SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 76, NUMBER 10

# EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1923


(PUBLICATION 2752)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1924

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

# CONTENTS


PAGE

Introduction ..... 1

Geological Explorations in the Canadian Rockies (Dr. Charles D. Walcott) ..... 1

Geological Field-Work in the Ohio Valley (Dr. R. S. Bassler) ..... 8

Expedition to the Dinosaur National Monument, Utah (Mr. C. W. Gilmore) ..... 12

Collecting Fossil Footprints in Virginia (Mr. C. W. Gilmore) ..... 16

Paleontologic Reconnaissance in the Great Basin (Dr. Charles E. Resser). 18

Field-Work of the Astrophysical Observatory (Dr. C. G. Abbot) ..... 22

Biological Explorations in the Yang-Tze Valley, China (Mr. Charles M. Hoy) ..... 30

Molluscan Studies about the Florida Keys, Bahamas, and West Indies (Dr. Paul Bartsch) ..... 35

Botanical Exploration in the Dominican Republic (Dr. W. L. Abbott) .. 43

Botanical Exploration in Panama and Central America (Dr. W. R. Maxon) ..... 47

Studies on Early Man in Europe (Dr. Aleš Hrdlička) ..... 56

Archeological Investigations in South Dakota (Mr. M. W. Stirling) .... 66

Archeological Investigations at Pueblo Bonito, New Mexico (Mr. Neil M. Judd) ..... 71

Explorations in San Juan County, Utah (Mr. Neil M. Judd) ..... 77

Archeological Field-Work in New Mexico (Dr. J. Walter Fewkes) .... 82

Archeological Field-Work in Florida (Dr. J. Walter Fewkes) ..... 88

Ethnological Studies in Maine, Canada, and Labrador (Dr. Truman Michelson) ..... 99

Ethnology of the Osage Indians (Mr. Francis LaFlesche) ..... 104

Archeological Work in California (Mr. John P. Harrington) ..... 107

Archeological Field-Work in Tennessee (Mr. William Edward Myer) .. 109

Field Studies of Indian Music (Miss Frances Densmore) ..... 119

Bannerstone Investigations in Pennsylvania (Mr. John L. Baer) ..... 127

# EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1923

## INTRODUCTION

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

## GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

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

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

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

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

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

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

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

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

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

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


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

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

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

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

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

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

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

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

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

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

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

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

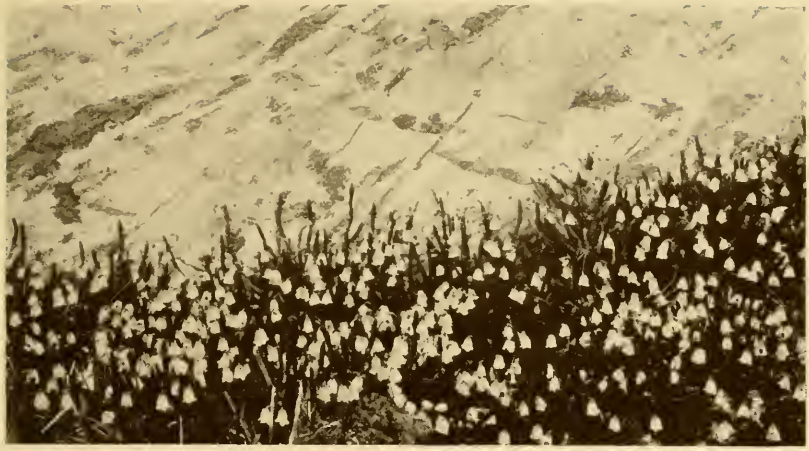

FIG. 10.—Bell heather (*Cassiope mertensiana* (Bong.) Don) which carpets large areas in the Canadian Rockies. From Lake of the Hanging Glaciers, British Columbia. (Mrs. Mary V. Walcott, 1923.)

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

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

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

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

## GEOLOGICAL FIELD-WORK IN THE OHIO VALLEY

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


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

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

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

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

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

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

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

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

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

## EXPEDITION TO THE DINOSAUR NATIONAL MONUMENT, UTAH

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


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

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

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

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

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

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

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

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

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

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

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

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

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

## COLLECTING FOSSIL FOOTPRINTS IN VIRGINIA

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

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

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

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

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

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

## PALEONTOLOGIC RECONNAISSANCE IN THE GREAT BASIN

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

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

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

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

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

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

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

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

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

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

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

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

## FIELD-WORK OF THE ASTROPHYSICAL OBSERVATORY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

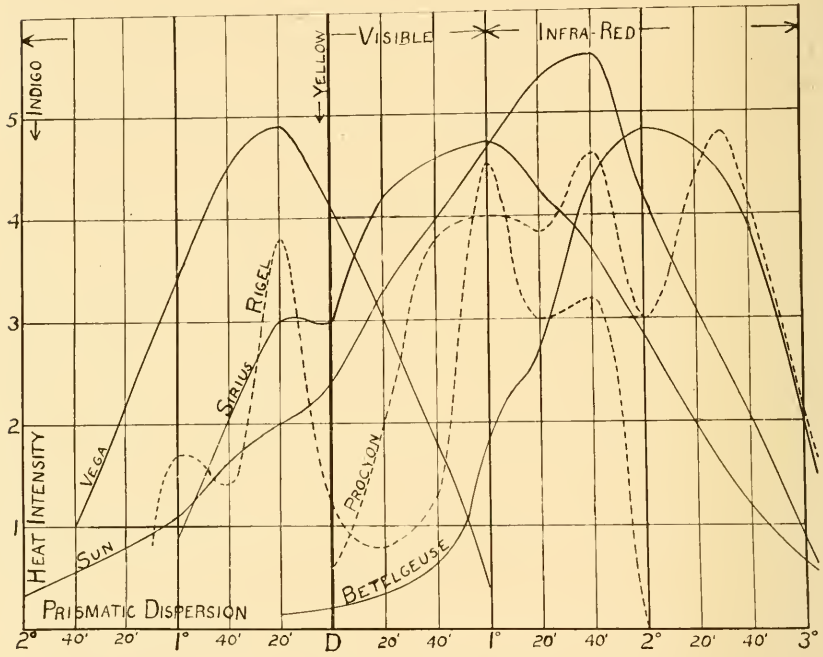


FIG. 30.—Observed Prismatic Energy Spectrum Curves of the Sun and Stars.

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

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

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

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

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

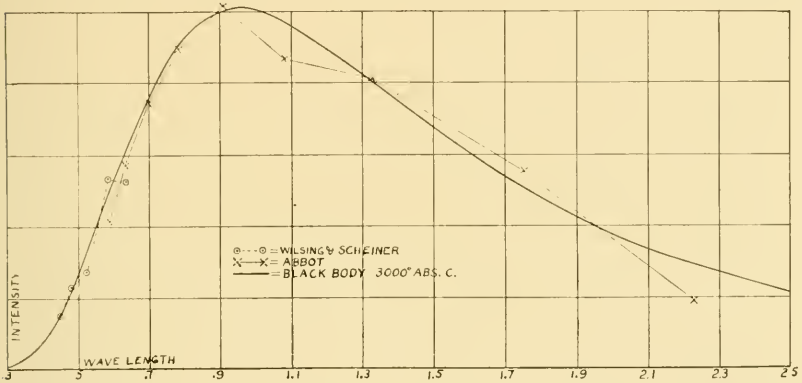


FIG. 31.—The energy spectrum of Aldebaran, as reduced to wave-length scale, and compared to the perfect radiator at 3000° Absolute Centigrade.

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

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

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

## BIOLOGICAL EXPLORATIONS IN THE YANG-TZE VALLEY, CHINA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. 37.—Upper: Columbus Bay, San Salvador, in which it is believed the ships of Columbus came to anchor, upon his discovery of America.
Lower: Columbus Point, San Salvador, showing the monument erected by the Chicago Herald in commemoration of Columbus' discovery of America.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## BOTANICAL EXPLORATION IN THE DOMINICAN REPUBLIC

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

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

FIG. 43.—Harbor and town of Samaná.

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

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

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

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

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

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

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

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

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

## BOTANICAL EXPLORATION IN PANAMA AND CENTRAL AMERICA

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

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

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

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

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

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

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

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

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

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

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

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

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

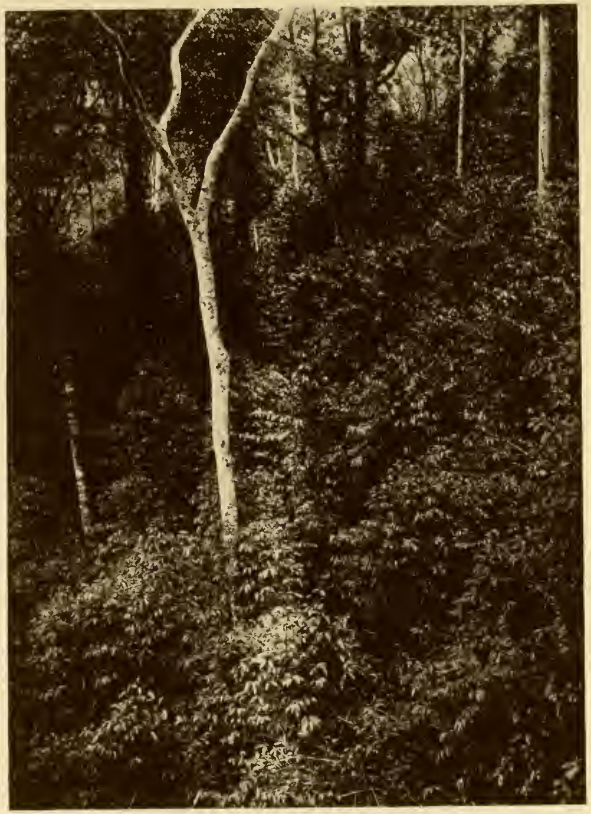

FIG. 53.—Coffee growing under shade, vicinity of Juan Viñas, Costa Rica.

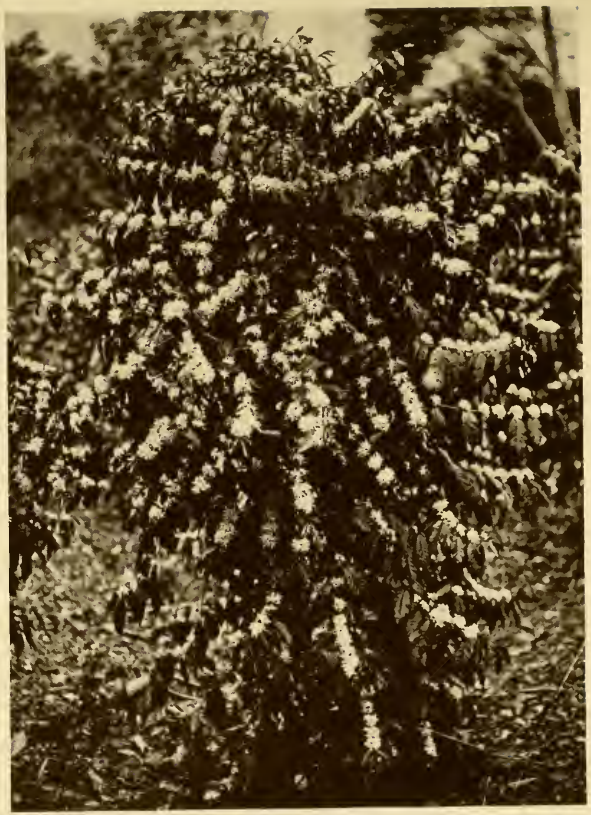

FIG. 54.—A small coffee tree in full flower, vicinity of Cartago, Costa Rica.

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

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

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

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

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

## STUDIES ON EARLY MAN IN EUROPE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## ARCHEOLOGICAL INVESTIGATIONS IN SOUTH DAKOTA

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

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

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

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

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

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

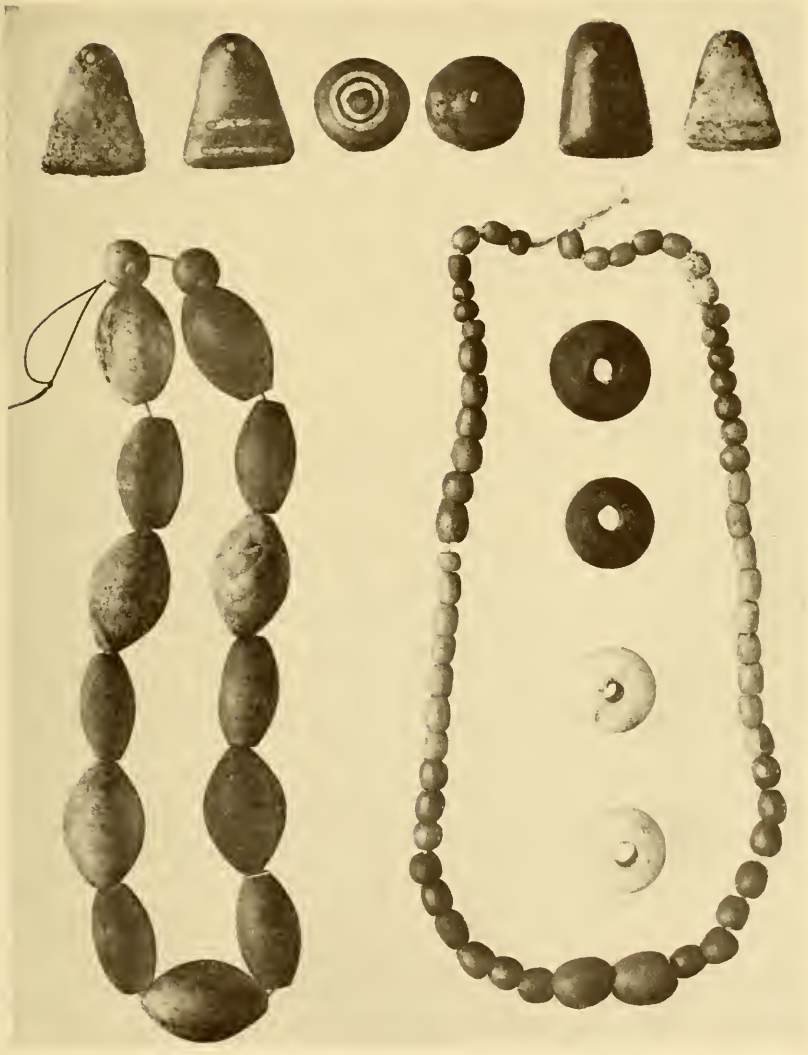

FIG. 66.—Glass beads and ornaments of native manufacture. Arikara.

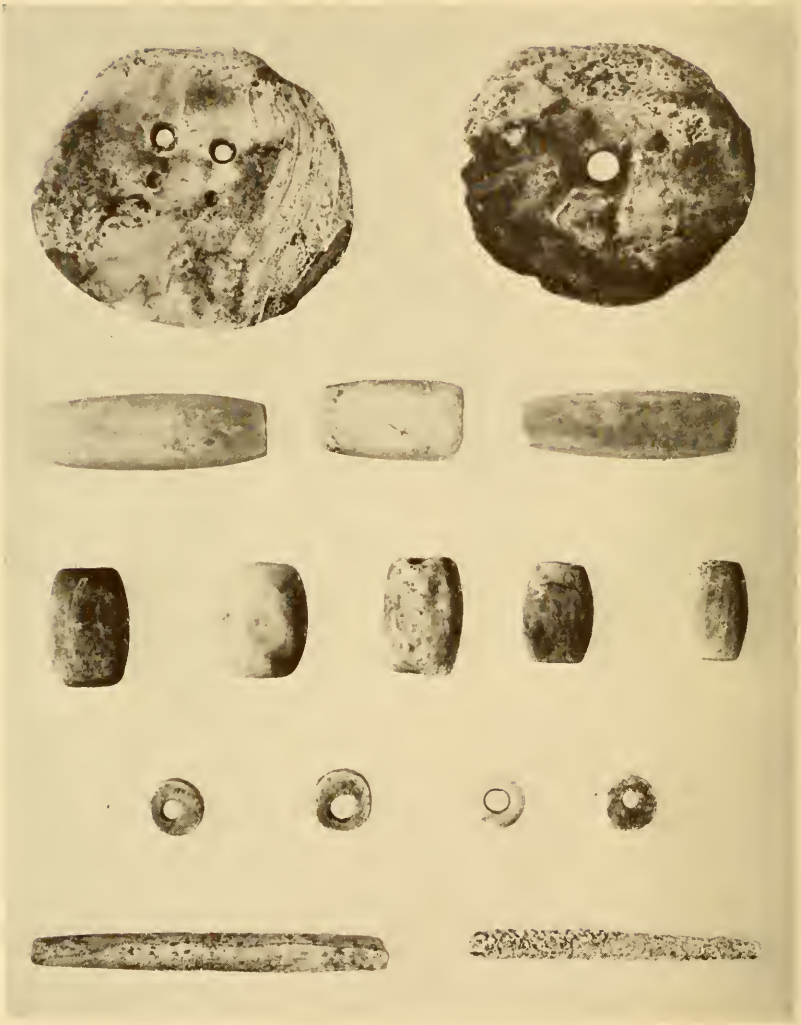

FIG. 67.—Shell beads and ornaments. Arikara.

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

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

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

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

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

## ARCHEOLOGICAL INVESTIGATIONS AT PUEBLO BONITO, NEW MEXICO

During the spring and summer months of 1923, Mr. Neil M. Judd, curator of American archeology, United States National Museum, continued his investigation of prehistoric Pueblo Bonito[1] under the auspices of the National Geographic Society. As heretofore, Mr. Judd's staff consisted of several trained assistants; 27 Navaho and Zuñi Indians were employed for the actual work of excavation.

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

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

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

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

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

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

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

FIG. 69.—The roof of a Pueblo Bonito council chamber was a very complicated affair. Beginning on eight or ten low masonry supports, pairs of logs lay close to the kiva wall; above these were other poles laid in threes, fours, etc., until a neat vault, flat on top, covered the room. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

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

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

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

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

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

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

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

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

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

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

## EXPLORATIONS IN SAN JUAN COUNTY, UTAH

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

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

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

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

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

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

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

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

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

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

FIG. 77.—The Rainbow Natural Bridge, one of the most majestic and inspiring spectacles in the United States, rises to a height of 309 feet yet it is dwarfed by the sheer red walls of the canyon which shelters it. (Photograph by E. L. Wisherd. Courtesy of the National Geographic Society.)

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

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

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

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

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

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

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

## ARCHEOLOGICAL FIELD-WORK IN NEW MEXICO

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

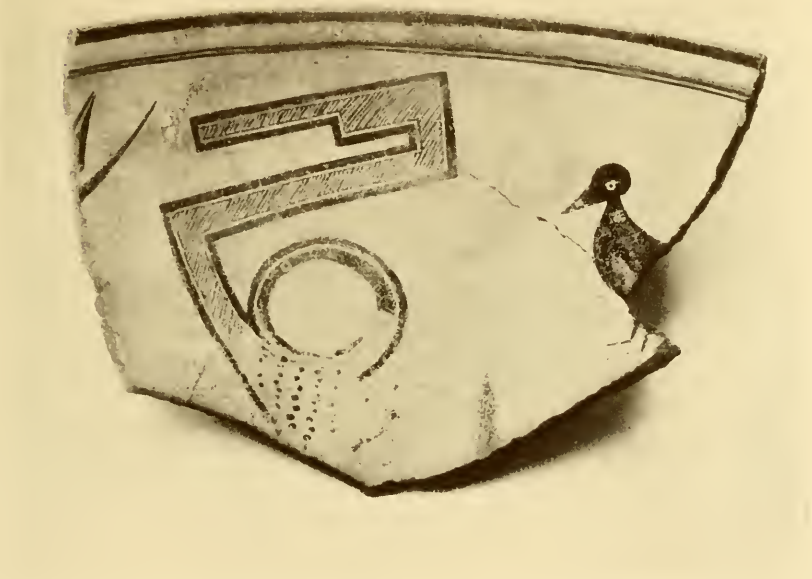

FIG. 84.—Fragment of ancient Zuñi pottery, Canyon del Muerto, Arizona, collected by Dr. W. H. Spinks. U. S. National Museum.

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

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

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

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

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

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

## ARCHEOLOGICAL FIELD-WORK IN FLORIDA

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

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

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

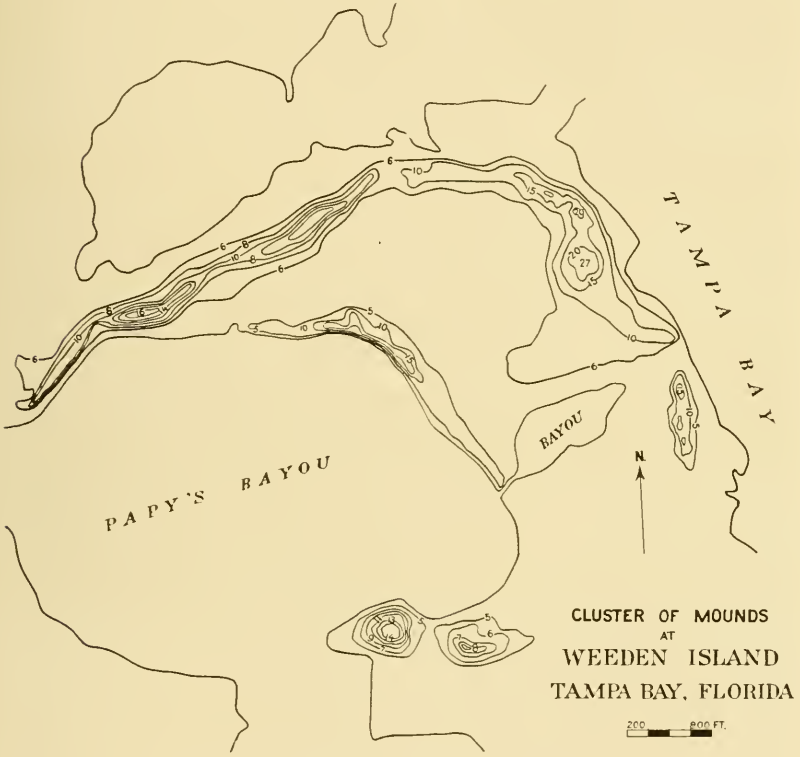


FIG. 86.

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


FIG. 87.

A. Entrance of the canal to Shell Mound near Porpoise Point.
B. Landing place at Porpoise Point Settlement.
C. Mangrove jungle near canal at Porpoise Point Settlement.
D. Live oak on mound at Weeden's Island.
(Photographs by Fewkes.)


FIG. 88.

A. Typical shell-heap on Ten Thousand Islands, Florida.
B. Large tree on periphery of Weeden's Mound.
C. Inhabitants of Porpoise Point in front of their new schoolhouse.
D. Old house at Porpoise Point.
(Photographs by Fewkes.)

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

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

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

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

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

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

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

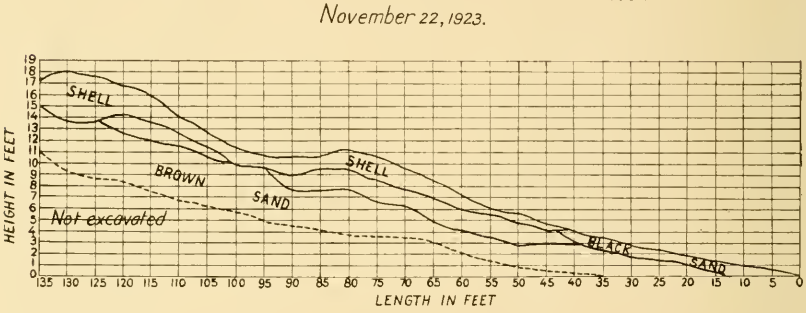


FIG. 90.

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

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

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

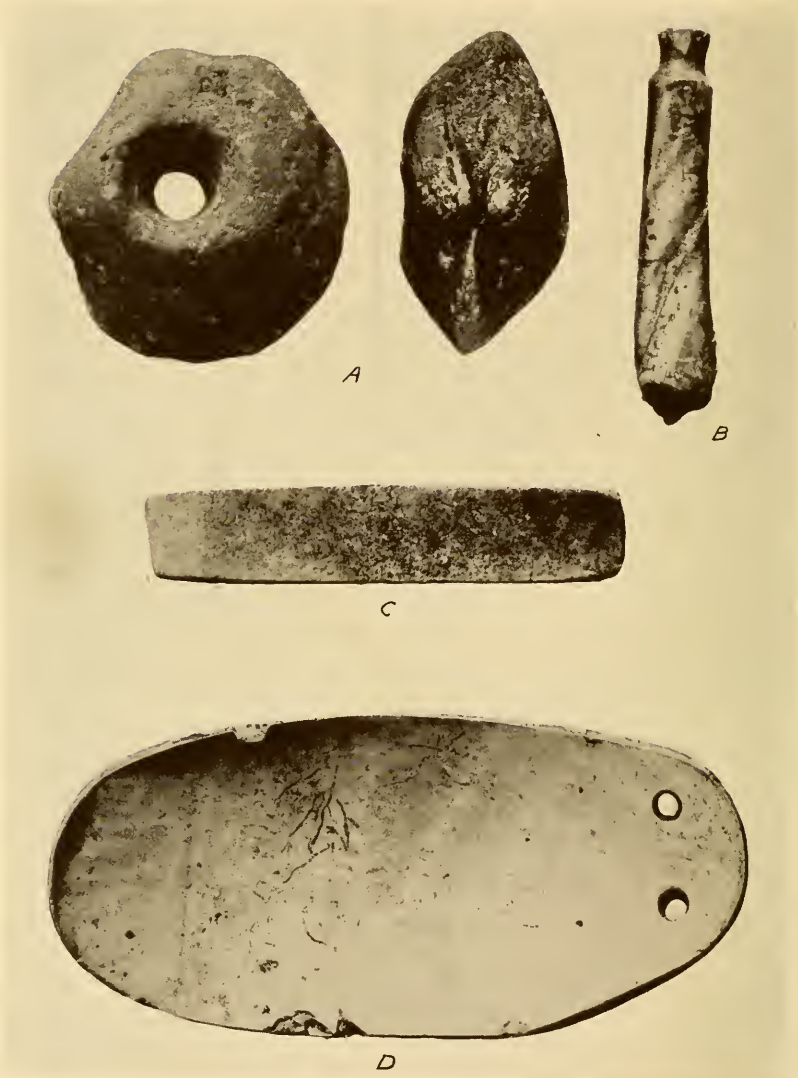


FIG. 92.—Shell objects from southwestern Florida.
A. Perforated fossil bivalve shell.
B. Shell pendant.
C. Unknown shell implement.
D. Shell gorget.
(U. S. National Museum.)

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

Center, frontal amulet of shell.
Upper left, frontal amulet of indurated clay.
Upper right, frontal amulet of quartz.
Lower figures, frontal amulets of Falcore mineral.

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

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

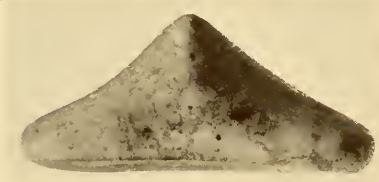

FIG. 94.—Three-pointed stone of the fourth type, Mayaguez, Porto Rico. Loaned to the U. S. National Museum by Mr. D. W. May.

FIG. 95.—Apical view of figure 94.

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

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

## ETHNOLOGICAL STUDIES IN MAINE, CANADA, AND LABRADOR

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## ETHNOLOGY OF THE OSAGE INDIANS

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

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

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

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

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

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

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

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

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

long armlike roots, which were then cut into one- or two-inch pieces, strung together (fig. 104) with thongs and hung up to dry in the sun on racks erected for the purpose. The root is eaten raw when fresh, and it is also cooked for immediate use. The nuts are also eaten when fresh and taste somewhat like chestnuts. The nuts are also dried and stored for winter use.

The çta-i$^{n'}$-ge (persimmon) is a fruit that is gathered in large quantities for winter use. In preparing the fruit for preservation the

seeds are first separated from the pulp with a rude screen made of small saplings. The pulp of the fruit is then moulded into cakes, put on wooden paddles and held over live coals to bake. After baking the cakes are dried in the sun and stored. The persimmon cakes thus prepared resemble chocolate cakes. A specimen which was furnished by Mo$^{n'}$-çi-tse-xi is now in the National Museum. The process of preparing the persimmon for preservation is called Çta-i$^{n}$-ge ga-xe, making çta-i$^{n'}$-ge. In the autumn the people go out in groups and camp in the woods to gather persimmons for preserving.

Wa-to$^{n'}$, the squash, was also cultivated by the Osage. They always raised a sufficient quantity to last till the next season. The pulp of the fruit, after removing the seeds and the skin, is cut into long strips which are hung up for a time to partly dry in the sun, after which they are taken down to be braided or woven into a mat-like shape and hung up for the final drying. When thoroughly dried these woven pieces are packed away in raw hide cases for winter use. The smaller pieces left over are strung together on strips of bark to be dried in the sun and stored. The squash was also counted as a sacred food and was given special mention in the ancient tribal rites.

A number of other wild plants afforded the Osage plenty of food, but the corn, squash, water chinkapin and persimmon are valued most because they never fail to yield a dependable supply of food.

## ARCHEOLOGICAL WORK IN CALIFORNIA

During the past summer the Bureau of American Ethnology has been engaged in cooperative work in California with the Museum of the American Indian (Heye Foundation). At the request of Mr. Heye, Mr. John P. Harrington, ethnologist of the Bureau, was detailed to take charge of the exploration of the site of the principal rancheria of the Santa Barbara Indians, which is called the Burton Mound. Several years ago efforts were made to obtain permission to excavate this site, but when the Potter Hotel was erected on it in 1901 all hope was given up, and it was supposed that the opportunity for opening this mound had vanished; but this hotel was burned a few years ago, and the opportunity to excavate the site was obtained by Mr. Heye from the Ambassador Hotel Corporation. The excavations under the direction of Mr. Harrington for the Heye Museum and the Bureau of American Ethnology were begun early in May, 1923, and the first day's work located the position of the cemetery on the slope leading to the beach.

FIG. 106.—Collection of soapstone and sandstone bowls taken from Burton Mound cemetery. Left to right: G. W. Bayley, Professor D. B. Rogers, John P. Harrington. (Photograph arranged by J. P. Harrington.)

FIG. 107.—Santa Barbara beach, looking east from Castle Rock Bluff. The cove this side of the further wharf is the former puerto de cayucos or canoe landing place of the Indians in front of Burton Mound. (Photograph by J. P. Harrington.)

Several hundred human skeletons and a valuable collection of mortuary and other objects were found, among which was a fragment of a canoe made of soapstone, stone utensils and implements, mortars, pestles, beads, daggers, pottery, and other articles. By arrangement with the Heye Museum the report of this important discovery will be published by the Bureau of American Ethnology and a collection of duplicates of objects obtained will be deposited in the U. S. National Museum. The collection is the finest illustrating the culture of the Santa Barbara Indians that has been made in many years.

## ARCHEOLOGICAL FIELD-WORK IN TENNESSEE

Mr. William Edward Myer, special archeologist, Bureau of American Ethnology, spent May and June, 1923, exploring the remains of a great prehistoric Indian town in Cheatham County, Tennessee. These remains are known as the Great Mound Group on account of the great central mound. Some interesting scientific problems were revealed by his excavations at this old town on the Harpeth River near Kingston Springs. Through the kindness of Mr. Wilbur Nelson, State Geologist of Tennessee, Mr. Crawford C. Anderson made a survey of the group. His maps are shown in figures 108 and 109. Through the efforts of Lieutenant Norman McEwen, of the 136th Air Squadron, Tennessee National Guard, aeroplane photographs were secured.

The remains of this ancient town or towns are found in two adjoining bends of the Harpeth, about a mile apart, and cover about 500 acres. The two sections of the town or two separate towns had each been protected by its own line of defenses, consisting in part of perpendicular bluffs and the remainder of palisaded walls.

### GREAT MOUND DIVISION OF THE GROUP

In the upstream bend of the Great Mound division of the town he found a bold projecting hill which had been artificially shaped from base to summit. The original rounded summit had been leveled until a great plaza or public square, about 1,000 feet in length and 500 feet in breadth, had been formed. This plaza is indicated by *P* on figures 110 and 111. At the northeast corner of this plaza, at the brow of the tall terraced hill and overlooking the adjoining region for several miles, the Great Mound had been erected. It is denoted by *M* on figures 110 and 111. Along the eastern edge of this plaza two smaller mounds had been built. Three wide terraces had been formed along

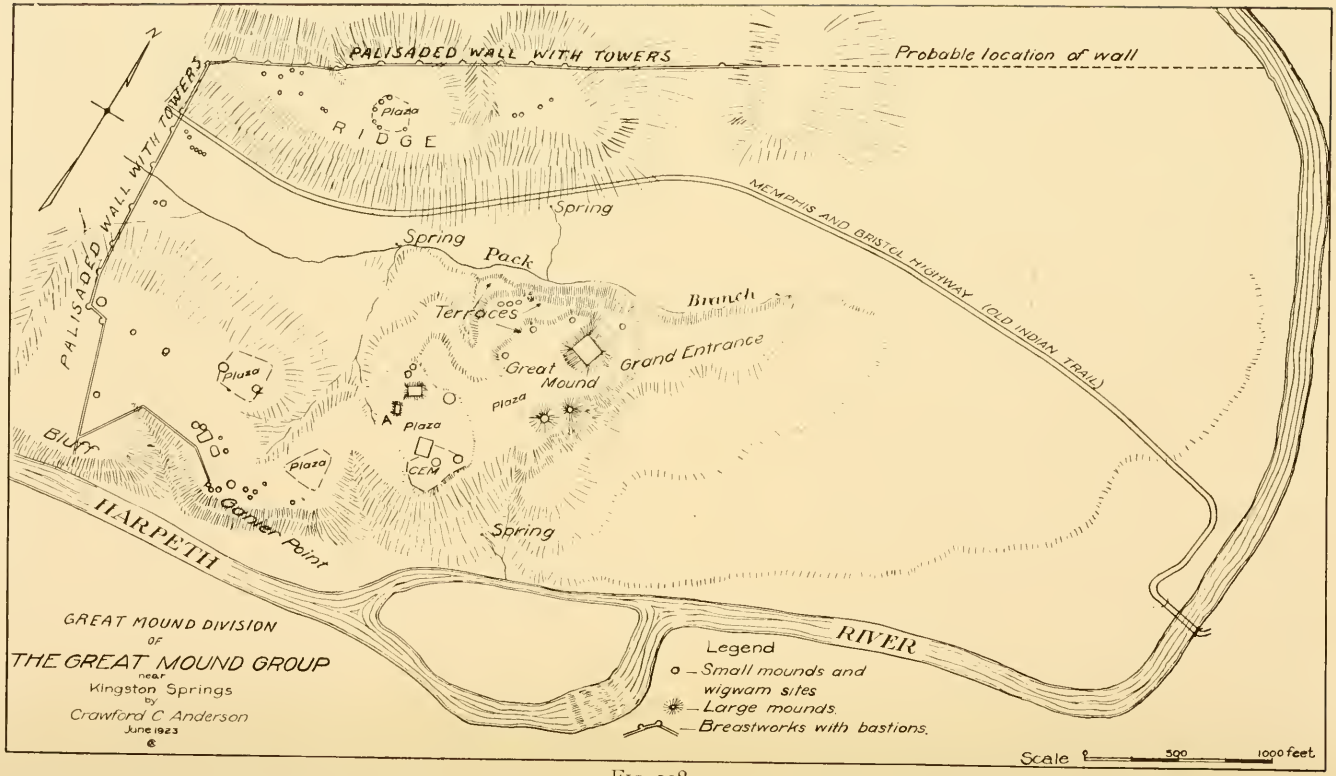
PALISADED WALL WITH TOWERS
Probable location of wall
PALISADED WALL WITH TOWERS
Plaza
RIDGE
Spring
MEMPHIS AND BRISTOL HIGHWAY (OLD INDIAN TRAIL)
Spring
Pack
Branch
Terraces
Great Mound
Grand Entrance
Plaza
Plaza
A
Plaza
Plaza
Plaza
CEM
Bluff
Garner Point
HARPETH
Spring
RIVER
GREAT MOUND DIVISION
OF
THE GREAT MOUND GROUP
near
Kingston Springs
by
Crawford C. Anderson
June 1923
Legend
o — Small mounds and wigwam sites
— Large mounds.
— Breastworks with bastions.
Scale
500
1000 feet.

FIG. 108.

the northern side of this hill. Very faint traces of them can be seen at *T, T, T,* figure 111.

The Great Mound division of this ancient town was protected on the water side by the perpendicular cliffs of the Harpeth River. On the land side it was defended by an earthen embankment or breastworks surmounted by a wooden wall from which at intervals semicircular wooden towers projected. These earthen breastworks, which had formerly supported this wooden wall, were still to be found in the undisturbed woodlands where they yet extend about $1\frac{1}{4}$ miles, and there is evidence that they originally ran much farther. Wooden palisades, consisting of small tree-trunks, had been driven into the ground side by side and wedged together and the soil thrown against

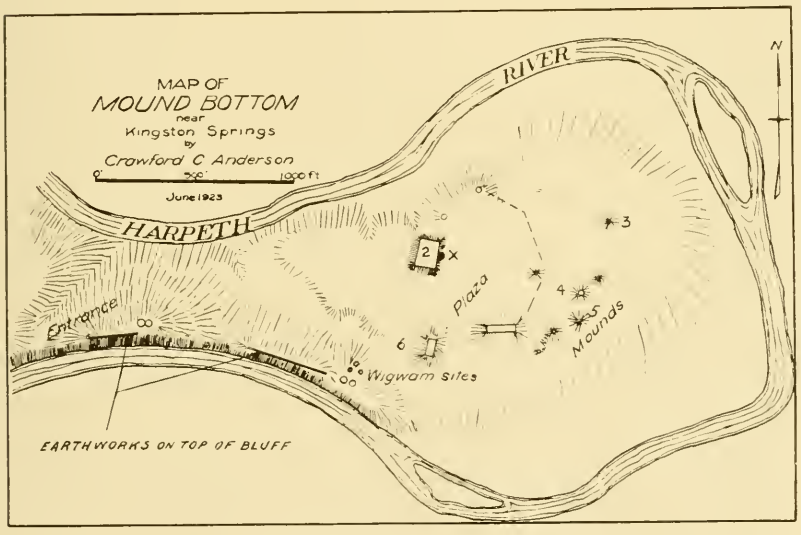


FIG. 109.

them until they were by this means firmly imbedded in these earthen embankments or breastworks. These palisades, bound closely together and strongly braced, formed a wooden wall which had been plastered on the outside in order to make scaling by an enemy difficult. Earthen bastions projecting beyond this line of wall at intervals of about 150 yards were still to be found. These had formerly supported semicircular wooden towers. The enemy advancing to attack was therefore subjected to fire from the defenders through port-holes along the main wall and also to a flanking fire from the warriors in the towers on these bastions. Faint traces of some of the timbers of these


FIG. 110.—Great Mound, in Great Mound Group.

palisades and wooden towers were found in the soil of these embankments.

This prehistoric town is notable for the artistic ability displayed by the ancient man who planned the beautiful, terraced, bold central hill with its fine plaza surmounted by towering Great Mound. No other remains of ancient man have been found in our southeastern


FIG. 111.—Aeroplane view of northern side of central hill, showing Great Mound, M, Plaza, P, faint traces of terraces at T, T, T. (Photograph by Lieut. Norman McEwen.)

United States which approach this Great Mound Group in an artistic sense. On the other hand, the pottery and the stone artifacts are somewhat ruder than those of the adjoining region. The remains of about 15 mounds of various sizes were found on this site.

While this great central mound topping the bold terraced hill formed the most striking feature of this ancient town, there were within the walls four other eminences whose summits had likewise been leveled

into plazas. All these plazas yielded traces of earth lodges and other evidences of former buildings. On the edges of the terraces were the earth lodges of the common people. See map, figure 108. The larger mounds had probably supported important public buildings and the lodges of leading personages.

All the buildings unearthed appeared to have been destroyed by fire. A line of wall-post holes and fragments of the charred poles used for wall posts in the large building, *A*, can be seen in figure 112.

Under the fallen-in walls of this building the charred remains of woven cane-matting wall hangings were found and carefully preserved. The woven design could still be discerned.

FIG. 112.—Wall post holes and fragments of charred wall posts of building A, Great Mound Group.

There is some evidence that this group of important buildings around five separate plazas and in different parts of the town very probably indicates that the population was made up of what had once been four or five separate groups of kindred peoples. These groups had probably formerly been autonomous. Here in their later home each group had gathered around their own public square in their own section of the town and thus preserved at least some of their old ceremonials and held together in some fashion their old organizations.

It is impossible to determine even approximately the number of inhabitants, but the large number of the buildings and the long extent of the walls to be manned required a population of several thousand.

MOUND BOTTOM DIVISION OF GREAT MOUND GROUP

Figure 109 shows a map of the Mound Bottom division of the Great Mound Group. This portion of the remains covers nearly all of the lower river bend which is called Mound Bottom by the local people. The accounts of the early white visitors to the region indicate that a line of walls with towers every 40 paces at one time extended around the edge of this river bottom. If so, all trace has disappeared under long cultivation. A curious line of earthen embankments was found on the narrow neck of bluffs through which entrance was gained to the ancient town. These embankments do not appear to have been portions of fortifications.

A photograph of a portion of Mound Bottom is shown in figure 113. Numbers 2, 4, 5, and 6 are large mounds. Number 1 is a wide artificial


FIG. 113.—Mound Bottom, Harpeth River, two miles below mouth of Dog Creek, Cheatham Co., Tennessee.

earthen platform adjoining mound number 2. Number 7 is a cemetery containing stone-slab graves.

It is not as yet possible to determine the age of these remains. Beyond all question the town had been destroyed long before the coming of the whites. In like manner the Indians living in this section when the whites arrived stated their ancestors had also found these vestiges of some unknown people lying silent and deserted along this beautiful river when they came into this region.

DENNY MOUND

Later in the summer of 1923 Mr. Myer explored a small mound on the Denny farm at Goodlettsville, Sumner County, Tennessee, which proved to be of unusual importance, in that it yielded relics which showed it to belong to a culture quite different from that of much of

the surrounding region in the valley of the Cumberland in middle Tennessee.

Several of the potsherds found in this mound were decorated with fabric impressions which throw new light on the clothing of some of the southern mound-builder women and reveal important differences between some of the customs of the builders of the Denny mound and those of ancient man in the adjoining states.

The burial customs, pottery fragments, pipes, implements of bone and antler, copper ornaments, and other artifacts brought to light in this excavation were of great interest as they furnished intertwining clues which led to tracing out a cultural relationship between many widely scattered important ancient sites occupied by prehistoric man in the upper valleys of the Tennessee River in eastern Tennessee, northwestern North Carolina, the Shenandoah Valley, the upper valleys of the Potomac, the valleys of the New and the Kanawha, the central and lower Scioto valley, a site in the suburbs of Cincinnati, certain sites in the southern peninsula of Michigan, and in southern Wisconsin and elsewhere in our central northern states.

Probably the most interesting contributions to knowledge brought to light by the exploration of the Denny mound were the clues which led to determining what modern Indians are the descendants of the ancient mound-builders who erected this old Tennessee mound. A study of the material cultures aided by the scanty written records and traditions regarding the localities where cultures have been found somewhat similar to that of the Denny mound brings out the fact that the little outlying settlement of ancient people who lived at the Denny mound belonged to a culture group whose remains are found at various points in eastern Tennessee, northwestern North Carolina, southwestern Virginia, Shenandoah Valley, the upper Potomac valleys, the valley of the Kanawha, southern and central Ohio, southern Wisconsin, the southern peninsula of Michigan, and possibly in other sections. This culture group appears to have belonged to the Algonquian stock. The many interlocking evidences render it probable that the Denny mound and some of the other culturally related sites here mentioned were at some time occupied by the Shawnees or people closely akin to them.

### REMAINS IN LINCOLN AND MOORE COUNTIES, TENNESSEE

Mr. Myer also visited Lincoln and Moore Counties, in the southern part of Tennessee, where he studied several ancient sites and surveyed and mapped a large and hitherto undescribed mound group on Elk

FIG. 114.—Vase from Lincoln County, Tennessee.

River, in the southern corner of Moore County at the point where Moore, Lincoln, and Franklin counties corner. This group of large mounds, plazas, and traces of ancient wigwam sites covers a large bottom on Elk River. Its accompanying cemetery is found on a tall bluff overlooking the site. These remains of some important ancient mound-builder town have never been explored. It has been named the R. H. Gray group in recognition of Mr. R. H. Gray's services to archeology in seeking out and accurately recording for the Bureau of American Ethnology 74 ancient Indian sites in Lincoln County where formerly only two had been reported. Through the kindness of Mr. E. C. Brossard, of Fayetteville, some unusual relics were secured from an ancient site in Lincoln County, on Swan Creek near its junction with Elk River. One of these, a long-necked vase decorated with three unique heads, is shown in figure 114.

FIG. 115.—Boat-shaped object from Lincoln County, Tennessee.

An exact duplicate of this vase in material, size, shape, and heads was found in the suburbs of Nashville, Tennessee, several years since. These very striking heads probably are connected with some ancient tradition or religious rite of these prehistoric men in Tennessee.

A fine boat-shaped object from the same Swan Creek site is shown in figure 115.

### LINK GROUP

Mr. Myer also visited Humphreys County, Tennessee, and studied and mapped the Link group of mounds on Duck River, some six miles southwest of Waverly. This is the site where the famous cache of fine, long, chipped flint ceremonial blades and chipped flint implements now in the Missouri Historical Society collection was found. He secured some new information in regard to this important group and the surrounding region.

## FIELD STUDIES OF INDIAN MUSIC

In July, 1923, Miss Frances Densmore went to Neah Bay, Washington, to continue her study of Indian music for the Bureau of American Ethnology. The purpose of the trip was to record the songs of Pacific Coast Indians for comparison with the songs of desert and plains tribes. The Makah were selected for this comparison as they are particularly efficient in the catching of whale and seal. The result fully justified the undertaking. Proof of the effect of environment and occupation on Indian song was obtained, together with descriptions of musical customs not found in tribes previously studied. The

FIG. 116.—Neah Bay village, Olympic Mts. in distance. (Photograph by Miss Densmore.)

resultant material comprised phonographic records of 103 songs, more than 200 pages of manuscript notes, 26 specimens of plants with descriptions of their use, 5 portraits of singers and numerous photographs of the locality. A considerable number of specimens relating to the material were obtained, and several specimens which the owners refused to sell were photographed with their permission.

Neah Bay is on the Strait of Juan de Fuca and lies within a few miles of the end of Cape Flattery. Across the Strait can be seen the mountains of Vancouver Island while back of the village rise the Olympic mountains (fig. 116). Communication between Neah Bay and the outer world is entirely by water. Long ago, the Spaniards

came here, built a dock and "surveyed the place." An informant said this took place in the time of his grandfather's grandfather. The Indians were friendly to the Spaniards until they molested the women, when they drove them away. A trace of Spanish influence was found in the statement that the earth revolves once every day, but the Makah added that "the earth is a flat disk, supported by something underneath but resting on the surface of the water." One edge was said to be a little lower than the other, so that in revolving it dips below the water, this causing high and low tides. Further evidence of Spanish influence lay in the description of an armor made of narrow wooden slats, worn in war by the early Makah. The next white visitors were "Boston men" concerning whom it was said "they dug large deep holes and buried a great many bottles to prove they discovered Neah Bay."

Four tribes of Indians are under Neah Bay Agency, the largest number being the Makah who comprise 414 persons. They frequently exchange visits with the Indians on Vancouver Island but did not mention the tribes living on Puget Sound. A clear distinction was made between Makah songs and those of the British Columbia Indians; it was said, however, that many of the Makah songs had "B. C. words." No explanation was given for this usage. The words of the gaming songs were in the "Chinook jargon." Many songs were in a "dream language."

As an outstanding peculiarity of Makah music we note the custom of pounding on planks instead of drums. Timber was easily obtained and the material for a drum head could be obtained only by hunting in the mountains. The planks were "shag," made by splitting a log with a wedge, and the short sticks used for pounding were of the same crude manufacture. The Thunderbird dance was performed on the flat roof of a house and as an accompaniment for that dance a plank was placed on the ground near each side of the house, the company sitting beside these planks, facing the house, and pounding as they sang. A somewhat similar arrangement was used at a social gathering on the beach, attended by the writer (fig. 117). The planks are raised a few inches above the ground, giving space for resonance. Drums appear to have been used by individuals. Mrs. Long Tom (fig. 118) declined to sell her drum, saying "it was so much company for her in the long winter evenings." Certain songs were accompanied only by handclapping, and certain dances had no songs, being accompanied only by pounding on the planks.

Throughout the general culture of the Makah is seen the influence of the "caste system" and the keeping of slaves. Many acts were permitted only to the "first families" and forbidden to the "lower classes." In former times a prominent Makah owned at least 12 slaves usually obtained from other tribes in exchange for the various products that resulted from his successful whaling. These products included whale meat, oil, blubber, and bone. The possession of slaves affected the position of women, as they were relieved of much arduous labor. This enabled them to spend more time on their personal appearance and to enter more fully into an enjoyment of their children. A

FIG. 117.—Makah singing on beach. Pacific Ocean in distance. (Photograph by Miss Densmore.)

woman who was careful of her appearance washed her hair and massaged her face and body every day. Men as well as women rubbed their bodies with cedar bark fiber or with fine hemlock branches, the men following this with prayers for physical strength. Occasionally the women also desired great strength.

Two ideals were noted in this tribe, personal beauty in the women and physical strength in the men, and we find also a certain grace in social intercourse. For instance, each person at a feast was expected to sing a "gratitude song" before his or her departure and there were many songs, sung at social gatherings, in which men and women expressed an admiration for each other. A charming custom was that of "lullaby singing" by the older women which was always followed

FIG. 118.—Mrs. Long Tom. (Photograph by Miss Densmore.)

FIG. 119.—Mrs. Wilson Parker. (Photograph by Miss Densmore.)

FIG. 120.—Mrs. Sarah Guy. (Photograph by Miss Densmore.)

by gifts supposed to be bestowed by the infant. There were songs for boys and for girls. Frequently the words were supposed to be those of the child. Thus a lullaby for a baby girl contains the words

> "The only reason I cannot gather more berries
> Is that so many other babies are bothering me."

The following lullaby is addressed to a boy,

> "What a nice basket full of snipes you are carrying.
> You got them at Tcatcatiks."

The singer of this song would expect to be rewarded with a feast of snipes. Several of the lullabies were recorded by Mrs. Wilson Parker (fig. 119), whose head shows a deformation observed frequently among the Makah.

The wedding customs were elaborate, including mock and genuine feats of strength as well as dramatic performances of various sorts. An instance of the latter was the presentation of what might be termed a "model" of an island, given by a man to the girl who married his son. A song concerning this action was recorded by Mrs. Sarah Guy (fig. 120) and contains these words,

> "My island home is ready,
> There are many ducks around it."

The most characteristic songs and legends of the Makah are those connected with whale catching. In these songs we find tones prolonged to the length of four or more counts in slow tempo, suggesting the "*ahoy*," or call across the water, which is used among sea-faring people of other races. In addition to these very long tones the whaling songs contain short rhythmic units, crisp and decided, like the motion of the paddles in the water. The intervals and compass of these melodies is rather small. Mr. James Guy (fig. 121), who recorded whaling songs, said they were sung "in time with the paddles" and that between renditions the men held their paddles upright and gave a long wail or moan, imitating the sound made by a wounded whale

The prominence, power and wealth of a Makah depended on his success in catching whales. One or two whales was the average catch for a man in a season but sometimes a man caught four or five. In that event he was able to give an oil potlatch, at which about 500 gallons of whale oil were given away. Not only was the oil taken home by the guests but buckets of it were poured over the women relatives of the host who danced at the potlatch. The host even showed his lavish intention by pouring a large quantity of oil on the fire. In the songs of the oil potlatch a captured whale is supposed to be speaking.

FIG. 121.—Mr. James Guy. (Photograph by Miss Densmore.)

FIG. 122.—Young Doctor. (Photograph by Miss Densmore.)

Among the songs peculiar to this tribe was one learned from the frogs, another concerning the story of an encounter between a man and a shark, and another concerning a mysterious creature of the sea called by a term meaning "lightning belt of the thunderbird." Concerning one song it was said, "In old times the people believed that the singing of this song would bring rain." Three "echo songs," with prolonged tones, were recorded by Young Doctor (fig. 122) who said he heard them in a dream, sung by men in a canoe on a very calm day. Young Doctor was an excellent singer, a proficient, industrious worker in wood and whale bone and formerly treated the sick, using a rattle of shells strung on thin whale bone.

Other subjects studied were war, contests of strength, and the ordinary potlatch, with its songs of invitation, welcome and feasting.

The following incident is of interest, in connection with the study of Indian music. Miss Densmore played for Young Doctor the phonograph record of a Yuma song. He listened attentively and then said, "That sounds like a song calling on the southwest wind and asking for rain. It is calling for a soft wind, not a strong wind." He was interested to learn that the song came from a desert country where the desire for rain is often in the minds of the people, and the song belonged to the Kurok, or Memorial ceremony of the Yuma. The words of this song were in an obsolete language, unknown to the man who recorded it.

Two phases of singing by the Makah women deserve special mention. It was said to be the custom with all old songs that a man sang the introduction, then a certain woman pronounced the words, after which all sang the song. This woman acted as a sort of precentor, and her action was not unlike that of "lining out the words." The second interesting phase of singing by the women was the use of a high drone, or sustained tone, while the other singers gave the melody. It was said "the Makah women sometimes do this if they are not sure of a song and are asked to help with the singing, but the Quileute women do it a great deal, calling it the 'metal pitch' because it is like a piece of metal which can give only one pitch." Miss Densmore heard and noted this high drone in the singing of Papago women in southern Arizona, where it seemed to be regarded as an ornamentation to the music. A high drone is said to characterize the singing in "some parts of European Russia and all over the eastern Caucasus, in the wild recesses of the mountains where the native music has not felt the modifying influence of European culture." Its presence in these localities in the United States, and not in tribes living farther from

the Pacific coast, is of peculiar interest. There has been no opportunity for investigating the possible use of the high drone by California tribes.

After leaving Neah Bay Miss Densmore went to Prince Rupert, B. C., where she interviewed some members of the Tsimshian tribe and learned that their old songs are remembered by at least one member of the tribe. No attempt was made to record songs in British Columbia, but there seems an important opportunity for musical work in that region.

FIG. 123.—Unfinished banner stones, showing different stages of workmanship on various types found in eastern Pennsylvania.

## BANNERSTONE INVESTIGATIONS IN PENNSYLVANIA

John L. Baer, special archeologist for the Bureau of American Ethnology, spent three months in eastern Pennsylvania studying bannerstones and the method of their manufacture. Four more aboriginal workshops, where bannerstones were made, were located; two along the Susquehanna and two along the Delaware. None of these, however, was as large as the one formerly reported on Mt. Johnson Island in the Susquehanna River. At each of these workshops the bannerstones were made either after different patterns or of a

different material. By learning the sources of the various types of these ceremonial objects Mr. Baer hopes to discover some of the prehistoric migrations of certain tribes of the American Indians. Many interesting specimens of bannerstones were located in small private collections in Pennsylvania. In one town there are nearly a dozen which were found within a radius of 10 miles. Unless this section of the country was specially favored, bannerstones must have been much more numerous than has heretofore been supposed.

Numerous reports of a cache of rhyolite blades, ranging from 20 to 150 per cache, attracted Mr. Baer's attention to the source of material in the South Mountains west of Gettysburg, Pennsylvania. These prehistoric rhyolite quarries were discovered and described by Prof. W. H. Holmes a number of years ago. Recently a trench for a pipe-line was dug over the side of the mountain, which exposed chips and reject blades of rhyolite and trap hammers for a distance of half a mile. The bushels of rejects scattered along this narrow path are indications of the magnitude of this prehistoric workshop, which was as broad as it was long.