult, skeleton No. II that of an adult man of somewhat advanced years. The bones of the former lay close together, those of the latter were dissociated though lying within a moderate-sized ellipse. Broken pottery, bone and stone implements, and stone chips, were found in the same strata, more particularly in the muck layers, with the human bones.

FIG. 28.—The locality of the Vero finds.

Besides the two skeletons, single bones of three additional human bodies—one a child, one a young person and one an adult—were discovered in the vicinity. The human bones were considerably mineralized and in the same strata in which they occurred are found many bones of long extinct animals such as mastodons, tapirs, etc.

Due to the presence of the fossil animal bones in the same strata with the human remains, and to the mineralization of the latter, the opinion was advanced that the human remains were of the same age as the animal bones, which would relegate them to the early part of the Quaternary.

This was not sustained by an anthropological study of the case and of the remains. The human bones show no signs of weathering, gnawing, or trampling, and the two skeletons were represented by so many parts, that the only satisfactory explanation of the conditions can be found in the assumption that the remains are those of intentional burials.

FIG. 29.—The Vero skull (Skeleton No. II), top view. Reconstructed at the U. S. National Museum.

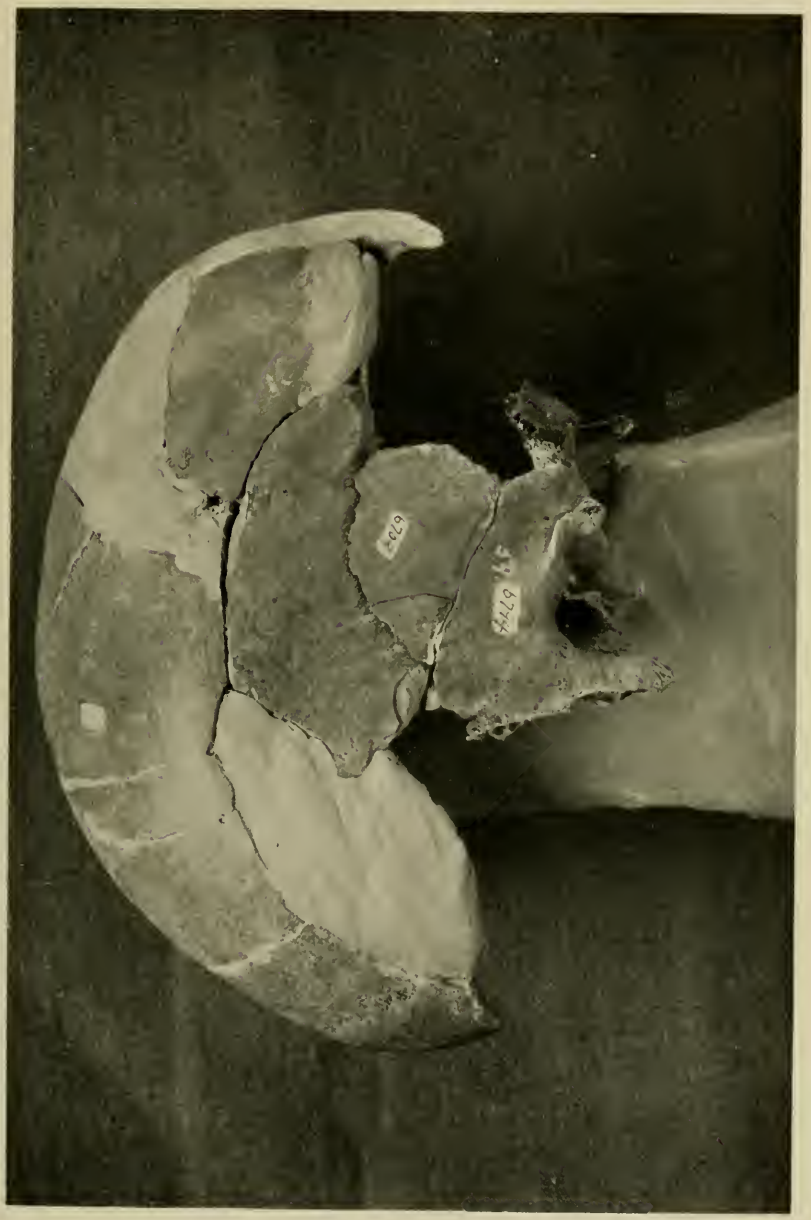

FIG. 30.—The Vero skull (Skeleton No. II), right side.

The pottery and the bone and stone implements are all identical with similar artifacts of the Florida or south-eastern Indians; while the human bones themselves show without exception modern features, with numerous characteristics which permit their identification also as Indian.

The conclusions arrived at are, that the Vero finds represent another of those cases, which are bound to occur from time to time, where the circumstances seem to point to antiquity of the human bones, but where a thorough all-sided inquiry shows that the mass of the evidence is decisively against such an assumption.[1]

Aleš Hrdlička.

TRIP TO FORT MYERS REGION, WEST COAST OF FLORIDA

Following the visit to Vero a trip was made to Fort Myers, Fla., and to several of the outlying keys, where human remains were reported. The particular object of this trip, was to visit a small island off Fort Myers known as the Demorest or Demere Key, on which, according to information obtained from Mr. Sam L. King of Bristol, Tennessee, human bones could be found "imbedded in concretionary materials."

After arrival at Fort Myers a number of gentlemen were met who gave material assistance in locating and reaching the small key, and in making such exploration and collections on the same as were possible within the limited time at our disposal. Those who should be especially mentioned in this connection are Capt. George F. Kinzie, Mr. A. H. Gillingham, and Mr. Richard Eybor.

Demere Key, the surface of which measures about fifteen acres, was originally a low and swampy island, like all the small keys in the vicinity, but a larger part of its surface was in the course of time artificially elevated by the Indians, by means of shells, sand, and soil, for the purposes of habitation and cultivation. Along the middle of this large artificial elevation runs a remarkable platform about 80 feet long, the eastern boundary of which is supported by a still fairly well preserved, well-made wall of conch shells. This structure has been briefly reported by Cushing,[2] and by Mr. Clarence B. Moore,[3] but its origin is in doubt. At a short distance north-east of this elevation there is a low, irregular heap which contains numerous Indian burials. On examining the surface of this heap it was found to

[1] A preliminary symposium on these finds appeared in The Journal of Geology, No. 1, 1917; Dr. Hrdlička's full report will be published by the Bureau of American Ethnology.

[2] Proc. Amer. Philosoph. Soc., Vol. 35, 1896, p. 237.

[3] Antiquities of Florida, West Coast, p. 366.

consist of shells, detritus, sand and vegetable matter, and to be everywhere more or less consolidated to the depth of from six to eighteen inches. The consolidation was such that in many places it was very hard to penetrate the crust with an ordinary mattock. Within this crust, on breaking parts of it off and turning them over, were found numerous human bones, including some more or less defective skulls. Beneath the crust was white sand, which also contained many bones, with a few Indian ornaments and fragments of pottery. The consolidated crust differed in composition. For the larger part it was coquina, of just about such a composition as beach accumulations along the sea; but in other places the solidified part consisted almost entirely of white sand, while in still others it was a dark concretionary mass enclosing shells, sand and vegetable matter, besides the bones. The human bones, though evidently more or less changed, were not yet petrified; and the mound as a whole appears to have no claim to antiquity greater than perhaps a few hundred years; but its surface offers a fine example of what favorable conditions can accomplish in no great space of time in the way of consolidation and inclusion in rock of human remains.

A series of interesting specimens from the mound are now on exhibition in the U. S. National Museum.

Aleš Hrdlička.

EXPEDITION TO BORNEO AND CELEBES

In the report on explorations during 1915 (Smithsonian Misc. Coll., Vol. 66, No. 3, pp. 41-44), I said that Dr. Abbott had decided to continue the work begun in Celebes by Mr. H. C. Raven, and that Mr. Raven had spent part of the summer of 1915 in Washington assembling his outfit. The return journey began late in October. On January 4, 1916 Mr. Raven arrived at Menado, Celebes. His work from January to the end of August was in the northeastern part of the island. Some idea of the conditions under which it has been carried on is given by the photographs here reproduced, and by the following passages from letters:

Menado, Celebes, January 4, 1916.

I arrived here this morning and am very glad to have finished my journey. As yet I have not definitely planned my route, but it will probably be best to start on the extreme end of the peninsula, somewhere in the mountains near Likoepang and work along toward Gorontalo.

Likoepang, Celebes, March 9, 1916.

I have been collecting here and at a place a few miles southeast of here since January 12th. I am now living in the kampong, but my other camp was in heavy forest more than two miles from any home or clearing. The natives call the former place "Teteamoet" and the forest there is the finest I have seen in

Celebes. Rats were fairly common and I have gotten about seven species. *Sciurus leucomus* is also common as is *Sciurus murinus*, but I have seen no other squirrels. Big game is scarce and I have shot nothing larger than the black monkeys, of which I have a good series (15) and feel quite sure that you will find them to be a different variety than those I formerly collected. The crest seems much longer, the callosities are a different shape and the face narrower. [They are *Cynopithecus* (fig. 34), while those previously obtained were *Magus* (fig. 33).]

FIG. 31.—A mother and her two daughters, natives of Temboan, Celebes. Nearly all of the natives of Minahassa are Christians.

This is not just the bat season, the natives claim, as it has been raining almost steadily and there is no fruit about. I have got five species of bats, among them five specimens of a large-eared *Megaderma* which is new to my collection. In all I have something over five hundred specimens, most of which are mammals; also I have got quite a number of land shells.

I am now about to start for Goenoeng Klabat, as with much trouble I have managed to get fairly dry the specimens on hand.

AYERMADIDI, MINAHASSA, CELEBES, May 9, 1916.

I am sorry to have to say that since Likoepang I have been able to do only a few days' work. Shortly after leaving Likoepang I had a little fever, but thought it was about over. So I hired a native house here and tried to do a little collecting and to get rid of my fever. After a week or so the fever disappeared and I went up on Goenoeng Kalabal and made camp at an altitude of about 5,600 feet. We were in the clouds almost continuously and there was also a great deal of rain. Animal life of all kinds was scarce, though what

FIG. 32.—An old man of Temboan. There are very few natives in Minahassa at the present time who dress in this manner.

little I did get may prove interesting. I saw tracks of two or three Anoa [dwarf buffalo] on the very summit and in the crater; also tracks of a pig, but nothing else large. I changed my traps every night so that I trapped all the way from about 5,000 feet to the summit, but got only a few rats. There are five species, I think, and one or two of them seem to vary somewhat from the ones from Likoepang of the same species. I got ten or eleven species of birds, eight of which are new to my collection, and I think not found in the low lands.

At the end of eight days I felt bad and came down to Ayermadidi. That was on April 12th, and from then on I had more or less fever and finally mumps and high fever. This gradually increased so that I was unable to eat or drink anything for 9 days. As quinine had no effect on the fever I finally had to go to Menado to the military doctor there. He stopped my fever in two days, but then I was nearly "all in," my temperature way below normal and pulse little more than fifty. I came around all right anyhow, so that I

FIG. 33.—"Betchie," my black monkey from Toli Toli, a most affectionate and gentle animal. She remembered me after an absence of ten months.

could walk after four or five days and now am all right but a little weak. The hotel at Menado (or in fact anywhere, where one can get European food) is expensive; here is better (cheaper) than Menado and cooler. The doctor said I should go to Tondano for a couple of months where the climate is very cool, but if I improve as of late I think that in less than a week I can start for Lembeh and do some collecting. Lembeh has no resident population, whereas Tondano has more than 12,000.

FIG. 34.—The black monkey of Likoepang, showing the well-developed crest in comparison with the one from Toli Toli.

FIG. 35.—Many of the natives here use the ground as a floor, with the dooryard always swept surprisingly clean. Temboan, Kalait R., Celebes.

MENADO, CELEBES, August 20, 1916.

I returned to Menado about a week ago from south of Amoerang in the mountains where I had made a camp and stayed for about a month. There I got a great many rats, including one or possibly two species that I had not before seen in Minahassa. Something that you may find interesting is quite a good series of shrews of two species, one grey and one black. I am looking forward to getting more of these now that I know how to catch them. The ones I have were caught by native boys. I have often tried with "Out-o'-sight" traps to catch these, but without success. To catch them the

FIG. 36.—Mount Sapoetan, an active volcano in central Minahassa, Celebes.

natives dig a hole about 4 feet deep and three or four feet in diameter and put corn in the hole as bait.

I have decided that a slight change in our plans will probably save time, so instead of going from here to Makassar I am going from here to Parigi and work southward from there to the Lake of Posso; thence to Palopo. Dr. Abbott has written me about the importance of this central part of Celebes ethnologically, and from what I have heard from officials here it must be very interesting country.

I think if I use Paloe or Parigi as a base and first make a trip north from there I shall have fairly well covered all this northern peninsula. Then I can work southward.

In Minahassa I have been disappointed at not being able to get more bats and more large mammals. A short time ago I got a large squirrel about the size of a Ratufa which I believe is very rare here.

During this expedition Mr. Raven has traveled by land instead of by water. His covered cart is shown in the photograph (fig. 37). At Parigi he intended to secure about six pack horses.

Only one shipment of specimens had been received up to January 8, 1917. It includes three hundred and nineteen mammals and about three hundred birds; also numerous reptiles, mollusks, and insects.

GERRIT S. MILLER, JR.

FIG. 37.—My cart and horses on the road to Tondano. In this way I traveled wherever there were good roads in Minahassa.

EXPLORATION IN CHINA

Owing to a variety of circumstances, the work of Mr. Arthur de C. Sowerby, in China, has been less successful than usual. At the end of 1915 he visited Shanghai and parts of the neighboring country on the lower Yangtze. Field-work during this expedition did not produce any very important results; but the examination of the Heude collection of mammals in the Sikawei Museum has thrown much light on one of the most difficult problems connected with the systematic study of Chinese mammals. Heude assembled a large collection of skulls, chiefly of bears and ungulates, from all

parts of China, and from other regions in the east. He made this material the basis of many technical papers. In all of these he applied a standard of specific differentiation so unlike those in use by other zoologists that his work could not be understood. Mr. Sowerby has been able to make good preliminary reviews of Heude's bears, pigs, and goat-antelopes. Papers on these three important groups may be expected to appear in the near future.

In March Mr. Sowerby returned to the Yangtze. This expedition was an almost complete failure. Mr. Sowerby writes (June 10, 1916):

> My recent trip to Che Kiang was brought to a summary close by the outbreak of hostilities in that region. I could not get any transport and very nearly had my retreat cut off. Nothing can be done now till the provinces have come to an agreement as to who shall be president and just how the government is to be run. There is only north Chili left to work in and I hope to go there this autumn. China is in such an unsettled state that if it were not for the war in Europe it would be attracting everybody's attention. Conditions are no better than they were during the revolution of 1911.

No specimens collected during 1916 have yet been received from Mr. Sowerby. Material from the Yangtze and from several localities in northern China is expected soon to arrive.

GERRIT S. MILLER, JR.

EXPLORATIONS IN SANTO DOMINGO

Dr. W. L. Abbott, whose energies for nearly thirty years past have been devoted to explorations in the Old World, made a short visit to Santo Domingo (the scene of his earliest expedition, in 1883), where he spent a few weeks in late summer and fall, 1916, at the eastern end of the island, chiefly in the vicinity of the Bay of Samaná, with trips to several localities in the highlands of the interior, notably at Constanza and El Rio. On this expedition he made a very interesting collection of mammals, birds, reptiles, mollusks, insects, and Indian relics.

In the coast region, Dr. Abbott investigated numerous caves in search of remains of an extinct mammalian fauna. The results of this part of his work have been described by Mr. Miller (Smithsonian Misc. Coll., Vol. 66, No. 12, December 7, 1916). One of the most interesting mammals whose remains were found in these caves is a large rodent, described from a freshly killed specimen in 1836, but not captured since then. Whether it is extinct or not is at present an uncertainty. The skull found by Dr. Abbott is shown in figure 38. At San Lorenzo Bay, on the south side of the Bay

of Samaná, there are "many precipitous limestone hills," which, Dr. Abbott writes, are "literally honey-combed with caves. The cave (usually inhabited) near the pier of the abandoned railroad is full of shell-heaps, and contains many Indian carvings, more or less obliterated by smoke and lime deposits." Here he uncovered two hundred or more archeological objects, including terra cotta images, fragments of pottery, stone pestles, carved stone plates and similar material.

After exhausting the caves in the vicinity of Samaná, Dr. Abbott visited the mountains of the interior, where, at El Rio,[1] he made a most surprising discovery in the bird fauna. He writes "I had heard of a very small 'parrot' which lived in flocks in the pines

FIG. 38.—Skull of *Plagiodontia*, a rodent once common in Haiti and Santo Domingo, but now perhaps extinct. It was eaten by the Indians and by the European settlers of the island. (Enlarged.)

on the pine cones. I suspected a crossbill—said to occur here at Jarabacoa, below 2,000 feet, but the pair I shot were at near 5,000 feet." The bird proved to be a veritable crossbill and, what was most extraordinary, a form closely related to the White-winged Crossbill (*Loxia leucoptera*), a species restricted in the breeding season to the Boreal zone of North America (from Alaska to the higher Adirondacks), migrating in winter at rare intervals as far south as North Carolina. Red Crossbills, of the *Loxia curvirostra*

[1] El Rio is "a new settlement formed 16 years ago in the upper valley of the Emenoa, which flows into the Yaqui River (del Norte). Elevation about 4,000 feet. About 20 miles by road from Jarabacoa. There are about 600 to 800 people settled within a few miles of El Rio. No town, only a shop (tienda) and a cock-pit. Beautiful and fairly fertile district," according to Dr. Abbott's descriptive notes.

group, are now known to inhabit the highlands of Mexico and Guatemala and of the Philippines (Luzon), but the presence of a form of White-winged Crossbill within the tropics was wholly unexpected. The new bird, recently described as *Loxia megaplaga,* closely resembles its Boreal relative in color, but possesses a much heavier bill, the mandibles approximating in bulk those of the Red Crossbills, whereas those of the White-winged species are of much feebler build (see fig. 39).

Another problem in distribution is furnished by a new species of *Brachyspiza,* obtained at Constanza, at an elevation of about 4,000 feet. *Brachyspiza* is a genus of non-migratory sparrows, ranging

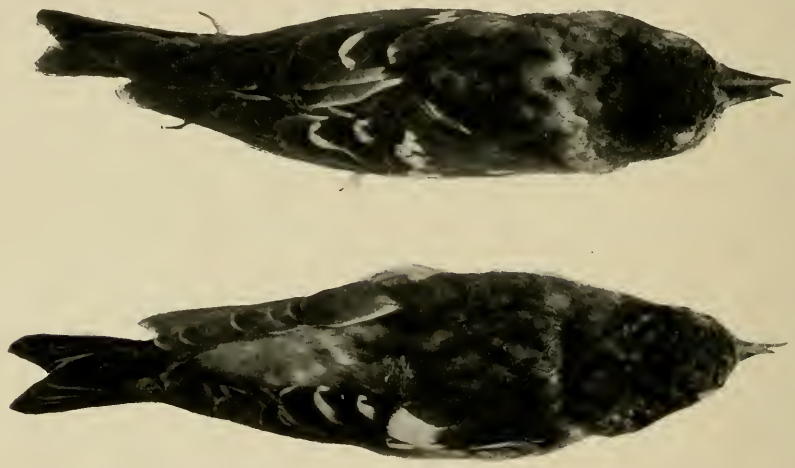

Fig. 39.—Upper figure, Santo Domingo Crossbill (*Loxia megaplaga*), showing heavy bill. Lower figure, White-winged Crossbill (*Loxia leucoptera*), showing slender bill.

from the mountains of Mexico to Chili, with related species in British Guiana and Curaçao, but hitherto not recorded from any part of the West Indies proper. The discovery of a species of this genus in the mountains of Santo Domingo is noteworthy, particularly as the new bird (*Brachyspiza antillarum*) is more nearly related to the mainland bird (*B. capensis peruvicnsis*) than to the form from Curaçao (*B. capensis insularis*). A large owl (*Asio noctipetens*) found at Constanza proved to be new, though not distantly related to a species of Cuba and Mexico. The Santo Domingo Barn Owl (*Tyto glaucops*), described many years ago, but still very rare in museums, is represented by three fine specimens, the first received by the National Museum. Five examples of the equally rare Narrow-

billed Tody (*Todus angustirostris*) were obtained near Constanza, where it replaces the ordinary Tody (*T. subulatus*) of the lower country. A very rare siskin (*Loximitris dominicensis*), peculiar to the island and hitherto represented in the Museum only by the type of the species, was found at El Rio.

One of the commonest and most conspicuous birds, and one restricted to the island, is the Palm Chat (*Dulus dominicus*), sole member of the family Dulidæ, whose systematic position is in doubt. It is a species of peculiar habits and traits; its manner of nesting, for example, is quite unlike that of any other known American bird. The members of a colony (these birds are gregarious) construct a large mass of sticks and small twigs, within which they build their nests. Dr. Abbott collected skeletons and specimens in alcohol, to serve as a basis for further investigations into the affinities of the family.

The series of birds totalled about two hundred and fifty specimens, of fifty or more species, over thirty of which are peculiar to the island. The indigenous species of this island have long constituted the Museum's chief desiderata among the birds of the West Indies, hence Dr. Abbott's collection has proved of the greatest interest, aside from the special discoveries mentioned above.

CHAS. W. RICHMOND.

DREDGING FOR MARINE INVERTEBRATES OFF THE FLORIDA KEYS

In May 1916, Mr. John B. Henderson, a regent of the Smithsonian Institution, conducted a series of dredgings from his yacht *Eolis* off Key West, Florida. Owing to exceptionally good weather conditions and to the fact that the Gulf Stream had receded much farther off shore than is usual, the party was enabled to carry on most successful operations upon the Pourtales Plateau. This is a strip of rocky bottom off the Florida Keys extending some forty or fifty miles and lying between the depths of 100 to 200 fathoms. It is one of the richest localities in American waters with a fauna peculiarly its own. Owing to the great difficulty of dredging over the rocky floor swept by the maximum current of the Gulf Stream, but little attempt has been made to explore it since the work done there by Pourtales, fifty years ago. The material collected covers all groups of marine invertebrates.

COLLECTING IN WESTERN CUBA

In the last few years, numerous collecting trips to western Cuba have been made by Mr. Henderson, usually accompanied by some

member of the museum staff. During the course of these explorations, very large series of land shells have been secured, giving to the Museum by far the largest and most complete collections in the world of that exceedingly rich and interesting mollusk fauna. Practically the entire range of the Organos Mountains, the Sierras of western Cuba, had been explored by representatives of the museum, but there still remained untouched three localities of importance. These were, (1) the extreme eastern prolongation of the Sierra de los Organos, or that region known upon Cuban maps as "Loma de Cuzco" and "Guayajabon." This region furnished the types of several of the first described mollusks of Cuba but has

FIG. 40.—Mr. Henderson's yacht *Eolis* in Florida waters. Photograph by Henderson.

been neglected by all subsequent collectors. (2) The region about "Rangel," one of the most famous of type localities in Cuba, and (3) that section of the Organos Mountains lying between Rangel and the Taco Taco River Gorge and the town of San Diego de los Baños.

In May and June, Mr. Henderson and Dr. Paul Bartsch, curator of marine invertebrates of the Museum, spent a month exploring these three regions. For most of the trips they were accompanied by Dr. Carlos de la Torre and Sr. Rodriquez of the University of Havana. The many localities and stations occupied were thoroughly collected and fine series of mollusks and other organisms were brought home.

Before returning, Mr. Henderson and Dr. Bartsch visited the "Luis Lazo" region in the extreme western part of the Sierra in order to supplement collections hurriedly made there several years ago.

With the completion of the last few items upon the comprehensive program of collecting in western Cuba, the Museum is now in possession of sufficient material for a thorough study of the special fauna of that exceedingly interesting region.

FIG. 41.—Bird Key Reservation, Tortugas, Florida. The large birds on the stakes are Man-o'-war birds; the white-crowned birds nesting in the bushes are Noddy Terns; the birds nesting in the open stretches on the ground are Sooty Terns. Photograph by Bartsch.

VISIT TO THE CERION COLONIES IN FLORIDA

Through the cooperation of the Carnegie Institution and the U. S. National Museum, Dr. Paul Bartsch, curator of marine invertebrates, was enabled to visit the Bahama Cerion colonies which he has planted on the Florida Keys, between Miami and the Tortugas, last May for the purpose of studying the effect of the changed environment upon these organisms. He reports the finding of many adult specimens of the first Florida grown generation, which together with those

FIG. 42.—Bahama Cerions grown on Loggerhead Key, Tortugas, Florida. Photograph by Bartsch.

FIG. 43.—Least Terns on Loggerhead Key. Photographs by Bartsch.

FIG. 44.—Noddy Terns on Bird Key. Photograph by Bartsch.

found last year of the same generation, will furnish the basis of a report now in preparation.

No adult specimens of the second generation have as yet been obtained, although many immature individuals of it were observed, which should attain complete development during the year (1917). The results to be shown by this second generation, probably the most interesting one, are eagerly looked forward to.

An unlooked for result was obtained on New Found Harbor Key, where four hybrid specimens between the native *Cerion incanum* and the transplanted Bahama stock were obtained.

FIG. 45.—Mr. Bethel, the Bird Guardian on Bird Key. Photograph by Bartsch.

The Florida tree snails, *Liguus fasciatus,* transplanted from Brickles Hammock near Miami, to the grounds of the Commandant's residence at Key West, and Garden and Loggerhead Keys, Tortugas, have completely disappeared from these places, not even a trace of a shell being found, thus stamping the experiment a failure.

During the Cerion investigations, and while traveling on a slow train between Key West and Miami on June 24, Dr. Bartsch kept records of the birds observed. These are to be shortly published in the Year Book of the Carnegie Institution, as his fourth annual list of the birds observed in southern Florida. Eight species were added this year, which had not been previously noted, bringing the total so far seen to ninety-seven.

STUDY OF THE MARINE INVERTEBRATE FAUNA OF CHESAPEAKE BAY

The hydrographic and biologic study of Chesapeake Bay begun by the U. S. Bureau of Fisheries in 1915 was continued during the past year. On two of the cruises of the steamer *Fish Hawk,* used for these explorations, the U. S. National Museum had a representative aboard with instructions to give particular attention to the invertebrate fauna of the bay.

Mr. J. A. Mirguet was detailed for this work from April 20 to April 26, 1916, during which time dredgings were made at Stations Nos. 8497 to 8536 inclusive. A few of these dredgings were made in Lynnhaven Sound and in the vicinity of Cape Henry. The others were in various parts of the Chesapeake between the mouth and the Patapsco River. But little opportunity was afforded for collecting along shore, the only work of this kind being done during a brief visit to the shores of St. Mary's River and Buckroe Beach.

Mr. William B. Marshall was detailed to the *Fish Hawk* for similar work from July 12 to July 31, 1916. During this cruise, Stations Nos. 8593 to 8622 inclusive were investigated, extending from the mouth of the bay to above the Patuxent River. Near the capes the dredgings yielded rich returns, but the fauna appears to dwindle out to the northward.

On this cruise, many opportunities occurred for collecting along shore and in the inlets and back bays. Lynnhaven Inlet and its shores, the shores of Fisherman's Island and at New Point, Cedar Point, and Solomon's Island were carefully examined. Lynnhaven Inlet yielded some fine material and interesting data. At Cedar Point a fresh-water lake of many acres in extent comes to within a hundred feet of the bay, above which its banks are elevated but a few feet. A small mollusk (*Amnicola*) is abundant in the floating vegetable matter and seems to be the only molluscan life occurring in the lake.

With a small dredge operated from a motor-boat, five or six hauls were made in Mogothy Bay at depths of from 20 to 32 feet. The fauna proved to be very rich, probably owing to the narrow channel and fair current and the clean shores and flats covered with seagrass. Unfortunately the netting of the dredge was carried away by the weight of a mass of coral. Having no means of making repairs, the party returned to the ship which then moved to another station, leaving the investigation of Mogothy Bay unfinished.

EXPEDITION TO SOUTH AFRICA FOR LIVING ANIMALS

For some years past the National Zoological Park, in common with other similar institutions in the United States, has felt the effect of conditions that operated to hinder more and more the importation of wild animals from abroad and to reduce the supply. While various causes contributed to this, the regulations designed to prevent the introduction of infectious diseases of animals into the United States, have until very recently had most effect. Deer, antelopes, camels, and all other ruminants, also swine, have long been forbidden entry into the United States when coming from the continent of Europe; and for several years past a quarantine has been in effect much of the time against Great Britain because of outbreaks of foot-and-mouth disease there. The same is true of South America; and the restrictions against Africa and Asia are only a little less stringent. With ruminants already almost unobtainable, the outbreak of the European war cut off practically all of the established means of supply for other animals, as the business had been almost wholly in the hands of German dealers.

That this situation was likely to bring serious trouble was soon realized by those having collections of living animals to maintain, and they began to take counsel together. At the suggestion of Dr. W. T. Hornaday, Director of the New York Zoological Park, a conference was held at the Philadelphia Zoological Garden to consider the question of sending a joint expedition, on behalf of the New York, Philadelphia, and National Zoological Parks, to South Africa for animals. From correspondence which Dr. Hornaday submitted at this conference it appeared that some desirable animals were then being offered at a South African port, and that a fairly good representation of the rich fauna of that region would be available if a reliable market were assured. A line of steamships had recently been put in operation between African ports and New York, so that direct shipment could be made. Altogether the conditions seemed reasonably favorable, and it was decided to send a man out to look the ground over, see what could be done in the way of arranging for a supply of animals for the future, and bring back anything desirable that could be secured at the time. As no one of the three institutions could spare a suitable man for this work, they engaged Mr. J. Alden Loring, who had been successful in bringing animals from Europe for the New York Zoological Park, and had also had experience in Africa as a member of the Smithsonian expedition to East Africa.

Mr. Loring sailed from New York July 22, 1916, taking with him hay and grain enough to feed as many antelopes and other

herbivora as he was likely to obtain, for one of the conditions necessary to secure their entry into the United States was that no forage from Africa should be brought with the animals. He arrived at Port Elizabeth, South Africa, August 31, and, returning, sailed from Durban November 22.

The opportunities for securing animals to bring back were found to be in some respects less favorable than had been anticipated. Business conditions generally had been disturbed by the war, and animals were no longer being captured and held for sale to the traveling buyers for European dealers, who, it was known, would now be unable to come. Most of the few animals that had been

FIG. 46.—Herd of sable antelope brought in by the hunters. National Zoological Gardens, Pretoria, South Africa.

available were bought and taken away by a private buyer who passed through the region not very long before Mr. Loring arrived. Fortunately the zoological garden at Pretoria was fairly well stocked, and the director was kind enough to deplete the collection somewhat for the benefit of his distant colleagues. Most of the animals which Mr. Loring brought back were obtained there, an interesting collection of mammals and birds being secured. Two nice lots of snakes and tortoises were obtained elsewhere. There was practically no loss during transportation except a koodoo which broke its neck soon after being put in the shipping crate. The voyage from Durban occupied forty-one days, from November 22 to January 2, and on arrival at Boston the animals were immediately transferred by express to the New York Zoological Park, where

the ruminants were held in quarantine for fifteen days, under the supervision of an inspector of the United States Bureau of Animal Industry. The mammals obtained include a gemsbuck, a blessbuck, a white-tailed gnu, a nilgai,[1] four springbucks, a pair of duikers, a pair of meerkats, and a few monkeys and rodents. Among the birds are two secretary vultures, a bateleur eagle, a hornbill, francolins of several species, a few touracous and hawks, and a number of smaller birds. The collection has been divided between the three institutions concerned, according to their choice, and in proportion to the share of the expenses that was borne by each. Altogether

FIG. 47.—Yards for antelope, National Zoological Gardens, Pretoria, South Africa.

there were secured 28 mammals, representing 13 species; 60 birds, of 25 species; and 55 snakes and tortoises, of 8 species.

It may be of interest to give a brief abstract of Mr. Loring's notes regarding the zoological gardens which he visited in South Africa, where this feature of municipal life seems to find favor.

Cape Town has a small collection of animals, including lions, antelopes, and various smaller mammals, and some birds. This is on the Cecil Rhodes estate.

Durban, with a population of some 34,000, has a small site and a small collection, with apparently not much popular support.

[1] An Indian antelope, born in the Pretoria Zoological Garden.

Bloemfontein, of about the same size, is developing a very creditable zoological park.

Johannesburg, with a (white) population of more than 250,000, has a zoological garden that is the second in importance. It occupies a large, well-wooded site, and its animals are in good condition.

The garden at Pretoria is the largest and best. The animals are in clean, spacious cages and inclosures, and are in fine condition. The garden is favorably located on a well-watered and wooded site, and is supported in part by the Government. It has long had a high reputation for attractive appearance and interesting exhibits, and

FIG. 48.—Flight cage, National Zoological Gardens, Pretoria, South Africa.

its director, Mr. A. K. Haagner, is well known as a contributor to knowledge of South African animals. He is anxious to establish direct relations with institutions in this country which will secure for Pretoria a supply of American animals and enable him to find place for African animals, of which the Pretoria Garden can arrange to furnish many important and most desirable species.

A. B. BAKER.

BOTANICAL EXPLORATION IN VENEZUELA

Dr. J. N. Rose, associate curator of plants in the National Museum, accompanied by Mrs. Rose, carried on exploration work in Venezuela during October and November, 1916, on behalf of the Carnegie

FIG. 49.—Royal Palms along road north of Caracas, Venezuela. Photograph by Mrs. J. N. Rose.

FIG. 50.—View of harbor at Willemstad, Curaçao, showing the Governor's Palace in the distance and the pontoon bridge which closes the mouth of the harbor to the left. Photograph by Mrs. J. N. Rose.

FIG. 51.—A mountain view between LaGuaira and Caracas, Venezuela. Photograph by Mrs. J. N. Rose.

FIG. 52.—Governor's Palace, Willemstad, Curaçao. Photograph by Mrs. J. N. Rose.

Institution of Washington. Both on his way to and from Venezuela stops were made at Curaçao, where opportunity was given to study the very interesting Cactus flora of this Island. The people of Curaçao make very substantial baskets out of the mangrove, which is so common in all tropical coastal thickets. It is rather surprising that this plant is not more extensively used for this purpose in other countries.

In Venezuela Doctor Rose made extensive collections, especially

Fig. 53.—Market scene at Caracas, Venezuela.
Photograph by Mrs. J. N. Rose.

in the mountains about Caracas and Puerto Cabello. While the purpose of his visit to Venezuela was to study the Cactus flora, he obtained also plants in many other groups, especially the Orchids. Through the cooperation of Mr. Homer Brett he secured for the Museum specimens of "Sabadilla." Very much has been written and said about this plant during the past two years, as it is a source of one of the asphyxiating gases which has been used in the European war. At the present time it is listed as a contraband of war by the British Government.

BOTANICAL EXPLORATIONS IN FLORIDA AND NEW MEXICO

During February and March, 1916, Mr. Paul C. Standley, of the division of plants, National Museum, spent about three weeks in the vicinity of Fort Myers, Lee County, on the west coast of southern Florida. Although the trip was a private undertaking, most of the time was spent in an investigation of the interesting flora of the region.

This part of Florida is remarkable for its uniformly level surface, lying only a few feet above sea level, the soil consisting of almost pure white sand, with scarcely any humus, underlain by beds of marl. Rock exposures are infrequent and are confined chiefly to the banks of the small streams. The two most conspicuous plants are a large pine (*Pinus caribaea*) and the saw palmetto (*Serenoa serrulata*). The former is a large tree, occurring everywhere in uniform, rather sparse stands. The saw palmetto is a palm, forming large dense patches two or three feet high almost throughout the pine woods. On close inspection the palmetto is seen really to be a tree or shrub, whose branching trunk is prostrate upon the surface of the soil and rooted to it. With these two plants are associated many kinds of herbs and low shrubs, some of them with very handsome flowers. Coarse grasses and sedges are very abundant.

The pine woods are interspersed with numerous cypress swamps of varying extent, shallow depressions into which the surface water drains, remaining for most of the year. The vegetation here is quite different from that of the sandy soil. The largest and by far the most abundant tree is the cypress, but it is accompanied by many shrubs and small trees, such as ash, maple, elm, holly, wild fig, custard apple, and numerous others less widely known, which are characteristic of subtropical regions. The wild fig is one of the most interesting plants of these swamps: commonly it is a shrub, but often it is a climber, with a long, slender, whitish, rope-like stem which ascends the cypress trees by means of aerial roots, sometimes to a height of sixty feet or more. The trees of the cypress swamps support a varied and often dense growth of epiphytes or air-plants, chiefly ferns, Spanish moss, bromeliads (*Tillandsia* spp.), and orchids. Some plants which farther north are terrestrial become epiphytes in these swamps. Numerous species of herbaceous plants line the margins of the swamp ponds or "lakes," as they are known locally, which are frequented by flocks of water birds, and by many alligators and other reptiles.

Fort Myers lies only about fifteen miles from the Gulf, and the small streams in the vicinity, as well as the large Caloosahatchee

River, are under the influence of the tides. Their banks are bordered with mangroves and other halophilous trees and shrubs. In many

FIG. 54.—Fort Myers, Fla. An air-plant (*Tillandsia* sp.) growing on a cypress trunk, with Spanish moss (*Dendropogon usneoides*).

FIG. 55.—Fort Myers, Fla. A fern (*Blechnum serrulatum*) growing upon the base of a cypress tree.

localities a conspicuous feature of the vegetation is the cabbage palmetto, a tall, handsome palm with a large tuft of leaves, the "cabbage" of which is used for food.

The town of Marco, about 40 miles farther south on the Gulf, was visited also, for the purpose of collecting plants. Marco is

FIG. 56.—Fort Myers, Fla. Scene in a cypress swamp during the dry season. Numerous epiphytic plants are seen on the tree trunks.

FIG. 57.—Fort Myers, Fla. A saw palmetto (*Serenoa serrulata*). The prostrate trunk, covered by old leaf bases, is seen at the left.

noteworthy because of the large shell mounds of the vicinity, the refuse from the shell-fish used as food by the early Indian inhabi-

tants. The vegetation here is much more tropical than that about Fort Myers and the mounds have a characteristic association of

FIG. 58.—Fort Myers, Fla. A tree in a cypress swamp covered with epiphytic plants, including several species of ferns and bromeliads (*Tillandsia* spp.).

plants. Coconut palms are common along the shores, sometimes forming large groves.

During the three weeks spent in Lee County, about 700 specimens of plants were collected, representing some 500 species. Many of them are plants of rare occurrence, and some represent notable extensions of range, one, at least, being an addition to the known flora of the United States. One of the lichens was determined by Mr. G. K. Merrill as a new species, and some of the parasitic fungi are of unusual interest.

During August and September Mr. Standley was detailed for field-work in New Mexico. He spent four weeks at Ute Park, Colfax County, a locality in the southern extension of the Sangre

FIG. 59.—Ute Park, N. Mex. Showing sandstone hillsides covered with pinyon and cedar.

de Cristo Range of Colorado, and only a few miles south of the Colorado boundary.

Ute Park lies at an altitude of about 7,500 feet upon the Cimarron River, one of the characteristic swift, clear streams of the Rockies. The valley here is rather wide, with gently sloping meadows on one or both sides, although at some places the stream is shut in by cliffs which rise precipitously on both banks. Immediately along the stream and its tributaries are groves of cottonwood, with thickets of alder, aspen, birch, hawthorn, and other shrubs. The stream is inhabited by large numbers of beaver, whose dams are found everywhere. In places fully half of the trees seemed to have been cut down by these animals, to be used as food or in the construction of their dams.

Beyond the stream banks the meadows extend for varying distances. They are characterized by numerous grasses, especially blue grama, and by many showy-flowered herbs which exhibit a wealth of color found only in mountains at high altitudes. Beyond the meadows on one side rise low sandstone mountains covered with cedar and pinyon, and with many characteristic southwestern plants, such as cacti, yuccas, and bear grass. On the other side of the valley rise high mountains of igneous origin, covered with typical Rocky Mountain forests of yellow, white, and foxtail pine, Douglas and other spruces, fir, and aspen. One of the common trees is the cork-bark fir (*Abies arizonica*), a comparatively little known tree, whose

FIG. 60.—Ute Park, N. Mex. Cottonwood tree felled by beavers. The largest trunk felled in this manner was slightly over 2 feet in diameter.

bark, instead of being thick and hard, as in most of the conifers of the region, is soft and thin. After the trees have been dead for some time the bark separates from the wood in great cork-like sheets.

The highest mountain in the vicinity of Ute Park is Baldy Peak, which rises to 12,490 feet. Its top is well above timber line and supports an Arctic-Alpine vegetation.

During the time spent in the region about 5,000 specimens were secured, representing 1,540 collection numbers. Among the flowering plants several genera new to the State were obtained, and many additional species. Special attention was devoted to the cryptogams, and the collection of these is by far the largest ever obtained in the

State. Nearly one hundred rusts were obtained and about 250 collections of fleshy fungi, a group of which scarcely more than a dozen species have been reported from New Mexico. Probably more than 300 species of fungi have been added to the known flora of the State as a result of the expedition.

BOTANICAL EXPLORATIONS IN THE HAWAIIAN ISLANDS

During the summer of 1916, from June to November, 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 National Museum, traveled in the Hawaiian Islands studying and collecting the flora, especially the grasses. Mr. Hitchcock was assisted by his son, A. E. Hitchcock. The islands visited were Kauai, Oahu, Lanai, Molokai, Maui, and Hawaii, these comprising all the islands of the main group except the two small ones Kahoolawe and Niihau. The islands are all of volcanic origin and the rock is lava except a very little that is coral formation. Kauai, the geologically oldest island, shows the greatest effect of erosion, the deep canyons rivaling in beauty the Grand Canyon of the Colorado. The rainfall on the mountains of the windward side is excessive, that of Waialeale, the highest peak of Kauai, being as much as 600 inches per annum. The lee side of the islands is arid, the rainfall being often reduced to less than 15 inches per annum. The islands to the south are successively younger, Hawaii, the largest, being now in a state of volcanic activity. On this island are the two highest peaks of the group, Mauna Kea, 13,825 feet, and Mauna Loa, 13,675 feet in height. Above 10,000 feet there is scarcely any vegetation upon these peaks, especially upon Mauna Loa which is made up of comparatively recent lava. There is much snow upon the peaks in winter and extensive banks persist throughout the year. The magnitude of the mountain mass is greater than at first appears, because the cones arise from the floor of the ocean 18,000 feet below the surface, thus making the total height over 30,000 feet. The gradual slope from the sea to the summit deceives the eye and the great height is not at first fully realized. Upon Hawaii is the active volcano Kilauea (4,000 feet) with its pit of boiling lava. What is said to be the largest crater in the world (Haleakala) is upon Maui, the second largest island of the group.

The important agricultural industries of the islands are sugar, live stock, and pineapples. The native Hawaiian population is decreasing. It is only in the less accessible parts of the islands that

FIG. 61.—A deeply eroded canyon of the Waimea River, Kauai.

FIG. 62.—A view of Mauna Kea near timber line. The small trees in the middle distance are mamani (*Sophora chrysophylla*). The grass in the foreground is *Koeleria glomerata*. Mauna Loa is seen in the distance. A cloud bank lies between at the left.

FIG. 63.—Near summit of Mauna Kea. Cinder cones in the distance. Snowbank in the foreground about 6 feet high (August).

FIG. 64.—A view in Haleakala crater showing the numerous cinder cones within the main crater.

FIG. 65.—A view in the eastern part of Haleakala crater, looking west, two cinder cones in the center.

the primitive customs still prevail. Here may be found the grass huts of the natives. These huts are made of a frame work of wood filled in with a thatch of grass. The grass used for this purpose is usually pili (*Heteropogon contortus*), an indigenous grass abundant upon the rocky soil of the lowlands.

The cultivated trees and shrubs are of great variety and beauty, and are drawn from all tropical and subtropical lands. The introduced flora is very pronounced in the region of the towns, ranches, and plantations. One must go several miles from Honolulu to find indigenous plants. Of 60 species of grasses found on Oahu about 50 were introduced. One of the introduced trees of great economic

FIG. 66.—View in the garden in Honolulu, formerly owned by Dr. William Hillebrand, author of "Flora of the Hawaiian Islands," showing a tropical tree with brace roots.

importance is the algaroba tree, or kiawe, as the Hawaiians call it (*Prosopis juliflora*). It is found in a belt on the lowlands along the shores of all the islands and occupies the soil almost to the exclusion of other plants. The pods are very nutritious and are eagerly eaten by all kinds of stock. The flowers furnish an excellent quality of honey. The Molokai ranch produces 150 to 200 tons of strained honey per year. The prickly pear cactus (a species going under the name of *Opuntia tuna*) has become extensively naturalized in the dryer portions of all the islands. The ranchmen utilize this for feed when other kinds become scarce, the cattle eating the

succulent joints in spite of the thorns. Two introduced shrubs now occupy extensive areas and have become great pests. These are guava (*Psidium guajava*), whose fruit furnishes the delicious guava jelly, and lantana (*Lantana camara*), with clusters of handsome particolored flowers. In the moister portions of the islands large areas have been occupied by Hilo grass (*Paspalum conjugatum*) which has little value as a forage plant. The kukui or candlenut tree (*Aleurites moluccana*) with its light, almost silvery, green foliage is now a common and rather striking element in the valleys and gorges.

FIG. 67.—A forest of algaroba trees (*Prosopis juliflora*). The pods are much relished by stock and are an important cattle food. From the flowers are produced an excellent quality of honey which is an important article of export.

The indigenous flora is highly interesting though not abundant in species. Two of the commonest trees are the ohia (*Metrosideros polymorpha*) and the koa (*Acacia koa*). The former, also called ohia lehua and lehua, resembles, in the appearance of the trunk, our white oak, but bears beautiful clusters of scarlet flowers with long-protruding stamens. The koa produces a valuable wood much used in cabinet making, now becoming familiar through its use for making ukuleles. Characteristic of the upper forest belt on the high mountains of Hawaii is the mamani (*Sophora chrysophylla*), a leguminous tree with drooping racemes of yellow flowers and long 4-winged

FIG. 68.—Trees on the windward side of Lanai, showing the effect of the strong trade wind.

FIG. 69.—Grass hut of the Hawaiians. The wooden framework is thatched with pili grass (*Heteropogon contortus*).

pods constricted between the seeds. In the arid regions is found the wiliwili (*Erythrina monosperma*), a deciduous tree with gnarly growth, a very soft light wood, and bright scarlet seeds. Among the peculiar plants of the islands is the silversword (*Argyroxiphium sandwicense*), a strikingly beautiful composite with glistening silvery leaves, which grows only on the slopes of cinder cones in the crater

FIG. 70.—Palms at Hilo. Two royal palms with a slender betel palm between.

of Haleakala and in a few very limited localities on Hawaii. The family Lobeliaceae is represented by about 100 species belonging to 6 genera. The numerous arborescent species are very peculiar and characteristic. Many of them form slender trunks like small palms, crowned with a large cluster of long narrow leaves. The trunks of some species are as much as 30 or 40 feet high and the large bright colored flowers are sometimes remarkably beautiful.

FIG. 71.—A foot bridge across the Waimea River, above Waimea, Kauai. On the opposite cliff are seen numerous plants of prickly pear cactus (the so-called *Opuntia tuna*).

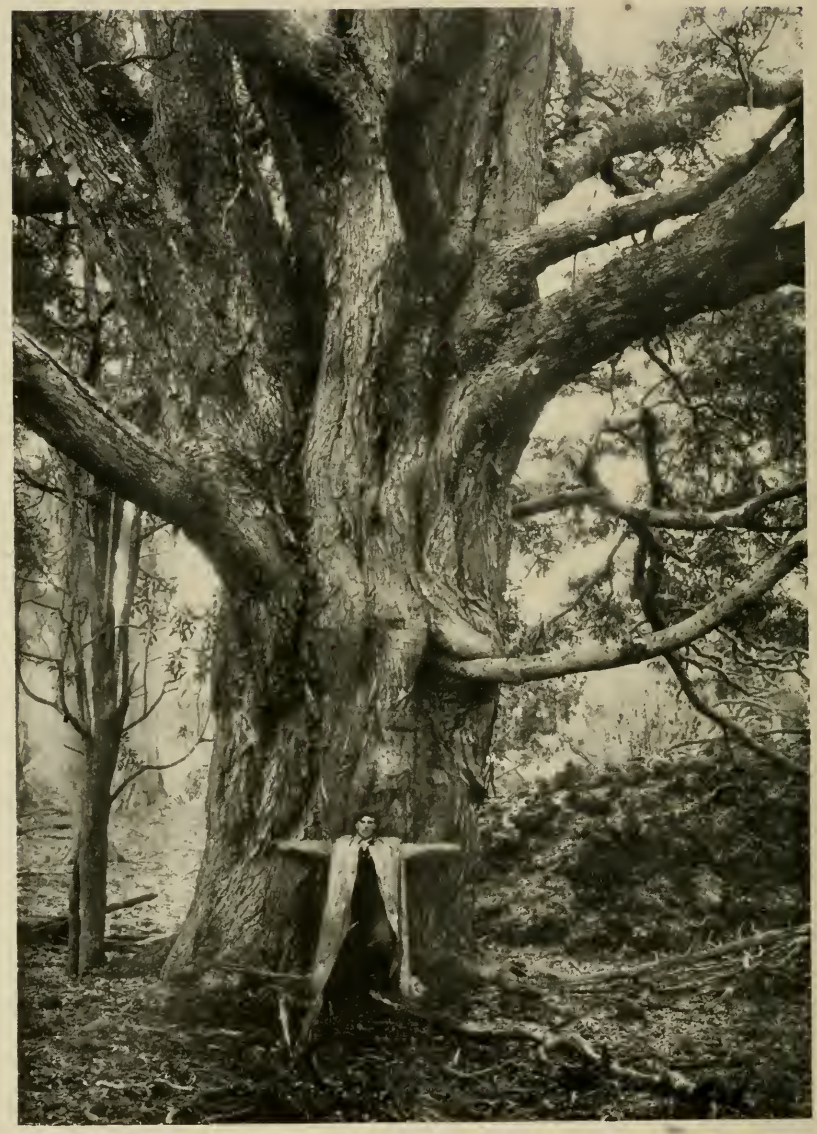

FIG. 72.—Trunk of a large koa tree (*Acacia koa*), on the eastern slope of Mauna Loa, Hawaii. A valuable wood much used in cabinet making, especially for ukuleles.

The indigenous grasses of the Hawaiian Islands are not numerous. The most interesting belong to the genera Panicum and Eragrostis. A tall species of the latter (*E. atropioides*) is the dominant grass upon the plain between Mauna Loa and Mauna Kea. Three peculiar

FIG. 73.—Wiliwili (*Erythrina monosperma*), in an arid gulch on the western part of Molokai. At this season (October) the tree is devoid of leaves. Flowers and pods may be seen at the extremities of the branchlets.

species of Panicum inhabit the open bogs formed on the tops of many of the high mountains in the wet zone such as Mt. Eeka and Mt. Kukui in West Maui, some of the peaks of Molokai and Oahu, and Waialeale in Kauai, that upon the latter covering in all several

FIG. 74.—The silver sword (*Argyroxiphium sandwicense*), growing on cinder slopes in the crater of Haleakala, East Maui, at an altitude of about 9,500 feet.

FIG. 75.—A tree fern (*Cibotium menziesii*) near Puu Waawaa, Hawaii. The undergrowth is a common fern (*Dryopteris fuscoatra*) found in much of the wet forest at an altitude of 3,000 feet.

square miles. These bogs are found near the summits of ridges in the regions of heavy rainfall, are devoid of trees and shrubs, and harbor a peculiar vegetation. Many species form more or less globose tussocks which rise above the general level of the bog. The most interesting of these tussock plants are a sedge

FIG. 76.—A representative of the peculiar arborescent lobelias (*Cyanea* sp.). Forest near Kaholuamano, Kauai.

(*Oreobolus furcatus*) and the three species of Panicum mentioned. The panicums form close masses, the interior consisting of many generations of dead leaves and stems, scarcely decayed, the exterior consisting of short living shoots an inch or two long, with a few contiguous ovate blades and reduced panicles of one to a few spikelets. A showy lobelia (*L. gaudichaudii*) with numerous large

FIG. 77.—Bracket fern (*Elaphoglossum acmulum*) growing on ohia (*Metrosideros polymorpha*). The branching trunk of the latter is common and is probably due to the fact that the early growth was upon some other tree and these roots were thrown down to the ground for support.

cream-colored flowers as much as 3½ inches long, peculiar violets, and a sundew (*Drosera longifolia*) are found in these bogs.

The ferns of the Hawaiian Islands are numerous in species and individuals. They are the dominant feature of all the wet forests. Three species of tree ferns of the genus Cibotium are found and in some places form extensive forests. These produce at the base of the stipe a great ball of brownish-yellow wool called pulu by the natives and used by them for stuffing pillows and mattresses. One species (*C. menziesii*) is shown in figure 75. Contrasted with the tree ferns are numerous small epiphytic forms, some species with fronds only an inch or two long. The ferns and fern allies number about 170 species.

ARCHEOLOGICAL EXPLORATIONS IN GUATEMALA AND HONDURAS

In February, 1916, W. H. Holmes, head curator of anthropology, United States National Museum, had the good fortune to become a member of the Carnegie Institution's archeological expedition to Central America under the direction of Sylvanus G. Morley. Among the ancient cities visited was Antigua, the ancient capital of the Spanish kingdom of Guatemala during the period of its greatest prosperity and power. The splendor of its religious establishments is amply testified by the ruins of upwards of forty great churches now scattered through the modern Indian town which occupies the ancient site. The city was visited by a series of earthquakes during which the splendid structures were shattered or thrown down and it was found impossible to restore them and keep them in repair, and in desperation the capital of the kingdom was removed to a neighboring valley, to the site of the present Guatemala City.

The history of the Spanish capital city and its great buildings proves most instructive to the student who would discover the causes that led to the downfall and destruction of the numerous cities built by the Mayan people in prehistoric times, the ruins of which are now found scattered over Central America.

The present Guatemalan capital is built on the site of one of these ancient cities represented to-day by numerous pyramids, terraces, and quadrangular enclosures as well as by works of sculpture which are scattered over a large area just outside of the limits of the capital city.

An extended visit was made to the ruined city of Quirigua in eastern Guatemala. This city has been the subject of much scientific interest during recent years and its remarkable sculptural and

architectural remains have been studied and described by numerous explorers, among whom are Stevens, Maudslay, and Hewett. Much of interest, however, still remains hidden away in the dense tropical forest. The sculptures found here are among the most important known products of aboriginal American genius, the most remarkable example being the "Great Turtle" or Dragon which will be described

FIG. 78.—Temples 20 and 22, Copan, showing the vast magnitude of the substructures. Courtesy of the Peabody Museum.

in detail in an article by Prof. Holmes in the general appendix of the Annual Report of the Smithsonian Institution for 1916.

From the city of Zacapa in Guatemala an excursion was made across ranges of rugged mountains into Honduras where the ancient city of Copan was visited and studied in as much detail as the limited duration of the visit permitted. The vastness of the pyramids, terraces, and courts, the grandeur of the temples and the marvelous

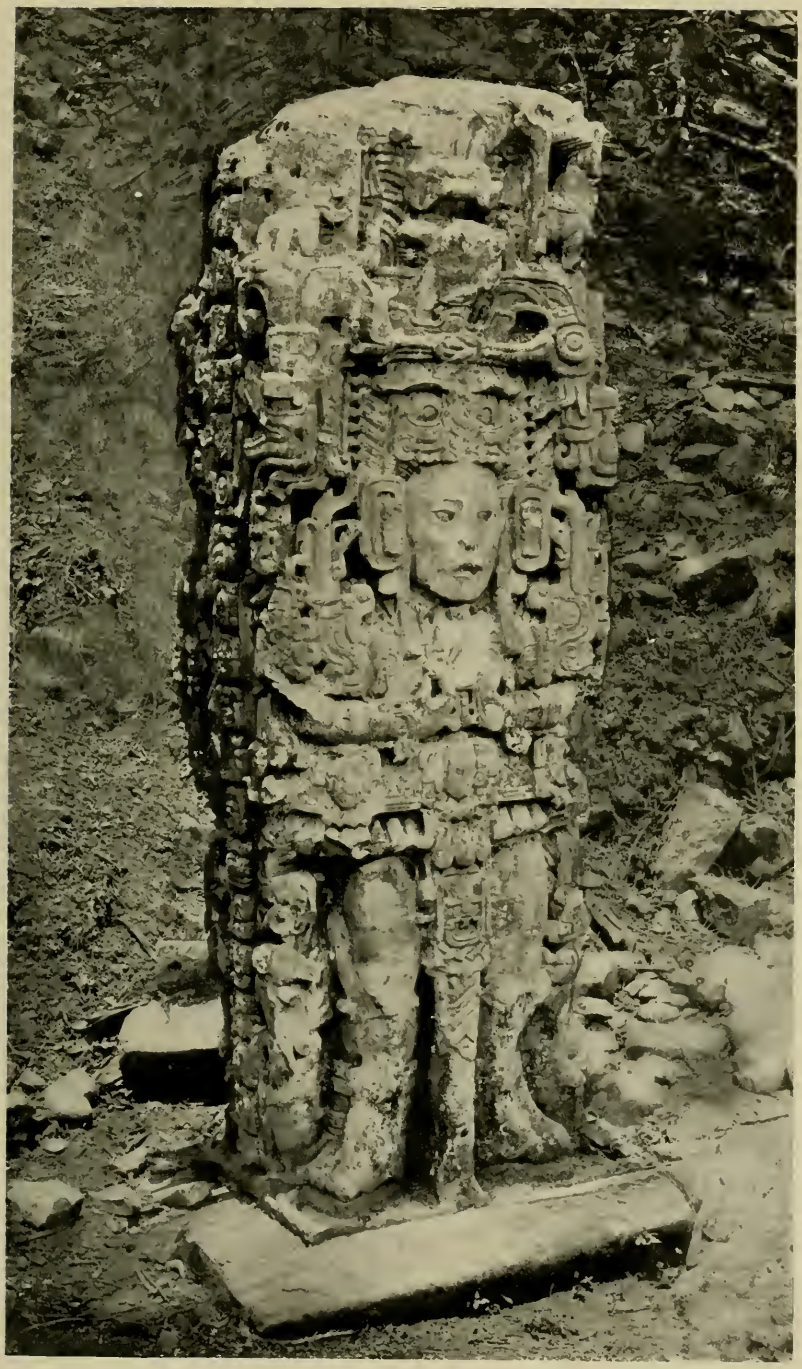

FIG. 79.—A colossal stela at Copan illustrating the remarkably deep and elaborate carving. Courtesy of the Peabody Museum.

sculptures, tell an eloquent story of the civilization and power of the ancient people.

Especial attention was given to the collection of data and drawings to be utilized in preparing panoramic views of the several cities visited, and every effort was made to obtain information regarding the technical methods employed by the ancient sculptors and builders. The quarries from which the stone was obtained were too deeply buried in tropical vegetation to yield up their story without extensive excavation and the methods employed in dressing and carving the stone remain in large part undetermined. Certain chipped and ground stone implements that could have served in dressing the stones used in building were found in numbers, but the story of the carving, especially of the very deep carving of the monuments of Copan, remains unrevealed. Although it is thought that stone tools may have been equal to the task, it is believed by some that without bronze the work could not have been done. There are, however, no traces of the use of bronze by the Central Americans.

PREHISTORIC REMAINS IN NEW MEXICO, COLORADO, AND UTAH

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, spent a little less than five months in the field studying the remains of some of the prehistoric buildings scattered over western New Mexico and Colorado, and eastern Utah. The first month of that time he endeavored to increase our knowledge of the prehistoric migration trail of the Hopi fire people. The months of July, August, and September, were devoted to excavations and intensive studies of a ruined pueblo at Mummy Lake in the Mesa Verde National Park, Colorado. In October Dr. Fewkes investigated certain ancient towers above Hill Canyon, Utah, one of the most northerly localities in which these structures have yet been found.

The inhabitants of the Hopi villages in northeastern Arizona are recognized by ethnologists as a composite people, made up of several clans whose ancestors in some instances spoke different tongues, having drifted into this isolated region of waterless mesas from all directions. The descendants of these clans, some now already absorbed and their language assimilated, others, retaining their original speech and now a people of homogeneous culture, inhabit villages perched on high plateaus. The first colony, or the original

settlers, to arrive in this arid country, are said to have been immigrants from the east, or from the region now embraced in Colorado

FIG. 80.—Fire House, a former home of the Hopi Fire Clans.

FIG. 81.—Ruin near Crown Point, New Mexico. Photograph by Fewkes.

and New Mexico, where the peculiar buildings known as pueblos probably originated. These incoming clans of housebuilders forming

the nucleus of the Hopi population were augmented, in the seventeenth and eighteenth centuries, by additions from this and other directions.

The arrival in the Hopi country of the first clans occurred in prehistoric times, but legends of that event have been preserved in traditions which may be verified by examination and comparison of archeological data. It is possible by a study of the halting places mentioned in legends to determine the migration trails of these increments and to extend into prehistoric times our knowledge of the history of one of the most instructive groups of North American Indians.

FIG. 82.—Kin-a-a, near Crown Point. Photograph by Fewkes.

The ruin of Sikyatki, situated three miles from Walpi, is generally regarded as one of the oldest of the prehistoric Hopi settlements. All traditions and archeological evidences prove that it was settled before the Coronado expedition in 1540. Legends declare not only that the ancestors of this pueblo came from a region near Jemez, New Mexico, but also recount that before they built Sikyatki their ancestors constructed, on the brink of a canyon 25 miles east of Walpi, a village they called Fire House, the ruins of which (fig. 80), known to Navaho as Beshbito, "Pipe water," are still pointed out in support of this claim. These circumstantial statements can be verified or disproved by archeological observations on the ruin itself or by an examination of pottery found in it.

Doctor Fewkes, who has given much attention to the verification of similar Hopi migration legends by archeological data, took the field in June, having in mind to investigate evidences bearing on the

FIG. 83.—Kin-a-a, near Crown Point. Photograph by Fewkes.

Sikyatki legend. He began work with a visit to Fire House, the locality of which had previously been determined by Mr. Victor Mindeleff who described it in his valuable work on pueblo architec-

FIG. 84.—Far View House, northwest angle before excavation.

FIG. 85.—Far View House, north wall, partially excavated.
Photograph by E. E. Higley.

ture, published by the Bureau of American Ethnology. Doctor Fewkes found the architectural features of this ruin essentially the same as when visited by Mindeleff. The ground-plan of Fire House is exceptional in being circular, while that of Sikyatki appears to be rectangular. On the very threshold of the investigation this radical difference in form seemed to disprove the legend, but it is by no means disastrous to a theory of relationship of the two ruins. On the rim of the East Mesa, above Sikyatki, there stand two conspicuous conical mounds, which legends always associate with the village in the foothills. They are remains of the only circular pueblo

FIG. 86.—Northwest angle of Far View House. Dr. Fewkes in the foreground. Photograph by E. E. Higley.

ruins in the Hopi country, and were probably constructed by relatives of the emigrants from Fire House before they built the larger rectangular village at the foot of the Mesa.

The round form of Fire House has a still more important significance, for it corroborates the Hopi legends that their ancestors came from some place near Jemez, a pueblo situated in or near a zone of round ruins extending from southern Utah to the Zuñi River.

The pottery of Fire House is more instructive than its architecture, for its symbolism is the same as that characteristic of the zone of circular ruins. Its rude character and simple conventionalized figures, as compared with the fine specimens from Sikyatki, add

evidence to the theory that characteristic old Hopi pottery is a specialized type distinct from all others in the Southwest.

After having visited Fire House, Doctor Fewkes continued his investigations eastward from this place, still searching for archeological evidence of a possible trail of migration along which people may have left habitations in their travels before they built Fire House. He failed to discover any large pueblo ruins that can be attributed to the Fire clans, although he found many ruins scattered in the extensive interval between the site of Fire House and the next

Fig. 87.—Mummy Lake, Mesa Verde National Park.
Photograph by Mrs. C. R. Miller.

cluster of large ruins, or those of the Chaco canyon. The general character of these ruins does not resemble but is closely related to that of the ancient ruins in the Zuñi valley. A number of representative specimens of pottery collected in these same ruins, especially whole pieces from Black Diamond ranch, were brought to Washington, and were found to resemble those from Kintiel, a ruin situated 25 miles north of Navaho Springs. Kintiel was shown by Cushing to be a Zuñi ruin, and from his knowledge of Zuñi traditions he was able to enumerate the clans that once inhabited it.

After Doctor Fewkes examined, photographed, and roughly surveyed several of the ruins between Fire House and Crown point

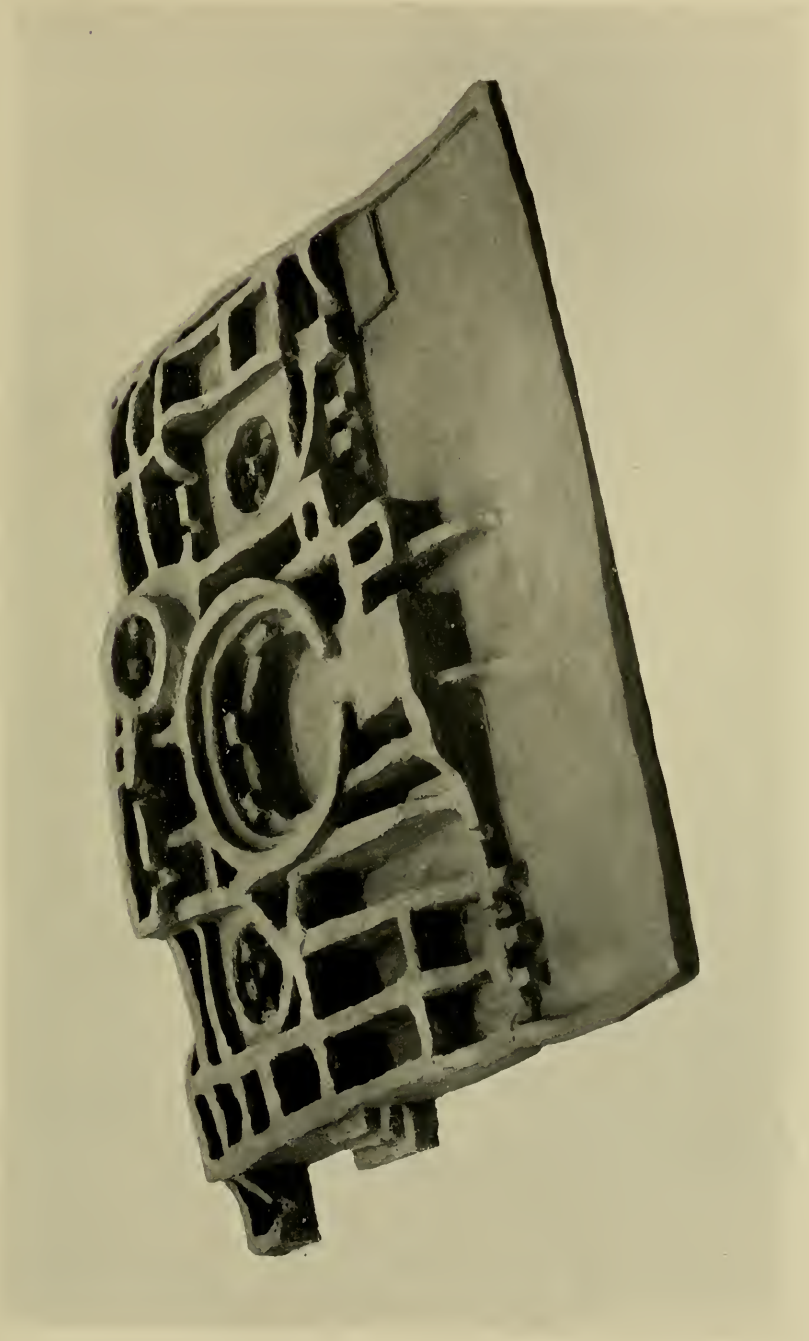

FIG. 88.—Photograph of a model of Far View House, from southwest.

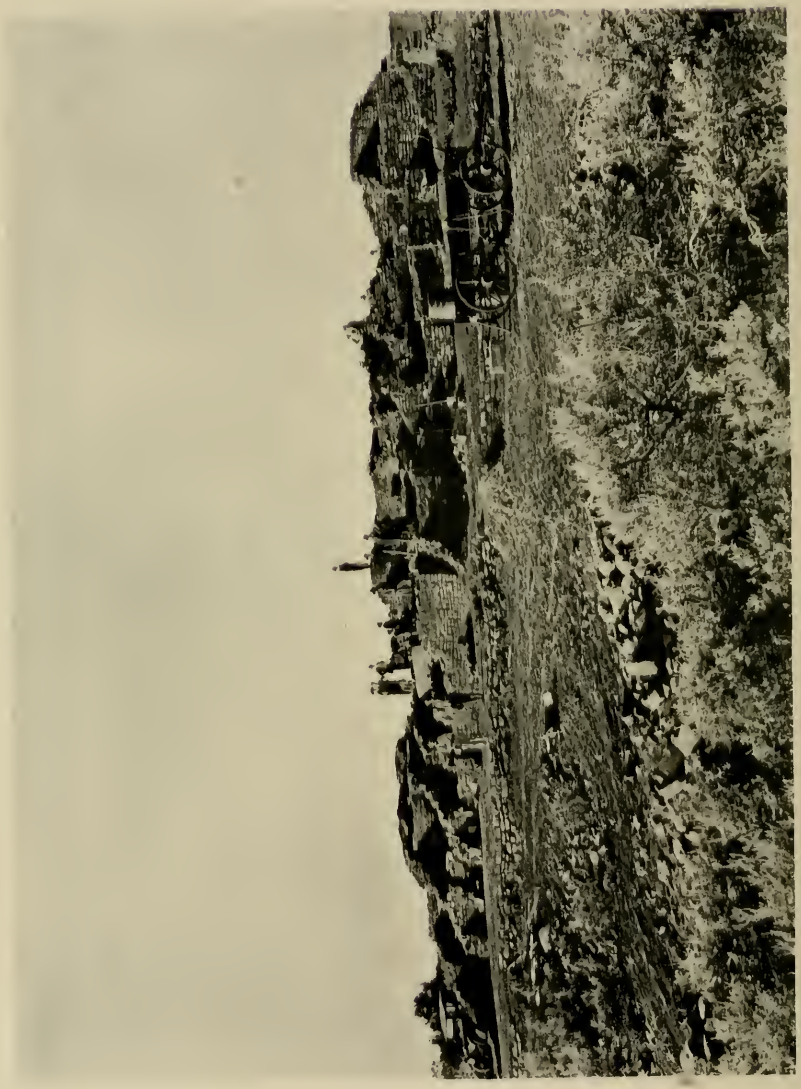

Fig. 89.—Far View House, from the south. Photograph by George L. Beam.

FIG. 90.—Southwest angle of Far View House, Mesa Verde National Park, Colorado. Photograph by W. H. Austin.

FIG. 91.—Tower near Spruce Tree House, Mesa Verde National Park, Colorado. Photograph by Fred Jeep.

(fig. 81), he reached the conclusion, from the resemblance of their pottery to Kintiel, that the majority of them belong to the Zuñi series, or were links, in a cultural chain, connecting the great Chaco ruins with those of the Zuñi valley, thus supporting by archeological evidence, the Zuñi legends that one or more of the Chaco ruins were once inhabited by Zuñi clans. Although not a novel suggestion, it is a significant one, as the fate of the inhabitants of these magnificent buildings is one of the unanswered problems of Southwestern culture-history.

Fig. 92.—Tower in Navaho Canyon, Mesa Verde National Park, Colorado. Photograph by E. E. Higley.

In pursuance of another archeological problem Doctor Fewkes was obliged temporarily to leave his studies of Hopi migration routes unfinished, and on July 20 began the extensive work of excavation and repair of a pueblo ruin in the Mesa Verde National Park, Colorado. This is a continuation of work in which he has been engaged at intervals for the last eight years for the Department of the Interior. The appropriation for work on Mesa Verde was exhausted at the close of September, obliging Doctor Fewkes to abandon the work. A report on this aspect of his summer's field operations has been transmitted to the Secretary of the Smithsonian Institution and will be published in the Smithsonian Report for 1916 under the title, "A Prehistoric Mesa Verde Pueblo and its People."

The plan of the work at the Mesa Verde was to excavate one of the many mounds situated on the top of the plateau for the purpose of discovering the characteristics of the Mesa Verde pueblos, of which formerly nothing was known. One of the most conspicuous

FIG. 93.—Tower in Navaho Canyon, Mesa Verde National Park, Colorado. Photograph by J. Wirsula.

piles of stones (figs. 84, 85, 86), in a cluster of 16 mounds near the reservoir called Mummy Lake (fig. 87), was chosen for this purpose, and in this were uncovered the walls of a rectangular ruin, 113 feet long by 100 feet wide; once 20 feet high on the north side where

there were formerly three stories. Led by the distant outlook south of this pueblo, which will serve as a type of many others awaiting investigation, Doctor Fewkes has suggested the name Far View House (fig. 89). His excavations show that it was compactly built, without plazas; it contains about 50 rooms on the ground floor, and four ceremonial chambers, one of which, centrally placed, is 32 feet

FIG. 94.—Mushroom Rock Ruin, Hill Canyon, Utah. Redrawn from a sketch made by the author on the spot.

in diameter (fig. 88). These last-mentioned rooms, known as kivas, are structurally identical with those of cliffhouses. They formerly had vaulted roofs, as indicated by pilasters erected around the room for support of the rafters, and a hatchway. Far View House (fig. 88) is not only a type of ruin hitherto unknown on the Mesa Verde, but also is important in comparison with the architectural features

of cliffhouses and pueblos throughout a region extending over one hundred miles from the Park in all directions. A considerable collection of objects, as pottery, stone and bone implements, idols and ornaments, illustrating the culture of the inhabitants of Far View

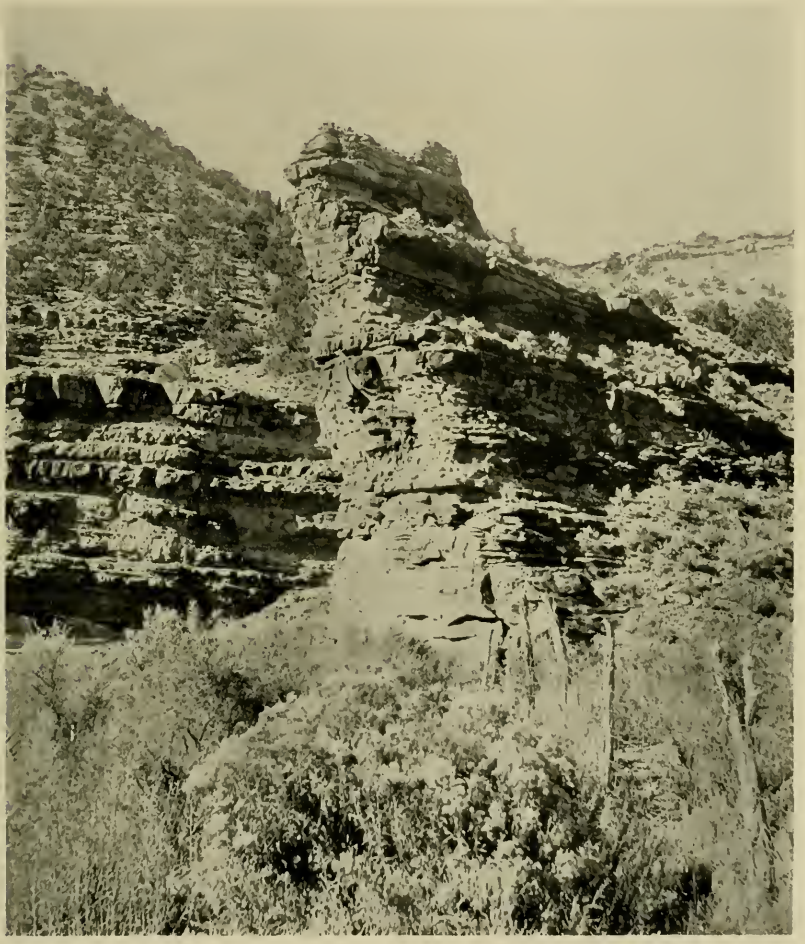

FIG. 95.—Leaning Tower Ruin, Hill Canyon, Utah.
Photograph by T. G. Lemmon.

House, was brought to Washington for future study. The collection is rich in incised designs on stone, spiral forms predominating.

One of the most striking forms of pueblo architecture in the Southwest is known as the tower. These buildings (figs. 91, 92, 93),

were first called to the attention of archeologists by Jackson and Holmes over 40 years ago, and are particularly abundant along the McElmo and its tributaries. The tower is not limited to this area, but is intimately associated with another widely distributed well-

FIG. 96.—Pinnacle Ruin, McElmo Canyon, Colorado.
Photograph by T. G. Lemmon.

defined architectural type known as the circular ruin, which is most abundant in a narrow zone extending north and south, midway between eastern pueblos and the Hopi. There are important variations in the form of towers in different areas, and it is instructive

to determine the northern limit of this peculiar prehistoric structure. For this purpose Doctor Fewkes made a trip to Hill Canyon, 40 miles south of Ouray, Utah, having learned from Mr. Kneale, agent of the Ute, of hitherto undescribed ruins of unusual character in that neighborhood.

The ruins in Hill Canyon belong to the true tower type, but they were built at times on top of rocks of mushroom shape, which has led to the designation "Mushroom Rock ruins" (fig. 94), and seems to have placed them in another category. Several of these towers were photographed (figs. 95-97) by Mr. T. G. Lemmon, a volunteer associate, and the writer made sketches of the ground-

FIG. 97.—Eight Mile Ruin, Hill Canyon, Utah. Photograph by T. G. Lemmon.

plans of those he could enter. These observations not only add to our knowledge of the northern limit of the zone in which towers occur, but also introduce to the archeologist several striking forms bearing on important theoretical questions. So far as his observations on these hitherto unknown ruins have gone, Doctor Fewkes regards them as sacred buildings, comparable with the towers along the Yellowjacket, a branch of McElmo Canyon. They have all the appearance of tower kivas, sometimes single, more often in clusters, accompanied with rectangular buildings.

At the close of the work on Far View House, a trip was made from Mancos, Colorado, down the McElmo Canyon, to examine in a comparative way, towers, round, square, or semicircular, in Cannon

Ball and Ruin Canyons. The special object was to compare them with Sun Temple, a mysterious building uncovered last year (1915) on the Mesa Verde. The data obtained, too extensive to be here considered save in a general way, support the view, already published, that the tower is a type of kiva or ceremonial room.

ANTHROPOLOGICAL WORK AMONG THE SIOUX AND CHIPPEWA

Certain critical conditions among the Chippewa tribe and particularly that part of the tribe which occupies the White Earth reservation, have led during the year just past to anthropological work in this tribe, and among the Sioux, which proved not only highly desirable and interesting, but was followed so far as the Chippewa are concerned by certain very practical results.

The Chippewa tribe as a whole is considerably mixed with whites. Most of this mixture is of French origin, but that of more recent times includes different elements of whites now settled or employed in the country.

In behalf of the numerous mixed-bloods on the White Earth reservation, some of whom are well educated and self-supporting, the United States Congress in 1906-1907 enacted laws which made possible individual allotments of the tribal lands and permitted alienation of property. Some of the allotments were covered with valuable timber, while others were desirable on account of the rich soil, the proximity to lakes, or for other reasons. The majority of the Indians were poor, without knowledge of the value of their property or of the ways of white men, and with little or no protection. They became a rapid and easy prey of lumber companies and a multitude of land sharks, as a result of which, within a few years, hundreds of individuals, including full-bloods and minors, were pauperized, and the White Earth affair became one of the most shameful pages in the history of the white man's dealings with the Indian.

These facts are mentioned, however, only because they led to the anthropological study of the tribe. The frauds practised against the White Earth Chippewa became known to the Government, and a serious and prolonged effort was made by the Department of Justice to correct the evil. During the course of the last few years, more than fifteen hundred suits were filed against companies and individuals concerned in the frauds, and many of these could have been settled in justice to the Indian had it not been for the uncertainty respecting the blood status of many of those involved. Efforts were

made by the Government authorities, as well as by the opposing interests, to obtain a satisfactory genealogy of each Indian concerned, only to reach the conviction that such data could not be relied on to establish beyond legal doubt the full-bloodedness of any individual.

It was at this point that anthropology was appealed to, and the writer was intrusted with the examination of the White Earth Chippewa who claimed to be or were regarded as full-bloods, with the view of passing on their blood status. There were about 800 such

FIG. 98.—Two Sioux school girls, Standing Rock.

persons, 696 of whom were actually examined and their status determined.

In order to be fully prepared for this important work and to test certain new reactions bearing on the question of full-bloodedness of Indians, a most profitable month was spent among the Sioux along the Missouri, and some time was given also to the outlying parts of the Chippewa territory. This gave on one hand the opportunity to examine a good series of men and women among both tribes for anthropological purposes, while the additional experience gained

FIG. 99.—Chippewa mixed-bloods.

among the Sioux proved invaluable in the final work, so that it was not only possible to detect and separate all mixed-bloods from full-bloods, but to form some estimate of the proportion of white blood wherever mixture existed. Nevertheless, a number also were discovered of those who, so far as physical examination could show, were still genuine full-bloods.

The first report on the work among the Chippewa was published toward the end of the year;[1] while a report on the observations among the Sioux is in preparation.

FIG. 100.—Full-blood Chippewa women.

The study among the Chippewa reached the majority of the full-bloods still existing in that tribe. These full-bloods within a decade or two will have mostly if not entirely died out for with a few exceptions they are all old people. The observations and measurements of these full-blooded Chippewa showed the following main points:

In color, physiognomy, hair, and visible characteristics in general, the full-blood Chippewa were completely of the ordinary Indian type, showing no special features.

In stature they ranged from medium to tall, in body development from medium to stocky, the latter predominating.

[1] Hrdlička, Aleš, "Anthropology of the Chippewa," Holmes Anniversary Volume, Washington, 1916, pp. 198-227.

FIG. 101.—Full-blood Chippewa, Red Lake.

The head is large, predominantly mesocephalic, and of medium height. The face is both long and broad, the supraorbital ridges frequently pronounced, the forehead often more or less sloping, especially among the men, and often low in appearance, particularly among the women.

FIG. 102.—War Chief of the Twin Lake Chippewa.

The nose is of good size, with medium prominence, and differs considerably in shape; in men it is in half the cases more or less aquiline, in women mostly straight, concave, or concavo-convex. The septum is frequently horizontal or nearly so, especially in the females. The average nasal index is mesorhinic, as among the majority of Indians.

Alveolar prognathism in the average is slightly to moderately more marked than in whites; the lips in the majority of cases are of medium dimensions, comparable with those of whites, but occasionally the lower lip or both lips are slightly stouter; the chin and lower jaw are well though not excessively developed; the mouth is rather broad. The ears are large, as among Indians in general.

Fig. 103.—Wife of the War Chief of the Twin Lake Chippewa.

The tribe, though Algonquian in language and supposedly of eastern origin, shows a larger and relatively broader head, as well as a broader face, than most of the Eastern Indians. In these respects it is probably nearer some of the more central and northern Algonquian tribes, and as will be shown in a future report, it also approaches the Sioux fairly closely in some respects, though in the

latter the stature is still somewhat higher, the face larger, and the vault of the head lower.

The Sioux were found to be on the average even taller and stronger than the Chippewa. They are also characterized by the large size of the head as well as a large internal cranial capacity, equaling practically that of U. S. whites. But the skull is relatively low, which distinguishes it not only from the Algonquian but also from all the Plains tribes, and especially from the whites.

Aleš Hrdlička.

PRELIMINARY ARCHEOLOGICAL SURVEY OF LA POINTE ISLAND, WISCONSIN

In August, 1916, on the advice of Dr. Hrdlička, Mr. Philip Ainsworth Means, honorary collaborator in archeology, U. S. National Museum, visited La Pointe Island (now commonly called Madeline) with the intention of conducting archeological investigations on the site of the Ojibwa village on that island. The island is one of the archipelago known as the Apostle Islands, in Lake Superior. The Chippewa have occupied it since 1490. They lived there uninterruptedly until about 1620 when the place was deserted. In 1693 a French fort and an Ojibwa village were built on La Pointe Island and the site was occupied by the tribe with one or two interruptions until the nineteenth century.

There are thus on La Pointe Island two important and dated sites of occupancy by the Ojibwa, and the earlier of these sites with its accompanying cemetery dates from a period when no or but very little mixture with whites existed as yet in the tribe. This makes the site of the greatest importance for both the archeology and the anthropology of the Ojibwa who to-day, although one of the largest existing tribes, are also one of the most mixed. A careful and thorough exploration of this earlier site is one of the most urgent and promising tasks of archeology in this country.

A report on the preliminary survey of La Pointe Island by Mr. Means was published by the Smithsonian Institution.[1]

ARCHEOLOGICAL INVESTIGATIONS IN NEW MEXICO

Dr. Walter Hough, of the National Museum, was detailed to the Bureau of American Ethnology in June to conduct archeological investigations in western central New Mexico. Proceeding to Luna,

[1] Smithsonian Misc. Coll., Vol. 66, No. 14.

Socorro County, Dr. Hough commenced the excavation of a ruin previously located by him, as described in Bulletin 35 of the bureau (p. 59). This site was thought to contain evidence of pit dwellings exclusively, and excavations showed that an area of about 40 acres contained circular, semisubterranean houses (fig. 104) in which no stone was used for construction. Seven of the pits were cleared, and it was ascertained that many more existed beneath the surface, dug in the yellow sandy clay substratum of the region. Burnt sections of roofing clay showed that these houses were roofed with beams, poles, brush, and mud, as in present pueblo construction. The roof was supported by wooden posts, charred remains of which

FIG. 104.—Showing circle of pit. Also showing the environs of the pit village beyond.

were found. Nothing was ascertained respecting the construction of the sides of the dwellings or in regard to the height of the roofs. On the floor of each of the pits uncovered were a rude metate (fig. 105), grinding stones, slabs of stone, and the outline of an otherwise undefined fireplace not quite in the center of the chamber. A bench about a foot high and a few feet in length was cut in the wall of some of the pits, and in one of the pits, against the wall, was a fireplace (fig. 106) with raised sides of clay.

Another type of structures adjoined the pits; these were rectangular, open-air houses with mud roofs, in which mealing and culinary work was carried on. Here were numerous metates, manos, rubbing

stones, pottery, etc.; some of the metates were set up on three round stones. Near the pit was a cemetery in which infants were buried,

FIG. 105.—Metate on floor of pit near fireplace.

the burials being associated with burnt clay hearths and much charcoal, and near the bodies were placed small pottery vessels. On the east of the village is a circular depression, 84 feet in diameter,

which was found to be a ceremonial assembling place. It was 10 feet deep and has been filled with about 6 feet of fine débris. Large

FIG. 106.—Fireplace in dwelling pit. Jambs of smoother baked clay, bottom a flat stone, hearth of baked clay.

pines grow on the margin and in the depression. Scrapers of flint and bones of deer were also found among the burials. So far as ascertained, the people who used the circular semisubterranean houses

had a limited range. Traces of their culture have not been found below an elevation of 7,000 feet in the mountain valley, and it appears probable that their culture was associated with an environment of lakes which once existed in these valleys. It is evident in some cases that the pit dwellings were displaced by houses of stone. In most instances artifacts are different from those of the stone-house builders, and the latter have more points of resemblance to, than of difference from, the ancient inhabitants of Blue River. It is probable that the range of the pit-house people would be found to be more extensive by excavation around the sides of stone houses in other localities, the remains of pit structures being easily obliterated by natural filling. At this time the pit-dweller culture can be affiliated only with uncertainty with that of the ancient Pueblos. At the present stage of the investigation the lack of skeletal material is severely felt, but further work may overcome this difficulty.

ARCHEOLOGICAL RECONNOISSANCE IN WESTERN UTAH

In the last report[1] of the explorations and field-work of the Smithsonian Institution notice was given of the inauguration of an archeologic reconnoissance of western Utah, conducted under the auspices of the Bureau of American Ethnology by Mr. Neil M. Judd of the National Museum. During June, 1916, it was found possible to supplement this first survey, and Mr. Judd was again directed to proceed to Utah, there to engage in limited excavations in continuation of his previous work.

As observed in the report of last year, the mounds at Paragonah, in Iron County, represent but a small portion of the large number which formerly existed at that place; the recent reconnoissance was undertaken primarily for the purpose of gaining definite information regarding the remaining ruins before their final destruction was accomplished by removal of the elevations which concealed them. Limited in time and handicapped by unfavorable local conditions, the expedition was less successful than had been anticipated; the results obtained, however, establish a similarity between the ancient Paragonah habitations and those previously exposed in Beaver and neighboring valleys and tend to show that the builders of the western Utah ruins were more closely related to the house-building peoples of other sections of the Southwest than has been generally suspected.

One of the largest and at the same time one of the least disturbed of the Paragonah mounds was selected as a type for examination. Its dimensions were approximately 100 by 300 feet; its average

[1] Misc. Coll., Vol. 66, No. 3, 1915, pp. 64-71.

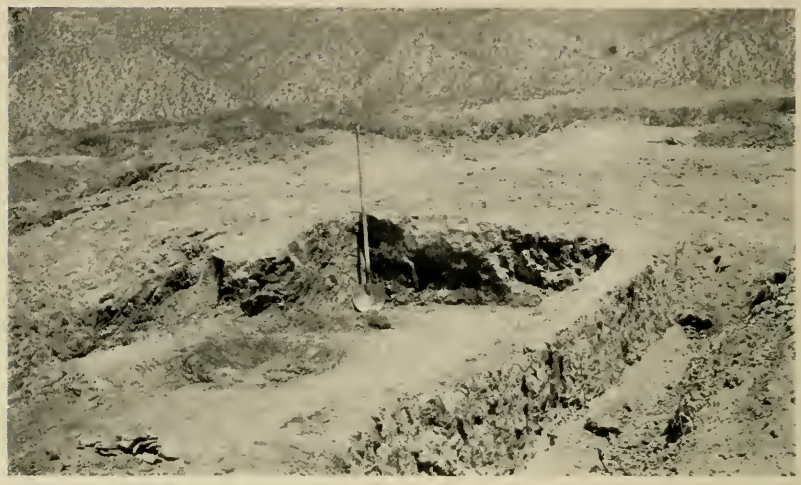

FIG. 107.—One of the ancient Paragonah dwellings. The adobe walls were of the same color as the surrounding soil and frequently were distinguished only by the small roots which followed their sun-dried surfaces.

FIG. 108.—Circular kiva or ceremonial room, Paragonah, Utah. Attempts to brace the thin earthen wall at the left had proved unsuccessful; its final collapse probably hastened the abandonment of the structure. Upon this sloping wall, near the end of the long shadow, is a fireplace which belonged to a temporary shelter, erected subsequently to the destruction of the kiva.

FIG. 109.—Ancient dwellings disclosed during the excavations of 1916. The circular fireplace above the wall in the immediate foreground belonged to a structure which was built upon the floor and which utilized the partially razed walls of a larger house.

FIG. 110.—A long room in the Paragonah mound. These walls had been exposed during previous excavations and were traced only with considerable difficulty.

height was less than 5 feet. Excavations of many years ago had left two great gashes, one at each end of the mound, each partially disclosing a single long room. Including these dwellings, which were reexcavated only with considerable difficulty owing to the hardness of the clay which had accumulated over them, Mr. Judd successfully revealed and measured the walls of 14 rectangular houses, 11 of which were entirely cleared of fallen wall material and other débris. In addition to these habitations less permanent structures were disclosed in various parts of the mound, situated between the ruins of larger houses and even above their razed walls. These temporary structures were built of logs leaned against cross-

FIG. 111.—Interior of an ancient adobe dwelling, showing remains of a wattled partition constructed after completion of the house.

pieces supported by 4 upright posts surrounding a central fireplace and were of the same general character as those discovered in 1915 at Willard and Beaver City. They apparently represent the survival of an earlier type of habitation, preserved in association with the adobe houses as mere shelters wherein were performed most of the domestic activities of the community.

The characteristic ancient dwelling of this region was rectangular in shape; its vertical walls were constructed of superposed masses of plastic clay, forced into position and smoothed by the hands of the workmen. Lacking evidence to the contrary, it is believed that roof openings formed the only means of entrance to these houses, a belief substantiated by the very nature of the dwellings

and by the presence of numerous stone disks, in and about the mounds. The roofs were flat and, as in most primitive southwestern habitations, were oftentimes utilized as workrooms.

One of the most interesting discoveries made during the course of the Paragonah excavations was that of a circular room which, with similar remains previously discovered in the Beaver City mounds, tends to establish the use of the kiva, or ceremonial chamber, by the prehistoric house-building peoples of western Utah. The importance of this discovery is quite evident when one recalls that many of the clans composing the modern Pueblo settlements in Arizona and New Mexico constantly point to the north as the general

FIG. 112.—Walls of ancient adobe dwellings exposed at Paragonah, Utah, in 1916.

location of their ancestral homes. It is well known that many of these clans once occupied cliff-villages such as those so widely distributed throughout the upper San Juan drainage, villages in which the circular kiva reached its highest development. Students of southwestern archeology have labored many years with the problem of the origin of the cliff-dweller culture; the round rooms associated with villages of detached adobe houses in western Utah, together with the artifacts recovered from such houses, suggest that a solution of the problem may yet be found in the unknown canyons north and west of the Rio Colorado. It is earnestly hoped that the reconnoissance of western Utah may be concluded in the near future in order that the information resulting therefrom may be used in correlation

with archeological data now available from other sections of the Southwest.

Following his studies at Paragonah, Mr. Judd proceeded to Fillmore, Willard County, for the purpose of investigating certain mounds reported from that neighborhood. These and similar elevations near the villages of Meadow, Deseret, and Hinckley, were all superficially identified as of the same type and representing the same degree of culture as those previously described near Beaver City, Paragonah, and other settlements.

STUDY OF INDIAN MUSIC

During the summer of 1916 Miss Frances Densmore continued the study of Indian music, making phonographic records of Indian songs on the reservations. For this purpose she revisited the Uintah and Ouray reservation in northeastern Utah, to complete the study of Ute music commenced in 1914. The work at that time was limited to the Uintah and White River divisions of the tribe, but during the last season it was extended to the Uncompahgre. On comparing the two sets of songs it was found that those recorded by the Uncompahgre differ slightly in structure from those recorded by the Uintah and White River Ute.

The principal subjects of investigation among the Ute were the songs used in the treatment of the sick, the war songs, and those of tribal dances. Among the most valuable songs are those of a certain medicine-man who represented a class that treat the sick without the use of material means and who stated that he received his songs supernaturally and could not transfer them to another. Songs were also recorded by a woman who was actively engaged in treating the sick and who belonged to the class of those who use herb-medicines. Her power was believed to be supernaturally given, its source being an eagle. Songs of this class of "doctors" are usually received in a supernatural manner but may be bought and sold, together with the herbs which, it is believed, would be ineffective without the singing of the songs.

The Bear dance is the most distinctive dance of the Ute, and many songs of this dance were recorded. The Ironline dance and the Double dance are among the more or less unusual dances studied. These dances have long since passed into disuse.

A peculiar war custom of the Ute is that of "washing the wounded." It was said that "when a war party returned with a wounded man they placed him in the center of the circle as they

FIG. 113.—Ute burial ground. Photograph by Miss Densmore.

FIG. 114.—Man weaving net for trapping rabbits.
Photograph by Miss Densmore.

danced. Someone washed his wounds and all the warriors sang. The same songs were used if a man had been killed and his body placed in the center of the circle." Several of these songs were

FIG. 115.—Woman with baskets for gathering berries. Photograph by Miss Densmore.

recorded, together with scout songs and those connected with an attack upon the enemy.

A burial ground in recent use was visited. On the burial places were scattered the bones of horses and dogs slain at the death of their owners (fig. 113). Household utensils had been placed on many

graves, and above them hung garments which were evidently tattered by long exposure.

The material culture of the people received attention and specimens have been added to the Ute collection in the National Museum. Notable among these are a set of grinding stones for corn, with specimens of corn, and of bread made by mixing the finely-crushed corn with water and baking it on heated ground, from which coals have been removed. Piñon nuts form a staple article of food among the Ute; some of these parched and still covered with the ashes in which they had been prepared, were added to the collection. Berries were gathered, dried, and prepared in various ways. Figure 115 shows the baskets used for this purpose, it being stated that the berries were placed in the smaller basket when picked, then emptied into the larger basket by passing it over the shoulder. Nets for trapping rabbits were woven from the outer bark of reeds, a specimen of this netting being made by a blind man. The frame used for this purpose and the manner of beginning the net are shown in figure 114.

Analysis of the Ute songs presents many striking contrasts to that of the Sioux and the Chippewa, in which connection it is interesting to note the difference in the environment of these tribes, as well as in their temperament and tribal history. It is not unlikely that all these may have affected the form assumed by the musical expression of these several peoples.

ETHNOLOGICAL RESEARCHES IN OREGON AND WASHINGTON

On July 19, 1916, Dr. Leo J. Frachtenberg left Portland, Oregon, where he spent the preceding winter and spring in the preparation for publication of the Alsea texts and traditions that were collected by him in 1910 and 1913. On that day he proceeded to the Quileute reservation, situated at Lapush, in the northwestern part of Washington, with a view of making an exhaustive study of the ethnology of the Quileute Indians who, with the now extinct Chimakum, form the so-called Chimakuan linguistic family. This work was carried on during August, September, October, November, and December. The most voluminous data were obtained, and the investigation was facilitated by the fact that the Quileute Indians, numbering approximately 300 individuals, live together in a single village and still cling tenaciously to their native language, and to their former customs and traditions. Consequently, Dr. Frachtenberg encountered little difficulty in collecting exhaustive data on the various phases of the ethnology of these Indians, and he succeeded in thoroughly investigating the following phases: Early History

FIG. 116.—View of the Quileute Reservation at Lapush, Washington. Photograph by L. J. Frachtenberg.

FIG. 117.—James Island, former principal village of Quileute Indians at Lapush, Washington. Photograph by L. J. Frachtenberg.

and Distribution, Manufacture (including Basketry, Matting, Weaving and Netting), Houses and Households, Clothing and Personal Adornment, Subsistence (including Hunting, Fishing, Sealing, and Whaling), Travel, Transportation and Trade, Warfare, Games and Pastimes, Social Organization and Festivals, Ceremonials and Societies, Pregnancy, Birth, Childhood, Twins, Puberty, Customs regarding Women, Marriage, Burial Ceremonies, Religion (including Conception of the World, Country of the Souls, Prayers and Observances, Guardian Spirits, Beliefs regarding the Soul, Shamanism, Ethical Concepts and Teachings), Medicine, Surgical Operations, Charms, Current Beliefs, Physical and Mental Traits, Decorative Art, Music and Dancing. This material is contained in 8 volumes numbering approximately 600 manuscript pages. In addition, Dr. Frachtenberg obtained several hundred native drawings and took photographs of some 150 specimens of material culture. He also added considerably to his previous collection of Quileute traditions, by collecting additional 22 native myths and traditions (in Quileute) and 3 narratives in English. These myths and tales comprise 200 pages. Furthermore, Dr. Frachtenberg succeeded in inducing two inhabitants of Clallam County, Washington, to present to the National Museum their valuable collections of Quileute baskets and specimens. These collections contain over 200 baskets, two carved house-posts, and approximately 25 specimens illustrating the material culture and ceremonial life of the Quileute Indians.

The comprehensive study of the ethnology and language of the Quileute Indians, conducted by Dr. Frachtenberg during the calendar years 1915 and 1916, has brought out some very important points, a few of which may be mentioned here in passing. Unlike the other tribes of the Pacific Coast, the Quileute Indians are not a vanishing tribe. On the contrary, these Indians are gradually, though slowly, increasing. Although since 1883 they were subjected to 5 separate epidemics of measles, smallpox, whooping cough, and grippe, their number has increased during that period by more than 10 individuals. The proportion of half-breeds among them is exceedingly small, and they are undoubtedly the most moral and law-abiding tribe of that area. This condition seems to be due to their complete isolation from the other tribes and from the white people, and to their persistence in adhering to the former customs and beliefs. A good proportion of these Indians are members of the Shaker Church, whose chief doctrine is total abstinence from gambling, smoking, and liquor. Up to about 4 years ago the Quileute still hunted whales in the open sea. In former years whale-hunting

FIG. 118.—Types of Quileute canoes. Photograph by George C. Cantwell.

FIG. 119.—Quileute dip-net. Photograph by George C. Cantwell.

constituted one of their principal occupations, in which they were second only to the Makah Indians of Neah Bay. The daring, courage, and skill with which these primitive people hunted, attacked and killed the "Giant of the Sea" in their frail canoes and with their primitive weapons, must have been remarkable. At the present time pelagic hunting is confined to the hunting of the valuable fur-seals which constitute a not unimportant source of income to the Quileute. Last year alone they sold $6,000 worth of furs. The Quileute learned the art of sealing some seventy years ago from the Ozette Indians, who in turn obtained it from the Nootka of Vancouver Island. In the meanwhile, the Ozette and Nootka have abandoned this occupation, partly voluntarily and partly owing to public interference, so that, to-day, the Quileute are the only Indians in the United States proper who are permitted to hunt and kill fur-seals. The Quileute use special canoes for that purpose; these canoes are dug-outs, made of cedar, and are manned by three people. The sealing season lasts from March until July, and the hunters very often go 30 and 40 miles out into the sea. The Quileute derive most of their revenue from the sale of the several species of salmon that are caught in the Quileute river.

A novel feature of American Indian ethnology has been found among these Indians in their former ceremonial life. Like the other tribes of the Northwest area, the Quileute had a number of secret societies, corresponding more or less to the fraternities of the Nootka, Kwakiutl, and Salish tribes, with this remarkable exception: All Quileute secret societies were occupational; that is to say, an individual became a member of a certain order, because he followed the profession of that order. Thus, Dr. Frachtenberg found special orders for Warriors, Hunters, Fishermen, Seal-hunters, Whale-hunters, Rain-makers, etc. The importance of this new phase of primitive social life cannot be overestimated. There can be no doubt that the culture of the Quileute Indians is closely related to the cultures of the Kwakiutl-Nootka and Salish groups. Furthermore, Dr. Frachtenberg is practically convinced that he will be able to produce conclusive evidence in the near future, showing that the languages of the Wakashan, Salish, and Chimakuan families have been derived from one common mother-tongue, which he proposes to call the *Mosan* language, from the numeral *mōs* "Four," which occurs, in one form or another, in all languages that constitute these three groups.

On October 12, Dr. Frachtenberg interrupted his Quileute field-work and proceeded to the Tulalip Reservation, Washington, where

for two weeks he assisted Dr. H. K. Haeberlin, of Columbia University, in his ethnological and linguistic researches among the Salish tribes. This trip was made at the suggestion of Prof. Franz Boas and met with the approval of the Bureau of American Ethnology.

FIG. 120.—Twined baskets of the Quileute Indians.
Photograph by George C. Cantwell.

The expenses of the trip were paid by Columbia University. Dr. Frachtenberg resumed his Quileute work on November 6, 1916, but interrupted it again on November 24, when he proceeded to San Francisco, Cal., for the purpose of conferring with Dr. A. L.

Kroeber, of the University of California, and with Mr. John P. Harrington, of the Bureau of American Ethnology, in regard to the relations of the researches of the Bureau of American Ethnology with those of the University of California, especially with respect to the ethnology and linguistics of the Indian tribes of northern and southeastern California and the adjacent regions. This conference took place on December 1 and 2, and a report embodying its results was sent to the Ethnologist-in-Charge of the Bureau of American Ethnology. While in San Francisco, Dr. Frachtenberg attended the meeting of the Pacific branch of the American Association for the Advancement of Science, reading four papers that dealt with the ethnology, mythology, and philology of the Indian tribes of Oregon and Washington. Dr. Frachtenberg returned to Lapush on December 9, resuming his Quileute field-work.

In the latter part of November it became evident that the appropriation granted Dr. Frachtenberg in the beginning of the fiscal year would not be sufficient to enable him to bring the field-work among the Quileute to a successful conclusion. Fortunately, an offer for cooperation was received from Columbia University, through the courtesy of Prof. Franz Boas, whereby Dr. Frachtenberg was enabled to continue his field-work. The Bureau accepted this offer, with the understanding that Dr. Frachtenberg would devote this sum to a comprehensive study of the music of the Quileute Indians, with special reference to the problem of song-variation. Dr. Frachtenberg is, at the present writing, conducting this investigation. He expects to collect about 80 songs, taking down the tune, burden, and translation of each song and obtaining the identical songs at separate times by the same and by distinct individuals. Dr. Frachtenberg expects to complete this work by the latter part of January, 1917, and will then return to Washington.

STUDIES AMONG THE INDIANS OF CALIFORNIA

Mr. John P. Harrington, ethnologist, was engaged during the year in continuing his exhaustive study of the Chumashan Indians of the Santa Barbara region of California. January was spent at Berkeley, Cal., where linguistic and historical manuscripts in possession of the Bancroft library were copied and studied, through the courtesy of the University of California. In the course of the summer this material was thoroughly worked over, transliterated, and corrected with the aid of Indian informants.

At the end of January Mr. Harrington returned to the Southwest Museum, Los Angeles, where he spent the months of February and

March in work on the Ventureño dictionary, which already covers about 8,000 cards and has served as the basis for similar dictionaries which have been started for the other dialects. The entire summer was devoted to an intensive study of the Barbareño, Ineseño, and Purismeño dialects. The supposedly extinct Purismeño is now represented by a vocabulary of several hundred carefully written words and phrases. This work was followed by a month's further study of the Obispeño dialect, beginning September 16. More and better material was obtained than previously. The informant's health being such as not to admit of long or steady hours of work daily, there was opportunity to memorize every word and to digest the material thoroughly as it was presented.

The period from October 14 to November 15 was spent at the Southwest Museum, Los Angeles, in elaborating the notes, and the remainder of the year in field-work on Ventureño, correcting, improving, and adding to the previous notes.

Some of the interesting features of language and culture discovered in Mr. Harrington's studies have been: the use of vowel triplication as a unique grammatical process; a system of relationship terms which extends to the fourth generation (for example, great-great-grandparent, great-great-grandchild, and not merely to the third as with most tribes); the use of sun shrines and their renewal at the coming of the new year; the use of one word for world, year, and God; the use of seaworthy board canoes (fragments of these taken from excavations and now at the Southwest and other museums not hitherto having been recognized as such); the institution of berdaches as undertakers; the erection of tall poles hung with property on the graves of rich persons; the identification of the site of "Pueblo de las Canoas" of early Spanish narratives, and that the Ventureño name for it was Shisholop, meaning "the mud." In connection with this last determination it is interesting to note that the surrounding tribes called Ventura the "mud place" and the Ventureños the "mud people."

WORK AMONG THE OSAGE INDIANS

During the year 1916, Mr. Francis La Flesche, ethnologist, visited the Osage reservation in Oklahoma for the purpose of continuing his researches among the people of that tribe. While changes are continually taking place in the religious institutions of these people, many of the full-bloods still believe in the ancient rites and retain the practices that have grown out of them.

After considerable difficulty Mr. La Flesche prevailed upon Sho^{n}'gemo^{n}i^{n}, one of the oldest members of the tribe, to recite two

FIG. 121.—Shoⁿ'gemoⁿiⁿ, an Osage Noⁿ'hoⁿzhiⁿga.

rituals belonging to his gens, the Tsi'zhu Washtage, namely, the ceremonial naming of a child of the gens, and the initiation of a young man into the mysteries of the war rites. A portrait of Sho^{n}'gemo^{n}i^{n} is here given (fig. 121).

The ritual of the ceremonial naming of a child belonging to the Tsi'zhu Washtage gens is the second ritual of this rite that Mr. La Flesche has succeeded in recording since commencing his study of the Osage tribe. The first obtained is the ritual used by the Puma gens, whose gentile function is to conduct the principal parts of the war ceremonies; the second ritual procured is that of the Tsi'zhu Washtage gens whose duty it is to take part in the ceremonies connected with the hunt. This gens is one of the two gentes to which belong the hereditary office of chief, and it is also a peacemaker gens. These two rituals of the child-naming ceremony comprise 107 typewritten pages and will form a chapter in the forthcoming memoir on the Osage tribe. Many of the full-bloods still cling to the idea that a child who has not been ceremonially named has no place in the tribe as a person, and that it is only through the rights acquired at this naming that the child on attaining manhood can command the respect of other members of the tribe. In these child-naming rituals the gentile symbols are clearly set forth.

The second ritual obtained during the year from Sho^{n}'gemo^{n}i^{n}, *i. e.*, the initiation of a young man into the mysteries of the war rites, bears the title of No^{n}zhi^{n}zho^{n} Watho^{n}, which signifies, "the fasting songs." These relate to the rite of fasting which the chosen leader of a war party takes upon himself in order to excite the compassion of Wako^{n}'da and thereby enlist the aid of that power in winning success.

The No^{n}'ho^{n}zhi^{n}ga of the Tsi'zhu Washtage gens always render their version of this ritual with an air of reluctance, the reason being that the office of this gens is to protect life, even that of a caterpillar that happens to stray into the chief's house. During the ceremonial approach to the Sacred House the song and the wi'gie sung and recited have no references to war or to valorous deeds, but to the path of life in which all must strive to travel in peace. In the No^{n}'zhi^{n}zho^{n}, or fasting ritual, of the other gentes there is a wi'gie that explains the significance of the rattle used in the ceremony, one that relates strictly to war. But as it has to be included in the fasting rite of the Tsi'zhu Washtage gens, when they recite it they omit the authoritative refrain at the end of each line, *a bi^{n} da, tsi ga,* ("it has been said, in this house"), for the reason that war was not taught in the Sacred House of the Tsi'zhu Washtage; but as the

No^{n}′ho^{n}zhi^{n}ga are obliged to use this wi′gie, they changed the words of the refrain to *a bi a*, ("they said," that is, they of the House of the Ho^{n}′ga). Furthermore, the entire wi′gie is recited in a very low tone so that only the Xóka and the candidate can hear the words.

The task of transcribing the text of the ritual as recorded by the graphophone, and the translating of the wi′gie and the songs is still in progress. At the present time 30 typewritten pages have been completed.

The rigidity with which the Tsi′zhu Washtage gens in its rituals adheres to the peace principle it represents may be regarded as being theoretical rather than an actual restriction of warfare, for the reason that among its members there have been men who have won war-honors and who have even been leaders of war-parties. Sho^{n}′gemo^{n}i^{n} himself is an example of this, for he has won more than the number of war-honors required for the ceremonial counting of odo^{n}′; he has often been chosen to act as Wádo^{n}be, the counter of war-honors, at the war ceremonies.

Sho^{n}′gemo^{n}i^{n} recounted in the phonograph for Mr. La Flesche his thirteen war-honors, giving them exactly as he counts them at the war ceremonies. For this service he is usually paid from one hundred to one hundred and twenty-five dollars when he fills the office of Wádo^{n}be. It was as an act of friendship to Mr. La Flesche that he made, for a small sum, the record of his counting of odo^{n}′.

This record by Sho^{n}′gemo^{n}i^{n} has been included in the already completed No^{n}′zhi^{n}zho^{n} ceremony as described by Waxthi′zhi of the I^{n}gtho^{n}ga gens. The reason for placing it there is that, according to tribal regulations, Sho^{n}′gemo^{n}i^{n} cannot be chosen to act as Wádo^{n}be on his side of the tribal division, but must be called upon from the opposite side to perform this ceremonial act.

In 1863 Sho^{n}′gemo^{n}i^{n} took part in a fight in which the Osage warriors destroyed a party of Confederate officers who were on their way to Mexico. In the struggle he struck some of the men, "but," he added, "I do not recount these strokes at the war ceremonies because I am a friend of the white people."

Sho^{n}′gemo^{n}i^{n} is one of three surviving old men of the tribe who can count the full thirteen odo^{n}′, or war-honors, at the war ceremonies.

ETHNOLOGY OF THE IROQUOIS

On April 19, 1916, Mr. J. N. B. Hewitt resumed his field studies of the League of the Iroquois, near Brantford, Ontario. His time was devoted chiefly to the collection of native texts, largely in

FIG. 122.—The Black God of Disease and Death: One of three Disease Gods of the Iroquois.

Mohawk, Onondaga, and Cayuga, and as far as practicable interlinear and free translations and expository interpretations in English were also obtained for these texts. This material is being prepared for his projected memoir on the League of the Iroquois or Five Nations. The subject-matter is complex and difficult to understand. It deals with the laws and ordinances, the rituals, the addresses, the chants, the songs, and the traditions of origin, of the League as an institution, which still exists best among the Six Nations of Iroquois in Canada. The very technical and highly figurative diction of the native material is not in most cases understood by the ordinary native speaker, and so it is necessary to test the knowledge of an informant or interpreter before accepting his or her services; even such information must be revised and compared with other sources of information. This is not at all strange, because the native life is being gradually displaced by the culture of European peoples.

These texts embrace a very wide range of subjects—laws, ordinances, decisions as to the meaning or applications of laws, rituals, ceremonies, and constitutional principles—often stated in technical and highly metaphorical terms derived from mythic and legendary sources. The tradition of the parthenogenetic conception and birth of Dekanawida and of his work in establishing the League of the Five Nations diverges into several versions which have adopted striking, though often contradictory, incidents from the legendary and mythic lore of the people. The most noteworthy of these incorporations is the Saga of the Wrath of Hiawatha. So, to obtain a fair understanding of the entire subject it becomes imperatively needful to collect these varying versions, no matter how fragmentary they now may be, for the purpose of providing means for disentangling the probable historical nucleus of the original saga from these variant stories. It must be kept constantly in mind that no small proportion of these ancient laws and ordinances—now largely in abeyance—are recoverable only from the language of the chants and songs and addresses of the Condoling and Installation Council.

Thus the work of recording these native texts dealing with the most highly developed and complexly organized activities of these tribes is most tedious and irksome, and one of some difficulty, because of the highly-wrought diction of these narratives and rituals and because the native annalists of these tribes, whose knowledge of the history and wisdom of their past was unmodified by European culture, are no more, and also because their sons and daughters of to-day have become interested largely in other things, and so they have forgotten, if they ever had learned, the lore and the wisdom

FIG. 123.—Mask of a Corn Goddess of the Iroquois.

of their ancestors. These things do not interest the great majority of persons as they did their ancestors; and as it is absolutely essential that correct lexical and grammatic forms be recorded and expounded it is found a very difficult matter to secure trustworthy informants and interpreters. Inability to translate the meaning of the native vocables into equivalent English words is the greatest bar to the student in the acquirement of a consistent knowledge of the structure of the League and of its constituent institutions. Too pronounced personal views and fanciful preconceptions often render an informant's work useless.

A most important result of Mr. Hewitt's work in the field is the finding of conclusive evidence that the number of federal chiefs of the League of the Iroquois was originally forty-seven, which later by the addition of two recalcitrant Seneca chiefs was raised to forty-nine. The number fifty has appeared in all available written records and printed accounts of the League chiefs. This number has never been questioned hitherto but has been accepted as historical. The supernumerary chiefship, it is learned, was unwittingly added by Thomas Webster, a chief of the New York Onondaga, more than fifty years ago, through a misunderstanding of the meaning of the "Bear-Foot" episode of the ancient time and the significant action of the Federal Council of the League of the Iroquois, with reference to it. This false Websterian interpretation gained credence only after the dissolution of the integrity of the League of the Iroquois following the treaty of 1838 with the United States, which had the effect of permanently dividing the several tribes.

The famous "Six Songs" of the Condoling and Installation Council of the League of the Iroquois were first translated, so far as known, into English for Mr. Horatio Hale ("The Iroquois Book of Rites," 1883) by Chief John "Smoke" Johnson, who is there described as "the only man now living who can tell the meaning of every word of the 'Book of Rites.'" Yet, they were erroneously translated as "Songs of Greeting and Welcome." But on grammatic grounds and from their position in the ritual Mr. Hewitt has decided, tentatively at least, to translate them as "Songs of Parting" or "Songs of Farewell," which are so dramatically sung, therefore, in behalf of the dead chieftain.

The Dekanawida legend rehearsing the story of the founding of the League of the Five Nations, as told by the Mohawk and Onondaga annalists, is largely repudiated by the Cayuga wisemen now living. And there appear to be some grounds for their doctrine. So Mr. Hewitt recorded a Cayuga version of the so-called

FIG. 124.—Small drums for the Onehowih dances of the Iroquois.

FIG. 125.—Figure at top, medicine flute; two bottom figures, knee-rattles of deer hoofs. Iroquois.

Dekanawida legend, in which the great statesman is anonymous. In this interesting version Dekanawida is known throughout the account by the descriptive title, "The Fatherless," or literally, "He

FIG. 126.—Turtle-shell rattle, horn rattle, and gourd rattle of the Iroquois.

Who Is Fatherless." This title was designed probably to emphasize a prophecy that he would be born of a virgin by an immaculate conception. This Cayuga version was dictated by Chief John H.

Gibson of the Cayuga tribe, a son and disciple of his great father, the late Chief John Arthur Gibson of the Seneca tribe. In this account "The Fatherless" is represented as having established among the Cayuga people a form of civil government, the exact type of which he later in life founded among the Five Iroquois tribes, inclusive of the Cayuga. It is stated that the Cayuga statesmen did not realize the suitability of that form of government to the affairs and welfare of all men, and so they had limited its scope and benefits selfishly to their own Cayuga people. And this account relates that because of this bad stewardship on the part of the Cayuga people it became needful for "The Fatherless" to return "from the sky" to the neighbor tribes of the Cayuga for the purpose of establishing among them the League of the Five Nations of the Iroquois, of which he declared all the tribes of men should be co-equal members.

Further, in this account there is an attempt to explain the origin of the obtrusive dualism which appears as the basis of all public institutions of the Iroquois peoples. According to this explanation this dualism arose merely from an alleged agreement between two Cayuga persons who were related the one to the other as "Father And Son," or better, as "Mother And Daughter," to transact public affairs jointly from opposite sides of the Council Fire. It is seen that this explanation seemingly does not account satisfactorily for the occurrence of similar dualisms among other peoples. The most satisfactory explanation of this phenomenon is one proposed by Miss Alice C. Fletcher and Mr. Hewitt, although working independently, a number of years ago, namely, that this dualism is, in brief, a dramatization of the relation of the male and the female principles of nature in the forms of governmental organization.

Mr. Hewitt also recorded in the Onondaga dialect a brief legend describing the three Air- or Wind-Man-beings, or Gods; these Gods are the so-called Hoñdu''i', the patrons of the Wooden-Mask With the Wry-face or "False-face" Society, whose duty is the exorcism of disease and sickness from the community and from the minds and bodies of the people; also a short story of the Medicine Flute; and another on the Husk-Mask Society; and another on the Moccasin Game as Used at the Wake for a Dead Chief; these texts aggregate more than 175 pages of manuscript exclusive of the materials relating to the League.

A number of fine specimens illustrative of Iroquois culture were procured; these objects show a high order of art, and they consist of one wooden mask, colored black (fig. 122); a husk mask for a

Medicine Society (fig. 123); two small drums (fig. 124); a "medicine" flute (fig. 125); a pair of deer-hoof knee-rattles (fig. 125); a horn-rattle, a turtle-shell rattle, and a gourd rattle (fig. 126).

At the close of June, 1916, Mr. Hewitt was still on field duty; up to this time, he had read, revised, studied, and annotated about 8,000 lines of text other than material mentioned in the closing paragraphs of this statement. He also made a number of photographs of Indians.

ETHNOLOGICAL WORK AMONG THE SAUK, FOX, AND PEORIA INDIANS

The first part of June, 1916 found Dr. Truman Michelson among the Sauk and Fox of Iowa. The main work accomplished was the phonetic restoration of a long text, written in the current syllabary, on the origin of the White Buffalo Dance, which is intended as a future bulletin of the Bureau. He secured several sacred packs for the Museum of the American Indian (Heye Foundation), of New York, under the agreement that the Bureau should retain the right to publish the information pertaining to them. In this way more information on these difficult topics was obtained, and more is expected. Other ethnological data, especially sociological, was also acquired. About the middle of August Dr. Michelson proceeded to Oklahoma, where, under the joint auspices of the Bureau of American Ethnology and the Illinois Centennial Commission, he conducted researches among the Peoria. Their ethnology properly speaking has practically vanished, and although their language and folklore still persist, knowledge thereof is confined to a very limited number. The phonetics of the Peoria language, contrary to ordinary belief, is extremely complicated. As surmised from the notes left by the late Dr. Gatschet, Peoria linguistically belongs fundamentally to the Ojibwa group of Central Algonquian languages; yet at the same time it is clear that there has been another and more recent association with the Sauk, Fox, and Kickapoo group. A study of Peoria folklore and mythology also points to this double association, as does the system of consanguinity, which agrees with Sauk, Fox, and Kickapoo, as opposed to Ojibwa, Ottawa, Algonkin, and Potawatomi. It should be noted that Peoria folklore and mythology contain a number of Plains and Plateau elements which thus far have not been recorded among other Central Algonquian tribes. How these elements spread eastward is as yet unknown. A number of strictly aboriginal tales were collected that have not been recorded elsewhere. A large number of European tales have been incorporated, and

yet the Peoria Indians are unaware of their origin. While among the Peoria some incidental notes on Shawnee sociology and folklore were obtained by Dr. Michelson. After about four weeks' stay in Oklahoma he returned to Iowa to renew his investigations among the Sauk and Fox at Tama. There the phonetic restoration of a number of texts on minor sacred packs pertaining to the White Buffalo Dance was accomplished, and about 200 pages of the extremely long myth of the Fox culture-hero were also restored. Dr. Michelson witnessed most of the ceremonies that

FIG. 127.—Some of the descendants of the Fox Chief Poweshiek.

were performed when the Potawatomi of Wisconsin presented the Foxes with a new drum of the so-called "Religion Dance."

RESEARCHES BY DR. JOHN R. SWANTON

The only undertaking in the nature of field-work by Dr. John R. Swanton during the year was a visit to Chicago in September to make an examination of the manuscript material in the Ayer collection of Americana in the Newberry Library. This occupied less than a week, but proved rich in results, the most important of which was the discovery of a French memoir containing the best Karankawa

vocabulary so far known and the only known vocabulary of Akokisa. A photostat copy of this was secured later, and similar copies of several other original manuscripts or copies of originals: one a second French memoir giving a considerable account of the Choctaw Indians, and censuses, town by town, of both the Choctaw and the Creeks, another an enumeration of the Louisiana Indians, apparently by Bienville, and a third a Spanish census of the Indians in Florida in the early part of the eighteenth century, which includes the town, the name of each Indian, and his approximate age. This library also preserves what appears to be the original manuscript from which the *Mémoires Historiques sur La Louisiane* of Dumont de Montigny was composed. On the basis of the material enumerated it is now possible to classify exactly the little known Akokisa, Washa, and Chaouacha tribes, and to add considerably to our knowledge of the Indians north of the Gulf of Mexico in other particulars.

VISIT TO THE CHEROKEE INDIANS

Owing to impaired health the field-work of Mr. James Mooney in 1916 was confined to a visit of about ten weeks (May 28-August 10) to the old Cherokee country in western North Carolina, during which time he visited the principal Indian settlements and railroad towns and added to his information on the tribal folklore, besides securing several important documents bearing on the participation of the Cherokee in the Confederate service during the Civil War.

SOLAR RADIATION OBSERVATIONS AT MOUNT WILSON

The Smithsonian Astrophysical Observatory has a station at Mount Wilson, California, on ground leased from the Mount Wilson Solar Observatory of the Carnegie Institution. In 1916, as in former years since 1905, observations of the intensity of solar radiation were made there during the months June to October by Messrs. Abbot and Aldrich.

In the course of the research, now continued for more than a decade, the variability of the sun has been definitely proved. Expeditions for checking Mount Wilson results were conducted to Algeria in 1911 and 1912, and simultaneous measurements in California and Algeria confirmed the reality of the suspected variations of the sun. Further confirmation was obtained at Mount Wilson in 1913, and subsequently. For it was found that the distribution of brightness over the solar disk is variable in association with the sun's total radiation. Not only does the sun's radiation fluctuate

from day to day, but the average values found in a whole season's work, vary from year to year.

It was primarily to continue and amplify these studies of the solar variability that the observing was done on Mount Wilson in 1916. Both the total radiation of the sun and the distribution of brightness over the solar disk were measured on as large a number of days as possible. Owing to considerable cirrus cloudiness in June and August, a dense haze suggesting the volcanic haze of

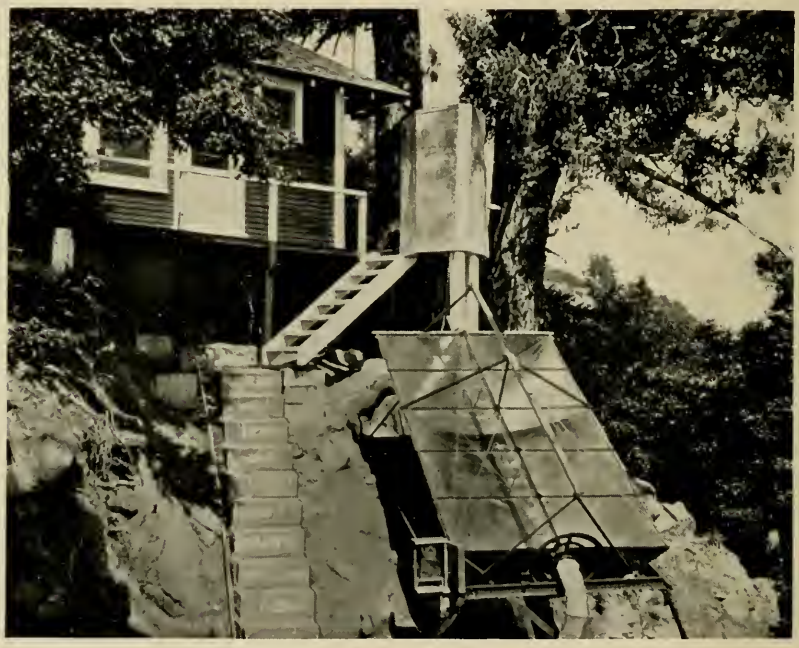

FIG. 128.—Observers' cottage and solar cooker, Mount Wilson, California.

1912 in late July and early August, and to heavy rains in late September and early October, the season proved less favorable than usual, but nearly 100 days of observation were secured. Full reduction of the observations must be awaited before noting the solar changes during the season, but generally high values of solar radiation seemed to prevail, as was expected in view of numerous sunspots. At one time in June nearly 100 spots were seen on the sun's image. Large magnetic disturbances were associated with this spot outbreak, and observations had to be suspended on one day because of them.

As the sun is the ruler of the earth's temperature, and his rays the dependence of all vegetation, solar fluctuations of five, or even sometimes ten per cent, such as have been discovered in these studies must be important. Great need is apparent of checking and completing the Mount Wilson work at other favorable stations. In 1914 Mr. Abbot went to Australia and urged the erection of an observatory for the purpose there, but owing to the outbreak of the war, the Government, though favorably inclined, was unable to take the matter up. Fortunately it has recently become possible for the Smithsonian Institution itself to undertake the support of a station in South America for observing solar radiation, and this is expected to be installed in July, 1917 by Mr. Abbot. It is hoped to make the solar radiation observations every day in the year hereafter either at Mount Wilson or in South America or at both stations.

Further work was done with a solar cooking appliance at Mount Wilson in 1916, but owing to the delay until September of materials ordered for it and expected in April, no satisfactory tests have yet been made. Food was cooked in 1915, including meat, potatoes and other vegetables, and cereals. It is confidently expected to bake bread also when the apparatus is done.

A great drawback to the solar work done hitherto has lain in the tarnishing of the silvered mirror surfaces used to reflect the sun rays onto the bolometer. This is the more serious because it affects rays of different colors differently. Violet and ultra-violet rays are most weakened by the tarnishing of silver. At last a new alloy "stellite" has appeared which does not tarnish, even if exposed for months to sun, rain, snow, and smoke. Two stellite mirrors for the spectro-bolometer were introduced on Mount Wilson in 1916, along with a vacuum bolometer of greatly increased sensitiveness. It is now hoped to determine definitely whether all rays of the sun wax and wane in their intensity proportionally, as the sun varies, or increased solar radiation is preponderatingly associated with special regions of the spectrum.

Comparisons were made in 1916, of the pyrheliometers used daily in Mount Wilson work with the standard waterflow pyrheliometer. The results showed that no detectable change of the sensitiveness of the secondary pyrheliometers has occurred. We may be confident that the entire series of observations at Mount Wilson, from 1905 to 1916, is expressed on a constant scale of radiation to within one per cent. Numerous and varied measurements show also that this constant scale is the true standard scale of measurement whose

unit is the calorie. About thirty standardized silver disk pyrheliometers have been sent out by the Smithsonian Institution at cost, so that this same scale of measurement is now available in many countries, including Canada, United States, Mexico, Peru, Brazil, Argentina, Philippines, Java, Teneriffe, Spain, Italy, France, England, Germany, and Switzerland.

A new instrument, the "pyranometer," adopted for measuring the brightness either of the sun alone, the sun and sky, the sky alone, or the nocturnal radiation of a blackened surface to the whole sky, has been perfected and was much used at Mount Wilson in 1916. This instrument is suitable for measuring the intensity of light where plants grow, whether in full sunlight or deep shade. Its results agree accurately with the standard scale of radiation mentioned above.