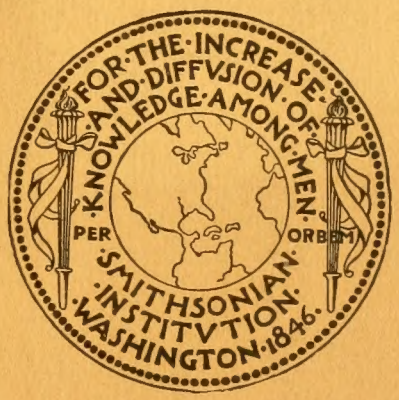
SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1930



(PUBLICATION 3111)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1931

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Mammals

PREFACE

Each year the Smithsonian Institution and certain of its branches—notably the U. S. National Museum, the Bureau of American Ethnology, and the Astrophysical Observatory—send into the field expeditions for the purpose of obtaining information and collections needed in the pursuance of their researches in biology, geology, anthropology, and astrophysics. The results of these researches are published sooner or later, usually as technical papers, in one of the series issued by the Institution. In the meantime it is considered desirable to present in this annual explorations pamphlet brief articles on the field expeditions themselves. The articles, written by the field workers, tell of the purpose of the expeditions, the methods of acquiring the desired material, something of the results obtained, and perhaps a little of the interest of scientific work in the field, often in places seldom visited by man. The whole gives an idea of the wide scope of the Institution's scientific activities, undertaken with the sole purpose of increasing knowledge and diffusing it.

W. P. True,
Editor, Smithsonian Institution.

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STUDYING THE SUN

By C. G. ABBOT,

Secretary of the Smithsonian Institution, and Director of the Smithsonian Astrophysical Observatory

For many years we have operated stations on high mountains in distant desert lands making daily observations of the intensity of the sun's rays, on which all life and weather depend. This tedious campaign is just reaching its victory.

As shown in figure 1, short-interval changes of solar radiation, taking four or five days in which to produce a rising or a falling sequence of solar change averaging only 0.8 per cent, obviously cause changes in the temperature and barometric pressure at Washington.[1] Opposite causes in solar change plainly produce opposite effects in weather. Some of the effects are simultaneous with their solar causes. Others are delayed 10 or more days, probably drifting down in waves from distant centers of direct solar action. These delayed effects, as well as the direct ones, are often large, equalling or exceeding 5° Fahrenheit in their average values.

The conclusion is surprising. Hitherto it has commonly been supposed that weather is merely the fluctuation effected by local terrestrial conditions in the orderly periodic march of climate. These new results indicate, on the contrary, that weather is principally caused by frequent interventions of variations of the sun, affecting terrestrial affairs.

The delayed effects just pointed out give promise of long-range forecasting values. It would be still more promising if regular periodicities should be found in the solar variations. This is the case. Figure 2 shows that from 1918 to 1930 the principal variations in the solar radiation, as given by monthly mean values, are well represented as the sum of five periodicities, and five only. They are of 68, 45, 25, 11, and 8 months, respectively, and are all closely related to the $11\frac{1}{4}$-year sun-spot cycle and the 33-year Bruckner cycle. The search for shorter periods is beginning, and, as curve H shows, reveals a period of 45 days and another one-eighth thereof as having continued through the year 1924.

The expected march of solar variation in the years 1931 and 1932 is shown in curve I.

[1] And other stations as well.

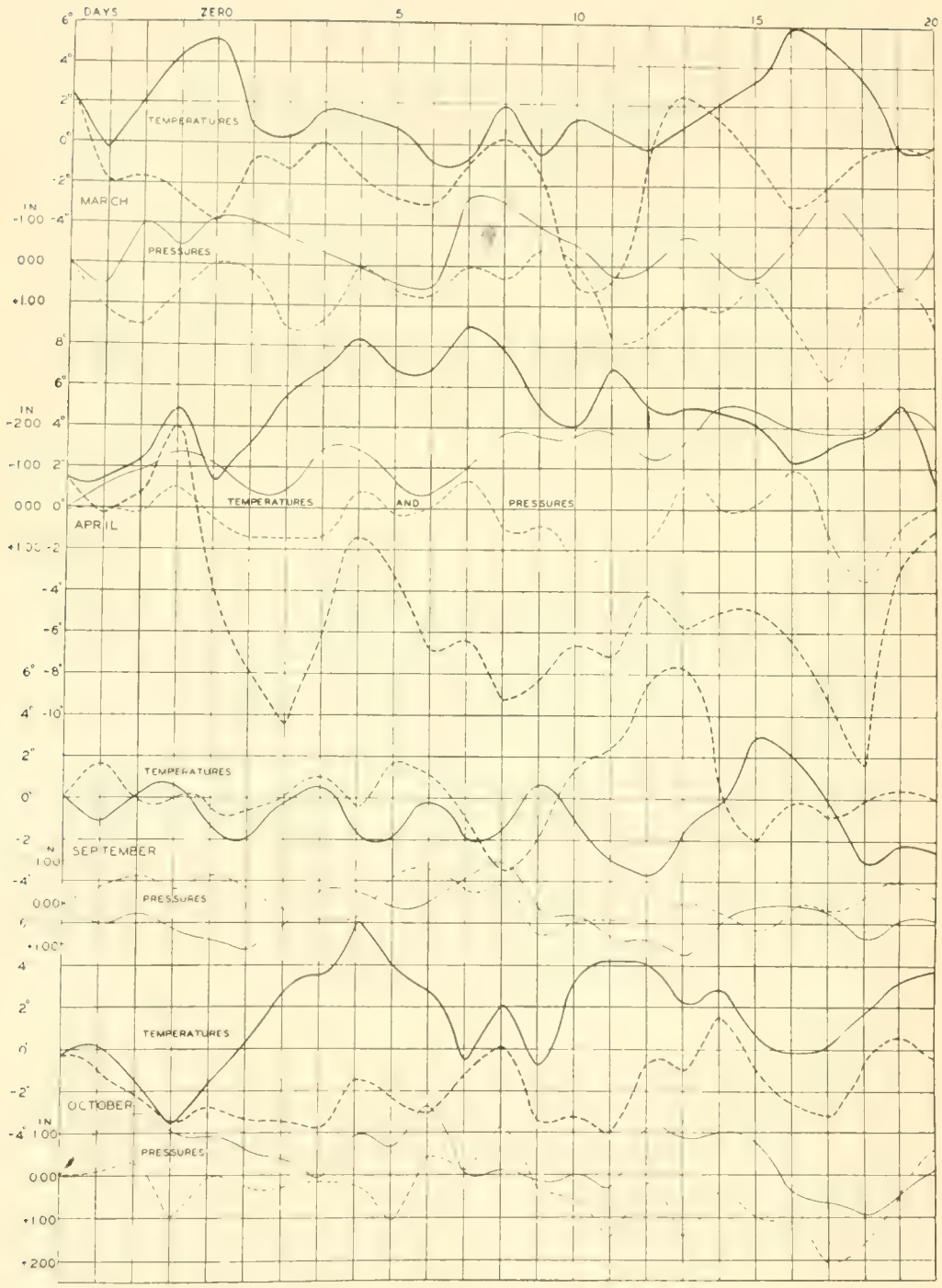

FIG. 1.—Average trends of temperature and pressure at Washington corresponding to average solar changes of 0.8 per cent. The solar changes culminate on the day "zero," but weather effects sometimes occur much later. Weather effects corresponding to rising solar radiation, full lines; to falling radiation, dotted.

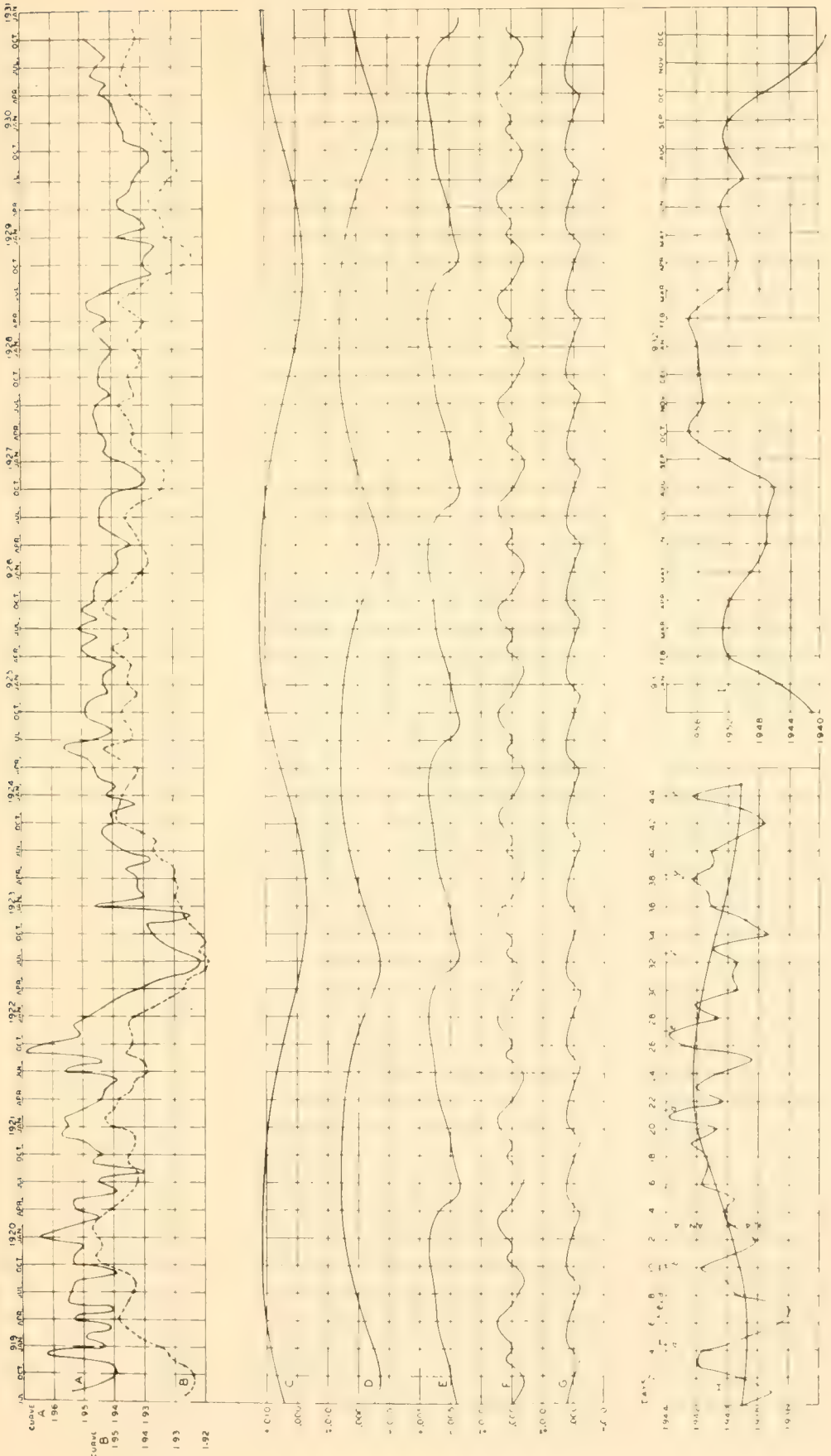

FIG. 2.—Periodicities in solar radiation.

FIG. 3.—Mount Brukkaros, South West Africa. The Smithsonian solar observing station is near the top.

FIG. 4.—Observing tunnel and instruments, Mount Brukkaros, South West Africa.

FIG. 5.—Mrs. Sordahl demonstrating a Hottentot fish trap. Mount Brukkaros, South West Africa.

FIG. 6.—The springbok shot from the car with a pistol. Mount Brukkaros, South West Africa.

Our three observatories in the field at Montezuma, Chile, Table Mountain, California, and Mount Brukkaros, South West Africa, have carried on as usual. The following extracts from the diary of Mrs. Sordahl, wife of the director at Mount Brukkaros, show some of the unusual incidents of life in a Hottentot reservation.

January 2, 1930. The blue cats of Mount Brukkaros celebrated the New Year by raiding our chicken house at two o'clock this morning. Adam woke us up, and Louis jumped out, grabbed his pistol and rifle and flash light and went up to the chicken house. The wild cat was still inside. Louis shot it with his .32 Luger. Adam skinned the cat and I prepared it as a flat skin. We had a chicken dinner.

January 24, 1930. During last night's storm, the lightning had struck the tunnel. The cotton wrapping on the wires was burned, also the wires, box, shunt, resistance box and Wheatstone bridge; both strips in the bolometer were broken, lights burned out, second Wheatstone damaged, and theodolite blackened. Alfred went to town, sent cablegram to Dr. Abbot. . . . . *January 25, 1930.* The men worked all day repairing instruments. . . . . *January 26, 1930.* The men worked all day at the tunnel. I stood by and tried to be of help, but perhaps was more of a hindrance. They ran a plate test at 5:30 p. m. Had a terrific whirlwind today. The stove became "stopped up" so the men had to fix that too, and the whirlwind took the sacks off the coleman lamps. Trouble never comes singly.

May 18, 1930. Went back to Berseba and waited to see the wedding. The Hottentots perform their own pagan ceremonies of marriage first, and the next day they have the missionary marry them according to Christian rites. The bride was hidden away from all the ceremony and celebration. This is done to test her faithfulness as a lover. The groom walked about with a look of loneliness and despair as he could not take part in the gayeties either. He wore a bright orange pair of trousers, black pointed shoes, and a felt hat, all of which made a peculiar combination of Hottentot and European styles. The groom's relatives form a procession and go to the bride's parents' home with the inheritance. The bride's relatives do likewise to the groom's home. The groom's train consisted of seven yoke of oxen drawing a wagon load of food. The wagon was covered with green foliage. Behind the wagon, the men drove teams of goats. A long line of women walked on either side, carrying green branches forming an arch over the oxen and goats to conceal the gifts that the bride was to receive. The two parties met half way between the homes, crossed paths and proceeded to the opposite home. After this ceremony the celebration begins. They build a large fire to barbecue the meat and cook the mealy meal. Mr. Mutz told us that in good years they kill as many as twenty head of oxen for a wedding, but during poor years such as this one the number seldom exceeds seven. They eat, drink, dance and sing all night. The next noon the missionary marries them again.

PURSUING MICROFOSSILS

By R. S. BASSLER,
Head Curator of Geology, U. S. National Museum

During the last quarter of a century the Smithsonian Institution has fostered the study of three groups of micro-organisms, the Bryozoa, Ostracoda, and Foraminifera, originally as a contribution to pure science, and later, when their value in determining oil and other zones in the earth's crust became evident, as a distinct aid to economic progress. In this work the Institution has had the valuable assistance of two collaborators, Dr. Joseph A. Cushman of Sharon, Massachusetts, the well-known authority on Foraminifera, and Dr. Ferdinand Canu of Versailles, France, one of the foremost students of post-Paleozoic and Recent Bryozoa. Since 1909, it has been my privilege to be associated with Doctor Canu, not only in research on the Bryozoa, but also in building up the Museum's study series of this class.

Our first extensive work, based on the Tertiary rocks of North America, was prepared under the joint auspices of the Smithsonian Institution and the United States Geological Survey. Its purpose was to work out a classification for the group, and also to learn the stratigraphic occurrence of the numerous American species to further their utilization in geologic work. Our later studies have included both the Mesozoic and Recent faunas, while there was recently completed a monographic study of the Philippine fauna in which many of the post-Paleozoic genera are described and illustrated.

Our collaboration has been carried on almost entirely through correspondence, and it was not until the past summer that Doctor Canu found an opportunity to make his first visit to the United States. Meeting in New York upon his arrival early in June, we immediately started on a field trip through the New England States, during which we combined the collecting of Recent bryozoans along the coast with explorations for suitable exhibition material from the igneous rocks of Massachusetts and Maine. We were fortunate during part of our trip in being the guests of our friends Dr. and Mrs. J. A. Cushman. They took us by automobile to the various areas we wished to study, and most kindly entertained us at their home in Sharon, also the site of the Cushman Foraminiferal Laboratory. This laboratory is of such interest to scientific students that I am including an account of its work and aims, furnished me by Doctor Cushman:

FIG. 7.—The Cushman Foraminiferal Laboratory.
(Photograph by Cushman.)

FIG. 8.—Rocky cove along the Massachusetts coast.
(Photograph by Bassler.)

The Laboratory was built in 1923 to serve as a private research laboratory connected with problems on the Foraminifera. Later one room was opened for graduate students of Harvard University and Massachusetts Institute of Technology who received instruction here. There is also room for visiting workers on the Foraminifera. The building consists of laboratory rooms and rooms for clerical work, library, etc., on the main floor, together with a steel and concrete addition somewhat separated from the main building but connected with it, in which are housed the collections, special library, card catalogue, etc. The basement is given up to rooms for preparation of material, photographic work, and a room for carpentry work such as building cases, etc. There is gathered together here a great deal of material from classic localities representing various parts of the world, which has been acquired through exchange, collecting, or purchase. There is a library of between 2,000 to 2,500 separates, including practically all the important works on the Foraminifera. There is also a unique card catalogue of figures and references to published records on the Foraminifera. These, which number at the present time about 75,000 cards, have a copy of the original figures pasted on the card with the references given, the original place of publication, formation and locality, with often times the complete description and notes. These are arranged by genera, by species under each genus, and the references under each species chronologically. In addition there is a separation of Recent, Tertiary, Cretaceous, Jurassic, and Paleozoic, indicated by colored tab cards. This makes it possible to very quickly find the original figure of any species, or the records for a given formation. There are also collections containing many thousand slides of identified species, many of which are from the original type localities, together with a very considerable number of actual holotypes and figured specimens. These collections are being augmented rapidly, and are eventually to go to the U. S. National Museum where it is hoped active work will be continued on the group for a long time as is now being done here.

After several days at the Laboratory spent in reviewing past work and planning for the future, and studying Doctor Cushman's methods, we motored north along the Atlantic Coast from Cape Cod to Portland, Maine. On this trip my attention was given over to the location of outcrops of igneous rocks from which large specimens showing geological phenomena could be quarried for exhibition at the Museum. Doctor Canu's interest, on the other hand, was concerned with the collecting of Recent Bryozoa, which he found encrusting pebbles of the igneous rocks or attached to the seaweed. Our present studies were therefore far apart in time, his relating to the present while mine dated back millions of years—almost to the beginning of earth history. Figure 8 illustrates how a small area can serve such widely divergent interests. Doctors Canu and Cushman are seen collecting Recent bryozoans in the rocky cove (near Scituate, Mass.), while nearby can be observed a dike of dark igneous rock cutting through the light colored granite.

FIG. 9.—Outcrop of Paleozoic glacial tillite at Squantum Head, Boston Bay. (Photograph by W. S. Cole.)

FIG. 10.—Quarry at Vincentown, New Jersey, showing the well developed unconformity (indicated by ink line) between Vincentown bryozoan marl, below, and Tertiary sands, above. (Photograph by Bassler.)

Proceeding northward along the coast, the Boston Basin, one of the classic geologic areas of America, was next in order. Here Doctor Cushman pointed out the complicated structure of the Paleozoic rocks, particularly the Roxbury conglomerate and the associated beds of tillite. The origin of these two formations was much in doubt until, in 1910, a resemblance of the tillite to present day glacial bowlder clay was recognized by Dr. R. W. Sayles. This tillite, now known to be of Upper Paleozoic age, is especially well exposed at Squantum Head (fig. 9), the peninsula jutting out into the southern part of Boston Bay. The outcrops here are of such interest that the area has been presented to the city as a public park. Consequently no exhibition specimens could be collected, but Doctor Sayles, who is much interested in having a display of the conglomerate and associated bowlder clays in the National Museum, holds out a hope that permission may be granted for obtaining such an exhibit in the near future.

Since two of the main building stones of our Natural History building came from adjacent areas—the granite used in the construction of the basement from Milford, Massachusetts, and the white mica granite used in the first and second stories from Bethel, Vermont, I was naturally interested in spending some time in a study of their characteristics and occurrence.

Continuing north, other regions along the coast were explored, the last being the Leda clay district of Maine where the possibility of securing a considerable section of this interesting laminated clay was investigated.

On the return trip we took the route through the White Mountain district and the peneplain area of lower New England, securing photographs illustrative of the physiographic development of these regions.

Leaving New England, where we had enjoyed such pleasant associations and gained important geological information, Doctor Canu and I proceeded to Washington. After spending several weeks together at the Museum in preliminary work on our next bryozoan monograph, several short trips were made to Atlantic Coastal Plain areas to study at first hand the geological relationships of faunas under consideration. Our particular interest lay in the bryozoan fauna of the so-called Vincentown, New Jersey, marl, whose close faunal relation to the Upper Mesozoic of Europe is most striking. Until recently this marl has been regarded as marking the top of the Mesozoic era, but American students who have investigated the other classes of fossils of this fauna and associated strata, now question the Cretaceous age of the deposit, believing it to be Middle Eocene, a much younger formation. As the Vincentown marl is at the boundary between two great eras of

geologic time, the Mesozoic and Cenozoic, and apparently shows relationship—at least in its bryozoan fauna—to certain strata in Europe, it is desirable that a detailed study be made, not merely to present descriptions of the species, but to bring out principles involved in intercontinental correlation. Our collections of Bryozoa secured from Vincentown, New Jersey (fig. 10), and other points along the Atlantic Coastal Plain, assure us of abundant material from which to obtain tangible results. The work had progressed so far by July, the time of Doctor Canu's return to France, that completion of the monograph is practically assured.

FOSSIL HUNTING IN THE BRIDGER BASIN OF WYOMING

By CHARLES W. GILMORE,
Curator, Division of Vertebrate Paleontology, U. S. National Museum

In the southwestern part of Wyoming an extensive area of badland country known as the Bridger Basin has long been a fertile collecting field for those in quest of the remains of fossil vertebrates. This basin, the formation, and the early military post called Fort Bridger were all named in honor of Jim Bridger, that intrepid frontiersman, scout, and Indian fighter who pioneered this region.

The first collection of fossils from the Bridger formation was made in 1870 by a Yale party under the leadership of Prof. O. C. Marsh, and it marked the beginning of a long series of expeditions which have disclosed the varied and abundant animal life that existed here in Eocene times. The need of an adequate representation of this important fauna in the National Museum collections has been long felt, and it was to supply this need that in the spring of 1930 plans were consummated for an expedition into the Bridger area.

In the latter part of May, I left Washington for Green River, Wyoming, the base of operations, where I was joined by Messrs. George F. Sternberg and George B. Pearce, both of Hays, Kansas; the former as field assistant and the latter as cook for the party. From Green River we proceeded almost immediately to Fort Bridger in the southwestern part of the Basin where supplies were obtained, and our first camp was established on Smith's Fork, near the small town of Mountain View.

Prior to entering the field my tentative plan of operations was to begin in the southwestern part of the Basin and work eastward, searching in succession the exposures which are to be found paralleling the courses of the several creeks that flow northward into the Basin from the foothills of the Uinta Mountains to the south. In the main this plan was adhered to.

Failing to find much of interest along Smith's Fork, we soon moved camp to the head of Little Dry Creek where better success awaited us. Several weeks were spent here in systematically searching the denuded breaks and hills that form the escarpment along this creek and our work was well rewarded. In the first few days here an incident occurred that is so unusual as to seem worth relating. One day in crossing a small water course the car became stalled in the soft mud of the creek

FIG. 11.—Bridger badland exposures along Little Dry Creek, Bridger Basin, Wyoming. Lower half of formation. (Photograph by G. F. Sternberg.)

FIG. 12.—Badland exposures south of Sage Creek Mountain, Bridger Basin, Wyoming. Upper half of Bridger formation. (Photograph by G. F. Sternberg.)

bottom. Looking about for stones with which to block up the wheels, we noticed a rocky layer protruding from the bank and Pearce was instructed to get the pick and pry out some of it for ballast. A stroke or two with the pick brought an exclamation of surprise, for on the under side of the first slab detached was the complete skull of a crocodile in excellent preservation. A most happy surprise and a valued addition to our then small accumulation of fossils.

On June 11, camp was moved to a site on Leavitt Creek and here we were successful in finding some of the best collecting ground yet encountered. Four weeks of collecting here brought us past the middle of the season and inasmuch as all of our work had been in the lower half of the formation, it was decided to move to a locality where the upper measures offered good collecting ground. Accordingly on July 16 our fourth and last camp was established on Henry's Fork, about a mile north of Lone Tree postoffice and here the remaining weeks of the season were profitably spent.

As a result of this work a great mass of material was accumulated which is thought to contain much of scientific interest and importance, in addition to some few specimens of an outstanding character. The collection filled 24 large cases having a combined weight of 7,430 pounds.

Among the specimens of outstanding interest are an almost complete articulated skeleton of *Hyrachyus,* a rhinoceros-like animal about the size of the modern tapir; a skeleton slightly less complete of *Orohippus,* a small primitive horse; two partial skeletons of *Palaeosyops* and two crocodile skeletons that are more or less complete. At least four mountable skeletons for the exhibition series will result from the above mentioned materials. In addition there are many parts of skeletons, *i. e.,* skulls, jaws, articulated limbs and feet of both large and small mammals.

From a scientific point of view, the small mammal material such as tooth-filled jaws and parts of skulls in some instances associated with parts of skeletons, may prove to be the more important part of the collection. In all there were nearly 200 such specimens coming from all horizons, ranging from near the base to the top of the formation, representing beds of not less than 1,000 feet in thickness.

In this connection it is of interest that in two instances we definitely located the source of certain elements of this micro-fauna by finding a considerable number of specimens actually *in situ.* The importance of thus locating them may be better appreciated if I explain that perhaps 50 were thus located, whereas 150 others were collected from

FIG. 13.—Skeleton of the primitive rhinoceros *Hyrachyus* partly uncovered and as it lay in the ground. (Photograph by G. F. Sternberg.)

FIG. 14.—*Hyrachyus* skeleton swathed in plaster bandages, preparatory to removing it from the ground. (Photograph by G. F. Sternberg.)

FIG. 15.—Collecting the shell of a large land tortoise.
(Photograph by G. F. Sternberg.)

the weathered surfaces and their precise position in the geological section could not be accurately determined.

Thirty-eight turtle specimens representing several genera and species and varying in size from those with shells a few inches in length to giant tortoises nearly a yard long are also included in the collection. In two instances complete skulls and other bones of the skeleton were found associated with the carapace and plastron. Turtle skulls are extremely rare, and both of those obtained appear to be perfect with the lower jaws in place. Perhaps in no other formation of North America is there such an abundance of turtle specimens as are found in the Bridger. They occur almost everywhere in the formation both horizontally and vertically. In one locality we found an outcropping layer 50 feet or more in length that was composed almost exclusively of turtle shells. These were packed together so closely that it was impossible to remove one specimen from the mass without damaging a number of others. So far as could be determined in the field all appeared to pertain to a single genus.

Although there can never be more than surmise as to the catastrophe that brought about this great destruction of chelonian life, several possibilities might be mentioned. A shower of volcanic ashes, noxious gases, or a sudden flow of superheated water—any one of these would be capable of destroying these animals. That volcanoes were active in Bridger times is abundantly proved by the well established fact that many of the layers of this formation are composed exclusively of volcanic ash.

The concentrated accumulation of so many turtles in this one spot may possibly be explained as having been brought about by current action. A flowing stream during a freshet may have assembled the shells from a considerable area and floating down stream these were caught in an eddy or were stranded on a sandbar and thus were brought together in this one spot. The many broken shells and the manner of their overlapping, one shell upon another, would make such an explanation plausible.

Despite their abundance, however, well preserved turtle specimens, while not rare, are found only occasionally. Crocodiles are also common and in the collection made there are no less than nine skulls, two of which are associated with much of their skeletons. A considerable variety of lizards is known from the Bridger and of these small reptiles several specimens of a fragmentary nature were collected.

The value of the collection was greatly increased through the cooperation of Dr. W. H. Bradley of the United States Geological Survey, who secured the necessary field data from which he will prepare

FIG. 16.—Collecting a disarticulated skeleton of *Palaeosyops*. Many small mammal jaws were found *in situ* here. (Photograph by G. F. Sternberg.)

a scale map on which all of the more important finds will be accurately located. This mapping, combined with the several geological sections measured by him, insures the accurate placement both geologically and geographically of the specimens collected. This phase of the work should be of the utmost importance in making this a basic collection for the more exact determination of the faunal zones as well as assisting in a more precise correlation of the horizons with those of the other Tertiary basins of the Rocky Mountain region. So far as I am aware never before in the work on the Bridger formation has a paleontologist had the cooperation of a trained geologist in these determinations, and it is felt that the final results will prove of great importance.

THE SEARCH FOR ANCIENT LIFE FORMS IN THE ROCKS OF THE WESTERN UNITED STATES

By CHARLES E. RESSER,
Curator of Stratigraphic Paleontology, U. S. National Museum

The geologist, in his endeavors to obtain the minutiae that will eventually yield an understanding of the laws of his science, must spend many hours of patient toil climbing steep mountains, penetrating deep canyons, or tramping the bare expanses of deserts. From year to year he must take advantage of favorable weather and of every other opportunity to seek details for completing the picture he is attempting to draw.

My quest for facts to assist in depicting earth conditions that prevailed when the earliest life record was in the making took me over a considerable part of the western United States during the field season of 1930. Two general problems were chosen for attack. In view of the increasing interest of geologists in the earliest forms of life on the earth as well as the rôle played by algae as rock makers, the purpose of the first explorations of the season was to study the ancient sedimentary rocks exposed in the Grand Canyon of the Colorado River. The search for organic remains in these old, relatively unmetamorphosed sediments was particularly desired by Dr. David White, Research Associate of the Carnegie Institution, in conjunction with his studies at the Grand Canyon, and it was through his arrangements with the Carnegie Institution and the National Park Service that the trip was made possible.

The second general field of inquiry to be given consideration was Cambrian geology, in which I am especially interested and which I had previously studied in the Great Basin and the Rocky Mountains to the north. As I had never seen the geology of Arizona, it was with eagerness that I seized the opportunity to make a hurried visit to most of the more important Cambrian exposures in that state.

In order to do the contemplated work in the Grand Canyon before hot summer weather, I left Washington May 13. At the Grand Canyon, I found everything in readiness. The party consisted of Dr. A. A. Stoyanow, of the University of Arizona, and myself as geologists, with Ernest Appling as guide and Howard Childers as packer. Upon the arrival of Doctor Stoyanow we immediately crossed the Canyon to the North Rim. We planned to traverse the narrow peninsula which

FIG. 17.—Museum at Yavapai Point, Grand Canyon National Park. Interesting geologic exhibits have recently been installed both within the building and on the porch. (Photograph by Resser.)

FIG. 18.—View from the Tonto Platform up the Bright Angel Trail. Indian Gardens is situated under the big trees. The fault that makes this trail possible is apparent in the offsetting of the beds near the top of the trail. (Photograph by Resser.)

separates the head of Bright Angel Creek, up which the Kaibab trail leads to the North Rim, from the pass into Nankoweap Creek, where our field investigations were to be conducted. However, as the winter snow still lay deep in the woods, offering too much difficulty for laden pack animals, our plans had to be changed. Doctor Stoyanow and I, with food and equipment, were transported by a Park Service automobile 90 miles to South Canyon. Meanwhile our riding and unladen pack animals were driven by a straighter route through the forest to the rendezvous.

In order to understand this narrative more fully, both the geography and the geologic structure of the Grand Canyon must be called to mind. The Grand Canyon of the Colorado is developed where the river cuts deeply into almost horizontal strata on the flanks of the Kaibab Plateau, the higher portions of which attain an elevation of 9,500 feet above sea-level. As this mountainous mass was bowed up, the river, which previously probably followed a rather straight southwest course, was forced to make a wide sweep to the east, where, after notching into the surface, it cut the canyon. As a consequence, the Grand Canyon is now a great curved gorge.

Work in the canyon is very difficult. Besides the obstacle of its vast depth, the harder horizontal strata everywhere form cliffs, and since several of the geologic formations are rather thick, these vertical faces often reach several thousand feet in height. However, a thousand foot cliff is not needed to stop one's progress—a vertical wall only a few feet high, adjacent to steep slopes, becomes unscalable when the footing is insecure. The uplift of the Kaibab Plateau having occurred rather gently, few breaks in the horizontal formations resulted, and therefore weathering has not torn the rocks to pieces to form talus slopes over which trails might be made. Furthermore, in this dry region few side streams enter the river, particularly on the south rim where the gentle dip of the beds carries all water southward from the margins of the uplift. Therefore trails in the Grand Canyon exist only where advantage can be taken of slight natural breaks, and there only by the expenditure of considerable sums of money.

South Canyon, just east of the Park boundary and south of House Rock Valley, is a small dry valley cutting into the Kaibab Plateau and draining into the Marble Canyon. Our camp was made in the former home of "Uncle" Jim Owen; now a subsidiary National Forest ranger station—and some of the claws of the 2,200 cougars he is said to have killed are still seen tacked to the barn. In the cool Kaibab forest nearby, deer as well as the big cats are exceedingly plentiful.

FIG. 19.—South Canyon Ranger Station. Note the cougar claws on the barn in the rear, and the juniper forest. (Photograph by Resser.)

FIG. 20.—View across upper portion of Nankoweap Valley into Kwagunt Valley, Grand Canyon. (Photograph by Resser.)

We noted many scores of hoofs and other parts of deer killed in the great slaughter of the previous fall.

The morning following our arrival, our pack train was organized and we made our way through the juniper forests up into the pines of the higher levels to the peculiar gap that breaks through most of the thickness of the massive Kaibab limestone and Coconino sandstone which form the unscalable cliffs just under the rim of the Canyon. From this point into the Nankoweap Basin, we traversed a trail built in 1881 by Major John W. Powell, then Director of the United States Geological Survey, and used the following winter by Dr. Charles D. Walcott, who succeeded Major Powell and who later became Secretary of the Smithsonian Institution. Today there stands on the South River a finely executed monument commemorating Major Powell's successful navigation of the Colorado River throughout the Grand Canyon.

It is assumed by the general public, and even by most students, that the geological history of the major national parks is well known. Thousands of people from all over the world who visit these parks each year seek an explanation of the things seen—rocks, fossils, erosional features, or plants and animals. Notwithstanding this widespread interest, little has been accomplished toward mastering the geologic history of the Grand Canyon since the studies that resulted from Major Powell's and Doctor Walcott's explorations 50 years ago.

As the Nankoweap trail has not been repaired since it was first constructed, except casually by a prospector or two, travel was quite precarious and at places even dangerous, especially for the pack animals. Fortunately no accidents happened, although several of the animals had very narrow escapes from falling over the cliffs, which at places drop away from the trail-side 3,000 feet. Nankoweap Creek is the most easterly in the Grand Canyon National Park and hence lies below Point Imperial. Its valley is variously referred to as a valley or a basin, the latter designation being unusual for a tributary to the Colorado in the canyon country. Nankoweap valley like its near neighbors is basinlike in its openness, which simply reflects the local structure. With the uplift of the Kaibab plateau, some faulting—slipping of the strata along lines of weakness—took place. These basins lie inside the row of buttes margining the river for many miles, beginning at the up-river edge of the Kaibab Plateau and extending below the mouth of the Little Colorado. The Colorado River cut its channel beyond the fault, and erosion, operating in the usual manner along the fault, produced a high ridge in the intervening space, which was cut into rectangular buttes by the side washes. Nankoweap Creek,

FIG. 21.—Pack train on the Nankoweap Trail. Note how advantage is taken of a softer bed to locate the trail. (Photograph by Resser.)

FIG. 22.—One of the large algal masses found in the shales of the Nankoweap Valley. (Photograph by Resser.)

where it cuts across this block, has the usual steep canyon, but upstream it widens into a basin where softer rocks have been removed. Doctor Walcott's interpretation of this unorthodox fault is sometimes questioned, but Doctor Stoyanow and I, after considerable discussion of several alternatives, think Doctor Walcott is correct; in fact, we found further corroborative evidence not mentioned in his publications.

Our chief task on this expedition was to search the rocks thoroughly for traces of animal remains. As expected we found abundant imprints of delicate plant tissues and rather large masses of algal limestones, but nothing that can really be regarded as animal, though the limey and carbonaceous shales are fitted in every way to preserve a record of the life extant in the waters by which the sediments were deposited. Just what significance the barrenness of these sediments has, is not yet apparent. We camped, without tents, in the channel of Nankoweap Creek under a cutbank where one of the half-dozen sizable trees in the basin is located at the only campsite in the valley near water. Each day the search for fossils was extended to new ground so that almost every exposed bed was investigated in the eight days we remained in this basin.

When we prepared to climb out of the Nankoweap basin, I did not care to trust my notes or photographs to the mule but carried them in my pack. Fourteen hours of strenuous work were required to climb the vertical mile between our camp and the north rim, and to traverse the 15 miles of trail to the point on the road where the Park Service automobile could pick us up. Within the Canyon the last few days had become quite hot, but on the north rim we found early spring, with the snow bank just shoveled from the hotel porch and spread in the sun for quicker melting. The crossing to the South Rim, which was completed in a snow storm, seemed very cold, since we were outfitted for the heat of the canyon depths.

Now that the Nankoweap trip was completed, Doctor Stoyanow kindly arranged for use of the State Geological Survey automobile to afford us means for a brief examination of other Arizona Cambrian outcrops. This interesting journey began with the study of the Music Mountain section west of Peach Springs. A day here showed us how this section, which offhand would be assumed to coincide exactly with its apparent continuation northward in the Grand Canyon, differs in lithologic detail and relative thickness of beds. From Peach Springs our course naturally led southeastward diagonally across the State, for the older strata outcrop only along the northeastern edge of the old basement rock mass forming the southwestern portion of the State.

FIG. 23.—Another view of the large algal masses found in the shales of the Nankoweap Valley. The pictures represent masses washed into the gullies; it is not possible to photograph entire colonies in position. (Photograph by Resser.)

FIG. 24.—A. A. Stoyanow and Robert E. S. Heineman of the Arizona State Geological Survey, standing by a cholla or jumping cactus, so called because the smaller branches cling so easily and persistently to shoes and clothing. In fact the heat or moisture of one's hand held close causes the branches to turn toward it. (Photograph by Resser.)

The rocks in this old land mass are quite similar to the gneisses in the inner gorge of the Grand Canyon, and must have furnished the material now composing much of the Cambrian and subsequent strata offshore to the north.

The Cambrian series exposed in Music Mountain outcrops southeastward for a short distance, extending perhaps to the vicinity of Seligman. In the middle portion of the above-mentioned diagonal boundary of the sedimentary plateaus, no Cambrian is present, and a much younger series of beds rests directly on the ancient weathered rock surface. Southeastward from Globe, however, Cambrian sediments reappear, but contain no beds correlative with the Grand Canyon sequence. Doctor Stoyanow had worked out these general stratigraphic facts by years of patient work and it was a great privilege and pleasure to have him point out the evidence on which he based his conclusions.

In a trip across Arizona, it is interesting, especially to one who has not previously seen the southwest, to note how very sensitive the flora is to elevation. The various cacti seem to have exact physiologic requirements, and therefore even a low hill will often rise above the level required by a conspicuous cactus. Another exceedingly interesting experience was a visit to Natural Bridge, which is situated not far from the villages of Pine and Payson. Here one finds both unusual geologic features and interesting human activities. A deep, V-shaped canyon was cut by a small stream flowing apparently along a fault zone, as the rock series in the two walls of the canyon are not the same. Several large springs issue from the east side of the canyon several hundred feet above its bottom. Algae living in the abundant waters from these springs have precipitated enormous quantities of lime, until a level fill several hundred feet deep and 25 acres in extent was formed across the canyon. Subsequently, the creek dissolved a channel through this fill, thereby forming a large natural bridge. More than 50 years ago a Scotch family occupied this level tract which is naturally very fertile but almost completely shut off from the world. Mrs. Goodfellow, the wife of the original settler, is still living, and it is very interesting to hear her accounts of the early days. Fruit trees of many sorts were planted when the Goodfellows first arrived. An apricot tree planted 52 years ago beside one of the irrigation ditches apparently found its situation most favorable. Its trunk is now more than 3 feet in diameter, with a spread of branches exceeding 100 feet, and this summer the tree bore approximately 100 bushels of fruit. After an extended survey the Los Angeles papers are reported to have admitted that this is the largest apricot tree in the world!

About the middle of June I returned to the Grand Canyon, where the Park Service again kindly put at my disposal equipment and animals. I now had the pleasure of studying the well exposed rocks along the Kaibab and Bright Angel Trails. This work was done in conjunction with Edwin McKee, the efficient Park Naturalist, who is carrying forward investigations that will contribute much to our deficient knowledge of Grand Canyon geology.

My journey to Salt Lake City was made via San Francisco, where I examined certain type specimens in the University of California collections.

At Salt Lake City, I was joined by Dr. Riuji Endo of Mukden, Manchuria, who was to accompany me during the remainder of the season. After organizing for camping, we went to Delta, Utah, preparatory to a trip into the Utah desert. Here we were joined by Mr. Frank Beckwith, editor of the local paper, who is greatly interested in the geology of his country. At this point the unusual weather of the season began to impress itself upon us. During May and June rains fell when none were due, but the departure from normal was not so great as to attract more than passing notice. The past several years had been dry throughout all the west and consequently rain was greatly desired. At Delta much rejoicing was apparent when heavy rain began to fall particularly on the watersheds that fed the irrigation canals. Cloudy, threatening weather attended our departure into the desert, making the temperatures very comfortable where we expected to experience the usual burning heat.

In the House Range Mr. Beckwith took us to Antelope Springs, a small permanent flow of water near the fossiliferous outcrops studied many years ago by Doctor Walcott. After reviewing these sections we crossed the range by Marjum Pass and then followed the usual rough desert track that by courtesy is called a road. Travel was exceedingly rough as heavy showers had either washed ridges of dirt and stones across the road or cut parallel grooves.

Saturday evening we reached Ibex in the Confusion Range. Mr. Beckwith introduced us to Jack Watson who has lived there for many years, mostly alone. No springs or streams occur here, as the nearby ranges do not attain the height of 10,000 feet necessary to cause sufficient precipitation to insure springs. Consequently Mr. Watson must depend solely on rain water captured in tanks formed by dams across gullies. When we arrived we found that he had no water left in his tanks, since the regular spring showers had not materialized, nor had the rains that began ten days previously in the higher mountains to the east yet spread this far into the desert. He was particularly

FIG. 25.—View down stream across Natural Bridge, Arizona. The flat cultivated land is merely a fill of algal limestones under which a huge natural bridge was subsequently dissolved by the creek. The flower stem of a century plant stands in the immediate foreground. (Photograph by Resser.)

FIG. 26.—One of the excellent new mud volcanoes that developed last spring near the Dragon's Mouth, Yellowstone National Park. (Photograph by Resser.)

annoyed a few days earlier by having a heavy shower pass within a few miles of the bare rock expanse that catches most of his water. Consequently he had to get up each morning at 2:30 and haul water in barrels on a truck from Wah-Wah Spring, 31 miles away for 33 head of cattle! Information he was able to give us and the fact that our engine was functioning perfectly caused us to risk a reduction of our car's water supply and we gave one of the cows 9 gallons.

Upon returning from our investigations in the desert ranges, we decided to visit the nearby Zion National Park. Quite unexpectedly we found that, as in the Algonkian rocks of the Grand Canyon, the much younger sediments in Zion Canyon also lack fossils except algal limestones.

The final field for investigations before beginning our homeward journey lay in the vicinity of the Yellowstone Park plateaus. Consequently we went north from Zion by way of Bryce Canyon and the Sevier Valley through the Salt Lake region, then by way of Star Valley to the Tetons.

From about the 24th of July onward the rains that had been increasing in frequency all summer began to interfere with our travel and work. In the Teton Range, where last season not a drop of rain fell all summer, it was almost continuous. Our tents were wet for weeks at a time. Finally rain became so frequent and so violent that few roads remained open. For this reason we abandoned our attempts to reach several localities and went northward away from the high regions. During our investigations in the Tetons and the Yellowstone we were accompanied by Dr. Curt Teichert and Mrs. Teichert of Freiburg, Germany.

Our final studies in the Rocky Mountains were in the Beartooth Range near Red Lodge, Montana, where Princeton University has begun geologic studies. Scarcely another region in North America exhibits such varied geology, and if researches are continued for a sufficient length of time, important results may be expected. This appears to be the focal point where the Rocky Mountains change their general type of structure, and the extensive Yellowstone Plateau with its lava flows ends, joining both the central and northern types of ranges, and where the results of glacial, erosional, and other geologic processes are clearly exhibited.

CONTINUATION OF THE FOSSIL HORSE ROUND-UP ON THE OLD OREGON TRAIL

By JAMES W. GIDLEY,
Assistant Curator of Mammalian Fossils, U. S. National Museum

The results of the Smithsonian expedition to the Snake River Valley, Idaho, in 1929, were so encouraging that it was decided to continue operations for another season or two. Accordingly, early in May, 1930, preparations were made to resume work at the site of our former collecting ground.

For five days, rain, snow, and general bad weather held our party in the little town of Hagerman, Idaho. But on May 9, high winds and a brilliant sun gave promise of drying up the county roads sufficiently to make possible a move into camp, and no time was lost in loading a two ton truck with camp equipment, a week's supply of rations, boxes, lumber, and about 30 gallons of water. Our trusty Ford was also loaded with baggage and lighter material, and we were soon on our way. Our objective, a camp site at the edge of the desert near the fossil bone deposit worked last year, was only two miles in an air line from Hagerman, but there intervened the canyon of the deep and swiftly flowing Snake River, and on its bank to the west a sloping sandy escarpment of over 600 feet elevation above the river bed. To reach this camp, therefore, it was necessary to cross the river on the main highway bridge about four miles south of Hagerman and make a detour of about 25 miles over a hilly and little-used country road through the border of the desert country. Part of this route was over a portion of the picturesque Old Oregon Trail, hallowed by the struggles and privations of a pioneer people opposed by the stubbornly waged warfare of the Indians, who were fighting for their beloved lands and hunting grounds. Over this trail during the following weeks we made our biweekly trips to town for water, supply provisions, and materials as they were needed. I learned from the early settlers in the region that this was a particularly hazardous stretch of trail in the early days. Here the old trail left the river to wind its way up the steep divides to the top of the plain about 5 miles to the west, whence it continued westward over a dry sage-brush-covered desert to the next place where water was to be found, a total distance between watering places of over 20 miles. In these days of automobiles this journey is so easily accomplished that the word hardship does not occur in connection with it.

But not so with the early users of the trail. To them it was a real hardship to be overcome. Even for the stage coach, drawn by four or occasionally six light horses, it was a long and tedious day's travel. And for the heavier loaded and slower moving emigrant and freight outfits a single day did not suffice for the journey. It was their custom, I was told, to divide their wagon trains at the Snake River, taking one half up the first five miles of heavy climb to the top of the divide and leaving them there for the night, while the oxen or horses

FIG. 27.—A bit of the Old Oregon Trail, looking east toward Snake River from the top of the Plain, near which an Indian attack is reported to have taken place.

were taken back to the river to bring on the remainder of the wagons early the next morning, when the journey through the sandy sage brush country to the next water hole was resumed. The necessity of breaking up the wagon trains at this point naturally weakened their defense against attack by hostile Indians. This fact was evidently recognized and taken advantage of by the latter, for it was here some of their most successful attacks were made. It was said that here one whole emigrant train was surrounded and burned. Mute evidence of the tragedy is still perceptible in the form of occasional pieces of wagon irons that may be found scattered through the sage brush near

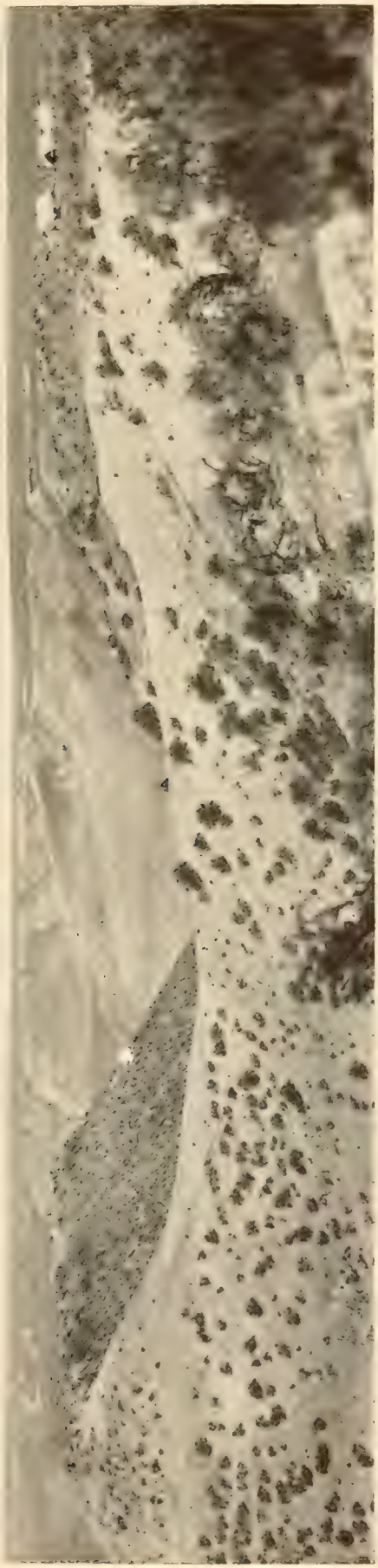

FIG. 28.—Camp and the fossil bone deposit in the Hagerman locality. (Photograph by J. W. Gidley, June, 1930.)

the top of the hill. I here secured for the National Museum's historical collection three of the old cast iron hub-thimbles.

Our party this year included Mr. C. P. Singleton, chief field assistant; Mr. S. P. Welles, graduate student of the University of California; Mr. Frank Garnier, cook and camp assistant; and as occasion permitted Mr. Elmer Cook, the discoverer of the fossil bone deposit. After a week's service Mr. Garnier was replaced by Mr. J. Young Rogers as camp man.

Camp established, the work of the summer began where we left off the previous season in the development of the fossil bone deposit. This deposit is situated at the southern extremity of a short hill or spur that juts out from the border of the plain, about a quarter of a mile from our camp and about 45 to 60 feet below the top of the hill. (See fig. 28.) It is evidently the remnant of a stream channel deposit made up of cross-bedded layers of coarse and fine sand with occasional pebbles and here and there patches and lenses of almost pure clay, forming a part of the horizontally laminated beds of the Idaho formation. These beds reached a thickness of several hundred feet and at one time extended many miles in every direction, completely occupying the area now excavated by erosion to form the Snake River Valley of this region, and the present day rough terrain to the west and south of Hagerman. The bone deposit was evidently at the time of its formation a boggy, springy terrain, perhaps a drinking place for wild animals in a semi-arid country where water holes were not abundant. This assumption is based on the general character of the deposits as stated, and the fact that it contains the bones of literally hundreds of animals, mostly belonging to an extinct species of horse. For the most part the bones are disarticulated, intermingled, and scattered in a way to suggest that they represent the slow accumulation of many years rather than the sudden overwhelming of a large herd in one grand catastrophe. Springs and swampy conditions are indicated from the fact that there are in the deposits the remains of frogs, fish, swamp turtles, beavers, and other water living animals, and abundant evidence of vegetation as shown by remnants of coarse grass stems, leaves, and even small pieces of wood. The best evidence of the former presence of springs is the fact that numerous pebbles are found scattered throughout many of the layers of both coarse and fine sand, although there are no distinct layers of gravel. In the lower stratum of this deposit the sand is heavily stained and many of the fossil bones are encrusted and stained with light accumulations of bog iron.

FIG. 29.—The fossil bone deposit from opposite side of small canyon.

FIG. 30.—Fossil bones *in situ*. At left center is a skull and jaws of a horse, *Plesippus shoshonensis*, still articulated with the entire neck and the anterior portion of the thorax.

Regardless of its origin, two seasons' work has developed the fact that this fossil bone deposit is one of the important discoveries in the field of vertebrate paleontology of recent years. The outcome of these operations by the Smithsonian Institution parties has been most gratifying. As already stated the principal yield of the deposit consists of abundant remains of a hitherto unknown species of horse belonging to the rare genus *Plesippus,* an animal which stands directly intermediate between the horses of the Pleistocene and present day, and the three-toed kinds of still more ancient time. The material collected from this deposit in the two seasons includes more than 40 more or less complete skulls and sufficient bones of other parts of the body to restore at least three or four entire skeletons. The bones collected represent all stages of growth of both sexes from embryo to old age. Thus they afford an unusual opportunity for a systematic study of the species, especially in reference to the limits of individual and sex variations.

Other fossil remains found associated with the much more abundant horse material were those of a large beaver, an otter, a mastodon, a large peccary, a rodent of the muskrat group, a frog, a swamp turtle, and a small fish. From exposures of the same formation in the general vicinity were also collected remains of these and additional extinct species of mammals, the latter including several species of rodents, a large cat, two species of camel, and a small ground sloth. These, together with the animal remains of the fossil bone deposit, when studied, will give rather definite evidence regarding the true age of this mass of sedimentary accumulation to which has been given the name *Idaho formation.* This formation has hitherto been regarded by some authorities as belonging to the Pleistocene, or so-called Ice Age, and by others as representing the upper member of the next older geologic period, the Pliocene. The preliminary study of the fossils collected by our party in the Hagerman locality seems strongly to favor the placing of their age as Upper Pliocene. This marks their time of deposition as not less than a million years ago.

To the fossil hunter such a deposit as the one here described is of much more than passing interest. First there is a satisfaction in working out a successful technique for collecting and preparing the bones for shipment to the laboratory; and there is the added keen pleasure of anticipation and expectation, as foot after foot and yard after yard of undisturbed ground is worked over, that the next bone to be discovered and developed will prove to be new to science or at least a better specimen than has before been found of an already known species. Such collecting also has its monotonous and prosaic side. At

FIG. 31.—Camp at the Hagerman locality, 1930.

FIG. 32.—Close-up of section in excavation showing the general character of the deposit. The shovel point rests on the bottom of the bone bed which here is about 2 feet thick.

the Hagerman locality it is often necessary to spend hours and even days in just plain shoveling of many cubic yards of sand to come to the bone-bearing layer. Once reached the bones are for the most part well mineralized, or petrified, and although more or less scattered are usually complete. But often the separate bones are much broken or cracked up, especially where they have lain for a long time near the surface of the sloping hillside from which they outcrop. This necessitates working very carefully around each bone, as developed, and giving many of them special treatment to prevent their being pulled apart in removing them from the loose sandy bed.

The first care, therefore, was to make long strippings to remove the overburden from the bone bearing layers. Then as the bones were uncovered one by one or in groups and brushed clean on top and sides, the cracks and soft places were saturated with a thin solution of gum arabic (acasia). Following this treatment, as their condition and the collector's experience suggested, they had to be still further protected by pasting them with strips of burlap dipped in raw flour paste or thin plaster of paris. This, when dry, forms a light, tough jacket which securely holds each piece in its original position, and the specimen then may be turned over and the jacket completed on the lower side to finish its preparation for packing and shipping. For skulls and articulated sections this method had to be followed in nearly every case. In certain sections in the deposit the bones instead of being surrounded by a soft sandy mass, were completely incased with a nodular or concretionary formation of varying thickness of very hard sandstone that is very tenacious and most difficult to break free from the bone without injuring its surface. Sometimes the bones were thus so deeply and solidly embedded as to make them almost worthless as specimens.

FURTHER INVESTIGATIONS ON EVIDENCE OF EARLY MAN IN FLORIDA

By JAMES W. GIDLEY,
Assistant Curator of Mammalian Fossils, U. S. National Museum

Following the controversy raised in scientific circles several years ago by the discoveries of Dr. E. H. Sellards at Vero, Florida, regarding the antiquity of man in that region, the Smithsonian Institution has conducted a series of investigations at various localities along the east coast of Florida, but principally at Melbourne and Vero. The results of these expeditions, which were placed under my charge, have been reported on from season to season, the last report appearing in last year's number of this publication,[1] Thanks to an extension of the kind generosity of Mr. Childs Frick, who for the past few seasons has shared with the Smithsonian the expenses of these expeditions, work in Florida was continued this year.

Melbourne was again chosen as the base of operations, and during the greater part of February and March Mr. C. P. Singleton, my chief field assistant of former years, and I carried on explorations, excavating considerable areas especially at Melbourne and other nearby localities. Fair success crowned our efforts, though perhaps not to the same degree as on some of our former expeditions. The most important discoveries of the season at the Melbourne locality included the finding of two artifacts under circumstances that constitute additional evidence of early man in Florida. The first of these is a crudely formed arrow or spear point found by Mr. Singleton *in situ* in the undisturbed upper layer of the fossil-bone-bearing deposit known as " bed No. 2 " of Sellards. It was lying directly under one of the large bones of a poorly preserved skeleton of a mastodon.

The other artifact is a small bone awl taken from the undisturbed sand of the No. 2 bed somewhat below its middle section. In both instances the excavated areas were originally covered with a few feet of loose but characteristically stratified swamp deposit composed of alternating layers of sand, leaf mould, and swamp muck, positive evidence that the artifacts were a part of the formation in which they were found and not to be accounted for on the assumption of later intrusions. Several good specimens also were added to our growing collection of fossil mammal bones from this locality.

[1] Explorations and Field-Work of the Smithsonian Institution in 1929, p. 37.

FIG. 33.—Following a lead near the old canal bank. Locality, a few hundred feet south of the Country Club Golf Links, 1930 expedition. Melbourne, Florida.

FIG. 34.—Searching for fossil bones in the lower stratum of the "No. 2 bed" (Pleistocene). Locality just below Golf Links. Melbourne, Florida.

FIG. 35.—Inlet to the St. Lucie Canal near where mammoth remains were found at the Indiantown locality.

FIG. 36.—Excavating in "No. 2 bed" for remains of mammoth discovered at the Indiantown locality, just back from point shown at extreme right foreground in Figure 35.

During the season we had occasion to examine a reported find of mammoth and mastodon bones on a truck farm near the ocean below St. Augustine. Here we found that the workmen, under the direction of the son of the farm foreman, had excavated the large part of a skeleton of the mammoth, but as they then planned to keep the specimen for private exhibit we did no excavating there and returned to Melbourne. The most important work done other than at Melbourne was along the St. Lucie Canal, about 12 miles east of Lake Okeechobee near Indiantown. Here we secured a well preserved pair of lower jaws and a few other parts of a mammoth, and did sufficient development work to determine that the general geologic structure is the same as that at Vero and Melbourne. The formation underlying the No. 2 bed in the Indiantown locality, however, seems to vary in character more than at Melbourne, where marine shells form the greater part of the mass. At Indiantown large masses of sand underlie thin layers of shells or in certain areas replace them entirely. The item of greatest value, perhaps, resulting from our work in this locality, was the finding of a molar tooth of one of the more primitive mastodons. This tooth came from a consolidated bed of sand about 20 feet below the present surface of the land and underlying a thin shell layer of supposedly older age than our fossil-bearing beds known as the Melbourne or No. 2 bed formation. The mastodon tooth in question is of the type of those found commonly in the Pliocene, and thus implies either that the lower strata of the fossil beds at Indiantown are Pliocene in age, or that here in Florida this particular species of mastodon lived on into the Pleistocene, or still more probably, the tooth may have been redeposited, in the place where found, from an older deposit of Pliocene age.

This and other interesting problems in connection with the early history of Florida remain still to be solved, and it is only by a continuation of systematic work similar to that which the Smithsonian Institution has been carrying on for the past few years that this can be done.

COLLECTING SILVER MINERALS IN ONTARIO, CANADA

By EDWARD P. HENDERSON,
Assistant Curator of Geology, U. S. National Museum

For the purpose of acquiring a series of silver minerals for exhibition, I left Washington late in August on a collecting trip into the Province of Ontario, Canada, the National Museum's collections being badly in need of material from the rich silver camps of this nearby region. Practically the entire month of September was spent in northern Ontario, and it would be difficult to select a more delightful season in which to visit this magnificent country.

At Toronto I spent several days in inspecting the collections at the Royal Ontario Museum of Mineralogy, selecting exchange material, and consulting with the mineralogists of the staff as to the best areas and mines to visit.

Leaving Toronto, I first visited the Cobalt district some 300 miles north, where the country in general is rather rough with many rocky ridges, between which are lakes, swampy wastes, or agricultural lowlands. These lowlands and therefore the streams, lakes, and highways generally lie in a north and south direction. There is abundant timber, mostly spruce, birch, balsam, and jack pine. Many forests have been swept by devastating fires leaving only charred stumps standing; in other areas, where more time has elapsed since the fires or original clearing for lumber, a dense, almost jungle-like growth has taken possession, the new growth being less suitable for lumber than the original stand of virgin timber.

Previous to 1903 the area around Cobalt consisted of wooded land which served as a source for lumber and constituted a natural barrier to the agricultural lands farther north, but in that year, during the excavating for the Temiskaming and Northern Railroad, narrow veins of phenomenally high silver values were discovered. The silver content was so great that trained engineers who came to examine the find thought that the quantity could not be large because of its rich quality but time has proved these conclusions to be erroneous. The history of this celebrated silver camp is very dramatic and has been told so often that it need not be repeated here.

The silver veins vary from minute seams up to a thickness of ten inches. In places the veins are almost solid silver and again the metal

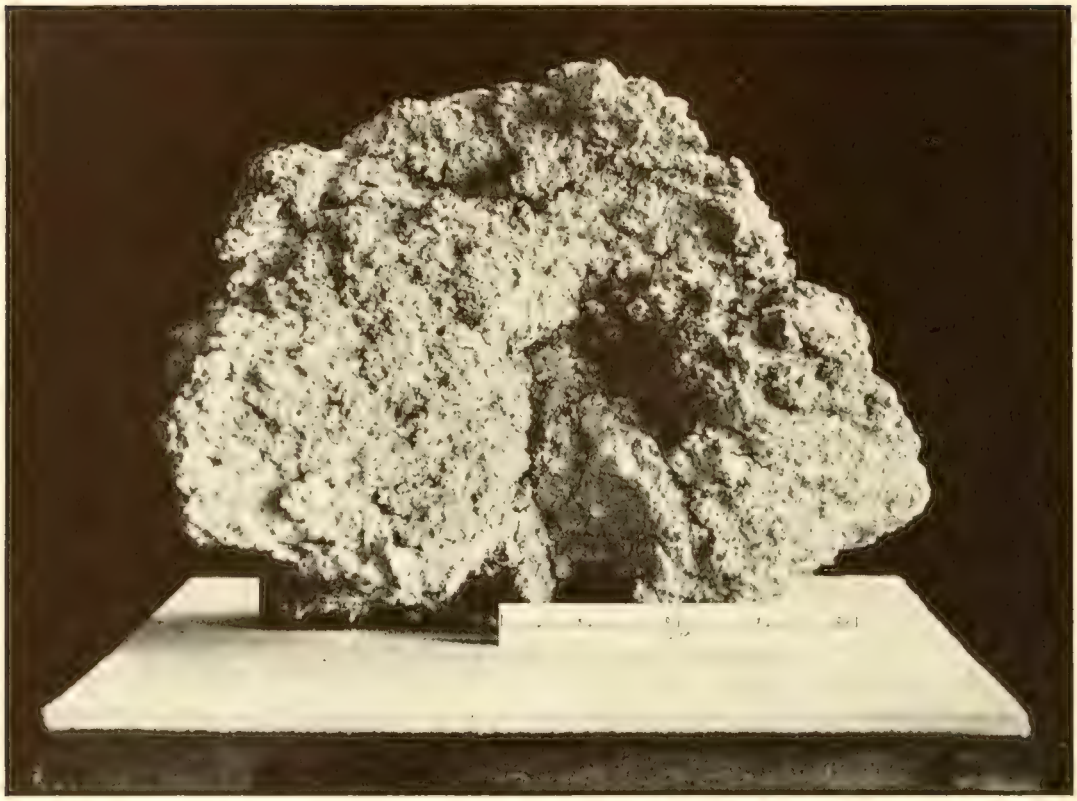

FIG. 37.—Silver mass from Keeley Mines, Silver Centre, Ontario. Weight 263 pounds, estimated to be 80 per cent pure silver.

FIG. 38.—The vein here shown varies in width from 6 to 25 centimeters, consisting of silver and calcite.

occurs as a fine network of delicate veins or small irregular masses in both calcite and cobaltite.

As simple a statement of the geology as can be given is that when this basic rock, called Nipissing diabase, was intruded into the older rocks, fractures were developed along the contacts and in these fractures the ore was undoubtedly deposited by solution originating in the diabase.

A large irregular mass of silver found at the Keeley Mines, Silver Centre, Ontario, was exactly the type of material needed for our exhibition, provided some of the ragged appendages which marred the symmetry of the specimen could be removed. This operation developed into a thrilling experience. Hammering, even with a sledge, made no impression except a small bruise on account of the toughness of the silver. Finally, in despair, the mine captain suggested a shot of dynamite. Two sticks were plastered on the side of the specimen under a damp blanket of sand, the fuse was lighted, and we retreated to safe quarters to await the report. And what a report it was! Strangely enough very little silver was removed. One small fragment made a non-stop flight through the side of the mill house and several windows in nearby buildings were shattered, but most important, from my point of view at least, was the small crack which had just started through the specimen. Smaller charges of dynamite were carefully placed and exploded and little by little the irregular silver prongs were removed. Perhaps few geologists have had the experience of trimming such a precious sample by so unique and striking a method.

The next district visited was Sudbury, the most important nickel district in the world. Much of the region surrounding the city of Sudbury is practically barren of vegetation and perhaps to the tourist appears as a desolate waste, but to the geologist it is an admirable exposure of a series of interesting rocks. The igneous rock in which the nickel ore is found is a norite, this intruded rock forming a laccolithic sheet some 36 miles long and approximately 17 miles wide. This nickel eruptive was intruded under a thick blanket of older sediments and the slow cooling permitted the ore minerals to separate out towards the bottom of the laccolith. The ore is monotonously uniform in character over much of the district. It consists of pyrrhotite, pentlandite, and chalcopyrite, and appreciable quantities of platinum metals are also recovered from the ore body.

A rather rapid series of visits was made to a number of the different pegmatite dykes in this province, resulting in the acquisition of several rather recently described minerals which were lacking in the

National Museum's collections. These pegmatite dykes are located in two rather widely separated districts surrounding Parry Sound and farther east toward Bancroft. Several large and a few small specimens were collected which are now in the Museum's exhibit.

The success of the trip was due in a large measure to the hearty cooperation of mining companies, quarry owners, and of the staff of the Royal Ontario Museum of Mineralogy.

AFIELD WITH THE BIRDS OF NORTHERN SPAIN

By ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution

Landing in the little seaport of Vigo in northwestern Spain late in the evening of April 23, 1930, I was awakened at dawn the following morning by the cheerful twittering of swallows at my window, the first species of living bird seen on a continent whose life was entirely new to me. Formalities for the entry of my scientific equipment were soon completed, thanks to arrangements made by the American Ambassador to Spain, the Honorable Irwin B. Laughlin, a Regent of the Smithsonian Institution, and in a few hours I was en route for Madrid, where through the same interested official necessary permits for field collecting were granted.

As an introduction to what was in store for me, friends at the Museo Nacional de Ciencias Naturales arranged an excursion into the nearby pine forests of the Sierra de Guadarrama where I spent three days quartered in the Estación Alpina de Biologia at a little more than 5,000 feet above the sea. In spite of almost continuous snow and rain I found here numerous birds, including among others two species of titmice, the nuthatch, robin, stone-chat, hedge sparrow, and goldcrest, all common birds but of keen interest to one who had not before seen them alive.

Field work began in earnest on arrival at the little town of Puente de los Fierros at an elevation of 1,800 feet above the sea on the north slope of the Sierra Cantabrica, the great range of rugged mountains that as a continuation of the Pyrenees extends across northern Spain. The town lay in a deep valley that led up to the Pajáres Pass, with the lower slopes divided by stone fences or lines of brush into pastures and cultivated fields frequently pitched at an angle of 45°, while winding lanes crossing the hill slopes led to higher levels grown with brush and occasional groves of trees. The country people told me that I had brought spring, as the grass became green, fruit trees blossomed, and violets and other spring flowers appeared during the few days that I was there.

Trees in Spain are as much a crop as grass, and impress one as having a hard and cheerless life. The forests in the Cantabrians are principally of oak and chestnut, growing to a diameter of four to six feet, there being no native pine in this range of mountains. The tops

FIG. 39.—Estación Alpina de Biologia in the Sierra de Guadarrama.

FIG. 40.—Near Puente de los Fierros. Note pollarded trees.

and larger limbs are cut off 20 to 30 feet from the ground, leaving the huge trunks grotesquely gnarled and twisted to stand in irrregular array, a hobgoblin woodland that often appears dark and gloomy with little animal life in evidence. When new shoots grow from the pollarded trunks these are cut at intervals of a few years until with the passing of time decay creeps in through these repeated wounds, the tree trunk gives up the uneven battle with man, and is finally cut down and made into fire wood. Extensive forests are distant from the towns and in the better settled regions are of little area.

Travel along the numerous footpaths at Fierros ordinarily was not difficult, except that one was continually climbing or descending, but the intervening slopes were steep and high so that collecting specimens was attended with considerable labor. The higher slopes had huge exposures of massive rock while far beyond were peaks covered with snow. Trees and bushes along the rushing streams of the lower valleys were half in leaf but a thousand feet above on exposed slopes the winds blew chill and buds were barely opening.

Small birds were common, particularly in the shrubbery along the lower footpaths. The wren, a counterpart of our winter wren, sang gaily from tangles of weeds and brush, searching for holes in which to place its nest. The chiff-chaff, an Old World warbler of tiny size, sang its insistent song from low trees while hunting busily for insects in company with the black-cap, a larger species of the same family, with more musical song and quieter movements. The meadow bunting, a sparrow with gray and black streaked head, was found in pairs through the open pastures, and on occasion I found its more brilliant relative, the yellow-hammer. Both are like our crowned sparrows in habit. Titmice were found in profusion ranging from the delicately colored blue tit to the slender bodied long-tailed tit, five species ranging through the same thickets and woodlands.

Boarding the *Mixto* one morning—a train that carried both passengers and freight—I arrived within a short time at the little village of Busdongo on the northern side of the Pajáres Pass at an elevation of about 4,300 feet with the summit of the pass a few hundred feet above. In the valleys here were little squares of cultivated fields and pastures separated by rock fences, and above, slopes covered with green grass or mats of heather and gorse. Banks of snow lay everywhere, their melting feeding the little streams, and the higher hills were entirely white except where naked rock projected in rough, angular spires and massive blocks of cold, blue-gray stone. Flowers dotted the meadows, clear bird notes and songs came to the ear, and over all

FIG. 41.—The mountain village of Busdongo.

FIG. 42.—The Pajáres Pass above Busdongo, one of the principal thoroughfares through the Cantabrian Mountains.

FIG. 43.—Valley of the Río Esla below Riaño.

FIG. 44.—A channel of the Esla in the village of Riaño.

lay a golden sunshine bathing the world with a warm light that mitigated the chill of breezes blowing over the snowbanks. Pajáres Pass, the frontier of the ancient kingdom of Asturias from which I had just come, was a sharply cut dividing line between the better watered brush- and tree-grown slopes descending steeply to the northern coastal plain toward Oviedo, and the more arid gradual decline toward the broad plains of León on the north with scattered mats of low brush as the principal woody vegetation.

In this world of open mountain slopes and meadows, birds were abundant. Chaffinches, pipits, and yellow-hammers were everywhere. Whin-chats and stone-chats were common, and skylarks sang above the higher meadows, appearing as tiny specks hovering high against a sky of the clearest blue. Wheat-ears followed stone fences or rocky ledges, and white wagtails were found along the rough stream beds. The latter, called locally *lavanderas* (washerwomen) because like the native laundresses they had their principal activities along the streams, on alighting after a short flight twitched their long tails rapidly a dozen times and then stood motionless. On the rocky slopes above were found occasional rock thrushes singing clearly from open ledges, and approached only by arduous climbing. With them were alpine accentors, cousins of the little hedge sparrows that abounded in the matted brush above the valleys. One morning among the higher ridges a curious birdcall came for a time without visible source, until finally I located a black shadow moving along the mountain slope far below and, tracing it to its source toward the sun, saw a crowlike bird sweeping in bounds and circles over the mountain ridges. The binoculars revealed the curved red bill of a chough, and I watched its graceful evolutions for some time with keen delight.

The heat of the city of León in the lowlands was almost oppressive after the sharper air of the mountains, and after a day during which I visited the cathedral, with jackdaws and merlins flying about its huge tower, I was pleased to continue by auto to Cistierna and from there to the inland village of Riaño located in an open valley among mountains at an elevation of 3,500 feet. The little fonda where I obtained quarters was clean and comfortable, the people of the village were friendly, and the weather was pleasant; and I was told again that spring had arrived in my company. Buds were already opening on the trees near the village, and during the next two weeks leaves grew apace until the lower slopes were entirely green and buds were bursting on the trees at the upper edge of the forests.

At Riaño the Esla and Yuso rivers joined in a large stream abounding in trout. The open valleys were cultivated, while the slopes of the

FIG. 45.—Beech forest near the summit of the Collado de Tergüeña.

FIG. 46.—A storehouse for grain in Riaño. Note the flat stones at the corners to prevent entry of rats.

hills were given to the grazing of herds of sheep, goats, and cattle. On many of the lower slopes were extensive forests of oak, beech, and chestnut, while above were open meadows dotted with low mats of gorse, and beyond, bare, rocky peaks rising to an elevation of 6,000

FIG. 47.—Stork's nest on a church tower near Riaño.

feet or more. As in other sections in northern Spain the people lived clustered in little towns and villages, where their houses of stone with roofs of tile and slate huddled closely together. Daily men and women went out to tend their flocks or work their fields so that there were few country habitations.

FIG. 48.—View in the village of Riaño.

FIG. 49.—View down the valley below the Ponton Pass in the Sierra del Ponton.

In the village, storks built huge nests in poplar trees, with one on the tower of a little church, wagtails nested under loose tiles in the roofs, and chaffinches and bright colored linnets chattered gaily. Northward migration among the smaller birds was in full course so that daily there were new arrivals. The song of the cuckoo—of which the striking of the cuckoo clock is so exact an imitation—was heard through the hills, with the rolling calls of the green woodpecker and the harsh notes of jays that inhabited the scrub and seldom came into the open.

As days passed excursions were made steadily farther afield. Below the pass known as the Collado de Tergüeña was a fine forest of beech with the trees so heavily hung with moss that small birds were seen among the branches with difficulty. In the Sierra de Ormas was a great woodland of oak and chestnut as yet largely untouched by the ax of the woodchopper. From the snow-covered slopes above there was a wonderful view across wild, uninhabited mountain country in which wolves, wild boars, and bears were reputed to range. From the more distant Sierra del Ponton I had a view of the jagged Picos de Europa, the highest points in the Cantabrian Range, inaccessible however until later in the season because of the depth of snow in the intervening mountain passes. Work here was finally concluded because of the necessities of a schedule including other duties, though another month might have been profitably spent in this area.

From Riaño I continued by motor to Cangas de Onis toward the north, passing through a remarkably deep and narrow defile, cut in places to a depth of more than 1,500 feet, at times with barely room for a stream and the auto road at the bottom, with cliffs rising precipitously on either hand. Field work was at an end; the interesting collections of specimens included a number of local races of birds new to the collections of the National Museum, where the birds of Spain had been previously almost unrepresented, and I came finally to Santander and the French frontier with the hope that some future journey might let me see more of the pleasant lands of Spain.

THE CRUISE OF THE *ESPERANZA* TO HAITI

By ALEXANDER WETMORE,
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AND

WATSON M. PERRYGO
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The Parish-Smithsonian Expedition to Haiti, organized by the late Lee H. Parish, with the financial assistance and cooperation of his father S. W. Parish, left Miami, Florida, in the 80-foot ketch-rigged auxiliary yacht *Esperanza,* on February 15, 1930. In addition to the two mentioned the party included Mrs. S. W. Parish, who assisted in radio communication, in photography, and in other ways, and Watson M. Perrygo of the staff of taxidermists of the United States National Museum. Lee Parish served as captain and navigator and head of the party, and in addition assisted his father and Perrygo in collecting specimens, being indefatigable in his efforts to promote the success of the work. The work of the expedition was concerned with the collection of zoological material, particularly of birds and reptiles. The *Esperanza,* thoroughly seaworthy, offered an exceptional opportunity for work on islands lying off the Haitian coast, and it was to these little-worked areas that the major part of the time in the field was directed.

The route to Haiti led along the north coast of Cuba with stops for the collection of specimens at Gibara, Port Tanamo, and finally at Baracoa. The first specimen of the expedition was a migrant Maryland yellowthroat obtained as the *Esperanza* passed near Bimini in the Bahamas. Numerous birds were obtained at Gibara, and in the better watered region about Port Tanamo, with its dense forests, collecting continued apace. Cayo Grande de Moa and the Moa and Fabrico River were fruitful spots. Birds abounded, with trogons, parrots, todies, and others of brilliant plumage giving a touch of color to the daily bags of the collectors.

On March 9 after a delightful trip through waters where imagination might picture the passage of pirate ships and Spanish galleons of earlier days, the *Esperanza* anchored in the harbor of the quaint tropical town of Baracoa. Bananas and cocoa-beans are the two chief products here and the plantations from which they come are well worth seeing. The party again set sail two nights later by the light

FIG. 50.—The *Esperanza* under sail.

FIG. 51.—The rocky shore of Petite Gonave Island.

of a tropical moon, passed into the Windward Passage between Cuba and Haiti, and then on March 13 anchored in the harbor at Port-au-Prince.

After obtaining the necessary permits for scientific collecting through the kind offices of Gen. J. H. Russell, American High Commissioner, and others, the *Esperanza* with Col. and Mrs. Coyle and Lieut. Wirkus added to the party, crossed to Gonave Island, working first at Petite Gonave, where the anchor was dropped in crystal clear water in which schools of brilliantly colored fish swam among beautiful coral formations.

Petite Gonave, east of La Gonave Island, has an area of approximately 15 acres, most of which is of a very sharply eroded limestone formation, with the center a mangrove swamp. Dozens of rhinoceros iguanas sunned themselves on the rocks, and when approached bobbed their heads up and down, swelling their throats like the *Anolis* before disappearing clumsily in the crevices of the rocks.

Gonave Island proper, more than 30 miles long and from 7 to 8 miles wide at the widest point, in general is arid and open, rising in hills like those of Haiti opposite. Collections were made at the western end and at Anse-à-Galets, the headquarters of the Gendarmerie for the island. Native dances executed to the barbaric rhythm of wooden drums with heads of hide stretched while green, and the weird and mournful accompaniment of bamboo flutes added to the interest of the work.

On March 23 the party returned to Port-au-Prince for supplies and then, reduced to the original personnel, sailed for the Cayemite Islands on the northern coast of the southern peninsula.

En route they anchored for a time in Baradères Bay. After showing credentials to the chief of the section at Grand Boucan, the collectors crossed Baradères Bay in one of the small boats to Mapou to explore two caves for extinct animal bones. The first one was small and very dry, and several tests there produced nothing. A barn owl was shot, and on a shelf some human remains were found. The other proved to be equally barren; it was a deep cave with water seeping through the ceiling, the moisture destroying any bones that might have been preserved there. Many birds were seen in the banana, cocoanut, and mango trees.

An expedition on horseback up the fertile valley of Petite Trou de Nippes, grown with royal and cocoanut palms, high bush cotton, bananas and coffee, with the chief of the section as guide led to another very large cave containing a pool of crystal-clear water, which was said to have been used by natives as a place of worship. Birds,

FIG. 52.—View on the Baradères River.

FIG. 53.—A group on Grande Cayemite Island.

reptiles, and mollusks were collected, and the natives captured 100 live lizards for exhibition in the National Zoological Park in Washington.

Grand Cayemite, the next stop, is a rather large island, rough and rocky, with large patches of Madame Michel grass. Parrots and white-winged doves were abundant. More detailed work was done on Petite Cayemite, little or no collecting having been done there previously. Petite Cayemite is a small island of roughly eroded limestone covered with Madame Michel grass, which grows densely in some sections. Travel was difficult, but the collectors were persistent, securing excellent series of birds and reptiles, with some fine specimens of fish and crustaceans.

On April 19 the *Esperanza* left for Île à Vache, stopping for mail at Jérémie, an old French town, and then sailed west along the coast to Dame Marie. A rough sea forced the yacht to anchor for two days in Bigie Bay, a small indentation on the extreme western end of the peninsula. Fish, crustaceans, and other aquatic creatures were collected at night by lowering a light over the side of the boat, attracting hundreds to the surface where they were easily secured with a net.

After a brief lay-over at Aux Cayes for supplies, the *Esperanza* anchored in Feret Bay, Île à Vache Island, on April 27. This island is approximately 8 miles long and 4 miles wide. Feret Bay is on the west end, surrounded by sandy beaches, behind which large cocoanut palms, cashew, and mango trees grow. The natives as a whole are much healthier looking than the average Haitian of other regions and are well-to-do through their crops of bananas, sugar cane, and sweet potatoes as well as their cattle. Crocodiles were obtained from one of the two lagoons on the western end of the island; lizards, boas and vine snakes were very common; and over one hundred birds were obtained. The island had previously been unknown zoologically.

Returning to Bigie Bay, under favorable weather conditions, the *Esperanza* sailed 30 miles west to Navassa, an island seldom visited by naturalists, or for that matter by others, except for the lighthouse tender that comes to it periodically. Navassa is a rocky mass about 1½ miles long, a 20-foot cliff around its entire shoreline making it inaccessible except in Lulu Bay, a small indentation in the rocky wall where there is a steel ladder leading down to the water. Because it is exposed to the open sea, this little bay is unsafe for ships except in the quiet seas of the early morning. The *Esperanza* anchored there in the calm of the morning of May 10. The island itself is uninhabited, and is covered with low trees and thorny bushes. The rough, eroded

FIG. 54.—Native hut in picturesque surroundings at Petit Trou des Nippes.

FIG. 55.—Crocodiles from the lagoon on Île à Vache.

FIG. 56.—A shark on board ship.

FIG. 57.—The *Esperanza* at anchor off Navassa Island.

surface rock makes travel extremely difficult. Multitudes of red-footed boobies and frigate birds nested and roosted everywhere, and doves and a vireo were the common land birds. Lizards abounded, and black marine iguanas were reported but were not found. A very fair collection was made in the few hours that it was possible to remain, though the blazing sun over the dry scrub nearly prostrated the collectors.

On the return to Port-au-Prince a second stop was made at Petite Gonave to secure living iguanas for the National Zoological Park. The native fishermen who live there are very much afraid of these great lizards, but said that they could be captured by putting rum in hollows in the rocks where the iguanas would drink it, making it an easy matter to catch and handle them. The six obtained however were captured by hand, the dangerous attributes of these animals being wholly imaginary.

The *Esperanza* sailed from Port-au-Prince for Miami on May 24, leaving Mr. Perrygo to return a few days later on the steamer *Ancon* to New York.

In its objective of collecting specimens on remote islands little known zoologically the expedition was singularly successful, the many specimens obtained, particularly of birds and reptiles, forming a valuable addition to the Haitian collections of the United States National Museum. The birds will be the subject of a special report, and the notes on the reptiles will be included in a complete account of the herpetology of this region. The success of the work was due largely to Mr. Lee H. Parish, who was responsible for the organization and plan, and whose skill as a navigator, and resourcefulness under the trying conditions of this type of travel in waters remote from facilities and assistance, made possible the itinerary followed. He assisted constantly in the zoological work, both in collecting and preparation, in addition to his other duties. His untimely death a few months after the close of the trip, on the eve of development of plans for further work of a similar nature, is mourned by his many friends.

BIOLOGICAL COLLECTING ON "TIN-CAN ISLAND"

By HENRY C. KELLERS,
United States Navy

Niuafoou Island in the Toga Archipelago, nicknamed "Tin-Can Island" for reasons explained later, the last independent kingdom in the South Seas, was the site selected for the operations of the 1930 United States Naval Observatory Eclipse Expedition. Through the courtesy of the Naval Observatory and the friendly cooperation of the Navy Department, I was again detailed to act as representative of the Smithsonian Institution for the purpose of making biological collections. The expedition left San Francisco July 31 and arrived at Tutuila, American Samoa, August 13. We remained at Samoa four days while the *U. S. S. Tanager* was loaded with the 60 tons of stores and scientific apparatus, and the 12,000 feet of lumber required in setting up the various cameras and astronomical instruments. Leaving Samoa August 18, we arrived off Niuafoou Island August 21. The shore is rocky, with lava benches backed by cliffs 70 to 100 feet high rising abruptly from the ocean. Landing on the lava rocks at the village of Angaha was a most difficult feat, but luck was with us, and the sea was calm for 48 hours, a very rare occurrence. All the equipment, including the tube of the Einstein camera which weighed 1100 pounds, was transferred from the small boats to the lava rocks with the assistance of the natives without accident. The equipment was then hauled up a steep trail to the top of the cliff 70 feet high and the camp site was located on the summit near the village of Angaha.

Niuafoou Island, pronounced New-ah-fo-oh, latitude 15° 33′ 52″ S., and longitude 175° 37′ 46″ W., was discovered by Captain Edwards in the British Naval vessel *Pandora,* August 3, 1791, and named by him Proby Island; it was afterwards named Good Hope Island by the Dutch navigator Schouten, and is still so designated on the hydrographic charts. The nickname "Tin-Can Island" was given to it from the unique method by which mail is delivered there. The mail steamer, which comes about every six weeks, throws the mail overboard in a sealed can and the natives swim out and tow it to the shore. The outgoing mail is carried out to the steamer by the swimmers, who hold it on poles above the water. Niuafoou Island, one of the Toga Archipelago, is the last independent kingdom in the South Seas, ruled over by Queen Salote Tabou and a parliament, foreign

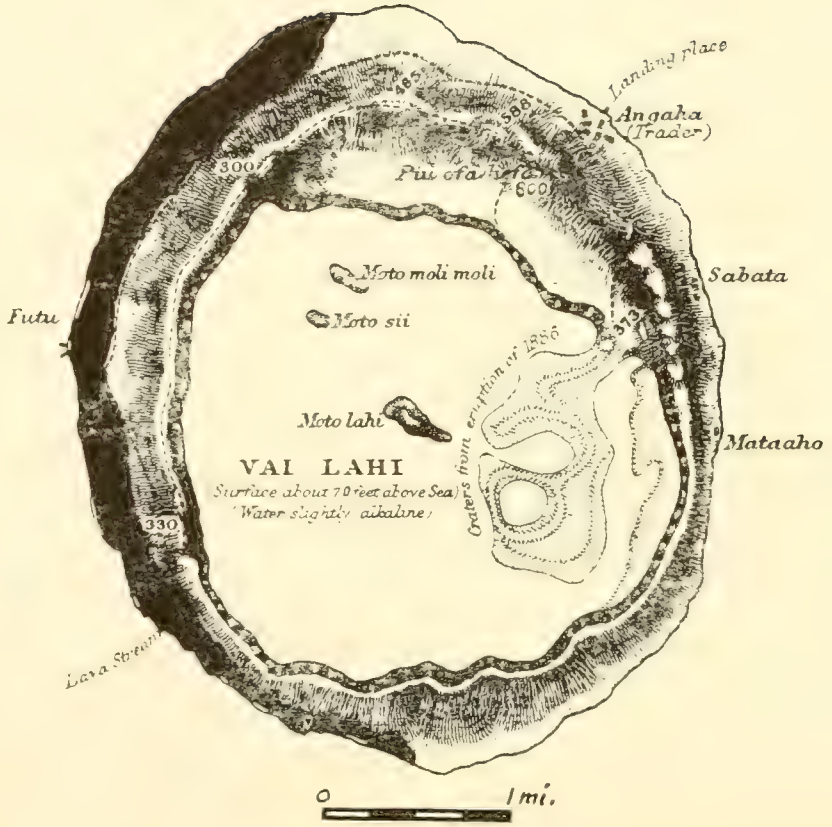

FIG. 58.—Chart of the island of Niuafoou, Toga Archipelago. The black area at left shows the extent of the lava flow of 1929.

FIG. 59.—Ceremonial dress of the men, made of tapa cloth and colored tissue paper. (Photograph by Kellers.)

affairs being looked after by the New Zealand Government under the mandate.

Niuafoou is one of the world's famous volcanoes. It is a crater island 4½ by 5 miles in size, inclosing a circular lake about 2 miles in diameter. The narrow circular ridge of land around the lake is 200 to 800 feet high, forming steep cliffs facing the lake. The lake has three small wooded islands in it, one of which contains two smaller crater lakes. The island is the peak of a volcano rising 6,500 feet from the ocean floor, which in that vicinity is formed by a flat shoulder of the Australian continent about 6,000 feet below the surface. Upon this the volcano rises as an immense cone 25 miles in diameter at the base.

FIG. 60.—General view of the astronomical camp, showing the 63-foot direct view camera, the 65-foot reflecting camera, and the Einstein double camera on the right. (Photograph by Kellers.)

The known eruptions occurred in 1853, 1886, 1912, and 1929. All started with the splitting of the mountain across its flank except that of 1886, which was in the old crater lake, explosive in type, and mostly of ash, forming sand hills and lagoons. These ash hills are being gradually covered with a dense growth of ironwood trees, the only trees that appear to grow and thrive in the volcanic ash of the island.

The 1929 eruption was on the western side of the island, the fissure system bursting open at 3 a. m., July 25, 1929, near the southwest corner of the island, and extending northward in a series of fissures until it nearly reached the shore at the northwest. The cracks were more than 3½ miles long, requiring several hours in opening the full length of the line of fracture. This delay gave the natives of the village of Futu time to escape to the ridge. The sick and the aged were

FIG. 61.—The S. S. *Tofua* of the Union Steamship Company, which passes the island every six weeks. The mail for the island is thrown overboard from the steamer in a sealed can. (Photograph by Kellers.)

FIG. 62.—Natives swimming in with the mail in the sealed can. Hence the popular name "Tin-Can Island." The swimmers use long poles as life preservers. (Photograph by George Finau.)

FIG. 63.—After the volcanic eruption of 1929 the walls of the Catholic Church is all that remains of the village of Futu, on the western shore of the island. The natives had a miraculous escape. (Photograph by Kellers.)

bundled up and many fled naked, a drizzling rain adding to their misery. Over all hung the pall of smoke from the oncoming fire at the south, the trade winds bringing the menacing odor of deadly sulphurous fumes. The Futu-ites got across the northern crack before it opened, but when it did open, what a flood of fiery lava poured down on the ill-fated village! Two-thirds of the village was completely wiped out by the lava, and at least ten lava flows reached the sea along a three-mile front. The chasms are 30 feet across where the lava came in greatest volume. Cocoanut trees by thousands were molded in lava casing, some of which were measured and found to be 13 feet high. They stand now in groves of rocky sentinels, the largest field of tree molds anywhere in the world. The eruption lasted until 10 a. m. on that day, and many of the fissures are still smoking and giving off sulphurous fumes. Fortunately, no lives were lost, and the natives of Futu have now settled near the village of Angaha.

As soon as we were settled in camp intensive collecting began. Using the lure of candy, chewing gum, and bead necklaces, I soon had all of the children and many of the grown folks of the island working for me as collectors, and numerous specimens of crustacea, shells, lizards, and insects were brought in that I could not otherwise have obtained in the eight weeks allowed for collecting. Owing to the rough and rugged coast line, only three outrigger canoes were used about the island, and consequently the natives do very little fishing. The large seine I had with me was a curiosity to them, and as no beaches suitable for hauling it were found, it could not be used.

When the native does go fishing he uses a large pole called Vaca-Kauhaga, which has two small pieces of wood lashed to the sides at the end, on which the catch of fish is strung. The native dives into the ocean with the pole, swims out for some distance and rests on the pole, fishing with a hand line often for hours at a time. The natives are good swimmers and divers; one boy was adept in diving and picking starfish off the rocks in water four and five fathoms deep. Each time he emerged with a number of specimens he was rewarded with a corncob pipe and tobacco, which meant as much to him as the starfish did to me.

Dragonflies were very numerous, and many were collected. Only one kind of butterfly—a world-wide species, *Anosia plexippus*—was seen, and several were collected. All the birds, 20 in number, noted by Hübner in 1876, were seen except *Puffinus obscurus*, a dusty shearwater, and all but two were collected.

A large series of the interesting Megapod was obtained. This genus contains many species; the one found on this island is known as

FIG. 64.—One of the fumaroles still smoking from the 1929 eruption. The lava on cooling takes on fantastic shapes; the large mass to the left appears to have had the face of "Santa Claus" carved in it. (Photograph by Kellers.)

FIG. 65.—Doctor Kellers examining a morning catch of fish. Strange as it may seem, these South Sea Islanders are not expert fishermen. (Photograph by T. A. Jaggar, Jr.)

FIG. 66.—Digging for the eggs of the "Melau." Upper, a nest has been discovered by the scratchings of the bird on the side of the hill. Middle, going down head foremost. Lower, the boy has found the egg, and all are rewarded with cigarettes. The lad with the white hat is the son of the trader and my able assistant on collecting trips. (Photograph by Kellers.)

Megapodius pritchardi, and is among the smallest of the genus but lays a very large egg. The average measurements of the bird are: length 304 mm., circumference 228 mm., and spread of wings 609 mm. The average measurements of the light buff-colored egg are: long diameter 76 mm., short diameter 45 mm. The bird lays its egg in the ash hills of the 1886 eruption on the western side of the lake shore. It then buries the egg 1 to 2 meters deep in the ash and fills up the hole all the way to the surface. The temperature of the ash at the spot where the egg is laid is 98.1° F.; this heat is not connected with the heat of the volcano, but is rather a Dutch-oven effect. When the chick is hatched it scratches its way out of the ash and is ready to begin life's battles. I could not find any evidence of the male bird tending the young chicks, as is usual with this genus in Australia and the Philippines.

The most important product of the soil is the cocoanut. The island is a veritable paradise for cocoanut palms, for they have never been attacked by the rhinoceros beetle, *Oryctes rhinocerae,* the scourge of the South Sea Islands. It is one of the few islands in the Pacific free of that pest, probably because of its isolated position and consequent lack of communication with other islands. The trees here grow very tall, the roots forming a dense network extending out in all directions for many feet, enabling them to withstand the intense trade winds. This tree gives the natives shelter and food; it also furnishes a welcome substitute for drinking water, as there is no fresh water on the island except the rain water that is caught in small tanks, which is quickly used up in the dry season. The water of the green cocoanuts is therefore the natives' only beverage, and on the warmest days it is found to be cool and a very refreshing and wholesome drink. The extensive use of cocoanuts for domestic purposes by the natives does not seem to decrease the crop to any extent, for copra (the meat of the ripe cocoanut) is the one and only export from the island.

There is evidence that the western side of the island is rising. The western shore of the lake shows an uplift and the lava is covered with lime deposits in the shape of large blisters, probably formed by blue-green algae. Under these blisters were found numerous small crabs of the genus *Metasesarma.* Tow-net hauls were made from time to time in the lake with good results, one of the interesting specimens thus collected being a small shrimp of the genus *Caridina,* but no fish were found in the lake The water is no doubt accumulated rain water, and its alkalinity is due to the volcanic gases bubbling up from below. Five small sulphur lakes are located on the southern end of the island near the crater lake, one a bubbling lake giving off sulphuretted hydrogen gas, the temperature of which was 98° F. Samples of water from all the lakes and craters were collected and brought back for analysis.

FIG. 67.—A buxom Niuafoouite maiden combing her lustrous black hair. (Photograph by Kellers.)

FIG. 68.—Natives roofing a house with the fronds of the cocoanut palm. Very little sugar cane, the leaves of which are generally used by the South Sea Islanders as thatch, is grown on Niaufoou. (Photograph by Kellers.)

The natives are true Polynesians, light reddish-brown in color, well formed, erect in bearing, and handsome in features. The women in early womanhood have beautiful figures, but like all native women of the tropics, they soon lose them as they grow older. Their eyes are dark, with an expression of gentleness. They do not like to work, their wants are few, and little clothing is worn, although foreign clothing adapted to the climate is being worn more and more by both the men and the women. The men consider it undignified to appear without a shirt or coat, and always wear them on ceremonial occasions.

The natives are expert weavers of rough baskets, taking from three to five minutes according to size to weave a basket out of the frond of a cocoanut palm. They are also adept in making fire by the primitive method of rubbing two sticks of wood together, 30 seconds being the time required to perform the feat.

The natives were friendly, hospitable, and curious; they were in and around the camp at all hours of the day or night, except when attending one of the missionary churches, where they sang interminable hymns with much gusto, but very pleasing harmony. They were at all times quiet, dignified, and extremely interested in all the eclipse activities, and they had offered many prayers for our success. A few of the "Doubting Thomases" wagered a pig against a shirt with the son of one of the traders that nothing would happen and that the sun would not be darkened, so that the young lad now owns more than his share of pork, which, next to roast dog, is their favorite food. Among other good qualities, these natives are absolutely honest and extremely virtuous.

Towards the end of our stay on the island they brought in presents of many fine grass mats—Falas—and Tapa cloths. Finally on the morning of our departure, at least half of the population of the island including the High Chief Fotofili, his son-in-law and future successor, and the Magistrate, with their families, were down to bid us farewell. They all expressed genuine regret and many sincere Tofas (goodbyes) at our departure, and were particular to inform us through the trader interpreter how much they had enjoyed having our party honor Niuafoou with such a noteworthy visit.

The collections which have been forwarded to the National Museum as its share of the results of this expedition include 100 bird skins and over 7,000 alcoholic specimens of various kinds, as well as numerous geologic specimens, stalactites of lava, lava tree molds, and water samples from the alkaline and sulphur lakes on the island.

EXPLORATIONS OF THE REV. DAVID C. GRAHAM IN SZECHUAN, CHINA

By HERBERT FRIEDMANN,
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The Rev. David C. Graham has continued his missionary work in the province of Szechuan, western China, during the past year, and as usual has utilized his spare time in collecting for the Smithsonian Institution. Although no outstanding trip was made during the year, much material of value was gathered at or near Graham's station at Suifu, all of which supplements previous collections from that area. During the year something over 62,000 specimens were received by the National Museum. Dr. Graham has also made plans and already taken care of the advance details for two trips of importance which he hopes to be able to realize next year—one to eastern Tibet, and the other to Tatsienlu.

Just as last year the excessive rains made the journey to Moupin unusually arduous, so in the beginning of this year a prolonged general drought made collecting rather disappointing for a while at Suifu, and it was not until later in the year that rains began to fall and conditions were much improved. The drought caused a general scarcity of insects and other forms, and this scarcity considerably increased the effort involved in making collections.

As in previous years, the hordes of bandits and robbers have been the greatest obstacles to travel and collecting. Thus, Graham writes in his diary on August 24, ". . . . we took a boat from Suifu to San Kuang, crossed overland at San Kuang, and went sixty li up the San Kuang River to Yo Keo. We could have gone farther, but there is a place between Yo Keo and Sa Ho where robbers constantly appear. . . . ."

That robbers are not the only source of annoyance is evidenced by the following entry on September 4. " When we were coming down the high mountain towards Tsanglinshien, I noticed that there was no one else on that road either going or coming. After reaching this city I learned that both leopards and robbers are fierce at the top of the high mountain between here and Tseo-Jia-Geo. Leopards were fiercer and more common over a wide territory than they have been known to be before, and probably hundreds are killed every year

FIG. 69.—Village beside a river and boats in Szechuan Province, China. (Photograph by D. C. Graham.)

FIG. 70.—A memorial tablet saying that when a certain good man inhabited a place generally infested by demons who bring bad luck, it became lucky because of his goodness and the good man prospered. This memorial arch is one of the simplest type. The most elaborate has three sets of uprights or pillars. (Photograph by D. C. Graham.)

FIG. 71.—Artificial hill or mound near Chengtu, Szechuan, China, said to have been erected 700 B. C. as the burial mounds of an aborigine king and his queen. (Photograph by D. C. Graham.)

FIG. 72.—The new modernized streets of Suifu, Szechuan, China. No automobiles or horse carriages or street cars bump into the pedestrians. (Photograph by D. C. Graham.)

in the country south of Suifu, called the Lan Lut Shien District." The country around Tsanglinshien is described by Graham as a beautiful district with high mountains, perpendicular limestone cliffs, and great forests. Coal, iron, and sulphur occur plentifully and all are being mined, although by crude methods. A phase of natural-history collecting in out-of-the-way places that probably would not occur to anyone not familiar with such work is hinted at in the following notes jotted down by Graham on September 3 at Tseo-Jia-Geo. "One of

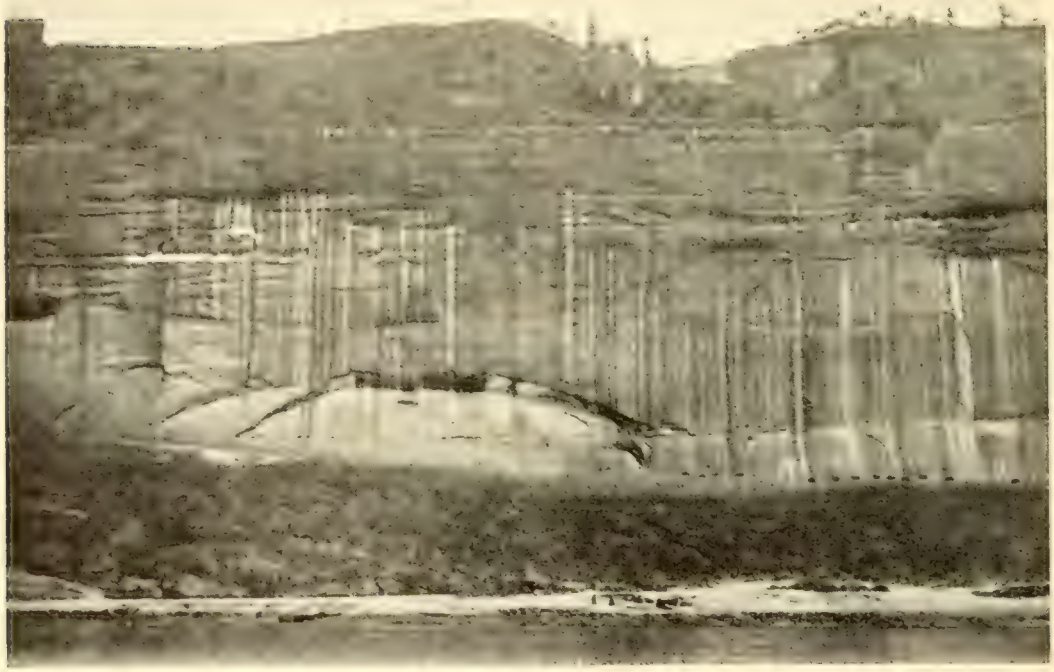

FIG. 73.—A famous cliff, called by some foreigners "The Ribbon Counter," on the north side of the Min River, about 60 li above Suifu. (Photograph by D. C. Graham.)

the most trying experiences to a foreigner in West China, when travelling, comes from the fact that a foreigner expects and loves privacy when sleeping, studying, and working. It is nearly impossible to get privacy in Chinese homes (as a guest) and in Chinese inns. The Chinese have little conception of it. You try to work in a Chinese inn, and the first thing you know the room is packed, and crowds are peeking through the cracks and looking through the windows."

The great bulk of the collections sent in this year is made up of fine series of insects of all orders. Among these are many species new

FIG. 75. A worshipper of Tibet using a hand-turned "prayer wheel" in his religious devotions. This is not really prayings. On paper inclosed in the wheel, portions of the Buddhist Scriptures are written. Every time he turns this wheel around once, he has the merit of reading all the Scriptures written therein once. This gives him favor with the gods and protection from demons. (Photograph by D. C. Graham, near Yin Kuan Tsai.)

FIG. 74.—Chinese coolie carrying tea from Yachow to Tibet. (Photograph by D. C. Graham.)

to the National Museum and others new to science. The best results of this year's explorations and collections are undoubtedly in the field of entomology. Other groups, both of vertebrate and of invertebrate animals, are also represented, as well as a number of interesting and important ethnological objects, such as rock carvings, vases, etc.

ANCIENT RELATIVES OF LIVING WHALES

By REMINGTON KELLOGG
Assistant Curator, Division of Mammals, U. S. National Museum

Nearly one hundred years have elapsed since the attention of the readers of the Transactions of the American Philosophical Society was directed to the finding of an extinct relative of living whales in a marl bank within the present boundaries of the State of Louisiana. In the ensuing years numerous dissertations have been written in regard to this animal and yet many details of its bodily construction remained unknown. Notwithstanding the rather wide distribution of deposits in which such fossil remains occur, there still exists a surprising scarcity of material suitable for critical study of the peculiarities of this animal. In connection with a general interpretation of the geological history of the cetaceans, an effort has been made to augment available evidence by further field work in areas that gave some promise of increasing our knowledge of these animals. Accordingly plans were made for a visit to one of these fossil bearing deposits and on October 2, 1929, the writer and Mr. Norman H. Boss left Washington for Alabama under the joint auspices of the Carnegie Institution of Washington and the Smithsonian Institution.

The Jackson formation of the Gulf Coastal Plain, which consists of calcareous fossiliferous sands and clays of marine origin, outcrops in eastern Texas in the region between Trinity and Sabine Rivers, and also extends eastward across central Louisiana, Mississippi, and Alabama. This formation extends up the Mississippi embayment to near Forrest City in St. Francis County, Arkansas. In northern Louisiana the Jackson formation is concealed over a large area by swamp deposits, but crops out in southern Caldwell Parish. It was in this parish that Judge H. Bree in 1832 found a partial skeleton of an at that time unknown colossal animal. Some 28 vertebrae were exposed by the slump of a hill near the Ouachita River after long continued rains. One of these vertebrae was sent to Dr. Richard Harlan at Philadelphia who hastened to publish an account of the discovery. On account of its supposed reptilian affinities, Harlan proposed to call this animal the king of lizards, *Basilosaurus*. The supposed affinities of *Basilosaurus* immediately aroused a world wide controversy. It was not until January, 1839, when Dr. Harlan arrived in London, England, with additional fossil remains which had been found on the plantation

FIG. 76.—Fossil bones of a gigantic zeuglodont, *Basilosaurus*, partially exposed in a prairie field.

FIG. 77.—A damaged head of the gigantic zeuglodont, *Basilosaurus*, was found on the hardened ledge in the background.

of Judge J. G. Creagh in Clark County, Alabama, in 1834 that the precise relationships of *Basilosaurus* were recognized. Included among the fossil bones that Dr. Harlan brought with him were teeth which Professor Richard Owen was permitted to section and study. On the basis of a microscopic examination of these teeth, Professor Owen was enabled to demonstrate conclusively the mammalian nature of the animal. Consequently, Owen proposed to substitute for *Basilosaurus* the name *Zeuglodon cetoides,* in allusion to the yoke-like appearance of the cheek teeth.

The next important discovery was made on the plantation of Judge Creagh in Clark County, Alabama, in 1842 by Mr. S. B. Buckley, who excavated a skeleton of *Basilosaurus* that consisted of portions of the head and of the fore limbs, and a vertebral column extending to a length of 65 feet. These remains were shipped to the office of the Geological Survey of New York at Albany where they were studied and described by Ebenezer Emmons. The subsequent history of this particular specimen is somewhat interesting in that some time later it passed into the possession of the Warren Museum at Boston. In time the Warren Museum passed out of existence and some years past this skeleton along with other vertebrate fossils was purchased by the American Museum of Natural History in New York City.

The interest aroused by these discoveries induced Dr. Albert Koch, a German collector, to visit Alabama. Koch arrived at Claiborne, Alabama, in January, 1845, and after a brief reconnaissance in that vicinity moved his headquarters three weeks later to Clarksville. He was not entirely successful there, although portions of a zeuglodont were found nearby. While at Clarksville, however, Koch received the news that remains of this animal were rather plentiful near the Old Court House in Washington County. Arriving at the Old Court House on March 16, 1845, Koch immediately commenced excavating a skeleton that was found in the same neighborhood. Several wagon loads of bones were assembled at Washington Old Court House, from which Koch reconstructed an animal measuring 114 feet in length, but composed of five or more individuals. This composite skeleton of *Basilosaurus* was exhibited for some weeks as a sea serpent in the Apollo Rooms on Broadway in New York City.

Later on this skeleton was shipped to Germany and exhibited in the principal cities of Europe. The King of Prussia having purchased this skeleton for the Anatomical Museum in Berlin, Dr. Koch with the proceeds of the sale was enabled to visit Alabama again in 1848 and to resume his search for zeuglodont remains. A second skeleton was assembled in the vicinity of Washington Old Court House and

shipped to Dresden where the work of preparation for exhibition was begun. This zeuglodont was exhibited for some weeks at Vienna, Austria, and later, although the exact details are unknown, it was sold to the Chicago Academy of Sciences where it remained until destroyed during the Chicago fire of 1875.

These discoveries and current stories in regard to the unusual abundance of remains of zeuglodonts in the Gulf states led the United States National Museum in 1894 to consider field work in this region. Accordingly Professor Charles Schuchert was detailed to investigate these occurrences and to collect if possible a specimen for the exhibition series. On arrival at Cocoa, Choctaw County, Alabama, on November 2, 1894, Schuchert began his search and within a short time successfully excavated the head of one individual and twenty-four consecutive vertebrae of another, beginning with the atlas and ending with the third lumbar vertebra, in addition to the ribs and the major elements of the fore limbs. This material formed the basis for the restoration of the *Basilosaurus* skeleton exhibited at the Atlanta Exposition in 1895. Inasmuch as the assembled skeleton was incomplete, Schuchert again returned to Alabama and in November, 1896, found near Fail in Choctaw County the tail portion of another zeuglodont which consisted of thirty-five consecutive vertebrae counting from the penultimate one forward, as well as the pelvis and one vestigial thigh bone (femur). This material was prepared for exhibition in the laboratory of the United States National Museum and for some years this mounted skeleton has been on exhibition in the hall of fossil animals.

After a rather hasty trip through Clark County, Alabama, Mr. Boss and I arrived at Silas, where we began our paleontological exploration of the Jackson exposures in Choctaw and the adjoining Washington County. Inasmuch as we were unsuccessful in our search for well preserved specimens of zeuglodonts in this area, we departed for Melvin, also in Choctaw County. In that vicinity and under the guidance of Mr. Robert Land, we were shown the places where Schuchert had excavated the major portion of the material now in the United States National Museum.

Associated with the gigantic *Basilosaurus cetoides*, which attained a length of from 50 to 70 feet and whose skull measured approximately 5 feet from extremity of snout to back of braincase, was the little short bodied *Zygorhiza kochii*, which may have had a maximum length of from 12 to 15 feet. In the vicinity of Melvin and across the line in Clarke County, Mississippi, we were fortunate enough to

FIG. 78.—Typical view of Jackson exposures in a "washed-out" prairie field near Melvin, Alabama.

FIG. 79.—The head and neck of the little zeuglodont, *Zygorhiza,* was dug out of indurated elevation in the foreground.

locate an exceptionally well preserved skull and both lower jaws of one individual, and other portions of the skeleton of five additional individuals of the little zeuglodont, *Zygorhiza,* which was our chief objective on this trip. In many places remains of this little zeuglodont are almost as numerous as its larger relative. Among the contemporary inhabitants of the same coastal seas were a large aquatic snake and a large tortoise-like turtle. Fish vertebrae measuring two or more inches in diameter, teeth of sharks, and the curiously ridged rod-like beaks of an extinct sword fish (*Cylindracanthus ornatus*) are frequently noticed in the washes. An abundance of rounded shells of small sea-urchins (*Schizaster armiger* and *Macropneustes mortoni*), a small scallop (*Pecten perplanus*), a little oyster (*Ostrea falco*), with a thin shell fancied to resemble a hawk, and a large nautilus (*Aturia alabamensis*), the chambers of which are locally known as "goat's heads," occur in the "Zeuglodon" horizon.

The yellowish or gray marl, in which these zeuglodonts occur, is often hardened around the bones. From two to four hard ledges, a few inches in thickness and separated by layers of this marl, are also generally present in the "Zeuglodon" horizon. These ledges are quite resistent to the effects of erosion. Bones found in such ledges are generally difficult to extricate on account of the hardness of the matrix and the rather soft consistency of the bones themselves.

The typical outcrop of the Jackson formation is located near Jackson, Mississippi, from which locality it takes its name. The exposures of this formation in the prairie region of central Mississippi occupy an irregular belt that ranges in width from about 6 miles near the Alabama line in Clarke County to a maximum of more than 35 miles in the region west of Jackson. The total thickness of the basal member, consisting of quartz sand and glauconite, and the overlying clay member is approximately 150 feet in eastern Clarke County. This formation increases in depth in a westerly direction and attains a thickness of more than 600 feet in Yazoo County. Inasmuch as the "Zeuglodon" horizon is relatively thin and is situated near the base of the upper clay member, which attains a total thickness of 70 feet in Clarke County, one usually has to locate deeply eroded prairies to be successful in a search for this fossil-bearing horizon. Several skeletons of the gigantic *Basilosaurus* were located along the eastern border of Clarke County, but erosion and cultivation of the land had destroyed whatever value they may have originally possessed for paleontological study. Portions of two skeletons of the diminutive zeuglodont, *Zygorhiza,* were excavated in this area.

FIG. 80.—Restored skeleton of the gigantic zeuglodont, *Basilosaurus cetoides*, in the U. S. National Museum.

In central Alabama, the Jackson formation occupies the prairie region in Choctaw, Clark, Monroe, and Conecuh counties, but the exposures are often restricted to narrow belts by the overlapping of more recent formations. Although most of the territory, which was settled by the early pioneers, was at that time covered with coniferous and deciduous woods, there were small treeless tracts here and there which were called "prairies." These open spaces were the first to be farmed and upon them flourished fields of cotton, which were cultivated with the assistance of slaves. In time the natural fertility of the soil was greatly depleted and many of these prairie fields were allowed to revert to their natural condition. Others became impossible to cultivate because in plowing the furrows were thrown in such a way that the fields were subjected to severe erosion during long continued rains. Each drainage path in time became a deep gully and ultimately the field was so cut up that further cultivation was impossible. For years the destructive action of erosion has been allowed to continue without any serious effort being made to check its ravages until now many of these fields are criss-crossed in every direction by deep gullies. In some places the "Zeuglodon" horizon was so close to the surface that the skeletons were thrown out by the plow. These bones were gathered up by the negroes and dumped along the edges of the fields where occasionally they may now be found partially buried in the accumulated débris. Some twenty occurrences of remains of the gigantic zeuglodont that had been destroyed either by the plow or by erosion and weathering were observed in Choctaw County during the period of our visit. It is in these so-called "washed-out" prairie fields that one finds today numerous exposures of the "Zeuglodon" horizon. In such fields were found a number of more or less complete skeletons of the small zeuglodont, *Zygorhiza*, and various portions of the skeleton of the gigantic *Basilosaurus*. In one instance various fragments of a skeleton of *Zygorhiza* were found scattered along an abandoned logging road. This skeleton has been exposed by the iron-rimmed wheels of lumber trucks and subsequently destroyed by the same agency. At another place a skeleton of another individual lay in a cow-path where it had been trampled on for many years by the feet of innumerable cattle.

FURTHER EXPLORATIONS FOR MOLLUSKS IN THE WEST INDIES

By PAUL BARTSCH,
Curator, Division of Mollusks, U. S. National Museum

The granting of the Walter Rathbone Bacon Travelling Scholarship to me for the third year made it possible to explore some of the West Indian territory much in need of investigation. Two years ago this same scholarship made it possible to subject all the provinces of Cuba, except Oriente, to a close scrutiny for land mollusks. The three and one-half months spent in this island, which supports a greater land shell fauna than any other equivalent area in the world, yielded an enormous amount of material. The same grant made it possible to spend the summer of last year in an exploration of Porto Rico and the Lesser Antilles lying between this and the island of Trinidad, as well as the islands of Margarita, Orchilla and the Dutch West Indies lying off the coast of Venezuela. This year our efforts were focused on the southern Bahamas, the islands off the south coast of Cuba, and the Caymans.

After a futile attempt to obtain a suitable vessel in northern waters to take the expedition to the Bahamas, contracts were finally closed in Miami, Florida, for the use of the *Island Home*, a boat that seemed to meet our needs. The reason for again securing a vessel for this cruise was the fact that commercial transportation in the area to be visited was non-existent, for most of the territory to be explored consists of islands rarely visited by man. For this reason also, it became necessary to provide food for the trip at the outset. The large territory to be covered—some 2500 miles—made it desirable to secure sufficient assistants to reduce to a minimum the time spent upon each of the many islands visited. For this reason I tendered an invitation to Mr. Harold Chittick, one of my students at the George Washington University, and to two Washington Boy Scouts, Ray Greenfield, who accompanied me to Cuba two years ago, and Alva G. Nye, Jr.; also to Mr. Harold S. Peters of the Bureau of Entomology of the United States Department of Agriculture. To this staff were added the Captain of the *Island Home*, E. Roberts, and the engineer, B. E. Lowe.

The *Island Home* was a 33-ton vessel, flat bottomed, 59 feet in length, with a 21 foot beam, and a draft of 4½ feet, and provided with

FIG. 81.—Loading fuel oil on the *Island Home* at the Naval Station, Key West, Florida.

FIG. 82.—My scientific associates: right, Peters; next, Greenfield, Chittick, and Nye.

a 60 H. P. engine. Leaving Miami June 9, we reached Key West after a two-day interval in which engine trouble developed, which, combined with fueling, delayed our sailing for the Bahamas until June 16. Here should be mentioned the kind assistance rendered our expedition by the United States Navy Department. Not only were we permitted to draw fuel and other supplies needed, but the engine shop made the necessary repairs to our engine and rendered every possible assistance to have us adequately equipped for the cruise.

Leaving Key West June 16, we headed for the Cay Sal Bank, an irregular, pear-shaped submarine flat, a little more than 60 miles in length in a southeasterly and northwesterly direction. This bank is covered by a shallow sea, ranging from 3½ to 15 fathoms, and fringed by a chain of cays on all but the southern side. The bank, while only some 20 miles from the central portion of the north coast of Cuba, is, nevertheless, separated from that island by very deep water—the Nicholas Channel—ranging from 212 to 534 fathoms. This great depth does not bespeak land connections with Cuba. From Florida it is separated by some 50 miles of equally deep water, and since the whole bank slopes abruptly on all sides to great depth, the land molluscan fauna was looked for with considerable interest.

Each of the cays, beginning with Cay Sal on the southwestern edge of the bank and ending with Anguilla Cay, was explored, and the many interesting things thus obtained are now resting in the Museum, awaiting analysis. How little visited some of these cays are may be inferred from the fact that on one of the Damas Cays we found an elevated stake and curled about its base the white bleached bones of a man who had evidently been shipwrecked here and perished.

On June 24 we left the Cay Sal Bank and crossed the deep Santaren Channel to the Great Bahama Bank. The 25th and half of the 26th were spent sailing some 180 miles over an almost calm shallow sea, out of sight of land but with the glaringly white calcareous sand of the bottom constantly in view. Like the northern Bahama Bank, this reach appears almost devoid of life—at least visible life. We came to anchor at about 11 a. m. in the snug little harbor formed by islets, collectively known as Jamaica Cays.

From this date until the evening of July 3 we explored the cays which stretch in an open looped chain southeastward to Great Ragged Island. These islands, which mark the western limit of another deep, are all composed of elevated reef rock less than 100 feet in height, and vary in size from mere rock points to miles in extent. They are

very rugged and may be barren or covered in spots with a growth of *Sesuvium* or *Portulaca* or a dense, almost impenetrable, thicket of *Platopuntia* or other cacti.

Some of the larger cays, on the other hand, bear tangles of brush, or even what might be called trees, all of the vegetation, however, being of the drought-resistant type, save here and there where tangles of mangrove jut into shallow bays. On these cays the most conspicuous elements were the land mollusks of the genus *Cerion,* of which we gathered thousands, though these were by no means the only land mollusks of the region as evidenced by the collection now resting in the National Museum.

Early on July 4 we left our anchorage in the Great Ragged Island harbor and headed for Cay Verde. All along our course we had met with many breeding colonies of sea birds, but Cay Verde is the only cay boasting a breeding colony of Man-o'-War birds in the Bahamas. Dull skies, squalls and heavy seas constantly breaking over our decks, somewhat modified our looked-for celebration of the day. Our ship soon had the putty, which had been used to close the seams of the vessel in place of oakum, pounded out by the waves, and a call to man the pump was in order. To make a short story of the longest day of our cruise, I will say, simply, that the ship slipped entirely off the Columbus Bank upon which Cay Verde is located, and we failed to sight Cay Verde, but were greeted about 2 o'clock the next morning by the welcome faint flashes of Castle Island lighthouse.

The next two days were spent in an attempt to repair our ship, which was only in part successful, since we were unable to careen her on account of her flat bottom. From this time until August 11 we were forced to pump one hour out of every three, day and night, to keep the ship habitable, and even then the leaky decks soaked most of our belongings stored below.

July 5 to 15 we spent exploring the Crooked Island group, a triangular bank about 45 miles in a north and south direction, and 35 miles east and west. This bank consists of Castle, Aklin, Crooked, Fortune Islands, and the Fish Cays. Here again the sea drops immediately off shore to a great depth, in places to almost 3,000 fathoms.

The group is isolated from all the adjacent groups of islands by more than 1,000 fathoms. Some of its hills attain an elevation of 200 feet and habitats for our mollusks vary from bleak and barren sand spits to mangrove tangles, and from dense grass flats and brush land to small timber, as well as cultivated fields. The days spent here again proved worth while and very profitable.

FIG. 83.—Three stages in the development of Audubon's Shearwater (*Puffinus l'herminieri*) from the Cay Sal group, Bahamas.

July 16 we sailed for the Plana Islands from Jamaica Bay, Aklin Island, reaching our destination late in the afternoon. The evening of this day and the next day were spent collecting on the westernmost of the two cays. July 18 we attempted a landing on the eastern cay, being particularly anxious to do so because this cay appears to be the only one in all the Bahamas upon which *Hutias,* the large West Indian rodents are present, and we had been asked especially to secure a series of these for the National Museum. High seas and a very effective barrier reef frustrated all our attempts at landing, and as there are no residents on the Plana Islands who might have guided us through some narrow passage in the reef, we were compelled, very reluctantly, to forego an exploration of this island. The Plana Islands are also bounded by deep water.

We next headed for Mariguana Island, a large cay some 25 miles in length and 8 in its largest diameter, with a shallow flat at the eastern extremity. This cay rises to an elevation of 80 feet at Abraham's Hill, and presents all the varied habitats listed for the Crooked Island group. Here again we have deep sea on all sides immediately off shore. Mariguana and Booby Cay on its southern flat yielded many interesting mollusks, as well as a fine collection of birds, bats, and reptiles.

At the crack of dawn July 22 we headed for the Caicos Bank, crossing the long stretch of the Caicos Island passage with some apprehension, but we reached Malcolm Bay without mishap. From then until July 30 we explored the various cays bordering the Caicos Bank on the north and east side between Blue Hills and Cockburn Harbor. The Caicos Bank, like the other banks examined, rises abruptly from the sea, practically forming an atoll. It is some 72 miles in a southeast by northwestern direction, and about 58 miles in its widest east to west diameter. Its highest hill is said to be 280 feet. The same diversity of habitat mentioned for previous groups exists here, but in addition, at least one cay—Pine Cay—of the Fort George group, west of North Caicos, boasts a fine stand of pine. The group as a whole yielded a fine series of mollusks, as well as many other things.

July 30 we crossed the deep narrow channel known as Turk's Island passage, and from then until August 2 devoted our time to an exploration of the cays situated upon the Turk's Island Bank. The Turk's Island Bank is the easternmost bank of the Bahamas that has habitable land projecting above the sea. Most of its cays proved rich in mollusks. On the afternoon of the second of August we re-crossed the Turk's Island passage and explored the small cays at the southern

FIG. 84.—The *José Enrique* in Cuban waters.

FIG. 85.—The stern of the *José Enrique:* central figure Captain Andre de Leon and the rest his crew.

end of the southeast Caicos group. We then crossed the Caicos Bank and devoted August 3 and 4 to an exploration of the cays off the south coast of Providentiales and of West Caicos, all of which yielded rich collections. August 5 we crossed the deep channel between west Caicos and Little Inagua, and the remainder of this day and part of the next were spent in a search for the mollusks which it harbors.

On the afternoon of August 6 we headed for Great Inagua Island, which is by far the largest of the southern Bahamas. It has a length of almost 45 miles in a southwest by a northwesterly direction, and a north by south width of about 18 miles in its largest diameter. In reality it is another atoll which has emerged from the sea. Its highest hill is said to be 132 feet. Its shores slope precipitously into the great depths of the sea on all sides. This island, as its wonderful molluscan fauna indicates, in reality represents a host of cays fused by elevation. We explored not only the ocean rim in our boat, but also the interior of the island, in a Ford truck. Inagua proved by far the richest of all the Bahamas in diversity of molluscan fauna.

The barometer indicating fine weather, we put to sea at 4 p. m. on August 10 from Matthewstown for our naval station at Guantanamo, southeastern Cuba, a distance of some 120 miles. We selected a night run for its calmer sea. Favorable winds enabled us to sight the Cape Macy light in eastern Cuba a little after 10 o'clock, and we rounded the Cape at 2:30 in the morning of the 11th of August, reaching Guantanamo about 1:30 in the afternoon.

The Naval authorities, at my request, examined the *Island Home* and pronounced her unseaworthy and recommended her abandonment until suitable repairs could be made. Since it was impossible to obtain the necessary repairs for some weeks at the Station, other vessels being on the ways, I informed the owners in Miami of the fact and set about finding another suitable vessel in Cuban waters.

The *José Enrique,* a 35-ton sailing bark, equipped with a 22 H. P. gasoline motor, carrying a complement of five men, was finally chartered at Santiago, Cuba, and after fueling at the Naval base we set sail for Santiago. On August 28 we again set sail westward, stopping at convenient intervals along the south coast of Cuba and exploring the many low keys in the embayment between Cabo Cruz and Bretton Cay, the westernmost of that labyrinth of keys in that part of Cuba, which we reached September 10. While these keys did not yield an enormous catch, many of them proving entirely barren of land mollusks, the specimens obtained nevertheless furnished information very desirable to our studies.

FIG. 86.—Three views showing abundance of Cerion landshells on the island of Great Inagua.

On September 10 we headed southward for the Cayman Islands, a group of three peaks whose molluscan fauna proclaims them a continuation of the Sierra Maestra range of southeastern Cuba, from which they are separated by about 115 miles. About noon the following day we reached Cayman Brac, which looks like a block of honeycomb limestone elevated out of the sea to a height of about 130 feet. It is 10½ miles long and about 1½ broad. The top of the block is rough and covered with brush, and its sides are almost perpendicular. A coastal plain strip on the north and west furnishes arable land and good roads. We engaged an automobile and soon covered all parts sufficiently to get a representative collection of its molluscan and other faunas by the end of the next day.

On the evening of September 11 we sailed for Little Cayman some 4 miles west of Cayman Brac. Engine trouble caught us at sea after dark. Approaching the northeastern end of Little Cayman we almost came to grief on a fringing reef. The coolheadedness and good seamanship of our captain, however, saved the day. Little Cayman, to which we devoted September 11 to 13, is about 9 miles long and 1 mile wide. Its highest peak is said to be about 100 feet. As a whole, it appears much lower than Cayman Brac and has less tillable land than that island and only a very scant population. Most of the island is covered with brush and timber. We found it splendid collecting ground for mollusks and other things, and made a large catch.

On September 13, we left our anchorage in Blossom Village harbor and proceeded west toward Grand Cayman, which is about 60 miles distant. This is the largest of the three Caymans, having a length of about 20 miles and a breadth of about 8 miles. Its highest point is said to be only about 50 feet. Much of the island consists of sand dunes. North Sound, a great bay on the northwestern end, is mangrove-fringed.

At Georgetown, the capital of Grand Cayman, we were met by one of my former students, Dr. Overton, the Chief Medical Officer of the Cayman Island, and thanks to his assistance and the kind helpfulness of the Commissioner, we were enabled to explore the island thoroughly and to secure a large amount of material in the short time allotted to us. September 18, at 4 a. m., we set sail for the Cuban coast, and reached the shores of Sandy Cay at about 9 a. m., on the 19th, after sailing 145 miles. From this time until September 24 we cruised along and collected on the keys between Cayo Largo and the Isle of Pines.

At dusk on the 24th we tied up against the dock of the Customs House at Nueva Gerona, Isle of Pines, where we were graciously and helpfully received by the Government officials. By the use of an automobile we were able to visit all the desirable parts of the island, securing a magnificent catch of much needed material.

On September 27 we headed for our final port, Batabano, which we reached on the morning of the 29th with all things packed ready for transmission to Havana. The Port officials here, as elsewhere, had been apprised of our coming, which made it possible to have all things aboard a freight car within two hours after docking. A motor bus carried our party to Havana where we were met by Cuba's grand old naturalist, Dr. Carlos de la Torre, who helped me with all my needs and gave to the rest of my staff a real glimpse of Havana.

All things settled, we left Havana September 1 with 4 young, live tortoise-shell turtles purchased at Cayman Brac, 2 huge live iguanas captured on Cayo Rosario, and 120 huge hermit crabs caught on one of the Doce Leguas Cays as our chief baggage. These live animals were intended for the Zoological Park at Washington. In this connection it might also be mentioned that I shipped by parcel-post from Guantanamo to the same institution 22 live iguanas which we had caught on various cays in the Bahamas. All of these animals arrived in good condition. Our main collection was shipped by freight, in part from Fortune Island, in part from Guantanamo, and the rest from Cuba. We returned to Washington on October 3.

This cruise has yielded a larger amount of molluscan material than any other in which I have had a part, excepting the U. S. Bureau of Fisheries expedition in the Philippines in 1907-1910. We obtained some 250,000 specimens of mollusks, and in addition 925 bird skins and 596 reptiles and batrachians; likewise some mammals, fish, insects, and marine invertebrates.

Great credit for the securing of these splendid collections is due to my energetic associates mentioned at the beginning of this article. The Cuban crew of the *José Enrique* also deserves special mention, from the captain to the cabin boy. Foremost of all, however, thanks are due to our Department of State for having secured not only free entry to all foreign ports for our expedition, but also that good will and helpfulness on the part of all officials in the places visited that makes an expedition of this kind a real joy. It would take more space than all these notes to adequately express thanks for all the favors

received. To the officers of our Navy at Key West and Guantanamo great credit is due not only for the assistance rendered in equipping both vessels, but the kindly way in which hospitalities were extended to us, which will always leave a pleasant memory of the occasion.

TRAWLING FOR CRUSTACEANS AT TORTUGAS, FLORIDA

By WALDO L. SCHMITT,
Curator of Marine Invertebrates, U. S. National Museum

The richness of the crustacean fauna at Tortugas, Florida, and its importance in relation to the food habits and movements of certain fishes, led me to continue investigations at the Carnegie Marine Biological Station from July 9 to August 8, 1930, through the kindness of the Carnegie Institution of Washington. It is planned as a point of departure for further studies on the crustacea to complete a survey of their kinds and distribution. Judging from the results already obtained, it is anticipated that at least 200 species will be found to occur at Tortugas and vicinity.

This year was the first in which a preliminary investigation of the deeper waters readily accessible to the laboratory was undertaken. In the course of some 20 hauls made with the 30-foot otter trawl, two hauls between 180 and 237 fathoms brought to light 16 species of "deep sea" crustacea. Most noteworthy among these were eight specimens of that giant among isopods, *Bathynomus,* and a new Portunid crab of the genus *Benthocascon,* heretofore known only from a single specimen taken between 185 and 440 fathoms in the Andaman Sea.

Three specimens of *Bathynomus* were obtained from the first haul in 180 to 220 fathoms, and five specimens in the second haul in 220 to 237 fathoms. The largest specimen measures 10½ inches long by 4½ inches broad. In length it is only an eighth of an inch shorter than the record specimen taken at a depth between 225 and 594 fathoms off the northeast coast of Ceylon. The species is comparatively rare in collections. Between 1890 and 1906 nine specimens were taken by the Royal Indian Marine Survey Ship *Investigator* in Indian Seas in the course of six hauls in from 195 to 740 fathoms, while seventeen specimens have been secured by various American vessels. The first specimen known to science was taken by the *Blake* in 1878 from 955 fathoms in the Caribbean Sea; two specimens were secured by the *Albatross* in 1885 and 1888 in the Gulf of Mexico and the Bahamas in 730 and 1,186 fathoms respectively; six specimens were taken by the Bingham Oceanographic Expedition of 1925 off the coast of British Honduras north of Glover Reef in 366 fathoms and, finally, the

FIG. 87.—The yacht *Anton Dohrn* of the Carnegie Institution. (Photograph by Schmitt.)

FIG. 88.—Cocoanut palms shading the entrance to the main laboratory building. (Photograph by J. W. Manter.)

FIG. 89.—A glimpse of Bird Key, Dry Tortugas, Florida, showing the vast numbers of noddy and sooty terns, an estimated total of 75,000 to 80,000 birds. Due to the shifting of the coral sand forming the key, the house which was located approximately at the center of the island is all but submerged. (Photograph by Schmitt.)

FIG. 90.—A few of the Greek spongers at Tarpon Springs.
(Photograph by Schmitt.)

eight specimens recorded above were taken by the Yacht *Anton Dohrn* of the Carnegie Institution on July 31, 1930.

Many species of corals flourish in these semitropical waters, and as a result dredging is carried on with considerable hazard to one's gear, nets on occasion becoming hopelessly torn or caught on the huge coral heads. On one occasion our steel cable parted in ten fathoms of water, and the only large net seemed irrevocably lost. The swift run of tidal currents so stirs up the sediment in these otherwise unusually clear waters that the bottom can be seen only with difficulty. The buoy which marked the net was carried away in rough weather a day or two after its loss, but a week later, just at slack water when the sediment disturbance was practically at a standstill, Captain Mills of the Laboratory's yacht with rare good fortune saw the mud-covered meshes of the net on the bottom with the aid of a water glass. It was caught by several grapnels but could not be raised, and Captain Mills with the aid of only a metal diving hood descended in the 60 feet of water to affix a line to a strategic point of the net. He found that the net had at the time of towing brought up under a coral head not less than 12 feet high and thick and solid in proportion. Even a steel cable had to give way before such a mass of coral. It was with this net, after its recovery, that the most notable of the dredge hauls ever made by the *Anton Dohrn* were accomplished.

I returned to Washington by way of Tampa and Tarpon Springs for the purpose of visiting this headquarters of the Gulf sponge fishery. It is conducted almost entirely by Greek spongers, who, with their families, form a considerable percentage of the population of Tarpon Springs. On the way to Tortugas, I called upon Mr. Robert Ranson of St. Augustine, Florida, and upon Will Wallis at Bradenton, both of whom have contributed a number of interesting specimens to the invertebrate collections of the Museum from time to time. I am very grateful to them for the many courtesies shown me in their respective cities, and to the Carnegie Institution for the opportunity afforded for studying the Decapod Crustacea of the Tortugas region.

COLLECTING FLIES IN THE WEST

By J. M. ALDRICH,
Associate Curator, Division of Insects, U. S. National Museum

Continuing work which has now extended over a period of 40 years, I spent part of June and July, 1930, in making collections of flies in Idaho, Washington, California, and Colorado.

The vicinity of Lewiston, Idaho, offers a great variety of climate, the city being situated in a deep valley only about 800 feet in altitude while nearby are foothills and mountains rising to about 5,000 feet. The low altitude has a warm climate, with sage-brush and other plants characteristic of the plains region, as well as some which occur much farther south. The higher altitudes are cooler, with more rainfall, and above 3,000 feet are generally forested. Thus there is a wide range of plant life, and a correspondingly great diversity in the insect inhabitants. Having lived for 20 years at Moscow, Idaho, altitude 2,700 feet, I have collected extensively over the region; but there were many flies that I had found only once in the whole time, and undoubtedly others yet undiscovered. In the recent visit I endeavored to collect in as many places as possible in the time at my disposal, with especial attention to those which previous experience had shown to be richest in flies.

Across the Snake River west of Lewiston lies the city of Clarkston, Washington, at the same altitude. In this warm climate the collecting is better early in the season, and only the late species were obtainable in June. I visited the canyon of Asotin Creek, above the town of Asotin, Washington, on several days, with fair results. Two visits were made to Lake Waha, a small mountain lake 25 miles south of Lewiston at 3,500 feet elevation, among coniferous forests, where many interesting species of flies were found; this is one of the best places in the region in June. Lapwai Creek ten miles south of Lapwai, Idaho, at an elevation of about 1,500 feet, yielded some valuable information about the distribution of species and also about their habits. Juliaetta, Idaho, elevation 1,200 feet, in a deep, rocky valley with timber on the precipitous sides, was not so good as on some former visits, the best time for collecting having passed. About 12 miles northeast of Moscow, Idaho, is a small mountain range called Thatuna Hills on government maps, in which the main peak is called Cedar Mountain, but is locally known as Moscow Mountain. This is about 4,900 feet in

FIG. 91.—Moscow Mountain and adjacent range, back of Moscow, Idaho. A celebrated "type" locality for flies.

FIG. 92.—Collecting the fly with mandibles, Smith River, California.

altitude, and a splendid place for collecting in June. I visited the summit twice. It is becoming well known to students of the flies from the considerable number of new species which have been described from specimens captured there. Entomologists stationed at the University of Idaho (in Moscow) and those at the Washington State College (in Pullman, Washington, only ten miles west of Moscow) have done a great deal of collecting on Moscow Mountain, which is the "type locality" of the new species just mentioned. Some 20 years ago I collected a new species of flesh fly at the summit, described afterward as *Sarcophaga thatuna;* curiously enough it has never been found anywhere except at the extreme summit of this mountain, and was common there on both my visits this year.

The vicinity of Spokane, Washington, is also a diversified, semi-forested region lower in altitude than Moscow, but with many fine streams and lakes, which improve the collecting, as flies are generally fond of moist places. I collected at several places along streams in the outskirts of Spokane, and twice ascended Mount Spokane, the summit of which reaches an altitude of 5,808 feet. Little or no collecting of flies has been done on this mountain hitherto. The species are mostly the same as found on Mount Moscow, but there is a much larger alpine area. There is a fine road to the summit, and I should have spent more time there but for the fact that the mountain is 35 miles from Spokane. Moreover, I found the summit to be decidedly colder than that of Moscow Mountain, so that bright sunshine was necessary to make collecting of flies successful, as these insects are very sensitive to cold and disappear when the sun clouds over, even on warm afternoons. The total time that I was able to collect near the summit was much reduced by cloudy intervals during the two days I was there. There are a number of kinds of large, showy flies here, which are very characteristic of alpine situations in western North America, the same ones with some exceptions being found on many different mountains over a wide area. It is always thrilling to the entomologist to attain the altitude where they occur, even though many of them are well represented in collections and are therefore not especially desirable to collect.

Leaving the region in which many years of collecting had made me rather familiar with the species, I devoted a week to collecting in the vicinity of the town of Smith River, California, situated on the shore of the Pacific Ocean at the mouth of the Smith River, about six miles south of the Oregon state line. Being at sea level this locality might be thought to compare with Lewiston, Idaho, in its insect population; but this is not at all the case, as the narrow coastal strip is notably cool

FIG. 93.—Sea beach near Smith River, California.

FIG. 94.—Redwood Highway near Smith River, California.

in its summer climate, so that the vegetation and insect life are very unlike those of the interior. They are in fact largely a continuation southward of a flora and fauna which extend in some of its members all the way to Alaska. A few species of flies of more southern coastal distribution also come up this far. The forms characteristic of the seashore, living in the larval stage on seaweeds, coastal species of plants, or on other coastal species of animals, are by far the most important and interesting of the flies which I collected here.

On seaweed-covered rocks washed by the ocean waves, I found the two known species of the singular genus *Paraclunio*. It belongs to the midge family, but is robust and strong. Its leathery wings are unaffected by sea-water; coming out of the receding wave it runs with fluttering wings over the wet rock until submerged again. One of the species has a range extending to Alaska, the other one being more local along the Oregon and California shores. The larvae live in the seaweeds on the rocks, but I could not find any present at the time of my visit.

Another remarkable fly that I found is *Melanderia mandibulata*, previously known only from the Washington Coast immediately north of the mouth of the Columbia River. In this fly, the mouth is developed into a pair of pincers for holding its prey—a structure unknown in other Diptera, as the real mandibles or pincers, such as occur in lower orders of insects, are reduced in other flies to small blades or needles, or more often to rudiments hardly recognizable. In *Melanderia* the organs are derived by modification of other mouthparts, and only imitate true mandibles. Professor Melander, for many years connected with the Washington State College, is the only collector who had previously found this species. One of his specimens which I took to Europe last year and showed to many entomologists, excited the liveliest interest there. I found this species on the wet rocks above the ocean, where it finds its prey among the soft-bodied organisms occurring there. By spending much time for several days I obtained a large enough supply to enable me to present the species as a gift from the National Museum to several of the principal museums of the Old World, as well as those in North America; one went to Australia. This species was the principal find of my trip.

Returning through Colorado, I stopped as I have done several times at Tennessee Pass, on the divide of the Rocky Mountains at 10,290 feet altitude. Being on one of the main railroad lines, this is a very convenient stopping-place. There is no hotel, but as before I was indebted to Mr. L. E. Maupin, a pioneer who arrived at the Pass in

1879, for accommodations and pleasant intercourse. The evenings by his fireside were, as in previous years, a memorable part of my trip. The coldness of the nights makes a fire always necessary; there was a heavy frost on one of the nights. The climate in midsummer compares with that of the far north, and the insects also are very similar

FIG. 95.—Collecting place at Tennessee Pass, Colorado. Cabin of L. E. Maupin.

to those occurring at lower levels near the Arctic Circle. My visit was at an earlier date in the summer than my former ones; consequently I was able to get some species not before collected here.

While the total number of flies collected on my trip was not impressive as such things go—about two thousand—the collection included a larger number of interesting kinds than I have ever obtained before in the United States in a single season.

A BOTANICAL VISIT TO SOUTH AND EAST AFRICA[1]

By A. S. HITCHCOCK,

Custodian, Section of Grasses, U. S. National Museum

In June, 1929, I started for London on my way to South Africa to attend the meeting of the British Association for the Advancement of Science. The sessions were held partly in Capetown (July 22-27) and partly at Johannesburg (July 30–August 5). Leaving London on the *Llandovery Castle* the latter part of June we arrived in Capetown July 19. The passengers included 160 scientists bound for the meetings, and other boats brought their quota. We stopped a few hours each at Teneriffe, Ascension, and St. Helena but did not land at Ascension. Certainly good old St. Helena never saw such a swarming of scientists over her hills and valleys as took place on that day.

Every effort was made by those in charge of arrangements in South Africa to make the visitors comfortable. Excursions permitted an examination of the local flora. Though it was winter many plants were in bloom. A two-day excursion on a special train through the Karoo allowed botanists to examine the curious xerophytic flora of this arid region. A stop was made at Kimberley to inspect the diamond mines. There the members saw the method of mining, the separating of the diamonds from the pebbles and gravel by means of "grease tables," and great piles of the diamonds themselves worth hundreds of thousands of dollars.

After the conclusion of the meetings I joined an excursion to Victoria Falls and other points in Southern Rhodesia. We lived on a special train for 12 days, visiting points of interest to botanists, zoologists, geologists, and archeologists. At Bulawayo motor cars took our party to a cave to inspect Bushmen drawings and to Motopos Hills to see the grave of Cecil Rhodes, for whom Rhodesia was named. On a high round-topped hill overlooking the country for many miles around lies the grave surrounded by huge boulders.

The Victoria Falls of the Zambesi River are one of the wonders of the world. The river flows through a great lava bed and the surface of the surrounding country is the same above and below the falls. The

[1] Although this trip took place in 1929 the author returned to America so late in the year that his article could not be included in Explorations and Field-Work of the Smithsonian Institution in 1929.—Editor.

FIG. 96.—Longwood, the house in which Napoleon lived during his exile on St. Helena (1816-1821).

FIG. 97.—Victoria Falls on the Zambesi River. A small section near one side. It is very difficult to obtain a picture of the magnificent falls because of the contour and the spray.

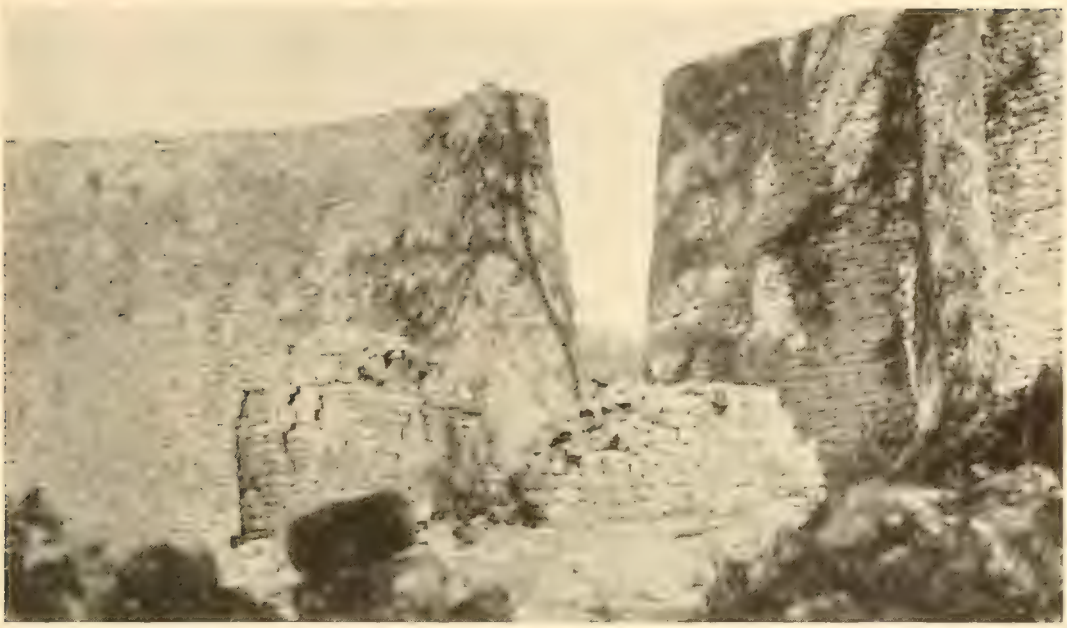

FIG. 98.—Zimbabwe Ruins, Southern Rhodesia. The ruins are in part well preserved and indicate that an earlier race extracted gold here.

FIG. 99.—Kilimanjaro, the highest mountain in Africa. The Kibo peak (19,710 ft.) as seen from about 14,000 feet.

falls are 420 feet high and about a mile and a quarter wide, thus exceeding Niagara Falls by a considerable margin. But the view of Niagara is much more impressive because the whole of the falls may be seen at once and the volume of water is little obscured by spray. The Victoria Falls can be seen in their entirety only from the air and, especially at high water, the view is almost obliterated by the spray.

One other point of particular interest in the province, especially to the archeologists, was the Zimbabwe Ruins, about 12 miles south of Fort Victoria, the nearest railroad station. The ruins are in part well preserved and indicate that an earlier race extracted gold here and used the stone structures for defense.

The excursion ended at Beira in Portuguese East Africa, where the party embarked for home. It was interesting to note that four important food plants in South Africa came originally from America, maize (called mealies in Africa), white potatoes, sweet potatoes, and cassava. The last is a Brazilian plant whose fleshy starchy roots yield the tapioca of our markets.

Some of the party went directly to London; others left the boat at Mombasa and spent two weeks at Nairobi. In company with Mr. Cotton, Keeper of the Herbarium at Kew, and a few others I disembarked at Tanga in northern Tanganyika. On the way from Beira we stopped a few hours at Dar-es-Salaam and Zanzibar.

Mr. Cotton and I first went to Amani where is located the Amani Agricultural Institute. This was previously a scientific station in German East Africa. There are here good laboratories and a herbarium. We next went by rail to Moshi for the ascent of Mount Kilimanjaro but found that the most favorable starting point was Marangu, a village 10 miles to the northeast. From Marangu we had an easy climb on mule back by a good trail, taking a cook and four porters. The first night was spent at Bismark Hut, a resthouse near the upper limit of the forest at about 8,000 feet. The second and third nights were spent at Peters Hut, a resthouse in the alpine region at about 12,000 feet. On the third day I ascended to the limit of vegetation at about 14,000 feet where there was a good view of Kibo, the western rounded snow-capped peak of Kilimanjaro (17,910 feet). The alpine grasses belong to such temperate genera as Festuca, Poa, Trisetum, and Deschampsia. On the fourth day we descended to Marangu.

Our next stop was Nairobi which we reached by rail from Taveta via Voi. Nairobi, the capital of Kenya, lies on a grassy plateau at an altitude of 5,500 feet, inland from Mombasa 330 miles. This is the point from which parties start on the big game hunts to the surrounding territory.

FIG. 101.—Cotton's senecio (*Senecio cottoni*) on Kilimanjaro above Peters Hut at about 13,700 feet. The plant is about 15 feet tall.

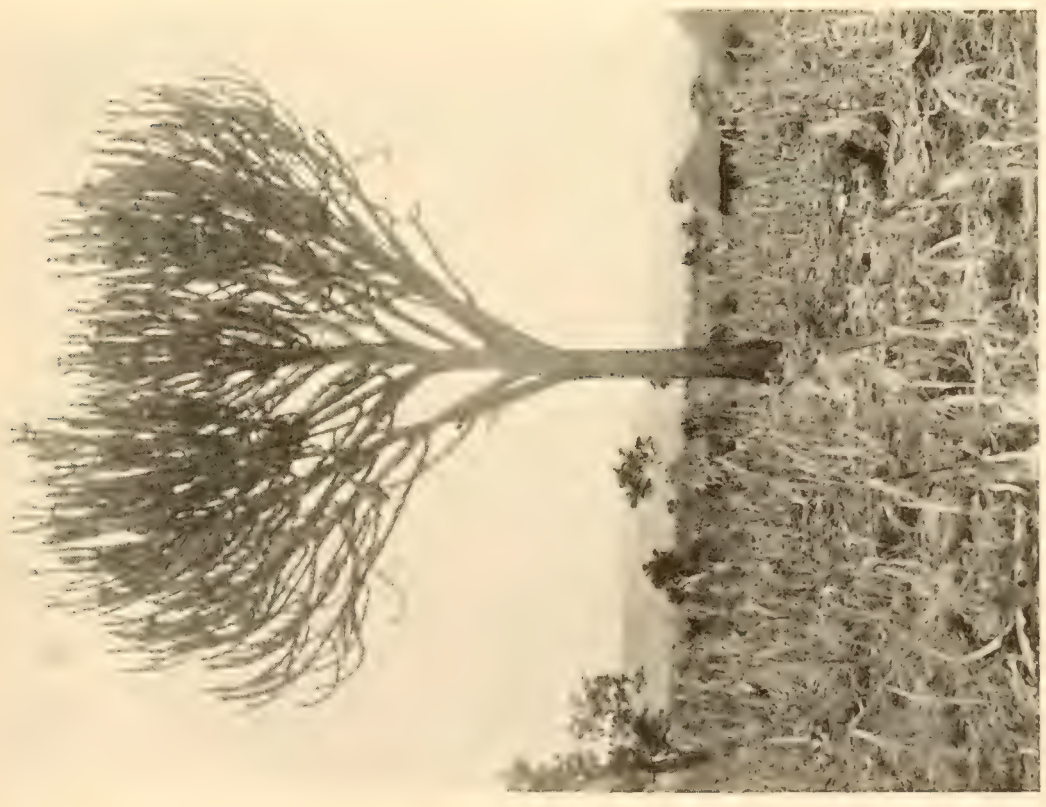

FIG. 100.—A cactus-like euphorbia tree at Moshi near Kilimanjaro. The plant is in an old native corn field (maize or mealies). A native hut is in the background.

FIG. 102.—Passing through the Suez Canal.

FIG. 103.—Giant senecio (*Senecio johnstonii*) near Peters Hut on Kilimanjaro at about 11,400 feet. Mr. Cotton is seen standing in the tall grass.

A two-day trip by motor car was made to the vicinity of Mount Kenya (17,000 ft.), but there was not time for the ascent. Through the courtesy of Government officials a trip through Uganda was arranged. The route was by rail to Kisumu, by steamer across Lake Victoria (26,828 sq. mi.; altitude 3,700 ft.) to Entebbe, the administrative center for Uganda, by motor car to Kampala, the center of agricultural and botanical research, by motor car to Jinja, the terminus of the Uganda railroad, by rail back to Nairobi, with one-day stops at Eldoret, Nakuru, and Naivasha in Kenya.

On September 28 I sailed from Mombasa for London via the Red Sea. Although I left the boat at Marseilles, crossed France and made close connections with a fast Atlantic liner, it took nearly a month to reach New York.

The collecting (grasses only) in the Union of South Africa was meager because I was there in the winter season (112 numbers collected here). Through Southern Rhodesia the collecting was restricted because it was the dry season, though at Victoria Falls the spray from the falls gave moisture in the immediate vicinity (204 numbers in Southern Rhodesia, including 87 numbers at Victoria Falls). At Beira on the coast the collecting was better (56 numbers). The stops at Dar-es-Salaam and Zanzibar were short, but by going immediately beyond the limits of the town one and one-half hours were utilized for collecting at each place (Dar-es-Salaam 27 numbers, Zanzibar 23 numbers). At Amani the collecting was good (63 numbers) and at Moshi also, except on the open ground where it was too dry (41 numbers). On Kilimanjaro the grasses were of much interest, especially in the alpine regions (89 numbers).

In Kenya and Uganda the collecting was good though it was the dry season around Nairobi. At Eldoret and Nakuru the grasses were abundant and in fine condition (the numbers were as follows: Nairobi 117, Kisumu 35, Entebbe 52, Kampala 22, Jinja 50, Eldoret 51, at stations between Eldoret and Nakuru 35, Nakuru 42, Naivasha, in a much-grazed region, 19, Mombasa in about one hour's collecting 40). The numbers for each locality represent for the most part different species.

So far as collecting was concerned my attention was given exclusively to the grasses. But my interest, of course, extended to other plants. The peculiar flora of the Cape region, so rich in Proteaceae, was of interest to all the botanists present. The many succulent plants

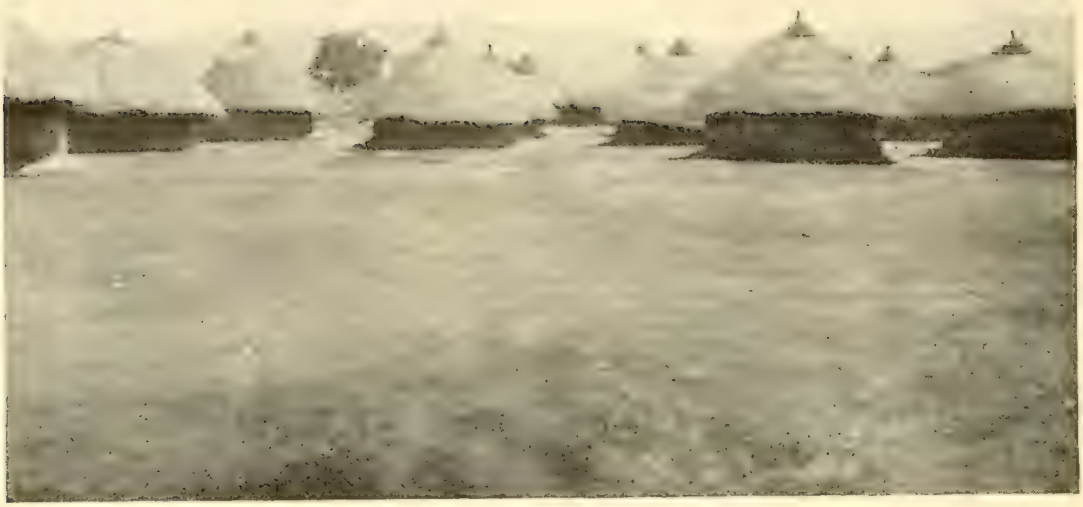

FIG. 104.—Native huts near Jinja on Lake Victoria (the source of the Nile).

FIG. 105.—Massai women, wives of a chief. Spirals of brass wire are worn around the neck and a heavy load is wound around the forearms. Heavy ornaments hang from the distended earlobes, supported by a band over the head.

FIG. 106.—*Mesembryanthemum bolusii* at the Botanic Garden in the "Karoo." A remarkable xerophytic plant closely resembling the stones among which it grows. Each plant consists of two hemispheric leaves.

FIG. 107.—A baobab tree (*Adansonia digitata*) at Moshi near Kilimanjaro. This curious and ungainly tree has dropped its leaves for the dry season. The fruits or pods may be seen among the branches as small specks. The large cylindric objects are beehives of hollow logs placed in the tree by the natives.

of the Karoo reminded me of our own arid regions of the West. The grotesque baobab tree with its great trunk all out of proportion to the branches was photographed by everyone who had a camera.

Altogether the trip was noteworthy because of the opportunity to meet the South African botanists, to renew acquaintance with the British botanists, to gain first-hand information concerning the floristic conditions of another continent, and to obtain a fine collection of grasses for the National Herbarium.

ANTHROPOLOGICAL WORK ON THE KUSKOKWIM RIVER, ALASKA

By ALEŠ HRDLIČKA,
Curator of Physical Anthropology, U. S. National Museum

The work of the summer of 1930 was devoted principally to the Kuskokwim River, the second largest stream of Alaska and hitherto unknown to physical anthropology. The Kuskokwim flows to the south of the Yukon, from the McKinley range of mountains to the Kuskokwim bay or bight; and like the Yukon it has been partly peopled by the Indian and partly by the Eskimo. In the thirties of the last century it was discovered and sparsely colonized by the Russians. It has at present a fairly large native and a small white population, the latter consisting almost exclusively of traders, Government employees, and, in the upper parts of the river, miners. It can only be reached by the costly airplane, or over a broad and at times difficult portage from the Yukon, or twice a year by a freight steamer from Seattle.

The route chosen was that across the portage. The trip from Washington took a whole month, due partly to the delayed season. Headquarters were established at Bethel, and from there two trips were made, one down the bay as far as Apogak, the other upstream as far as Stony River. The rapidity and success of the work were due largely to the long days, and to aid received through the U. S. Bureau of Fisheries and the Government Bureau of Education.[1]

The natives themselves were all that could be desired. To make the work on the living more intelligible and sympathetic to them, it was combined with examination of the lungs and heart, which led to the learning of collateral facts of decided value. And the pathological factor was accentuated with much benefit also in making the skeletal

[1] Special grateful acknowledgments are due to Messrs. Calvin F. Townsend and Charles MacGonagal of the Bureau of Fisheries; to Mrs. Lulu A. Heron, nurse, and Miss Anne Martin, teacher, Bethel, of the Bureau of Education; to the fine men and women of the Moravian Missions; to the President and traders of the Northern Commercial Company; to Mr. Clark M. Garber, Superintendent of the Bureau of Education Schools, at Akiak; to Messrs. Samuelson, Brown, Parent, and all the other traders along the river as far as this was covered; to Game Warden Hollson and Postmaster Link of Bethel; to Mr. Jacobsen in the same place; and to Messrs. Hofstedt, Frederickson, Sergei, and all those other friendly people of the river, white and also native, who aided me in my endeavors.

FIG. 108.—A "pagan" grave, old Apogak, lower Kuskokwim River.

FIG. 109.—The burial grounds of old Apogak, lower Kuskokwim River. Russian-church burials in the background, some very old remains in front.

collections. The latter was carried on with the full knowledge of the natives and often in their view and with their assistance. They were told that I wanted only the old " heathen " remains, in which no living person had any interest; that the bones were needed for studies and for comparisons of the development, the type, and the diseases of the old with those of the present people; and that they would be treated with all possible consideration. The results both with the living and with the skeletal remains were very gratifying. They comprise the measurements of every fullblood male that could be found along the lower 400 miles of the river and bay; observations on many of the women, children, and mixedbloods; and collections filling over 50 boxes of precious old skeletal material. An unexpected but welcome feature was the willingness of all the natives to be photographed, but unfortunately the prevalent drizzles and cold weather of this year prevented full success in this direction.

At Bethel, thanks especially to Mrs. Heron and Miss Martin, contingents of Eskimo were obtained from a much larger territory than could be visited. There were numerous individuals from the " tundra " (Johnson River) and some from as far as Nelson Island and Goodnews Bay. This gave valuable insight into conditions over a large and hitherto unknown region.

More in detail, the results of the work were manifold. They may briefly be enumerated as follows:

Population.—The native population of the Kuskokwim River is restricted to the lower 350 miles of the stream with its affluents and to its bay. It is estimated collectively at 3,000 individuals. It extends up to the Stony River. In the 200 miles between the Stony and McGrath there live now but three families of about 25 persons, a large proportion of whom are young children, with very few if any of the adults native to that region.

Race.—The entire region, up to near the Stony River and including the Hoolitna River, is now and has apparently always been occupied by the Eskimo. Only three Indians were encountered in this region, all close to Stony River and all from elsewhere. The current notion that the Eskimo reached to Sleitmute and the Indians began above that was not borne out by the finds; the present extension of the Eskimo certainly reaches to and includes the Hoolitna, and there are no old sites between this and the Stony River which would show a previous existence here of the Indian. The Indian territory if it may be so called—for there are hardly any of them there—begins close to the Stony River. But an occasional Indian type of face may be noticed as far down as Napaimute and there are indications that

FIG. 111.—A group of Eskimo, middle Kuskokwim.

FIG. 110.—Eskimo mother and child, lower Kuskokwim.

some Eskimo-Indian mixture has taken place in these reaches. The Kuskokwim Indian below McGrath has practically vanished. The strong probability is that he was never over this part of the river in any larger groups or numbers and that the Kuskokwim was not an old home of the Indian. From Napaimute down to the bight there is no trace of anything Indian excepting a few individuals (one a Cherokee, another a Cree) who came here accidentally and merged with the Eskimo.

The Eskimo.—The Eskimo of the Kuskokwim and the neighboring regions are of a remarkably homogeneous and interesting type. This type is characterized by short to medium stature, meso- to subbrachycephalic head, mostly a rather short and broad face, large malars, small prominence of the not very narrow nose, mongoloid eyes, full, dusky red cheeks in the children and young, black straight to broadly wavy hair, light brown (tan to submedium brown) skin, full chest, and often relatively short limbs.

From Akiachok and especially Napaimute up the river, this type shows a somewhat higher stature and greater robustness. It is poorest in the tundra region and in the coast villages towards Nelson Island. Those differences correspond directly to differences in environment and food—the worse these are, the lower in general is the physique and also the energy of the people.

In the upper half of the Eskimo territory on the Kuskokwim, there are numerous traces of Russian admixture. This is generally easy to recognize by a greater stature and robustness, by the physiognomy, by lighter eye color, by nearly white color of the skin of the body (the face may be much as in fullbloods), and by greater and more white-man-like beard. In some of the native fullbloods of the lower river and the tundra the face is quite hairy, but the beard is not so thick and soft as in whites. A few mixedbloods were seen on the upper river that looked like Mexicans, indicating some Mediterranean admixture. In but one case was there an indication of negro blood; the Eskimo as a whole have been more fortunate in this respect than some of our Indians.

Skeletal remains.—The skeletal remains along the Kuskokwim occur in two forms. The old burials, from the pre-Russian to about the mid-Russian times, were all above or on the ground, in boxes or "houses of the dead" made of roughhewn thick slabs, joined in dovetailed manner without nails. The bodies in these boxes lay invariably in the contracted position, on their side, and with the head in generally the same direction in one burial place, though this was not always the same as that in other burial grounds. The boxes were constructed

FIG. 112.—Louise, from Nelson Island. Six months ago she was a "savage."

FIG. 113.—Louise. The smile is natural to all of them; but Louise shows also a charming naive curiosity at what is going on.

FIG. 114.—A narrow ditch between two lakes—a part of the Yukon-Kuskokwim Portage. In places the boat has to be pushed or pulled through by the occupants.

FIG. 115.—On the Lakes, a part of the "Portage" between the Yukon and Kuskokwim Rivers, May 31, 1930.

much as were those on the Yukon, and many were evidently decorated by paint and even with animal and human figures. The body was covered with caribou skin, or laid in with just what little it had on. In some instances earth was placed about the corpse, but mostly there was no earth in contact with the body. A clay dish (lamp) was placed inverted in one corner, generally at the head but occasionally at the feet, especially with the males; and there was nothing else of value left or placed with the body. Above Bogus Creek, where the lamps must have been scarce, even they were usually absent in the burials.

Above the body in the box was a "roof" of supports, in some instances thick wooden slabs, and these were covered with birch bark; or there was only a birch bark cover, taken generally from a canoe and showing the sewing of the strips together. Then came 6 to 12 inches of earth; perhaps another birch bark layer and more earth; and finally slabs or flat rafters, forming the top of the box burial, the whole being supported by two side posts set in the ground and held together by cross-pieces.

The details of the burials differed at different villages, but in any one burial place there was great similarity, suggesting that all or most of the burials at a given site were made by some one individual, an "undertaker." The nature of the burial in these cases had a great effect on the preservation of the remains, some of these being in excellent condition, some crushed more or less and rotted. The burials under Russian influence were all ground burials, with simple, nailed coffins, two to three feet of earth and a sod or plank covering on the top, headed by a Russian cross.

The skeletal remains from the older box burials have proved to be of much more than usual interest from both the anthropological and the medical points of view. Over one hundred of the older skeletons were collected and more examined. They showed the following principal features:

1. The type of the skull and the stature are about the same as those of the people of today on the river. No marked change has taken place in these respects evidently within many generations of these people. The nature of the type, its sameness over a large territory, and its extension well into the pre-Russian times, are facts of much anthropological importance.

2. There is a remarkable freedom from fractures. There were found no wounds of the skull or face, no fracture of the ribs, and only two breaks of the long and other bones. These surely were no fighting people or people given to violent exercise or sports.

FIG. 116.—A fine Eskimo young woman at the Moravian Mission Orphanage, above Bethel, Kuskokwim River.

FIG. 117.—Annabelle—belle Annie of the tundra, northwest of Bethel.

3. There is no trace in the older burials of tuberculosis. Two cases that were encountered, were from burials of late Russian or earlier post-Russian times (near or after 1867). It is positive therefore that tuberculosis had not existed among these people before the contact with whites. It was evidently brought here by the Russians. This explains the present general lack of immunity against this scourge. Every one of these people must be regarded as predisposed to the disease, which is of consequence in dealing with them medically, in schools and otherwise.

4. None of the bones collected or seen showed any trace of cancer, tumors, inflammation, syphilis, or rachitis; and there were no signs of scurvy.

5. The prevailing pathological conditions in the older individuals were those of the spine, accompanied occasionally with those of the joints, and were arthritic in nature. All grades of arthritis deformans were seen in the spine, from the beginning of marginal exostoses in the lumbar and lower dorsal region to an ankylosis of the whole spine due to fusion of those exostoses. In several cases two and in one instance three of the cervicals were fused, with the rest of the spine not much affected; in these cases there may have been some special factor at play.

6. There were but a few really old people in these burials, showing that real old age was rare; on the other hand there were but few young adolescents or adults of both sexes, indicating lower mortality among especially the young women than was found last year to have prevailed on the Yukon. This indicates the absence on the Kuskokwim of some pernicious habit that was present on the other river and that probably related to the period of child bearing in the young women.

7. There were no perceptible traces in the burials of any Indian influence or admixture.

The whole study shows the presence, along the 400 miles of the lower Kuskokwim River and its bay, of a rather large and, in many parts of the region, still mostly fullblood population, of remarkably homogeneous character, and constituting the bulk of the western Eskimo. It makes it certain that this type did not arise through mixture with the Indian, but that it represents a pure old Eskimo strain, to which conform a large majority of the Eskimo people in the Bering Sea together with such important groups as those of Point Hope, Smith Sound and elsewhere. This is, according to present indications, the parental or basic type, from which the narrower and more keel-shaped skull type of parts of the Seward Peninsula and the Arctic, and

FIG. 118.—Three Eskimo girls, with their natural smiles. Kuskokwim River.

FIG. 119.—Three Eskimo "huskies"; they too smile, for they come from the happiest lot of people in Alaska.

especially that of southeastern Greenland and of Labrador, has been developed.

Thus the work of the last few years throws a new light on the whole Eskimo problem and brings it near, it would seem, to its final solution.

The work of the last two years indicates also much as to the future of the Alaska Eskimo. He has a high mortality, but even higher fecundity. He is not dying out and will not do so. But he is becoming rapidly admixed with white blood. Part of this came from the Russians, part from marriages or unions of later whites with the attractive native women; and the mixedbloods are diffusing the blood among the rest of the people. In all probability no pureblood Eskimo will be born a century from now. Thus as a pureblood the western Alaska Eskimo will in a few generations become largely if not entirely a matter of scientific history. But the Eskimo-white population promises to increase rather than decrease. The tuberculous troubles are already frequently assuming a chronic form, and there are many cases of partial and even complete recovery. With increasing knowledge the people will also be able to better care for themselves. Thus it may safely be expected that the Eskimo population, though more or less altered in blood, will remain to form the human backbone of these far away coasts and rivers. With this in view, everything possible should be done towards curing and safeguarding this good, happy, tractable, and already fairly civilized people, from their one great scourge, tuberculosis, which is of white man's introduction.

ANCIENT CULTURE OF ST. LAWRENCE ISLAND, ALASKA

By HENRY B. COLLINS, JR.,
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On May 13 Mr. J. A. Ford and I sailed from Seattle on the Coast Guard Cutter *Northland* for the purpose of conducting archeological investigations on St. Lawrence Island, near Bering Strait. This was my third consecutive cruise on the *Northland* and again I wish to thank Capt. E. D. Jones and the officers and men of the ship, especially Lieut. Comdr. N. R. Stiles, and Mr. H. Berg, for the many courtesies shown us.

In 1928 and 1929 my excavations on Punuk and St. Lawrence Islands had revealed the existence of a prehistoric phase of Eskimo culture ancestral to the modern in that region and derived apparently from a still earlier phase, the only evidence of which was a few elaborately decorated artifacts of walrus ivory that had been found at various old sites in the vicinity of Bering Strait. This oldest phase of Alaskan Eskimo culture, the Old Bering Sea culture, appears to be the oldest that has been found anywhere in the Eskimo regions. It also possessed an art richer and more complex than that of any later Arctic culture. The intermediate or Punuk stage showed similar implement types, but the decorative designs, while they bore sufficient resemblances to those of the Old Bering Sea culture to warrant the assumption that they had been derived therefrom, had become less flowing and profuse and had taken on a rigidity more like that of modern Eskimo art.[1]

While such a development of Alaskan Eskimo culture seemed certainly to have taken place, much of the evidence was of an indirect nature, for at the sites excavated in 1928 and 1929 I had found an abundance of the Punuk art but hardly more than traces of that of the Old Bering Sea period—not enough to afford evidence of the exact relationship at these particular sites of the two old art styles. It was very desirable, therefore, to find some old site at which occurred

[1] The Ancient Eskimo Culture of Northwestern Alaska. Explorations and Field-Work of the Smithsonian Institution in 1928, pp. 141-150, 1929.

Prehistoric Eskimo Culture of Alaska. Explorations and Field-Work of the Smithsonian Institution in 1929, pp. 147-156, 1930.

Prehistoric Art of the Alaskan Eskimo. Smithsonian Misc. Coll., Vol. 81, No. 14, 1929.

both the Old Bering Sea and the Punuk cultures, so that by stratigraphic excavation their relationship might be determined definitely.

In 1928 and again in 1929 the *Northland* stopped for a day at Gambell (Sevuokok) at the northwestern end of St. Lawrence Island and I had an opportunity to examine several deserted village sites in the immediate vicinity. From the nature of the artifacts that had been excavated from them—some collected for me by Paul Silook, an Eskimo at Gambell, and some shown to me by Mr. Otto Wm. Geist, who had been collecting for the Alaska Agricultural College—it was plain that these villages were of different ages. Only one of them had yielded artifacts bearing the Old Bering Sea ornamentation, and this was also the site which from its position in relation to former beach lines appeared to be the most ancient. Here then, at Gambell, was a series of old sites which gave promise of yielding the precise information needed as to the cultural changes that had taken place on St. Lawrence Island in prehistoric times, and it was accordingly selected as a place for investigation.

Situated at the northwestern extremity of St. Lawrence Island, the Eskimo village of Gambell is only 40 miles from the Siberian coast which on any clear day is plainly visible. The 200 inhabitants live during the winter in domed skin-covered houses with inner skin sleeping room such as are also used by their Eskimo kinsmen in Siberia and by the coast dwelling Chukchee; the smaller skin structures formerly used as summer dwellings have been almost entirely replaced by neat lumber houses, outward evidence of the prosperity that has lately come to these Eskimo, principally from furs.

The present houses are built at the far end of a flat gravel spit which extends westward for three-quarters of a mile from the base of the low Gambell Mountain. From the top of this mountain one has a clear view of the old beach lines, which, extending east and west on the gravel spit below, show the manner in which the spit has been built up. At the base of the mountain is the old village of Miyowaghameet, enclosed within the first and second (the earliest) beach lines, and at the present time three-fourths, and half of a mile distant from the sea. Since all maritime Eskimo villages are built close to the sea it is only reasonable to assume that when Miyowaghameet was occupied the sea was much nearer and that the greater part of the present gravel spit has been built up subsequently.

Some 200 yards to the northward is a smaller village site, Ievoghiyogameet, its grass covered midden rising like a small island from the flat gravel plain. This village is separated from Miyowaghameet by four old beach lines, while to the northward six more beach lines

FIG. 120.—Typical harpoon heads from the five old village sites at Gambell. 1, 2, from oldest village, on hillside (Old Bering Sea decoration); 3, 4, 5, from Miyowaghameet (Old Bering Sea decoration); 6, 7, 8, from Miyowaghameet (Punuk decoration); 9, 10, from Ievoghiyogameet; 11, 12, from Sekhowaghayaget; 13, from most recently abandoned village; 14, modern with iron blade.

lie between it and the sea. Its position would thus indicate that it had been built later than Miyowaghameet and that during the time of its occupancy and after its abandonment the sea had receded still further, piling up still more gravel ridges.

Toward the end of the spit, behind the present village is the third old village, Seklowaghayaget, but its position with reference to the old beach lines is not so clear. Finally, immediately to the south of the present village are the ruins of the semi-subterranean houses of wood and whale bones, the last of which were occupied as late as 40 years ago.

In the kitchen-middens and house pits of these old villages we and our Eskimo helpers excavated from June 20 to October 20. Our method of excavation was to sink pits 12 feet square at various places in the middens, taking them down in sections of a few inches thickness as the frozen ground slowly thawed upon exposure to the atmosphere. As the work progressed we began to uncover a great variety of objects—ivory, bone, stone, pottery, wood, baleen—representing the hunting implements, tools, household equipment, ornaments and other possessions of a people who were seen to have been uncommonly skillful in shaping to their ends the material resources at their command. The objects excavated number several thousand, and represent a complete cross section of Eskimo culture at this one spot from the earliest known period down to the present.

We had been excavating about a week when almost by accident we made a discovery that added greatly to the significance of these old villages as landmarks of Eskimo chronology. Just back of Miyowaghameet, on the lower part of the mountain slope, we found a site of pure Old Bering Sea culture. The trail to the top of the mountain passed over the surface of this old village and although many generations of Eskimo had followed it not one of those now living had suspected that anything lay beneath the moss and rocks. But this is easy to understand for the surface showed not the slightest irregularity, nor were there any timbers or whale bones or shallow depressions of house pits, such as usually mark the sites of old Eskimo villages. Only at one place was any refuse visible and this a small patch less than two feet square which by weathering had become exposed in a rock crevice. The rest of the midden for many yards around was so completely covered with moss and sod and fallen rocks that it blended perfectly into the hillside. As our work progressed it became clear that this site had been both settled and abandoned within the period of the Old Bering Sea culture, for from top to bottom of the small midden the decorated objects—about 30—were all of the Old Bering Sea style

FIG. 121.—Gravel spit at Gambell on which are situated the present village, at the far end, and four abandoned villages. Miyowaghameet, the oldest of these is shown in the foreground. The lines of snow follow the old beach lines.

FIG. 122.—Excavating a recent house ruin at Gambell. This type, with wooden floor and walls and roof of wood and whale bones, was occupied as late as 40 years ago.

with no trace of the later Punuk art. Many undecorated objects were also found, revealing for the first time the common implement types of the Old Bering Sea culture. Harpoon heads were of various types: with closed and open shaft sockets, with one, two, or three spurs, with end blades and with side blades.[1]

At Miyowaghameet, the next oldest site, the eastern and southern parts of the midden were found to continue deep below the sod and to be practically continuous with the old hillside midden. The decorated objects from this section of Miyowaghameet belonged also to the Old Bering Sea period, but already a change was noticeable; the designs, while still very elaborate, were somewhat uniform, in contrast to those of the hillside site which displayed more freedom in the utilization of the various design elements. However, the most beautiful objects were those belonging to this later stage of the Old Bering Sea Culture. At the upper levels of the eastern and southern sections of the Miyowaghameet midden were found a few scattered objects bearing the simple line and dot ornamentation of the Punuk period. At the opposite or northern and western parts of the midden Punuk art was found from the surface to a depth of about 5 feet, but below that Old Bering Sea pieces were the prevailing forms. A similar condition was found in regard to harpoon heads. Those from the older sections were mostly of the complicated Old Bering Sea types while the later ones, of Punuk age, were simpler in form as well as decoration.

It is evident, therefore, that when the first settlers came to Miyowaghameet—no doubt from the hillside village—they brought the Old Bering Sea culture with them. Somewhat later, as the village expanded to the northward and westward the rich old art had been replaced by the simplified art of the Punuk period. New types of harpoon heads appeared and some of the old types were discontinued. There were likewise changes in some of the other implement types but on the whole the material culture was not greatly altered.

The Punuk art, which had appeared in the later sections of Miyowaghameet, had continued to flourish at the next oldest village, now represented by the Ievoghiyogameet midden. But here it underwent certain changes; the lines became straighter and deeper, and mechanically made circles appeared. Harpoon heads became simpler in form

[1] Harpoon heads are seen to have assumed a wide variety of forms on St. Lawrence Island in prehistoric times but their development was along lines that to a considerable degree can be traced; there is reason to believe that these implements will have relatively as important a rôle in the elucidation of problems of Eskimo prehistory as pottery has had in the Southwest.

FIG. 123.—Eskimos hauling up a dead walrus on the beach.

FIG. 124.—Ruined house, probably 200 to 300 years old. In foreground is shown the oval antechamber, connected by a narrow passage with the square inner room. Constructed of stones and whale and walrus bones.

and included a few examples typical of the Thule culture, an extinct Eskimo culture which formerly centered about Hudson's Bay.

At Seklowaghayaget we found again only the Punuk art. The harpoon heads from the lower levels of the midden were of the type found at Ievoghiyogameet but the simplification that had been in process at that place had here gone still further, for those found in the upper levels of the Seklowaghayaget midden were mainly of two types, one, evidently local, a small flat undecorated head with open shaft socket which in cross section approaches a triangular shape, and the other a small open socket head of Thule type without end blade.

As Seklowaghayaget became abandoned, houses were built near by, immediately to the south of the present village, and these and the middens about them represent the latest of the five abandoned sites in the vicinity of Gambell. The two types of harpoon heads last mentioned had continued in use but the local type with almost triangular socket underwent a series of rather rapid changes and emerged as the thick, iron-bladed, closed-socketed form of the present time. The refuse about these latest ruins yielded a few examples of Punuk art, but more of the modern. Glass beads and iron were also found as well as a number of modern types of implements that had not appeared at the older sites.

In addition to the stratigraphic excavations made in the middens, ten house-pits were dug, one or more at each of the old sites. The houses of the Old Bering Sea period, heretofore unknown, were found to be small semi-subterranean structures, square in outline, with stone floors and walls of small driftwood timbers laid horizontally. There was a narrow entrance passage at a slightly lower level, with stone floor and walls and flat wooden roof.

The earlier houses of the Punuk period were of exactly the same type but of larger dimensions. At one place in the Miyowaghameet midden, evidence of direct superposition was found: the corner of one of these larger houses, in which only Punuk art was found, had been built over the fallen wall of a smaller house from which came decorated pieces only of the Old Bering Sea type. In the later part of the Punuk period, house walls were made of stones and bones, principally whale vertebrae and walrus skulls. There was also an enlargement of, and sometimes an annex to the entrance passage, for use as a store room or for cooking. Wooden floors and walls of small upright timbers were found only in the latest house ruins.

The excavations at Gambell have thus revealed in considerable detail the long succession of cultural changes that came about in past centuries as one village after another was established and then abandoned.

The resulting chronology, as outlined above, is based on three main lines of evidence: stratigraphy, the evidence of the old beach lines, and the demonstrable succession of art styles and implement types. The value of the chronology that is thus set up will in a wider sense be determined by the extent to which it can be applied to the elucidation of cultural sequences elsewhere in the Eskimo regions. We know that the material culture of the modern St. Lawrence Island Eskimo stands somewhat apart from the rest of Alaska, being derived for the most part from the Siberian Eskimo who in turn have been strongly influenced in comparatively late times by the Chukchee. As we go

FIG. 125.—Ruins of house of older type than fig. 124. Underground entrance shown in background. At center foreground the rear wall extends over the corner of a still earlier house of the Old Bering Sea period.

further back, however, it is seen that the St. Lawrence Eskimo, instead of being isolated, shared in the earlier and artistically more highly developed culture that formerly extended over a large part of northern Alaska and northeastern Siberia. For the Old Bering Sea culture is known to have existed also on the Siberian coast, the Diomede Islands, at Cape Prince of Wales, Point Hope, and Point Barrow, while the later Punuk art has been found at the Diomedes and at Point Hope. With regard to the relationship of the old Thule culture of the East, it is significant that on St. Lawrence Island definite Thule types do not appear until well into the Punuk period. This is in keeping with the general situation in Alaska wherever Thule types

are found; they seem to be always later than those of the Old Bering Sea culture. From present indications it appears probable that careful excavations around Point Barrow would reveal the best evidence of the exact relationship between these two old Eskimo cultures. Equally important is the question of the relation of the Old Bering Sea culture to the existing Eskimo groups between Bristol Bay and the Yukon and even to the Indians of the Northwest Coast, such as the Tlingit and Haida. Then there remains the most important problem of all—the origin of the Old Bering Sea culture itself; but this, as well as the other problems of Eskimo archeology can only be solved by further excavations.

While the *Northland* was staying at Unalaska for a few days in June and again in November we were able to make limited excavations at three ancient Aleutian sites on Amaknak Island. The midden deposits were of considerable size, ranging in depth from 5 to 15 feet. They were also easy to excavate, for unlike those on St. Lawrence Island, they were not frozen. However, compared with the Eskimo middens, they yielded but few artifacts, none of which were comparable either in art or craftsmanship with ancient Eskimo specimens. The prehistoric Aleuts seem to have possessed a rather simple material culture which continued with little or no change during the centuries that they inhabited these barren and inhospitable islands.

Fifty skulls and skeletons were collected at an old Eskimo site near Rocky Point, on Norton Sound, but probably none were over 100 years old. Twenty King Island Eskimos at Nome were measured and 60 St. Lawrence Islanders at Gambell; on the latter group hand and foot prints were also taken.

The most interesting feature of the season's work, aside from the archeological finds at Gambell, was the discovery of a fossil-bearing coal and shale outcrop of Tertiary age, rich with the remains of sequoia, poplar, and other plants. Prof. R. W. Chaney, of the Carnegie Institution of Washington, is responsible for the discovery, for it was he who requested that I try to locate such fossils. The existence of fossils of sequoia and other trees on the now barren St. Lawrence Island is regarded by Professor Chaney as affording conclusive evidence of a former land connection between Asia and America; for sequoia, which at the present time are restricted to California, have been found as fossils in Southeast Alaska, Northeastern Siberia and Mongolia. Paleontologists have long assumed that there must have existed a land bridge between Asia and America in the region of Bering Strait, in Tertiary times, for in no other way could the similarity of the fauna and flora of the two continents be explained.

PREHISTORIC SANTO DOMINGAN KITCHEN-MIDDENS, CEMETERIES, AND EARTHWORKS

By HERBERT W. KRIEGER,
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The third consecutive season of archeological work in Santo Domingo was begun in January and concluded in May, 1930. As in preceding years, the work was made possible through a subvention of Dr. W. L. Abbott, who had previously conducted biological investigations principally in the high mountains surrounding Constanza valley, and on the southern slopes of the Central Cordillera in the province of Azua.

The season's work opened on the south coast, at the little Dominican village of Andres on the Bahia de Andres, an arm of the Caribbean, situated approximately 30 kilometers east of the capital city of Santo Domingo. The writer first became interested in what had been reported as an Arawak burial ground at Boca Chica, when viewing in March, 1929, the collection of Señor Andres Socias, of Copey, Monte Cristi Province. In that collection was an earthenware vessel different from the usual type of pottery from the north coast of Santo Domingo. Señor Socias had obtained the vessel several years previously from a friend residing at Boca Chica. The Indian burial ground at Boca Chica (Andres) had in the meantime been worked by Mr. Thomas Howell, of New York, the president of the Compania Azucarera Boca Chica. In 1928 while excavating for a new sugar warehouse many skulls, skeletons, and accompanying pottery vessels were uncovered. Before Howell's attention was directed to these finds a large number of earthenware vessels had been wantonly destroyed by the laborers.

In 1930 the writer proceeded to Andres hoping to learn more of the culture stratification in the adjoining kitchen-midden. Mr. Fox, the resident manager of the concern, during the absence of Mr. Howell, kindly granted the writer permission to carry on investigations for the Smithsonian Institution on the property directly in front of the sugar warehouses where most of the finds were being made. Local officials of the Dominican Government granted permission to explore within the confines of the adjoining village of Andres. Living quarters were supplied by the Compania Azucarera, the officials of which assisted the undertaking in every possible manner.

FIG. 126.—A modern sugar factory, Compania Azucarera, Boca Chica.

FIG. 127.—Three-roller sugar mill, Valley of the Rio Tireo.

The former aboriginal village site at Andres extends along the coast all the way from Boca Chica, at the eastern end of the Bay of Andres, through the village of Andres near the western end of the bay, where it terminates abruptly in front of the warehouses of the Boca Chica Sugar Central. The unusually extensive shell midden characterizing this ancient Arawak settlement rests directly on a bed of coral rock. Directly fronting the warehouses and refinery buildings is a large sand spit projecting out into the bay and covering to a depth of 3 to 10 feet or more the coral rock which underlies the entire area. This sand spit was utilized by the former aboriginal occupants of the region as the only possible burial ground within an extensive area along the southeastern Santo Domingan coast. It was here that they buried with their dead many bowls, food dishes, and water jars.

The Andres-Boca Chica site is perhaps the most extensive of any West Indian archeological station known at the present time. More skulls and earthenware vessels and other objects representative of Arawak culture have been recovered intact than from all other known sites in the West Indies combined. There is a remarkable uniformity throughout, both as to midden deposits and as to burial offerings, which had apparently not been disturbed, a favored position for the water jars being at either side and for the food dishes directly in front of the flexed skeleton.

After making a representative collection of anteriorly deformed Arawak crania through excavating in front of the sugar warehouse and later within the village of Andres, studies were made of the midden deposits. These consisted for the most part of a dense layer of conch shells (*Strombus pugilis* L.) intermingled with fish bones, leg bones and carapaces of turtle, and of mandibles of several species of crab. The midden deposits resting on the solid coral do not exceed 5 feet in depth. A thin stratum of soil covers the midden. No stratigraphic changes within the midden were apparent at the places where test excavations were made.

The next project to be undertaken during the 1930 season was in the nature of an archeological reconnoissance in the high mountain valleys of the provinces of La Vega and Azua. The mountainous backbone of the island, the Cordillera Central, starts from low hills in the Republic of Haiti on the east and attains its greatest height in the west central part of Santo Domingo. The range appears as a jumble of ridges and peaks and flat valleys. There are outcroppings of many different kinds of rocks—effusive and intrusive igneous rocks, schists and other metamorphics, and a great variety of sedimentary

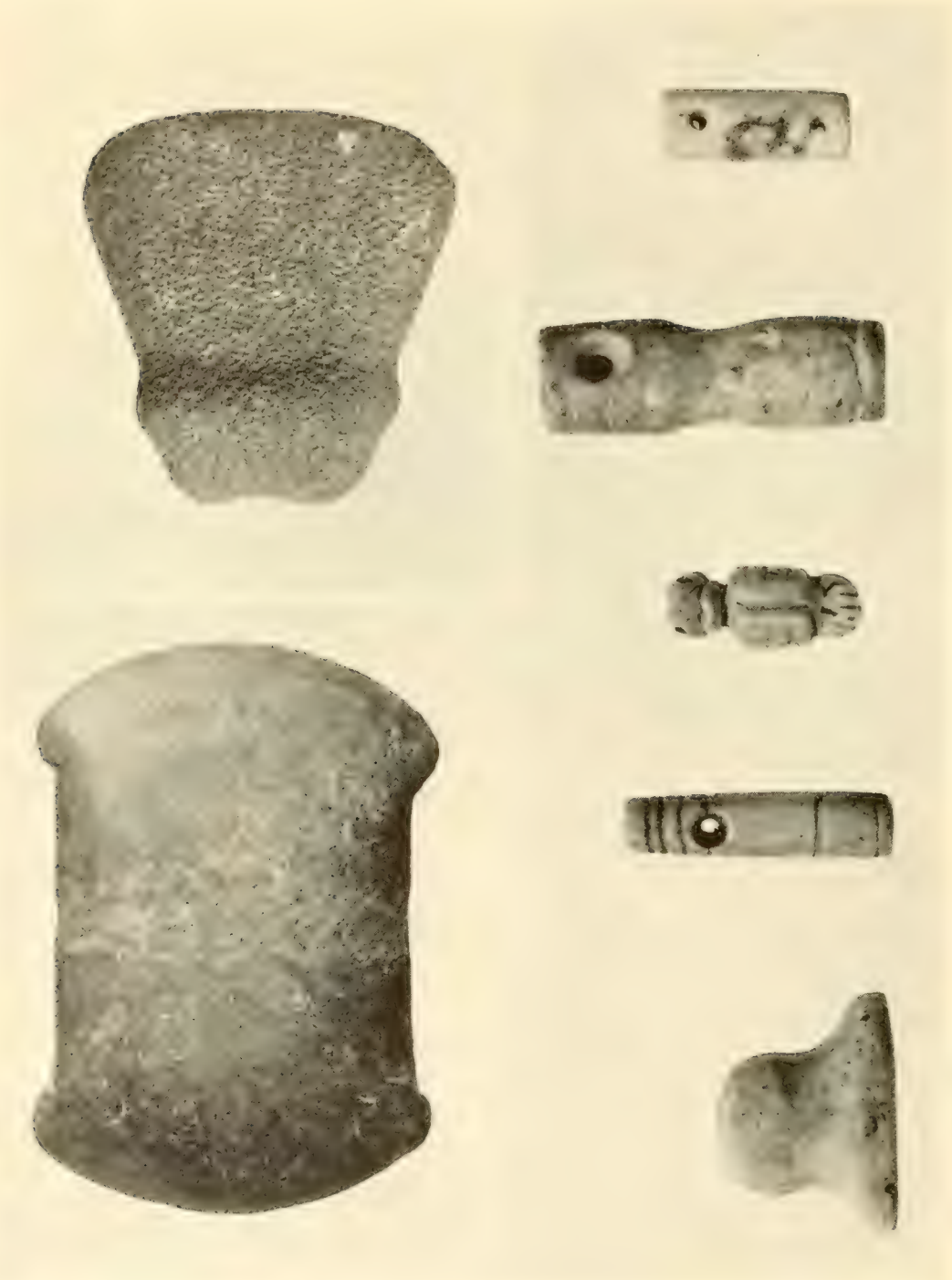


FIG. 128.—Examples of stone carver's art recovered from Arawak kitchen-midden at Andres: Above, unusual forms of stone work in axe blades; below, a labret, pendants, and beads.

FIG. 130.—Another means of transportation in Samaná.

FIG. 129.—Solving the transportation problem, near Jarabacoa.

rocks, including coral beds in the vicinity of Loma de Rio Grande south of Constanza.

The highway across the Cordillera Central from Santo Domingo City by way of the carretera Duarte passes through the town of Bonao, a town of 1,000 inhabitants, and terminates at La Vega. This is a well improved automobile highway and even from the seat of a speeding automobile one obtains a view of the surrounding countryside remarkable for its native and undeveloped beauty. La Vega is reached all too soon and the hunt is begun for a light car to take one on the first lap of the journey into the heart of the Cordillera.

The goal of the journey is the valley of Constanza, well known to naturalists from the days of Humboldt, Schomburgk, and Gabb. In recent years Abbott, Wetmore, Ekman, and others, including Wythe Cook of the survey party conducting a geological reconnoissance of the Dominican Republic, have carried on investigations in their respective fields along the Constanza trail.

One branch of this trail starts at Santiago de los Caballeros, passes southward along the east side of the Rio Yaque del Norte to the town of Baitoa. Later the Santiago trail is united with the La Vega branch of the Constanza trail which is passable for light automobiles, and trucks as far as Jarabacoa, although much work remains to be done in the way of bridge building and grading. The Rio Yami must be forded, as must also the Rio Jimenoa, before the immediate goal, the town of Jarabacoa, is reached, where the automobile is discarded for pack saddle and mule train.

After leaving the valley of the Jimenoa and the proximity of Jarabacoa, the climb up the steep and rocky defile of the Arroyo Baiguate brings one to the top of El Barrero. The narrow trail, following the crests of ridges that buttress the narrow mountain crest, descends the southern slope and again ascends to El Paso Bajito, once more encountering the Rio Jimenoa which is forded at El Rio. Here, in the narrow flat valley may be seen aboriginal earthworks resembling very much those to be described later from Constanza. After leaving El Rio one must ascend another mountain crest, the Loma del Hato Quemado which marks the watershed between the waters flowing east into the Camu and Yuna Rivers which empty themselves into the Bay of Samaná on the Dominican east coast.

Circling along the crests of ridges in a general southerly direction, the trail descends to the narrow valley of the upper Tireo River, a tributary of the Yuna River, where several aboriginal earthworks of the Constanza type were observed. There were also observed scattered groups of the peculiar natural mounds, resulting from exfoliation, but which are locally known as Indian burial mounds.

FIG. 131.—Jarabacoa, a village in the interior mountain valleys of La Vega Province.

FIG. 132.—The village of Constanza, Loma de Rio Grande in the background on the south.

From the valley of the Rio Tireo, the final ascent up the flank of the Loma del Valle brought into view the panorama of the flat valley of Constanza framed by encircling mountains. The valley occupies an area of 30 square kilometers and lies at an altitude of 1,100 meters above sea level. At its southeastern corner two tiny rivulets, the Pantufle and the Rio Constanza, drain the valley and unite to form the Rio Limon. The village of Constanza is sheltered under towering mountains at the northeast corner of the valley. Just north of the village is the largest of the series of parallel aboriginal earthworks, first described by Schomburgk in 1851.

Living quarters were obtained in the house of Señor Felix Matías, a kindly Dominican, whose aid in obtaining permits to carry on excavations was much appreciated and is here gratefully acknowledged. Laborers were readily obtained and within a few days a system of procedure was developed. Two apparently "natural born" archeologists, Antonio M. Garcia, the local weather observer for the Dominican government, and a campesino who answered to the simple name of Pong, began a systematic survey of the surrounding mountains in search of caves or rock ledges containing Indian burials. In this they were quite successful.

In the rock ledge burials on the flanks of the Loma la Cumbre between the Rio Tireo and the Jimenoa; on the slopes of Loma de Rio Grande, Monte Culo de Maco, Loma Rucilla, or Pico del Yaque, Loma Chinguela, and Monte Cucurucho, and of the hills in the more immediate vicinity of Constanza careful search was made for burial offerings. A few stone beads, pendants, zemis, fragments of burial pottery, also a small number of intact earthenware vessels were discovered in juxtaposition to the skeletal remains.

Under the tutelage of a Dominican whose family name is forgotten, but whose given name of Josesito seemed particularly appropriate, the writer began a search within the valley of Constanza for a domiciliary midden sufficiently well preserved to yield cultural material for stratigraphic study. At many places in Constanza valley, also in the upper valley of the Tireo, pottery sherds were examined. Upon investigation the culture deposit invariably proved to be merely a few inches in depth and unsuitable for excavation. Opportunity was seized on these reconnoitering trips to purchase any archeological specimen offered. Soon the entire countryside became engaged in commercial archeology, but the ideal midden deposit remained undiscovered.

Many natural formations resembling small circular artificial earth mounds, said to be Indian burials, were reported from widely separated locations, but on investigation they proved to be unusually ex-

FIG. 133.—Pine forests on the slopes of Loma de Rio Grande.

FIG. 134.—The Rio Grande.

foliated masses of rock and pebbles in circular heaps from five to eight feet in diameter projecting from one to four feet above the surrounding soil level under which lay rock fragments and pebbles similarly exfoliated and disintegrated. The regularity of these natural mounds, dotting a flat valley floor in a striking way, is remarkable. The proof that they could not be aboriginal burials was near at hand if one were provided with pick and shovel. Test holes were made of these peculiar formations at Manabao, also in the valley of the Rio Tireo, and in the valley of Constanza on the otherwise level valley floor between the village of Constanza and the streamlet named Pantufle.

Sir Robert Schomburgk in an article in the Athenaeum published in 1851 reported the presence of an Indian cemetery in the valley of Constanza and offers as evidence the following data: "Nearby is a burial ground toward the foot of the southern mountains of the valley—one hour of brisk walking through pine forests brought us to a rivulet. Here were earthworks of semi-circular form. Crossing the brook were burials covered with greenstone in circular form bounded by the mound, the rivulet, and the pine forest." Obviously Schomburgk did not dig into these mounds as he makes no further mention of them. His observation has, however, been recorded on his map of the Dominican Republic, and for many years thereafter all maps of the country indicated the presence of an Indian cemetery in the valley of Constanza. Nearby, just above the waterfall locally known as El Chorro southeast of Constanza village, begins the rocky crest of a hogback, a long upward-sloping hill, under the scattered comb of which the writer was successful in recovering skeletal and cranial fragments along with pottery offerings. This cyclopean-like outcropping of faulted rock has been mistakenly cited by some writers as an aboriginal monumental wall erected for defense.

The culturally more advanced Arawak of the mountainous interior of Santo Domingo deserve to be classified with the Mississippi Valley mound builders, even though they did not construct burial mounds. Many artificial structures of earth were erected by them principally in the uplifted valleys of the northern central mountain ranges of Santo Domingo. Some of these mounds, varying in height but never exceeding more than a few feet at most, are round, others are rectangular. Most of them, however, are in the form of two parallel embankments. Four series of these parallel embankments were observed by the writer in the valley of Constanza. Their average height is from 3 to 10 feet, with a width of 20 feet in transverse section at the bottom. The mounds are free from rocks and contain

FIG. 135.—Decorated earthenware water bottles in the collection of the Dominican National Museum, Santo Domingo City.

practically no artifacts except occasionally a broken celt, hammerstone, or broken sherd from some water vessel or food bowl. At their bottom beneath the embankment at a level with the adjoining terrain, we again find the same soil that normally appears elsewhere as a surface stratum, showing that the entire structure had been laboriously piled up by the natives with earth from nearby fields for some unknown purpose.

The 1930 season concludes the series of archeological investigations conducted by the Smithsonian Institution and the United States National Museum in the territory of the Dominican Republic. Acknowledgment is made of the courtesy and aid extended by Dominican government officials both in the capital city of Santo Domingo and in the provinces. It is hoped that the work accomplished may be of benefit to students of West Indian archeology generally and to those interested in correlating the northern and southern affiliations of Floridian and of Gulf State mound cultures.

ARIZONA'S PREHISTORIC CANALS, FROM THE AIR[1]

By NEIL M. JUDD,
Curator, Division of Archeology, U. S. National Museum

Out in central Arizona, where cotton fields, citrus groves and date palms reach out across endless miles to caress jagged igneous and sandstone buttes, prehistoric peoples once erected a noteworthy civilization upon an agricultural foundation. That ancient civilization is gone now—lost with the desert acres on which it flourished—and few traces remain of the gigantic canals that made its primitive agriculture possible.

But those few traces merit careful preservation. They are all we have left to remind us of that unnamed, aboriginal folk whose engineering achievements rightfully arrest the attention of our mechanical age. For those prehistoric canals—it has been estimated that half a century ago there were no less than 300 miles of them in the Salt River valley alone—were so accurately and efficiently constructed that portions of them, taken over by white settlers of 1870 and thereabouts, are actually in use at the present time. And here is another point we are apt to overlook: Every mile of those ancient channels was literally dug by hand, since the Arizona Indians knew nothing either of beasts of burden or metal tools until well on in the seventeenth century.

Following the old canal banks, one occasionally happens upon the fragment of a stone "hoe"—a thin blade of igneous rock, chipped on one side to a cutting edge. With such rude tools, with fractured cobblestones and sharpened sticks, the canal builders hacked and prodded at the hard desert soil. In baskets and blankets, we may safely conjecture, women and children carried the loosened earth out from the excavation. Thus, mile after weary mile, an entire community labored to construct the canals that watered their communal fields.

Nowhere else in the New World has evidence been found of prehistoric irrigation systems comparable to those of central Arizona. They may even have surpassed, both in size and in the number of acres served, those famous systems of the Tigris and Euphrates valleys—irrigation works that watered the seed of native ability and

[1] In December, 1930, Mr. Odd S. Halseth, of Phoenix, was continuing certain studies connected with this aerial survey, in behalf of the Bureau of American Ethnology.

FIG. 136.—Prehistoric Indian canal east of Mesa, Arizona, partly reconditioned and used by Mormon pioneers of 1878; subsequently replaced by the modern Consolidated Canal. (Photograph by Sgt. R. A. Stockwell; courtesy of the Chief of Air Corps, U. S. Army.)

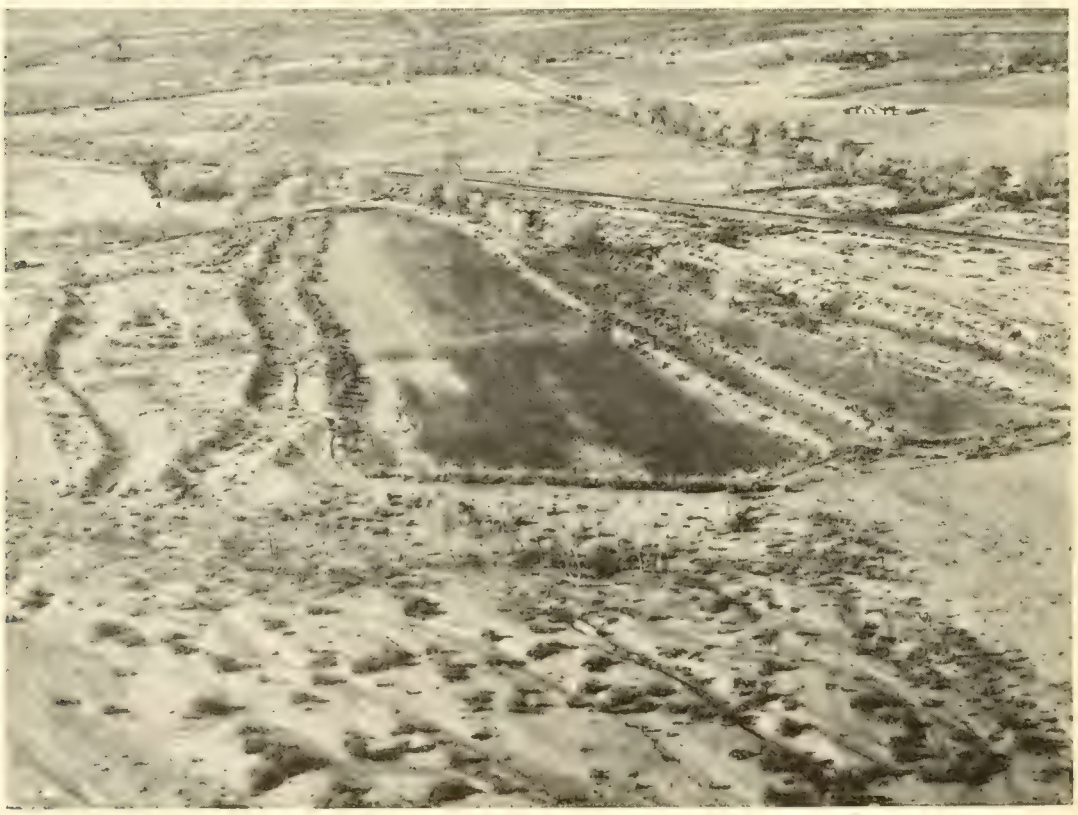


FIG. 137.—"The Park of Four Waters," near Phoenix, preserves remnants of old Indian canals and the "Swilling Ditch" of 1867. On the right margin, close above the Grand Canal, Pueblo Grande ruin shows through the trees. (Photograph by Sgt. R. A. Stockwell; courtesy of the Chief of Air Corps, U. S. Army.)

brought forth into full bloom high civilizations that made Mesopotamia known throughout the ancient world.

With prodigious labor, the Peruvians of pre-Spanish times led irrigation ditches along craggy heights of the Andes to their terraced gardens. Among the highlands of Mexico and again in various sections of the southwestern United States, Indian farmers had learned that irrigation was necessary to the successful cultivation of food crops. In November, 1694, Padre Eusebio Kino stood before the drab walls of Casa Grande ruin and speculated upon the feasibility of restoring its abandoned, overgrown canals. Five hundred years before Kino was born the inhabitants of Pueblo Bonito, in Chaco Canyon, New Mexico, were capturing the mid-summer rains, taming and guiding them onto thirsty fields. But none of these efforts matched the colossal, prehistoric irrigation systems of the Gila and Salt river valleys.

We wanted maps of these latter, hand-made Indian canals. We wanted to know their extent, their position relative to each other, the approximate acreage they once watered. Similar desires on the part of other observers had prompted surveys which were not altogether successful for the very simple reason that so little is now visible of the ancient ditches. Modern agriculture has been too destructive; it has plowed and planted until the aboriginal farming communities and their works were pretty thoroughly obliterated. From the ground, one's range of vision is too limited; from the air it might be possible to recover data for the maps we had in mind. At least this seemed the most promising, expeditious method when I made a preliminary study of the situation in the autumn of 1929.[1]

So, at the solicitation of United States Senator Carl Hayden, the Smithsonian Institution and the War Department cooperated in an aerial survey of the Salt and Gila river valleys, beginning late in January, 1930. Lieutenant Edwin Bobzien and Sergeant R. A. Stockwell, pilot and photographer, respectively, were detailed from the Air Corps unit at Crissy Field, San Francisco, and I was designated Smithsonian representative, to advise with the aviators.

Our small party assembled at Phoenix, blocked out the areas to be photographed and speedily set to work. Smoke and ground haze drew an impenetrable blanket over Salt River valley each morning and evening, thus restricting flying time to a brief two hours at midday when shadows are at a minimum. The longer shadows of early morn-

[1] Explorations and Field-work of the Smithsonian Institution in 1929, pp. 177-182. Washington, 1930.

ing and late afternoon would naturally have thrown into greater relief those slight elevations which mark ancient house sites and irrigation ditches.

But, despite handicaps of various sorts, our air survey proceeded about as we had planned it. First of all there was the Gila River valley, from its union with the Rio Salado to the northwestern slopes of the Tortilla Mountains—a far-reaching plain whereon Pima and Papago farmers tilled favored patches of irrigable land long before the advent of missionaries, trappers, Pony Express riders, and other pioneers of a period now all but forgotten.

American settlers trailed into the upper Gila valley during the third quarter of the nineteenth century and drew so heavily upon the available water supply that the Indian farmers below were finally brought to a state of destitution. Government promises of relief were made and remade but a half century passed before the Coolidge Dam was completed and provision thus made to meet the needs of whites and Indians alike. The great reservoir is slowly filling and, 70 miles away, farm lands wait thirstily for the life-giving waters.

With huge, snorting machines that make an Indian's home-made tools seem, by comparison, as nothing at all, 56,000 acres of desert land are being cleared, leveled, and otherwise prepared for irrigation at the rate of 20 acres a day. But the mechanical monsters of the modern engineer are no respecters of prehistoric canals! The latter were being destroyed along with other heritages from the past. Ours was the task of discerning and recording some vestige of those ancient irrigation systems while fleeting opportunity permitted.

Up one side of the Gila and down the other, Lieutenant Bobzien held his blue Douglas observation plane on a fixed course at 10,000 feet elevation while Sergeant Stockwell pointed his camera through a hole in the floor and snapped the shutter with clock-like precision to picture a square mile on each successive negative. Over famed Casa Grande ruins the ship sailed lower in search of those ancient canals seen by Kino and which new cotton fields seem to have erased absolutely. And then back to the Indian gardens that border the meandering Gila from Sacaton to Pima Butte and beyond.

Like strips of Grandmother's quilt those gardens are! Queer, misshapen patches with thin ribbons of dark green running this way and that where lesser irrigation ditches crazy-stitched the variegated scraps together. Yet, hopelessly confused and insignificant as these miniature farms appear from a height of nearly two miles, they played a not unimportant part in the conquest of southern Arizona.

FIG. 138.—Prehistoric canals on north side of Salt River, north of Mesa, Arizona. (Photograph by Sgt. R. A. Stockwell; courtesy of the Chief of Air Corps, U. S. Army.)

Indian farmers tended those fertile fields for untold generations before Francisco Vásquez de Coronado and his band of resolute adventurers marched gayly northward out of Mexico in 1540 to dig mythical gold from the Seven Cities of Cibola. When Padre Kino came plodding his patient way toward salvation of the Pima and Papago tribes late in the seventeenth century, those funny Indian gardens fed his men and mules. And they supported, too, the westward-bound gold-seekers of '49; the animals and personnel both of the Pony Express and the later stagecoach companies; the U. S. Army units stationed in Arizona before and after the Civil War. Except for those gardens and the Pima and Papago scouts who served so faithfully throughout the protracted Apache campaign, Victorio and Geronimo doubtless would have continued their murderous depredations for still another decade. The peaceful Indian tribes of the Gila valley have well merited, and with interest, the Government-aided irrigation system which once more makes possible the successful cultivation of their Lilliputian farms.

In the Salt River valley, prehistoric peoples also converted cacti-covered wastes into gardens of maize, beans, and squashes. They built, nearby, thick-walled, flat-roofed homes of mud, pressed and patted into layer upon layer. Here, as along the Gila, industrious generations dwelt in peace and plenty, tending their growing plants, digging new ditches, hunting deer among thorny mesquite, until some great, irresistible force came finally to claim possession. What that force really was no one knows today. It may have been a slight diminution in annual rainfall; more likely, it was increasing pressure from nomadic tribes. But, in either case, after a period which none may yet measure, the Indian farmers of the Rio Salado vacated their cultivated fields, abandoned their compact settlements and moved on to other, perhaps less favored localities. Substantial dwellings crumbled into low, spreading mounds; irrigation systems slowly filled with wind-driven sand; the desert crept back to claim its own.

Not until the middle nineteenth century did Salt River valley reawaken to such industry as it had known in prehistoric times. Not until 1865, or thereabouts, did hardy pioneers follow in on the dim trails of the beaver trappers and the gold-seekers to select the thorny plains of the Rio Salado as a likely place in which to build their humble homes.

Among these pioneers was one Jack Swilling, somewhat more imaginative than his neighbors, who appears to have been the first to recognize the possibility of local irrigation. Obviously influenced by the nearby prehistoric canals, Swilling started to clear out one of

FIG. 139.—A section of an ancient Indian canal west of Granite Reef dam. (Photograph by Judd.)

FIG. 140.—A partially destroyed ancient Indian canal west of Granite Reef dam, lying 25 feet above the present bed of Salt River. (Photograph by Judd.)

these as a ready means of watering his own fields. And then, in 1867, he organized the company which constructed the first modern canal in Salt River valley.

Remnants of this old " Swilling ditch " and sections of three ancient Indian canals are still visible in " The Park of Four Waters," wisely preserved by the city of Phoenix. Close by stands the ruin of Pueblo Grande, a huge pile of crumbling walls and pale yellow clay, excavation of which was initiated in 1929 by City Archeologist Odd A. Halseth.

Largest surviving example of the communal dwellings which dotted Salt River valley in prehistoric times, Pueblo Grande marks a former center of population from which industrious Indian farmers trudged forth to their daily toil. From the flat roofs of their earth-walled homes those same farmers saluted the rising and setting sun as the father of all living things. For in olden times, no less than today, the sun meant life to dwellers in Salt River valley.

Over on the south side, Pioneer Charles T. Hayden camped one day at the foot of Tempe Butte and watched the swollen river race past. Then he constructed a rude ferry to float his wagons across; remained to transport other early settlers, to build the first local store, walled with mud-plastered willows. More than this, he cleaned out an old Indian canal and drew into it, from the Rio Salado, water with which to turn the wheels of his primitive mill. The new Hayden mill, erected on the same site, is no longer powered by an irrigation ditch but it served, nonetheless, as one of our principal landmarks in the recent aerial survey of Salt River valley.

Mormon settlers came, in 1878, to found the contented village of Mesa; to recondition other abandoned Indian canals and thus save their pioneer community an estimated $20,000 in labor alone. Part of one such rebuilt ditch is still in use but, as elsewhere in the valley, increase in population has brought about larger, more serviceable canals with their far-flung network of laterals.

Inquiry elicits the information that there are no fewer than 1,200 miles of these modern watercourses. Most of them measure from 18 to 90 feet wide at the top and average about five feet in depth; sections of them have cost as much as $22,000 a mile to construct. But the prehistoric canal builders, with barefooted helpers instead of caterpillar tractors, with stone hoes as precursors of the steam shovel, unhesitatingly set about the completion of comparable works. I photographed one aboriginal canal north of Mesa that stands today 66 feet wide and 8 feet deep. It led from the Rio Salado far across the valley; as the river cut its channel below the canal floor, the useless ditch

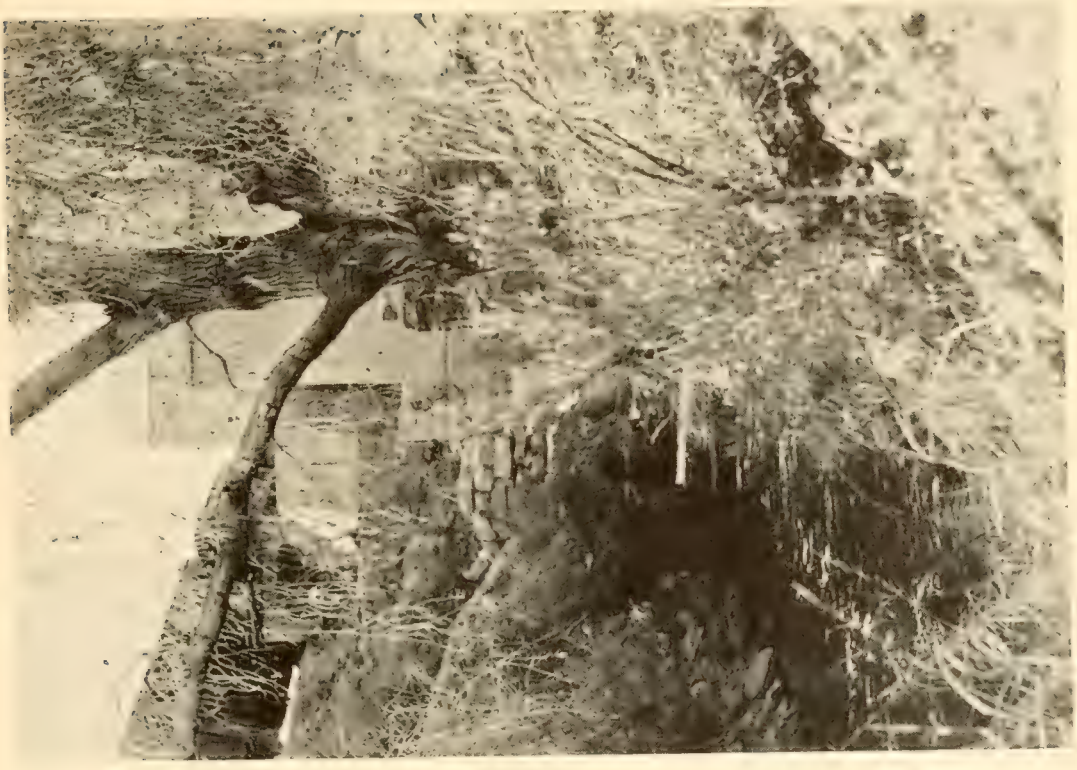


FIG. 142.—Reconditioned Indian canal at Hayden's Mill, near Tempe Butte. (Photograph by Odd S. Halseth.)

FIG. 141.—Lieut. Bobzien (left) and Sgt. Stockwell preparing for a mid-day flight. (Photograph by Odd S. Halseth.)

was replaced by another which connected with a new intake, farther up stream. Such substitutions were necessitated by altered conditions in prehistoric times no less than today.

Modern irrigation canals and the industry they symbolize have done most to erase from central Arizona former vestiges of that native civilization which once prospered there. The sad ruins of aboriginal homes have been leveled with their neighboring fields; the ditches which once watered those fields have been filled or scraped away. Where Indian farmers eight or ten hundred years ago cultivated gardens of beans, maize and squashes, vast acres of cotton, lettuce and melons are now harvested. Neat orchards of dates and grapefruit flourish where catclaw and mesquite stretched their spiny branches only a generation ago. The diabolical Apache has been tamed if not conquered. Bow-legged cowboys, garbed according to the latest fashion notes from Hollywood, ride herd on eastern "dudes." Attractive dwellings and sumptuous winter resorts, with green lawns and flower-bordered walks have replaced the mud-walled habitations of the ancient folk.

As one looks down from the air upon this Paradise that is Salt River valley today, one is impressed first of all by the orderly habits of mankind. At least there is a semblance of order, from a height of 2,000 feet or more. Long, straight roads on which autos slither away like headless roaches; brown and yellow fields all nicely squared; orange trees that seem as tiny pellets of dark green, patiently arranged, row upon row; little cubed houses, fringed with flat green things.

Reaching across these fields and under these houses, light or dark streaks mark former prehistoric Indian canals which only the aviator may readily detect. Silt deposited in those old ditches shows dark brown against the drab desert soil; pale yellow lines remain where embankments have been smoothed away. Slight differences in vegetation, imperceptible when close at hand, take on color variations that enable one at a considerable height to retrace works which otherwise have been wholly effaced.

The blue Army plane glides down from the clouds and back to port with numbed crew and empty cameras. Camel Back Mountain squats complacently at one side and looks out across the valley where such momentous changes have taken place within memory of men still living. Squaw Peak lifts her unkempt bulk to frown upon this new civilization, as she did upon the old. A setting sun momentarily gilds the giant sahuaro whose long, fingered shadows point eastwardly to rugged mountain ranges whence flow the life-giving waters of the Gila and the Rio Salado.

MOUNDS OF THE VANISHED CALUSA INDIANS OF FLORIDA

By M. W. STIRLING,
Chief, Bureau of American Ethnology

When the Spaniards first visited the west coast of Florida early in the sixteenth century, the region from Tampa Bay southward to the Keys was occupied by the Calusa Indians. At this time they were an important tribe, but in common with the other aboriginal Indians of Florida they disappeared rapidly upon contact with the whites. Unfortunately no early traveler has left an adequate description of this interesting group. As a result we must depend almost entirely upon the results of archeological investigations in reconstructing their mode of living.

It was for the purpose of continuing such researches that the writer visited Florida during February, March, and April of 1930. Through the kindness of Mr. Lee Parish, the writer was enabled to accompany him on his yacht *Esperanza* through the intricate channels of the Ten Thousand Islands, where a number of old village sites were located and excavations conducted on a typical southern Calusa mound on Horr's Island. Numerous trade objects of European manufacture discovered in course of the excavations helped to confirm the writer's previous view that the mounds of the Ten Thousand Island district are probably the most recent in Florida. It was in this hidden and comparatively inaccessible region that the Calusa Indians finally retired as a result of pressure from the north and here made their last stand against encroaching civilization. Here and there among the maze of keys comprising the Ten Thousand Islands is one which has caught the wind-blown sand in such a manner as to build it up, forming " high ground " above the level of the surrounding mangrove swamps. Such localities were invariably utilized by the Indians as places of abode, the height of the ground in most instances being considerably augmented by the accumulation of shells and village débris.

On the east end of Horr's Island is a rather extensive shell deposit now overgrown with a dense underbrush. Three hundred yards to the eastward of the village site is a sand burial mound 35 feet in diameter and 7 feet in height. Working among dense clouds of mosquitoes and sand flies, we excavated a sector of the mound comprising about one-third of its volume. Seven burials were encountered,

FIG. 143.—Mr. Lee Parish standing beside our mosquito-infested camp on Horr's Island.

FIG. 144.—The sand mound at Safety Harbor looking toward the bay. Before excavation the surface of the mound was covered with a dense growth of trees and underbrush. In its original condition the mound was 13 feet high.

FIG. 145.—The large shell mound at Safety Harbor as it now appears overgrown with vegetation. This flat-topped mound was once the substructure for an Indian temple.

FIG. 146.—Where the waters of Tampa Bay are cutting away the village site at Safety Harbor. Many relics were found along this stretch of beach.

FIG. 147.—Removing the top level of the Safety Harbor burial mound. In this level several articles of European manufacture were discovered.

FIG. 148.—As the burial mound appeared with excavations well under way. To prevent caving, the mound was excavated by a series of trenches.

all within 3 feet of the surface. These were secondary interments and in no instance was the skeleton complete. Objects accompanying the burials were scarce, consisting only of glass beads, an unidentified iron object with crude repoussé designs upon it, perforated *Arca* shells and conch shell cups.

After completing the work in Ten Thousand Islands the writer proceeded to Lacoochee, Florida, where a mound on the south bank of the Withlacoochee River was excavated. Upon the completion of this task a site was selected at Safety Harbor, at the head of Old Tampa Bay, where excavations were undertaken on the property of

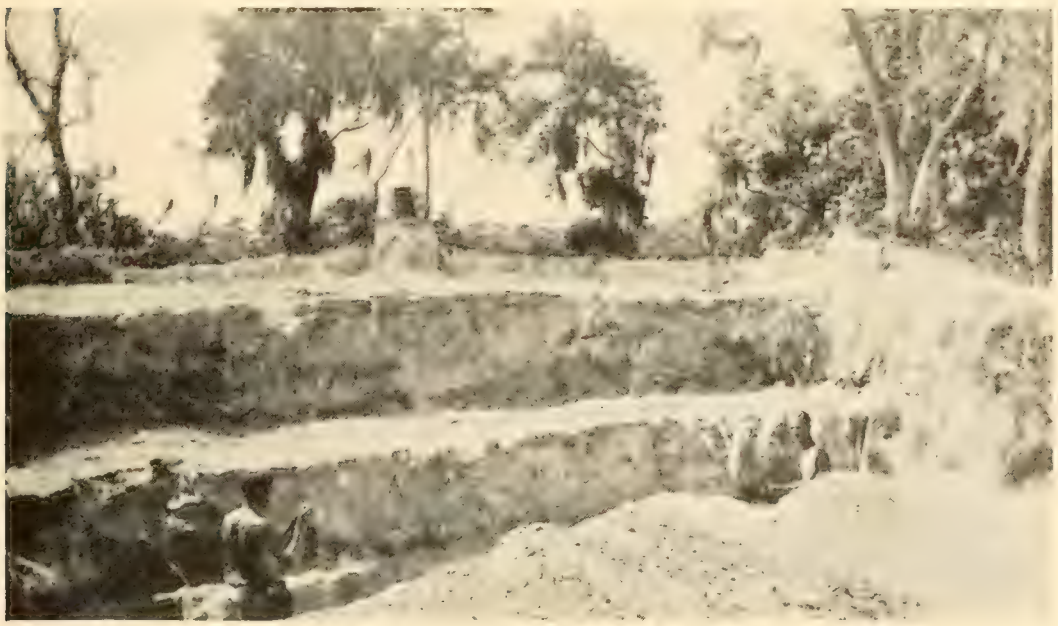


FIG. 149.—With the top of the mound removed. Showing the method of excavation of the Safety Harbor burial mound. The men are standing on an ancient ash bed at the base of the structure.

Col. Thomas Palmer, to whose interest is due the preservation of this interesting mound group. Permission was generously given to the Bureau for the excavation of the large burial mound.

The principal mound of the group is a large, flat-topped shell mound with precipitous sides. The waters of the bay have gradually encroached upon the site until the northern and eastern edges of the mound are but a few yards from the water. Extending eastward from the mound is a long sand spit which was formerly dry land and the site of part of the village to which the mound belonged. Fifty yards west of the large mound is a small shell mound about 7 feet high, while 50 yards west of this is a low circular shell mound 45 feet in diameter.

Four hundred yards to the west of the large mound is a sand burial mound. This mound had been considerably dug over on the surface by pot hunters, but it was so large that none of the diggers had penetrated very far. Just east of the mound was a deep circular depression from which the material was taken for its construction. The complete excavation of this mound showed that it had been raised by gradual stages, the burials being of a secondary nature and placed without order. Over 100 burials were removed and a considerable archeological collection obtained. The presence of such articles as a silver tubular bead and an iron ax with burials in the top portion of the mound showed that the latter stages were post-Columbian. No such objects were found in the lower levels of the mound, where artifacts of any kind were rare. Pottery, except for a few shards, was found only on the surface at the base of the mound where food bowls had evidently been placed as offerings, without interring them.

From the evidence gathered from the mound and village site it is probable that this village was occupied at the time De Soto visited Tampa Bay and continued to be inhabited for a considerable period subsequently. Because of the fact that it bridges the period between the historic and the prehistoric, it is of unusual interest to archeology.

ARCHEOLOGICAL RECONNAISSANCE IN TEXAS AND NEVADA

By M. W. STIRLING,
Chief, Bureau of American Ethnology

An important area marginal to the well-known culture centers of the pueblo section of the Southwest is the so-called Big Bend region of Texas. During the latter half of July, 1930, the writer went to Marfa, Texas, for the purpose of examining a number of caves which had been reported to the Bureau of American Ethnology from that region. Through the kindness of Mr. L. F. Curl of the Department of Agriculture, it was possible to visit all of the more promising localities within a radius of 30 miles from Marfa. Several caves containing pictographs were examined in the vicinity of Limpia Canyon north of Marfa, and on the Knight ranch 18 miles southwest of Valentine a number of very interesting caves were examined and selected as sites for excavation in the near future.

Leaving Texas the writer proceeded to Deeth, Nevada, where in company with Mr. William Murdock a number of caves and archeological sites were examined in the territory lying between the Ruby and Jarbidge Mountains. On the west side of Marys River, about 10 miles north of Deeth, a low flat-topped hill about 75 yards wide and 200 yards long rises from the sagebrush plain. It is capped by a conglomerate rock which has been undercut by the river so as to form a number of rock shelters, most of which are now almost entirely filled with débris. Most of these are smoke-blackened and show abundant evidences of habitation. About 10 yards below the largest of the shelters is a large flowing spring. A test pit dug in the floor of this cave revealed fragments of badly decayed matting, burned bones, flint and obsidian rejects. The flat top of the hill is littered with arrowheads, flint implements and rejects.

Several miles northwest of this site in the midst of a large bowl of barren desert hills stands a giant geyser cone about 300 feet in diameter. The Ute Indians of the region have the tradition that in the old days captives were disposed of by throwing them down the crater of this cone into the boiling water which still fills the throat of the cave. The geyser is no longer active as the water has broken through at the base, where a large hot spring now flows.

FIG. 150.—Cave formerly occupied by Indians on the headwaters of the Bruneau River in northeastern Nevada.

FIG. 151.—Hot Spring Butte, a giant geyser cone on Marys River, Nevada.

FIG. 153.—Opal quarry in Elko County, Nevada, where the Indians obtained material for manufacturing knives and arrowheads. The white flakes on the ground are quarry rejects.

FIG. 152.—Looking down the crater of Hot Spring Butte. Formerly the Ute Indians disposed of captives by hurling them from this natural platform into the boiling water 30 feet below.

Northward from this point the watershed between the Snake River and the Humbolt is crossed. Here on the headwaters of the Bruneau River several caves were visited. In the vicinity of Coyote Lakes a very interesting outcrop of white opal was discovered. This had been intensively quarried by the Indians. Most of the implements discovered for many miles around appear to have been made of material from this quarry or from obsidian obtained from the lava beds farther to the north. The entire region, which is well watered and abundantly supplied with game, made an ideal environment for the Indian, excepting for the one drawback of a very severe winter climate.

A PREHISTORIC VILLAGE ON THE ZUÑI RESERVATION, NEW MEXICO

By FRANK H. H. ROBERTS, JR.,
Archeologist, Bureau of American Ethnology

One of the most interesting groups of small house remains which thus far has come to light in the Southwest was uncovered by the writer in western New Mexico during the summer of 1930. The ruins are located 16 miles northeast of the Indian village of Zuñi, on the Zuñi Reservation, at the juncture of Red Paint and Nutria canyons. Three communal dwellings and two large ceremonial chambers or great kivas comprise the cluster. Although numerous investigations and extensive explorations have taken place in that region since it was first traversed by Coronado and his adventurous soldiery in 1540, few seem to have observed and no one has recorded the existence of these particular ruins. They were virtually unknown to the white inhabitants in the vicinity and most of the Indians were not aware of their presence. In contrast to numerous other house and village remains on the reservation, there is no Zuñi name for this group.

That the ruins escaped notice for so long a time may be attributed to their inconspicuous nature. Lying on the talus at the foot of a series of low cliffs the stone and grass-covered mounds appeared, unless closely observed, to be a part of the natural formation (fig. 154). The writer found them while conducting a reconnaissance on the reservation during the latter part of May. Their possibilities were so alluring that steps were immediately taken to have the permit which had been issued for another site changed to allow investigations at this place. The Department of the Interior, upon the recommendation of its archeologist, readily acceded to the request, and after a camp had been established excavations were started.

When the season was brought to a close late in September two of the houses and a number of ceremonial chambers had been excavated and three refuse mounds had been thoroughly explored for burials (figs. 155, 156, and 157). The larger of the two houses had contained 64 rooms and 3 average size circular ceremonial chambers or kivas, and had a great kiva joined to its southern side. South of the main building and completely subterranean in character were four more ceremonial chambers. The smaller of the two structures had contained

FIG. 154.—Site at the beginning of excavations. Camp of expedition in the background.

FIG. 155.—Same view as figure 154 taken at the end of the season. Large structure in foreground and small house at right center of picture. Two great kivas appear in central part of the photograph.

only 20 rooms and in contrast to its larger neighbor had no circular chambers. Lying in the court formed by the two buildings, and completely detached from them, was the second great kiva. South of it was the mound covering the third house, which had been a very small dwelling (fig. 158). It was not possible to excavate the isolated great kiva, but its walls were traced in order that the size could be determined and the structure properly plotted on the map of the site. Only one room was excavated in the small structure to the south. This was sufficient to indicate that the building had been of the same general character as the other small dwelling.

The largest of the houses shows only 60 rooms on the ground plan (fig. 158). The four additional chambers constituted a second story in the central portion of the building. The rest of the structure had been but a single story in height. Evidence showed that it had not been erected as a complete unit and that it was not occupied in its entirety at any time. The central block and great kiva constituted the original part of the structure. The east and west wings and the series of chambers south of the main block and east of the great kiva were subsequent additions. Masonry in the walls of the later portions was inferior to that in the old section and the outlines of the rooms are so irregular that it would seem that they may have been built by a different group of people. Walls in the original section were constructed of well dressed stones, long and tabular in form, and are characterized by alternating thick and thin courses. This feature is one which is outstanding in some of the ruins in the Chaco Canyon 85 miles northeast of the Zuñi district. The walls in the later additions were formed from large blocks of stone, not particularly well shaped for the purpose, and were not carefully laid. A considerable part of the older section was abandoned after completion of the newer units. This was evidenced by the fact that several of the rooms and two of the kivas were completely filled with refuse of the kind which accumulates around an occupied village.

The ceremonial chambers dug into the earth in front of the structure appeared to have belonged to the later sections of the building. Both these and the ones located within the mass of the house are of interest because they show a decided northern characteristic in the deep niche or recess at the southern side. Two of the kivas were found to contain features which thus far have been observed in only a very few examples of small ceremonial chambers. They are long, rectangular pits or vaults at the west side of the room (fig. 161). There is no satisfactory explanation as to their purpose and the Zuñi

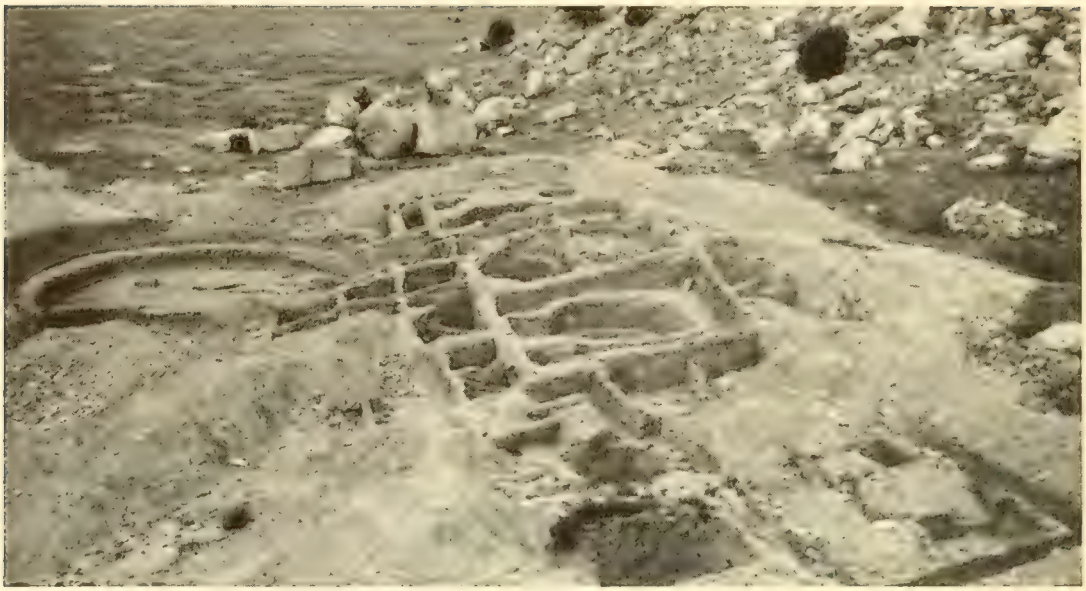
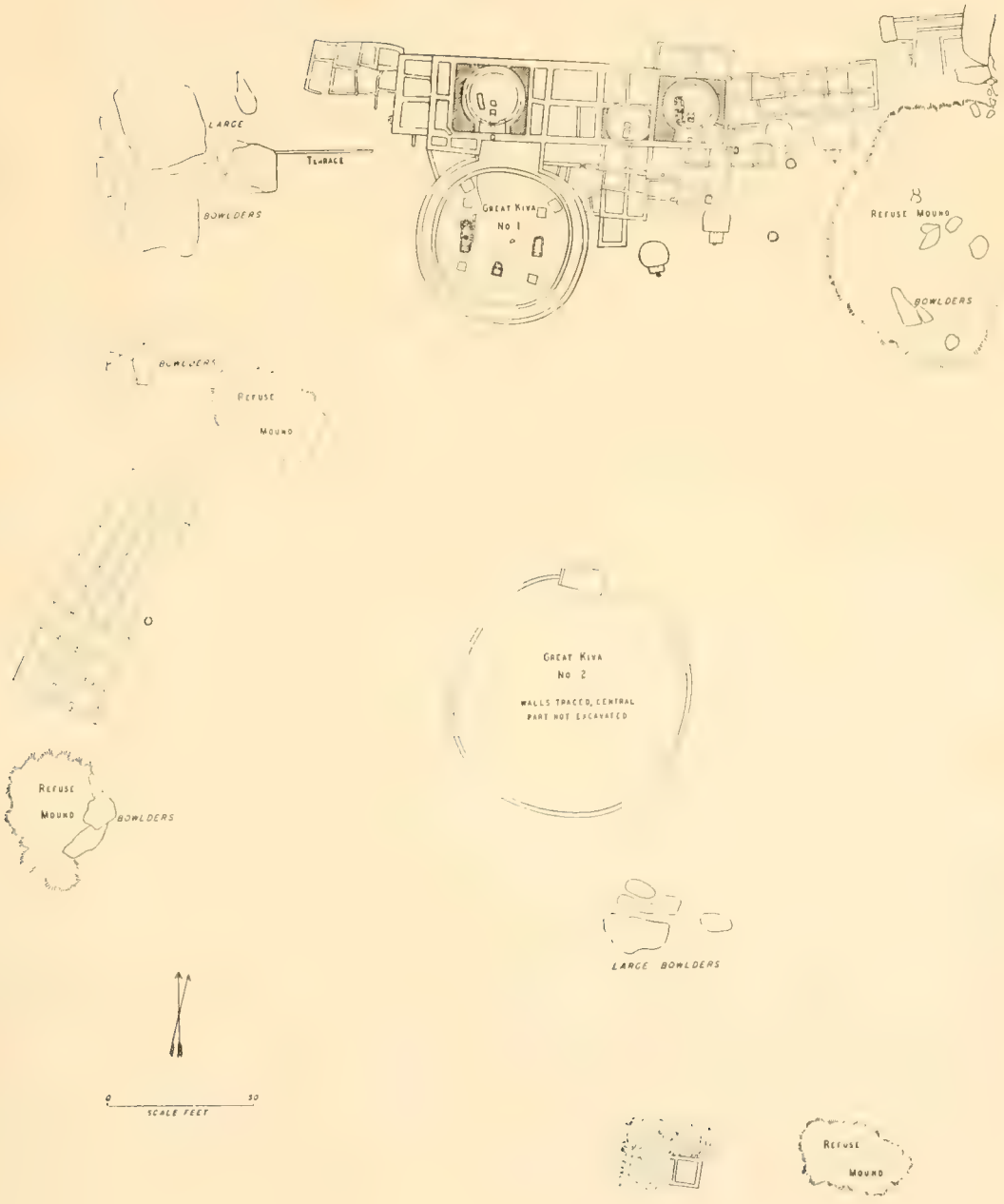


FIG. 156.—Large ruin from the east end. One of the great kivas at left center of picture.

FIG. 157.—Portion of the small ruin.



MAP OF RUINS AT MOUTH OF RED PAINT CANYON

FIG. 158.—Plan of the house group.

could give no reason for their presence. Similar vaults form one of the typical elements in great kivas but are not common in the lesser chambers.

The small house did not give evidence of growth stages as distinct as those observed in the large building. It did show, however, that a fairly small structure had been enlarged from time to time by the erection of additional rooms. The walls, like those in the later portions of the large structure, had been built of cubical blocks of stone. But in contrast the material in this building had been worked and shaped to a greater degree and more care had been expended in the construction. The dwelling may have been erected by the same group which built the later portions of the large structure, but they were more particular about results in this instance. The lack of ceremonial chambers in the block of the building, as well as their absence in the earth outside, presents a perplexing problem. One explanation for the condition is that the people from this dwelling may have joined those in the large structure in the performance of sacred rites and for that reason did not construct chambers of their own.

The finding of two great kivas is significant. They demonstrate that the type had a wider distribution than has heretofore been suspected and are another indication of a Chacoan element in the community. Investigations in the Southwest have shown that such structures are always associated with some form of that culture. Great Kiva No. 1 was completely excavated, and it revealed all of the essential characteristics of such a building. Because of this it may be supposed that they also were present in the other one. Great Kiva No. 2 is the largest yet discovered. Casa Rinconada in the Chaco Canyon has long been regarded preeminent among super ceremonial houses, but it must yield to the one in this group. Great Kiva No. 2 averages 78 feet in diameter while Casa Rinconada is only 72 feet across. Great Kiva No. 1 is larger than many great kivas. Its average diameter is 55 feet. These super kivas represent a tremendous amount of labor on the part of people equipped only with stone implements and must have been of great importance to them. The exact function of such structures is not known but it is probable that they were dedicated to the performance of major communal ceremonies whereas the lesser observances took place in the small circular chambers. Two great kivas in a community as small as this might imply that the ceremonial side of its life was overemphasized. It is possible, however, that this was the religious center for the whole district. Within a radius of several miles are many house sites, none

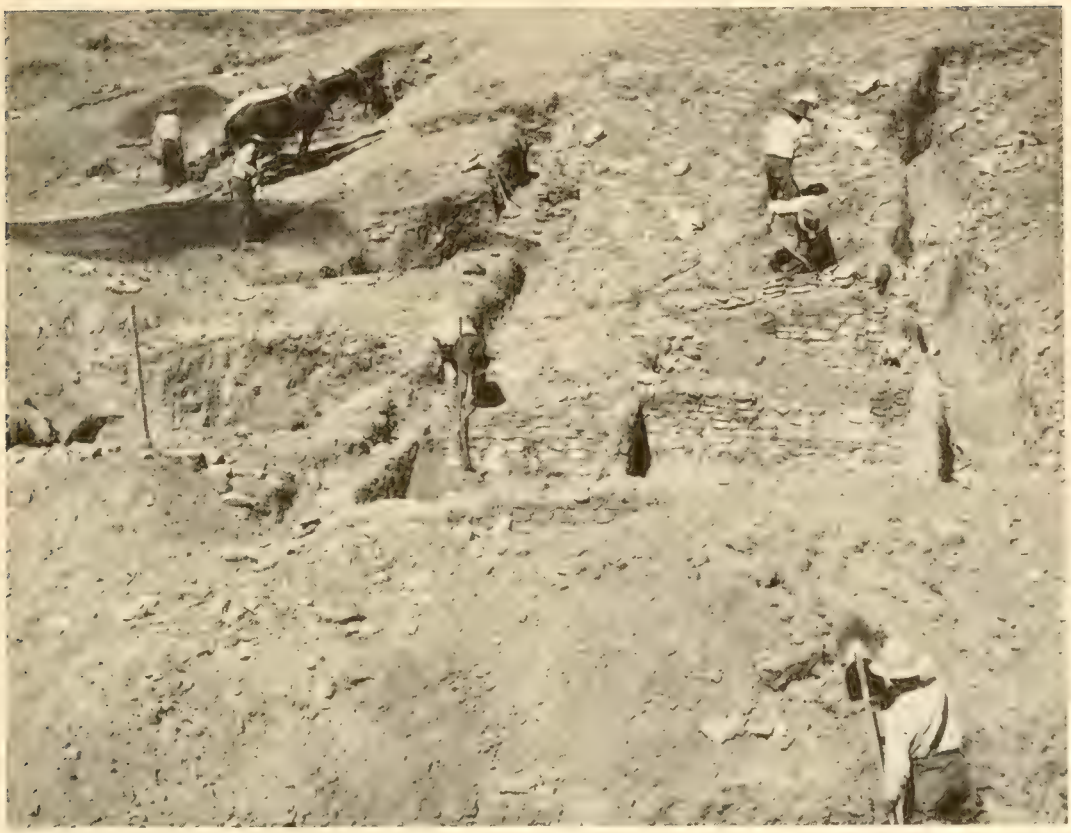


FIG. 159.—Starting the excavation of the large ruin.

FIG. 160.—Removing débris from the small house.

of which indicates the presence of a large ceremonial structure. Consequently it may be postulated that all of the people in the valley gathered here during periods of exceptional liturgic importance and participated in the religious rites appertaining to the super kivas.

The excavations yielded, in addition to the information on house types, 400 specimens of the people's handicraft. The collection includes pottery vessels, stone and bone tools, ornaments, and a number of stone images. The pottery consists of two groups, painted

FIG. 161.—One of the ceremonial chambers in the large ruin. Portion of subfloor vault shown in lower right corner of picture. Fire pit and ventilator opening in front of Indian boy.

and unpainted wares. The latter comprise the culinary jars. The painted vessels are of the black-on-white and black-on-red varieties. Both classes contain specimens typical of the Chaco Canyon wares and of the ceramics of the Upper Gila region to the south. Other examples indicate that the characteristics of the two cultures were blended to form a local ceramic type. Of the other groups of objects the stone images are the most interesting. They are the heads of animals but probably are only symbolical, as the creatures depicted cannot be accurately identified. They may have been the symbols of the clans which dwelt there. This is suggested by the fact that they were found in the small ceremonial chambers.

FIG. 162.—Group of prehistoric pictures on cliff back of large ruin.

FIG. 163.—Modern drawings made by Zuñi Indians.

The specimens were obtained from the houses and the graves. Burials were for the most part located in the refuse mounds. The remains of 60 individuals were uncovered and in all but one instance funerary offerings were found near the head. In the case of the single exception the pottery accompanying the body had been placed at the feet. This was probably due to an error and the unintentional reversing of the body bundle, because all of the other interments had the head to the east while here it was to the west.

Additional examples of the handiwork of the inhabitants of the community are to be observed along the cliffs to the north of the large structure. Here a large number of figures were cut and pecked into the rocks. They occur singly and in groups. One cluster is especially interesting because of the variety of things represented (fig. 162). In addition to strictly geometrical patterns, there are numerous quadrupeds, a humpbacked flute player, a human hand, and a great diversity of serpent symbols. Not far from this prehistoric series of rock drawings is a group of pictures made by some of the present day Zuñi. The contrast between the two sets of figures is striking. The modern examples are done in color and are quite lifelike in character (fig. 163).

As a result of the summer's investigations it is possible to state that this community belonged to the great period of the prehistoric Pueblos, the era which is designated Pueblo III in southwestern chronology. The houses were probably built and occupied late in the 12th century A. D. Evidence also shows that there was a fusion of two groups of people at this location. One came from the Chaco area in the north and the other from the Upper Gila villages in the south. This is the first time that a complete group belonging to this phase of Pueblo development had been thoroughly excavated in the Zuñi region and the information obtained from it will be of considerable help in the solution of problems pertaining to the district.

STUDYING THE INDIANS OF NEW MEXICO AND CALIFORNIA

By JOHN P. HARRINGTON,
Ethnologist, Bureau of American Ethnology

The old dogma of the textbooks that the Pueblo Indians of New Mexico and Arizona speak four stock languages unrelated with one exception to other North American languages seems doomed to ultimate abandonment according to indications revealed in a careful comparison of the Taos and Zuñi languages made by me in New Mexico as part of a general plan of reexamining these languages. The work in 1930 was a continuation of researches begun the year before and described in "Explorations and Field-Work of the Smithsonian Institution in 1929." Working with Natchipanih, an excellent informant if one already knows a little of the Zuñi language, for only his English is deficient and he does not hesitate in giving to his friends the most sacred religious terms, a Taos dictionary was worked over into the Zuñi tongue, thus obtaining voluminous material for comparisons—and contrasts. The Zuñi language is spoken, at present at least, in a single dialect, and by a population of some 1,600 individuals, nearly all of whom live in a single city as quaint and isolated as Lhasa, the old Tibetan capital. This city is called Cíwin'ah, and one of its inhabitants is called Cíwih (Cíw'a: tchih, dual; 'Á: ciwih, triplural).

The language is about as harsh and clear sounding as German; its alphabet consists of 35 letters, including the five well-known vowels, pronounced as in Spanish, varieties of stops with h after them and with simultaneous choking in the larynx as well as the ordinary Spanish variety, k, n and ng inflected with y position as well as the ordinary kind, and a Welch ll, written by the Polish character of l with a swipe through it. Examples of the clean-sounding words of this language are Tówayalanneh, name of the famous mesa to be seen south of Zuñi; and Hó'°n'á: wona: wil'onah, God, or better Fate, one of the religious words, literally Our Holder of the Trails. Although it was not necessary for phonetic exactness, this work was supported by the obtaining of several hundred kymographic tracings on sooted paper, which at least give the satisfaction of showing for instance that a sound heard as long had such or such a duration in units of the second. Some

FIG. 164.—Mrs. Phoebe Maddux (Imkʸanvan), my aged Karuk informant, with her grandchildren. (Photograph by J. P. Harrington.)

FIG. 165.—La Brea, the mineral oil lake between San Juan and Gilroy, in which wild animals used to get mired and perish. Don José Mondragón, son-in-law of Doña Ascensión, shown standing by the tar pits. (Photograph by J. P. Harrington.)

of these tracings were assembled to form a Zuñi alphabet, an album of the sounds' own pictures.

The work established what had long been suspected by me, that there is a definite but distant genetic connection between the Taos and Zuñi forms of speech, and that this connection also extends to the language of Acoma and other Keresan dialects. Whether anything still

FIG. 166.—Mrs. Fannie Orcutt, aged Karuk Indian, Salmon Billy's younger sister, holding her white great-grandson. (Photograph by J. P. Harrington.)

more closely related to the Zuñi will be discovered in the great field of American languages remains for the future to reveal. The phonetic systems of Taos and Zuñi and many of the grammatical features are as much alike as children of the same family, and come from the same cradle of old Indian linguistic inheritance.

On the Klamath River in northern California, in a wilderness of soapstone formation mountains overgrown with conifers and brush

of a hundred species known to the Indians, I did further work with Imkʸanvan (Mrs. Phoebe Maddux) on the customs of the Karuk people of the lower central section of the river, and especially with Mrs. Fannie Orcutt, younger sister of the famous Salmon Billy, the Indian who went around with Stephen Powers when he was collecting information for the Smithsonian in the early seventies of the past century, nearly 60 years ago. This sister of Billy's is now more than 80 years old, and evidently possesses the knowledge that the deceased Billy had, and along certain lines doubtless more. Mrs. Orcutt was diligently interviewed along the lines of old family history and gossip and in the field of Indian ceremonial doings as well. She has in her possession several old relics, including a black flint blade, to which great importance was attached until I learned that one of her sons had made it and many others, some of which are doubtless now treasured by collectors and museums, with modern tools, whereupon my appreciation only increased at the uniqueness of the situation. Another unique situation in Mrs. Orcutt's family is that this family typifies the great process which is everywhere going on of amalgamation of the Indian race into the white. Each successive generation is "twice as white" as the preceding, and Mrs. Orcutt requested that I take her picture holding her little great-grandson (fig. 166), amused at the situation that this normal appearing white child had her blood.

Field-work attempting to rescue what can still be obtained from the wreck of former Indian custom and language at San Juan Bautista, in central California, not far south of San Francisco near the coast, was accomplished in the very nick of time, for I arrived while Doña Ascensión Solórsano, last speaker of the language, was still alive, and although very ill, survived long enough to enable me to put on paper practically all that she knew about her people. In fact, Doña Ascensión was the best person who could have been obtained as informant even several years ago, for she had the qualifications of a truthful heart, a vivid memory, and lifelong curiosity about Indian ways and things, many of which had passed out of use even before the lifetime of her mother. The peculiar amount of knowledge which survived in her was due to the fact that her father and mother talked the language together throughout their lives, each having lived more than 80 years. Doña Ascensión lived with them practically all her life.

Doña Ascensión was known as a doctora or curandera of the sick, for she treated cases of all kinds during all the latter part of her life at her little home in Gilroy, near San Juan, which was known as her hospital. Indian and Spanish Californian herb remedies were largely employed, and from her and her old nurse, Doña Antonia Sanchez,

FIG. 167.—San Juan Bautista Mission, taken from the "Bajillo" or lowlands east of the Mission. The old Indian cemetery, overgrown with gigantic olive trees, where lies the body of Doña Ascensión, is seen on the slope between the Mission church and the plain. (Photograph by J. P. Harrington.)

FIG. 168.—Early etching of San Juan Bautista Mission by Henry Chapman Ford, looking from the southwest. (Photograph by J. P. Harrington.)

FIG. 169.—The ranch of Doña Ascensión's father and mother at Los Picachos de Santa Ana, showing one of the peaks. The ranch was at the cleared space in the center of the picture. (Photograph by J. P. Harrington.)

FIG. 170.—The old "calabozo" or jail of San Juan Mission. Miss Marta J. Herrerra, granddaughter of Doña Ascensión, is standing in front of the ruin. (Photograph by J. P. Harrington.)

I obtained accounts of the treatment given for some 137 different diseases and ailments. These accounts were obtained, as was all the work done, in California Spanish text along with all the Indian that she could recall. The memory of the cures and kindnesses extended to

FIG. 171.—"Abuhas" or needles, the divining rods, carried by members of Doña Ascensión's family when we went on our expeditions to visit various Indian places. Used for locating minerals and buried treasures. (Photograph by J. P. Harrington.)

the sick by this poor woman will long survive in the families of those who were benefited.

Other material obtained consisted of Indian myths, Spanish tales, voluminous and unique material on early Indians and the lore and history of the Mission, and accounts of artifacts made. A long list of plants with scientific identifications is closely related to the medicine

practices. An animal list, in the preparation of which I was assisted by Dr. C. Hart Merriam, who had also worked with the San Juan Indians, gives descriptions and lore about the animals as well as their names. Accounts of several mineral products were also obtained.

Doña Ascensión survived long enough for me to do full duty to the recording of her information, and the material is at the present writing practically ready for the printer with the exception of some sections of the linguistic information. The information is of the greatest importance for understanding the ethnology of a section of California from which little has been recorded, for the history of San Juan Mission, and for putting on record the San Juan language and the Spanish language as spoken by San Juan Indians.

INDIAN LANGUAGE STUDIES IN LOUISIANA

By JOHN R. SWANTON,
Ethnologist, Bureau of American Ethnology

More languages were spoken within the boundaries of the present State of Louisiana when it was settled by the French than in any similar area north of the Rio Grande and between the Rocky Mountains and the Atlantic. The number was even increased at a later date by the entrance of several tribes from points east of the Mississippi. In consequence Louisiana has always been one of the most interesting regions in the eastern United States for students of American Indian languages. Systematic work was begun here by Dr. A. S. Gatschet of the Bureau of American Ethnology about 1880 and it has been continued at intervals ever since. In 1907 the writer took up Dr. Gatschet's work and has visited the State a number of times, but until the introduction of the automobile it was difficult to reach all corners of it or to say positively how many speakers of the aboriginal tongues still survived. The past summer, however, through the kind cooperation of Miss Caroline Dormon, of Chestnut, Louisiana, a leader in movements for the conservation of the natural resources and antiquities of this commonwealth, and her sister Mrs. Miller, who acted as chauffeur in the various expeditions which were undertaken, nearly all groups of Indians in that part of Louisiana west of the Mississippi of whom knowledge could be obtained were visited and accurate information was secured regarding the remaining ethnological possibilities of the section.

The language of the Atakapa or "man-eating Indians," formerly spoken on the coast between Vermilion Bayou and Galveston, Texas, in two dialects, is absolutely extinct, except as the knowledge of a few words survives in the memory of one old woman at Sulphur. Chitimacha, which was in use by an interesting tribe about Grand Lake, is known to but three or possibly four individuals, most of whom live at Charenton, a picturesque old Creole town on Bayou Teche. Their cane basketry industry is the best that survives in the eastern part of our country, and its preservation was largely due to Mrs. Sidney Bradford of Avery Island, who induced the Indians to discard store dyes in favor of their old native colors derived from

FIG. 172.—Basketry of Indians living at Charenton, a picturesque old Creole town on Bayou Teche, Louisiana.

black walnut and a species of dock (fig. 172). From Benjamin Paul, chief of this little band, small additions were made to the writer's collection of folklore and native texts.

Choctaw was formerly spoken by some small tribes along the Mississippi and is still used by several scattered families, one of which was visited, but it is preserved by several thousand Indians in Oklahoma and Mississippi and is in no immediate danger of extinction.

The Tunica, who have occupied a small reservation near Marksville for over a hundred years, may properly be regarded as Louisiana Indians since they hunted and boiled down salt in the northern part of the State from the earliest times of which we have any knowledge, though their towns were usually just beyond the Mississippi. Their reservation contains remnants of other tribes to which it furnished a haven of refuge from the advancing white settlements. Among these tribes were the Biloxi from the Gulf coast of Mississippi, and the Ofo or Ofogoula, a people associated historically with Yazoo River but traceable as far north and east as Cincinnati. With them were also descendants of the Avoyel (from whom the parish of Avoyelles receives its name), the oldest known inhabitants of the country and said to be a branch of the famous Natchez Indians. The Avoyel tongue itself is extinct but the blood of the tribe is preserved in the veins of Earnest Pierrette (fig. 173) along with strains of Tunica and Biloxi. Since his wife was an Ofo woman, their daughters are descended from four tribes belonging to three distinct linguistic families. From the mother, Rosa Pierrette, the writer collected in 1908 a considerable vocabulary which showed its affinity with the Siouan linguistic family, including such well-known peoples as the Sioux, Osage, Omaha, and Crow. This fact also helped to identify the tribe with an ancient people formerly living in Ohio. When Rosa Pierrette died, about 15 years ago, the Ofo language died with her. The extinct Avoyel tongue was probably nearly like that of the Natchez still known to two or three Indians in Oklahoma.

Earnest Pierrette himself is one of the few individuals who can still speak Tunica fluently. Another, Sesostrie Yauchicant (fig. 174), whose name his American neighbors have "shortened" to Sam Young, was for many years chief of the tribe, and he proved to be a splendid informant, possessed of the ability, rather rare among Indians, of dictating texts slowly in his own language. The stories in Tunica and English obtained from him, while for the most part short, are a valuable addition to our too limited knowledge of the tongue and traditions of these Indians.

FIG. 173.—Earnest Pierrette, one of the few remaining speakers of the Tunica language, also descended from the Avoyel and Biloxi tribes. His wife, Rosa Pierrette, was the last who knew the Ofo tongue. (Photograph by Miss C. Dormon.)

FIG. 174.—Sesostrie Yauchicant or "Sam Young," one of the last speakers of Tunica and the writer's principal informant. (Photograph by Miss C. Dormon.)

When the two men just mentioned are gone, Tunica also will probably go, but the speech of the Koasati who live near Kinder (fig. 175) will have a considerably longer lease of life since it is spoken by 60 or 70 individuals of both sexes. The writer worked about 10 days with Jackson Langley, chief of this group, collecting bits of information regarding the ancient life of his people, native texts, and a considerable vocabulary of the language. Although an interesting variety of speech, it is not so unique as either Chitimacha or Tunica, for it is

FIG. 175.—A group of boys belonging to the Koasati Indian tribe. (Photograph by Miss C. Dormon.)

a sister tongue to Alabama which is still used by about 200 Indians, and is also related to Choctaw and Creek. The Alabama and Koasati Indians both came from the State which bears the name of the former, and they are quite late intruders west of the Mississippi River.

From the above narrative it is evident that the work of the ethnologist in Louisiana is urgent, and that it must soon be replaced by that of the archeologist for whom the State may prove to be an even richer field. Near the Tunica reservation at Marksville is a group of mounds which was partially explored by Mr. Gerard Fowke for the Bureau

of American Ethnology some years ago. A few interesting pots were obtained at that time and the writer was able to add some fragments, picked up during his visit to the site. The whole northeastern portion of the State is dotted with mounds and other marks of aboriginal occupancy calling for systematic and extended examination.

FIELD RESEARCHES AMONG THE SIX NATIONS OF THE IROQUOIS

By J. N. B. HEWITT,
Ethnologist, Bureau of American Ethnology

To resume his field researches among the tribal remnants of the famous Six Nations of the Iroquois, the writer left Washington May 8, 1930. The war of the American Revolution wrecked the solidarity of the famous League of the Iroquois, consequently the several tribes composing it became separated into a number of divisions which finally settled in various places—some on reservations in the State of New York, others in Canada—so it is not strictly accurate to speak of the Six Nations of Canada or of New York State. Only portions of the Six Nations dwell in Canada on several reservations, while in the State of New York a remnant of the Onondaga tribe, the several sections of the Seneca, and the remnant of the Tuscarora of New York, reside, maintaining a dubious form of tribal organization, but not as coordinate units of the League of the Iroquois, for the Mohawk, the Oneida, and the Cayuga tribes no longer have a tribal organization in the State of New York.

On the Grand River in Ontario, Canada, and elsewhere in Canada, other portions of the Mohawk, the Oneida, the Onondaga, the Seneca, the Cayuga, and the Tuscarora tribes are found. Those on the Grand River Grant occupy a reservation of about 56,000 acres, in large part of very fine agricultural land, and these tribes up to the year 1924 maintained a semblance of the old government of the League of the Iroquois.

But the majority of the members of these Grand River tribes had become so indifferent to the institutions of the League—its institutions, its customs, and its laws, and regulations—that they were no longer able to maintain an efficient tribal organization for the establishment of order and justice, and therefore much disorder and lawlessness resulted. These conditions finally became such that in 1924 the Canadian Government wisely abrogated the remaining semblance of the ancient government of the League of the Iroquois. By this legal change of status of these tribes the famous League of the Iroquois came to an end on this reservation after enduring for 375 years. It was instituted by the statesmanship and the altruistic labors of

FIG. 177.—John Hardy Gibson, Cayuga Seneca Iroquois, Grand River Reservation, Canada.

FIG. 176.—Chief Jacob Hess, Senior, Cayuga Iroquois, Grand River Reservation, Canada.

Deganawida and Hiawatha for the purpose of establishing a state of peace and harmony among men which through the forms of law should cause the shedding of human blood to cease.

The organic units of an Iroquoian tribe were the Ohwachira, the Clan, and the Phratry or Sisterhood of Clans; two or more Ohwachira formed a Clan; one or more Clans formed a Phratry or Sisterhood of Clans; and two Phratries or Sisterhoods of Clans constituted the tribe. The organic units of the League were Phratries of tribes; two Phratries of tribes constituted the League. The definition of these several

FIG. 178.—Chief Simeon Gibson, World War Veteran, Cayuga Seneca Iroquois, Grand River Reservation, Canada.

organic units have come down to us in general terms, although they should be specifically defined to give a full comprehension of their structure. This deeper study of these units was a part of the writer's task this season.

It is among these people that one still finds today the very few persons who retain a precarious hold on the fragmentary knowledge of the complex institutions of the League of the Iroquois. And because of the paucity and the dubiousness of this knowledge it is fast passing out of the thinking of the native general public.

Outside of translations of texts and the textual criticism of the records, the writer had several important problems to solve. Of these one was to determine the probable number of clans which functioned in the first session of the Federal Council of the League of the Iroquois, and to obtain further information for a clearer definition and description of the Ohwachira and the Clan in Iroquoian polity. In regard to these matters there is much confusion in the literature.

No little mental effort is required to appraise fully and correctly the dominant and fundamental character of the functions of the Ohwachira—the uterine brood or family—in the organic structure of the tribal and the League organizations of the Iroquois peoples.

It is most important to bear in mind that the Ohwachira which owned a male Federal Chiefship title was self-governing within the scope of its rights and obligations. One of its important rights was to select and install suitable executive officers, namely a Chieftainess who was the Trustee for the public property, the rights, and the obligations, of the Ohwachira whose agent she was. She ranked as a peer of the male Federal Chieftains of the League, and was *ex-officio* a full member of the great Federal Council of the League, wherein she could sit at will. Like the male Federal Chieftains of the League she had assigned her by her own Ohwachira a male Chief Warrior who was her executive aide and spokesman in public assemblies and in the sessions of the Council of the League; she and he were chosen and installed in the identical manner in which the male Federal Chieftains were.

With the advice and consent of the members of her own Ohwachira, she was the official censor of the acts and the conduct of the male Federal Chieftain who represented her Ohwachira in the Federal Council of the League. And as spokeswoman for her Ohwachira she could with the active support of her Chief Warrior Aide depose said Federal Chieftain for just cause, but not before three admonitions had been made to him to reform and repent of his errors. She and her Chief Warrior Aide retained office only during good behavior.

This Chieftainess was entrusted with the very important duty also of seeing that the Federal Chieftain of her Ohwachira had the loyal support of its members, and to see that his larder at all times had the provisions needful in receiving and in entertaining foreign official visitors. It was also her duty to appoint such other minor functionaries as civil and religious affairs demanded.

One of the problems calling for explanation is the fact that certain clans, apart from the three stated to be common to all the tribes, had

FIG. 179.—A ferry-float across the Grand River on the Six Nations Indian Reserve; it is propelled by the hands turning a toothed wheel over which passes a chain fastened to the shore, at either end.

FIG. 180.—The Onondaga Mountain, situated about 8 miles south of Syracuse, New York; the Onondaga tribe received its name from this mountain.

no Federal representation in the Council of the League. Evidently they had vicarious representation in the officers of some sister clan.

The Mohawk and the Oneida tribes had nine Federal Chiefships respectively, equally apportioned among the three clans. But it is found that the titles of Chiefship do not belong to the clan as a whole. Certain Ohwachira (or uterine broods or families) within the clan owned such titles, one such to every owning Ohwachira.

It is a well-known fact to careful students of the tribes of the Iroquois League and of cognate tribes that there is a perplexing discrepancy in the number and in the names of the clans assigned to these several tribes in the several lists found in the literature on the subject. In the Mourner's Chant of Welcome in the Ritual of Condolence and Installation of the League, the Liturgy, after reciting a long list of towns assigned to the Wolf, the Turtle, and the Bear Clans, contains this brief statement: "This was the number of the Clans in ancient times." These three clans are the only ones found among the Mohawk and the Oneida tribes. The other tribes of the original League, the Onondaga, the Seneca, and the Cayuga, have these and five or six others.

This fact is noteworthy since the Mohawk tribe belongs to the Male or Father tribal phratry, while the Oneida belongs to the Female or Mother tribal phratry. Thus, it seems probable that these three clans were the founding clans of the League and that therefore they were primordial. The researches of the writer among the scattered remnants of the Wyandot peoples disclose the remarkable fact that these peoples had a like organization of the three clans, the Wolf, the Turtle, and the Bear, each having three Ohwachira, and each Ohwachira possessing a Chiefship title, thus making nine Chieftains for the three clans.

The writer had the satisfaction also of demonstrating conclusively that the Chieftainesses of the several Ohwachira formerly bore official personal names which corresponded with those of the male Federal Chieftains, like *Tekari'ho'kĕⁿ'* and *Haiyoⁿ'hwă''t'hă'*. This system of names has long been lost to the teachers of the Iroquois peoples.

Attention was also devoted to the methods of preparing wampum strings, for the purpose of determining whether the admixture of the white and the purple beads in varying proportions was in accordance with fixed rules. The writer was urged to do this because of the very contradictory meanings assigned to a large collection of such strings in his possession.

STUDIES OF THE CHEYENNE, KICKAPOO, AND FOX

By TRUMAN MICHELSON,
Ethnologist, Bureau of American Ethnology

The Cheyenne and Kickapoo tribes of Oklahoma and the Fox of Iowa formed the subjects of my field-studies during the summer of 1930. I left Washington for Oklahoma early in June, and first spent a week of intensive study of Cheyenne linguistics, general ethnology, and physical anthropology. The results of this may be briefly summarized as follows: The statement made by me in 1912 in the 28th Annual Report of the Bureau of American Ethnology, that Cheyenne is a major group of the Algonquian stock, is valid. The thesis stated by Sapir (J. des Américanistes de Paris, 1923, p. 46, footnote 1) that Arapaho and Cheyenne should be grouped together in a single major division of the Algonquian stock, is untenable. The phonetic shifts of the two are too divergent, and their grammatical specializations too great to permit such a view. Owing to the complex phonetic shifts which exist, only a small percentage of the Cheyenne vocabulary thus far can be rigorously proved to be Algonquian, but it is always possible that a larger percent *actually is.* Without a knowledge of the shifts who would suspect that Fox pōni "cessation," Arapaho tcīn (same meaning), and Cheyenne ẹn (same meaning) all go back to the same archetype? So with discovery of more such shifts, more lexical material may fall in line. It may be added that I discovered some Algonquian grammatical traits hitherto unrecognized. The results of the work in physical anthropology are rather interesting. The cephalic index of 17 adult males averaged 82.55 which is rather higher than that given by Boas (Z. f. Ethnologie, 1895), namely, 80.3 (57 subjects being measured). I have nevertheless found out by calculation that the difference is one which may be entirely due to random sampling. The stature of 18 adult males, deducting 3.5 cm. for shoes, averages 170 cm. which is much lower than the average given by Boas. If, however, a veritable giant, whom I suspected of having a little white blood, had been included in my series, it would have raised the average. Also a couple who were found to have other Indian blood than Cheyenne, were excluded: had they been included, as both were taller than 170 cm., the average would have raised. The auricular

FIG. 181.—Frank Shawata. A Fox Indian of Iowa. He is an important ceremonial leader. (Photograph by Michelson, 1930.)

FIG. 182.—Jewelry makers. Fox Indians of Iowa. (Photograph by Michelson, 1930.)

bregmatic height of the head (Hrdlička's method), yielded but an average of 130 mm. for 15 adult males. However, one subject was distinctly very platycephalic; so this adversely affected the average, and it should be remembered the series is small. The width of face of 20 adult males averaged 148 mm., a pretty good guarantee that only fullbloods were measured.

Work among the Kickapoo was confined largely to mythology and, to a lesser extent, social organization. The myths were obtained prac-

FIG. 183.—Two Mexican Kickapoos, Oklahoma. (Photograph by Michelson, 1930.)

tically exclusively in the current syllabic script which though deficient in phonetic niceties, is nevertheless very practical. And myths obtained in this manner from native informants are in much better literary style than those obtained by dictation. Most of the material published previously by Jones (edited and translated by myself) was duplicated, and a large body of new material collected. As I have mentioned previously (Explorations and Field-Work of the Smithsonian Institution in 1929, p. 207), Kickapoo mythology is more northern than is Fox; this season's work confirmed this. The portion of Kickapoo mythology

which is still practically terra incognita is the ritualistic origin myths. The conservative character of the Kickapoo is responsible for this. I even failed to obtain the tale of the death of the culture-hero's younger brother. One informant admitted with obvious fear that he knew it, but not sufficiently well to narrate. It has become clear that among the Kickapoo of Oklahoma some gentes definitely belong to one of the tribal dual divisions, others to the other; and a few gentes are not strict. As descent is male, it follows that the tribal dual division does not divide each gens as it does among the Fox.

The object of the trip among the Fox of Iowa was to restore one Fox text phonetically, and to obtain some new texts (in the current syllabic script) on Fox ceremonials, in both which projects I was successful. Conditions are rapidly changing from when I first was among the Foxes in 1911. The fight against schooling was rampant at that time. Ceremonial life is still very active, but the younger generation are becoming sophisticated. Years ago this was not so, as the following anecdote will show. On one occasion during field-work several years ago, a young Indian man drove me to town. In the bank, where I had an errand, I happened to notice that the barometer read "cyclone." I hurried out, and, in spite of the protests of my Indian driver, insisted upon going out to my residence, explaining that there was going to be a big rain, although the sun was then shining brightly. We drove out, but had barely reached the outskirts of Tama when the sky became black, and a terrific storm was upon us. The worst was over when we reached my residence, so I took my packages, and started to go to the house. The Indian drove on, and then turned back and beckoned to me. "Mike," he said, "how did you know it was going to rain?" I explained the workings of a barometer to him, but he looked at me incredulously, almost with awe. Had I told him that I had been blessed by the Thunder-birds, he would have understood and believed me.

MONACAN SITES IN VIRGINIA

By DAVID I. BUSHNELL, JR.

When the English colonists reached the shores of Virginia, early in the seventeenth century, they found the country occupied by several groups of tribes speaking different languages. Extending westward from the coast to the falls were numerous villages of the Powhatan Confederacy. Beyond the falls, in the piedmont section of the present state, lived Siouan tribes constituting two or more distinct groups. Southward from the Potomac to the Rapidan were the Manahoacs; adjoining them and claiming the country as far as the valley of the James were the Monacan tribes. In 1608 the latter occupied five large villages, and although only two of the ancient towns were visited by Europeans the names and locations of the remaining three were so clearly stated by Indians that it was possible to indicate them on a map prepared in 1612. The three villages which had been abandoned by the native inhabitants before the country was entered by European settlers, and consequently may never have been seen by the colonists, were Rassawek, which stood at the confluence of the Rivanna and James Rivers; Monahassanugh, on the left bank of the James just below the present town of Norwood, Nelson County; and Monasukapanough, on both banks of the Rivanna, a short distance above the Southern Railway bridge, in Albemarle County.

The area, roughly triangular, bounded on two sides by the rivers and on the third by the foothills of the Blue Ridge, with the three native villages occupying the angles, was evidently a favorite hunting ground as is shown by the vast number of arrowpoints scattered over the surface, as well as by traces of small camps often encountered in the vicinity of springs or on the banks of the smaller streams. Many sites have been examined by the writer during the past year and small collections of typical stone objects formed. In the southern part of the triangular area, a few miles from the left bank of the James, on both sides of the line between Albemarle and Nelson Counties, are extensive outcroppings of soapstone. Many pits, excavated by Indians, are easily discerned, and quantities of broken bowls and bits of stone left by the Indian artisan are scattered over the surface near the quarries.

Settlers entered the region just two centuries ago. Few Indians remained. Game was abundant and even buffalo are known to have

FIG. 184.—A double cabin, east of Israel Gap.

FIG. 185.—Old log cabin south of Hardware River.

crossed the mountains from the westward. Log cabins soon occupied the sites where mat-covered lodges had stood a generation before, and roads soon followed the courses of the Indian trails through the dense forests. Now, after the lapse of many years, traces of the early days may often be found in secluded spots. Deserted cabins are frequently encountered near old clearings, in some instances believed to be " Indian fields," and sunken graves may usually be discovered near-by. It is a region of much natural beauty, and beyond the valley of the Rockfish the Blue Ridge attains an elevation of more than 3,500 feet above sea level.

FIG. 186.—A road in the Blue Ridge.

The most extensive site examined stands on the banks of the Rivanna, believed to have been the village of Monasukapanough of the Saponi and deserted by that tribe some time after 1608 and before 1670. It is a beautiful situation for a native village, divided by the Rivanna and protected by encircling hills at the foot of which are many large flowing springs. Corn was probably raised on part of the low grounds where it is now grown by the present occupants of the land. Numerous stone implements have been discovered on the surface and quantities of pottery, broken into small bits by the plow during the past years, have been recovered. No objects of European origin

FIG. 187.—Eastern portion of the site of Monasakapanough. The Rivanna visible between trees on right.

FIG. 188.—Hardware River, east of Red Hill. Site of iron furnace built in 1781.

FIG. 189.—Arrowheads, etc., found on the surface about midway between the sites of the two great native villages. These are made of white quartz. The great majority are made of quartz and quartzite, a small proportion are made of chert, jasper, and argilite. Two-thirds natural size.

have been found on the site, and nothing has been discovered to suggest that the inhabitants of the village had come in contact with the English settlements far eastward. Many of the implements recovered from the site are crudely made, rough but serviceable, and are believed to represent the last of the stone age in this part of Virginia. The small fragments of pottery vary greatly in texture, finish, and decoration, but better examples may be secured later. The large burial mound, examined and described by Jefferson soon after the Revolution, belonged to this village and stood near the right bank of the Rivanna. Smaller sites which evidently belonged to the same people have been discovered on the banks of the Rivanna both above and below the great village. Material recovered from the village site on the James, believed to have been occupied by the Tutelo, and designated Monahassanugh on the early map, resembles that found on the Rivanna site. However there is a noticeable difference between this and the objects encountered on the surface in many localities between the sites of the two great native villages. The real significance of this variation is not known; whether all should be attributed to the same people has not yet been determined. This and other questions may be solved during the coming season as work, now planned, progresses.

MUSIC OF THE WINNEBAGO, CHIPPEWA, AND PUEBLO INDIANS

By FRANCES DENSMORE,
Collaborator, Bureau of American Ethnology

In continuance of the writer's study of Indian music for the Bureau of American Ethnology, three field trips were made during the past year. The work has comprised further study of Winnebago and Chippewa music and the recording of songs by Pueblo Indians who were connected with a pageant at Kilbourn, Wisconsin.

The first field trip was made in June, 1930, to the Winnebago living near Tomah and Pittsville, Wisconsin, songs being recorded in both localities. John Smoke (fig. 190) was the Indian selected near Tomah, and he had as his guest Paul Decora, a Winnebago of Nebraska who also recorded songs. Smoke, whose Winnebago name means " Standing in the day," is the possessor of a water-spirit bundle, inherited from many previous generations. He permitted the writer to see this bundle, removing the outer wrapping of deer hide and revealing a bag, or packet, of soft matting filled with medicines, several small packets of herbs, and a short flute. In the spring he gives a feast at which this is the only bundle opened, and sometimes he takes it to the Winter Feast of Bundles, when the contents of many bundles are exposed to view. He believes that by the proper use of this bundle he is free from calamity and his wants are gratified. The songs belonging to the bundle and sung to make it effective are 18 in number, six being sung while a feast is cooking and 12 during the dance which follows the feast. He recorded songs of both classes. The other songs recorded at his house were those of the green corn dance, friendship, war, " fortynine " and squaw dances, the moccasin game and hand game, love songs, and a lullaby which was recorded by Mrs. John Smoke. Two flute melodies were recorded by Frisk Cloud who said that " love songs are words put to flute melodies." Frisk Cloud is a maker of flutes and described his system of measurements in terms of fingerwidths; he also transferred to the writer the flute on which he had been playing. It is made of iron pipe, is $23\frac{1}{2}$ inches long and has six finger holes.

George Monegar, living near Pittsville, also recorded a flute melody, using a flute made of brass pipe. The legendary origin of the Winnebago flute was described by this informant who said that a young man

FIG. 190.—John Smoke.

FIG. 191.—Winnebago women dancing the wild goose dance, commonly called the swan dance.

FIG. 192.—Grand Portage, Minnesota, looking east.

FIG. 193.—Grand Portage, Minnesota, looking northwest.

FIG. 194.—Mr. and Mrs. Tom Thunder, Winnebago.

in a fasting dream saw a man walking through the air, travelling toward the west and playing on a wooden flute. He instructed the boy in making the first flute known to the Winnebago. Numerous songs were recorded by Monegar who is considered an authority on the Winnebago of Wisconsin. A fine specimen of a wooden flute was obtained later in the season.

In July the writer went to the Grand Portage reservation in Minnesota to attend the dancing at a Fourth of July celebration. This locality was visited in 1905 in connection with the early study of Chippewa music, so a return to the place was particularly interesting. Grand Portage (figs. 192 and 193) is on the north shore of Lake Superior, near the Canadian boundary. It is the site of the oldest settlement of white men in Minnesota and was a trading post of the Northwest Company in 1780. Today it is an isolated village of about 20 Chippewa families, descendants of the old inhabitants who retain many of the old customs. Among the dances seen in 1930 was a war dance that could be danced only by men who had dreamed of a grizzly bear. Such dances imitated the actions of a bear before going to war. The dream and this dance were said to have been so strong a protection that the arrows of the enemy could pass through a man's body without injuring him.

A *wabunowin* (east god dance) was held on July 5 and the writer was invited. The dance was held in a long Medicine lodge, and a little windmill was whirling on a post at the east entrance. This was placed to summon the east wind which, it was said, always came and made its presence known in this manner. Those who have dreamed of the east god are believed to have particularly strong "medicine" and this dance was believed to benefit a certain sick man. The dance was in charge of Edward Ely Burntside (Sun climbing the sky), a medicine man reputed to have great power, who afterward sang four of his *wabuno* songs for the writer. The melodies were similar to the songs of the Chippewa and Menominee Medicine Lodge. The words were concerning the *wabuno* spirit who gave medicine to cure the sick, and the words of the first song of the set were translated as follows:

> On the north shore of Lake Superior,
> Seashells around my neck.
> The cliffs are where I get my medicine.

More than two weeks later, at the same place, the shaking of a juggler's tipi was seen. This performance is very rare at the present time and was given by Edward Ely Burntside to ascertain whether his treatment of a certain sick man would be successful. In a subsequent

FIG. 196.—Evergreen Tree, a singer from Cochiti.

FIG. 195.—Anthony Lucero, a singer from Isleta.

conversation he said that if the spirits whom he summoned into his tipi " spoke loud and clear " he knew the sick man would recover, but if their voices were faint the man would die. The response at this time was said to have been satisfactory. The writer, remaining at a reasonable distance, watched the shaking of the tipi and listened to the juggler's songs for almost an hour. The singing and drumming was similar to that of the Chippewa Grand Medicine (Midewiwin). Although the evening was without a breeze, the tipi (a tall, slender structure) swayed back and forth with the regularity of a pendulum, its top describing a wide arc, then it stood still for a few moments and then was shaken convulsively, the cloth cover flapping as though in a tempest. This was repeated over and over. Burntside said that he was securely tied with thongs when he was put in the tipi and freed himself from these cords. The writer was allowed to inspect the hoops and poles of this tipi a few days later. The holes in the ground were more than a foot deep and their edges did not show the crumbling that would inevitably have resulted if the framework of the tipi had been shaken as violently as it appeared to be shaken during the juggler's performance. Numerous cords were attached to the hoops and it appears possible that these cords could have been manipulated in such a manner as to produce a motion of the cloth cover without disturbing the framework of the tipi. This trick of Indian medicine men has, however, remained without a satisfactory explanation for many years.

The purpose of this demonstration was to cure a man said to be suffering from typhoid fever. A " beneficial dance " was held at his house the next day and attended by the writer. The dance was in a long Medicine lodge, and the dancing and songs were like those of the Midewiwin. About a week later the man was said to be recovering.

The study of Indian music was resumed in August at Kilbourn, Wisconsin. Two pageants are given simultaneously at the Dalles of the Wisconsin River, each employing about 100 Indians from many tribes. While the Winnebago were the chief interest, songs were recorded by two Pueblo Indians, Pawi'tla of Isleta, known as Anthony Lucero (fig. 195), and Hatcu'ke of Cochiti, known as Evergreen Tree (fig. 196). The Pueblo songs thus obtained were more than 30 in number, including songs of war, hunting, corn grinding, and various dances, with detailed descriptions of their use.

On arriving at Kilbourn the writer learned that Mrs. Tom Thunder, a Winnebago, had died during the previous night. Mrs. Thunder and her husband (fig. 194) were photographed in 1927 when he recorded songs at Hunter's Bridge. The writer went at once to Thunder's tent

FIG. 198.—Mrs. Henry Thunder, a Winnebago dancer.

FIG. 197.—Sam Carley of Nebraska.

and found him with blackened face, after the manner of his people when in grief. The burial of his wife was according to the ways of the white man but the native custom of four feasts was observed. There was no singing until the fourth night when the spirit of the dead was believed to start on its journey. During the four days that followed Mrs. Thunder's death her cooking fire was kept burning in her wigwam and it was with charcoal from this fire that her husband blackened his face.

The gathering on the fourth night was attended by the writer, who remained until midnight. The later events were described by Sam Carley (fig. 197), brother of Jasper Blowsnake, and a leader in the native rites. He said that a feast was served, and after the people were seated Andrew Black Hawk, a relative, talked to the spirit of Mrs. Thunder. He told her that she would follow a trail to a wigwam (representing the earth) where she would find an old woman (our earth mother). This woman would say " You are going to leave your earth mother and begin a *spirit* life." Then the old woman would tell of a blazing thicket, an enemy who would spit upon her, and finally a great darkness beyond which she would find her deceased relatives and be welcomed to the spirit village. She was told to go bravely through these difficulties. It is the belief of the Winnebago that the spirit of a slain enemy is at the command of its conqueror and at this feast four Winnebago who had served in the United States Army during the World War commanded the spirits of their slain enemies to attend the spirit of Mrs. Tom Thunder on its journey, to assist it in every way and provide warmth, food, and light for it at night.

As the edge of the sun appeared above the horizon the women began to play the bowl-and-dice game, given to Indian women by the spirit women in the eastern sky. While they were playing, the spirit of Mrs. Thunder went away.

The next morning her cooking fire had been obliterated, the cover was gone from her wigwam, and someone was swinging a baby in a little hammock, suspended from the framework of the wigwam.

Two songs of the fourth-night feast for the dead were recorded, as well as songs of the Winnebago Medicine Lodge, the buffalo feast, and the night-spirit bundle. Among the songs of games and dances were those of the fish dance and the wild goose, commonly known as the swan dance. The latter is danced by women and was witnessed at Stand Rock (fig. 191). Mrs. Henry Thunder (fig. 198) is frequently a leader in this dance, taking the position at the point of its wedge formation.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1931

(PUBLICATION 3134)

CITY OF WASHINGTON
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PREFACE

The present pamphlet contains preliminary illustrated accounts of the year's field expeditions of the Institution and certain of its branches, namely, the National Museum, Bureau of American Ethnology, Astrophysical Observatory, and National Zoological Park. The full results of this field-work will be published later in the various series issued by the Institution.

In the branches of science that constitute the main activity of the Smithsonian Institution—geology, biology, anthropology, and astrophysics, field-work is essential in the collection of specimens and information needed in the researches under way. Many of these expeditions perforce visit little-known regions of the earth, and it is the hope that the reader will find in these brief accounts some of the interest of scientific exploration.

W. P. True,
Editor, Smithsonian Institution.

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THE SEARCH FOR A NEW SOLAR OBSERVATORY SITE

By C. G. ABBOT

Secretary of the Smithsonian Institution, and Director of the Smithsonian Astrophysical Observatory

The sun's radiation varies in a combination of five regular periods. Such is the harmonious result of exact independent observations made at three stations in California, Chile, and South West Africa. There are strong indications that these solar variations affect temperature conditions all over the world. At present the results of the Chilean station are far better than those of the other two, owing to the exceptional clearness and steadiness of sky conditions there.

A friend of the Institution became strongly impressed with this apparent correlation between solar variation and weather. He believed that before long the Observatory would be called on to furnish solar-radiation values of highest accuracy on every day of the year, for the use of official weather bureaus of all countries. He therefore made a grant of $28,000 to enable the Institution to keep a trained observer, A. F. Moore, in the field for a whole year, testing high altitude desert stations and seeking to find another in the Old World as favorable as Montezuma, Chile. It was hoped that such a station could be found where observations of Montezuma on many days could be duplicated, and many days lost by clouds at Montezuma could be filled in by observations under fine sky elsewhere.

Mr. and Mrs. Moore visited Fogo Island in the Cape Verde group, and made daily observations on a high peak there for over a month. Though generally cloudless, this mountain proved to be surmounted by a very high thick blanket of haze nearly all the time, which seems to arise in the Desert of Sahara. Disappointed here, Mr. and Mrs. Moore went on to South West Africa, where they occupied Mounts Lord, Erongo, Gansberg, Grosskopf, and attempted the Brandberg unsuccessfully. Some of these stations were occupied for several weeks on two separate occasions, and their skies were compared with those of Mount Brukkaros where regular observations were going on. Although some of these South West African peaks proved a little superior to Brukkaros, they lacked much of the excellency of Montezuma.

Funds for continuation of Mount Brukkaros station being now nearly exhausted, and no station of much better character being found

FIG. 1.—Bearers carrying Mr. Moore's outfit on Fogo Island. How would you like to carry a box like these on your head for 20 miles for $1.50?

FIG 2.—The main volcanic cone of Fogo Island; huge lava flow in the foreground. The cone rises about 3,000 feet above the floor of the outer crater.

FIG. 3.—Camp and observatory of Mr. Moore at Fogo. From left to right Mr. Moore, his assistant, and Mrs. Moore. The principal instrument for measuring atmospheric humidity, brightness of the sky, and intensity of solar radiation in the background.

FIG. 4.—The new instrument at Fogo. Close-up view of Mr. Moore with the combination instrument for measuring atmospheric humidity, brightness of the sky, and intensity of solar radiation.

near it, Brukkaros was closed in November, 1931, and its outfit shipped to Washington. Mr. and Mrs. Moore and Mr. and Mrs. Sordahl have gone on to Egypt, where a test of Mount Saint Catherine, near Mount Sinai, is to be made.

Meanwhile regular solar-radiation measurements are being continued at Montezuma, Chile, and Table Mountain, Calif.

FIG. 5.—Mr. Moore's observations in South West Africa. West Gansberg taken from eastern part of peak. This mountain is about 7,600 feet high.

The writer, after attending as delegate the Faraday and Maxwell celebrations in England September 21 to October 2, 1931, and addressing the hundredth anniversary meeting of the British Association, compared instruments at Potsdam. Twenty years ago the Smithsonian Institution furnished to the Meteorological Observatory at Potsdam one Abbot silver-disk pyrheliometer, standardized to the Smithsonian scale for measuring solar radiation. Comparisons made in October, 1931, show no change above one-tenth of one per cent in the scale of this instrument after 20 years of use.

STUDYING FOSSILS IN ENGLAND, AUSTRIA, AND HUNGARY

By R. S. BASSLER

Head Curator, Department of Geology, U. S. National Museum

The circumstances attending the acquisition by the Institution of the remarkable Frank Springer collection of fossil echinoderms, as well as Doctor Springer's plans for its study and increase, were set forth in the Explorations Report for 1929.[1] Here also I reported how in fulfillment of his wishes I spent my field season of 1929 in Europe in obtaining new material and especially in preparing casts of unique type specimens in the Barrande collection at Prague, Bohemia. It was here noted that time was available for collecting only in France and Germany, leaving other equally interesting areas for future investigation. Much effort has since been spent in the preparation and installation in the study series and the exhibition series of fossils resulting from that summer's work.

One of the results, a slab of limestone about 4 feet in length, obtained from the Mesozoic (Triassic) limestone of Germany in cooperation with the Geological Institute of the University of Halle, originally showed upon its surfaces only a few calices of crinoids, or so-called sea-lilies. Preparation in the National Museum's laboratory by carefully chiseling away the surrounding rock has revealed no less than 30 complete bodies and a multitude of columns, many preserving their bases. Although not a result of the present field season's work, this slab is of such interest as an exhibit and also as evidence of tangible results in building up the Springer collection that a photograph of it is here introduced (fig. 6). This illustration does not do the subject justice, as the solid, slightly expanded bases of the crinoid, the long columns composed of many buttonlike segments with a body or calyx several inches in length are unusually well preserved in the rock and still possess a reddish tint, possibly as in life, which causes the fossil remains to stand out sharply on the creamy white background of the limestone.

Opportunity for continuing field-work abroad was afforded the past summer when in the interests of the Springer collection I was detailed to study in various European museums, particularly of Eng-

[1] Explorations and Field-work of the Smithsonian Institution in 1929, p. 9, 1930.

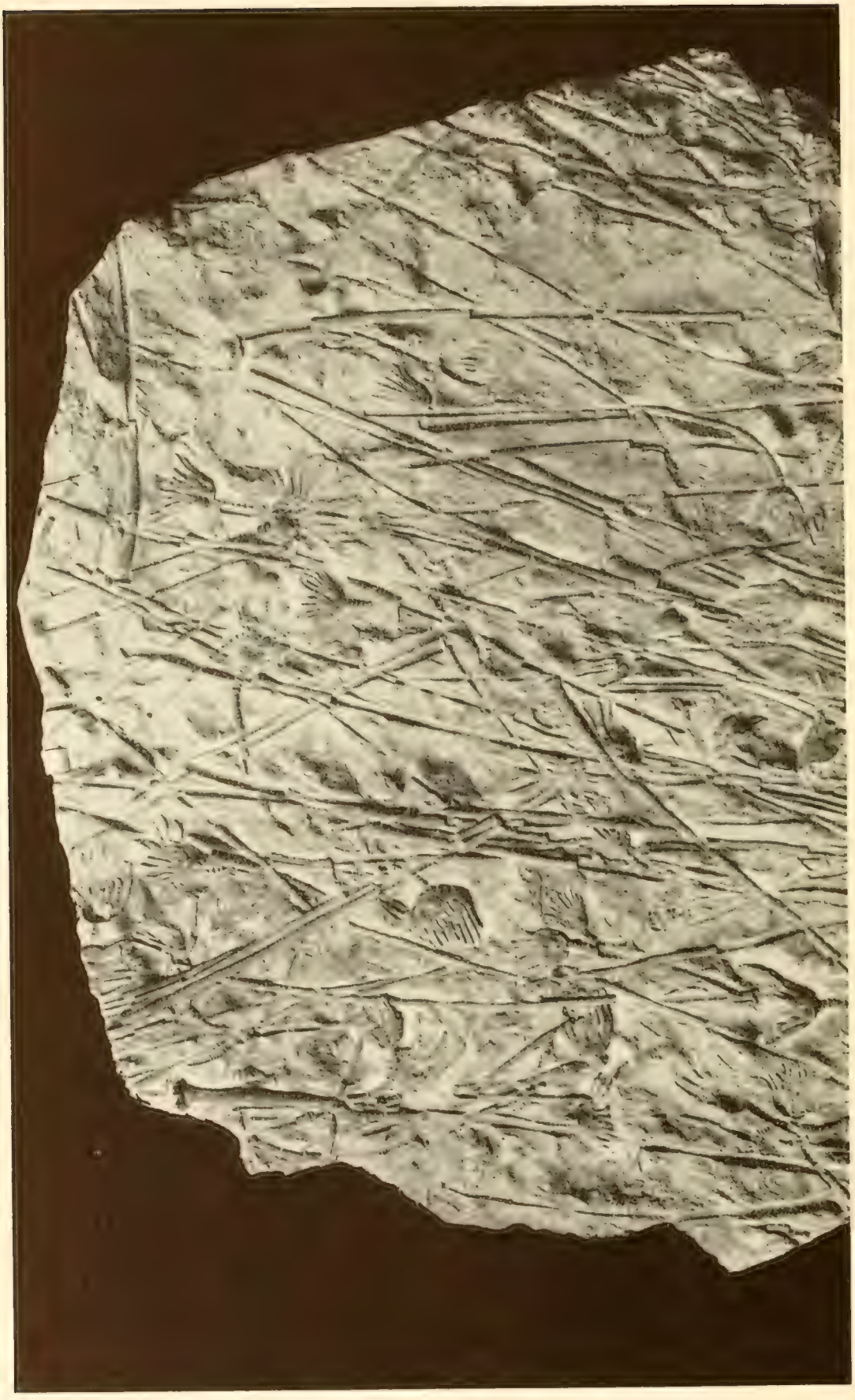

FIG. 6.—Portion of crinoid slab ($\frac{1}{2}$ natural size) from the Triassic limestones of Germany. (Photograph by G. I. Hightower.)

land, Austria, and Hungary, and to collect in certain of their classic geologic areas.

Doctor Springer's last work, "American Silurian Crinoids," a quarto volume published by the Smithsonian Institution shortly before his death, monographed the very complete series of these fossils in his collection, but some of the rare species found in Great Britain where the Silurian strata are typically developed were lacking. To remedy this I spent a week at the British Museum of Natural History in studying the collections and preparing casts of many of the fine fossil crinoids assembled by Dr. F. A. Bather, Europe's leading student of these forms.

A great similarity of the fossil crinoids in certain formations of the English and American Silurian has given rise to interesting problems of intercontinental correlation of these strata, so that complete suites of fossils of both areas are necessary for future studies. Incidental to the work for the development of the Springer collection arrangements were made with the authorities of the British Museum for a mutual exchange of recent and fossil bryozoans and also for obtaining samples of deep-sea dredgings resulting from the *Challenger* and other exploring expeditions of many years ago. These dredgings will furnish the National Museum with rather complete sets of Ostracoda and Foraminifera described long since and now much needed in the pursuit of micropaleontology by American students. While in England opportunity was also taken to gain an idea of the Tertiary deposits of the London Basin and to study the Chalk cliffs along the southeastern coast. In each case samples of the different strata containing microfossils were secured for future study.

After a few days at Versailles, France, spent mainly with Dr. F. Canu in collaboration upon our next joint work (the Tertiary Bryozoa of Australia) I proceeded to Salzburg, Austria, stopping at Zürich and Innsbruck for short periods to get an idea of Alpine structure. Near Salzburg I had the pleasure of meeting two valuable correspondents of the Smithsonian, Dr. Othenio Abel and Dr. Curt Ehrenberg of the Paleontological and Paleobiological Institute of the University of Vienna who have their summer home at Mondsee, a glacial lake in the Salzkammergut region. Again one of the rare clear days of the season occurred and through Doctor Abel's kindness I obtained an excellent impression of the Salzkammergut, an area of ancient salt mines in the Austrian Alps, interesting in history as well as in geological structure. Part of the day was spent upon Mondsee itself, in which interesting environment arrangements were made for future interchanges of needed collections.

The next objective was the Vienna Basin and Hungarian Plain for the purpose of securing echinoderm fossils and washings, with microfossils from the various Tertiary formations of these classic areas. It should be explained at this point that in Europe there are various basinlike areas which were flooded by the sea during the era preceding the present and that these preserve rather complete records of the life of the time, particularly of the microscopic organisms that abounded in the sea then as now. These basins, now uplifted often high above the sea, are usually occupied by large rivers on whose fertile flood plains people have settled in great number. Accordingly we have these basins named after large cities such as London, Paris, and Vienna, each of which has become a center for geologic research. In the United States these same marine Tertiary rocks were deposited along the Atlantic and Gulf Coastal Plains and the Pacific Coast. In the last two areas these rocks are the source of economically important products such as oil and gas, in locating which it is necessary to have a knowledge of the microscopic fossils found in the strata. Such fossils from the various European basins have been described in great detail but in most cases these accounts published years ago are accompanied by such diagrammatic drawings that in the refinement necessary in present day work it is usually impossible to recognize these European species from their illustrations. Collections from the type localities must therefore be obtained and studied before accurate work can be done upon the corresponding American fossils. Such collections are now being assembled in the National Museum as a result of trips like the present one and are being rapidly studied by specialists so that within a short time the National collections can be employed in the accurate study of the American species.

The study of the geology of the Vienna Basin and Hungarian Plain is greatly facilitated by the use of the steam-boats of the Danube Steamship Company. Boarding the boat at Linz, Austria, for Vienna we pass first through beautiful meadowlands and then mountain scenes with granite outcrops as the river skirts the edge of the Bohemian massif of igneous rocks to the north. The Danube now narrows and we are passing the rocky region of the Struden or Swirls, once a dangerous passageway for the navigator and now an area with ruined castles and churches on either side as in the Rhine Gorge and equally rich in legend. Soon in the distance high up on the rocks are seen the towers of the ancient monastery of Melk, a medieval town well known as the site of the Niebelungenlied. Before reaching Melk however the Ruin Whitenegg on the ridge contrasts strongly with the modern

houses and the ship station at its base (fig. 7). Viewed against a setting sun such ruins display to the fullest extent their interest and charm (fig. 8). From Melk to Krems the Danube flows in a gorge through the Wachau, a mountainous region of cool forests, imposing ruins, bright green vineyards and quaint villages to attract the artist and many rock outcrops to interest the geologist. We are now in the foothills of the Alps and range after range of mountains appear.

FIG. 7.—Ruin Whitenegg along the Danube. (Photograph by Bassler.)

The first ridge is guarded by Schloss Schönböhel, an ancient stronghold. Ruin after ruin now comes to view and everywhere the mountain slopes are terraced for grape culture. On a steep height is the castle Dürnheim where once Blondel found his imprisoned King—Richard. the Lionhearted—and where now the village at its base is the center of the celebrated wine industry (fig. 9).

At Krems the Wachau is left and broad stream valleys and willow-tufted plains now prevail. Tulln, an old Roman settlement, celebrated for the great festivals of the Niebelungen, is soon passed and shortly the Wienerwald, the Vienna Woods of Song, comes into view; then Vienna the beautiful city of music and art.

FIG. 8.—Sunset on the Danube. (Photograph by Donau Dampfschiffahrts Gesellschaft.)

FIG. 9.—Dürnheim on the Danube. (Photograph by Donau Dampfschiffahrts Gesellschaft.)

FIG. 10.—View from Royal Castle in Buda overlooking Pest on the Hungarian Plain. (Photograph by Magyar Rotophot.)

FIG. 11.—Buda by night. (Photograph by Magyar Rotophot.)

Much could be written of Vienna as a scientific center but it must suffice here to state that it is a paradise for the geologist. Neighboring localities are classic ground for the paleontologist, the nearby Alps afford many problems of structural and stratigraphical geology, and the museums along the Ringstrasse give the student every opportunity for study and research. Here I spent a week most pleasantly and profitably in the field and in the several natural history museums. Wonderful exhibits of rocks, minerals, and fossils have been installed in the Natural History Museum under the direction of Dr. F. X. Schaffer and supplementing these in the Paleontological and Paleobiological Institute of the University of Vienna, Doctor Abel and his assistants have built up most interesting series of fossils illustrating the relation of the life of the past to its environment.

The trip to Budapest is likewise made most pleasantly by means of the Danube boats. For miles the scenery is charming, especially in the region of the Bakony Forest and the Little Carpathians. Then the Danube takes a southern course and approaching Budapest after dusk one can see the brightly illuminated Coronation church and other public buildings an hour or more before they are reached. Approached thus after dark, Budapest presents an enchanting spectacle, but equally delightful is its charm in the day time, for quiet Buda with its Royal Castle, Coronation church, and other ancient artistic monuments located on the slope of the Buda Mountains is in great contrast with Pest, a modern business metropolis on the other side of the Danube.

Several days were spent at Budapest where a study of its museums and the local geology of the Hungarian Plain was made, but no field collections were possible because language difficulties prevented finding the localities. However, through friends made at this time it will be possible to obtain valuable material later on. Returning to Paris in order to take the boat at Cherbourg, short stops were made at Vienna and Munich, particularly to study the new developments in natural history museums.

The cold, rainy condition in Europe made field-work, especially in the clays of the London and Vienna basins, somewhat difficult, but, nevertheless, I feel the time was profitably spent, for considerable collections from various classic localities were obtained. The work in the various museums, however, was very successful, with the result that many casts of type fossil echinoderms and particularly Silurian crinoids hitherto wanting in the Springer collection have been obtained.

FOSSIL HUNTING IN MONTANA AND WYOMING

By CHARLES W. GILMORE

Curator, Division of Vertebrate Paleontology, U. S. National Museum

Exploration of the Miocene and Oligocene formations of southwestern Montana was planned for the season of 1931, in an effort to fill existing gaps in the fossil vertebrate collections of the National Museum.

Leaving Washington on June 1, I first visited Trinidad, Colo., to investigate a discovery brought to our attention by George Heap of that city. A week spent here resulted in the recovery of a large marine turtle from the Pierre formation. Turtles are rarely found in this formation, and since this large swimming turtle (*Archelon*) was previously unrepresented in our collection it is a welcome addition.

Following this, I joined my party at Belgrade, Mont., on the evening of June 11, where camp had been established and work begun by George F. Sternberg and M. V. Walker, engaged as field assistants prior to my leaving Washington. A week's work on their part in the Miocene exposures paralleling the Madison River for some miles along its lower course had produced meager results and it required but a short time to convince me that to continue exploration in the Madison formation of this region was but a waste of time and effort. Collecting conditions were rendered difficult by the vegetation which covered the exposed slopes and the fact that bands of sheep had recently grazed over the area. Some desirable material new to the collections was found, but not sufficient to justify the expense and labor involved.

Unlike many fossil fields where a party of three men may spend an entire season in one locality without covering all of the ground, the Tertiary of this part of Montana consists for the most part of small, scattered patches of exposures. Consequently from June 13 until the latter part of the month we were almost constantly on the move. Under the guidance of C. A. Kinsey, of Belgrade, a correspondent of the Museum who is familiar with the fossil beds of this part of Montana, we visited the famous Pipestone Creek locality near Pipestone Springs. The formation here, named for the creek, is of Oligocene age and consists of a few outcropping exposures along the

FIG. 12.—Badland exposures of Pipestone Creek formation, near Pipestone Springs, Mont. Many specimens were collected from these denuded slopes. (Photograph by C. A. Kinsey.)

base of the foothills (fig. 12). In fact, so much has been written of this formation and its fossils that the literature is all out of proportion to the extent of the collecting ground, which consists of only a few widely scattered acres.

Although Mr. Kinsey and his associates had collected in this locality the previous year, we were well repaid for the two days spent here. More than 150 tooth-filled jaws of extinct rabbits, rodents, insectivores, and lizards of the microfauna, a complete turtle shell, and parts of two *Mesohippus* skulls rewarded our efforts.

FIG. 13.—Collecting a skeleton of a large merycoidodont from the Miocene, near Canon Ferry, Mont. (Photograph by G. F. Sternberg.)

Having prospected all available ground, we next investigated an outcropping of Oligocene exposure along the Big Hole River near Glenn Station some 80 or 90 miles southwest of Pipestone Springs. According to information furnished by an old collector, important specimens from this locality had been obtained years ago by Earl Douglass. Again, however, we were disappointed not only by the scarcity of fossils but also by the small extent of available collecting ground.

On June 17 we arrived at Canon Ferry, a locality on the headwaters of the Missouri River that in years past has yielded important

Miocene and Oligocene fossils. In the few days spent here we secured a small but interesting collection especially rich in the larger merycoidodonts, of which several skulls and a considerable part of the skeleton of one individual were found (fig. 13).

Having collected in all outcrops in the vicinity of Canon Ferry we next moved to White Sulphur Springs, where the Deep River formation of Miocene age was explored. In fossil collecting, ground devoid of vegetation and débris always offers the best opportunity, for in such areas the occurrence of specimens can be more easily detected. Of the several miles of escarpment of the Deep River formation along Smith River it is only here and there that ground is thus denuded, and although specimens are fairly abundant, our work was again hampered by the small size of the outcrops. A considerable number of desirable specimens were obtained, but so much time was spent in traveling from one area to another that with the completion of this work we decided to abandon further collecting in the Tertiary of Montana.

The material assembled at Belgrade was boxed and shipped, and upon receiving authorization to transfer our activities to the Wasatch formation for the remaining part of the season, we started for Basin, Wyo., some 300 miles distant, on June 27. Basin, the county seat of Big Horn County, is a small town on the eastern edge of the badland country in which we proposed to work. The Big Horn Basin has long been known as a rich field for the remains of Eocene vertebrates, and as the Wasatch badlands cover an area approximately 60 miles long and 40 miles wide, our worries in regard to restricted collecting grounds were over for the season.

The term "basin" as applied to many of these Tertiary fields is just what the name signifies—a low, central area, the sides of which are formed by mountain ranges. The central part has been filled with stratified layers of rocks, and it is in these layers that the fossil bones occur. In the case of the Big Horn Basin, the deposits are made up of materials derived chiefly from the erosion of the surrounding heights.

Acting upon the recommendation of William A. Stein, an experienced collector thoroughly familiar with the region, we commenced work on the breaks along South Fork of Elk Creek on the eastern side of the basin. Confining our efforts to the lower part of the formation on the eastern side of the basin, we successively worked the badland escarpments of South Elk Creek, Fifteen Mile or Cottonwood Creek, Ten Mile Creek, and Five Mile Creek. The latter part of the season was given over to the Middle Wasatch as exposed along

FIG. 14.—Collecting the skull and lower jaws of a creodont mammal in the Big Horn Basin. (Photograph by G. F. Sternberg.)

FIG. 15.—Collecting a disarticulated skeleton of *Coryphodon* from the Wasatch, Big Horn Basin, Wyo. (Photograph by G. F. Sternberg.)

the western side of the basin, especially on Dorsey Creek. For lack of time no collecting was done in the upper beds.

In the time spent here we were successful in obtaining some few specimens of outstanding interest and a great mass of scientifically important material. Worthy of especial mention are the following: A considerable part of the skeleton of a large creodont, *Pachyaena,* a large carnivorous mammal; three partial skeletons of *Coryphodon,* a rhinoceroslike animal (fig. 15); a skull and lower jaws of the dawn horse *Eohippus;* a skull and lower jaws of a rare edentate; lizard remains; and six more or less complete crocodile skulls of the genus *Allogonathosuchus.* In addition there were found fragmentary parts of no less than five individuals of *Diatryma,* the giant nonflying bird of this period. Since it reached a height of nearly 7 feet, the large size of its bones probably accounts for the considerable numbers of individuals that have been found, as bird remains are among the rarest of fossils. In this connection, William Stein brought to my attention the interesting fact that all of the known *Diatryma* remains found in the Wasatch formation of the Big Horn Basin, including a nearly perfect skeleton discovered by him, have come from a narrow strip of country on the eastern side, not more than 2 miles wide and 4 or 5 miles long.

During the entire field season good weather prevailed, except for the extreme heat, and only two days were lost on account of rain. Although we were not fortunate enough to find a paleontological prize, such as a complete skeleton, the collections made are of the utmost importance from the fact that practically all of the specimens secured are new to our collection and thus fill gaps existent since the establishment of the division of vertebrate paleontology in the National Museum. From a scientific point of view, the small mammalian material—tooth-filled jaws and parts of skulls, some of them associated with skeletal material—forms the most important part of the year's collections. In all there are more than 600 such specimens, which, although containing some duplicates, give to the division an adequate working series of this basic fauna. It is anticipated that many new forms of animal life will be revealed when a systematic study is made.

DRY-DREDGING IN EASTERN CENTRAL NEW YORK

By G. ARTHUR COOPER

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New York State has long been classical ground for the study of Paleozoic formations, particularly those of the Devonian system. Many Devonian localities are now world famous and are visited every year by geologists. It would not be expected, therefore, that much of the new or unusual is still to be found. Nevertheless, several regions in New York have been neglected or overlooked since the earliest survey of the State in the years 1836-1842. This is notably true of the country lying between Chenango Valley and the Helderbergs in eastern New York. The writer has long been interested in the Devonian rocks of this little-known region and most particularly in the outcroppings in the vicinity of Hamilton, where the geologists of New York's early survey chose the typical or reference region of a series of rocks which they termed the Hamilton Group. When in the employ of Colgate University some years ago, the writer mapped the detailed stratigraphy of this critical area. It was his purpose this year to make collections for the United States National Museum from the more fossiliferous layers, few specimens of which had ever been acquired by this institution.

The region furnishing the bulk of the material collected is embraced by the Cazenovia, Morrisville, and Norwich quadrangles. The Cazenovia and adjacent Morrisville quadrangles lie between the meridians of Syracuse and Utica and some distance to the south. The Norwich quadrangle adjoins the Morrisville on the south. Physiographically the region is a portion of the maturely dissected Allegany Plateau. The hills are gentle, having a relief of about 300-500 feet, but rarely attaining 1,000 feet. Post-glacial gorges tributary to the main streams afford adequate exposures and good collecting grounds. Hamilton, a quiet little village, lies near the head of the Chenango Valley. Natural exposures and quarries are abundant in and about the village.

The general geology of Hamilton and vicinity is rather simple. The rocks are all Paleozoic in age, dipping gently to the southwest a little less than one degree. Minor undulations cause local changes in dip; no faults complicate the sequence. The portion of the Paleozoic column exposed is from the Upper Silurian (Vernon shale) to the

Ithaca division of the Upper Devonian. The writer was interested chiefly in the Middle Devonian and the lower Upper Devonian, the times during which the Hamilton Group and Tully formation were deposited, the latter overlying the former.

Although the structure of the Hamilton Group is simple the detailed stratigraphy is more difficult. As a whole the group is a great wedge of clastic rocks less than 300 feet thick at Lake Erie but increasing to an unknown thickness, probably exceeding 2,500 feet in eastern New York. In western New York much of the lower part is a black shale denoting near-shore conditions of a peculiar kind and containing a peculiar fauna. Toward the east these black shales are replaced by mudstones and sands and the peculiar black shale fauna gives way to large species which inhabited the active shore zone. In other words, as one travels eastward in following the Hamilton across the State, he leaves an old land on the site of the present Lake Erie and approaches the shoreline of the old continent of Appalachia which lay southeast of New York. Between the two lands was the open sea which trapped the sediments.

The village and township of Hamilton are in a critical geographical position as regards the stratigraphy of the Hamilton Group, lying in the area where there is a notable change from characteristic marine conditions to the close-shore region. Still farther east, in the vicinity of Albany and Catskill, the upper part of the Hamilton has been replaced by continental beds.

A fourfold division of the Hamilton rocks from the bottom up is recognized: Marcellus, Skaneateles, Ludlowville, and Moscow. In the region visited the first formation is composed of black shales which cover the hilltops in the northeastern part of the Morrisville quadrangle and form the bottom of the Chenango Valley as far southward as the village of Hamilton. The Skaneateles division underlies the villages of Cazenovia and Morrisville, and in Chenango Valley extend to the south margin of the Morrisville sheet. The succeeding divisions cover the southern portions of Cazenovia and Morrisville quadrangles and the northern one-third of the Norwich area.

The numerous ravines and quarries around Cazenovia, Morrisville, and Hamilton are delightful collecting grounds, yielding a great variety of fossils. For the most part the entombed animals are invertebrates. Most numerous are the clams occurring in great numbers and representing nearly 150 species. Second in point of numbers and species are the brachiopods. Other divisions of the invertebrates are present but less numerous. The fossils occur usually in the form of external and internal impressions, as the actual substance of the shell has been dissolved away by surface waters.

FIG. 16.—Delphi Falls, a delightful collecting locality in the lower Skaneateles beds.

FIG. 17.—*Devonaster eucharis* (Hall), a Devonian starfish from the University Quarry on the campus of Colgate University. Note also the small ophiuroids or brittlestars of the genus *Encrinaster*.

The writer arrived in Hamilton in early autumn and collected in this region for two weeks. Later he moved to Cazenovia where he was joined by Dr. Edwin Kirk of the United States Geological Survey and the two collected togther for one week from several famous localities. Pratts and Delphi Falls (see fig. 16) were visited in order to secure fossils from the Skaneateles formation, and for the Ludlowville and Moscow fossils Earlville and Georgetown were visited. At Hamilton collections were made from the quarry just south of the buildings of Colgate University. It is well known for its yield of starfishes and other rare echinoderms as well as peculiar types of clams and brachiopods. (See figs. 17 and 18.) Doctor Kirk and the writer obtained a splendid collection from this place, including some of the rare echinoderms.

FIG. 18.—University Quarry on campus of Colgate University.

The Tully limestone was also of interest and was visited for the purpose of making collections. In the Cazenovia, Morrisville, and Norwich quadrangles it consists of about 20 feet of argillaceous limestone. Across the Chenango Valley, at West Brook, 3 miles south of Sherburne (on the New Berlin sheet, adjacent to the eastern edge of the Norwich sheet), there is a predominance of silty shale and sand. Some of the shale beds abound in good fossils. Collections were obtained alike from limestone and shale in the vicinity of Georgetown, Fabius, and Sherburne. The collecting trip was culminated by a visit to Palmers gully in Unadilla Valley about 16 miles east of Hamilton where some fine crinoids were obtained. In all, more than 2,500 specimens of fossils were added to the Museum's collection as a result of three weeks' work.

GEOLOGICAL STUDIES IN EUROPE

By CHARLES ELMER RESSER
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Usually the geologist takes advantage of suitable summer weather to examine rock outcrops for needed data, but occasionally it becomes desirable to learn by personal contact what others, working along similar lines, have discovered. Thus, during the past field season I pursued the latter course and spent the available time in examining the Cambrian fossils in European museums and visiting the local workers. As space does not permit the recording of more than a mere fraction of my observations, it is necessary to present but a very sketchy account of the season's work.

In recent years several Norwegian geologists have attacked the very difficult problems presented by the mountain region that forms the backbone of Norway, and by patiently and faithfully applying modern geological principles, they have been able to uncover unsuspected structure and to elucidate whole chapters of geological history. Having read much about this work I was anxious at least to see these highlands from the train windows in crossing to Oslo, and therefore I first went direct to Bergen.

Bergen is, in many respects, the most beautiful city it has been my lot to see. Situated on several narrow strips of comparatively flat land at the head of a long, winding fjord, it is flanked on three sides by hills that rise very abruptly to a height of a thousand feet. Viewed from the restaurant high up near the top of these hills, reached comfortably by a funicular, the city is spread out as on a map. From this vantage point the intimate contact of the Norwegians with the sea is forcibly brought to one's attention by the numerous ships and boats dotting the waters and by the proximity of the buildings to the sea.

June 15, the Sunday spent in Bergen, was one of the three or four cloudless days experienced all summer. The ride across the mountains to Oslo was very interesting and instructive for besides the opportunity to observe the topographic, glacial, and geological features, numerous illustrations of intelligent adjustments to the environment were constantly brought to my attention. Notwithstanding the late spring which had not yet melted the heavy winter snows or permitted vegetation to put out leaves, our train was filled up several times with people young and old all carrying back packs, either going

out or coming in from long tramps through the mountains. Certainly more enjoyment can thus be had than by driving about in automobiles as we in America are wont to do.

In the beautiful capital of Norway, as in the other places I worked, local geologists were more than generous in giving me assistance. Thus in Oslo, Prof. Johan Kiaer corrected mistaken views derived from my reading of Norwegian geological literature and freely gave additional unpublished information obtained through his field-work.

At Oslo I was advised to go to Stockholm via Trondhjem in order to discuss with Prof. Thoralf Vogt the unique folded belt in the Norwegian mountains. This route follows for many hours the shores of beautiful Lake Mjøsen, which contrasts most strongly with the bleak though attractive Dovre Mountains traversed in the afternoon. Professor Vogt has spent many seasons studying the complicated structures, and a pleasant and profitable day was spent here in spite of the cold and rain. In going by this route to Stockholm the Norwegian highlands were crossed for the third time, whereby I gained an indelible impression of the landscape as well as some knowledge of the geological structure.

Stockholm well deserves its reputation as the most beautiful European capital; it is often referred to as the " Venice of the North." Of particular interest to the geologist are the wonderful fossil collections dating back to the time of Linné, now housed for the most part in the Riksmuseum and the adjacent Geological Survey Museum. Several of my old friends, particularly Dr. A. A. Westergaard, went to great lengths in supplying information.

From Stockholm the ancient university town of Uppsala is easily reached. Here it was a great pleasure to have Prof. C. Wiman explain certain obscure geology, and to view the new Paleontological Institute building now nearing completion. That Professor Wiman has spent many years dreaming of this structure is apparent from its most satisfactory arrangement and design. The old quarters of the geology department are scarcely more than 50 feet from the main entrance to the cathedral, within which is the tomb of Linné, and a delightful hour was spent in his old garden, started with his own hands, where descendants of many foreign plants described by him are growing. A thrill was experienced in seeing the maize, even though the plants were rather sickly owing to the adverse climate.

After a few days given to studies in Copenhagen, I visited an old friend at Helsingborg, Sweden, where I was shown interesting topographic features developed prior to glaciation and recently exposed in the sand pits. Of even greater interest are the terraces cut by the

FIG. 19.—Hotel at Finse, the highest point on the Bergen-Oslo line, famous resort for mountain sports, both summer and winter. Aspect of the Norwegian mountains well shown in this landscape.

FIG. 20.—Beautiful Lake Mjøsen, north of Oslo. Many famous fossil localities occur on its shores.

sea as the land was uplifted following the removal of the ice. Careful work has enabled the local geologists to correlate these terraces fairly precisely with the development of the human race as illustrated by its artifacts.

Perhaps nowhere in Europe is the recent enlargement of cities and villages so strikingly apparent as in Czechoslovakia; the old buildings are usually dark colored from weathering, so that the new construction forms a light-colored ring around the old nucleus. Six years ago I first became acquainted with attractive Bohemia and consequently welcomed the opportunity of spending several weeks within its confines this summer. Prague is ever alluring. Hours pass as moments when one walks about in the narrow winding streets of the two old sections of this ancient city. Each corner opens a different vista by day, but the greatest charm is at night when the soft white gaslamps in the quaint old lanterns shed just enough light to bring out the picturesque buildings. The fossil collections also are more than usually interesting, as they contain some of the earliest described fossils, besides many others to which long histories are attached.

Under the guidance of Dr. Jan Koliha I visited several interesting villages east of Prague. One evening we went out to the beautifully restored monastery-castle at Zbraslov, presented by its owner to the government to be used as an historical museum, and another of our visits to important outcrops took us to the famous Karlstein Castle, now also national property. The most interesting Czech village visited was Skreyje, famous as the locality from which so many fine Cambrian fossils have been obtained. The hotelier, Mr. Šindler, maintains a fine private museum which he delights in showing to visitors.

At Prague I was joined by Prof. and Mrs. B. F. Howell, of Princeton University, and Dr. E. S. Cobbold, the octogenarian English geologist of whom I shall speak later, for a geological trip to Poland. At Kielce in central Poland southeast of Warsaw, our party was met by three of the local geologists; automobiles were provided and our entire party was shown the geology about the city and eastward into the Sainte Croix Mountains, the most primitive region in all Poland because of its sandy soil, derived chiefly from the glacial débris. Immediately east of the Sudete Mountains, which separate former Russian territory from that which belonged to Austria, Russian dress, farm implements and methods of farming appear and increase in relative numbers eastward.

We next visited Warsaw and looked over the collections at the Geological Survey and the university. The Geological Survey was

FIG. 21.—Landscape of the rich, carefully farmed lands near Skreyje, Bohemia.

FIG. 22.—Zbraslov, south of Prague, an old castle-monastery, now a national historical museum. The small lookout, built for Napoleon's visit, can be seen above castle.

FIG. 23.—Evening in Skreyje, Bohemia; wheat cut with the sickle being thrashed by electricity.

FIG. 24.—Karlstein, Bohemia, street scene beneath the castle. Note the cows used as draft animals, the ever present geese, and the complete distribution of electricity.

just completing a very handsome and efficiently arranged building to house the magnificent collections made since Poland obtained its independence. It is astonishing to note how much scientific progress these eastern countries have made in recent years.

The Jewish villages in central Poland differ from the Polish towns, in lacking farmers. It is difficult to see how these people, often in very unproductive surroundings, are able to make a living without farming and manufacture, but our guides told us that they subsist solely on trade.

Leaving Warsaw, where our party disbanded, I stopped next at Dorpat, the university town of Esthonia, and after looking over the collections at the university took a train to Tallinn, the city we knew as Reval. This beautiful city was founded by the Danes many centuries ago and the old walls still stand nearly intact. Since more peaceful days have come to Europe, houses have been built against the walls and of course the city has grown far beyond them. It is the intention to restore the walls and remove the houses built against them.

From the vicinity of Tallinn, the Baltic shores stretching away to Russia are peculiarly attractive to the geologist, for here the Cambrian or other old sediments are still unconsolidated and the millions of shells which make up some of the layers still retain much of their original nacre. Elsewhere in the world all of these strata are hardened and often buried under tremendous masses of younger sediments, from which fact we draw the conclusion that this region must have had approximately its present day aspect for hundreds of millions of years. Because the shells in these beds have been so little altered they are quarried for the manufacture of phosphate—in fact they are often used directly on the land. During the war the Russian government undertook to make Tallinn its chief naval base in the Baltic and consequently erected large shipbuilding docks which of course today are standing idle, the machinery rusting away. But—more important to the geologist—they also began land fortifications, drawing three circles around the city, the outer one being 12 kilometers out. As the country is low-lying and the rainfall considerable, much drainage had to be undertaken, so that besides the diggings for the fortifications themselves, long drainage tunnels had to be constructed, one of which is shown in Figure 27. The result of this work was the opening of fine exposures in these soft sediments which could have been brought about in no other way. Because these sediments are soft it will be only a few years until the excavations slump, again concealing the sediments and therefore I had rather extensive collections sent to the National Museum.

FIG. 25.—Beautifully farmed lands northeast of Kielce, central Poland.

FIG. 26.—Our group in Kielce, Poland. Left to right: Jan Samsonowicz, the writer, Roman Kozlowski, Jan Czarnocki, E. S. Cobbold, and B. F. Howell.

FIG. 27.—Dr. A. Öpik (at right) and the writer at the mouth of a drainage tunnel belonging to the uncompleted Russian fortifications about Tallinn, Esthonia. The rock is the famous Obolus sandstone.

FIG. 28.—View across Doctor Cobbold's garden to the Caradoc range. Overhanging branches of the cedar of Lebanon.

Returning to Germany from eastern Europe I visited first Frankfurt a. M., one of the livest centers of scientific activity in Europe. Following the transfer of Strasburg to France, the German students of the old university moved out and established themselves at Frankfurt, where in consequence exists the only European university in the American style. A little time was spent in Bavaria and Freiburg during the latter part of August, when the continuous rains became particularly heavy, changing to snow in the Bavarian Alps. Two clear days followed this excessive rainfall, but with the great mass of fresh snow, temperatures were barely above freezing. In fact there was no more than 10 days all summer when one could go without an overcoat.

The last three weeks of September, were given to work in England, beginning with a half week in the Sedgwick Museum at Cambridge University where so many of the historical Cambrian collections, as well as more recent ones, are housed. From there I went across to Shropshire and spent a number of days in the home of Dr. E. S. Cobbold. For nearly 50 years he has lived quietly and pleasantly in the Caradoc region and by painstaking searching has unraveled much of its exceedingly complicated geology. As a consequence of this work Doctor Cobbold is now the outstanding Cambrian geologist of Europe. It was most delightful to live in his beautiful house, part of which is three centuries old while the newer addition is only about two hundred years of age. The garden, a corner of which is illustrated, has been cultivated continuously for at least two centuries, so that its attractiveness rests not alone on the beauty of the blooms or the landscaping. In the midst of the garden stands a beautiful example of the cedar of Lebanon.

London claimed my attention during the last 10 days, both for the purpose of studying the collections in the Geological Survey and the Natural History museums and for the Centenary meetings of the British Association for the Advancement of Science and the 50-year Jubilee of the Natural History Museum. This brought together not only a good representation of British scientists but many others from all parts of the world.

FURTHER MINERAL COLLECTING IN MEXICO

By W. F. FOSHAG

Curator, Division of Mineralogy, U. S. National Museum

After leaving Laredo, the border point on the Mexican National Railroad, the traveler proceeds for a short time over flat and uninteresting country. Soon, however, he sees before him, rising from the monotonous plain, rugged mountains, the first of the series of loosely connected ranges that make up the Sierra Madre Oriental. From here south, mountains are always close at hand, some of them low rolling ridges, but most of them steep or palisaded masses of limestone or flat-topped ridges of broken lava. Scant brown herbage or stretches of scattered thorny scrub, cactus, and yucca cover much of the country; only the highest elevations are forested with groves of pines and cedars.

When one has passed the first range he enters a mineral region rich in gold, silver, copper, lead, and zinc. There are also minor deposits of mercury, antimony and tin, and of precious stones—topaz, turquois, and opal. Numerous evidences of mining activity can be seen as the train passes southward, but the most important localities are away from the main line and hidden in the heart of rugged ranges.

On this, my third trip into Mexico, it was my desire to seek new collecting fields; consequently at Monterey, the first important point on the railroad, I stopped for a few days to obtain information from mining men regarding favorable localities to visit. This modern city is almost surrounded by high and rugged mountains, the most striking of which is the Sierra de la Silla, or Saddle Mountain, lying a short distance north of the city. From here I proceeded to the district of Concepcion de Oro to explore its mines of copper, silver, lead, and zinc. The high granite peak of Temerosa, one of the highest points in the state of Zacatecas is the focal point of the district; to the south lie the copper mines of Aranzazu and Concepcion del Oro; to the west and north the lead, silver, and zinc mines of Bonanza, of which the Providencia is now the most important. Its extensive workings penetrate the mountain for long distances and extend through the flank of the range to connect with mines on the other side. The peak of Temerosa is flanked on all sides by steeply tilted beds of limestone and shale, and it is at or near the contact of the granite with these rocks that the important bodies of ore lie.

FIG. 29.—Sierra de la Silla or Saddle Mountain, at the outskirts of Monterey, during a storm.

FIG. 30.—The camp of Providencia, Zacatecas, with the trail to Aranzazu.

The camp of Providencia clings to the steeps flanks of Temerosa, and facing it is a high and rugged palisade of limestone up which a burro trail zigzags its way to the pass and on to the copper camp of Aranzazu across the range, where a second granitic mass is exposed. At or near the contact of this rock with the surrounding limestones are extensive deposits of copper of the contact type. The principal cop-

FIG. 31.—Patio of the Santa Maria de la Paz mine with workmen breaking ore by hand.

per minerals are chalcopyrite and bornite associated with bodies of garnet, epidote, and related minerals. A long tunnel, two kilometers in length, has been driven through the massive granite to intersect the ore bodies, offering an exceptional opportunity to study this type of ore occurrence. At Aranzazu is a small grove of pines and cedars, the last remnant of the extensive groves that once covered all the higher slopes of the range. A rocky trail, in places blasted out of the

dense granite, takes one to Concepcion del Oro, the commercial center of the district and the rail head.

Matehuala in the northern part of the state of San Luis Potosi is a little town sprawled out in a barren valley, with little to commend it but the interesting mineral deposits close by. To the west rises a short but steep range of mountains, the Sierra del Fraile, at the foot of which lies the famous silver mine, Santa Maria de la Paz. The rich silver ores are found as an intricate vein system cutting shale. Many of the mine workings are extremely hot and until these have progressed sufficiently for proper ventilation the miners can work for only one-hour periods.

West of the Sierra del Fraile lies a long and rugged mountain chain, the Sierra de Catorce, containing the old and once very rich camp of Catorce. Like the Sierra de Concepcion this range is said to have been forested formerly with pines and cedars but the slopes are now almost bare rock with the scantiest herbage that can be imagined. Only the lower slopes are covered with a growth of cactus, yucca, and similar plants. The town itself is one of the most picturesque in Mexico. It occupies a high shoulder overlooking a deep and rugged canyon, here little more than a cleft in the mountain range. Behind the town rise mountain slopes of red, mauve, and purple shales, almost totally devoid of grass or other vegetation. Its population, once numbering over 50,000, has dwindled to less than 400 persons, but the town, except for its lack of the human element and the usually ubiquitous dogs and pigs, seems little changed from its original condition. The houses and shops are well preserved, the sloping streets with their paving of geometrically laid cobbles are worn but still intact. Above all rises the huge bulk of the cathedral, built, it is said, at a cost exceeding one million dollars. The mines are scattered over the barren hills about the city and over the ridge toward the more recent town of Potrero.

The ore-bearing veins occur in both shale and limestone and are variable in width. The smaller ones are often very rich, and some of the larger ones contain great bodies of extremely rich ore—the bonanzas of the early days of mining—in the leaner vein matter. Like many of the rich old camps of Mexico, the mining works are imposing structures. At the San Augustin mine not only workshops but also the mine chapel have been hewn out of the solid rock at the mine entrance.

From Catorce I proceeded to Charcas, one of the oldest of Spanish towns in Mexico. It lies some distance from the main line of the

FIG. 33.—Lane at Santa Maria de la Paz, San Luis Potosi.

FIG. 32.—Huge yuccas with pendulous flowers as big as bunches of bananas. Bonanza, Zacatecas.

railroad, with which it is connected by a small branch. Situated in a broad open valley surrounded by low hills, its green trees, the blue domes of its churches, and the whitewashed adobe houses give it a pleasing and restful aspect. The city of Charcas was founded in 1574, the rich silver veins in the vicinity attracting early attention. It was also an important stage stop. On the walls of the old stage station can still be discerned in faint characters the destinations of the stages and distances of the stations to points as far away as California. It is said that Cortez once made this his stopping place. The mines, once worked for silver, are now more valuable as producers of lead, zinc, and copper. The principal mine, Tiro General, situated a few miles west of town at the base of a low range of hills, is one of the great producing mines of Mexico. Copper and lead-zinc-silver ores are both mined; the ores occur at or near the contact of a porphyry and limestone. Old accounts describe the number of mine workings in the district as innumerable but by far the greatest number of them are shallow and appear to be of little economic importance. Antimony, mercury, and tin are also found in minor quantities in the surrounding hills. Caves containing old Indian remains are occasionally discovered in the surrounding region and I had an opportunity of visiting one recently discovered from which skeletal material and a few shell ornaments and similar material were recovered.

Between Charcas and San Luis Potosi the character of the country changes abruptly from an area characterized by steep and rugged limestone mountains to one of the flat-topped ridges of old rhyolitic lava flows. Vegetation, too, becomes more abundant, the most conspicuous forms being candelabria and organ cacti. The lava flows contain minor deposits of tin and topaz but the more important ore deposits are still largely confined to the limestone rocks.

Fifteen miles east of the city of San Luis Potosi is the mining camp of San Pedro, another ancient camp discovered in the latter part of the sixteenth century. The richness of its mines gave it at one time the name Potosi, which was afterwards applied to the entire state. The district lies in a comparatively low range of barren mountains. The slopes of the mountains show abundant evidences of intensive mining operations; in places large blocks of the mountain side have collapsed into the old mine workings. The ore bodies lie along fault planes in limestone with porphyry in close proximity. The rich ores for which the district was famous appear to be largely mined out, the only evidence of their former presence being the huge underground chambers from which the ore seems to have been totally removed. Mining operations are at present confined to a large, recently devel-

oped body of sulfides of lead, zinc, and silver near one edge of the district.

The city of Queretaro, capital of the state of the same name, lies among green and fertile fields and is a place of considerable historical interest, having been the scene of many incidents of Mexican history. To the south of the city are low hills capped by old flows of

FIG. 34.—A cottage at San Pedro, Mexico.

rhyolitic lavas that contain, in numerous places, the opal mines so famous for the richness and variety of their products. The opals are found in the steam cavities of these old lavas over a wide area but active mining is carried on only in a desultory manner by the natives. The stones are brought to Queretaro where they are cut upon common grindstones and polished on wooden wheels. Clear opals with little fire are abundant and cheap; the finest stones are much rarer, more costly and are of great beauty.

From Queretaro, I proceeded to Mexico City, and further field studies were deferred until another season. During the two and one-half months spent in active field-work a considerable amount of geological material was collected including systematic series illustrating the mineral occurrence, processes in ore formation, such as oxidation and enrichment, and large exhibition specimens of lead, silver, zinc and copper ores. A small collection of Indian remains and artifacts was obtained at Charcas.

EXPLORATIONS FOR FOSSIL HORSES IN IDAHO

By NORMAN H. BOSS

Chief Preparator, Department of Geology, U. S. National Museum

Field operations in the vicinity of Hagerman, in the Snake River Valley, Idaho, had demonstrated the fact that here was the greatest accumulation of fossil horse remains ever discovered. Two seasons' work under the direction of the late Dr. J. W. Gidley had brought to light and added to the Museum's collection such a vast amount of valuable material without exhausting the resources of the quarry that a third season was deemed profitable. As the condition of Doctor Gidley's health made it imprudent for him to undertake the strenuous work of directing a party this year, I was detailed to take charge of the 1931 expedition.

Arriving at Hagerman on June 4, I was joined by C. P. Singleton of Melbourne, Fla., who had had previous experience with Doctor Gidley; C. W. Caldwell was employed as "handy man," and Charles Bremer as cook, thus completing the personnel of the party. I wish to say here that such success as attended the expedition was due in large measure to their cooperation and understanding helpfulness.

Camp established, the work of the season began by collecting such specimens as were left from the previous year's excavations. It was soon determined, however, that to work the deposit successfully other means than pick and shovel would be necessary for removing the overburden of sand and gravel. Two weeks spent by the entire force in stripping by use of plow and scraper resulted in exposing a portion of the bone-bearing layer approximately 5,000 square feet in extent. The magnitude of this task may be better understood when it is explained that the back wall of the excavation was 45 feet in height.

This deposit of fossils is situated on the southern extremity of a short, steeply sloping hill that juts out from the border of the plain. Thus, as work progresses into the hillside, the depth of the overburden above the fossil layer rapidly increases, for not only is the face of the hill steeply inclined, but the bone horizon dips rapidly downward. Resuming work with small tools on the ground uncovered, we found fossil bones in great abundance (see fig. 37). Literally hundreds of bones are present here, although disarticulated and widely scattered, and nearly all pertaining to the extinct horse *Plesippus shoshonensis*. However, 5 more or less complete skeletons, 32 skulls,

FIG. 35.—Fossil horse quarry, from the opposite side of canyon. (Photograph by N. H. Boss.)

FIG. 36.—Starting the stripping above the bone layer. (Photograph by N. H. Boss.)

FIG. 38.—Portion of back wall of quarry. Level where man is standing is 28 feet above the bone horizon. (Photograph by N. H. Boss.)

FIG. 37.—Bones of the skeleton of a horse as they were uncovered. (Photograph by N. H. Boss.)

48 pairs of lower jaws, and numerous articulated limb and foot bones, all in an excellent state of preservation and representing all stages of growth of both sexes, were recovered. In order to preserve the evidence of original association all articulated skeletons were collected in large blocks and the removal of these to the camp on top of the hill, a quarter of a mile distant, in order to pack them for shipment, presented one of the difficulties of the task. The blocks varied in weight

FIG. 39.—Method of removing heavy bone encased blocks to the level of the plain. (Photograph by Harold Tucker.)

from 200 to 400 pounds, and to transport them suspended from the center of a pole resting on the shoulders of two men along a narrow cow path (see fig. 39) was a matter of no small difficulty, particularly in the extreme heat which prevailed most of the time.

At the request of the State Historical Society of Idaho, arrangements were made by which their representative, Harold Tucker, spent six weeks at our camp collecting material for the society. He obtained a small but representative collection which it is their intention to exhibit in the State Capitol at Boise.

RAIN FOREST AND DESERT IN HISPANIOLA

By ALEXANDER WETMORE

Assistant Secretary, Smithsonian Institution

In continuation of the biological survey of Hispaniola initiated for the Smithsonian Institution a number of years ago by Dr. W. L. Abbott, the writer returned to Haiti in the spring of 1931, with Frederick C. Lincoln, of the Bureau of Biological Survey, as companion, to visit regions from which information on the bird life was desired. We landed in Port-au-Prince, Haiti, from the Panama Line Steamship *Ancon* on March 22. After three days occupied in necessary arrangements for our work, in which we were aided most courteously by the American Minister Doctor Munro, by Colonel Cutts in command of the Marine Corps, by officers under his command, and other officials, we were off for the northern plain. In company with S. W. Parish, M. W. Stirling, and H. W. Krieger, who were engaged in archeological work, we proceeded to a great plantation near Terrier Rouge where we were hospitably received by Mr. and Mrs. R. Pettigrew and began our studies and collections.

The thorny scrubs of the level plain had been cleared for an area of 7,500 acres to allow the planting of sisal, and additional acreage of like extent was at the time being cut away for extension of the fields. A low, double-pointed hill, the Morne des Mammelles, rose at a little distance, being the only eminence in an otherwise level landscape. On this we found the curious flat-billed vireo, a little known species, to be common, and while collecting specimens we were able to gain some insight into its manner of living, hitherto uncertain. Here too we obtained the fourth specimen of a curious goatsucker, *Antrostomus cubanensis ekmani*, and other rarities.

Returning to Port-au-Prince, one clear morning at dawn, with Sergt. R. A. Trevelyan, of the Marine Corps, as pilot, I made a reconnaissance by airplane of the little known mountain range of La Hotte near the end of the Tiburón Peninsula. Three peaks composed the mountain mass, and it was exhilarating to circle above the deep valleys separating them and to fly low over slopes heavily forested with pines and rain forest, looking down into dark, wet depths of jungle unknown to man and peopled in imagination with any manner of strange and unusual birds.

FIG. 40.—Looking across sisal fields toward the Morne des Mammelles near Terrier Rouge, Haiti.

FIG. 41.—Field party at Post Avancé, Haiti.

With the invaluable information thus gained from the air we organized a pack train at Post Avancé, the present terminus of a proposed roadway between Aux Cayes and Jérémie, and accompanied by S. W. Parish set out into the La Hotte region. The journey by air had been a simple matter of three hours absence from the flying field at Port-au-Prince, but on land we found travel slow and laborious. At the end of six days of almost constant rain, over trails whose steepness and badness beggars description, we came finally to La Cour Z'Anglais where the slopes became so abrupt that our animals could go no further and it was necessary to gather a train of porters. After another day of this travel, including a night when our outfit was scattered for miles across the face of a great mountain, and we ourselves sat around a smoky fire in a little native hut thankful to be out of the downpour of rain, we reached the little group of three huts called Caye Godet, the last human habitation on the higher slopes of Pic de Macaya, the highest mountain in the La Hotte group.

At the edge of the forest, at an elevation of 4,200 feet we dug out the face of a slope against a huge log wedged against boulders and made a level platform large enough for our Baker tent. The mountain descended steeply below us into a deep valley whose sides were planted in bananas, sweet potatoes, coffee—grown without shade because of the almost continuously clouded sky—and other crops. Across from us rose the steep pitches of La Grande Colline, and ahead we had a glimpse of the forested slopes of Pic du Formon, the third of the peaks of La Hotte.

Wind currents drawing through the valley brought an everchanging appearance in the landscape. Clouds of fog came swiftly in to obscure the view and then in a few moments broke away to show the ragged silhouettes of the pine covered ridges opposite. Occasionally the mountain slopes stood out clearly except for scattered, drifting rays of mist but this was exceptional as rain fell for the greater part of each day. In spite of this continued precipitation the slopes were so steep that we had to depend on rainwater caught from the tent for camp use or else have water brought up the steep trails from a river 3,000 feet below. At 4,000 feet the rain disappeared into the ground and there were no streams or pools.

From this camp we climbed to the summit of Pic de Macaya through a dense growth of rain forest, replaced above 6,000 feet elevation by a stand of tremendous pines 4 to 6 feet in diameter with their lower limbs cloaked in moss and epiphytes and the ground beneath covered with dense growths of dripping bracken.

The botanist, Dr. E. L. Ekman, had collected plants in this region but to our knowledge we were the first to make zoological collections on this mountain, so that our enthusiasm for the new and unknown repaid the hardships of scrambling up and down muddy trails, of cutting passages through the jungle across the mountain slopes, and of the continual rain.

Trogons, hummingbirds, brilliant-colored tanagers and other birds abounded, but the most attractive form was the solitaire, found throughout the forest and at this season in full song. Its marvellously clear, flutelike notes were constantly in our ears and we never tired of the music of these gifted performers. At our camp interesting birds were continually under observation at our very door.

The country Haitians came in groups, interested in a friendly fashion in the strange customs of the white man, and marveled at our little tent with its compact camp equipment. Each morning at dawn Monsieur Godet, whose real name was Plaisimond Gélin, climbed up from the huts below to drink a cup of coffee, with an abundance of sugar, and to discourse on food, the coffee crop, and kindred subjects. His family brought us vegetables, including excellent white potatoes, profiting thriftily through our purchases. On occasion the local *Societé* came at dusk and to the throbbing beat of drums danced and sang for hours before our tent.

With our cases filled with specimens we came finally out of this mountain area, moving slowly over the wretched trails and finally descended again to Aux Cayes on the coast. From here through the kindness of Lieut. Charles Klein of the Garde d'Haiti we crossed in a launch to Île à Vache a few miles distant, and in a short time had our camp once more established, this time back of the sandy beach of the little land-locked harbor of Feret Bay. After the muddy trails of La Hotte it was a welcome sensation to be clean and dry and to walk about on level ground. Collecting went on apace supplementing the material obtained here last year by the Parish-Smithsonian Expedition led by Lee H. Parish. By the beginning of May our work here was finished and we were again in Port-au-Prince.

Abandoning mules as a means of transport we obtained a Ford and with our equipment crossed through the mountain highways into the Dominican Republic, where, thanks to the interest of the President, Gen. Rafael Trujillo, we were received at the border with every courtesy. We continued to San Juan and from there to Barahona through an area of desert with giant cacti and mesquite growing over hills cut by dry arroyos that were reminiscent of Arizona.

FIG. 42.—Arranging packs, Post Avancé, Haiti.

FIG. 43.—Crossing the Roseaux River below Bois Lacombe.

FIG. 44.—Caye Godet on the slopes of Pic de Macaya.

FIG. 45.—Camp on the shore of Feret Bay, Île à Vache.

Frank Warmoth, John L. Segall, and George Hamor of the Barahona Company, devoted to the making of sugar, received us most hospitably, and through their kind assistance we engaged a little sailboat, the *Rosita,* with a crew of three men, and set out one evening for the island of Beata off the extreme southern tip of the Barahona Peninsula. The following afternoon we landed in the little bay of Ocrik on the north shore of Beata where through the kindness of Don Eduardo Echevaria we were given quarters in a little house, a most welcome attention, as the sun's heat was so strong that a tent would have been almost unbearable.

Beata Island is low and slightly undulating, composed of a mass of limestone much eaten by erosion so that the surface is rough and broken. Thorny bushes, trees, and vines growing from the scanty soil accumulated in crevices in the rock form a jungle so dense that it may be penetrated only along trails cut laboriously into the interior. The coast was bare and open with stretches of sandy beach alternating with low, rocky headlands.

Within 15 minutes after leaving camp on our first morning afield we obtained specimens of a wood warbler that was recognized instantly as new to science. Its near relatives inhabit the high rain forests of the mountains so that it was a surprise to find a representative in the dry scrubs of Beata. Snakes were common and lizards abounded, and several collected proved to be new to science, as did several forms of land shells. We captured a number of brilliantly colored, ground-living lizards alive, and brought them home with considerable difficulty for the National Zoological Park.

Our work afield was pursued principally in early morning as by 11 o'clock the blazing sun beating down on the island made any physical exertion arduous. Even in the earlier part of the day the heat was at times most oppressive. Our afternoons were occupied at camp with notes and specimens. Pelicans, terns, and gulls fished along the beach just beyond our front door, while from the opposite doorway we looked out over a lagoon where often three or four pink flamingoes stalked solemnly about, occasionally within 200 yards. One day we went out in the boat to a series of offshore rocks where we saw boobies, frigate-birds and tropic-birds, and found breeding colonies of bridled and noddy terns. Roseate terns and least terns nested near our camp. A kingfisher and a few barn swallows from North America passing in migration as late as the middle of May were reminders that the time for our own journey northward was near, and we finally set out one evening in the *Rosita* on our return to Barahona. With contrary winds a small sailboat is not to be recommended for

FIG. 46.—Dominican frontier at Comendador.

FIG. 47.—Desert water-hole between Azua and Barahona.

FIG. 48.—The *Rosita* at Puerto Caïman en route to Beata Island.

FIG. 49.—Settlement at Ocrik on Beata Island.

travel, particularly when a crowded deck offers the only passenger accommodation, and it is necessary to shift about at every tack in the course. The morning and evening light on the water, a flock of flamingoes passing at sunset along an uninhabited shore, and bands of terns, shearwaters, and other interesting birds are pleasant memories of this voyage that overshadow the blazing, shelterless heat of midday and the interminable tacking in an endeavor to work up the coast, that continued for three days before we finally arrived at Barahona.

Return to Port-au-Prince was varied with stops to search for specimens and when once more in Haiti we had time for several journeys into the Cul de Sac region, including a trip to the great salt lake, the Étang Saumâtre, before we left on May 27, sailing once more on the *Ancon* for the north.

Hispaniola and our many friends and acquaintances there will live long in pleasant memory.

COLLECTING LIVE ANIMALS IN BRITISH GUIANA

By W. M. MANN
Director, National Zoological Park

Under an appropriation for travel for the purpose of collecting live animals, the writer and Frank Lowe, assistant head keeper at the National Zoological Park, spent the months of August and September, 1931, in British Guiana. Mrs. W. M. Mann accompanied us unofficially.

At Georgetown the party was very kindly received by His Excellency the Governor, Sir Edward Denham; facilities were given for work in the interior, and a permit to collect certain protected species was issued to us.

The first objective was Tumatumari on the Potaro River, reached by launch from Bartica, which is on the Essequibo. The government mail launch was not due to leave Bartica for 10 days after we arrived there, but members of the Mount Roraima Boundary Commission, A. J. Cheong, Theodore Orella, C. P. de Freitas, and James Bamford, generously invited us to accompany them in their already well-laden boat. This boat was 30 feet long, and contained in addition to 5,000 pounds of baggage these four members of the Commission, twenty-two boatmen, and the steersman. Added to these were the three of us and a native assistant, Eric Chin. What we lacked in comfort and space on the up-river voyage was delightfully compensated for by the companionship of these gentlemen, all of whom had spent their lives in the more out-of-the-way places of Demerara.

Bird life on the river was abundant and varied, and I personally acquired a violent dislike for toucans. We saw literally hundreds of them sitting on bare branches of trees near the river's edge and squawking derisively at us. At the end of our trip our total catch of toucans was three!

Three days of gasoline engine and paddling took us to our first destination, the government rest house at Tumatumari. This was formerly a thriving gold and diamond mining center, but due to the falling off in the price of diamonds, we found it almost abandoned. Moreover the Potomoonie Indians, on whom we had depended for assistance in collecting, were nearly all gone. The chief, Captain Johnson, and Paul, a Macoushi Indian from above Kaieteur, were there and they joined our party as guides and collectors.

FIG. 50.—Tame manatee. One of six in Botanic Garden at Georgetown. This botanic garden is second to none in the New World.

FIG. 51.—Hindoo fruit vendors at Old Fort Island. There are over 100,000 East Indians living in British Guiana.

Collecting was not good at Tumatumari, so, in a boat loaned us by Michael McTurk, a local settler and trader, we went up the river and then walked to Minnehaha, a gold-dredging station, and remained there a week as guests of Allan Humphreys. Here a number of reptiles and one sloth were secured. On our return to Tumatumari we raided the Indian village for pets, and brought away several parrots, finches, and chachalacas.

The head of the Boundary Commission, Mr. Cunningham, arrived at Tumatumari at this time and gave us permission to return down the river in the boat that had brought him up. The down trip took a day and a half, with a night's camp at Rockstone, where we stayed in what was formerly a thriving hotel but was then entirely deserted and stripped of furniture. Rockstone is just above the rapids of the Essequibo and in times past was a way station for Wismar on the Mackenzie River some 19 miles distant. By going overland to Wismar and then down the Demerara River the rapids could be avoided, but the little overland railway is now abandoned. We continued in our launch down the river to Bartica. The ride was interesting but not especially exciting until we noticed some wreckage in the river and later learned that two boats preceding us had been wrecked and 12 men had been drowned. After that we had more respect for these rapids.

Returning to Georgetown we were invited by Mr. Rucker, manager of the Bauxite Mines, to visit him at Mackenzie, 65 miles up the Demerara River, where we were taken on a Bauxite Company's steamer. Mackenzie is a model tropical village, each house with great screened verandahs and all modern sanitary conveniences. In addition to the genial hospitality of Mr. and Mr. J. S. Rucker, we here found numerous people willing and able to help us in our collecting. People began bringing birds and animals into camp, so we decided to make this our headquarters for the rest of our stay in Demerara. Mr. Lowe took up his residence in the clubhouse of the community. This had an open basement under it—an ideal place for keeping animals; and there he spent the next month, collecting, making cages, and caring for the stock that was brought in.

Mrs. Mann and the writer returned to Georgetown and from there left immediately on a small but comfortable river steamer maintained by the government, going about 70 miles up the Pomeroon River to Pickersgill, the site of the Pickersgill saw mill, and moved into the government rest house. Pelham Young, manager of the saw mill, had notified Mr. Lee, his resident manager, of our coming and had had his own private system of electric light installed in the rest house, so

FIG. 52.—Left, Paul, a Macoushi Indian; right, Captain Johnson, chief of the Potomooni tribe. These were our guides and assistants in the Potero region.

FIG. 53.—Members of the Boundary Commission who invited us with them up the Essequibo. Left to right: Mr. Orella, Mr. de Freitas, Mrs. Mann, Mr. Bamford, and Mr. Cheong.

FIG. 54.—Tumatumari, Potero, once a thriving mining settlement.

FIG. 55.—Rapids in the Essequibo River, from snapshot made from launch while passing through.

FIG. 56.—The Commission leaves us at Tumatumari, headed up-river for Kaietieur Falls, and then to Mount Roraima.

we had the experience of living in a large, airy, palm-leaf house set on piles on the swampy river bank, and at the same time enjoying this modern luxury.

Pickersgill was the best region for collecting that we found. The river people were anxious to help us, and animal life was fairly abundant. The things one does not catch are often the most interesting. We had the pleasure of seeing a troup of seven otters on the river, some of them sliding down the bank into the water and the others swimming with their heads held high up to observe us in our boat.

Five hours up the river from Pickersgill was a lumber camp, named for Mr. Laulys, the resident manager. The camp consisted of three sideless houses, the largest of which was 8 by 10 feet. This was turned over to us, and palm-leaf sides put on to give us a little privacy. It was jungle life de luxe, for Mr. Laulys even cut a trail for us down to a little clear-water bathing pool. A cage with two live curassows in it serving as our table and two equipment boxes for chairs comfortably furnished our house. From the uprights were hung our hammocks.

Game was abundant, and in the newly cleared areas on the forest and along the wood trails were obtained a fair number of specimens, including *Anilius scytale,* a small brilliant red and black burrowing snake related to the boas, and as far as we know the first to come alive into any collection. Seventeen Indians and Negroes, engaged in felling greenheart trees and roughing them into logs, kept on the alert for specimens. One morning Mrs. Mann discovered a specimen of the "jumping johnnie" (*Liophis* sp. —), a small snake which has the under side of its tail colored a brilliant red. When picked up it goes through the motions of stinging with its tail, hitting the hand that holds it again and again with the vivid red tip. Unfortunately this specimen died before we could exhibit it in Washington.

Our time was much too short at Laulys Camp and we left with deep regret. From Pickersgill we made one short excursion up Tapacuma Creek, a winding, black-water stream, with Indian villages scattered along the bank. At its very end there is an incline to about 15 feet above, which takes one to the Essequibo drainage basin—one steps abruptly from dense jungle country to open savannah land. We spent two days here at the Indian Mission School and were hospitably entertained by the schoolmaster in charge. We obtained from the Indians several parrots and other birds.

When we left Pickersgill finally we had 37 crates of specimens. On our way up the Pomeroon more than two weeks before, the little

FIG. 57.—Government rest house on the Pomeroon. Though 70 miles up the river, there is a 5-foot tide.

FIG. 58.—Green-heart logs at Laulys' camp on the Upper Pomeroon. These logs are hand-hewn and taken down the river to the saw mill at Pickersgill. Green-heart is used chiefly for piling in docks.

steamer had stopped at almost every house on the river and we had gone ashore and explained to the residents that we were in the market for snakes, lizards, and small animals. On the down voyage we discovered that we had demoralized, at least temporarily, the entire population of the river. They had stopped other work and gone out collecting, usually with very poor success, but at almost every settlement there was something for us. Various small creatures in quakes (openwork Indian baskets used for carrying vegetables but adapted to the confinement of animals for us) were brought aboard the boat and after the usual amount of gesticulation were purchased and placed on the deck of the steamer, to the consternation of the stewardess responsible for the condition of that deck. We trust that by this time all traces of our menagerie have been removed.

At Georgetown we found Mr. Lowe who had come down from Mackenzie with his catch, and we combined the collections in a large storeroom beneath the Park Hotel, through the courtesy of the management. Mr. Lowe remained here while Mrs. Mann and I made a hurried trip eastward into Berbice, in the hope of securing some Surinam toads. Dr. Roth of the Georgetown Museum had told us that he believed *Pipa* did not exist in British Guiana but we hoped to find it towards Surinam.

Berbice is low and flat, tenanted largely by Hindus. One had the impression one was crossing the Punjab, except that the Punjab is never flooded as was this area. Wading birds swarmed, white egrets, blue herons, jacanas, and gallinules predominating, and we saw many readheaded troupials.

We had been introduced by telephone to our host, G. M. Eccles, at Blairmont on the Courantyne River, and his first question to us was "Where do you expect to find these toads?" There was a canal beside a canefield and we asked how long it had been there. He told us that it had been dug about a hundred years before, so it seemed probable that if the toad existed in the area it might be found in the mud at the bottom of the canal. Mr. Eccles thereupon had the canal drained for us. A half-day's exploration of ooze 6 inches deep resulted in the finding of nothing but some catfish. Mr. Eccles placed a car at our disposal and we crossed the Courantyne River on a ferry and scouted the countryside, dipping in pools with nets and raking mud and weeds from the bottom, but still with no success.

The Surinam toad lives in Surinam, so we decided, despite the short amount of time at our disposal, to go there. A half-day's automobile trip took us to Springlands, the last British settlement. The customs boat took us across to Nickeri, where Mr. Gordon of the

Waterloo estate met us and took us to his home. A canal had just been drained and we spent a half-day, assisted by 26 Javanese laborers, poking into the mud. The same 26 Javanese spent another half-day groping in the mud at the bottom of a flooded rice field. Then we took a seine and worked half a mile of a canal, drawing the seine every 20 or 30 feet. Snakes were found, and many fish, but no *Pipa*. Our time was drawing to an end. The assistant manager of the plantation, born and raised in Surinam, remembered the toad from his boyhood days in Paramaribo, but he had never seen it in the vicinity of Nickeri; so as it seemed fairly certain that we were in the wrong place, we reluctantly abandoned our quest and returned to Georgetown.

A friend of ours in Paramaribo had promised to collect some of these specimens for us, but during two months he was unable to find any on account of the high water. Later on, when the pools dry out more, he has promised to send us a milk-can full of toads, so we feel that our search was not entirely in vain, especially as we secured in Nickeri a number of rare birds and lizards.[1]

Each evening in the village of Nickeri there come from the surrounding country thousands of red-spotted green parrots (*Aratinga* sp.) which crowd the fronds of the palms on which they roost and fill the air with their cries.

At Georgetown on the day of sailing we heard that our steamer was caught beyond the bar and could not get in until high tide the following morning, so we dismissed the porters and proprietors of donkey carts waiting to help us load our specimens, and told them to be on hand at five o'clock next morning. But we had misjudged the captain of the steamer, who waded his boat through the mud of the bar and docked at ten o'clock that night. The boat was to sail at four in the morning! With a hurriedly gathered crew of assistants we loaded 99 crates of specimens, and 12 days later landed practically all of them alive in New York for shipment to Washington. The first officer had given us ample space between decks so the stock had comfortable, uncrowded quarters.

Many courtesies were extended to us during our stay in British Guiana. Dr. George Giglioli, of Mackenzie, himself a keen naturalist,

[1] A. J. Jessurun, our friend at Paramaribo, kept his promise and three months after our arrival at Washington we received two crates of the sought-for Surinam toad *Pipa americana*. We met the steamer in New York and came to Washington immediately with them. There were 88 live specimens, enough for a splendid exhibition in the new reptile house, as well as some for distribution to other collections.

cared for Mr. Lowe when he was ill with malaria, and gave us several of his personal pet birds and a beautiful baby deer. F. M. Walcott, of Hope Estate, presented us with a fine ocelot that he had captured. Aurelio Gomes gave us a fine pair of whistling ducks. John Swearingen, United States Vice Counsel at Georgetown, from the very first took an active interest in our work and for his assistance and friendship we are deeply grateful.

FIG. 59.—Three-toed sloth with baby in arms.

The results of the trip were an addition of about 350 live specimens to the National Zoological Park, including 128 birds, 21 mammals, and 189 reptiles. Several of these, such as the black-headed saki monkey, the tailed agouti, the yellow-breasted flycatcher or kiskadee, the ani or tick bird, the Itai macaw, and numerous reptiles are new to the history of our Zoo. Those not new to its history, but not represented in the collection at the time, include a fine Yaguarondi cat, two-toed and three-toed sloths, a four-eyed opossum (so called because of a spot above each eye), black-headed caiques, and a splendid series of boa constrictors, anacondas, and other reptiles.

COLLECTING IN THE CAVES AND KITCHENMIDDENS OF JAMAICA

By GERRIT S. MILLER, JR.
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The pre-Columbian inhabitants of the Greater Antilles are known to have commonly eaten mammals of several kinds that are now either very rare or quite extinct. The remains of these food animals have been rather carefully investigated in the kitchenmiddens of Cuba, Hispaniola, and Porto Rico, but those in the middens of Jamaica have received little attention. Duerden recorded the frequent presence of bones of the now almost extinct "coney" (*Geocapromys brownii*) in most of the Arawak deposits that he excavated (Journ. Inst. Jamaica, vol. 2, pp. 1-51, July, 1897), and I called attention to remains found near Salt River that appear to indicate the former occurrence of a different but nearly related animal (Proc. Biol. Soc. Washington, vol. 29, p. 48, February 24, 1916). No one else, apparently, has given the subject any attention, in print, at least. Mr. Anthony's report (Bull. Amer. Mus. Nat. Hist., vol. 42, pp. 469-475, December 11, 1920) deals with the remains of Jamaican mammals that probably became extinct long before man arrived at the island.

With the main object of systematically collecting bones of mammals from kitchenmiddens and from the superficial deposits in caves I visited Jamaica during February, March, and April, 1931. Work was carried on from three principal centers, Kingston, Mandeville, and Montego Bay.

At Kingston, Dougall McDougall, Esq., kindly permitted me to investigate the extensive deposit of shells and broken pottery that covers an area approximately 200 yards long and 75 to 100 yards wide on his estate at the summit of Long Mountain (figs. 60, 61, 62). Exactly why the Arawaks should have made a situation of this kind their dwelling place is not easy to explain. The only water supply appears to have been some pools that seem likely to have gone dry during the winter; and the people were forced to bring all their fish and shellfish up a very steep slope 1,300 feet high. Bones of mammals, mostly those of the "coney," were rather numerous among the shells and fragments of broken pottery of which the deposits chiefly consist. The photographs (figs. 60, 61) give some idea of the abruptly

FIG. 60.—Long Mountain, whose steep 1,300-foot slope limits the growth of Kingston toward the east. Arawaks carried tons of shellfish to their settlement on the summit.

FIG. 61.—A general view of the kitchenmidden on the summit of Long Mountain.

FIG. 62.—A section of the kitchenmidden on the summit of Long Mountain.

FIG. 63.—Tobacco culture in eroded limestone near Mandeville.

FIG. 64.—A Jamaican "barbecue." Every large estate has one of these concrete platforms for drying coffee and other products.

FIG. 65.—Market at Santa Cruz. The hats in the foreground are for sale. The large pillowlike objects are heaps of cassava bread covered with white cloth.

rising Long Mountain ridge as seen from Kingston and of the gently rolling topography of the summit, near Mr. McDougall's house. At one end of the flower bed shown in Figure 62 the Arawak deposit was nearly 3 feet deep, with abundant shells and pottery fragments, and a few bones.

In the Mandeville region I was unable to find any Arawak deposits. Three small caves in the decomposing limestone, a very slight idea of which is given by the photograph of a recently cleared and planted peasant's tobacco field (fig. 63), yielded some interesting remains of mammals. No rock carvings or other indications of Arawak occupancy were detected.

At Mandeville and also at Pepper, in the Santa Cruz Valley, I was enabled, through the kindness of Aubrey M. Lewis, Esq., and my cousin, Mrs. Lewis, to make a large collection of samples of wood of the native trees, which grow in great profusion on the Lewis estates at both places. Attention was also given to the reptiles and to the treefrogs that take advantage of the miniature aquaria held at the heart of the larger epiphytic plants.

Near Montego Bay the chief objects of interest were the burial cave at "California" (now merged with the Rose Hall estate) on the north shore of the island and the extensive middens on the Bogue estate across the bay from the town.

The cave at Rose Hall has been accurately described by Duerden. During the 35 years since he visited the locality the vegetation on the surface of the ridge where the cave is situated has changed from "more or less ruinate" pasture to dense young forest. Under such a cover so small an object as the entrance to the cave is effectually hidden. The difficulty of finding it was greatly increased by the reluctance of the negroes on the estate to act as guides. One old man who had shown the place to Duerden nearly collapsed when ordered to accompany me. He said that immediately after going there with the "other gentleman" he was sick for two years, and that the night before my visit, having been told that he was to be ready the next morning to guide me, he dreamed that he saw two men digging his grave. That he was rendered quite useless by fear was evident. A bolder man was finally persuaded to take me to a point from which he could indicate a tree that marked the entrance of the cave. Arrived there he immediately sat down in the middle of the cart track that we were following, and for some time refused to move, thus signifying his determination to avoid danger. Some idea of the reason for this fear is given by Duerden's remark (p. 28) that many of the bones in another Jamaican cave had been removed by the "obeahmen" for

FIG. 66.—The Rose Hall mansion, of historic and legendary fame. An important Arawak burial cave is hidden in scrub back of the ridge.

FIG. 67.—View on the Hampden estate. The pond abounds in native water birds, very tame and easily observed.

FIG. 68.—Montego Bay. The sail boat is in water about 10 feet deep, so clear that the patches of coral and sponge on the bottom are plainly visible.

their superstitious practices; and the local atmosphere of terror that is the heritage of the negroes with whom I came in contact has been vividly described by Herbert G. de Lisser in his "White Witch of Rose Hall." (Ernest Benn, London, 1929).

At the cordial invitation of Mrs. Maurice Malcomb and with the assistance of her overseer Cyril R. Andresen, I spent three days in examining an extensive Arawak village site on the shore of the Bogue estate near the mouth of the Montego River. The area occupied by this site is now at least three acres in extent. Formerly it must have been much larger, as the shoreline is undergoing rapid encroachment by wave action. Many stumps and trunks of large trees can be seen along the beach and in the shallow water of the bay. Bits of pottery and broken shell plates are numerous on the beach and in the water near it. How much has been removed by the sea cannot be determined, but I was told that the land extended out at least two chains (132 feet) beyond the present shoreline within the memory of persons now living. Shells and pottery fragments are thinly scattered everywhere over the remaining portion of the village site, and are concentrated in several large flat-topped mounds and ridges arranged with their long axes parallel with the beach. These deposits are of all depths up to about 4 feet. Though somewhat obscured by brush and by the cocoanut trees that have been planted on them the middens become sharply outlined as soon as their surfaces are cleared. This site was not described by Duerden, and is not mentioned in the manuscript list of more recent discoveries kindly given me by Frank Cundall, Director of the Institute of Jamaica. It appears to have remained unnoticed until Mr. Andresen detected it in January, 1931. Trenches cut through each of three of the mounds yielded many pottery fragments of the usual type as well as roughly chipped flints and some shell utensils. Bones of mammals were rather scarce.

The Windsor estate (fig. 70), in the northern edge of the Cockpit country, was visited as a side trip from Montego Bay. Every facility for becoming acquainted with this exceptionally interesting region was furnished by Mrs. Agnes Donald-Hill, the owner of the estate, and her son, William Donald-Hill. A very large cave of great beauty, well lighted by electricity, is a notable feature of this estate. This cave shelters great numbers of bats, mostly of three kinds at the time of my visit, one of them the smallest known to occur in Jamaica. One shot from a "game getter" secured 27 specimens of this rather uncommon species (*Chilonatalus micropus*).

At Windsor a small cave and a rock shelter gave evidence of having been inhabited by Arawaks. Ashes, large land shells, mostly

FIG. 69.—View of Newcastle, in the mountains near Kingston.

FIG. 70.—Windsor estate in the edge of the Cockpit country.

FIG. 71.—Jamaica's nearest approach to desert conditions. Coast region east of Kingston.

Pleurodonte acuta and *Pleurodonte jamaicensis,* and broken pottery were deposited in both, though in small quantities as compared with the marine shells in the middens on Long Mountain and at Montego Bay. A noteworthy feature of both deposits was the presence of bones of the domestic pig, an animal of which I found no trace at the other sites. Possibly this occurrence of pig remains indicates that the natives were able to hold their own longer in the excessively rough Cockpit country than was possible for them along the coast, where their extermination by the Spaniards must have been easy and rapid.

As the Cockpit country is of great botanical interest I spent much time, while at Windsor, in collecting plants. I also visited the cave at Pantrepant, the estate adjoining Windsor on the west, and there successfully photographed the curiously carved stalactite, a rough diagram of which was published by Duerden (p. 49).

Here, as at all the other localities that he described and I visited, I found that Duerden has given a very full and accurate account of the existing conditions. Except for obtaining more complete details about the mammalian remains and discovering some rude shell utensils that he apparently failed to recognize as artifacts I found little that the earlier investigator had not seen or that was not fully represented in the Museum at Kingston. Characteristic specimens of these shell utensils have been given by the United States National Museum to the Institute of Jamaica.

MOLLUSK EXPLORATIONS IN THE FLORIDA KEYS

By PAUL BARTSCH

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During 1931, my explorations were confined to the Florida Keys with the main object of determining the status of my Cerion colonies, brought here from various parts of the Bahamas and the West Indies to determine the effects of changes in environment upon these organisms, as well as the effects of hybridization produced by crossing various members of the genus. These colonies have been established at various times in the interval between 1912 and the present, and, thanks to the joint cooperation of the Smithsonian and Carnegie Institutions, I have had the opportunity of examining them nearly every year since the beginning of this work.

Arriving at Key West on August 12, I made a collection of *Cerion incanum* there which I felt might possibly be needed in my experiments at the Tortugas. I also examined the two colonies planted at the former Fisheries Station, which were found to be merely hanging on.

On August 13 I joined the *Anton Dohrn* on her last trip to the Tortugas, where the time between August 14 and 27 was spent in examining Cerion colonies on Loggerhead and Garden keys, and in photographing the bird rookeries on Bird Key. I also exposed 800 feet of standard moving picture film undersea, obtaining additional photographs of the coral reef and its associated elements. I also joined the *Anton Dohrn* on a deep-sea dredging expedition off the Tortugas, where a lot of very interesting material was collected, which has been brought to the National Museum.

I shall first say a word regarding the bird rookeries, and then return to the Cerion problem.

In the Annual Report of the Smithsonian Institution for 1917, I published a short article on "The Bird Rookeries of the Tortugas," in which were described, among other things, the tern colonies of Bird Key. Since that paper was published, a decided change has taken place on Bird Key. All of its tree, bush, and shrub vegetation has been either entirely swept away by hurricanes or by their after effects, leaving little vegetation beyond the few species of ground-covering plants. Even the many coconut palms planted by the Audubon Society have gone under, only one of them remaining this summer. This change of vegetation has produced an interesting effect upon the habits

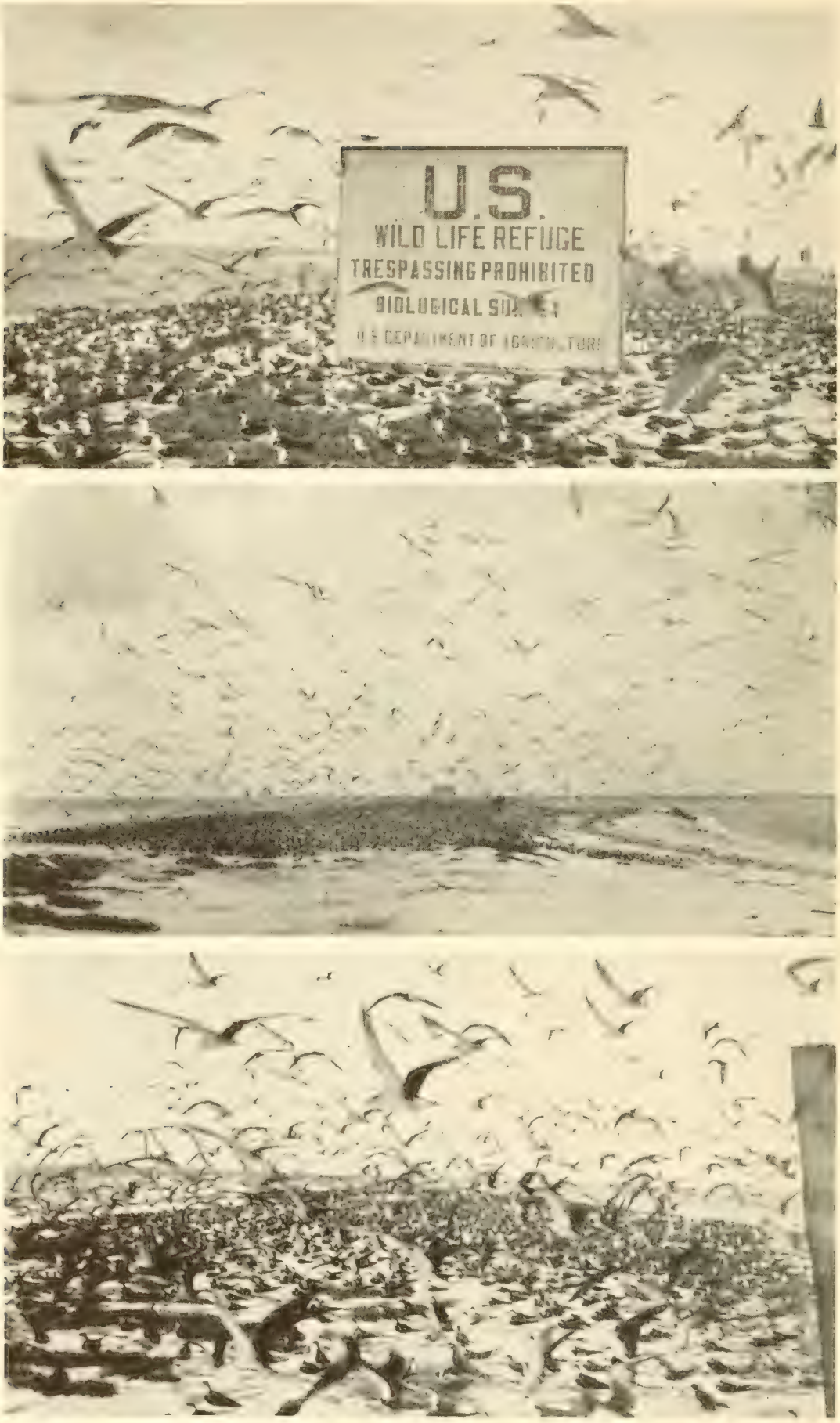

FIG. 72.—Bird Key with its tern colony at the end of the breeding season of 1931, showing the barren condition of the island and the crowding of its birds.

FIG. 73.—Bird Key, taken on the same day as Figure 72, showing the birds sunning on the beach, and the fate of the warden's house, which will soon be a thing of the past.

of the noddy terns, which formerly made their nests in trees or shrubs. This summer all had changed to a ground-dwelling habit. Still retaining the desire to make nests, they gathered bits of dead twigs and shaped them into a semblance of a nest upon the ground. They appear to have a decided ligno-tactic sense, for old boards seem to satisfy the desire for wooden homes, and birds were found incubating their eggs placed upon bare boards. All but one nest was on the ground, the exception being a nest placed in the single remaining young coconut.

Bird Key has been reduced to about half its former size by wind and waves, and the warden's house, which some years ago was transported from the west side to the center of the island, has been destroyed, the roof now resting upon the ground. This marks the encroachment of the sea, which has eaten away the western half of the island.

Figures 72 and 73 show glimpses of conditions as they obtained this summer. They should be compared with the illustrations in the paper referred to above.

CERION COLONIES

Prior to my experiments with Cerion breeding, it was generally held that these land mollusks were very plastic and readily responded to annual differences in environment; for example, it was held by some that a dry year might produce a dwarf progeny, a wet year with its more luscious vegetation, the opposite, and that the many forms which characterize the Bahamas, for example, might best be considered merely responses to temporary environmental conditions. Our breeding experiments have already determined that the Bahaman Cerions require three years to attain maturity, and the West Indian four, which eliminates the seasonal effect. All our experiments to date, with one exception, have shown that during the interval of our experimentation, the various generations produced under the changed environmental conditions, and these are many, have produced no recognizable changes in the progeny of the different generations. Our hybridization experiments, on the other hand, have brought to light what I believe to be the basis of mutation. In both of the instances reported here and elsewhere where we have crosses of unrelated species an enormous number of mutants have appeared in the second generation, paralleling such observations as have been noted for Lamarck's evening primrose and the fruitflies. I have elsewhere recorded a similar state of affairs for the genus *Cerion*, which I have found taking place in nature without the intervention of man.

FIG. 74.—Three views of deep-sea dredging operations on board the *Anton Dohrn,* the yacht of the Marine Biological Laboratory of the Carnegie Institution.

On Loggerhead Key the colonies of *Cerion casablancae* and *Cerion viaregis* are in excellent condition. The small colony of *Cerion incanum* between the dining hall and the water tower is doing well. From the mixed Colony I of *Cerion casablancae* and *C. viaregis* I gathered all the dead specimens—some 200—in order to study them at my leisure in Washington, to determine if the shells show any signs of hybridization of these two species. The colony of *Cerion crassilabris* from Porto Rico, while not in a flourishing state, is, nevertheless, holding its own. On Loggerhead Key all the other West Indian transplants have disappeared, including the huge importation of *Cerion uva* from Curaçao.

FIG. 75.—Eight hybrids of *Cerion incanum* and *Cerion viaregis* produced in cages on Loggerhead Key, Fla.

The most interesting part of the Cerion problem, however, hinges upon the low cages in each of which I had planted a specimen of *Cerion viaregis* and *Cerion incanum*. Here I obtained six adult specimens of the first generation hybrids, one almost adult, and young individuals. These we have planted in a similarly constructed cage, 6 x 6 feet in size, and it is hoped that we may obtain second generation progeny from them.

No survivors were found on all the little artificial islands which have been reported upon previously.

On Garden Key, I was greatly surprised to find three of the five Cuban species planted on the parapet in 1924 thriving, namely, *Cerion*

mummia, Cerion chrysalis, and *Cerion tridentata.* Two, *Cerion sculptum* and *Cerion* species?, seem not to have survived.

On the morning of September 22 we set out for Key West in the launch *Darwin,* stopping at Boca Grande Key to determine the state of our *Cerion viaregis* colony there. This place seems to have been persistently burned over, even the Government beacon about which we scattered our mollusks failing to furnish protection, as it too has been burned down.

We next visited Man and Boy Keys, and found that on both of these islands the places where our colonies had been planted were burned over. And, as on Boca Grande, not even a single dead shell was to be found.

On September 23 we set out for Miami on the *Darwin,* and made our first stop on New Found Harbor Key. Here we found the hybrid colony *Cerion viaregis* × *Cerion incanum* flourishing. Mr. Munson, the owner of the island, has well kept his promise to protect these mollusks. I took 200 specimens, 100 for cytologizing and 100 for the National Museum collection at Washington. This did not make a serious inroad in the colony.

Our next stop was on Bahia Honda, where I received several surprises. The first was the finding of a thriving colony of *Cerion incanum* in the elevated sandy stretch of the southeast portion of the island. In all our previous visits to this key we were unable to find any living specimens of *Cerion incanum.* Dead shells, it is true, were buried in the sand in many places, but so were those of *Oxystyla undata.* I took several hundred of these shells for the collection at Washington.

The second surprise was a hybrid between *Cerion incanum* and *Cerion casablancae.* These hybrids occur about the junction of the *incanum* colony and the colony of *Cerion casablancae* on the south side of the ditch that divides the *Cerion casablancae* colony. Judging from the great diversity of form among these hybrids, I believe them to represent, at least in part, second generation material. Next to the New Found Harbor Key colony I consider this the greatest return in the hybridization work. Figures 76 and 77 show a hundred of these mollusks; the specimens are now in the collection of the United States National Museum.

Still a third surprise was a change in size—even apparent in the field—in the members of the *Cerion casablancae* colony on the north side of the ditch. Comparing the average measurements, as well as

FIG. 76.—Fifty hybrids of *Cerion incanum* × *Cerion casablancae*, which together with those shown in Figure 76 represent the first cross so far effected between these two species. The colony is on Bahia Honda Key, Fla. Our selection shows a gradation from the *C. incanum* (top of fig. 76) to the *C. casablancae* (bottom of fig. 77).

FIG. 77.—Fifty more hybrids of *Cerion incanum* × *Cerion casablancae*.

the greatest and least altitude and diameter of a check series measured in 1920 with the present results, we obtain the following table:

		No. of whorls	Altitude of shell	Diameter of shell
Average	Check series	10.92	27.19	13.7
	Bahia Honda series	10.05	23.118	11.592
Greatest	Check series	11.1	32.9	15.6
	Bahia Honda series	11.4	28.3	13.3
Least	Check series	10.0	24.0	11.0
	Bahia Honda series	8.6	18.5	10.2

This shows plainly that there has been a decided tendency toward dwarfing in all measurements in this colony; the single increase of 0.3 of a whorl in one of the hundred specimens seems negligible. It would be interesting to know the factors that are responsible for this.

We next visited Cerion Key, wrongly listed as Duck Key in 1912 when we planted 500 *Cerion viaregis* here. As on several previous visits, not a Cerion was to be found, the rank grass having completely swamped them.

Anchoring near Tea Table Key for the night I visited that island at dusk and was very pleasantly surprised to find the colony of *Cerion casablancae* flourishing to such an extent that I was easily able to pick up 100 specimens from the vegetation bordering the north shore of the island. These are now in the United States National Museum.

A comparison of the average measurements, as well as the greatest and least altitude and diameter of the check series with similar measurements of the specimens from Tea Table Key, yields the following table:

		No. of whorls	Altitude of shell	Diameter of shell
Average	Check series	10.92	27.19	13.7
	Tea Table Key series	10.537	28.097	12.793
Greatest	Check series	11.1	32.9	15.6
	Tea Table Key series	11.5	32.8	15.1
Least	Check series	10.0	24.0	11.0
	Tea Table Key series	9.5	23.8	11.2

This shows that the Tea Table colony has continued to breed true to type.

On August 24 we visited Indian Key where a careful search failed to show Cerions. This colony, too, is extinct.

Later in the day Sands Key and the Ragged Keys were subjected to an equally careful search, but all of these failed to reveal Cerions. The colonies near Miami must therefore be considered wiped out—one of the results of the Florida boom, which changed these keys from primitive tangles into estates and building lots.

COLLECTING FLIES IN THE GASPÉ PENINSULA OF EASTERN QUEBEC

By J. M. ALDRICH

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That portion of eastern Quebec lying south of the St. Lawrence River is included in the so-called Gaspé Peninsula. This region has several features of interest to the student of geographic distribution. For one thing it represents the extreme northeast end of the Appalachian Mountain system, which terminates, as far as the main land is concerned, at Cape Gaspé, although the mountains of Newfoundland are considered to belong to the same system.

A second feature of interest is that this region is separated by a comparatively narrow body of salt water (the Lower St. Lawrence) from Labrador. The latter region includes many plants and insects of the northern circumpolar region, in other words, species occurring in Northern Europe and Asia as well as in North America. I was interested in endeavoring to learn whether any of the characteristic northern flies of Labrador could be found on the south side of the St. Lawrence.

About three years ago a graveled automobile road was completed around the entire outer edge of the Gaspé Peninsula with a connecting link from St. Flavie across the base of the peninsula, forming a loop about 525 miles in length. It has therefore become possible quite recently to explore the peninsula by automobile and this was the purpose of my trip carried out in July, 1931.

Leaving Washington on the first day of the month, accompanied by my wife, we drove through New England and New Brunswick to Shippigan, a fishing town at the northeast point of the province of New Brunswick. Here we turned west and followed the south shore of Bay de Chaleur to its head at Metapedia, where we entered the province of Quebec. Turning eastward we followed the automobile road close to the seashore to the eastern extremity of the province at the town of Gaspé, and after a few days continued west along the north side of the peninsula, returning to Washington via the cities of Quebec and Montreal.

The Peninsula is almost entirely without settlement in its interior, the population living in a very narrow strip along the seashore all the way around the margin. A railroad extends along the south side to

FIG. 78.—Gaspé Bay, looking northeast from Buckley's Camp, Gaspé. Daisies grow so luxuriantly that they soon crowd out the timothy in the hay fields.

FIG. 79.—Head of Gaspé Bay, looking northwest. Note the settlement confined to ocean shore.

FIG. 80.—Cape Gaspé, north side, looking east against the sun. Gasoline launches used in cod fishing are at anchor in foreground.

FIG. 81.—Riviere a la Martre, Gaspé.

the town of Gaspé and another line extends from the city of Quebec along the north side of the peninsula to Matane, but eastward from Matane to the tip of the peninsula is a strip of nearly 200 miles not provided with any railroad, where the new automobile road is the only means of communication except the ocean.

Of course, the entire population is French and we found comparatively few people who could speak English, even those in charge of the hotels. Tourist business, however, is increasing so rapidly that it seems inevitable that more provision will be made in the near future for travellers who speak only English.

The country is very beautiful and we enjoyed every hour of our stay in it. I found it much more difficult than I had expected to reach the higher altitudes of the mountains in the interior; so I was unable to collect on any real mountains at all, although altitudes of 600 to 800 feet were occasionally attained. A considerable number of flies were collected, representing many species, most of which however seemed to be the commoner forms occurring in the Appalachian Mountain system much farther south.

A good deal of attention was given to collecting the species of flies characteristic of the seashore, in the hope that some of the Labrador forms would make their appearance here. As far as the material has yet been studied, however, it seems that no striking northern forms were found; from which the preliminary conclusion is drawn that the breadth of the Lower St. Lawrence is sufficient to form a barrier against the spread of the northern flies southward. Curiously enough I repeatedly found on the seashore of this peninsula the same species of flies I have often collected on the shore of Chesapeake Bay, near Washington, D. C. These flies have a much wider distribution northward than had hitherto been supposed, which was one of the interesting discoveries of my trip.

We found the automobile a very satisfactory means of travel. We did not try to make very long daily journeys, stopping to collect insects occasionally. At night we stopped at tourist camps where these were available, and where there were none, we made use of the hotels of the country.

My illustrations are from photographs that I took on the Gaspé Peninsula.

COLLECTING GRASSES IN TEXAS, LOUISIANA, AND NORTHEASTERN MEXICO

By J. R. SWALLEN
Section of Grasses, U. S. National Museum

The territory including Louisiana, Texas, and northeastern Mexico contains many varied and interesting grasses. During April, May, and June, I made a trip to various localities in this region to study this element of the flora in the spring and early summer. Arriving at Brownsville, Tex., early in April, I spent about two weeks in collecting in the Rio Grande Valley and on the Coastal Plain as far north as Sarita.

During recent years the Rio Grande Valley has greatly developed its agricultural resources—so much, in fact, that if the same rate of advance is continued in the future, it will not be many years until the native flora will be largely a thing of the past. As the soil is naturally very fertile all that is needed to bring it into productivity is clearing of the land and a sufficient water supply. Where there was once mesquite and cacti, truck farms and orange groves now flourish. It is highly desirable that as much of the original flora as possible be known before it is gone forever. Of especial interest along the Rio Grande is the grove of the endemic palm (*Sabal texana*).

In sharp contrast to the rich valley are the sandy stretches of Kennedy and Willacy counties, an excellent region for grasses which provide good forage for cattle. Characteristic of this region are the low sand hills—areas of barren, loose, shifting sands. It is not difficult at places to imagine oneself in the midst of a vast desert.

The month of May was spent in the state of Tamaulipas, Mexico, a region that has scarcely been touched by botanical explorations. The area is a rolling plain, with mountains in the south and central portions, and is only slightly developed. Stock raising, for which the country is well suited, is one of the principal industries. Fruits, henequin, and sugar cane are among the principal agricultural products. For several days I collected near Victoria, the capital of the state, and in the foothills of the Sierra Madre nearby. The lower part of the mountains supports a dense growth of brush and small trees, making travel difficult off the regular trails. The upper slopes, however, are more open and are covered with a dense growth of various kinds of

FIG. 82.—One of the hills of shifting sand in Kennedy County, Tex.

FIG. 83.—Low sand dunes on Padre Island off the coast of Texas. The vegetation here is mainly *Sporobolus virginicus*.

FIG. 84.—A view along the main ridge of the Great Smoky Mountains looking from Thunderhead to Gregory Bald.

FIG. 85.—Near the summit of Thunderhead are brilliantly colored azaleas and rhododendrons which contrast sharply with the brilliant green of the grassy meadow.

grasses, one of the more frequent being a species of *Epicampes,* a genus which is rather common in the mountains of Mexico.

I made a short trip to Jaumave, which is situated in a mountain valley to the southwest of Victoria, where a large amount of henequin is grown for fiber. However, the season was a little too early in the mountains for profitable collecting.

The largest and most interesting part of my collections I obtained at El Chamal, about 7 miles from the coast and a short distance north of the Soto la Marina River. The grass flora is surprisingly rich in this locality, owing in part at least to the diverse habitats, which vary from open sandy grasslands to rich brushy woodland. A large proportion of the species found were either additions to the flora of Mexico or extensions of known ranges.

The work in Louisiana included a study of the marsh lands of Cameron Parish and a visit to Last Island. Last Island is one of a series of islands a short distance off the coast in the Gulf of Mexico. They are of special interest in that they are gradually disappearing and eventually may be reduced to nothing more than sand bars. A number of years ago Last Island was a well-wooded, popular resort, and hotels were maintained there. Severe storms, however, have completely denuded it, and the only inhabitants are a few scattered fishermen. From the mainland it appears only as a dark line on the horizon. About 12 species of grasses are found there, one of them being a little-known species of *Andropogon* which is common on some of the low sand dunes.

Toward the last of June I made collections in the vicinity of Biloxi, Miss., and in the Great Smoky Mountains of Tennessee.

During the three months' trip a total of nearly 1,000 specimens were collected, together with the necessary information concerning them.

ANTHROPOLOGICAL WORK IN ALASKA

By ALEŠ HRDLIČKA

Curator, Division of Physical Anthropology, U. S. National Museum

My work in 1931 extended to the Nushagak, Molchatna, and Wood rivers, Bristol Bay, the Kvichak River, parts of the Iliamna Lake region, and portions of Kodiak Island. It consisted, as in previous years, of anthropometric observations on the living, and of the collection of the older skeletal as well as archeological material, involving considerable excavation. The results were gratifying, definitely clearing up a number of problems, and adding over 100 boxes of specimens to our collections.

The success of the work in these difficult and isolated regions was largely due to the generous aid extended to me by the Alaska Packers Association, San Francisco, through its Vice-President, B. R. Hart, and its Superintendents, particularly Gordon Jones in Larsen Bay; by the Pacific American Fisheries, through its Vice-President, A. W. Shiels, and its Superintendents, especially F. Daly, A. D. Daly, and A. S. Foster; by the officials and employees of the United States Bureau of Fisheries, particularly Dr. W. H. Rich and F. Lucas; and by many individual friends. Especial thanks among the latter are due to Mrs. Laura Jones, of Larsen Bay, who not only donated a series of rare specimens but aided me in every possible way and even assisted, with Doctor Rich, Mr. Hart, and other friends, in the actual excavations. Much valuable aid and hospitality was also received, and is hereby gratefully acknowledged, from P. A. Berglund, Superintendent of the Northwestern Cannery at Naknek; from Chris Nielson, at Koggiung; from Hans Sieverson of the Iliamna Lake; and from the captain and other officers of the steamships *Chirikof, Chilcat, Admiralty, Crane,* and *Lakina.*

The work began in the latter part of May at the head of Bristol Bay, but as the ground was still much frozen, I proceeded to Dillingham, on the Nushagak River, where I hired a small trapper's boat and with this and the aid of Butch Smith, its owner, covered in three weeks over 600 miles of the Nushagak River and its tributaries. The region was found to be but very sparsely peopled now, the total number of natives reaching barely over 200, most of them mixed bloods. But there we found a good number of old sites, at least one of which was of greater extent than any seen on the more northern rivers.

There were indications that all these villages existed up to the time of the coming of the Russians and some even until the arrival of Americans, the last remnants of their people dying out during the influenza epidemic of 1919. The natives now on these rivers are almost all later comers with accretions from places as far distant as Togiak and the Kuskokwim. No part of this region had ever been touched by a scientific man and it therefore presented a virgin field for exploration. The old sites yielded much precious skeletal material, but all attempts at archeological excavation had to be abandoned for the time, owing to complete lack of labor.

The measurements on the living and the skeletal remains showed conclusively that the entire watershed of the Nushagak, with the probable exception of the uppermost reaches of the Molchatna, was peopled by a uniform type of Eskimo population, identical with that of the Kuskokwim basin. The burials also were of the Kuskokwim type, with local modifications. A few of the burials in the old sites had been above ground, but the majority were from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet deep in the ground, which was still partly frozen. The bodies in the older burials were invariably in the contracted position.

Upon return to Naknek a second effort was made to excavate the burials of the old "Aleut" village of Pawik, uninhabited for at least 75 years and covering a large site on the high right bank of the Naknek River, not far from its mouth. But the ground was still frozen so deeply that not much could be done, and so I proceeded 35 miles westward, to the Egigik River. Here was found the very advantageously situated burial ground of the old Egigik village, and a few days of trenching and other excavation produced some excellent material. Here is also one of the shortest and still used passes across the Peninsula. It takes but nine hours with a small motor boat and over the short portage to reach the Pacific.

All through these regions and those visited later there were heard tales, both from the natives and the old white settlers, of former incursions from the Kuskokwim, from Togiak, from Kanakak, and even from the western "Aleut" territory, and of consequent "battles," some of which "made the waters run red." It was invariably those from the north or the west who were attacking the people of the eastern parts of the Peninsula. The results of this were the introduction of more or less newer blood and customs, but also more or less local breaking up or depopulation. The complete extinction of the old peninsular villages however is ascribed invariably to epidemics brought by the white man, the final blows having been the several attacks of the "flu." That of 1919 left so many dead in places that

FIG. 86.—Our boat on the Nushagak River, off Kákwak. Approximately 600 miles of the Nushagak and affluent rivers were covered in this boat, which also carried our gasoline, provisions, empty boxes, specimens, and tools.

FIG. 87.—Nushagak River, June 5. Deep snow on north bank, 30 miles above Dillingham. In places the snow and ice were still up to 10 feet in thickness. The frozen ground in these regions constitutes a great obstacle to excavation.

FIG. 89.—Kaliganak, Tikchik River. The Chief's daughter, fullblood, about 15 years old.

FIG. 88.—Kaliganak, Tikchik River. The Chief's boy, fullblood, about 16 years old.

the United States Coast Guard Service had to be called on for the disposal of the bodies.

From Egigik I returned for the third time to the important Pawik site on the Naknek River and this time, thanks to the kind aid and hospitality of P. A. Berglund, Superintendent of the nearby Northwestern Cannery, and because of the advanced season, it was possible to unearth a series of old skeletons, as well as a fair collection of archeological remains. A particularly interesting find among the latter was that of parts of four slate arrow or dart points of the "Folsom type," one of which lay in the deposits near a blue Russian bead. Another point of the same type had been obtained previously on the Nushagak River, and the same bilateral fluting is common in the points of the fossil ivory culture of the Bering Strait region.

The next prolonged stop was on the Kvichak River, 4 miles from its mouth in the Iliamna Lake. Here on the left bank of the river exists a large old site, abandoned "long ago," which notwithstanding much frost and ice in the ground could be explored with some adequacy, thanks to the aid of the fine lot of boys from the nearby weir-camp of the Bureau of Fisheries, headed by Fred Lucas, and which yielded very valuable material.

From the Kvichak two trips were made to the great Iliamna Lake, which although not rich in anthropological results yielded some observations on a remnant of living "Aleut" natives at the Newhalen River, and four fine "Kenai" skeletons from Knud's Bay.

The route then led, in company with Mr. Hart, across the 12-mile portage to Iliamna Bay on Cook's Inlet, and, with the invaluable aid of one of his boats, to Larsen Bay on Kodiak Island.

The work in Uyak and Larsen bays, Kodiak Island, proved from the start one of absorbing interest. It is another virgin field, and proved to be one of unexpected richness. With the help of excellent friends, Mr. Hart, Mr. and Mrs. Jones, Doctor Rich, Mr. Barnaby, and others, I was soon able to locate a series of sites, several of which were of considerable extent, and the excavations in one of these proved so fruitful from the first day that they were carried on for 15 days without interruption. Not a day elapsed without the discovery of some unique specimen; some of the objects showed remarkable art, hitherto wholly unknown from these regions. Much skeletal material was also recovered.

The site in which the excavations were carried on is on an elevated rocky point projecting into Uyak Bay. It extends both back and laterally and covers approximately about two acres. Over this

FIG. 90.—Woods Lake. Old site at mouth of Woods River. Depopulated during the last epidemic of influenza.

FIG. 91.—Woods Lake site excavations. Strenuous work in the jungle which obscured traces of ancient burials. "Butch" Smith on the right, the writer taking out an old skeleton.

FIG. 92.—Kaskanok, Kvichak River. The Bureau of Fisheries boys at the excavations. Doctor Rich farthest on the right. These men, and particularly the third from the left, have helped much in the author's excavations on the river.

FIG. 93.—Kodiak Island, Uyak Bay. Jones Point, from the east. The top of the elevation in middle and all the background to the extent of about 2 acres is covered by an important pre-Russian site. It was here that excavations were conducted. The site has been named by the author in honor of Mrs. Jones, who made the original excavations on the site.

the remains of semisubterranean dwellings and their accumulations (kitchen refuse) range from approximately 4 to over 15 feet in depth, reaching collectively about 500,000 cubic feet of ashes, shell detritus, rubble, and earth, throughout all of which are found with more or less frequency specimens of cultural nature, with animal and human bones. According to all indications this site is one of the oldest yet discovered in the far north. The lack of all traces of white man, wood reduced to streaks of formless brown rot, and the considerable filling in of the dwelling depressions with subsequent burials in these by later natives, all point to the conclusion that the site is prehistoric,

FIG. 94.—Jones Point, Uyak Bay, Kodiak Island. Excavations by the writer on the east side of the point. Mrs. Jones standing to the left of the excavation.

pre-Russian, and that its occupation extended for a relatively long time backward. The deposits, further, are not homogeneous and may be the result of repeated occupation.

As on the Nushagak and on Bristol Bay, I was confronted here with an enormous and highly promising task, and at the same time with a total lack of labor. The very few whites and natives that live on the bay were all fishing, and the cannery, with the unexpectedly large run of fish this year, was itself short of labor. As a great favor, nevertheless, they gave me one of the dock hands to help for two weeks with the shoveling. With him, though he observed strictly union rules and hours, and the help each day of from one to four friends, it was possible to make four satisfactory " incisions " into the

edges of the deposits, besides a few trenches and holes in the more central parts of the site, all of which resulted in 19 boxes of specimens. The burial ground of the site, which may contain many skeletons, was not discovered, and a vast amount of promising material remains to be worked over. This must be the task of another season and under better conditions so far as help is concerned.

Besides the work at the site just mentioned, which in honor of Mrs. Laura Jones I have called the "Jones Point Site," visits were made to the important region of Karluk Village and River on the northern shore of the island; to Chiefs Point, at the head of the Uyak Bay; to Amok Island, deep in the bay; and to the head of Larsen Bay. At all these places were found large and important sites that call for exploration. And many other sites were reported in different other parts of the island, calling for a survey of the whole region.

This summer's exploration and anthropometric observations have resulted in clearing or settling the following hitherto obscure points:

The natives of the Nushagak River and watershed are definitely all Eskimo. They belong to the southwestern type of the race, are identical with the Kuskokwim and the neighboring Tundra Eskimo, and are largely if not entirely derived from these.

The Peninsula was a regular sieve for movements of people from the north southward. There is a whole series of passes more or less easily practicable for even primitive people. About every 30 to 40 miles from east to west a good sized "river" extends for various distances from the north into the peninsula, ending in one or more lakes from which generally smaller streams lead farther southward to within a short distance of streams that run towards the Pacific. People such as the Eskimo or the Indian could readily, it was seen, have come along the western coasts, reached these passes and carried their skin boats over the few rapids and portages, after which they found themselves close to or within Shelikof Strait, facing the visible Kodiak Island, or in Cook's Inlet; and from both of these regions the way towards the northwest coast and the rest of the continent was open. This was plainly the most natural and the easiest way of procedure for all comers from the Bering Sea and northwestern Asia. The peopling of America therefore, as surmised before, took place not through Alaska but along its western coasts and through the Peninsula.

The now nearly extinct people of the eastern half of the Peninsula, from probably beyond Port Moller to and including the Kvichak River, though they uniformly called themselves "Aleuts," were found in substance to be the same as those of the Nushagak, the Togiak, and the Kuskokwin regions, and are doubtless of the same old derivation.

FIG. 95.—Beautiful old ivory plaque showing a remarkable portraiture; also some decoration and a sort of crown surmounting the whole. Probably a breast pendant. Orbits may have been inlaid with stone. Height, 3 inches.

FIG. 96.—A large breast pendant carved out of a whale rib, showing a remarkable portraiture. Found by the writer in excavation at Jones Point, Uyak Bay, Kodiak Island. Length, 8¼ inches.

FIG. 98.—Photograph of original large stone lamp, from Kachemak Bay, Kenai Peninsula. The bowl shows two remarkably faithful sculptured figures of black whales. Property of C. S. Hubbell, Seattle, Wash. Length, 9 inches.

FIG. 97.—Photograph of a large stone lamp from a pre-Russian site in Uyak Bay, Kodiak Island. Donated to the United States National Museum by Mrs Laura Jones. Specimen shows a little human figure at the head of the bowl and other carvings on the convex surface. Length, 10¼ inches.

The root of the word Al-eut is really, it seems, "ute," meaning "people," and identical with the "ute" or "uit" in "In-uit" (pronounced "In-ute") in "Mahlem-ute" and other names ending similarly, of the Eskimo further north. There are only some dialectic with a few cultural differences between these "Al-utes" and the people of Nushagak, Kanatak, Togiak, Kuskokwim.

These eastern "Al-utes" extend, or did so in the recent past, over the Iliamna Lake to Newhalen River and Knud's Bay, on the northern shore, where they met with or superseded the Kenai; and they extended along the whole southern shore, though there were but a few settlements. The Kenai began at Newhalen River, Knud's and neighboring harbors, and at Iliamna Village, extending thence to the Clark Lakes and Cook's Inlet.

The lines of demarkation between these eastern eskimoid Al-utes and the neighboring "Kenai" are not very distinct and many individuals of either group cannot be distinguished from those of the other, but in general the Kenai in their physiognomies approach more closely the Indian.

The Kodiak Island culture presents considerable individuality, and evidence of considerable age. It shows a relationship on one hand to that of the Eskimo, and on the other to that of the northwest coast. The skeletal remains appear to resemble those of the eastern Al-ute, but show also other interesting characteristics.

Kodiak Island shows the first trace in the far north of cranial deformation, of the cradle-board variety (occipital flattening). But this was not universal.

The remains on Kodiak Island show numerous and unmistakable signs of long-continued cannibalism.

The numerous old rich deposits on Kodiak Island, hitherto untouched, open an important new, large, and promising field for American exploration.

ARCHEOLOGICAL INVESTIGATIONS IN NORTHERN ALASKA

By HENRY B. COLLINS, JR.
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In continuation of the Institution's program of investigation of prehistoric Eskimo cultures, Messrs. James A. Ford and Moreau B. Chambers were detailed to carry on archeological work in Alaska during the past summer. Mr. Ford had spent the summer of 1930 in Alaska, principally on St. Lawrence Island, with the writer. Attention was directed again to St. Lawrence Island, just south of Bering Strait, where the previous excavations had revealed abundant evidence of the ancient and highly developed Old Bering Sea culture. In addition, the work was extended to Point Barrow on the Arctic coast, which apparently marked the eastern limit of this culture. The St. Lawrence investigations were conducted by Mr. Chambers, while Mr. Ford proceeded to Point Barrow.

As in previous years, transportation from Seattle was furnished by the Coast Guard Cutter *Northland,* and especial thanks are due to Capt. E. D. Jones for his usual interest and cooperation. While waiting at Unalaska for the ice in the Bering Sea to break up there was opportunity for excavating to some extent in the large kitchenmiddens which mark the sites of two of the prehistoric Aleut villages on Amaknak Island. The middens in this part of Alaska are large in extent, and being unfrozen, are relatively easy to excavate; but, for the same reason, many objects of a perishable nature have not been preserved as is the case in the permanently frozen Eskimo middens farther north where material such as wood, hides, and baleen is held in perpetual cold storage.

A burial cave on a small island near Unalaska was also explored and a collection of bones and artifacts dating from pre-Russian times was obtained. The bodies apparently had been mummified and wrapped in matting and other fabrics according to Aleut custom, for pieces of dried flesh and fragments of the wrappings were found. However, the cave had been disturbed previously and the bones and other materials were scattered about in confusion. One of the most interesting objects found with the burials was a unique type of stone labret, having two projections representing the upper central incisor teeth.

Late in June Mr. Chambers was put ashore at the Eskimo village of Gambell, at the northwestern end of St. Lawrence Island, where he remained until the *Northland* returned for him in September. Excavations were carried on at several old village sites in the vicinity of Gambell which, in 1930, had yielded a remarkably clear picture, or cross section, of prehistoric Eskimo culture from a very early period down to the present time.[1] The material excavated by Mr. Chambers adds to the completeness of the picture, furnishing additional links between the several culture stages.

The oldest evidence of human occupancy thus far found on the Island was obtained at a small village site near Gambell which was discovered almost by accident. This site, on the lower slope of the Gambell cape or mountain, had been completely covered over by moss and tundra and the Eskimos living at Gambell, less than a mile away, were not aware of its existence. Excavation has proved this to be a pure site of the Old Bering Sea culture, a village which had been established and abandoned during the period, many centuries ago, when this rich old Arctic culture existed along the coasts of Siberia and Alaska in the vicinity of Bering Strait.

The material excavated from this site and from the next oldest site, nearby, affords a basis for a reconstruction in outline of the life and habits of the Eskimos of the Old Bering Sea period. They lived in small houses, square or rectangular in outline, which were built partly underground and entered by means of a long narrow passageway. The floors were of stone slabs and the walls were made of small driftwood timbers laid horizontally one above the other and held in place with bone and wooden stakes. The nature of the roof construction has not been determined clearly but it seems likely that timbers were also employed for this purpose. These earliest St. Lawrence Eskimos lived by hunting, very much as do those of the present day. The principal animals captured were walrus, seals, and birds, and these supplied the essential means of livelihood: blubber and meat for food; oil for heat, light and cooking; and skins for clothing, boat coverings, and other purposes. Whaling occupied a much less prominent rôle in their lives than it came to have among the later Eskimos. Many of the common implements in use at that time differed little or not at all from those used centuries later. Their art, however, was unique, and it is this feature which gives the Old Bering Sea culture its characteristic stamp.

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[1] Ancient culture of St. Lawrence Island, Alaska. Explorations and Field-Work of the Smithsonian Institution in 1930, pp. 135-144.

FIG. 99.—Ivory objects excavated from abandoned Eskimo villages on St. Lawrence Island showing two stages of prehistoric Eskimo art. The objects numbered from 1 to 5 are decorated in the Old Bering Sea style; those from 6 to 9 are later and are decorated in the Punuk style.

FIG. 100.—St. Lawrence Island Eskimos. Paul Silook, at left, and his family at Gambell.

FIG. 101.—The walls of an ancient Eskimo house begin to appear in one of the excavations at Miyowaghameet, a deserted site near Gambell, St. Lawrence Island.

Working with stone tools, these prehistoric Eskimo artists carved from bone and walrus ivory their many and ingenious forms of implements, weapons, and ornaments. Some of their productions, such as animal figures and human heads, are very good examples of carving in the round, but the art that is most typical of the period consists of a graceful arrangement of curving, flowing lines deftly incised on ivory surfaces. The essential motives around which the designs center are circular or elliptical figures, made free hand and usually slightly raised so as to suggest the eyes of an animal; lightly incised lines, some of them dotted, along with more deeply cut lines for contrast, serve to balance and unify the designs. The beauty of the Old Bering Sea pieces thus decorated is accentuated by the soft rich shades of cream, brown, and even black which the ivory has assumed through centuries of burial in the frozen soil.

After having flourished for centuries in northern Alaska and Siberia there came a time, probably more than a thousand years ago, when certain aspects of the Old Bering Sea culture, particularly its art, underwent rather sudden change. Instead of the skillfully executed curvilinear designs, the lines became deeper, straighter, and more evenly incised, resulting in a style which while still graceful, was distinctly inferior to that which had preceded it. This style of art has been designated as Punuk, from the small island 4 miles off the eastern end of St. Lawrence, where in 1928 it was first found in isolation.[2] At Gambell, Punuk art appears for the first time in the upper levels of the second oldest site and overlies material of Old Bering Sea type. In two other sites nearby it occurs exclusively, and at a third site, very recent as shown by the presence of iron, glass beads, and modern types of implements, it is scantily represented. There is now a sufficient body of material from the old sites on St. Lawrence to show that the simplified Punuk art was mainly an outgrowth of the curvilinear art of the Old Bering Sea period, even though at first glance the two styles appear hardly related.

While it is often a fruitless procedure to speculate on the causes which may have brought about cultural changes in the remote past, there is some evidence that a contributing factor toward the decline of the rich Old Bering Sea art was the introduction of iron tools from the Orient some hundreds of years before the arrival of the Russians into northeastern Siberia in the seventeenth century. Authentic Chinese records are known which show that iron was being used in north-

[2] Prehistoric art of the Alaskan Eskimo. Smithsonian Misc. Coll., vol. 81, no. 14, 1929.

eastern Siberia in the third century A. D. This being the case, it would be natural to assume that the neighboring Eskimos would likewise have possessed some of the metal, if only in very small quantities. At any rate, it is certain that the deeply and evenly incised lines and the perfect circles of the Punuk period were produced with metal instruments; and that these must have long antedated the time of first Russian contact is shown by the fact that typical Punuk art is found from top to bottom of 16-foot kitchenmiddens at old sites which according to every indication have been abandoned for two hundred years.

While the Old Bering Sea art was undergoing changes in the western area around Bering Strait, as outlined above, modifications along somewhat different lines were taking place farther to the eastward. Recent excavations in the central Eskimo area of northern Canada and also in Greenland have brought to light evidence of a widespread old Eskimo culture which has been designated as Thule. Instead of being similar to the culture of the present Central Eskimo, the old Thule culture shows a surprising resemblance to that of Alaska. Indeed, the resemblances are so close and so many that there can be no doubt but that the Thule culture had its origin in Alaska. Thule types of implements, particularly harpoon heads, are found also on St. Lawrence Island and at Bering Strait, but there they are comparatively recent, being associated with the later stages of the Punuk. As we proceed eastward along the Arctic coast, however, Thule traits are seen to become more abundant, and since there have been no systematic archeological investigations in this area the precise nature of the relationship between the two old cultures remains to be determined. The most important strategic point for such an investigation seems to be Point Barrow, for according to present indications this was on the one hand the most easterly point to which the Old Bering Sea culture extended and on the other the most westerly point at which the Thule existed as a predominant type.

The determination of the exact relationship between the Old Bering Sea and Thule cultures was made one of the primary objectives of the 1931 expedition, the investigation being intrusted to James A. Ford.

After leaving the *Northland* at Nome, Mr. Ford continued northward through Bering Strait and up the Arctic coast to Point Barrow on the trading schooner *Patterson*. The Institution is greatly indebted to Capt. C. T. Pedersen for his assistance in furnishing Mr. Ford with transportation. As originally planned, excavations

FIG. 102.—The Coast Guard cutter *Northland* plowing its way through the ice in Norton Sound.

FIG. 103.—Eskimos cutting up walrus killed on the ice off Wainwright, on the Arctic coast of Alaska.

FIG. 104.—Umiak used by Mr. Ford in landing the mail and camp equipment from the *Patterson* at Peard Bay. The 50 miles from Peard Bay to Point Barrow was made with dog team and sled. See Figure 107.

were to be made at Barrow during the period—about a month—between the arrival of the *Patterson* and the departure of the last ship late in August. However, ice conditions along the Arctic coast of Alaska were the worst in many years, and the *Patterson* and the few other ships bound for Barrow were greatly delayed. The following extracts from letters received from Mr. Ford will give some idea of the conditions encountered:

> The 15th (of July) found us off Point Lay. Since then we have been waiting for a favorable NE. wind to let us through but the southeasterlys have moved the ice pack up to Wainwright. We have been back to Point Lay five times and to Icy Cape so often that we are considering erasing the "of San Francisco" on the stern and substituting "of Icy Cape." . . . . While still stuck below Wainwright I took an Eskimo crew and worked along the shore in an umiak as far as possible and walked in carrying the mail. I went so that I might have an opportunity to examine several sites along the coast, but found none that were very old. At Wainwright the teacher showed me some harpoon heads he had purchased from a native living at the old site of Nunakaak, 23 miles up the coast, which led me to make an examination of the site. As the sea was closed I went by dog team and got in four days of work before the ice opened and the *Patterson* picked me up. The harpoon heads we found were mostly modern and Thule, no Birnirks.

Finally, after very slow progress through the ice pack, the *Patterson* reached Peard Bay, 50 miles below Barrow, and being unable to proceed further, Mr. Ford left the ship in an umiak, taking with him the mail for Barrow and the most necessary items of his equipment:

> No one could say when or if we would get through. The more experienced the ice man the less he said. Captain Pedersen wanted to get the first-class mail into Barrow; I wanted to get to Barrow and also to see the coast, so as he offered me his umiak, motor, and crew I took advantage of the first SE. wind—which opens a narrow shore lead—to go ashore where I found a camp of Barrow Eskimos just north of Skull Cliff. There I managed to scrape up 15 dogs and an old broken down sled. The natives had to work several hours fixing the sled with everything from baling wire to old Sunday neckties. We got over the 45 or 50 miles to Barrow with 200 pounds of mail and camp equipment in two days—15 hours travelling time. The people at Barrow were glad to get their mail but seemed even more delighted with the two packages of cigarettes I happened to have. I arrived on August 16 and started work at Birnirk the next day; worked until the 20th, finding Birnirk type harpoon heads in the top layers of the mounds. The older sites up here are not continuous middens as on St. Lawrence but each house is on a mound. These mounds are from 4 to 10 feet high, and dotted over a flat marshy place such as that occupied by Birnirk or Nunakaak, they look very much like Indian mounds in the Southeast.

As the ground was already freezing and there was little chance of getting any work done before the close of the season, Mr. Ford communicated by radio with the Museum, requesting permission to stay at

FIG. 105.—Miss Katherine Allen, daughter of Jim Allen, veteran trader at Wainwright, with part of the 1931 catch of foxes. Polar bear skins in foreground.

FIG. 106.—James A. Ford with the dog team he used in making a trip along the Arctic coast from Wainwright to Nunakaak.

Barrow over the winter in order that he might get in a full season of excavation in 1932. Permission being granted, he took advantage of the presence of Capt. Ira Rank's little trading schooner, the *Trader,*

FIG. 107.—When streams were reached the load was transferred to a kayak or umiak, while the dogs swam across with the empty sled.

to make a trip to Barter Island, 300 miles to the eastward of Barrow and almost to the Canadian boundary:

> We stopped at every camp we could hear of and I asked all the usual questions but not an "ipani igloo" (ancient house) did I see until we reached Barter Island. Heard of two sites though and got a little material from them, all modern and Thule. Could hear of no mounds like those at Birnirk or Nunakaak. The country to the eastward is lovely and the mountains behind Barter Island gorgeous, but the ice was bad and gave us plenty of trouble.

A further account of Mr. Ford's explorations at Point Barrow this coming summer will be given at a later time.

CULTURE SEQUENCES IN HAITI

By HERBERT W. KRIEGER

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Much has been written about the mystery and charm of the Black Republic of Haiti. From the days of the Spanish goldseekers, French buccaneers, and colonial squires, through the eventful era of the black king Christophe and his court at Sans Souci with its counts of Limonade and dukes of Marmalade, through the political intrigues and murders, caco raids and revolutions, to the days of the United States Marine with his gendarmerie and Treaty Government—the theme of Haitian culture-history is romantic indeed. Travel books of the people of Haiti in a natural history setting with more or less fanciful allusions of a historical flavor make delightful reading. The prosaic reports of the Treaty Government, however, are more factual. The most useful work dealing with the period of French occupation are the four volumes by Moreau de Saint-Méry published in 1797-8. His detailed historical narrative, observations on natural history, agriculture, and on the slave population of the French colony are remarkable for their accuracy.

Antedating these historical occupancies and culture sequences are the first inhabitants, the original Haitians. Of these only the Arawak, an offshoot of a South American linguistic stock, are known to literature. This people occupied the more humid northern coastal plain and the Massif du Nord and at the time of the discovery were ruled by a chief, Goacanageric, whose village, Guarico, was located in the immediate vicinity of Cap Haitien. In the South, the center of Arawak occupancy was in the Cul de Sac and the Plaine de Leogane, with the chief's village located where Port-au-Prince now stands. There, under their beautiful "queen" Anacaona they had attained a culture level superior, according to Spanish writers, to that existing elsewhere throughout the ancient island of Haiti. The arid central portion of Haiti, the valley of the Artibonite, was unsuitable for Indian habitation.

It was with pleasure that the writer undertook the Smithsonian detail to make an archeological reconnaissance of the country. The early months of 1931, from January to May, were delightfully spent in carrying on archeological investigations that took the writer from one end of the Republic of Haiti to the other, from the ancient Arawak

province of Xaragua in the southwest to the Dominican border in the east.[1] In the northern portions of the Republic excavations were made at widely separated Arawak sites: one near Ouanaminthe in the Massacre River valley; three in the confines of the valley of the Riviere Romeo; and five in the vicinity of the Bay of Forte Liberté, notably near the villages of Paulette and Terrier Rouge; one on the Riviere Trou, another near Caracol Bay; two near Cap Haitien and Petite Anse in the Plaine du Nord; one on the Limbe River; and two in the vicinity of Gros Morne in the valley of Les Trois Rivieres. These sites were trenched to obtain statistical samples of aboriginal pottery and other midden débris for comparison with lots from northern Santo Domingo obtained through excavations in the vicinity of Monte Cristi in 1929.

In the Cul de Sac and on the Plaine de Leogane, where according to Oviedo the Arawak Xaraguanians practiced a maize and a cassava culture with the aid of irrigation, archeological studies were less productive due to the obliterating influence of centuries of cropping in an area of garden agriculture. In the arid Plaine du Hinche and in the more humid Massif du Nord several pottery-yielding sites were located and cave deposits, previously located by Abbott and Miller, were worked.

Near the eastern end of the island of Tortua, which is in proximity to the Haitian mainland in the vicinity of Port de Paix, cave deposits revealed a succession of occupancies not the least interesting of which are gun flints and other relics of buccaneer days. Île à Vache (Cow Island), located in the Caribbean a few kilometers off the southwestern coast of Haiti in the immediate vicinity of Les Cayes, was repeatedly visited by motorboat, while Goat Island, located in the bay within sight of Port-au-Prince, was explored by sailboat. Goat Island is littered with Arawak midden débris, while Île à Vache has four large shell mounds, first sighted by Parish on the Parish-Smithsonian expedition of 1930.

The lake region of central Haiti, the eastern extension of the Cul de Sac, is of interest because of the progressive lowering of the water

[1] The archeological study of Haiti is in continuation of work of a similar nature carried on by the Smithsonian Institution in the Dominican Republic during the years 1928-1930. These several expeditions were sponsored and financed by the veteran explorer Dr. W. L. Abbott, who is responsible for much of our knowledge of the natural history of Haiti and of Santo Domingo. Doctor Abbott's visits to the West Indies extended from 1883 to 1923, since when he has sponsored biological and anthropological expeditions of Smithsonian scientists to Santo Domingo and to Haiti.

FIG. 108.—The African trait of frequenting country roads for business and for pleasure is not neglected in Haiti. A few of the many hundreds of peasant women of the Cul de Sac who visit Port-au-Prince on market days.

FIG. 109.—Mills for the grinding of sugar cane have not improved much since the departure of the French from Haiti more than one hundred years ago. The manufacture of rum from the juice of the cane is still the mainstay of the sugar industry. Mills of the type here shown from the vicinity of Leogane are propelled by diminutive Haitian horses.

level in the several lake beds. The water, impregnated with salt, is increasing in density owing to rapid evaporation. One of the lakes, Trou Caiman, is now entirely dry, while another, Étang Saumâtre, has receded much below its former shore line. Just over the Dominican border on the east is the large Lake Enriquillo, whose present water level is below that of the ocean. This may be in part due to diversion of water from the Yaque River for purposes of irrigation. The shores of these lakes yielded but little archeological material although the old Indian trail from Xaragua eastward to Santo Domingo followed the ancient shore line. A decade ago a collection assembled by Mr. Peters of Port-au-Prince from sites on the " Isla de Cabritos " in Lake Enriquillo was forwarded to the British Museum. The island is now a part of the mainland.

Thanks to the energetic functioning of the Department of Public Works under the direction of Commander Duncan of the United States Navy, many of the principal Haitian roads are suitable for travel by automobile. When it became necessary to travel along the more typical Haitian trails recourse was had to the more popular horse and mule transport. Sailboats were used to reach Goat Island and several of the Arcadins west of the town of L'Archaie. Islands off the southern coast in the vicinity of Aquin were also reached by sailboat, while it became necessary to hire a motorboat to encircle the larger Île à Vache. Grand Cayemitte and the small islands in Baradere Bay were not visited, nor was the visit to the Island of Gonave more than casual.

Haiti under present conditions is a peaceful country. People are hospitable and willing to lend a hand in an emergency. They are not at all the mysterious and cruel folk fiction writers would have them be. Their almost universal poverty is correlated with a remarkable freedom from economic opportunity. A dense population centers about the more favored agricultural regions where rainfall is ample as in the Plaine du Nord and in the Massif du Nord. The old Arawakan irrigation system continued by the French planters and the modern Haitians in the Cul de Sac and in the Plaine de Leogane makes possible the growing of crops sufficient to maintain a dense population in the vicinity of the capital city, Port-au-Prince. In the large and fertile but arid valley of the Artibonite River, the introduction of irrigation is under consideration, but for the present agriculture there remains restricted to a bean and corn crop planted on the sloping and moist river banks.

In the Republic of Haiti the small self-sufficient garden planting is the lineal descendant of the primitive clearing in the forest. It remains

FIG. 110.—Varied, indeed, are the products offered for sale or barter in the Haitian markets, though the amount of currency available is pitifully small. The slump in the world demand for coffee, sugar, and for other exportable crops has greatly affected sales in the local markets. The market shown is at Thomazique, a village in the Cul de Sac midway between Port-au-Prince and the Dominican border.

FIG. 111.—Market day at Cavaillon in the southwestern peninsula. This village has achieved vicarious fame through being the home town of Cator, the holder of the world's record in the broad jump. Not far distant are the town of Les Cayes, the birthplace of Audubon, the famous naturalist; and the town of Jeremie, the birthplace of Dumas the elder.

a pathetic survival in view of the demands of a dense population having no other means of existence.

Cultivation of exportable crops, as coffee, cotton, fiber, tobacco, and other products, is languidly conducted. Logwood, exported in large quantities as a dyewood in making a commercial black dye, and the many products locally consumed are laboriously transported by horse and donkey back or on the heads of human porters over the crowded roadways to the principal markets of the country. The majority of travelers are barefoot market-women, who journey either afoot or sit sidewise on the diminutive donkeys (burriques) all the while beating a tattoo on the bare flanks of the poor undernourished pack animal. Wheeled vehicles are limited to the creaking ox-carts of the sugar plantations. As the journey to market may consume several days and nights, flop houses at the side of the road are a characteristic sight. Hundreds of market-going folk may be encountered in the early hours of the morning on the final stage of their journey, each one hoping, perhaps, to sell the equivalent of a gourd's worth (20 cents) of eggs, indigo, or perhaps a bundle of woven straw hats each showing the characteristic twilled decorative design in straw color and black. Their journey may have taken them over mountains, or across deserts where even drinking water must be transported in the inevitable calabash container that shares the saddle bag with a live chicken or two, a baby perhaps, or a few yams or oranges.

Market day reveals the teeming population engaged in intense activity. Tiny portions of goat meat, squares of yellow soap, ropes, woven baskets and bags, pitch-pine for torches, loose matches, nails, buttons, small but artistically decorated clay pipes, squares of indigo, cassava bread in large round flat slabs folded over, unground pepper, rock salt, fruits, thread, unhulled rice, ground or shelled corn, beans of several varieties, leather, old shoes in unassorted lots, candles of beeswax, tin cans, bottles—all these and many other saleable articles give evidence of native enterprise in an attempt to eke out a meager existence. Saturday afternoon is market- and pay-day for the laborers of the Haitian-American Sisal Corporation at Paulette. Thousands of laborers and camp-followers are drawn to the scene. All of Saturday night and Sunday is a period of marketing, singing, gambling, and folk-dancing. The fire dance, executed solo, as are most Haitian dances, is a sight never to be forgotten.

As the Haitians assembled at Paulette come from the entire northern part of the Republic, it is possible to observe differences in their physical appearance. Saint-Méry, observing in 1797 similar differences, accounts for them by the diverse origin to which he ascribes

FIG. 112.—Ruins of Sans Souci, the palace of the black king Christophe near Milot at the foot of the Massif du Nord. Here were entertained members of court and nobility created by Christophe, first king of the Haitians. The Duke of Marmalade and the Count of Limonade received their acrid titles from the names formerly bestowed by the French on several of the northern provinces.

FIG. 113.—The citadelle here shown crowns the high peak in the Massif du Nord known as the Bishop's Bonnet. This monumental fortress was erected by Christophe as a last defense against the French, should they at any time return in force to again subdue their former African slaves.

FIG. 114.—In Port-au-Prince are the Champs de Mars and the adjoining Place l'Independence with their brilliantly white plaster government buildings in the background. When framed with the distant thunder-capped mountains and the azure sea a most beautiful view is presented to the unaccustomed northern eye.

FIG. 115.—Sizable natural caves in Haiti frequently take on a local name of Voute l'Eglise (grotto of worship). In these caves are carried on animistic rituals commonly known as Voodooism. The cave shown in the illustration, near Miragoane high up on the cleft of the stone escarpment, is too small for use as a "church cave." It did, however, yield many sackfuls of animal bones brought there by owls.

the African slaves. He names the distinct tribes and gives their African habitat. The lighter-skinned Haitians of the southern provinces betray admixture with the white race, while in the north mixed bloods were killed during the period of the slave eruption.

Intercourse and travel throughout the Republic has ever been limited. Paved carriage roads built by the French have been allowed to fall into disrepair. An occasional bare spot in the jungle growth reveals an abandoned flagged and curbed roadway with occasional glimpses of tall gate posts and sections of walls of mortised brick falling into oblivion. The wealthy French indigo, coffee, sugar and rum planter was once the equal in wealth and prestige of the American tobacco planter. In his case there has been no culture sequence. Black Haiti has absorbed but little of his culture.

While the century of French occupation is perpetuated in the arched bridges, porticos, and houses still standing in the cities, and in the occasional survival of a French sugar-mill, of the Spanish conquerors there remains less trace than of the Indians whom they destroyed. Spanish rule continued for more than one hundred years before they retired before the French. Their influence may be noted in the names of rivers, towns (*e. g.,* Lascahobas), and places near the Dominican border where Spanish nationality and influence is strong to the present day. Haiti never was completely occupied by the Spanish as was Santo Domingo. But little gold was to be had in Haiti after the Xaraguanians were deprived of their golden ornaments and sacred objects. The few Spanish colonists were readily absorbed by the French once a foothold was obtained by the buccaneers at Cap Haitien.

Across the bay from Cap Haitien is the village of Petite Anse, the historic spot where Columbus founded the first European colony in the New World. The colony, La Navidad, short-lived as it was, is of interest here as a possible link in identifying the site of the native village of Guarico, the seat of the Arawak chief Goacanageric who became the friend of Columbus. The Gendarmerie exhibit with enthusiasm at their headquarters in Port-au-Prince a ship's anchor reputedly found in the shallow waters of the bay at Petite Anse. It is of a type that might have been carried by the *Santa Maria,* the flagship of Columbus shipwrecked on Christmas Day, 1492, the timbers of which were used to build the fortified structures that were to house the 44 members of the La Navidad colony. It is probable that where Cap Haitien now stands is the former site of Guarico; at least tradition would have it so. According to Washington Irving, some of the older inhabitants still referred to the town (Cap Haitien) by the name of Guarico.

Three Arawak sites were excavated by the writer in the immediate vicinity of Petite Anse, including one on the Desglaireaux land of the American Pineapple Company just beyond the sentry box, east of the village, and another nearer to Cap Haitien but back from the beach approximately 3 kilometers. Potsherds collected from these two sites,

FIG. 116.—Illustrated are four sacred images, "zemis," of symmetrically carved stone from the historic Arawak village of Guarico, the present Cap Haitien. These "zemis" were potent agents of the Arawak priest when called upon to break a drought, or to ward off a hurricane, or to make a warrior invulnerable in battle.

while coming under the general Arawak type, differ in design, paste, form, and thickness of walls.

Anacaona, the sister of the Arawak chief Behechio, whose village occupied the site where now stands the capital city of Port-au-Prince, gave freely to Bartholomew Columbus of her stores in cotton yarn, pottery vessels, carved wooden seats, cassava bread, and golden

FIG. 117.—On the smooth stone walls of caves and on bowlders along the larger water courses appear deeply incised pictographs anciently carved there by unknown Indian artists. Many of these "petroglyphs" represent, no doubt, spirits who, in Indian lore, were ever present either to be appeased or supplicated.

FIG. 118.—Mollusks formed one of the staples in the food supply of the Ciboney and Arawak Indians of prehistoric Haiti. The same is true for the negroid occupants of present-day Haiti. The illustration is that of a shell mound on Beata Island, unusual in its makeup in that it consists exclusively of shell débris of the large conch *Strombus gigas*.

ornaments. Nevertheless she was hanged by Governor Ovando, who proceeded to found a town on the spot which he named Santa Maria de la Vera Paz.

The Xaraguanians, who practiced an intensive form of agriculture dependent on irrigation, possessed a superior form of material culture to that of the natives of Marien in the north where ample rainfall and a fertile soil required less effort in agriculture to maintain an adequate food supply. Oviedo mentions the fact that villages at Gros Morne and elsewhere numbered several hundred houses. This was no doubt an exaggeration on a par with the statement of Las Casas that the entire island bore a population of 3,000,000. Spinden's estimate of 100,000 inhabitants is nearer the truth, as large sections of the more arid regions of central Haiti and Santo Domingo were uninhabited.

There were in the mountainous areas and along the coast, particularly in Samaná in the northeast, and in Xaragua in the southwest, representatives of hunting and fishing tribes that did not practice agriculture. Abundant traces of these people are to be seen in the shell mounds of the Haitian littoral investigated by the writer. These shell mounds were originally described as from caves in Samaná, Santo Domingo, by Gabb; from Beata Island, off the south coast of Barahona by Wetmore; by Parish from Île à Vache, off the Caribbean coast of southwestern Haiti; and by the writer from sites on the Cul de Sac and on the north coast of Haiti.

An interesting archeological discovery is the recognizable sequence in Arawak pottery wares from the several Arawak sites. The pottery type predominant at the time of the Conquest is as yet not clearly established. An enigma, however, is the tribal identification of the non-pottery producing, shell-mound builders of the Haitian and Dominican littoral. Future investigation should bring out clearly the sequence in Arawak culture and its northern and southern affiliations as also its autonomous development as an island culture through study of the several known major historical sites. Future investigations, however, may never determine just what are the relations that once may have existed between the shell-mound builders of the Haitian, Bahaman, and Floridian coast.

HUNTING BASKETS IN ARIZONA

By NEIL M. JUDD
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Archeologists sometimes go on wild goose chases. My last field trip was just such a one and there have been others before. Archeological wild goose chases result from the fact that reported discoveries, once run to earth, are not always what they seemed to the original observer or, with equal likelihood, they are not always what the archeologist hopes they might prove to be.

For example, when I first learned that a number of old baskets had been seen lying about in caves in the rugged Natanes Plateau of eastern Arizona, there flashed before my mind's eye that same familiar mirage which sooner or later beckons to every student of the prehistoric Pueblos: A cave dwelling just as its aboriginal inhabitants left it, undisturbed by modern hands. Too, there was the vaguest sort of possibility these baskets might be relics of the ancient Basket Makers whose slab-sided pit-houses so frequently underlie habitations of the later Pueblo tribes.

There was some justification for this latter thought, however fantastic it subsequently proved to be. The so-called Basket Makers, first farmers of the Southwest, had changed from a nomadic to a semisedentary mode of life upon acquisition of maize. Their cultural remains, recovered by painstaking excavators from sand-filled caves in southern Utah and northeastern Arizona, provide a fairly comprehensive index to the degree of civilization these ancient folk had attained 1,500 years before Spanish conquistadores began the written history of the New World. And artifacts peculiar to the Basket Makers had been found in the Guadalupe Mountains of southern New Mexico. Between the Guadalupes and Navajo Mountain, on the northern Arizona border, lie 500 miles of semiarid land—broad desert valleys, deep canyons, towering mesas, gnarled mountain masses gray-green with oaks, junipers, and pines. Somewhere in these far-flung miles the primitive Basket Makers should have left footprints as they plodded southward from the basin of the Rio San Juan. Who could say but that an echo of that distant migration might be found in the very caves of which I had heard?

My first intimation of these, and the baskets they sheltered, came in early February, 1930, while I was engaged with an aerial survey of

the prehistoric canals in Salt River Valley.[1] My trustworthy informant was a reformed cowboy who had his information from a professional hunter who had actually seen the baskets while chasing cougars up and down the mountain side. Now, as a rule, hunters and cowmen are so preoccupied with signs of predatory animals and mossback steers that they pay little attention to anything else along the trails they travel. But here was a hunter who knew what he had seen and where he had seen it; and here was a cowboy so enthusiastic over archeology that he made mental note of all available details concerning this particular occurrence. Which information in due course was generously placed at my disposal. Yet it was not until the summer of 1931 brought warning that pot-hunters (diggers of curios for the commercial trade) were working toward the isolated region in which I was interested that provision was made for an early reconnaissance. Needless to say, this was undertaken with specific authorization from the Department of the Interior, as required by law.

In consequence of all this, the first week of September found me in Phoenix; a few days later, at Sawmill—mere speck on the serpentine road from San Carlos Agency to Fort Apache and beyond. With three weeks on horseback immediately in store, Previous Experience suggested that I take advantage of the modest comforts at hand and, while the saddle was getting used to me, examine those caves known to exist in the hills round about. So we rode part way down Sawmill Canyon, which nature never designed as a bridle path, and next day we walked 5 or 6 miles up Bronco Canyon and back again just because a horse with more than two feet could not possibly pick a way between the tumbled boulders.

Two of the five caves we[2] entered in Bronco Canyon had once been inhabited by aborigines. The larger of the two, a huge duplex affair (fig. 119), obviously was occupied throughout a considerable period but its entire ceiling has since fallen and permanently buried whatever of material culture lies within. Piled among these tons of broken limestone was the nest of a pack rat; we pilfered from his private museum (as a hobby, every pack rat collects queer curios) a painted bow, several reed arrows with long wooden tips, potsherds, etc. The small but alluring cave visible in the west wall of the canyon 500 feet or more

[1] Explorations and field-work of the Smithsonian Institution in 1929, pp. 177-182, 1930. Explorations and field-work of the Smithsonian Institution in 1930, pp. 157-166, 1931.

[2] Throughout his three weeks in the field, the writer was accompanied by Serg. Phillip E. Howard as guide; young Don Thompson of San Carlos, joined us at Ash Creek ranch.

FIG. 120.—Conglomerate cliffs and a small ruin near Arsenic Spring.

FIG. 119.—One of two entrances to a large cave in Bronco Canyon.

FIG. 121.—Cave ruin about 1 mile west of Arsenic Spring.

FIG. 122.—Ruin near Arsenic Spring.

above its stream bed and which we reached only by inching our way along precarious ledges and through some of Arizona's prickliest cacti, had been utilized by an owl, nothing more.

Natanes Plateau, locally known as " the Nantacs," " the Nantans " or " the Nantes," overlooks the remainder of Gila and Graham counties from an elevation of more than 5,000 feet. As one descends from the pine forests about Sawmill the temperature changes perceptibly and, with it, the fauna and flora. From the southwest base of the plateau, fringed with mesquite, catclaw, and like thorny shrubs, miles of seemingly level grasslands stretch away southward to end abruptly on the very brink of dreadful chasms, tributary to the placid Gila River. Within these silent gorges giant sahuaros reach skyward their stubby fingers just as on the hotter Arizona deserts.

Not until we had crossed the headwaters of Blue River, Rocky Creek, and Warm Springs Creek; not, indeed, until we had passed Ash Creek ranch, former rendezvous of the Chiricahua Cattle Company, and climbed out upon that vast and marvelously level valley ignominiously known as Ash Flat did we find the underlying formations of the Nantacs presenting themselves. Cautiously at first and then with sudden boldness thick layers of basalt, conglomerate, and limestone thrust out scarred faces to form towering cliffs. At their base, in the band of conglomerate or volcanic breccia, rock shelters and caves of greater or lesser size occur at irregular intervals.

Our prime objective in this vicinity was a rock shelter containing four old baskets. The covert lay hidden by thick oak brush close on the left side of a rocky gully. Sergeant Howard's memory was quite clear as to essential details. He had seen the baskets some years before while pursuing a mountain lion. His dogs, on an upper terrace, were barking " treed " ; he was hurrying to reach them. Unexpectedly, his way was blocked by an unscalable ledge in a miniature gorge. He had turned sharply to the left, glimpsed the baskets in passing—and had given them no further thought until swapping observations with my friend, the one-time cowpuncher.

But our search was not a day old before we learned that every rocky gully at the south foot of the Nantacs is, in part, a miniature gorge. And every gorge is barred by a wall that cannot be scaled; every one is bordered by oak brush so thick and tangled that, to quote the sergeant, " you can't stick a knife in it." There remained but to search every nook and cranny on the mountain side. Peering behind bushes and into hidden corners; scrambling up perpendicular cliffs and scrambling down again we missed few, if any, holes in which primitive man had found refuge (fig. 120). And we missed very few of the cacti that cling to the skirts of Natanes Plateau.

FIG. 123.—Cave containing baskets. Lower Blue River crossing.

FIG. 124.—Three Apache baskets from the above cave.

FIG. 125.—On the borders of Ash Flat.

FIG. 126.—Entering Natural Corral Canyon.

I felt like a pincushion long before our search came to an end. If I chanced to slip on a pebble or on the dry grass that carpets the several terraces, a cactus was waiting wherever I landed. Never before in all my southwestern experience had I personally encountered such an infinite variety of cacti. There were little spiny buttons, almost invisible among the stones. There were long cacti and short cacti; round cacti and flat cacti. Great leathery pads strung end to end lay spoke-like in the grass and out upon weathered rock surfaces. Chollas spread their loose-jointed arms to bar each narrow way. As every stranger to Arizona deserts can testify, passing these diabolical plants with impunity is well-nigh impossible.

Despite cacti on narrow ledges; despite a September sun that turned bare cliffs into veritable griddles; despite tangled oaks and catclaw, we finally solved the riddle of the baskets. They were not of Basket Maker origin, as I had dared to hope. They were not even Pueblo. Apache women wove them and there is every reason to believe they were hidden away during those uncertain years from 1871 to 1886 when the Apaches were making a last desperate effort to retain their mountains and their freedom.

In the conglomerate formation east and west from Arsenic Spring are numerous small caves. Some few of these were temporarily inhabited by Pueblo families at a time when pressure from nomadic enemies was especially keen. We know this from the defensive measures taken—concealment of storerooms and dwellings; rock barricades fronting caves; loopholes in the walls, etc.

The largest settlement we observed consisted of four detached houses toward the front of a roomy cave (fig. 121). Here, as elsewhere, the masonry was rude and so placed as to take advantage of protruding rock masses. Except at Arsenic Spring and in the other large cave a mile to the west, no perceptible accumulation of ashes was apparent; no indication of prolonged residence. Potsherds, rare at best, correlate with the Showlow-Pinedale area, 50 miles or so to the north, which Haury [1] has dated in the late fourteenth century. We observed no evidence of earlier occupancy. To the extent, therefore, that we failed to find what I dreamed might be found this brief adventure along the southwest face of the Nantacs may be regarded as a wild goose chase.

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[1] Haury, E. W., and Hargrave, L. L., Recently dated Pueblo ruins in Arizona. Smithsonian Misc. Coll., vol. 82, no. 11, 1931.

A PREHISTORIC CAVE IN TEXAS

By FRANK M. SETZLER

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In July, 1930, M. W. Stirling, Chief of the Bureau of American Ethnology, made a brief archeological reconnaissance in the Big Bend region of Texas.[1] As a result of that survey, plans were made for a more detailed examination of the region. The observations herein described inaugurate the studies we hope to pursue from year to year.

Leaving Washington on April 21, 1931, en route to the Big Bend region, I stopped at previously reported archeological sites near Victoria and Brownsville. From the first of these cities John L. Jarratt generously conducted me down the Guadalupe River to an old camp site and two large mounds, one of which belongs to a Mississippi Valley culture. From Brownsville, thanks to the wholehearted cooperation of the personnel at the Plant Quarantine and Control Administration of the United States Department of Agriculture, I was privileged to examine all the known archeological sites near the mouth of the Rio Grande. Prehistoric Indian artifacts have been recovered on the mud flats between Brownsville and Point Isabel, but as this low ground is constantly altered by both water and wind, no evidence of aboriginal occupancy remains visible. A. E. Anderson's collection from this general region was examined and found to contain Juastec pottery and sherds.

From Brownsville I proceeded to Marfa, the point of departure for Valentine and the Mollie B. Knight ranch, my ultimate objective. Marfa at five in the morning is not soon to be forgotten. Perhaps any place at that hour is remarkable, but there the surrounding mountains make the sunrise exceptionally spectacular.

It was my good fortune in Marfa to meet Frank and Royce Gottholt, local business men who realize the historical importance of artifacts from Texas caves. They gladly donated to the United States National Museum several specimens that they had previously collected. They also aided me in many ways throughout the period of my reconnaissance.

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[1] Archeological reconnaissance in Texas and Nevada. Explorations and fieldwork of the Smithsonian Institution in 1930, pp. 173-176, 1931.

Auto transportation over the "wide open spaces" to the Knight ranch was provided by L. D. Harris of the United States Department of Agriculture. The road, merely a series of parallel ruts in the sunbaked earth, was limited as to width by the colonies of prairie dogs on the one hand and cactus plants on the other. During the dry season these roads are sufficient, but during the spring when storms break in the mountains traffic stops. The numerous arroyos which we crossed on our way to the ranch seemed very dry. Upon our return to Marfa, however, a storm broke between us and the main highway. We drove at full speed, trying to reach a large arroyo before it filled. We were too late. Bridges over these washes are unheard of; the road simply drops into them and rises on the other side. Rather than camp all night along its bank we raced with the water to another crossing 10 miles away. We reached the crossing just as the water began to flow into it—ten minutes later and we would have had to sleep in the car.

To D. G. Knight, who made me welcome and placed the ranch house at my disposal, and to his mother, Mrs. Mollie B. Knight, I am indebted for their hospitality and cooperation. They were interested in the excavation and were always willing to facilitate the work.

The cave I came to examine lies 400 yards from the Knight ranch house and on the west side of a small canyon whose basaltic walls rise 200 feet or more. Although only 100 feet above the valley floor, the cave entrance is well concealed and very difficult to photograph (fig. 127). Huge fallen rocks block its narrow opening so that it had been unknown until 1923 when a fox which Mr. Knight was chasing conveniently found it. The infrequent rains have not penetrated beyond the opening, so within the main chamber all was perfectly dry.

The task of excavation would have been much simpler had it been possible to remove the rocks at the entrance. But these supported the cave roof (fig. 128), so that it seemed treacherous to remove even the rocks we did in order to make an entrance 4 feet wide through which to remove the dirt. To reach the main chamber we were at first forced to crawl on our hands and knees over the sharp cactus spines that the pack rats had carried in. Excavations began in the entrance way. Enough dirt was removed to permit entering in a semi-erect posture.

Our aim was to reach bed rock, and, with this as a base, carry forward our trench always trying to keep a perpendicular face. Three distinct strata appeared before we reached bed rock. The top 8 inches consisted primarily of rat dung. Beneath it was a stratum of dry earth $2\frac{1}{2}$ feet thick in which the artifacts and other evidences of human habitation were found. The remaining 6 feet to bed rock was made up of

FIG. 127.—Pursuit of a fox led to the discovery of the Knight cave which the man in white (seen in the center) is about to enter.

FIG. 128.—When the cave opening was enlarged to the utmost, unsupported rocks were left hanging like Damoclean swords over those who passed in and out.

stones which had fallen from the ceiling and the pulverized dust which had blown in before the entrance was blocked. A definite cleavage or floor existed between the habitation stratum and the lower 6 feet; however there was no evidence of pits. Although most of the coiled baskets and mattings were fragmentary, none of them gave the appearance of having been merely discarded. In almost every case we found a layer of matting, then a bundle of grass, and the basket fragment on top. After a small area of habitation stratum was carefully removed the remaining 6 feet of earth and stones was shovelled into buckets, carried outside and sifted through a $\frac{1}{8}$ inch mesh screen (fig. 130).

Only one who has worked in a cave where the sole means of ventilation was a small opening at the floor level can fully understand the physical difficulties under which our work was carried on. Dry dust, finer than flour, formed thick clouds. There was no escaping it; no movement of air to remove it. Dust masks were indispensable, and even with this protection it was necessary to leave every 15 or 20 minutes to fill our lungs with fresh air and change the filters in the masks. The fine dust even clogged the mantles of our gasoline lanterns, so that pocket flashlights had to suffice for illumination. Credit is due to my four Mexicans for remaining after the first week. But our lungs soon became adjusted to the ordeal.

Near the entrance the skeleton of a small child had been buried 2 feet 3 inches beneath the surface with several lumps of yellow ochre, two small flint projectile points, and a tiny waterworn quartz pebble. The child had been placed on a small sotol plaited matting and covered with grass.

More than 70 artifacts were in the habitation stratum. They consist of coiled baskets and plaited sotol mattings, sandals, twisted yucca fiber cordage, stone beads, gourd sherds, cradles, yucca bags, wooden and bone awls. Two techniques are apparent in the matting and plaques: one, the horizontal-vertical plaiting—over one and under one (fig. 131, *a*); over two and under two (fig. 131, *b*)—the other, diagonal plaiting, over one and under one (fig. 131, *c*). Dr. Gene Weltfish, who chanced to visit the National Museum shortly after my return from the field, after examining the coiled baskets described them as follows: "They consist of a coiled multiple reed foundation with a yucca blade used as a sewing thread; the stitching is bifurcated on the nonworked surface (fig. 132, *a*), and the concave surface, the work side, is analogous to the single rod foundation coiling (fig. 132, *b*)."

One of the most interesting specimens is a small cradle, 25 inches long and $10\frac{1}{2}$ inches wide, made of long twigs held together by inter-

FIG. 129.—The Knight cave was unlighted, unventilated and half filled with disintegrated rock and dust finer than flour. From a flashlight photograph before excavation.

FIG. 130.—Many tons of rock and earth were removed in hand buckets through the constricted cave entrance to be carefully screened in the open air. Dust masks were indispensable.

woven twisted yucca fiber cord, the ends overlapped and bound together (fig. 133). Three similar cradles were in a fragmentary condition.

We found neither earthenware vessels nor sherds in the Knight ranch cave. A fragment of gourd which had been broken and sewed together by the primitive owner indicates that here, as in the Pueblo area to the northwest, gourds were used as receptacles. There was no evidence of European contact. With the exception of two sandals, the

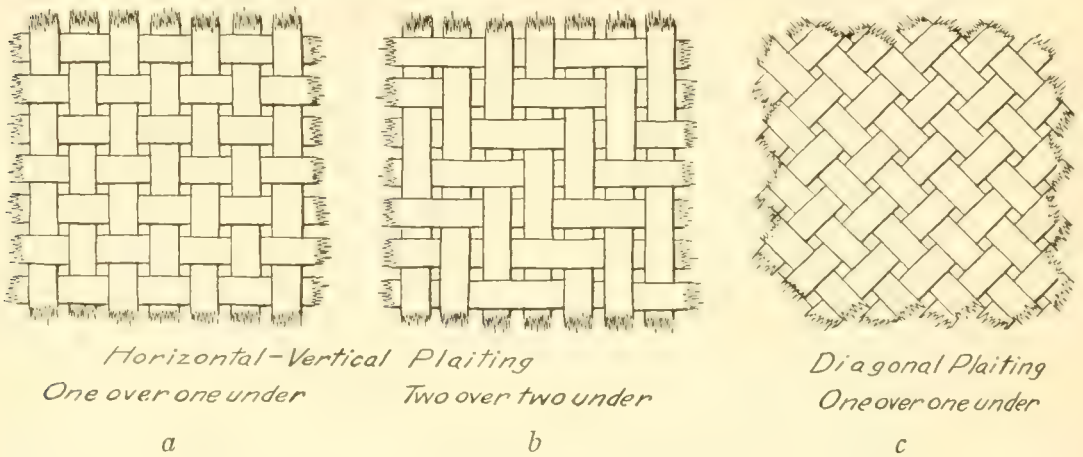

FIG. 131.—Schematic drawings of plaiting techniques used in weaving mats:
a. Horizontal-vertical, over one and under one.
b. Horizontal-vertical, over two and under two.
c. Diagonal, over one and under one.

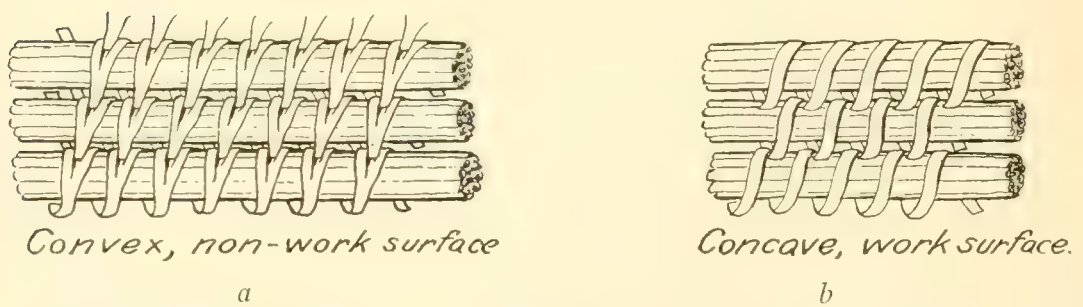

FIG. 132.—Diagrammatic study of coiled basketry showing multiple reed foundation with bifurcated yucca-leaf thread:
a. The outer or convex side.
b. The concave side from which the weaving was done.

artifacts show little resemblance to any of the southwestern cultures. This seems strange in view of the fact that Dr. F. H. H. Roberts, Jr.,[1] and others have recognized the culture known as Basket Maker near El Paso, 200 miles northwest of the Knight ranch.

After this cave was excavated three smaller caves and one rock shelter in the same canyon were investigated, but without results of archeological interest.

[1] Recent archeological developments in the vicinity of El Paso, Texas. Smithsonian Misc. Coll., vol. 81, no. 7, January, 1929.

FIG. 133.—Among the best-preserved artifacts from the Knight cave is this shallow, boat-shaped tray, presumably a cradle.

FIG. 134.—Texas cowboys have inherited countless myths concerning Spanish gold buried in caves of the Big Bend country. Search for this non-existent treasure has brought destruction to the cultural remains of unknown, prehistoric Indians.

Side trips from the Knight ranch to various other points in Presidio, Brewster, and Jeff Davis counties revealed caves and shelters which we hope to examine in the near future. Some of these have been pretty thoroughly dug over by collectors of curios and by seekers after buried treasure. Legends and tales are common everywhere describing the vast quantities of gold the early Spanish explorers are supposed to have cached in the mountains. This has prompted many men to spend weeks cleaning out the accumulated dirt, destroying whatever archeological material may have been present. Fragments of baskets, mats, cordage and the like having no commercial value are discarded with the rest of the dirt. Such vandalism destroys the evidence with which the archeologist is trying to piece together the unwritten history of prehistoric America.

The results of this excavation cannot be correlated with any of the known cultures in the State or in the neighboring culture areas. Further information must be secured, similar sites studied, and the marginal cultures found before conclusions can be drawn concerning the status of this culture.

AN IMPORTANT ARCHEOLOGICAL SITE IN EASTERN ARIZONA

By FRANK H. H. ROBERTS, JR.
Archeologist, Bureau of American Ethnology

Lying on top of a low mesa overlooking Whitewater Canyon and the broader valley of the Puerco River (fig. 135) in eastern Arizona is an archeological site which gives promise of contributing valuable data on the prehistoric Southwest. Although there are many ruins, representing various separate stages of Pueblo culture, scattered throughout the adjacent district, this particular location is of importance because it contains four distinct and sequent levels of occupation. Such an occurrence presents an exceptional opportunity for studying the changes that took place over a comparatively long period in the history of the ancient sedentary Indians. The owner of the site, J. A. Grubbs of Houck, Ariz., called the writer's attention to it during the summer of 1930 and a preliminary examination of the ruins and mounds was made in the autumn of that year. The possibilities of obtaining profitable information were so apparent that plans were made for an extensive exploration and investigation of the remains. Mr. Grubbs readily granted permission for a series of excavations and in May, 1931, an expedition from the Bureau of American Ethnology set up camp (fig. 136) and began work.

In June the Laboratory of Anthropology of Santa Fe, N. Mex., joined in the undertaking and through July and August cooperated in the project. Four graduate students, holders of fellowships granted by the Laboratory of Anthropology, participated in the researches during this period. These men were: Solon T. Kimball, Harvard University; Carl F. Miller, University of Arizona; Ralph D. Brown, University of Minnesota; and Dale S. King, University of Denver. Zuñi and Navajo Indians were employed as laborers in the excavations.

So that the significance of this site may be appreciated, it should be stated that archeologists have classified the sedentary peoples of the plateau portion of the Southwest under two main headings. These major groups are known by the terms Basket Makers and Pueblos, the latter including the far-famed and frequently described cliff dwellers. Each group has several subdivisions which are referred to by number. The Basket Maker, which is the older, includes three and

FIG. 135.—View of Whitewater Canyon and the Puerco Valley.

FIG. 136.—Camp of the expedition.

FIG. 137.—Subterranean portion of an early dwelling.

FIG. 138.—Pit portion of house. Wall faced with stones.

the Pueblo has five. Incorporated in the one group of remains in eastern Arizona are vestiges of Basket Maker III, Pueblo I, II, and III. Complete excavation of the site will throw light on the closing days of the Basket Makers, show the beginnings of the Pueblo culture, and trace its growth through two subsequent periods. For some reason, as yet unrevealed, the place was abandoned during the third Pueblo phase and never reoccupied.

A series of trenches dug in various portions of the site demonstrated that during the early stages the people lived in a straggling village of single family houses. These dwellings were semisubterranean in structure and had been scattered about with little attempt at order. As time went on the domiciles were placed in more compact groups and a certain system of arrangement developed. Later the pit type of house was given up and buildings were erected above ground. Ultimately two large communal houses capable of sheltering many families evolved. These last structures occupied only a small portion of the area covered by the older horizons in the village. As a consequence it is not necessary for the archeologist to completely excavate the more recent ruins before investigating some of the earlier remains. Activities during the summer of 1931 were confined to the outer fringes of the site, the excavating of pit houses and the trenching of their accompanying trash mounds.

When the field season was brought to a close late in September the subterranean portions of 14 structures had been cleared of the débris which accumulated in them during the centuries which have passed since their abandonment. The excavations showed that several of the dwellings had been destroyed by fire. The charred remnants of timbers lying on the floors demonstrated clearly the methods of roof construction. This evidence, together with the nature of the pits which remain, makes possible the drawing of an accurate picture of the type of dwelling in vogue during the early stages in the occupation of the site. As a matter of fact the details were so clearly shown that one of the houses was restored in order that visitors may see just what the domiciles of that type were like. In doing this it was necessary to use new timbers, but every effort was made to erect a structure as near like the original as possible.

The semisubterranean houses were rather crude but no doubt serviceable. They had consisted of a circular, oval, or rectangular excavation roofed over with a pole, brush, bark and plaster superstructure. The earth walls of the pits were covered with plaster made from adobe mud in which there was a slight admixture of ashes (fig. 137). One example differed in that the walls were lined with large stone slabs

set up on edge. Resting upon these slabs and rising some distance above them were several courses of rough masonry (fig. 138). In this case the plaster was applied to the faces of the stones and to the casual observer there would have been no difference between the interior appearance of this and other dwellings. The pits ranged from 2 to 6 feet in depth and 10 to 20 feet in diameter.

The superstructure erected over the pits was supported by four upright posts set in the floor a short distance from the walls. The upper ends of these main supports were forked, tree trunks with suitable crotches having been obtained for the purpose, and carried cross-beams (fig. 139). These stringers formed a rectangular framework against which were placed the upper ends of smaller timbers, the butts of which rested on the ground some distance back from the edges of the pit. The slanting poles formed the main part of the sloping upper walls of the house (fig. 140). At the top the rectangular space was covered with a flat roof with an opening near the center which functioned as a smoke hole and entrance. The entire framework was covered with brush, leaves, and strips of cedar bark. On top of this a thick layer of mud plaster was spread and over all there was a thin coating of earth. Indications were that the tops of the roofs were only elevated above the ground sufficiently to provide for drainage. A village composed of houses of this type would not be striking in appearance, for all that an onlooker would see would be a series of low, rounding mounds with the ends of ladders projecting through rectangular openings in their tops (fig. 141).

The interior features of such houses were simple. Near the center of each, directly under the opening in the roof, was a fire pit. Close to it, on the southeast side, was a second depression in the floor in which rested the lower end of the ladder used in gaining access to the chamber. Scattered about in the floor were numbers of small holes which served as depositories for minor objects, such as implements of bone and stone. An occasional dwelling had a storage recess in the wall. Where these were present they were on the floor level. None were placed above it. At the east or southeast side of each room there was an aperture in the wall which opened into a short tunnel. The latter led to a vertical shaft whose outlet was on the ground level some distance from the edge of the roof mound. This constituted the ventilator. The nature of the houses was such that a constant supply of fresh, cold air was drawn down into them through this ventilator, a fact conclusively demonstrated by the reconstructed dwelling. Between the opening in the wall and the fire pit, at the base of the ladder, an upright slab of stone was set in the floor. This

FIG. 139.—Preliminary framework for superstructure of restored pit house.

FIG. 140.—Interior view of restored pit house. Slanting wall poles and brush covering a characteristic feature.

FIG. 141.—Exterior of restored pit house. Smoke hole and entrance hatchway at feet of Indian boy. Ventilator opening is shown in foreground at extreme left.

FIG. 142.—Restored pit house in foreground. The shed roofs were erected over other pit remains to preserve them. Large stone mound in background covers ruins of surface house.

is called the deflector and was so placed to prevent the inrushing air from blowing directly on the fire. The draft at times was so strong that it was necessary to stop the opening completely. A well-worked oval slab of stone was provided for this purpose. The cover stones were in position over the opening in a number of the pits when they were excavated.

In general it may be said that the structures uncovered in 1931 conformed to the widespread semisubterranean type of house built in

FIG. 143.—Group of three connected pit houses.

many sections of the Southwest. They are particularly comparable to the pit dwellings which the writer found during previous seasons' investigations in the Chaco Canyon, in northwestern New Mexico, and at the old Long H Ranch, Ariz., some 30 miles south and west of the present location. All showed individual differences and variations as may be expected in any group of ruins, but in their main essentials they exhibited a striking similarity.

One really unique feature was brought to light by the excavations. In two different groups the houses were connected. There were no partitions at the sides where they joined and long, narrow dwellings

FIG. 144.—Child burial. Body position and placement of mortuary offerings is typical.

FIG. 145.—Examples of pottery found with burials and in the houses.

resulted. One of the examples was composed of two and the other had three connecting chambers. Each room was complete in itself, to the minutest detail, but because of the lack of a separating wall became an integral part of the larger structure (fig. 143). Every indication was that the associated dwellings in each cluster were contemporaneous and had been simultaneously occupied. It is possible that the two groups represent one of the prototypes for the communal buildings which in later times were erected above ground. If such were the case there is in this district evidence of an interesting variation in the evolution of the house. In the more northern parts of the area the single family domiciles had practically emerged from the ground before the development of the multiple-roomed structures began.

The sequence of house types was demonstrated by evidence secured from the trash mounds. The deposits had not been disturbed. Hence it was possible to make stratigraphic studies of the changes in pottery and types of implements. Inasmuch as the oldest material lies at the bottom and the most recent at the top it is not difficult to determine the relative ages of various parts of the site. Potsherds from the crudest pit houses are like those at the bottom of the refuse mounds, those from the better semisubterranean structures compare with fragments from higher levels, and material from the surface houses corresponds to that in the topmost layers. The dump heaps also yielded 42 burials with accompanying mortuary offerings (fig. 144). The latter constitute pottery (fig. 145), bone and stone implements, and other objects of the people's handicraft. All stages are represented in this collection.

At the start of the next field season attention will be turned to the large surface structures. One of them is superimposed upon the remains of a pit house group and its refuse mound. Its excavation should throw much light on certain archeological problems as yet unsolved. The ruins are easily accessible from one of the main transcontinental highways and already are proving of interest to travelers.

AN ARCHEOLOGICAL RECONNAISSANCE IN THE MISSOURI VALLEY

By WILLIAM DUNCAN STRONG
Ethnologist, Bureau of American Ethnology

When the travel-weary company of Coronado first visited the natives of the great Plains of North America in 1541 they observed large settled villages in the vicinity of the Espiritu Santo River. This river was evidently the northwestern extension of the Espiritu Santo proper, that is the Missouri River. Here they found an abundant and settled population among whom the horse was unknown. Less than 300 years later when Lewis and Clark came up the Missouri River they found a greatly reduced population possessed of large herds of horses and to a great extent dependent on buffalo hunting. These were the tribes that became famous in frontier history and their nomadic life, based so largely upon the horse, has come to be looked upon as the typical native culture of the Plains. It is obvious, however, that this horse Indian culture must have been very different from that observed by Coronado. Since the chroniclers of the colorful but unfortunate Conquistador were so remiss in furnishing details of Indian life it falls to the lot of the archeologist and the ethnologist to discover just what degree of civilization existed in the Missouri River valley prior to the coming of the white man and his horse.

It was this problem, in conjunction with work already commenced in Nebraska, that caused the writer to push his investigations farther afield on a rapid survey trip from August 8 to September 29, 1931. The trip covered parts of central and western Nebraska, and central South Dakota and culminated among the Arikara Indians on the Fort Berthold Reservation in northern North Dakota.

In central Nebraska a week was spent at a site near the little town of Sweetwater, where a University of Nebraska archeological party under the writer's supervision was excavating a prehistoric Pawnee village. Waldo Wedel, in direct charge of the University field party, had three earth lodges uncovered, beside many cache or storage pits. The three houses were especially interesting since one was round, one square, and one intermediate in outline (fig. 146). All had the four-post roof foundation and all were of the same period as demonstrated by abundant pottery and other cultural remains.

From this place the combined party moved over to the Platte River to investigate a reported association of fossil bison remains and flint points. After some difficulty the site was located, but owing to the inability of the man reporting the find to get in touch with us little could be learned as to the nature or significance of the discovery. Shortly after this our party visited a site near Angus, Nebr., where A. M. Brooking, of the Hastings Museum, had reported the finding of a flint point under the scapula of a Columbian mammoth. Mr. Brooking kindly gave us a glimpse of the point and showed us the place under the scapula from which it had been removed. While the writer, on the basis of other evidence, is inclined to favor the probability of human remains occurring with extinct animals in Nebraska, he rather doubts the significance of the present find. The bones were much disarranged, one tusk occurring some 60 feet from the scapula, while the majority of bones were in water-borne material. Granting that a dart point had been driven into the superficial muscles of the shoulder it is hard to imagine how it might have retained its direct association during the period of decay and subsequent movement. The time permitted for my examination of the point itself was too brief to form any conclusions in this regard and no other traces of human association were observed at the site.

The next three days were occupied by a trip up Medicine Creek, a northern tributary of the Republican River, and an examination of the forks of the Dismal River in Hooker County, Nebr. Prehistoric Pawnee sites were observed along the Republican River and on Medicine Creek. Along the latter stream the local collectors report stone-lined graves rather than the hilltop ossuaries which mark prehistoric Pawnee sites along the Republican. Otherwise, to judge from pottery and other artifacts, the cultures are closely similar. The forks of the Dismal River are of especial interest since it is here that Omaha Indian tradition locates a " fort " of the " Padouca Nation " who are known today as the Comanche. The high ground at the forks (fig. 147) was gone over carefully but no traces of any extensive occupation were observed. There are, however, deeply eroded areas or blowouts on this ridge which would serve admirably either for defense or concealment. Three surface sites are located on the Dismal in this vicinity. Two of these sites yielded a few fragments of a black, grit-tempered pottery. The third site yielded pieces of an extremely heavy ware, so deeply cord-marked as to suggest corrugations and without any visible tempering other than holes. The rather common occurrence of black obsidian on all these sites may indicate the more westerly connections of the Comanche who apparently occupied the

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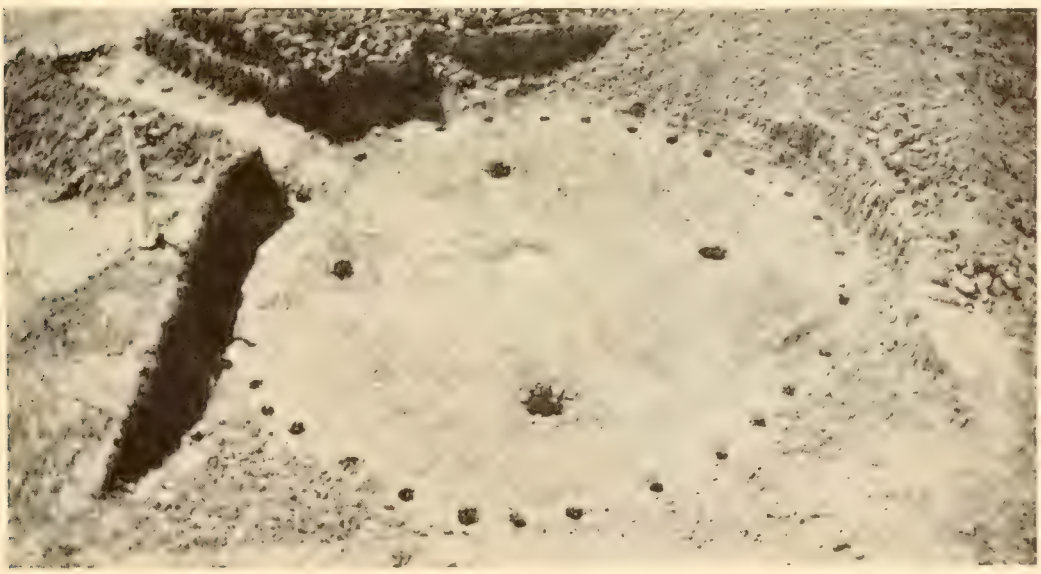
b



c

FIG. 146.—(*a*) Square, (*b*) intermediate, and (*c*) round earth lodges from same prehistoric Pawnee Village near Sweetwater, Nebr. (Photograph by W. Wedel.)

FIG. 147.—The forks of the Dismal River in Central Nebraska where Indian tradition locates an ancient fort of the Padonca or Comanche.

FIG. 148.—Butte near Scotts Bluff, Nebr., with the remains of three prehistoric occupations on its summit. (Photograph by Lee A. Daniels.)

region just prior to the visit of Lewis and Clark. The writer was especially fortunate on this part of his trip in being guided by A. T. Hill of Hastings, Nebr. Mr. Hill is an enthusiastic amateur worker in archeology whose knowledge of sites and cultures in southern and central Nebraska is unsurpassed.

After leaving the Dismal River, our party drove across the sand hill region of Nebraska with its many lakes swarming with water fowl to Scottsbluff, Nebr. Here we met Thomas L. Green of that city, who had previously notified the writer of what appeared to be a stratified site on a high mesa in the vicinity. Our excavations, aided

FIG. 149.—View from the top of the mesa showing the creek junction.

by Mr. Green and R. C. Swanson, amply confirmed the opinion of the latter investigators as to the importance of the site. The mesa (fig. 149) is about 100 feet high, nearly 400 feet long, and some 150 feet wide. It is composed of Brule clay and limestone but, unlike the many similar mesas nearby, it is capped with a deposit of some 6 feet of sand and cultural detritus. A trench (fig. 150) run across the center of the deposit revealed three levels of habitation. The first layer which occupied the upper 2 feet contained quite numerous sherds of pottery identical with the prehistoric Pawnee ceramics previously mentioned. In addition, the small, notched, triangular arrow points, diamond-shaped and bevelled knives, and other artifacts suggest this culture.

Below this deposit occurred 1 foot of almost unmixed sand and at the 3-foot level occurred a very thin deposit similar to that of the upper 2 feet. For the next 2 feet there was an absolutely clean layer of sand and under this a thick black layer composed of broken animal bones and stone artifacts (fig. 151). Although every bit of this

FIG. 150.—Trench across the top of stratified butte.
(Photograph by Lee A. Daniels.)

deposit was screened, not one piece of pottery was found in the lower strata which rests on the hard material of the mesa. This was also confirmed by the later work of Lee A. Daniels, a member of our party, who continued the trial excavations for several days after my departure. Flint artifacts were abundant in this lower layer but differed markedly from those in the upper levels. This site with its upper layers indicating prehistoric Caddoan occupation and its much

more ancient nonpottery culture in the lower deposit is tremendously important. Thanks to the action of Mr. Green, the owners of the site have granted the Smithsonian Institution exclusive rights to continue excavations here and it is planned to continue with the work early next season.

From Scottsbluff, our party drove on to Vermilion, S. Dak., where a group of Plains and Upper Mississippi archeologists held a conference from August 31 to September 3. After an exceedingly interesting meeting, the writer, with other members of the conference, accompanied W. H. Over on a visit to various prehistoric village sites along

FIG. 151.—Bottom strata, north end of original trench, where broken bones and stone implements occurred, but no pottery. (Photograph by Lee A. Daniels.)

the Missouri River. These sites are strikingly situated on bluffs just above the river and are remarkable for their size, their splendid preservation and the clearly delineated earthworks which surround them. It is impossible to obtain adequate photographs of such sites owing to their location on the highest points in the vicinity. They should, however, show up beautifully from the air and it is to be hoped that an airplane survey of the Upper Missouri River may be arranged before the plow or other modern agency destroys them. Some of these sites appear to be entirely prehistoric and a striking resemblance was noted between pottery from certain of these villages and the ceramic remains characteristic of the prehistoric Pawnee culture in Nebraska. Under the expert guidance of Mr. Over a large number of such sites

were visited and the writer was tremendously impressed by the great size and good preservation of these ancient villages which are so abundant throughout the Arikara and Mandan country of North and South Dakota. Especially interesting was a large, double village above Mobridge, S. Dak. This Arikara town, visited by Lewis and Clark and many other early explorers, was abandoned by the Indians in 1832, nine years after the bombardment of the town by United States troops under the command of Colonel Leavenworth.

Excavation work at this site is planned during the coming year in order to positively determine the archeological criteria that distinguish the historic Arikara. When these have been determined it will be easier to work out the apparently complex sequence of cultures in the region.

From Mobridge, the writer drove up to the little town of Nishu on the Fort Berthold Reservation, N. Dak., in order to visit the living Arikara Indians. Thanks to the assistance of Dr. M. R. Gilmore, of the University of Michigan, pleasant contacts were soon made with numerous good informants and plans were laid for future ethnological research into the culture of this extremely important but comparatively little known Plains tribe. Since the Arikara, the most northerly of all the Caddoan-speaking peoples, may well have been the carriers of the prehistoric horticultural civilization into the northern Plains it is essential that they be studied while old informants are still available.

Looking back over the main results of the reconnaissance, it appears that the prehistoric Pawnee culture may be traced through southern and central Nebraska, up the North Platte River and over to the Missouri River in South Dakota. It is lacking along the Missouri River in Nebraska where another prehistoric horizon, now termed the Nebraska culture, takes its place. The connection between the prehistoric Pawnee and an advanced prehistoric people, presumably the ancestral Arikara in South Dakota extends this early Caddoan horizon far to the north at an earlier time than has generally been supposed. It is already apparent that a combined archeological and ethnological approach to this problem will open new and unexpected vistas in Plains prehistory.

THE CAVE CULTURE OF ARKANSAS

By WINSLOW M. WALKER
Associate Anthropologist, Bureau of American Ethnology

The cave region of the Ozarks in north central Arkansas has long been considered a likely place in which to look for evidences of an early type of American aborigine. Last summer the opportunity came for the writer to visit that section as his first field trip for the Bureau of American Ethnology. A letter from a correspondent at Gilbert, Ark., spoke of caves in that vicinity, in which it was thought traces of ancient human remains might be found. Proceeding directly to this locality a stay of seven weeks was made, during which some 16 caves in the neighborhood of Buffalo River in parts of Marion and Searcy counties were explored and three were carefully excavated.

These caves occur in the limestone ledges of the Boone and St. Joe formations of Lower Mississippian age, here and there lying unconformably on sandstone of the Lower Ordovician. Where these limestone ledges outcrop along the streams and small creeks caves are sometimes found at the heads of side hollows. These are due to the action of underground rivers cutting away the soft limestone in an attempt to escape and join the streams in the creek beds. The caverns thus formed have large open mouths affording excellent sites for human habitation. Although many of them are now dry, some still contain small streams, usually at one side of the cave near the wall. It is in the dry caves that extensive deposits of dust, dirt, and ashes yield unmistakable evidence of primitive man's former occupancy.

The first cave visited was located near a bend in Buffalo River about half a mile above the town of Gilbert. A long gallery winding about for some 150 feet under the hill opened out under the limestone ledge at the head of a small cove 40 feet above the river level. This aperture had been nearly closed by the filling in of talus fallen from the overhanging ledge, leaving a hole just wide enough to permit a man to crawl inside. The owner of the property decided it would make a good storehouse for his dairy products because of the cold draft of air issuing from the underground gallery, and in beginning to clear out the chamber had encountered a dry dust which he mistook for ashes. Being of a scientific turn of mind he wrote in to the Bureau of American Ethnology to invite investigation of his cave on the chance of finding human remains there. But after three days of the hardest

kind of labor with pick, shovel, and crowbar attempting to remove the great blocks of fallen rock imbedded in a tough red gritty clay, and not finding so much as a potsherd or flint chip to reward our efforts, we at last gave up.

After this experience, time was taken for a scouting trip over the country, which revealed several promising localities where flints, potsherds, and camp refuse were actually present. These caves lie in the watershed of Water Creek and other small tributaries of Buffalo River in the northern part of Searcy and the southern part of Marion counties, Ark.

A small cave on Bear Creek about a mile across the river from Gilbert was chosen as the next site for excavation. Like the other this was also the mouth of a long winding gallery which we followed back for a distance of 345 feet until the narrowing passage, fallen rocks, and sticky clay floor prevented further advance. An examination of the walls and floor with a flashlight revealed nothing left by aboriginal human agency, but modern names were carved on the rocks in several places. Stalactites and stalagmites occurred in several parts of the gallery. The mouth of the cave was not blocked as in the other case, but a low ridge composed of detritus fallen from the overhanging ledge extended across the front. This front chamber had a width of 36 feet at the mouth, and for several feet back from the entrance was high enough for a man to stand up in. The back wall of the chamber was 20 feet from the mouth. This location—a southeast exposure 28 feet above the creek and 48 feet away from it—would have made it a good spot for a camp site of a small group of people. More recently it had served as a shelter for sheep and goats.

Ten days were devoted to the work of clearing out this cave with the following results: Artifacts of stone, flint, and bone were found, together with quantities of small fresh-water snail shells, some mussel shells, and fragments of bones of many kinds of game animals broken and charred, but no human burials. Pottery was of a very crude type, gray and some reddish ware, heavily tempered with shell, unpainted or decorated in any way, but with small handles attached to the rim and with flat bottoms. Fireplaces with water-worn stones in place were found at the front of the cave and even outside on the terrace slope. Everything seemed to point to the conclusion that this cave was used only as a temporary camping site for a small party of people probably engaged in hunting and fishing.

It was the large cave at Cedar Grove at the head of a little hollow just off Water Creek that yielded the most significant finds. This was an immense cavern measuring 68 feet across the mouth, 73 feet to the

FIG. 152.—Appearance of Cedar Grove Cave at the start of excavation. Daylight extends back into this cavern for about 75 feet.

FIG. 153.—The first burial found in the cave at Cedar Grove, that of an old man.

back wall, and 30 feet from the overhanging ledge to the ground below. The stream that had carved this huge recess was no longer visible, but the spring issuing out of the foot of the slope 25 feet below the cave's mouth may be a remnant of it. Thus a large dry shelter was left which was admirably suited to human occupancy.

It took us nearly three weeks to clear this cavern and remove the piles of ash, charcoal, dust, and dirt that had accumulated in places to a depth of 5 feet on the floor. The highest part of the deposit was at the front of the cave where a ridge had been built up across the mouth by rocks and earth falling from the cliff. Some of these fallen blocks were so large that it would have required dynamite to dislodge them; therefore only those were attempted that could be removed after breaking with a sledge hammer.

Ten burials were uncovered, comprising probably 12 persons. They were all in the flexed position except one individual, a male, whose bones had evidently been tied in a bundle and dropped into a hole where they were found partly resting on the flexed skeleton of a female. The ubiquitous "treasure hunter," the bane of archeologists, had been at work in the back part of the cavern and had disturbed and broken up the bones of several burials. Of those burials which could be identified there were three adults, two of them males; one adolescent male; and six very young children and infants. The bones of a dog were found near one of the child burials in a position which indicated careful interment with the forelegs crossed over the hindlegs. This would seem to indicate domestication of the dog as a pet among these primitive cave dwellers, especially as no fragments of burned or broken dog bones occurred in the refuse heaps. The burials were for the most part without mortuary objects. Two or three arrowpoints were found in one grave, and a necklace of some 600 freshwater snail shells were found draped about the face and body of a tiny infant. The burials themselves were scattered from front to back of the cave and ranged in depth from 10 to 32 inches. No attention seemed to have been paid to orientation of the bodies.

The skulls are dolichocephalic tending toward mesocephalic. There is a slight indication of asymmetrical occipital deformation. Teeth are well preserved and show little evidence of having been prematurely worn down by gritty food. No pathological conditions of the bones have been found.

The artifacts from this cave consisted largely of stone, flint, bone, and shell; with a crude, undecorated, flat-bottomed, shell-tempered pottery; but no traces of wooden objects or textiles of any kind. Flint artifacts comprised the largest class, numbering 233 specimens

FIG. 155.—Showing the flexed female skeleton after the overlying bundle burial of a male had been removed.

FIG. 154.—Double burial near the back wall of the cave. The bundled bones of a man resting on the flexed skeleton of a woman.

of spearheads, javelin heads, knives, drills, and scrapers, all made from native flint of various shades from white to black. Generally crude in workmanship owing partly to poor quality of flint, there is little about these points that is distinctive. Most of them exhibit notched and stemmed bases in varying degrees. But no true triangular types were found. The other stone artifacts are hammers and grinders made of water-worn stones with little artificial shaping. No polished celts, grooved axes, or pestles were found. Fifty bone tools and implements were recovered comprising awls, punches, needles, pins, and similar articles. The most interesting bone artifact was a small broken piece of deer antler notched near the tip, suggesting its use as part of an atlatl or throwing-stick. M. R. Harrington writes that it closely resembles the shape of the atlatls found by him except that this one is of bone instead of wood. As further support for this theory it was found that many of the flint projectile points are of the type associated by Harrington with his atlatls, a diamond-shaped point with contracting stem. Snail-shell beads have already been mentioned as being the only form of ornamentation discovered. They had small holes punched—not drilled—in them, to permit stringing. Mussel shells used as spoons were found inside the carapace of box tortoise shells which had been scraped out to serve as bowls or dishes.

Summing up the traits of this cave culture and comparing them with those of the known Ozark Bluff-dwellers we find the following common to both: water-worn stones used as crude hammers; manos and metates; small chipped axes, diamond-shaped spear and dart points, also some notched and stemmed forms but no true small arrowpoints; bone awls and needles, antler-tip flakers; flat-bottomed, coarse, thick, shell-tempered, undecorated pottery; turtle-shell dishes and mussel-shell spoons. The more perishable articles of material culture such as basketry, textiles, and wooden objects may also have been present but may have disappeared through the destructive action of the damp cave atmosphere.

Following the completion of the work in the caves, three sites containing petrographs were visited. At two localities there were true petroglyphs—pictures and symbols carved into the surface of rocks. The third exhibited painted pictures in red ochre on the wall at the back of a rock shelter. This was known locally as Jacobs Rock, situated on a spur of Boston Mountain about 6 miles south of the town of Snowball at the head of Calf Creek. The figures depicted were of both animate and inanimate objects—humans, snakes, tracks, sun, moon, stars, and unrecognizable forms. On the outer edge of the wall the pictures were blurred and obliterated. That they were done

FIG. 156.—Projectile points from Cedar Grove Cave, Ark. These were probably spear and dart points, as they are too large and poorly finished for arrowheads. The three specimens on the right side, third row from the top, were the type most suitable for use with the atlatl darts.

FIG. 157.—Petroglyph rocks near Snowball, Ark. Note the huge block that has been moved by the "treasure hunters."

FIG. 158.—Jacobs Rock shelter near Snowball, showing man looking toward pictograph.

FIG. 159.—Petroglyphs at Indian Grotto near Edgemont, Ark. The diamonds may have been a conventionalized way of representing the pattern on a rattlesnake.

FIG. 160.—Horse and human figures. Indian Grotto petroglyphs. These are the figures which have given rise to the Spanish legend.

by Indians seems plausible from the pile of ashes and refuse under the shelter, in which potsherds, flints, and bone fragments were found.

In the other direction from Snowball, on the farm of Mr. Burns, some curious rocks bearing petroglyphs were found in a field on a little knoll not far from Calf Creek. These rocks, 33 in number, lay with only their flat surfaces exposed at the level of the ground; on these surfaces geometric figures—circles, combinations of circles, and dots within circles—were inscribed. Time and weather had so nearly obliterated these carvings that it was necessary to brush the rocks clean, dampen them with water, and then dust fine sand into the depressions in order to bring them out at all clearly. In addition to the purely geometric designs there were realistic representations of human hand and foot prints and of tracks of other animals. The nature and location of these rock carvings suggest they were made with a ceremonial purpose, possibly the records of clan or tribal gatherings.

Petroglyphs were also found in a cave known as the "Indian Grotto," near Edgemont. This was a great recess 122 feet wide and 80 feet deep carved out of a perpendicular wall of sandstone. The eastern side was filled with an extensive deposit of camp refuse, ashes, and charcoal, above which on the wall within reach of a person standing on the floor were the petroglyphs, carved into the soft rock as deep as half an inch in some places. Here naturalistic figures predominated. There were realistic figures of men, turtles, birds, and other animals, and some geometric figures of diamonds, straight bars, and disks, but most interesting of all were the numerous representations of conventionalized human beings, and an animal strongly suggesting a horse. It is this group of figures that has given rise to the popular tradition that this cave was visited by the Spaniards, who of course must have buried some of their gold there and left the carvings as a record of the event! Naturally this has led to considerable digging in the floor of the cavern, and the petroglyphs have been very nearly obliterated.

The most surprising thing about these sites is that although they are within a hundred miles of one another no two of them exhibit the same type of figures, some being geometric, others naturalistic, and others conventionalized realistic types. The inference is that each type has been made by a different tribe, perhaps for a different purpose. The Osage and Cherokee are known to have lived in this region and careful investigation as to whether or not they made rock pictures, and if so what forms, may throw some light on this problem.

A RECONNAISSANCE OF NORTHERN LOUISIANA MOUNDS

By WINSLOW M. WALKER
Associate Anthropologist, Bureau of American Ethnology

In the middle of July, 1931, after completing an investigation of the caves in the Ozarks of north central Arkansas, the writer went to Louisiana to investigate reports of newly discovered mound and village sites. Headquarters were established at Briarwood, the sylvan home of Miss Caroline Dormon and her sister, Mrs. Miller, near Chestnut, La. These ladies have an enthusiastic interest in everything pertaining to the history, ancient or modern, of their native State, and they have been most energetic in informing the Bureau of American Ethnology of the need for archeological work in their State.

With Miss Dormon as guide it was possible to visit a large number of sites covering an area in the northern part of Louisiana from Red River on the west to the Mississippi on the east and as far south as Marksville, all in a period of four weeks. No intensive excavation was attempted on this trip, as it seemed desirable to get a general idea of the archeological work still to be done in that part of the State before choosing the most promising site for future work. Earlier investigations have been confined almost entirely to the Red, Black, and Ouachita river valleys, little attention being paid to sites existing in the hinterland between them. Unfortunately, many of the mounds in Louisiana have been dug over with little or no attention to the stratification or association of the specimens found, and these mounds, of course, now have little to offer to the archeologist.

Certain yellowed old maps in the possession of Mrs. Cammie G. Henry at Melrose Plantation were found to give the approximate location of some of the Caddo tribes including the Adai, Yatasi, Petit Caddo, and Grand Caddo. A good many days were devoted to running down all possible clues to these village sites with a fair degree of success. The Adai village was located on a small creek in the vicinity of the present town of Robeline, about 25 miles west of Natchitoches. This was also the site of the Spanish mission at Los Adaes, later acquiring even more prominence as the capital of the newly created province of Tejas. Although this village site has long been under cultivation a few flint artifacts were found on the surface in a cornfield. One Yatasi village in all probability formerly stood on land

FIG. 162.—Flat-headed skeleton found on Fish hatchery site near Natchitoches. Pottery shown *in situ* beside the head.

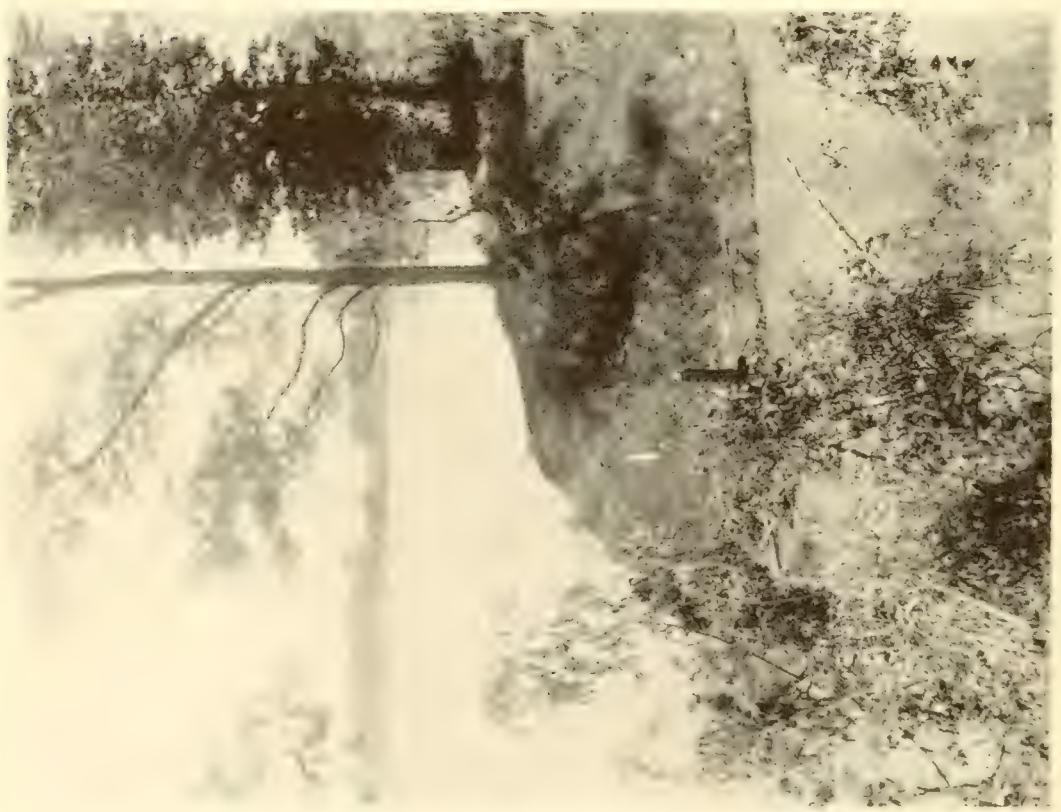


FIG. 161.—Looking across point where Koasati village formerly stood, now washed into Red River.

now occupied by the city of Shreveport, so that all traces of it have now been lost. Several miles north of the town is Caddo Lake, on the north side of which was the village of the Petit Caddo. The Grand Caddo were still farther north on the bend of Red River somewhere near where Texarkana now stands. These sites are the ones visited by Athanase de Mezieres, governor of Natchitoches first under French and later under Spanish dominion in the latter part of the eighteenth century. In addition to the village sites there are many conical and some flat-topped mounds in this part of Red River valley. It is likely that they were built by the Caddo, but it will require further systematic digging to determine this point; unfortunately these mounds have been particularly subject to the destructive digging mentioned above, so that very few are left intact.

An attempt to locate the Koasati village, which presumably gave its name to the town of Coushatta, revealed that the site had been completely swept away when the river changed its course, eating into the point of land between Red River and Coushatta Bayou. The high water of 1908 cut into the eastern bank until a bluff some 20 feet high was formed.

About a mile south of Natchitoches on the bank of Cane River lake a new fish hatchery is being constructed by the United States Bureau of Fisheries. During the course of this work several Indian burials were discovered and with them some pieces of pottery. Unfortunately most of this material was destroyed or damaged beyond repair. The writer hearing of this discovery, hastened to the spot, where through the courtesy of the superintendent, Mr. Casler, it was possible to save some of the pottery fragments. These when pieced together disclosed a portion of a beautiful polished black ware vessel decorated with incised scroll designs typical of the Caddo pottery. A few days later a long distance telephone call told of the discovery of another burial. Fortunately this one was damaged but little by the scraper, and it was possible to uncover the entire skeleton of a female, lying extended at full length, with an excessively flattened skull due to fronto-occipital pressure. This extreme type of artificial deformation has very rarely been observed in this part of the south. Lying by the right side of the head were two pieces of pottery, a jug and a bowl, of simple workmanship in coarse, poorly fired clay, heavily shell-tempered, and without decoration. Careful investigation of the surrounding area for about 20 square feet failed to reveal any other burials. There was no indication of a mound over the body, which lay on red sandy soil deposited by the river overflows, and the depth was estimated at about 2 feet below the original ground surface.

A special trip of three days was made to the important large group of mounds at Marksville, stopping en route to examine sites reported in the vicinity of Alexandria, La. Near the town of Lecompte on Bayou Boeuf a group of four flat-topped pyramidal mounds was visited and although one of them had been the scene of earlier digging it is quite possible that systematic excavation might still reveal new evidence as to the identity of the builders of the mounds. The Marksville group has been worked over by several investigators, the result being that such mounds as have escaped levelling under the process of cultivation present the appearance of small craters, good sized pits

FIG. 163.—Fronto-occipital deformed female skull, Natchitoches, La. This is an example of extreme head flattening by means of pressure applied to the skull from boards tied on the front and the back of the head during infancy.

having been scooped out of the tops, or else they are merely shells of mounds left after the digging of broad trenches through their centers. However, to the north of the structures in Enclosure A, as the main group is called, there are more mounds down on the bottom lands below the property of Alfred Greenhouse, a mulatto who lives on the bluff. These mounds, seven in number, comprise four flat-topped quadrilateral and three lower conical structures, all in definite relationship to one another. Tiny flint points and a variety of potsherds were picked up at this site, which looks like a profitable locality for further excavation. It is interesting to note that this group was completely submerged to a depth of 4 feet over the top of the highest

FIG. 164.—Two big mounds in field of Alfred Greenhouse, near Marksville, La. These are of the flat-topped quadrilateral type common to the low country bordering the Mississippi.

FIG. 165.—Group of mounds in bottom lands near Marksville below the Greenhouse property.

mound during the floods of 1927, thus removing any possibility of their having been erected to serve as places of refuge during high water periods.

But it was at Jonesville at the junction of the Ouachita, Catahoula, and Tensas rivers to form Black River that the writer was to experience his most bitter disappointment. Jonesville, or Troyville, as it was formerly called, is built on the site of a mound village similar to the one at Marksville. Another similarity is the low embankment of earth that encloses the ancient town on three sides between the Little and Black rivers. Conspicuous in the group was a very large mound possibly similar to the great mound of Cahokia, as it is described as being a great flat-topped pyramid with another broad platform near its base. Estimates as to its original size vary, some observers of over a hundred years ago giving its height as 60 to 80 feet, and its base area as covering over an acre of ground. Thomas in 1882 described it as being 45 feet high, 270 feet long, and 180 feet wide. This was the structure which the writer, visiting Jonesville about the middle of August, found had been levelled to the ground only three days before his arrival by a road construction company which used the dirt as a fill for the approach to the new highway bridge being built at that point. Of course the owner of the mound was delighted at the opportunity to get rid of what had been to him a "white elephant," but the loss to science from this act is inestimable. This was the first time such an enormous mound had ever been so thoroughly razed and it would have been a golden opportunity to have studied the method of construction of such a mound and perhaps to have found out something of the purpose for which it was built.

On looking over the site where the mound had stood it was noticed that scraps of cane stuck out above the levelled surface over an area 150 feet long and 50 feet wide. This possibly was part of the material from which the temple or chief's house had been built. Later for some unknown reason the great mound had been raised over it. Another curious thing was that various colored clays were found which were foreign to the native gumbo of that region, and hence must have been brought from some unknown locality. Some of the clay contained a bright blue mineral, "vivianite," evidently used as coloring matter for some of the wood in the structure, as a fragment of timber thus colored was found. This instance serves to show the immediate need for scientific excavation of these mounds in Louisiana before any more of them are destroyed.

FIELD STUDIES AMONG THE IROQUOIS TRIBES

By J. N. B. HEWITT
Ethnologist, Bureau of American Ethnology

In May, 1931, the writer left Washington to resume his field studies among the Iroquois tribes dwelling in Ontario, Canada, and in the State of New York.

As early as 1898 the writer had begun to record lengthy traditions in the native dialects of the several Iroquois tribes relating to the founding of the League of the Five Iroquois Tribes, and giving important biographical data concerning the personalities of the leading founders of the League.

In the main, these several traditions were consistent one with another, but naturally there were wide and basic variations; and these divergencies are so fundamental, in many instances, that it was imperative to find, if possible, by revisions and constructive interpretations, a consistent historical background to the events leading to the founding and establishment of the League of the Five Iroquois Tribes.

To have published these traditions as first related and recorded by the native annalists would have led to utter confusion in any endeavor to understand the purpose and structure of the League. An example of this may be found in the fact that in published lists of the number of Federal Chiefs of the League the figure is usually set at 50, although the correct number is 49; this error was due to a gross misunderstanding of a passage in the Ritual of the Eulogy of the Founders by the late Chief Thomas Webster, who for years was the Wampum-keeper of the New York Onondaga. Unwittingly, he mistook the office of Chief Warrior for that of a Federal Chief. Owing to his official position Webster's error was gradually adopted by the best annalists. It required the facts recounted in the legend of the transfer of the Deer Clan from the Cayuga to the Onondaga tribe, to correct Webster's unaccountable blunder.

In revising and retyping the variant native texts in the Onondaga, the Mohawk, and the Cayuga, concerning the birth and life-work of the prophet-statesman Deganawida, difficult problems of coordination and exegesis are brought out.

The uniform version of the several extant traditions is that his birth was parthenogenetic, it being asserted that his mother was a

FIG. 167.—Chief David John and grandson, an Onondaga of the Grand River Reservation, Canada.

FIG. 166.—Jesse Green, a Seneca, the ferryman at Chiefswood Ferry over the Grand River, Ontario, Canada.

FIG. 168.—Upper, Chiefswood, the former home of G. H. M. Johnson, a grandson of Sir William Johnson. Lower, sign-board erected by the Superintendent of the Six Nations, Col. Cecil E. Morgan.

FIG. 169.—Tuscarora women: seated left to right, Miss Sadie Johnson, Mrs. Mary Patterson; standing, Miss Eunice Mericle; taken at Niagara Falls, N. Y.

virgin. Hitherto, the available traditions gave *Djigo^{n}'să''sĕ^{n}', i. e.,* the Fatfaced, meaning the Wild Cat, as the name of his mother. But, this incongruous epithet is due clearly to a Seneca mishearing of the correct name, namely, Djigo^{n}'sa''sēē', and to a worse confusion as to her native land.

The uniform traditional statements that the mother of Deganawida was a virgin mother indicated that underlying them there must be an ideal figure, a symbolic type of womanhood and motherhood. But, owing directly to the misapprehensions just mentioned, this noble figure of a symbolic woman, the type of pure motherhood, was utterly lost from the traditional accounts. This discovery led the writer to see the need for a thorough search in the field for a living tradition in which this ideal mother is fully expressed. Such an ideal enhances the charm of the birth story of Deganawida and makes more enthralling the historicity of such a personage in the Stone Age of America.

The writer was highly gratified by his good fortune in recovering two such traditions, although fragmentary. The one he obtained from Chief Joseph Jacobs, a Cayuga, and Chief David Skye, an Onondaga, both of whom have died since imparting this information; the other version was contributed by Chief David John, an Onondaga.

Briefly, this new information recites that the mother of Deganawida was called *Djigo^{n}'să''sēē'*. This name signifies literally "She-Whose-Face-is-Doubly-New"; that is to say, having a face twice as pure and innocent as that of a newly born infant; a face which is pure, unsoiled, the face of a virgin because uncontaminated by contact with man or with any other earthly thing.

In the ceremonies inaugurating the Chiefs of the first Federal Council of the League, Djigo^{n}'să''sēē', the mother of Deganawida, took a prominent part as a Woman Federal Chieftainess to impress dramatically upon the participants the serious lesson that all future Woman Federal Chieftainesses, the Trustees of their several kinship ohwachira (families) must be virtually Virgin Mothers—must be as pure as was the mother of the great founder of the League.

This forcefully ejects the erroneous "Wild Cat" interpretation noted above, and completes the symbolic ideals embodied in the organic structure of the League of the Five Nations of Iroquois.

The writer also visited the Tuscarora near Niagara Falls; here he obtained several photographs of Indian women who were selling beadwork in the Park at Niagara Falls, N. Y.

ANTHROPOLOGICAL STUDIES IN OKLAHOMA, IOWA, AND MONTANA

By TRUMAN MICHELSON
Ethnologist, Bureau of American Ethnology

Leaving Washington at the close of May for the season's field-work, I first visited Oklahoma, where my attention was confined exclusively to the Southern Cheyenne. The prime object was to restore phonetically some 700 Cheyenne words and stems (extracted previously from Petter's dictionary) which can be rigorously shown to be Algonquian in origin. With correct restoration it is possible to enunciate the phonetic shifts transforming normal Algonquian into aberrant Cheyenne with greater precision than previously. Incidentally much new ethnological information was obtained—a great deal in an autobiography of a Cheyenne woman.

I also measured some 23 Cheyennes, among them 11 full-blood adult males. Combining this with the series reported last year it is very clear that the range of absolute measurements is great. For example, the minimum and maximum for head-length is 180 and 210 mm. respectively for adult male Southern Cheyennes. It is my belief that students of human paleontology are likely to ignore the great variations in living man and so are too prone to making a new species or genus of a skull that varies slightly from the usual run (*e. g.*, Sinanthropus 1). In this connection I may add that in my collections I find the head-length of a white adult male American, of English and Scotch descent, though American on both sides for at least four generations, to be 212 mm. No doubt had this been found in the ground it would have been heralded as a new species.

Near the middle of July I left for Tama, Iowa, to obtain additional material on Fox ceremonials, in which I was very successful. While at Tama I learned of the alleged discovery of human remains in gravel pits near Stratford, Iowa, and in company with Doctor Thone of Science Service I visited the site. The first man interviewed did not make it clear that two such pits were involved, so I personally examined only the gravel pit north of Stratford. Fortunately Doctor Thone subsequently learned from the mayor of the town of the second gravel pit southwest of the town and inspected it; there he obtained some additional information which is embodied in this report. The

FIG. 170.—Gravel pit southwest of Stratford, Iowa. (Photograph by Thone, 1931.)

FIG. 171.—The frame of a Sun Dance lodge, Lame Deer, Mont.

FIG. 173.—William Rowland, a Northern Cheyenne mixed-blood. Interpreter for Doctor Michelson.

FIG. 172.—Mack Haag, a half-blood Southern Cheyenne, and child. Mack Haag was Doctor Michelson's factotum in Oklahoma.

gravel pits were thoroughly wrecked by steamshovels, so that little could be gained from their inspection. It appears that the skeletons were exposed while the alluvium was being scooped away; thus most of the material was quite useless for scientific purposes. The four fragmentary skulls, however, tell the story very plainly. They are unmineralized, and patently of modern type; contrary to the statement made in the local newspapers, the sex of those that could be determined was male. Fortunately alluvial soil was inside one skull. The presence also of some gravel indicates a subsoil burial—nothing more. The associated potsherds are Algonkian in type. The mineralized tusk, lower jaw, and molar of a mammoth (which I saw) apparently came from the same gravel horizon, but from a different locality. The gravel thus is clearly Pleistocene, but the human remains are modern. So again what appeared to be evidence of ancient man in America is overthrown.

In August I left Iowa and went among the Northern Cheyenne of Montana with the primary object of restoring the list of words and stems, mentioned above, according to Northern Cheyenne phonetics. Incidentally it was determined that Southern and Northern Cheyenne differ in speech rather more than has been supposed. By good fortune I was able to measure a really representative group of Northern Cheyenne. Though the results of these measurements have not yet been worked up in a statistical sense, nevertheless the indications are that the vault of the skull is rather low, thus resembling the skull of Dakota Sioux rather than that of most Algonkins. I also took advantage of the occasion to gather some new ethnological information.

RECORDING INDIAN MUSIC

By FRANCES DENSMORE
Collaborator, Bureau of American Ethnology

Continuing her study of Indian music for the Bureau of American Ethnology, the writer made four field trips during 1931, two to the Winnebago Indians of Wisconsin and two to the Seminole of southern Florida.

Winnebago songs were recorded near Wisconsin Dells and at a basket-maker's camp near Holmen, Wis. The principal subject under consideration was the peyote cult, though additional information was obtained on material previously collected and interesting specimens were secured. The organization which has been created around the use of peyote was studied chiefly as a religious expression of Indians in a transitional state of culture. It includes many native customs, together with the simpler teachings of Protestantism. There are two branches of this organization, one following John Rave, who used the rite of baptism and the Lord's Prayer, and the other branch following his associate, Jesse Clay, whose teachings show a reversion to native customs, such as the use of certain songs for each of the four periods of the night. The ceremonial songs of both branches were recorded by men who have taken leading parts in the ceremony. William Thunder recorded the songs of the John Rave branch, and James Yellowbank (fig. 174) recorded the songs of the Jesse Clay branch, described the ceremony in detail, and drew a diagram of the ceremonial lodge. A young man recorded a song he received in a vision induced by peyote, and described the vision. Numerous general songs of the cult which had been learned by the Winnebago from other tribes were also recorded.

Pueblo Indians from Acoma and Cochiti took part in certain pageants given at Wisconsin Dells and by listening to their singing in the pageants it was possible to corroborate a previous observation that Pueblo Indians unconsciously raise the pitch of a song during its performance. James Paytiamo, an Acoma, added to material previously obtained on the songs and customs of this tribe, and Evergreen Tree, a Cochiti, recorded additional songs of the buffalo dance, enacted two Cochiti dances, and amplified the translations of songs recorded by him in 1930.

FIG. 174.—James Yellowbank (Winnebago).

FIG. 175.—Cory Osceola's wife and infant child. (Photograph by Miss Densmore.)

FIG. 176.—Portion of Seminole village in which songs were recorded. (Photograph by Miss Densmore.)

FIG. 178.—Annie Tommie.

FIG. 177.—Charlie Billie (Seminole). (Copyright by Claude C. Matlack, used by permission.)

The first trip to the Seminole of Florida was made in January and February, 1931, and the Indians observed were from Big Cypress Swamp. One visit was made to the southern part of the Everglades. The second trip was begun in November and the Indians observed were those of the Big Cypress Swamp, and also of the Cow Creek, or northern group of the tribe, now living near Dania. The Seminole Indians have been in contact with white men for about four centuries but have retained their old customs in a remarkable degree and are practically self-supporting. The Seminole of the Big Cypress Swamp subsist chiefly by hunting alligators and game and by cultivating small gardens in the Everglades. The fastnesses of the Everglades conceal the important phases of their tribal life. In these deep retreats the medicine men still treat the sick with herbal remedies revealed to them in dreams, and exercise an authority which is severe and unquestioned. The environment of the northern group is chiefly the flat land around Lake Okeechobee.

Both the southern and northern Seminole hold an annual Corn dance after the corn is ripe and before it is eaten. The leader of the singing in the Big Cypress group is Charlie Billie (fig. 177), who recorded Corn dance songs, including the four principal songs used only on the first night of the dance. He is required to fast before and after singing these songs. He sings each song only once, then the man who acts as his helper sings it once, and then the people join, dancing in a circle. He and his helper pound on small "water drums" which they carry. Charlie Billie also recorded the songs that precede a hunting expedition to ensure success. The people do not join in these songs. In order to compare the Corn dance songs of the two groups, a few Corn dance songs of the Cow Creek Seminole were sung by Willie Jumper at Dania. From his performance it appears that the songs of the two groups differ in structure. His sister, known as Annie Tommie (fig. 178), supplied interesting information on tribal customs. Another member of the group, called Jimmie Gopher, said that in old times he had seen the playing of a flute as well as the rattle and drum.

The dwellings of the Seminole, as well as their costumes, are admirably adapted to the climate. A typical Seminole house (fig. 181) consists of a platform covered by a thatched gable roof supported by posts. The average size of a house is about 11 by 14 feet, the height of the platform (floor) is about $2\frac{1}{2}$ feet, and the thatch of palmetto droops to a point about $4\frac{1}{2}$ feet above the ground. This thatch is held in place by logs tied together and slung across the ridge. In the houses of the Big Cypress Seminole seen by the writer a corner of the platform about 3 feet square was cut away, providing a convenient seat

FIG. 179.—Group of Seminole in native village.

FIG. 180.—Seminole cooking fire.

or shady standing place under the thatch. The Indians sit or recline on the platform without using cushions, benches, or furnishings of any sort. Their bedding consists only of light blankets which are stored under the roof, together with personal belongings. Thus the writer obtained an old spoon made of custard-apple wood which was stored by thrusting it under the rafters of the roof.

A portion of the village in which songs were recorded in February, 1931, is shown in Figure 176. The interpreter was Cory Osceola, a direct descendant of the warrior of that name. His wife and child appear in Figure 175. Work was also done in the Seminole village near Dania.

Several families use one cooking fire, but it appears that each has its own food and utensils and eats alone if desired. The Seminole cooking fire consists of logs arranged like the spokes of a wheel with an open space in the center. The number of logs varies from five to ten and they are equally spaced except at one point where the wider space is often filled by a box used as a seat. In the open space at the center a small fire is kindled for each meal and the logs are pushed forward as they are needed. The women put their kettles and skillets on the fire or ashes and often sit on the logs while at work. A typical camp fire is shown in Figure 180. The people eat chiefly from the cooking utensils. The dishes are put in pans of water after a meal, and washed while the next meal is being prepared. A high table for dishes is placed near the fire, and the heavy utensils are hung on crotched sticks or on the house-posts, if not placed on this table. Between meals the dogs often sleep in the ashes.

Corn is a staple article of food among the Seminole, and the manner of planting, harvesting, and storing corn was studied, winnowing and sifting baskets being obtained. The Big Cypress Seminole were seen eating a porridge made of corn, the liquid being drunk from a cup, and the corn in the bottom of the cup being removed and eaten with the fingers.

The clothing of the Seminole at present, as in the past, is like the brilliant plumage of tropical birds. The material is a patchwork made by cutting cotton cloth into strips and pieces of various sizes and sewing these together on hand sewing machines. Children and adults dress alike except that some men and boys now wear dark trousers, with full blouses of patchwork. A color scheme often appears in an entire garment but the women seem free to combine colors as they desire, producing a bold, artistic effect. The costume of a woman consists of a long, full skirt and a cape, and many chains of beads are worn about the neck. A little girl's dress is the same but

FIG. 181.—Typical Seminole house. (Photograph by Miss Densmore.)

FIG. 182.—Seminole woman with turtle to be cooked for food. (Photograph by Miss Densmore.)

shorter, and she wears only one or two strings of beads. A little boy wears a dress about two inches from the ground, the waist and skirt being gathered into a belt. A young man formerly wore a similar dress about halfway to his knees and a man of fifty wore a shorter dress, each costume being completed by a neckchief of plain color. Many of the men continue to dress in this manner (fig. 179). The old men wear a costume consisting of a cotton garment and cotton jacket edged with a ruffle, as seen on the central figure of this group. At present, as in former times, the men wear a neck-kerchief similar to that of Charlie Billie (fig. 177). No patterns seen in the patchwork can be considered native in origin. Only one sort of beads is worn in the strings around a woman's neck, but the number of strings increases as she grows older, sometimes weighing as much as 20 or 30 pounds. These beads are of medium size and opaque, and the favorite colors seem to be dark blue and pale, dull green or yellow. The technique of weaving beads on thread, using an oblong loom, is similar to that of northern tribes but the result does not appear in costumes. No foot-covering is worn by women, or children. A pair of moccasins, made according to the old custom, were obtained from a man who tanned the deer hide and made them. This moccasin consists of two pieces, one for each side of the foot, and has a gathered seam up the front which is sharply upturned. It has a small, loose piece of leather at toe and heel and is held in place by a thong. The old men still wear a draped cloth turban, and are practically the only Seminole who wear a head covering. Round ornaments of pierced silver, of native manufacture, are fastened to the women's capes in the front, or suspended from their beads in the back.

The Seminole are excellent wood carvers, and interesting examples of this work were seen among the Big Cypress Seminole. A wooden doll with carved head was obtained, as well as dolls made of coconut palm fiber.

SMITHSONIAN INSTITUTION

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1932

(PUBLICATION 3213)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
May 4, 1933

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1933

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PREFACE

In the furtherance of the Institution's researches in various branches of science—notably biology, geology, anthropology, and astrophysics—field expeditions play an important part in providing new material and new data. From its own limited resources the Institution is able to pay the expenses of but a few of these expeditions; for the others it must depend on the generosity of friends of the Institution or on cooperative arrangements with other institutions interested in the same lines of scientific investigation. The accounts in the present pamphlet for 1932 are in the nature of preliminary announcements of the purpose, methods, and results of the season's field-work. The scientific results are published in full later, after the new material has been thoroughly studied, in one of the technical series issued by the Institution.

Owing to present economic conditions, which have materially reduced the funds available for publication, it has been necessary to reduce this book to approximately one half its normal size. It is hoped, however, that enough is presented to show the purpose and scope of the Institution's investigations in the field, as well as something of the interest of scientific exploration.

W. P. True,
Editor, Smithsonian Institution.

CONTENTS

HARVESTING FOSSIL SEA LILIES IN THE OHIO VALLEY

By R. S. BASSLER

Head Curator of Geology, U. S. National Museum

The writer's field activities during 1932 were concentrated into three weeks' investigation of certain Ohio Valley fossil localities which had been under observation and preparation for collecting for the past quarter century. Observations were also continued on silicification, a subject which had interested him since 1908, when he published upon the formation of geodes, those hollow spherical rock masses lined with inwardly pointed crystals.

The localities visited were noted for the crinoid remains yielded years ago, so that the present exploration contributed chiefly to the upbuilding of the Frank Springer collection of fossil echinoderms. During the early part of this century, the writer, under the direction of Doctor Springer, made extensive excavations in the Silurian and Mississippian rocks of Kentucky and Tennessee to obtain fossil crinoids and other echinoderms. After every specimen in sight had been collected the quarry débris was spread out in the hope that weathering would in time expose additional examples. These old dump heaps were revisited and carefully searched on hands and knees under the hot sun of the past summer with the result that over 300 complete crinoids and several thousand fragmentary examples were collected.

Doctor Springer's old quarry in the Keokuk limestone near Crawfordsville, Ind., was first visited, but here it was found that expensive digging would be unwarranted. Next the early Mississippian rocks of Indiana and northern Kentucky were searched, especially in the Knobstone area—the belt of country encircling the fertile Blue Grass region of Kentucky, and crossing the Ohio River near Louisville, into Indiana, where numerous conical knobs have been left by erosion. Button Mold Knob, just south of Louisville (fig. 1), a typical example of one of these wooded elevations rising above a plain of Devonian limestone and shale, exposes the fossil-bearing rocks of Early Mississippian age in a broad gash upon its southern slope (fig. 2). Only a few of these layers are fossil-bearing, and intensive collecting in the past seemed to have exhausted their possibilities. However, trenches dug along them years ago now afforded some very excellent crinoids. Here were discovered many geodes which had formed from the infiltration of silica in fractured crinoid stems.

FIG. 1.—Button Mold Knob, Ky.

FIG. 2.—View from top of Button Mold Knob, showing fossil outcrops.

FIG. 3.—A glade of fossiliferous early Mississippian rocks in northern Tennessee.

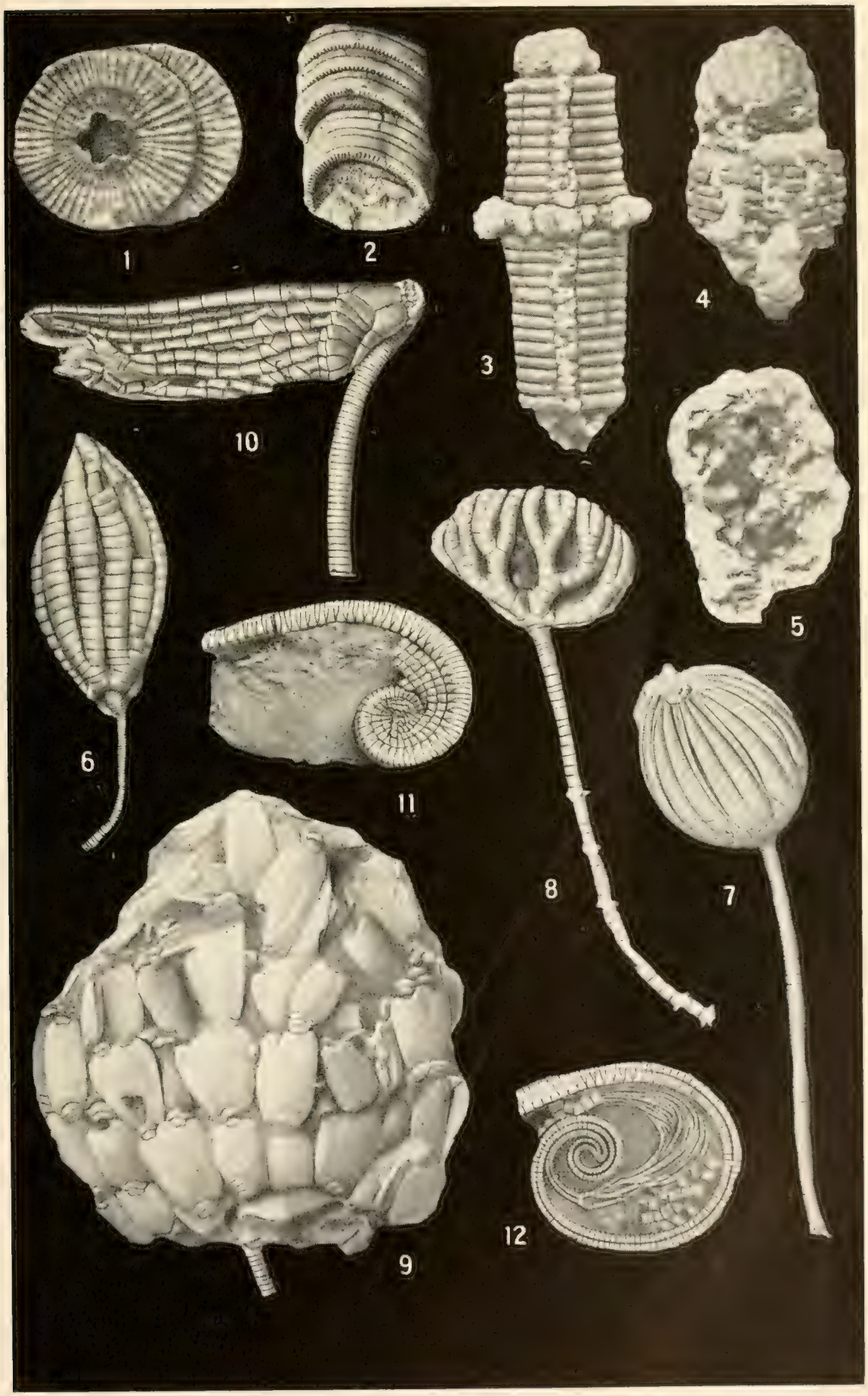

FIG. 4.—Numbers 1 to 5 illustrating the formation of a geode from a crinoid column; numbers 6 to 12, unusual species of Tennessee Silurian crinoids.

As illustrated in Figure 4, nos. 1-5, the crinoid buttons or individual segments composing the column (no. 1) may have the central canal filled with mineral matter deposited by circulating waters. Then a number of segments still in position but fractured (no. 2) may have the cracks enlarged by such mineral matter (no. 3) and still more so (no. 4) until there results a round, hollow ball which, when broken (no. 5), shows the inwardly pointing crystals of a typical geode. Silica is the principal mineral concerned in geode formation of many areas, but the problem of replacement by silica or silicification is of especial interest to the paleontologist because many beautiful calcareous fossils buried deep in solid limestone and impossible of extraction without marring their structure may be freed in perfect condition through this process. In this case the organic calcite composing the fossil is dissolved and replaced by silica, while the surrounding limestone is taken into solution and removed by mineral-bearing waters circulating through the rocks. It has been believed that such changes by silicification required thousands of years, so that localities which had been exhausted by present-day collecting could not be expected to yield additional specimens for centuries to come. However, it was shown on the present field trip that less than 25 years are required to cause this change from the calcareous to siliceous condition in fossils, when conditions are right. Fossils observed that long ago partly buried in the solid rock and covered then with a thin layer of mud to supply silica for the surface waters, were noted on the present visit to have weathered out into free, completely silicified specimens.

Leaving the Kentucky Knobs, strata of the same age in northern Tennessee were next investigated. Here the outcrops are in glades, or bare places along the hillsides, in which every layer could be traced often for long distances (fig. 3). Certain of these layers rich in crinoid fragments and which had been prepared for silicification by the writer some years ago now yielded abundant results. Proceeding then to western Tennessee, the writer investigated some of the dump heaps of Doctor Springer's quarries in the Silurian formations of Decatur and adjoining counties. Here again silicification and the usual forms of weathering during the past 20 years had exposed some additional specimens of rare species. Among these is the crinoid *Allocrinus*, with its heavy armplates and delicate column (fig. 4, no. 6); *Eucalyptocrinus*, with its tightly compressed arms (no. 7); *Gnorimocrinus*, known hitherto only in Europe (no. 8); *Gissocrinus*, also a European genus with peculiar broad plates (no. 9); *Calceocrinus*, with the crown recumbent upon the column through a hinged articulation (no. 10) and finally *Myelodactylus*, once mistaken for a coiled shell but really a dainty crinoid in which the column encircles and protects the delicate crown (nos. 11, 12).

HUNTING FOSSIL ANIMALS IN NEBRASKA, WYOMING, AND SOUTH DAKOTA

By CHARLES W. GILMORE

Curator, Division of Vertebrate Paleontology, U. S. National Museum

Our efforts of previous years have been directed toward an adequate representation in the National Museum collections of all important Tertiary faunas. In continuation of this program, exploration of the Oligocene was planned for 1932.

Harrison, Nebr., the county seat of Sioux County, adjacent to extensive badland areas of both Oligocene and Miocene, has for years been the base for fossil-hunting expeditions, and here I met my field party with camp equipment and truck. Fair success attended our efforts in the two weeks spent in this field, although the workable territory was much restricted owing to the presence of other collecting parties in adjacent areas. It is of interest to note that 46 men representing 13 institutions were collecting vertebrate fossils in or near the fields covered by us during the summer. In more than 30 years' field experience, never before in a single season have I encountered so many "bug hunters" as we are commonly designated by the local ranchers.

In the vicinity of Harrison, near the summit of the Lower Harrison formation occur the *Daemonelix* beds, named from the giant spirals of hard rock which resist erosion and at many points stand out prominently against the bluffs along the upper reaches of the Niobrara River (fig. 5). These spirals, popularly called "devil's corkscrews," were originally thought to represent the spiral roots of some gigantic plant, but later authorities have regarded them as the burrows of the extinct rodent *Steneofiber*, remains of which were found inside the spiral. Be that as it may, knowing the National Museum did not possess a specimen of *Daemonelix*, we grasped the opportunity to collect a representative specimen of this interesting fossil.

While I was visiting the Colorado Museum of Natural History at Denver, on my way to the field, the director, J. D. Figgins, voluntarily granted permission for my party to work in their rhinoceros quarry near Torrington, Wyo. (fig. 6), and it was decided to take advantage of this generous offer. A few days' work there resulted in the recovery of a large slab of rock containing a skull and several jaws of *Caenopus*, an Oligocene rhinoceros.

FIG. 5.—*Daemonelix, in situ.* One mile south of Van Tassel, Wyo.
Photograph by G. F. Sternberg.

FIG. 6.—Rhinoceros quarry near Torrington, Wyo.
Photograph by G. F. Sternberg.

FIG. 7.—Typical Oligocene badland exposure, northwest of Harrison, Sioux County, Nebr. Many good specimens were found here. Photograph by G. F. Sternberg.

Leaving Torrington, we worked in succession in the vicinity of Bridgeport and Crawford in Nebraska, Pine Ridge and Scenic in South Dakota, and Lusk and Douglas in Wyoming. A few days to a few weeks were spent in each of these localities with varying success, although material was collected from every place visited.

The bulk of the material collected is from the upper or Oreodon beds of the Oligocene, although a few specimens were obtained from the Titanotherium beds and from the Miocene formation. Among specimens worthy of special mention is the skeleton of a hawklike bird having the skull and lower jaws present, undoubtedly the most complete bird specimen ever found in the Oligocene of North America; a skull and partial skeleton of *Eusmilus,* a rare saber-toothed cat; two articulated skeletons of *Mesohippus;* two articulated skeletons of *Merycoidodon,* and one each of *Leptomeryx,* a small deer-like animal, and *Ischromys,* a large squirrel. Several of the forms acquired were previously unrepresented in the collection, and it is probable that some new to science will be found when a critical study is made. In all, the collections filled 17 large boxes having a combined weight of 4,865 pounds.

A novel feature of the expedition was the finding of numerous turtle skulls. The most common and widely distributed fossil of the Oligocene faunas is the land tortoise described by Leidy as *Stylemys nebrascensis.* Its fossil remains are found scattered throughout the middle and upper Oligocene, in many places in profuse abundance. Skulls, however, are rarely found, and for this reason a systematic search was made in and around the many weathered shells encountered, with the result that 15 skulls were recovered, the study of which will furnish a most interesting contribution to our knowledge of the turtle's skeletal anatomy.

The Mauvaise Terre of the early French-Canadian trappers and explorers has long been classic ground for those collecting the fossil remains of Oligocene animals, but the somewhat prevalent idea that its fossil treasures will be exhausted by continuous collecting, seems to be refuted by our experience of the past summer. Several areas in which we worked both in the big badlands and elsewhere had been explored for many seasons, some as late as the year before, and yet specimens were found at every locality visited. In almost any field where fossils occur, dogged persistence will be rewarded. The relatively rapid erosion of these beds is constantly exposing fossils to view, and so long as this continues there will never be a dearth of specimens.

I was fortunate again in securing the services of George F. Sternberg and M. V. Walker as field assistants, and the successful outcome of the expedition was in large part due to their intelligent and hearty cooperation.

COLLECTING FOSSILS IN GASPÉ

By G. ARTHUR COOPER
Assistant Curator, Division of Invertebrate Paleontology, U. S. National Museum

In all Quebec Province there is perhaps no portion more picturesque than Gaspé Peninsula. Bounded on the north by the St. Lawrence River and on the west by Matapedia River, the peninsula extends into the Gulf of St. Lawrence. Along the shores of the gulf, sediments deposited in the Palaeozoic era and containing many kinds of fossils have been exposed by wave action. Few of these fossils were represented heretofore in the collections of the United States National Museum, and it was to remedy this deficiency that the writer spent six weeks in Gaspé and northern New Brunswick.

To the eyes of the tourist the southern and eastern coasts of Gaspé present a succession of bold cliffs separated by low land. But to the eyes of the geologist these bold cliffs show distorted and crumpled fossiliferous strata of great antiquity, the roots of ancient mountains. These strata tell the old, old story of origin in an ancient sea, followed by mountain-making disturbances which wrinkled the sea bottoms. These contorted sea floors were elevated, and then for eons of time weather, wave, and river joined forces to reduce the once majestic mountains thus formed to their present modest heights. These ancient and worn mountains of Gaspé are composed of Ordovician, Silurian, and Devonian rocks. Detailed studies record a time of orogeny at the end of the Ordovician, followed by subsidence and deposition of Silurian and Devonian sediments over the worn edges of the Ordovician mountains. The middle and late Devonian saw more mountain-building, following which, red conglomerates of the Carboniferous period were deposited by rivers in valleys and depressions. Since this latter period, so far as known, Gaspé has been above the level of the sea.

Early settled by the French, Gaspé still retains much of the language and some of the customs of the mother land. These French settlers have been content to inhabit the shores of the gulf, earning their modest, often meager, livelihood from the fish of the sea and the few vegetables that can be raised in a short growing season. The interior of the peninsula is almost a total wilderness, unsettled and little explored, but a promising region for mineral development. Recently a good gravel road encircling the peninsula has been completed by the Quebec government.

FIG. 8.—View north from Mont Joli showing Cap Barré on the right, the southern side of Les Murailles, showing four peaks, the "Trois Soeurs" and "Pic d'Aurore."

FIG. 9.—Cod-drying racks, Percé.

FIG. 10.—Percé Rock seen from Bien Vue, Mont Ste. Anne.

FIG. 11.—Structural unconformity between the Silurian and Boneventure red conglomerate on the shore of Bay Chaleur, Jacquet River. Such an unconformity tells a story of mountain-making, erosion, submergence, deposition, and subsequent uplift.

FIG. 12.—Cliffs at Shiphead, the southeastern extremity of the Forrillon, showing a cross-section of the Devonian limestones.

The writer traveled by auto to northern New Brunswick and Gaspé from Quebec City via Matapedia Valley. The first locality visited was Jacquet River where 2,000 feet or more of Silurian rocks are exposed (fig. 11). Inland about 1½ miles Lower Devonian shales afford fair collecting. Thirty miles east of Jacquet River is Dalhousie, home of one of eastern Canada's largest pulp mills. Northeast of the village is Stewarts Cove, along the shores of which are steeply tilted interbedded calcareous shales and lavas. The sedimentary rocks carry a great abundance of fine fossils, chiefly invertebrates. In Devonian days Dalhousie was the site of numerous volcanoes and the scene of intense vulcanism. The writer next visited New Richmond, charming English village of farmer folk. Five miles east of town along the shore is Black Cape, composed of dark Silurian lavas underlain by fossiliferous sediments, all steeply tilted to the south and southeast.

Nearly 60 miles northeast of New Richmond is Port Daniel, a fishing village of about 2,000 inhabitants. Here the low hills are formed by hard, resistant Silurian limestone; the valleys and the low shore of the bay are composed of soft Silurian shales and sandstone. Port Daniel is a paradise for the geologist, because nowhere can Silurian fossils be found in greater variety or abundance.

Northeast of Port Daniel is scenic Percé surrounded by bold cliffs on the seaward side and steep and rugged hills to landward. Mont Joli, apex of the triangular land upon which most of Percé village rests, is formed of steeply folded Devonian sandstones and shales, and the cliffs lining South Cove to Cap Blanc are composed of Ordovician shales and limestones containing a fauna whose nearest relative is to be found in Europe. The cliffs along the south shore of Mal Baie, known as "Les Murailles," are composed of Devonian limestone like that of Percé Rock.

Gaspé Basin, once a delightful tourist haven, is at the mouth of the York River near the head of Gaspé Bay. This village is underlain by the Gaspé sandstone in which a variety of Devonian plants and invertebrates occurs. These sandstones extend southeastward along the north shore of Gaspé Bay to Little Gaspé where they overlie Devonian limestones which form the Grande Grève Peninsula or Forillon. Bold cliffs form the northeastern face of the Forillon, but the southwesterly side is the dip-slope of the strongly inclined limestones. Perched precariously on the sloping face of the Forillon is Grande Grève, quiet, unspoiled, seldom visited fishing village.

In the course of six weeks of collecting in this richly fossiliferous country many fine specimens were added to the collections of the United States National Museum, among them not a few new to science.

STRATIGRAPHIC STUDIES IN EASTERN NEW YORK

By G. ARTHUR COOPER

Assistant Curator, Division of Invertebrate Paleontology, U. S. National Museum

New York State's classical sequence of Devonian rocks still presents to the geologist many an elusive problem, among them the determination of the marine equivalents of the great mass of red and green nonfossiliferous sediments lying at the base of the Catskill Mountains in eastern New York. In order to determine these equivalents the writer undertook the preparation of several stratigraphic sections in this region. Before the present investigation was started the writer had traced the various layers of the Hamilton Group from their type locality at Hamilton, N. Y., westward to Lake Erie and eastward to Unadilla Valley. Briefly this year's task was to trace the stratigraphic units established in Unadilla Valley into the red and green beds of the Catskill front, in order to establish the equivalents of these little-known rocks. Knowing the Unadilla Valley section from past experience the writer planned to prepare columnar sections in Otsego, Schoharie, and Albany counties.

The Susquehanna Valley was the first area selected for the preparation of a section. The Susquehanna River rises in beautiful Otsego Lake (fig. 13) at the north end of the valley. Surrounded by steep hills, charming Cooperstown at the south end of the lake is the gateway to the valley which stretches far to the south. Rich in the legends of the immortal Natty Bumppo of Leatherstocking fame, the wooded and hilly environs of this village are sure to transport the visitor back to the days of the Iroquois and pioneer strife.

East of the Susquehanna is the valley of Schoharie Creek (fig. 15), probably the most beautiful of New York's numerous meridional valleys. Steep hills rising to a height of 1,500 feet above the floor line the narrow valley which ascends gradually southward to the Catskill Mountains. Thrifty Dutch settlers were attracted to the fertile bottomlands, and the Schoharie, like the Susquehanna, was the scene of a bitter struggle for possession between the red man and the white.

Southwest of the bold scarp of the Helderberg Mountains lies the little village of Berne, underlain by black shales of the lower Hamilton, and still farther southward at the base of the Catskills is Durham, surrounded by red shales and sandstones, subjects of our special investigation.

FIG. 13.—View of Otsego Lake from the tower of the hotel in Cooperstown. The Sleeping Lion at the end of the lake and all the hills surrounding the lake are formed of lower Hamilton rocks. Photograph by Telfer.

FIG. 14.—Leatherstocking Falls, 2 miles north of Cooperstown. Shales and sandstones of the lower Hamilton. Photograph by Telfer.

FIG. 15.—View of Schoharie Valley, looking north toward North Blenheim, from a point about 1 mile north of Mine Kill.

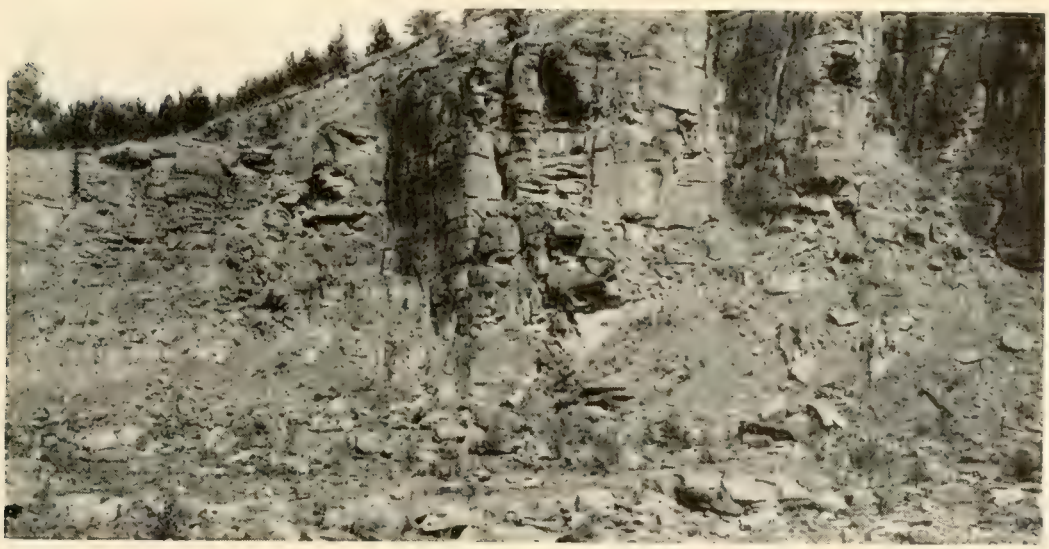

FIG. 16.—Quarry in Stevens Mountain, showing character of Devonian sandstone. From this quarry came most of the rock in Schoharie Reservoir dam.

FIG. 17.—Devasego Falls, Devonian sandstones.

Stratigraphy is the study of the superposition of sedimentary rocks and their contained organisms. Not less important to the modern geologist than the sequence of rock layers is the interpretation of sedimentary environments and paleo-ecology as indicated by the nature of the rocks. Thick-shelled clams and brachiopods in ripple-marked, often cross-bedded sands indicate a near-shore zone; plant fragments, tree stumps, and fresh-water clams indicate land environments—deposits in rivers or estuaries. From Lake Erie eastward the Hamilton sediments are those of a shallow sea, and from Unadilla Valley eastward the character of the faunas and sediments alike indicate close proximity to an ancient shore. Schoharie Valley is clearly the shore region of the ancient Devonian sea. Here continental beds alternate with strata laid in marine water. Variable east-west developments of the beds indicate an oscillating shore. In Schoharie Valley the lower and middle Hamilton rocks are of the two types, continental and marine, but the upper Hamilton is mostly continental, containing sizeable tree stumps in their original position of growth. East of Schoharie Valley the upper two-thirds of the Hamilton is composed nearly completely of red rocks, the origin of which is a moot question.

In order to ascertain the time of deposition of the red beds it was necessary to find fossils in them whose age could be definitely determined. Fortunate was the writer to be able to trace a single marine layer of the upper Hamilton from Susquehanna Valley to Durham, into the midst of the red beds. Heretofore all red beds in eastern New York were regarded as Upper Devonian in age, but the results of the present studies prove that some 2,000 feet, at least, of the red beds of the Catskill Mountains belong to the time of Hamilton deposition.

The geography and stratigraphy of the Hamilton rocks of eastern New York having been briefly described, the ancient conditions can be pretty safely restored. In Devonian days the site of Schoharie Valley was the shore region of the Devonian sea. Southeast of Schoharie were forests of huge and peculiar types of ferns, and off to the west of the site of the valley was the sea with its hordes of strange shelled invertebrates. So far as known huge and bizarre types of fishes were the only vertebrate life of the waters, and majestic crustaceans of scorpionlike form were the rulers of forest and river.

The stratigrapher, using fossils as the key to his vertical and geographic position in the rocks, is keenly interested in discovering a maximum number of specimens. These Devonian field studies brought to the United States National Museum a rich supply of specimens, many new to our collections and some new to science.

MINERAL COLLECTING IN THE ROCKY MOUNTAIN STATES

By E. P. HENDERSON

Assistant Curator, Division of Physical and Chemical Geology, U. S. National Museum

The field-work of 1932 was in cooperation with the department of geology of Harvard University and under the auspices of the Canfield Fund. In June, accompanied by F. A. Gonyer representing Harvard, I left Washington by automobile for the Rocky Mountain States. More than 10,000 miles of territory was covered, and the list of minerals collected or searched for rivals the index of a textbook on mineralogy.

The first collecting was in the dolomite quarries at Clay Center in northern Ohio, where crystals of celestite and fluorite are found filling cavities in the dolomite. The second stop was at Keokuk, Iowa, a district widely known for the quartz geodes found in the nearby clay beds. A geode is a rock with a hollow center partly filled with crystals, sometimes several different minerals, and it is difficult to understand how these different elements passed through the impervious siliceous shell covering. After a few hours of excavating in the clay two large and several small geodes were unearthed, but unfortunately these were damaged in opening them. However, William M. Thomas, a local collecter of geodes, kindly donated his largest geode to the National Museum, a specimen containing a cavity 6 inches in diameter and 18 inches deep completely lined with quartz crystals.

Our next collecting was at Lead, near the northern edge of the Black Hills of South Dakota, where is located the Homestake mine, the largest gold mine in the United States. Hundreds of individuals work along the nearby rivers in an effort to recover the gold which nature buried among the gravels or concealed by rock slides.

Turning west, we pushed on to Butte, Mont., named from the prominent hill, geologically known as a butte, on which it is located. This hill, known as the richest hill in the world, produces each year from within a mining area of about 5 miles enormous tonnages of copper, lead, and zinc, besides large quantities of silver and gold. Butte is the home of the Anaconda Copper Co., and the success of my collecting at this place was largely due to the generous cooperation of the company officials. Many mineral specimens were obtained, as well as several large pieces of ore for the exhibit of applied geology.

FIG. 18.—Topaz Mountain in the Thomas Range, Utah.

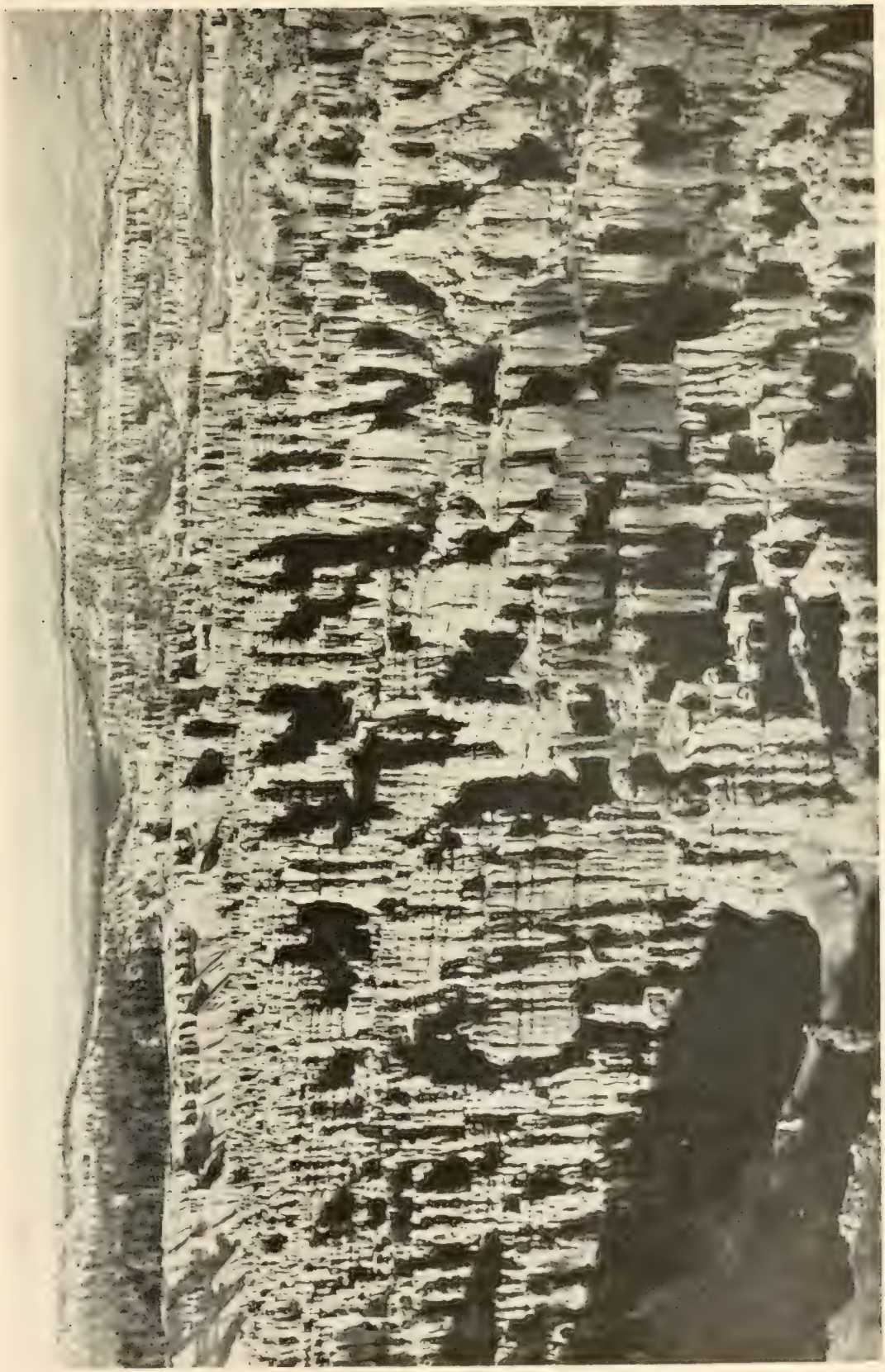

FIG. 19.—Bryce Canyon, Utah.

The next important district visited was Salt Lake City, Utah, where a week was spent in visiting the nearby mining camps such as Park City and Bingham Canyon.

In the Thomas Range, south of the Great Salt Lake Desert, is Topaz Mountain, made up of a volcanic rock, a rhyolite, in which small crystals of topaz are found in more or less abundance. This mountain rises rather abruptly about 2,000 feet above the desert valley, and it is only with great difficulty that its surface can be explored. Most of the exposed surface had to be examined before a site could be selected which looked promising as a source of worthwhile topaz specimens.

On the way to Topaz Mountain a stop was made at Joy, a town located in the Thomas Range. This "town" now contains but one house, with only one permanent resident; yet two score years ago, Joy was a flourishing mining camp. Today its sole inhabitant is known throughout the surrounding country as Aunt May or the Mayoress of Joy. Aunt May has chosen to spend the evening of her life among those hills which she loves and whose secrets she knows.

Among other important localities visited were the lodestone dykes near Cedar City, Utah, the vanadium and carnotite districts located along the Utah-Colorado State line, and the celebrated mining districts of Leadville, Alma, Breckenridge, and Cripple Creek, Colo.

Accompanied by H. H. Nininger, of Denver, and a guide, I spent about three weeks in the Uinta Mountains in a vain search for a huge meteorite reported as seen to fall about 20 years ago. Knowing the extreme variation of the weather at altitudes of over 11,000 feet, one is likely to get a false conception of the rate of weathering and rock movement. Sharp angular fragments of sandstone, the country rock at this point, may be found in large piles, and near them smaller broken fragments which can be fitted into their original places on the boulder. Often tree roots have grown over the rocks or a small tree has struggled up through them in such a manner as to prove that no appreciable movement has taken place, and in most cases the age of these roots and trees was between 50 and 75 years. I therefore concluded that the meteorite would not in 25 years be deeply buried by either the soil or rock movements. In the few places where there was an accumulation of clay, the presence of closely spaced roots, 50 years old and older, precluded any possibility that a large meteorite could be concealed beneath.

Space does not permit listing all the other localities visited nor acknowledging the many courtesies extended to me as an official representative of the Institution, but it was most gratifying to experience such widespread cooperation.

EXPLORATIONS FOR ROCKS AND MINERALS IN THE EASTERN STATES

By JAMES H. BENN

Junior Scientific Aid, Department of Geology, U. S. National Museum

During the past year the writer made various short field trips in search of rock and mineral specimens intended mainly for the mineralogical and geological exhibition series of the National Museum. In November, 1931, a short trip was made to the Seaboard Feldspar Mine, near Moneta, Nelson County, Va., to secure an unusually large orthoclase crystal reported by Dr. W. T. Schaller, Associate in Mineralogy in the Museum, and presented by the mining company. This large crystal of feldspar, weighing approximately 800 pounds and measuring about 2 feet high and 3 feet long, is now on exhibition in the National Museum.

Accompanied by Dr. W. F. Foshag, the writer later made two trips to the old Rutherford mica mine at Amelia Courthouse, Va. The main shaft descends vertically for about 100 feet, and then by tunnels and other shafts one descends to 180 feet, the deepest point in the mine, where the pegmatite is free from the impurities and stains of the weathered portion higher up. The sparkle of clean sheets of muscovite ranging in size from a few inches to over a foot in width, the snowy whiteness of platy albite crystals, and the deep green color of amazonstone greet the eye whichever way one turns the torchlight. Among the minerals collected at this locality were an extraordinarily large crystal of the rare mineral manganotantalite, several extra large microlites, a superfine group of albite crystals, and a large mass of gem quality amazonstone.

In June, 1932, a reconnaissance was made of the mineral localities in southern New York and New Jersey, with the result that much fine material was secured for the collections. In New York the most outstanding localities visited were Ellenville and Forest of Dean. Many years ago the copper-lead mines at Ellenville were prolific producers of exceptionally fine quartz crystals and rare mineral species, but they have been abandoned for 20 years. However, over a hundred samples of small quartz groups were collected. The Fort Montgomery iron mine at Forest of Dean has been in operation for the past 175 years and has an inclined shaft now well over a mile in length. A series of large pieces illustrating the geology of the ore deposit was

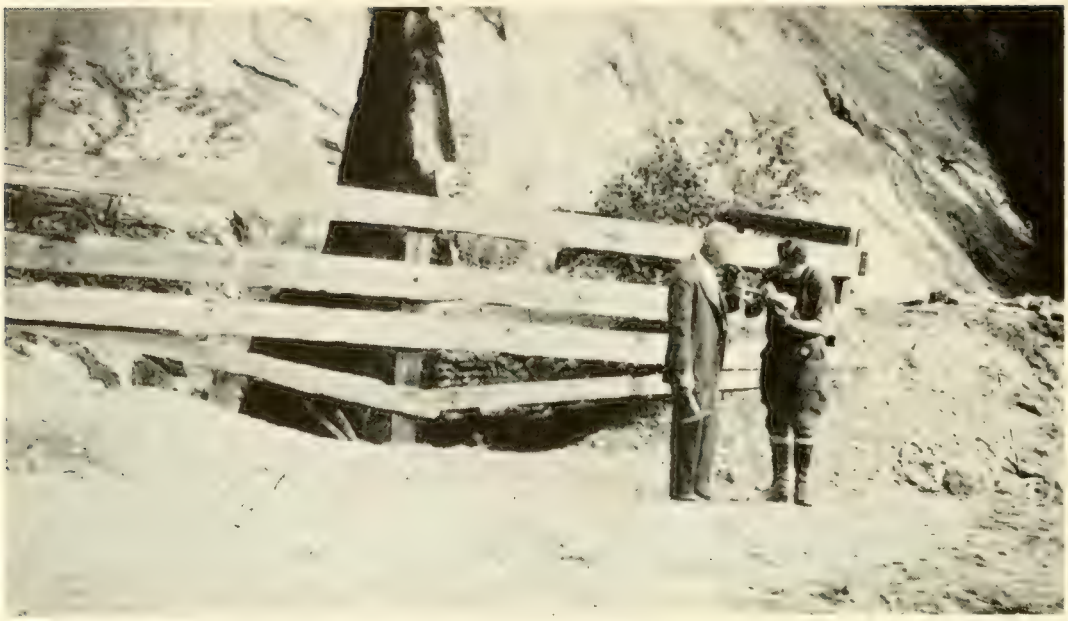

FIG. 20.—Workings of the old mines at Ellenville, N. Y. The mine descends into a natural rift in the tilted country rock.

FIG. 21.—A large feldspar crystal from Moneta, Va.

FIG. 22.—View of the interior of the cave at Mount Etna near Beaver Creek, Md.

FIG. 23.—Stalagmitic growth showing brainlike convolutions from cave at Mount Etna, near Beaver Creek, Md.

obtained for exhibition in the hall of economic geology, as well as hand specimens of plagioclase, magnetite, and other associated minerals.

At the celebrated zinc mines at Franklin Furnace, N. J., a collection was made of various kinds of fluorescent minerals for use in an exhibit now under preparation in the Museum. The writer had the kind permission of the New Jersey Zinc Company not only to collect the material but also to use the company's ultra-violet ray arcs, which enabled him to select only those minerals of the highest and richest fluorescence. Many specimens show two varieties of fluorescent minerals in the same sample and display more than ordinary beauty under the ultra-violet light. From lush green the colors change with a velvety softness through yellow, pink, red, and brown. Several of the species are phosphorescent as well as fluorescent and glow like living coals of fire even after the light has been turned off.

In October, 1932, the writer experienced the thrill of being the first to investigate a cave which had just recently been discovered at Mount Etna, near Beaver Creek, Md. From the opening on the side of a hill one descends by a short but strenuous journey into a large rotunda with a dome some 20 feet high. In the middle of the dome hangs an elaborate and massive stalactitic growth resembling a huge ornate chandelier. Flanking this on either side hang curtainlike growths which add charm to the whole setting. Three main passageways lead off into the darkness, two of which leave the rotunda almost side by side. These twin corridors are guarded by man-sized stalagmites resembling ghosts with capes drawn to shield themselves from light in this abyss of eternal darkness. Along the walls are row on row of stalagmites, almost, it seems, standing at attention while the procession passes. From the ceiling hang stalactites of innumerable sizes and forms. The descent becomes steeper and progress becomes more difficult, for the passageway has widened but the floor has become a forest of stalagmites of all sizes. The fore part of the cavern was striking, but this portion is splendid. Gleaming white stalactites covered with drusy crystals of calcite hang among growths of rich brown and yellow. Pillars, towers, fairy grottoes, steeples, castles, and polar scenes are there for the lively imagination. Deposits of mushroom growths and sparkling calcite enchant the eye. The passage is narrow but long, and every foot of the way is packed with something new. Most curious of all are stalagmitic growths on the floor with convolutions that resemble those of a human brain.

Permission was granted by the owner to take out a grotto at some future date for exhibition in the National Museum.

FIELD-WORK IN PUERTO RICO

By GERRIT S. MILLER, JR.
Curator, Division of Mammals, U. S. National Museum

In the caves of Puerto Rico, as in those of the other large Antillean Islands, bones have been found that prove the existence of an ancient fauna of land mammals that has recently become nearly or quite extinct. One member of this ancient fauna still exists in Jamaica (the "coney," *Geocapromys*), two are known in Hispaniola (the "hutia," *Plagiodontia,* and the "almiqui," *Solenodon*) and five in Cuba (four kinds of hutia and an almiqui). Others once lived on each of the islands, and some of these now extinct animals were still being eaten by the Indians with whom the first Spanish explorers came in contact. On Hispaniola, the island nearest to Puerto Rico, at least four different kinds are represented by bones found in heaps of refuse that mark the sites of the Indian villages. One of these same creatures, a hutia, has been found in the refuse heaps and in the caves of Puerto Rico. Wishing to know whether any of the other members of the old fauna continued to exist until the time when the Indians made their settlements I visited Puerto Rico during March and April, 1932.

I examined Indian village sites in San Juan City, near Cayey, near San Germán, and on Maguey Island off Parguera. These yielded many bones, as well as many Indian artifacts of pottery, stone, and shell. None of this material has yet been critically studied.

In the districts east of San Juan and south and southwest of Arecibo I examined many caves, but without important results. During the past decade most of the caves that are convenient of access have had their floor earth systematically removed by the peasant landowners for use as fertilizer on fields and gardens. Such bones as may have once existed have mostly disappeared with the earth.

While at San Germán I made a small collection of samples of the native woods, under the friendly guidance of Dr. N. L. Britton, who made himself responsible for the identification of the trees from which the specimens were taken.

Reptiles and batrachians were collected as opportunity offered. Among the frogs that I became acquainted with is a member of the treefrog group that Maj. Chapman Grant has recently described under the name of *Eleutherodactylus cooki.* This animal is conspicuous

FIG. 24.—A roadside "Tormentera" for shelter during the deadly Puerto Rican hurricanes.

FIG. 25. A roadside reminder to speeding motorists.

FIG. 26.—View among the mountains south of Arecibo.

FIG. 27.—North side of Pandura Mountain. The light spots are loose masses of decomposing granite.

FIG. 28.—Entrance to a "guajón"-inhabited cavity on Pandura Mountain.

FIG. 29.—Even when safely bottled the mysterious "guajones" are objects of dread.

among the frogs of Puerto Rico because of its limited range and the unusual nature of its habitat. It has been found nowhere but on Pandura Mountain (fig. 27), between Maunabo and Yabucoa. Here it inhabits the cavities among the huge masses of decomposed granite with which the steep sides of the mountain are strewn. Listening at the crevices between these rocks (fig. 28) one may hear the soft, musical song of the frogs coming from the cavities below. The song is a series of about a dozen short, rapidly repeated notes that rise vaguely by excessively small intervals. The effect is strange enough when heard from the surface, but it becomes even more strange after one has clambered down into the irregular and dangerous openings, which prove to be much larger and more cavernous than the surface appearance with its dense and deceptive covering of vegetation would lead one to expect. With flashlights the frogs are easily found and caught as they crawl slowly over the damp but not slippery surface of the granite.

To the natives, who know them as "guajones," these frogs are objects of dread. One man said they were about a foot long and armed with frightful teeth. Another assured me that anyone who saw a guajón would die afterward. No offer of money would induce the boys or men to go into the cavities in search of them. That some of this fear extends to the dead animals safe in a collecting bottle seems to be shown by the group depicted in Figure 29.

ZOOLOGICAL COLLECTING IN SIAM IN 1931 AND 1932[1]

By HUGH M. SMITH

Adviser and Expert in Fisheries to His Siamese Majesty's Government, and Associate in Zoology, U. S. National Museum

As in previous years, the writer has taken every opportunity to obtain zoological material for the National Museum. Early in 1931, collecting was under way at Tha Chang (Elephant Crossing) and Kao Lem (Sharp Mount), in a wild and rugged mountainous region northeast of Bangkok abounding in large game such as deer, gaur, banting, elephants, and tigers. During January and February collections were made at Bukit and Yala in Patani, the most southern Siamese province. The bird life here is strongly Malayan. In April a trip was made to a section of the Pran River accessible from Hua Hin, the celebrated government-owned seaside resort, and a fair collection of birds and small mammals was obtained.

In April and May a visit was made to a wild mountain region lying northeast of Chiengmai in northern Siam. The objective was a mountain mass locally known as Doi Nangka. On the top of the highest peak were observed gibbons, langurs, barking deer, serow, seladang, several species of squirrels including a giant form, bamboo rats, porcupines, black bears, and wild boars. Among the birds were a large hornbill with reddish-yellow belly, a giant white-bellied hornbill, a large dull-colored pheasant, a silver pheasant, and a tree partridge.

Visits were made to the coastal region comprising southeastern Siam, and in August and September a week was spent on Koh Samet, a forest-clad, hilly island, about 6.5 kilometers long, near the mainland. In October the forested region east of Sriracha, southeastern Siam, was visited, and collections were made at Hoophon (High Valley) and Nong Yang (Dipterocarp Lake) about 50 kilometers inland.

Koh Samui and Koh Pa-ngan are the largest members of a numerous archipelago lying off the western shore of the Gulf of Siam. Collections of land animals were made there in July and August. The principal mammals are langurs, sambars and barking deer, wild boars, squirrels, and palm civets. Conspicuous birds are hornbills, jungle fowl, and imperial pigeons.

In late September and early October collections were made in the upper valley of the Tapi River, at Tha Lo, west of Bandon, Peninsu-

[1] Doctor Smith's account of his field-work in 1931 was received too late for inclusion in the exploration pamphlet for that year; it is therefore combined with his account for 1932.—Ed.

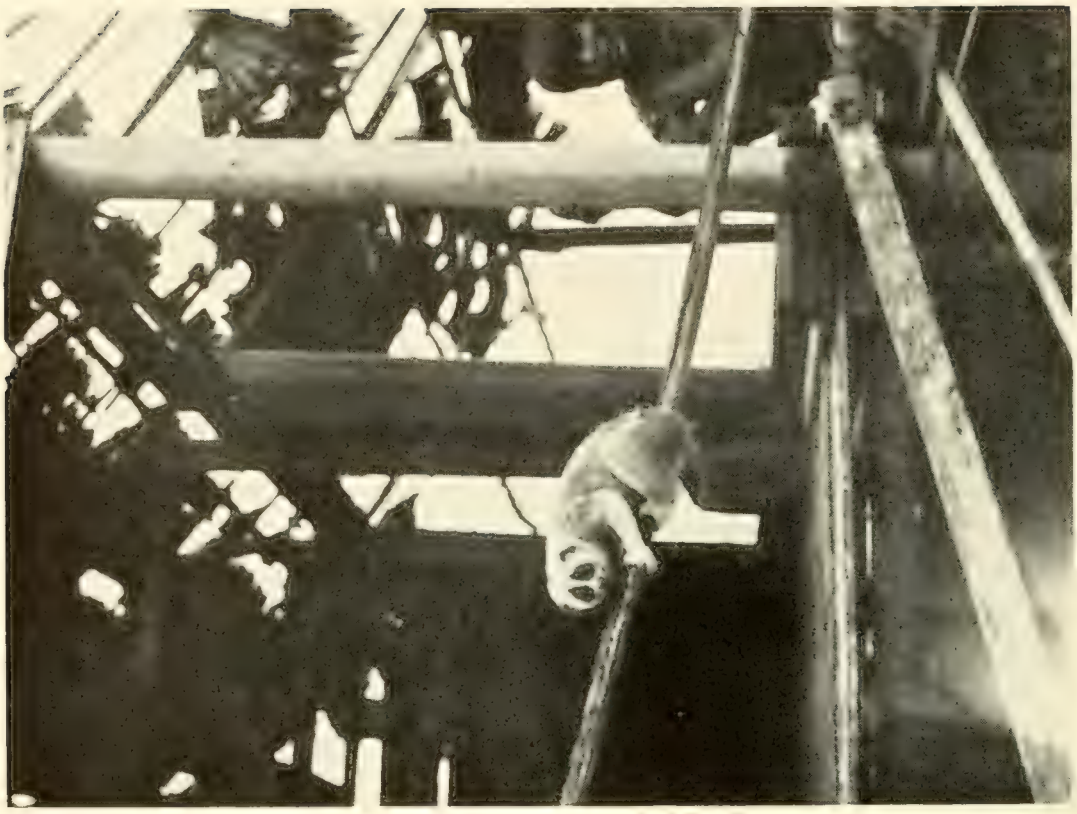

FIG. 31.—A captive slow loris. This curious creature (*Nycticebus tardigradus*) is known to the Siamese as "wind monkey." It is supposed to exercise influence over winds and is often carried on small sailing boats.

FIG. 30.—Lao fisherman with a cyprinoid fish showing a normally indented snout. Mekong Basin.

FIG. 32.—Karens, Northern Siam. These people, whose position among the races of southern Asia has been a puzzle to ethnologists, live in isolated villages in mountain districts; in Siam they number 60,000. They are animists and sacrifice fowls and other domestic animals to propitiate evil spirits.

FIG. 33.—Collecting fishes in a mountain stream in Northern Siam, 1932. A scare cord is combined with a cast net.

lar Siam. This is a big game region, and elephants, tigers, leopards, and seladangs abound. Early in December another visit was made to the mountainous district on the eastern railway, with Hin Lap (Whet Stone) as headquarters. Birds were numerous, and the collection included fire-back pheasants, tree partridges, broadbills, bulbuls, babblers, flycatchers, orioles, bee-eaters, and rock-thrushes. The last week of the year was spent at Koh Sichang, an island off the eastern mainland near the head of the Gulf of Siam.

Early in 1932 general collections were made in mountainous districts of northern Siam—Doi Sutep, Doi Chiengdaro, valley of the Mekhan southwest of Doi Sutep, and Khuntan Range. Lao men, women, and children brought in many live reptiles, mollusks, insects, tarantulas and other spiders, scorpions, and other animals. At the camp of the Mekhan, peculiar mountain-stream fishes in large variety were obtained. A striking feature of this camp was the great abundance of "daddy longlegs" (Phalangidae), which became active at dusk and literally covered the river bank. As a person walked among them the entire land surface seemed to be in motion; when they moved to the dried leaves of the adjoining hillside they made a noise like falling rain drops. Their legs were 9.5 centimeters long.

One day, while the National Museum's collector was staiking birds in the Khuntan Mountains, a strange European appeared in the jungle and showed interest in the collector's activities. The visitor proved to be Crown Prince Leopold of Belgium, at whose request the collector was detailed to accompany the Prince and assist in making natural history collections in the Philippines, Celebes, Bali, and Borneo.

Visits were made to sections of eastern and southeastern Siam, and in October a collecting trip up the Pasak River was undertaken for the first time. The Pasak, a long, tortuous stream marking the boundary between central Siam and the eastern plateau, carries a large volume of water which at Dha Luang is dammed and diverted for irrigation purposes into the rice-growing district of Rangsit. Stretching eastward from the Pasak is a vast primeval-forest jungle abounding in elephants, tigers, leopards, bears, deer, and several species of buffaloes. The passage up and down the river was made in a cargo boat towed by a launch, and stops were made at numerous places. Some idea of the abundance of animals in the Pasak district may be gained from the fact that in a normal year there are handled at Gengkoi 3,000 skins of the hog deer, 10,000 skins of the barking deer, and 200 to 300 skins of the gaur and the banting.

In the last months of the year collections were made in western Siam at the Sam Roi Yot (Three Hundred Peaks), and in the mountain-forest jungle of the northwestern corner of Siam.

HUNTING FLIES IN THE WEST

By J. M. ALDRICH

Associate Curator, Division of Insects, U. S. National Museum

Every year witnesses the discovery and publication of numerous new species of flies from the United States, especially from the region west of the Rockies. It was to keep up with the march of discovery and obtain some of the as yet unknown new species that I spent nearly 10 weeks on a western trip in 1932, from June 4 to August 13.

There are so many possibilities in a trip of this kind that one can only string together those collecting grounds within reach of a round-trip railroad ticket, unless he goes in his own automobile. It was decided that more ground could be covered in the time permitted by using the railroad, as the San Diego region, entirely off the path of my usual trips, seemed important enough to be included, and this lengthened the journey materially.

The first stop for collecting was made in eastern South Dakota. I had collected here in 1888 to 1892, and had found some species so rare that they have not been rediscovered since. I hoped I might have the good fortune to collect a few of them or at least might find them in the collections of the State College, which have grown greatly in recent years. In this hope I was disappointed, but I collected a fair number of insects of value to the National Museum. The next stop, a brief one, was at Spokane, including a side trip to Coeur d'Alene Lake, in Idaho. Then for a few days I made my headquarters at Clarkston, Wash., and Moscow, Idaho, while making automobile trips over a considerable radius—to southern Asotin County, Wash., in one direction, and Clarkia, Idaho, in the white pine country, in the other.

Mount Hood, Oreg., was the next stop. Cloud Cap Inn, at 6,000 feet, the terminus of an excellent auto road from the city of Hood River, was visited, but proved too high and cold for the early part of the season. Coming back to Homestead Inn, at 4,000 feet, I remained and collected with success for a few days. I was indebted to the Hood River entomologist, Leroy Childs, for transportation, and when I was ready to move on, he took me to Mount Hood Meadows, on the east side of the mountain. Here again the altitude was too high for the time of year, although a few good things were obtained. A few hours at the shore of the Columbia River gave some interesting comparisons with the insects obtained in the higher altitudes. Continuing to Port-

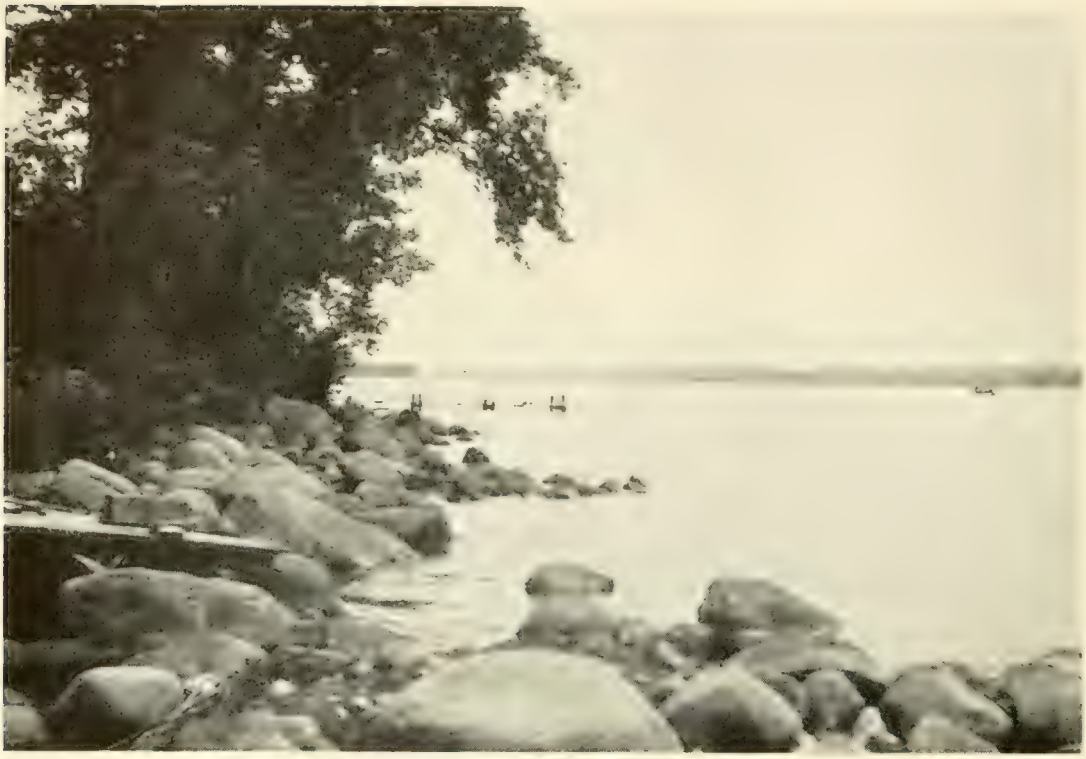

FIG. 34.—Big Stone Lake, near Big Stone City, S. Dak.

FIG. 35. Lapwai Creek, above Lapwai, Idaho.

FIG. 36.—Mount Hood, Oreg., from Homestead Inn.

FIG. 37.—Roadside near Smith River, Calif., on the Redwood Highway. A redwood stump behind the car.

land, I visited the western slope of Mount Hood at 1,500 feet, in heavy fir forest on Sandy River.

The next collecting was done at the beach of the Pacific near Smith River, close to the Oregon Line, just at the edge of the famous redwood country. Two years before, I had found here the celebrated rare fly with mandibles, or at least an imitation of mandibles. My stock of these remarkable flies had become depleted through donations made by the Museum to other institutions, and I sought a new supply. In the course of a few days I was able to get about 40 specimens, and to discover that the fly occurs at only one small place on the California beach, as far as known. The narrowness of these limits was not suspected on my former visit.

Insects of the Pacific seacoast usually extend for hundreds of miles along the shore, several being known from Alaska to or nearly to San Francisco. Observations on the flies of the coast are none too plentiful as yet, and I was glad to be able to compare the flies at Smith River with species I had obtained along the coast farther north up to Seward, Alaska, in earlier years, as well as with collections made southward as far as Long Beach. This year it was found feasible to visit San Diego also for several days, and to collect at Laguna on the way down. This gave us a better representation from the California seashore than we had before. A delightful 80-mile trip into the interior brought me to Warner's Hot Springs. The totally different interior climate naturally meant different flies, so the day's collecting was one of the best of the whole season.

While in Los Angeles I ascended Mount Lowe to the summit but was disappointed in the results, it being too late and too dry up there for many flies.

The trip covered a more diversified field than any previous single summer in my experience. As usual, it was not possible to be at each place at the best time of year for collecting; sometimes I was too early and sometimes too late. But on the whole a valuable collection was obtained, the study of which will not be completed for some time.

COLLECTING GRASSES IN TENNESSEE, KENTUCKY, AND YUCATAN

By J. R. SWALLEN
Section of Grasses, U. S. National Museum

As Kentucky and Tennessee were less adequately represented than the other States in the grass herbarium of the United States National Museum, I spent the month of June, 1932, collecting and studying the grasses in these two States. The localities visited were Camden, Jackson, Millington, Dyersburg, and Reelfoot Lake in Tennessee, and Mayfield, Morganfield, Leitchfield, and Central City in Kentucky, all in the central or western parts. Species of the genus *Panicum* are most numerous at that time of the year, and are commonly found in the sandy hardwood forests.

On July 1, I sailed from New Orleans for Yucatan to collect grasses and grass rusts in cooperation with the University of Michigan and the Carnegie Institution of Washington. I was accompanied most of the time by Dr. William C. Steere of the department of botany of the University of Michigan. The Yucatan flora is known chiefly from the collections of Doctor Gaumer and Doctor Millspaugh and from the early collections of Doctor Schott, none of whom paid special attention to the grasses, so that the opportunity for adding to the known grass flora seemed very promising. The results came up to expectations, as the specimens collected record more than a 50 per cent increase in the number of grasses previously known from Yucatan. As the time was limited to little more than six weeks, only a few representative localities could be investigated. It is reasonable to believe that further exploration would add still other grasses, especially in the states of Quintana Roo and Campeche.

The state of Yucatan is an almost level plain, unbroken except for a range of low hills near the southern boundary extending from near Muna almost to Peto. Beyond this range to the south can be seen a similar range in the distance. It is said that there are four of these, each succeeding one to the south being higher. In Quintana Roo and Campeche there are other low hills running roughly parallel to the east and west coast lines.

Nearly all the peninsula except that which is or has been under cultivation is covered with a very dense growth of small trees. Toward the south, however, in the states of Quintana Roo and Campeche, where there is more moisture, the growth becomes larger and a little

FIG. 38.—Reelfoot Lake, Tenn. In 1811 a severe earthquake occurred here which resulted in the sinking of the lowland forest. The charred stumps, left from the fire that followed, everywhere rise above the surface of the water.

FIG. 39.—A view looking south from the top of the "Castle" at the ruins of Uxmal. The large mound is an ancient ruin. The two small fields are "milpas" or cornfields.

FIG. 40.—Ruins of Tulum near the village of Tancah on the east coast in Quintana Roo.

FIG. 41.—A view along the east coast from the top of the ruins of Tulum. The wall around the ancient town is seen in the center of the picture. The ridge along the coast is covered with a dense growth of palms.

FIG. 42.—A street in the village of Tancah.

more open. In such a region grasses are not found in such great abundance, since only a few grow under these conditions. The most common grass is *Ichnanthus lanceolatus* Scribn. & Smith, which occurs nearly everywhere and is in some places the only grass to be found. In the very dense brush toward the central part of Cozumel Island even this is wanting—there is almost no ground covering of any kind. As if to make up for this lack, the trees are covered with lichens, liverworts, and mosses. Most of the grasses are therefore to be found along the roads and trails, in cultivated ground, in the few open places in the brush, and along the coast.

Henequin and corn are the principal products of Yucatan. The former is grown on large plantations in the western part of the state. The fiber is the chief export and largest source of income. In contrast to the henequin plantations are the " milpas " or cornfields of the Maya people. These are located far from villages and commonly traveled trails to avoid the ravages of live stock. The method of cultivation is very simple. The brush is first cut down and allowed to dry. Toward the end of the dry season it is fired and the ashes used for fertilizer. At the beginning of the wet season the corn is planted in small holes made with a stick. Nothing else is done except to cut the weeds off once during the season. In many places no other cultivation would be possible as the soil forms only a thin layer over the rocks. What soil there is, however, is of good quality and the corn grows very well. Beans are usually planted with the corn.

The flame tree or flamboyant, *Delonix regia* (Boj.) Raf. (*Poinciana regia*), early introduced into the American Tropics from Madagascar, is found in many of the towns and villages. Its scarlet or flame-colored flowers in large clusters are very striking.

A small native tree frequently found is *Byrsonima crassifolia* (L.) DC., the fruits of which are very much relished by the Mayas. They have a very pungent odor and were not at all to my liking, tasting to me very much like sour milk.

The insects which one usually expects to find in the Tropics were very few. For the most part mosquito nets were not necessary and were seldom used at night. The one exception was at Tancah, where numerous tiny insects continually flew around our faces but did not cause very much discomfort.

Collections were made at Chichen Itza, Tizimin, Uxmal, Muna, Peto, and Progreso in the state of Yucatan, and at Lake Chichencanab, called Chancabnab by the natives, Cozumel Island, and Tancah in the state of Quintana Roo. A collection of more than 2,000 specimens was made on the two trips.

ANTHROPOLOGICAL EXPLORATIONS ON KODIAK ISLAND, ALASKA

By ALEŠ HRDLIČKA

Curator of Physical Anthropology, U. S. National Museum

Anthropological and archeological research on Kodiak Island, Alaska, was carried on by the writer throughout the summer of 1932. The work consisted in excavations at one important site in Uyak Bay; in trial excavations at Chief's Point and other sites; in an archeological survey of the whole island; and in securing measurements and photographs of the few remaining fullbloods on the island.

The expedition received substantial aid from the Alaska Packers Association and their officials and men at the Larsen Bay Cannery; from the U. S. Bureau of Fisheries; from the officers and airplane men of the U. S. S. *Gannet,* Alaska Survey Expedition; and from the officials and captains of the Pacific Steamship Co.—all of which is hereby gratefully acknowledged. Especial thanks are due also to the many individuals, who cannot be listed in this brief article, all of whom rendered valuable assistance. Through the generosity of Mrs. Charles D. Walcott the expedition obtained a small boat with an outboard motor, which proved very valuable.

The excavation at the Uyak Bay site progressed so substantially that approximately one fifth of the area covered by the main deposits and estimated at two acres has been cleared. The accumulations in the main part reach from 8 to 15 feet in depth, ranging mostly between 9 and 12 feet. Excavation of these deposits was carried on throughout to the glacial bed-ground, consisting of greenish glacial sand, gravel, and boulders. Stone and bone implements were found at all levels and in all the deposits.

Skeletal remains occur mostly in three ill-segregated strata, the low or deep, the intermediary, and the upper or superficial. The deep remains are partly disseminated individual bones, some broken for the marrow and a few showing localized marks of fire; and partly regular individual burials. In a few instances the bones of only a portion of the body were interred, but mostly there were the complete skeletons. Some burials were more than 12 feet in depth, and most of the deepest were laid in hollows, up to 2 feet deep, made in the glacial bed pan. All were in the contracted position and the skull lay generally on its side. Near them were buried as a rule some cultural articles, such as bone points, slate knives, or a lamp or two. Repeatedly in these and also in the intermediate layers, two lamps, differ-

FIG. 43.—Aerial view of our point and excavations, August, 1932. The Alaska Packers' Cannery, our headquarters, in the background.

FIG. 44. Two ivory portraits from Kodiak Island, each 3 inches high. The one on the left was discovered in 1931; that on the right, in 1932.

ing in size and shape, were found together, suggesting a " male " and a " female."

The principal facts learned in the excavations of the season may be summarized as follows:

Up to the advent of the white man and for many centuries previously Kodiak Island must have been one of the largest, if not the largest, centers of the native populations of Alaska. There is definite evidence of two distinct populations on the island, an earlier one of long duration, and a later one of apparently not more than the last two or three centuries. The earlier and the later people were of similar moderate to medium stature, but differed much in the shape of head. Both types—the earlier with oblong, the later with rounded heads—although somewhat Eskimoid, approach also the Indian. There was noted but little if any mixture of the two types, and there appear to be no survivors of the earlier type on the island.

The newer people, though introducing some new cultural elements, had evidently taken over to a large extent the culture and perhaps even many of the actual tools of the older stock. The old culture was richer than and artistically superior to that of the late. It is devoid of pottery. Pottery is also absent in the upper, later, deposits, except in the southwestern part of the island, where somewhat crude large clay jars were fairly common. Contacts of the upper people with those of the Alaska Peninsula and those of Cooks Inlet are indicated by some of the finds and are otherwise corroborated.

Cannibalism, according to many indications, was practiced extensively by the earlier people. Adults of both sexes and many children were consumed. Evidences of death by violence are common.

The earlier population vanished in an unknown manner. It may have been through epidemics, or wholesale massacres, or emigration, or all these combined. So far, evidence is lacking on this point.

The survey of the coasts, first those of the extensive Uyak Bay with its side issues and then those of the whole island, resulted in the location of scores of old sites hitherto unknown to science and covering from a half acre to over 30 acres of ground. A particularly interesting line of old sites consists of refuges or fortresses on isolated and almost inaccessible rocky islands. There are at least a dozen other large sites along the coasts which show deep accumulations, are easily approachable, and offer promising chances for exploration.

The quest for surviving fullbloods resulted in the finding of nine males, eight of whom were measured and photographed. They all showed the late "Aleut " type and call themselves Aleut.

ARCHEOLOGICAL INVESTIGATIONS AT POINT BARROW, ALASKA

By HENRY B. COLLINS, JR.
Assistant Curator, Division of Ethnology, U. S. National Museum

Since 1928 the Smithsonian Institution has been investigating prehistoric Eskimo sites in Alaska in an attempt to unravel the archeological history of this strategic region of North America. The oldest remains that have come to light in northern Alaska belong to the Old Bering Sea culture, a highly developed Eskimo culture centering around Bering Strait and extending eastward to Point Barrow and westward into northeastern Siberia. On St. Lawrence Island it was found to have undergone marked changes probably a thousand years ago and to have developed into a simplified stage called the Punuk.[1]

The prehistoric Thule culture of northern Canada and Greenland, which apparently had its origin in Alaska, seems to be more closely related to the Punuk stage and even to modern Alaskan culture than to the earlier Old Bering Sea culture. But in order to obtain definite evidence it was necessary to work at an Alaskan site where Thule material occurred more than sporadically. A favorable place was Point Barrow, which represents the most easterly extent of the Old Bering Sea culture and also the most westerly point at which the Thule culture existed as a type. The Eskimos and other collectors have been excavating at the old sites around Barrow for a number of years, with the result that large collections of artifacts have been amassed. But since the work had not been done systematically, the cultural differences and relative ages of the various sites were not clearly known.

In 1931 James A. Ford was detailed to conduct archeological work in the vicinity of Barrow, but being unable to arrive before the ground froze he received permission to winter there in order to start work early the following spring.[2] Beginning early in June, Mr. Ford excavated until late September, when he left on the U. S. S. *North Star*.

The oldest and most important of the old sites was Birnirk. Here as around Bering Strait the harpoon head was found to have passed

[1] Archeological investigations in northern Alaska. Explorations and Fieldwork of the Smithsonian Institution in 1931, pp. 103-112, 1932.

[2] The Institution is indebted to the U. S. Coast Guard, the Bureau of Indian Affairs, and Capt. G. D. Pederson of the schooner *Patterson* for transportation furnished Mr. Ford to and from Barrow, and also to those at Barrow, particularly C. W. Brower, Dr. H. W. Greist, and Messrs. Morgan, Hopson, and Trendle for many courtesies.

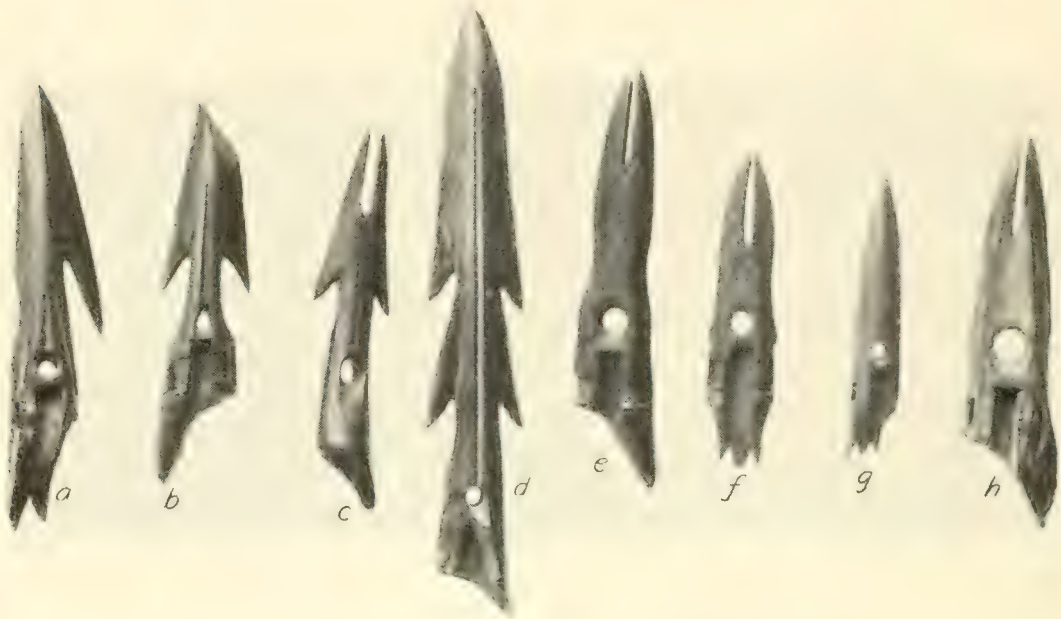

FIG. 45.—Harpoon heads from old Eskimo sites around Barrow; *a*, *e*, *f*, *g*, Birnirk; *b*, *c*, *d*, Utkiavik; *h*, Point Belcher.

FIG. 46.—Eskimos cutting up bowhead whale killed at Point Barrow.

FIG. 47.—James A. Ford hauling whale skull from Point Barrow to Barrow.

FIG. 48.—Hauling whale jaw to Barrow with sled and dog team.

through a number of developmental stages and for that reason furnishes the best criterion for determining the relation of one site to another. Most of the harpoon heads from Birnirk were of bone, with an open socket and two or more asymmetrical spurs at the base, and a side blade of flint with an opposite barb or with two side blades and no barb (fig. 45, *a*)—a type already known as the Birnirk. Other types of heads found at Birnirk are shown in Figure 45, *e, f, g*. Only one example of the Thule type 2, with two barbs, was found. However, this type (see fig. 45, *b*) predominated at the older part of the more recent site of Utkiavik. Here it later developed into forms characteristic of the period just preceding the historic as shown by their association with metal and late types of implements (fig. 45, *c, d*).

In the cultural sequence here revealed—Birnirk, Thule, modern—the Old Bering Sea culture is conspicuously absent. However, Mr. Ford found a few examples of Old Bering Sea art in burial mounds on the tundra back from Utkiavik. Burials similar to these were also found at Nunavaak and are reported by natives at various points down the coast. At Nunavaak the only sign of habitation near the mounds was a house ruin of no great age. This, together with the fact that the material from the burials does not correspond to that from the existing old or later sites nearby, leads Mr. Ford to the conclusion that the Eskimos of the Old Bering Sea period may have lived in low-lying settlements near the mouths of streams which, with later topographical changes, became lagoons.

Mr. Ford's excavations have furnished the basis for a cultural chronology of the north Alaska coast which supplements that previously established for the region about Bering Strait. In the latter region the sequence was Old Bering Sea, Punuk, and modern, with Birnirk harpoon heads occurring sporadically early in the Punuk stage and Thule heads beginning to appear somewhat later and becoming more abundant in the protohistoric period. Around Barrow the Old Bering Sea stage appears to be lacking except in the mound burials. Assuming it to have been the earliest there, we have next the Birnirk, then the Thule, and then the modern. The Punuk stage, so prominent around Bering Strait, finds no place in the Barrow sequence. However, from a house ruin at Point Belcher, 60 miles below Barrow, Mr. Ford obtained some typical Punuk material, including the harpoon head shown in figure 45, *h*. This house was partly beneath the water of the lagoon; in the bank above were house ruins and refuse piles which yielded Thule material. Here there seems to be evidence of a direct migration of a group of Eskimos from around Bering Strait, bringing typical Punuk culture to a region where it had not previously existed.

THE EARLY INDIAN CULTURES OF CUBA

By HERBERT W. KRIEGER
Curator, Division of Ethnology, U. S. National Museum

In recent years the Smithsonian Institution has sponsored seven anthropological expeditions to Santo Domingo, Jamaica, Puerto Rico, Haiti, and Cuba, with the purpose of determining prehistoric tribal and cultural sequence in those islands. With a view toward a more detailed analysis of the northern and southern affiliations of early Cuban cultures, the writer visited Cuba and the outlying Isle of Pines during the winter of 1932. This expedition was made possible by the joint cooperation of the Smithsonian Institution with Dr. W. L. Abbott, whose interest in West Indian research is of long standing.

Solution of two problems was sought: First, who were the Indians at one time occupying the littoral of the southern coast of the province of Camagüey, the builders of those enormous kitchen refuse heaps and shell deposits known to Cubans as caneyes? Were they the so-called Ciboneyes described by the Spanish historian Las Casas as simple fishermen living on the smaller islands off the Cuban coast and subject to the recent invader from Haiti—the superior Arawak?

Second, who were the people occupying western Cuba at the time of its discovery by Columbus? Were they perhaps in contact with the celebrated Maya of Yucatan Peninsula less than 100 miles distant? They certainly knew about the splendors of aboriginal Mexico by hearsay if not through trade and intercourse, for the Spaniards gained their first intimation of the superior mainland cultures from the lowly Indians of northern Cuba. Or were they the selfsame Ciboneyes who, according to the gossiping Martyr, lived in caves and roamed through the mountains of western Cuba?

There remains yet another theory, namely, that underlying or marginal to our rather elaborate southeastern United States Indian culture is an extremely ancient lacustrine or coastal culture based predominantly on the use of shellfish. This same underlying culture might account for the undifferentiated shell heaps and middens of the Floridan, Bahaman, Cuban, and Haitian coasts; it is here labeled, tentatively, as the Ciboney, so far as pertains to the West Indies.

The writer's work was confined largely to a study of the caneyes of the Cuban province of Camagüey, and to a reconnaissance of Pinar del Rio Province and the Isle of Pines. The Isle of Pines is the largest of the outlying keys of Cuba, from which it is separated by

FIG. 50.—Trench 5 feet deep through top of Ciboney mound. The light horizontal layers extending the full length of the cut are ashes.

FIG. 49.—Beginning work in Ciboney mound in Camagüey Province. The mound, which is 31 feet high, consists entirely of kitchen refuse, discarded utensils and implements, and layers of ashes.

FIG. 51.—A typical Cuban country home.

FIG. 52.—Types of Arawak pottery from Oriente Province, eastern Cuba.

shallow water, coral reefs, and keys. The island consists of two parts, a northern and a southern section, the latter apparently uninhabited in prehistoric times, as there are no shell middens along the coast, and the caves bear no evidence of former Indian occupancy. Traces of aboriginal culture or prehistoric human remains are limited to sporadic surface finds. The many caves explored by the writer in the Casas and Caballo Mountains of the northern portion of the island revealed no trace of prehistoric human occupancy.

Next was undertaken a reconnaissance of the known sites of former Indian villages, shell heaps, and kitchen middens of the extreme western portion of Pinar del Rio Province. Working from the village of Guane, the writer investigated caves and former Indian village sites in the Valle San Juan, at Cayo Redondo, and Viñales. Shell heaps and village sites are here clearly distinguishable, in part as Ciboney and in part as Arawak in origin. There is no evidence of other extraneous culture stages. Clearly the Maya did not influence the culture of western Cuba.

The scene of our investigations was next shifted to southeastern Cuba and to the southern coast of the Province of Camagüey. Here at El Caney de los Muertos in the vicinity of Santa Maria de Casimba Bay, as early as 1846, Rodriguez-Ferrer had made the first systematic excavation in Cuba of an Indian shell midden or kitchen refuse heap.

Attention was recently called to the thirty-odd circular caneyes or refuse mounds of southern Camagüey Province in a letter from Leonard B. Fox, of Florida, Cuba, in which he describes the results of an excavation by him of a "mound about 30 feet high by 100 feet in diameter," consisting of "successive layers a foot to a foot and a half in thickness of shells and ashes. In the layers of shells we found several very crude utensils made of shell and stone, but no sign of pottery." Mr. Fox lent every assistance to the writer, at the occasion of his visit, as did also the officials of the two neighboring sugar centrals, Florida and Agramonte.

Much remains to be done before the non-Arawak Indian cultures of Cuba, Haiti, Santo Domingo, Jamaica, and Puerto Rico may be assigned their proper place in the prehistory of the Antilles. The writer feels assured that during their comparatively brief occupancy of Cuba, the Arawak had practically eliminated their primitive predecessors, the Ciboney. Future investigation should discover whether the Ciboney themselves had gradually passed through several culture stages, or whether the marked differences apparent in the widely distributed, non-pottery-yielding non-Arawak shell middens and refuse heaps of Santo Domingo, Haiti, and Cuba are ascribable to early arrivals from Florida and the Bahama Islands.

PREHISTORIC CAVE DWELLERS OF TEXAS

By FRANK M. SETZLER

Assistant Curator, Division of Archeology, U. S. National Museum

Archeological researches in the southwestern portion of Texas centered this year in the Chisos Mountains area, 150 miles south of Alpine, and in Sunny Glen Canyon, 8 miles west of Alpine. Transportation facilities varied successively from railroad to truck, to horse, to burro, to airplane, and back to burro. Our first objective was the Johnson ranch, which had been suggested as field headquarters by Maj. C. E. Brenn, of Fort Crockett, Galveston, Tex.

Eighteen miles down the Rio Grande from Castolon we drew up before the door of Mr. and Mrs. Elmo Johnson and were received with genuine southern hospitality. Both Mr. and Mrs. Johnson are interested in archeology and have accumulated an interesting collection of specimens. Through their kind offices we secured an excellent guide, Dell Dodson, and were soon in pursuit of information pertaining to the primitive Indian tribes who dwelt in this region before Cabeza de Vaca made his memorable journey across the deserts of northern Mexico. We drove the truck over trails, creek beds, and mesas as far as possible; then resorted to burros and when the latter could go no further, we pushed on afoot. Our first camp was established near the south tip of Mule Ear Peaks (fig. 53) and here two caves were completely excavated. A third cave (fig. 54), on Wayne Cartledge's ranch, yielded information not found elsewhere. From these three sites we gained an excellent cross-section of the culture typical of the region.

The Chisos Mountains proper were first surveyed from the air, and numerous caves were sighted along the precipitous cliffs. The territory we covered by plane in an hour required four days to reach by muleback. And then we were disappointed in that none of the caves visited contained evidence of more than passing occupancy by prehistoric Indians.

On May 1, camp was moved to Sunny Glen Canyon where, with the cooperation of V. J. Smith of Sul Ross State Teachers College, and with the permission of the A. S. Gage estate, two other caves were excavated. These latter disclosed the same uniform type of material culture we had observed farther south on this and previous expeditions.

FIG. 53.—Airplane view of "Mule Ear Peaks."

FIG. 54.—Cartledge Cave.

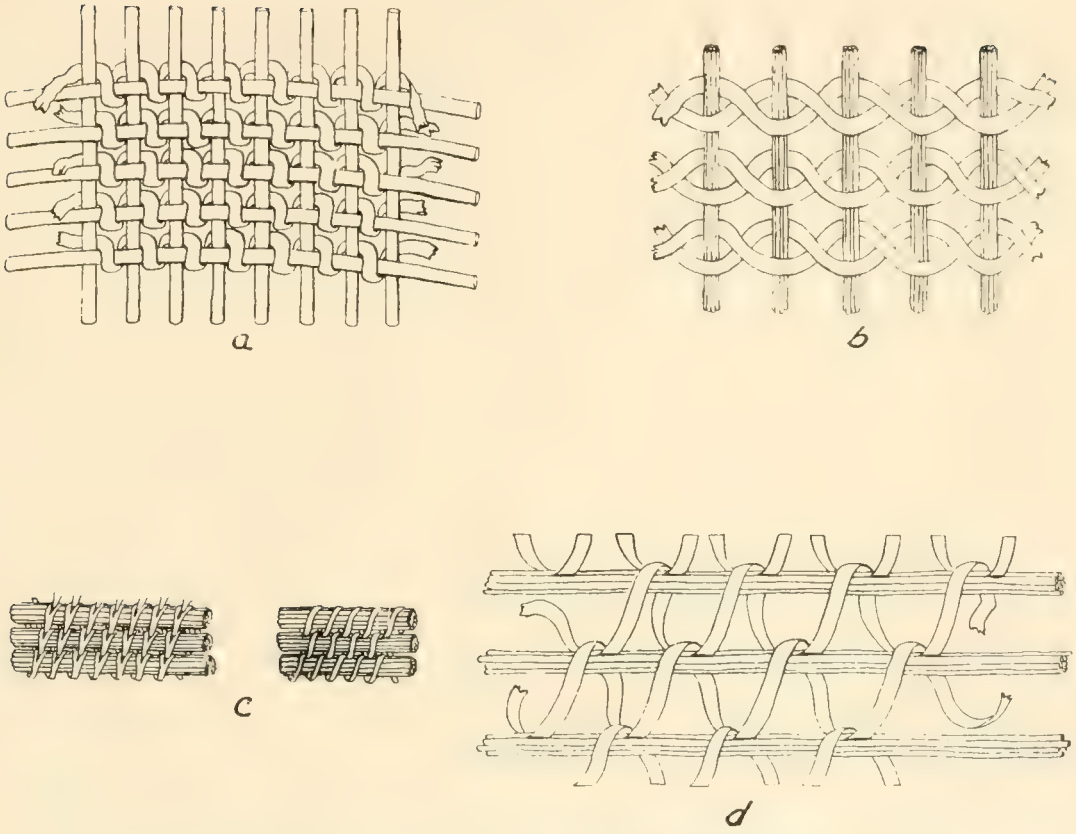

FIG. 55.—Schematic drawings of various basket techniques. *a*, Parallel and vertical rod foundation, yucca sewing thread; *b*, plain twining; *c*, split stitch, single bundle foundation; *d*, single bundle foundation with interlocking stitches.

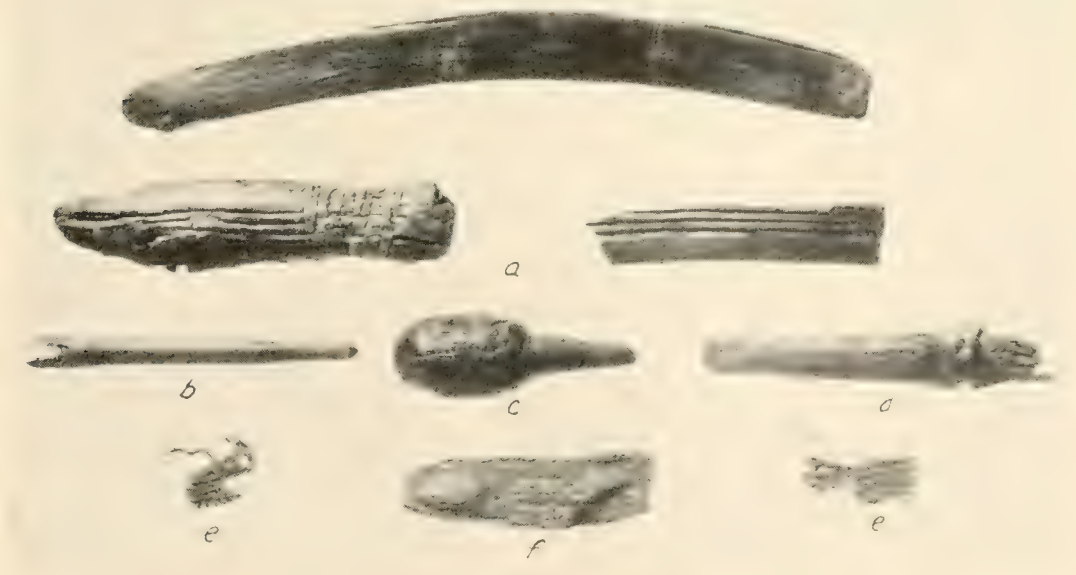

FIG. 56.—Basket Maker artifacts: *a*, grooved clubs; *b*, atlatl foreshaft; *c*, atlatl bunt point; *d*, atlatl handle fragment; *e*, painted, twined woven bag fragments; *f*, selvaged *apocynum* cloth, painted.

The five caves explored in 1932, produced an exceptionally uniform type of cultural material. No vestige of pottery, European artifacts, or stratification appeared in any site examined. Coiled basketry fragments are predominantly of the "split stitch with a single bundle foundation." This is the distinctive type in the Big Bend region (fig. 55, *c*) but there are also three others (fig. 55, *a, b, d*). None of these corresponds to the characteristic technique used by the ancient Basket Makers of New Mexico and Arizona. The sandals of southern Texas likewise differ from those of the Basket Makers.

Among the important artifacts found this year are grooved club fragments (rabbit sticks?) (fig. 56, *a*); atlatl foreshaft (fig. 56, *b*), a "bunt" point (fig. 56, *c*), and the proximal or hand end of an atlatl (fig. 56, *d*); two fragments of painted, twined woven bags (fig. 56, *e*), and a small sample of cloth woven with *apocynum* fiber, selvaged and complete (fig. 56, *f*). As similar specimens have been found with Basket Maker burials in the San Juan region, we have here, for the first time, evidence which may serve to indicate the relative age and development of our nonpottery culture in the Big Bend area. But it should be noted in this connection that, associated with the specimens above mentioned, we also found numerous arrow shafts and foreshafts which are not a characteristic of the classic era of the Basket Maker culture. They seem to suggest, rather, that the Texas cave dwellers lived during a transitional stage between the Basket Maker III and Pueblo I periods. Absence of pottery and house types in the Big Bend region still complicates this problem of possible relationship. Continuation of our studies may clarify this phase of the prehistory of southern Texas.

Besides the above-mentioned artifacts the caves we explored contained numerous metates, manos, projectile points, flint knives, painted pebbles, and end scrapers; yucca bags, mats, nets, and a great variety of *apocynum* and *lechugilla* cordage; wooden scrapers, scoops, awls, etc.; cane tubes containing minute seeds, corn cobs, gourd sherds, and bone beads; painted sticks, bones, and buckskin bags. Thus we have an index to the arts and industries of the unknown prehistoric tribes concerning whom we have been seeking information. Some of the other artifacts recovered show a similarity to those found around El Paso [1] and the Mollie B. Knight ranch.[2] But most important of all, our 1932 researches brought indications of a positive relationship between the Big Bend area and the southwest.

[1] Roberts, F. H. H., Jr., Recent archeological developments in the vicinity of El Paso, Texas. Smithsonian Misc. Coll., vol. 81, no. 7, January, 1929.

[2] Setzler, F. M., A prehistoric cave in Texas. Explorations and Field-work of the Smithsonian Institution in 1931, pp. 133-140, 1932.

SALVAGING AN ABORIGINAL DUG-OUT CANOE, CUMBERLAND ISLAND, GEORGIA

By FRANK M. SETZLER

Assistant Curator, Division of Archeology, U. S. National Museum

In February, 1932, the writer went to Cumberland Island, Ga., for the purpose of examining the newly discovered remains of a dug-out canoe thought to be of prehistoric Indian manufacture. The old craft had been found in 1931 by C. McLendon, of Saint Marys, who described his find to I. F. Arnow, a local historian. Mr. Arnow, recognizing the importance of the dugout, reported it to Dr. J. R. Swanton of the Bureau of American Ethnology, foremost authority on the Indian tribes of the southeastern United States.

Cumberland Island, the winter residence of Thomas M. Carnegie, is situated off the southern coast of Georgia just north of Fernandino, Fla.; it is separated from the mainland by the Cumberland River, with Saint Andrew Sound and the Satilla River on the north. The island, about 20 miles long by 5 miles wide, has had its inherent, natural beauty studiously preserved. The beach on the eastern side of the island, beaten smooth and hard by the pounding surf, is generally recognized as the finest along the eastern coast. Gulls, terns, and sandpipers patrol the shore line, and within the deeper woods, deer and wild turkeys, ducks, geese, and many land birds find a safe refuge on this most hospitable island.

Mr. Carnegie personally guided us to the site of the submerged canoe. Only one end of the dugout was visible (fig. 57); the remainder lay on its keel, buried under dun-colored sand. Close on one side a small creek has carved its way into Cumberland Sound; on the other, alluvial deposits rise to a height of 6 feet. Undercutting of this bank had exposed the visible portion of the canoe; salt water had preserved it throughout the passing centuries. Because of the tides we could work only four hours at a time. Our initial effort brought to light half of the canoe, but it was left *in situ* with enough sand about it to resist the pressure of the returning tide. Next day this 8-foot section, the only salvageable portion, was wholly uncovered. The remaining section lay broken and twisted where it had sunk into a hole, hopelessly crushed by pressure of the sand subsequently deposited upon it. To all appearances, the dugout had been moored by its owner

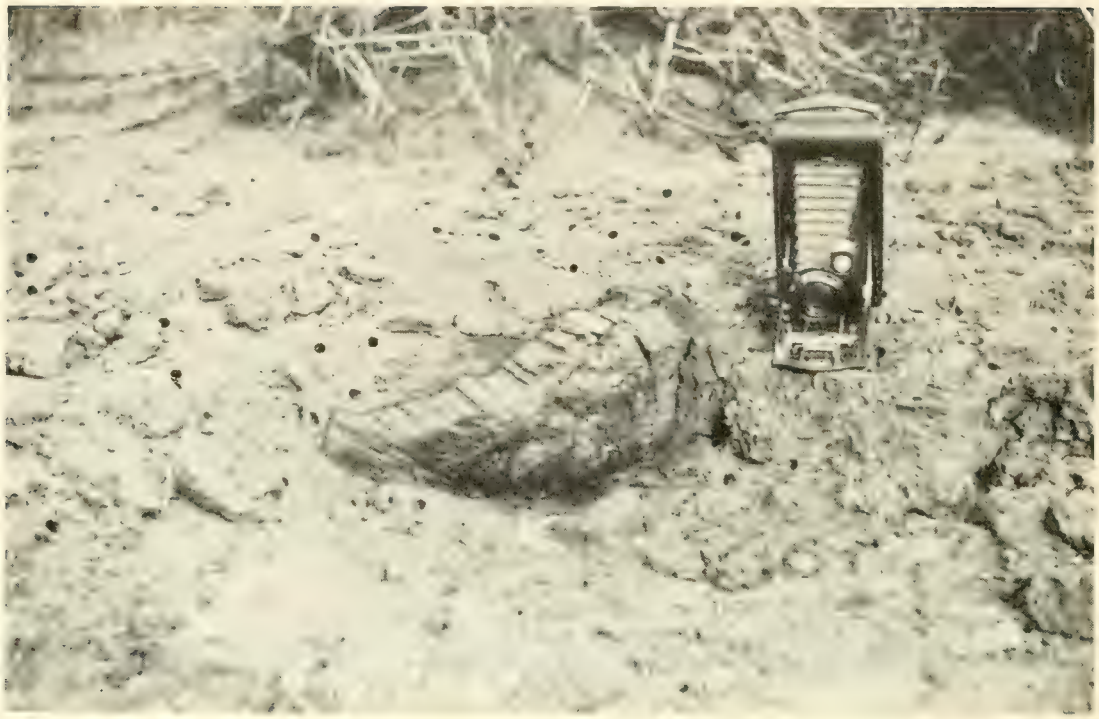

FIG. 57.—Exposed bow which led to the discovery of an aboriginal dug-out canoe. Photograph by T. M. Carnegie.

FIG. 58.—Salvaged portion of aboriginal canoe completely excavated.

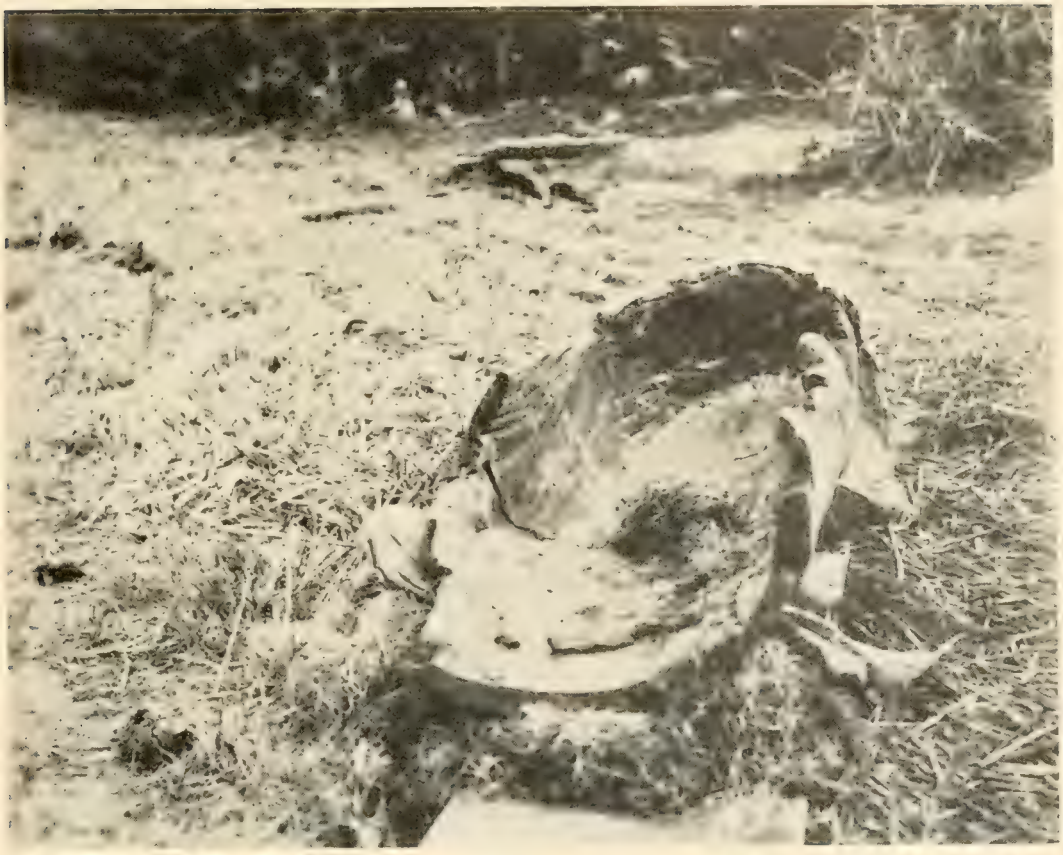

FIG. 59.—Canoe fragment removed from its resting place.

FIG. 60.—Another view of the aboriginal canoe fragment.

in the shelter of this small stream; it had been abandoned or forgotten and, in the course of time, buried by the tides.

On our second visit, a long plank was forced beneath the canoe end (fig. 58). Bands of burlap sacking bound the frail hull to the plank so the whole could be moved above the water level (fig. 59). When sand and mud were washed away, the methods by which the old dug-out had been made were at once apparent. A carefully selected pine over 2 feet in diameter had been felled; with fire and stone tools it had been burned and gouged out to leave the thin shell before us. Evidence of these alternating operations were unmistakable. There was no trace whatsoever of steel axes or other European implements. In my mind there is no question but that this fragment represents one of the canoes characteristic of the Atlantic coast prior to arrival of Europeans.

Safely above high tide, the canoe end was carefully boxed and shipped to Washington. In an effort to preserve it after it reached the National Museum, it was removed to the wood-treating laboratory of the Washington Navy Yard. Here, under the supervision of Lieut. M. E. Serat, the specimen was held for over two months under controlled humidity and temperature. Gradually the temperature was increased as the humidity was lowered, in the hope of drying the spongy wood so that preservative could be successfully applied. But, despite every attention, the rotted pine warped and split to a considerable degree.

In its present condition, the canoe end measures 6 feet in length, with a 2-foot beam; it has a depth of 18 inches. The bow is rounded and retreating as shown in the well-known John White paintings of Indian dug-out canoes, made in the summer of 1585 and reproduced by Theodore DeBry in 1590.[1]

It is quite possible that our Cumberland Island canoe was made and used by the Timucuan Indians, who inhabited the Georgia and upper Florida coasts during the sixteenth century. It is early historic, perhaps pre-Spanish, in origin; even in its present, fragmentary condition, it is a noteworthy reminder of the aboriginal civilizations which once flourished throughout our southeastern States.

[1] Bushnell, D. I., Jr., Virginia Mag. Hist. and Biogr., vol. 35, no. 4, pp. 419-437, fig. 6, Oct., 1927.

ETHNOLOGICAL RESEARCHES IN PANAMA AND EASTERN ECUADOR

By M. W. STIRLING
Chief, Bureau of American Ethnology

In September, 1931, the writer sailed as a guest of the Latin American Expedition to South America. The first objective was Panama, where, in company with John Verrill, the writer spent a month among the Tule Indians of the San Blas coast. The publicity given to the existence among them of white Indians—in reality albinos—has obscured the greater value of their interesting ethnology, which has changed but little after 400 years of contact with Europeans. Villages of the Tule Indians are scattered for 200 miles along the small, low islands in the Gulf of San Blas. The houses, built with cane walls and palm-thatched roofs, are sometimes constructed so close together that to go through the town it is necessary to pass through the houses. During their centuries of white contact, the Tule have remained a remarkably homogeneous and independent people. They do not welcome visits from white people and are particularly anxious that Europeans should not obtain a foothold in their territory. Because of this conservatism, there has been little admixture of foreign blood with these Indians.

The costumes of the Tule women are colorful and characteristic. They fabricate blouses decorated with a peculiar variety of appliqué work in many bright colors. On their heads they wear red calico mantas which flow across the shoulders; and the costume is completed by wrappers or skirts of blue and white calico print. Large gold-plated disks are suspended from the ears, and gold-plated nose rings are worn by all the women. The cheeks are painted red, and a blue line is drawn along the full length of the bridge of the nose.

Shamanism is developed to a high degree and there are many different classes of practicing medicine men. The Tule Indians have given an excellent demonstration of the ability of American Indian tribes to maintain a highly satisfactory native culture when permitted to remain relatively free from European influences.

From Panama the writer accompanied the expedition to eastern Ecuador, where, from December 22, 1931, to March 15, 1932, his time was spent among the Jivaro Indians of the Santiago-Marañon basin. Leaving Cuenca in the region of the high Andes, the party proceeded to the frontier post of Mendez where the first Jivaro Indians were

FIG. 61.—Tule women making cocoa.

FIG. 62.—Aguaruna Jivaros of the lower Santiago River.

FIG. 64.—A Jivaro woman of the Upano River making pottery.

FIG. 63.—A Jivaro warrior with lance and shield.

encountered. From Mendez the expedition proceeded on foot to the headwaters of the Yaupe River. By means of rafts and canoes the expedition passed down the Yaupe to the Santiago River and thence down the Santiago to its junction with the Marañon at the famous Pongo Manseriche, which gorge marks the limit in this direction of the Jivaro territory.

The Jivaro Indians are divided into upwards of 30 tribes, speaking a common dialect and maintaining similar customs and material culture. They are best known to the outside world for the peculiar custom which they have of collecting the heads of their enemies, whom they have killed in warfare, and shrinking these heads to the size of a small orange while preserving perfectly the features of the victim. Warfare is the very center of existence to the Jivaro Indian and his entire cultural pattern is woven around it. War is conducted on the principle of blood revenge, and small boys at the age of 5 or 6 years are instructed daily by their fathers on the necessity of taking blood revenge for their relatives who have been killed in the past. Small boys accompany their fathers on war expeditions in order to become accustomed to the realism of killing and to learn the tactics of warfare from direct observation.

So actively is head hunting practiced that the women, who generally are not killed in raids, greatly outnumber the men, thus making polygamy a social necessity. Three or four wives to a man are common and sometimes a prominent Jivaro will have as many as 12.

The Jivaro community consists of a single house in which live not more than 30 or 40 individuals, generally comprising a single family or a group of related families. The Jivaros subsist equally from agriculture and by hunting and fishing. The principal hunting weapon is the blow gun with poisoned darts, but for fighting purposes the lance and the muzzle-loading shotgun are utilized. There are many causes of war, but by far the most common is the killing, or supposed killing, of some member of the group by someone in another group. The medicine man of his household takes certain drugs, under the influence of which he learns the identity of the culprit. A feast is then held, and war is declared against the household of the supposed killer.

A very satisfactory ethnological study was made of the Jivaros of the Upper Santiago, and full accounts were obtained of specific head-hunting raids. The Jivaros proved to be an active, intelligent people, disposed to be friendly when treated fairly, kindly in their home life and social relations, and exhibiting ferocity only in connection with the fierce head-hunting raids which have become so indelibly a part of their culture.

SOME EARLY PUEBLO REMAINS IN EASTERN ARIZONA

By FRANK H. H. ROBERTS, JR.
Archeologist, Bureau of American Ethnology

The remains of three house groups belonging to the initial and following stages of the early Pueblo peoples were uncovered by the writer during the months of June, July, and August, 1932. The investigations were conducted at a site $3\frac{1}{2}$ miles south of Allantown in eastern Arizona and were a continuation of a program of excavations started in the summer of 1931.[1] The village and house remains located at this place present an unusual opportunity for studying the changes which occurred over a long period of time in the cultural growth of the pre-Spanish sedentary southwestern Indians. There are vestiges of four distinct and sequent phases of development incorporated in the site and the stages represented embrace those in which the most significant steps in the social advance were taken. The 1931 work was limited to the lower two levels, and that of the 1932 season centered around two house groups belonging to the second horizon and one representative of the third. The first or oldest level in the site is typical of the phase which has been called Basket Maker III, and the three subsequent ones are characteristic of the stages denoted Pueblo I, II, and III.

The dwellings of the second level, Pueblo I, were of the semi-subterranean type in which the major portion consisted of a pit, roughly circular in form, which was dug into the earth (fig. 65). The walls of the excavation in one of the examples were faced with a thick coating of adobe plaster, while in the other some stones were used. The superstructures were formed of heavy timbers, poles, brush, and plaster. They were supported by upright posts set in the floors of each chamber and were elevated above the ground level sufficiently to provide proper drainage. An opening near the center of the roof served as a smoke hole. In one of the structures entrance to the chamber was gained by means of a ladder passing through this smoke hole. In the other house the ladder was placed in a small antechamber, and access to the main room was through a narrow, covered passage. These houses correspond closely to other Pueblo I structures

[1] Explorations and Field-work of the Smithsonian Institution in 1931, pp. 141-150, 1932.

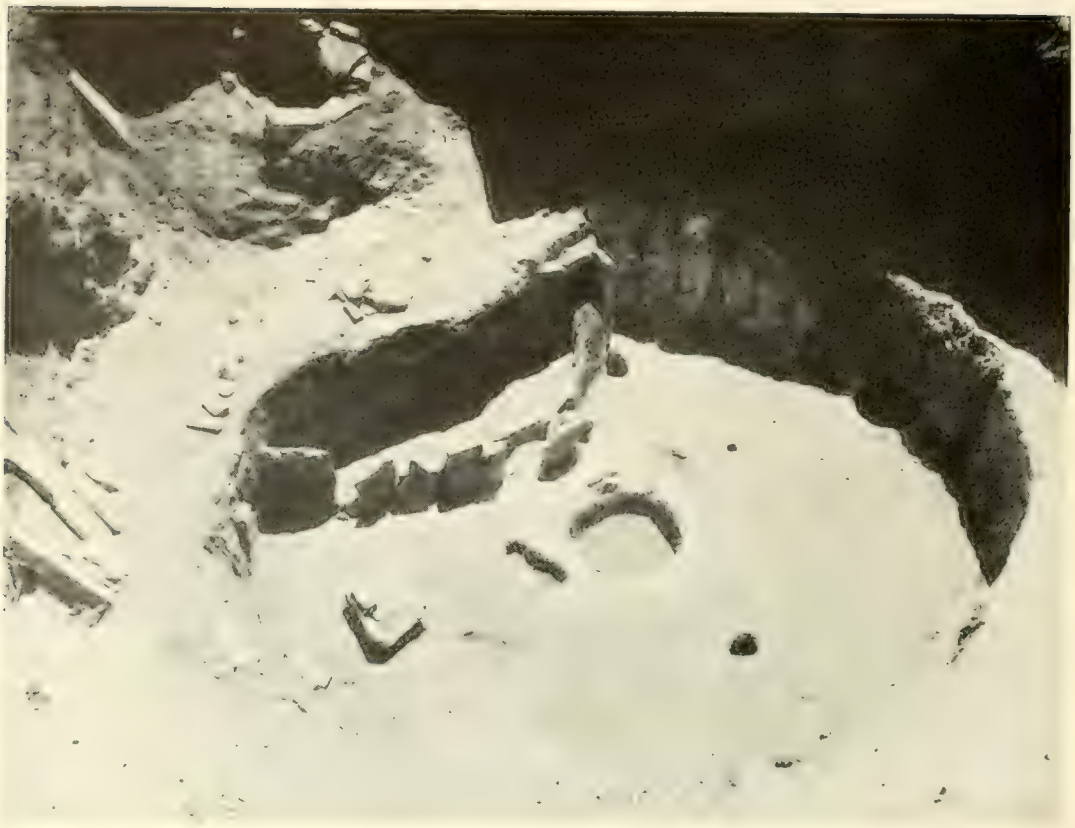

FIG. 65.—Remains of pit dwelling. The benchlike feature encircling pit indicates original ground level.

FIG. 66.—Uncovering charred room timbers in fill in burned pit dwelling.

FIG. 67.—Unit house and ceremonial chamber in process of excavation.

FIG. 68.—Workman digging out burial and accompanying mortuary offering of pottery.

of the type which the writer has excavated in New Mexico and Arizona.

One of the structures was destroyed by fire and although the heavier timbers were seared by the flames they were not completely destroyed (fig. 66). From the charred material it will probably be possible to determine, by the Douglass method of tree-ring dating, the year when the timbers were cut and the house erected. A preliminary plotting of the beams in the field gave a tentative date of 797 A. D., but this has not yet been definitely established as correct. Until a careful check has been made it can only be suggested that the house may date from the eighth century. The other dwelling did not furnish beam material which can be studied. Archeological evidence, however, indicates that it antedated the one which burned.

Adjacent to the pit dwellings were the remains of 12 granaries. These were also excavated, and it was determined that they were contemporaneous with the main structures. These storage places had relatively shallow, rectangular pits lined with stone slabs. They had also been covered with superstructures of pole and plaster construction. Although small, two of them gave evidence of having for a time, at least, served as living rooms. In two of them there were large quantities of carbonized corn. Eight of the structures belonged to one of the houses and four to the other.

The ruin corresponding to the third level or Pueblo II consists of six rooms and a ceremonial chamber. In all respects it is a typical unit house of the form which has been considered characteristic of this stage of Pueblo development. The six rooms were joined into a single-storied building which stood entirely above ground. The ceremonial chamber was placed in the earth several feet from the southeast wall of the main building (fig. 67). It was circular in form and suggested in a modified way the pit type of house of preceding stages. Timbers from the ruin indicate that the house was built in the latter part of the ninth century A. D.

A comparison of the plan of one of the pit dwellings and its accompanying granaries with that of the unit house and its ceremonial chamber shows clearly the germ of the Pueblo II small house type. All that would be needed to develop one from the other would be to enlarge the granaries and combine them into a single structure, making them the living quarters, and change the subterranean chamber from secular to ceremonial purposes.

Pottery, bone, stone, and shell objects obtained from the excavations illustrate the nature of the arts and industries of each phase. Burials found in association with the house remains demonstrated period differences comparable to these noted in dwelling types.

SIGNAL BUTTE, A PREHISTORIC NARRATIVE IN THE HIGH PLAINS

By W. D. STRONG

Ethnologist, Bureau of American Ethnology

In western Nebraska, near the Wyoming border, is a most unusual mesa. Located on the edge of the rough Wildcat Range, it represents an isolated fragment of the old High Plains surface that once stretched eastward to the Missouri River. Forces of erosion have dissected this once uniformly sloping plateau, leaving isolated badland areas intersected by stream valleys or dry water courses. Such a remnant is Signal Butte, which owes its peculiar significance to the long human record it has preserved. On its flat summit (fig. 69), where erosion was stopped long ago by a layer of hard, calcareous cap rock, is now an 8-foot earth cap deposited mainly by eddying winds. In this deposit occur three distinct prehistoric levels of human occupation. Succeeding each other in time like the chapters of a book, these horizons present a story of early man in the western plains.

As a result of the previous year's reconnaissance at this site [1] more extensive excavations were undertaken in June, 1932, with the kind permission of the owner, E. S. Simpson. The field party consisted of the writer, Messrs. Wedel, O'Heeron, Kirby, Daniels, and Swanson, and the cook, Leo Lennear. Mrs. Strong assisted in an unofficial capacity. On June 27 the Laboratory of Anthropology of Santa Fe, N. Mex., joined in the work, being represented by four holders of fellowships—Messrs. Fenton, Holmes, Love, and Wilder.

The earth cap on top of the butte was staked into 5-foot squares, and a series of trenches was carried through it to the undisturbed gravel or cap rock. The earth was removed a square at a time and level by level, and was screened to prevent loss of artifacts (fig. 70). Owing to strong winds the work of digging, screening, and mapping was extremely difficult, the dust swirling in clouds and blinding the workers.

The thin middle level (fig. 71) proved to be lacking in pottery and distinct from both upper and lower levels in its limited artifact content. A medium-sized barbed and stemmed stone point (fig. 72, *m*) was its most distinctive type. An important discovery was the occurrence of silt, sand, and gravel deposits directly underlying the lowest living level (fig. 71). These were obviously laid down at a period

[1] Explorations and Field-work of the Smithsonian Institution in 1931, pp. 151-158, 1932

FIG. 69.—Signal Butte from main escarpment to the south.
Photograph by C. L. Dow.

FIG. 70.—Excavating main north to south trench.
Photograph by W. R. Wedel.

FIG. 71.—Original test trench completed, showing three occupation levels and whitish water-borne material under lowest level. Photograph by W. R. Wedel.

FIG. 72.—Artifacts from upper levels on Signal Butte. Top level: *a*, Dismal River type potsherds; *b*, Upper Republican type potsherds; *c*, arrow points; *d*, end scrapers; *e*, bevelled knives; *f*, antler punch; *g*, antler flaker; *k*, bone awls. Middle level: *l*, end scrapers; *m*, arrow points; *n*, drill.

FIG. 73. Artifacts from bottom level on Signal Butte: *a*, knives; *b*, two main types of points; *c*, side scrapers; *d*, unusual points; *e*, drill; *f*, graver; *g*, end scrapers; *h*, bone flaker; *i*, incised bone; *j*, shell pendant; *k*, bone beads; *l*, bone awls, *m*, rubbing stone; *n*, sandstone artifact (?); *o*, shaft polisher.

when the butte was connected with the main escarpment to the south (fig. 69). Thus the earliest occupation on the surface of the butte occurred at a time when the process of aggradation had been arrested and a local upbuilding process inaugurated through wind action. Studies bearing on the age of the deposits are now in progress.

Articles of Caucasian origin were found only above the grass roots on the butte. Below this for 2 feet were evidences of sporadic occupation by pottery-using peoples. Potsherds of two types were found in this upper level (fig. 72, *a, b*). These later peoples were apparently attracted to the butte by its unusual appearance and the protection it afforded. Occasionally they buried their dead here in crude, stone-lined graves. Particularly characteristic of the upper-level peoples were beautiful little triangular arrow points and bevelled, diamond-shaped knives (fig. 72, *c, e*). An unusual find was a fishhook (fig. 72, *h*) recovered by G. L. Waters from the upper level and kindly presented to the writer. The middle level was too thin to offer many clues as to the nature of its inhabitants, but the bottom level was thick and contained much material bearing on the life of these early people. Apparently they had no fixed habitations but lived around stone-lined hearths which occur at frequent intervals. Near the fireplaces are small pits dug into the gravel containing animal bones and a few implements. Vast numbers of animal bones, often split for the marrow they contained, are scattered throughout this layer. Numerous awls and scrapers testify to working in skins (fig. 73, *c, g, l*) ; hence it can be assumed that these Signal Butte people were warmly dressed. Hunting was apparently done with the bow and arrow (fig. 73, *b, d*) though the spear thrower may also have been employed. The lighter side of life is suggested by large amounts of varicolored mineral paints, while geometrically incised bone fragments and a cut shell testify to their artistic efforts (fig. 73, *i. j*). That they ground stone is clear from the hammerstones, polishing stones, and other artifact types recovered (fig. 73, *m, n, o*).

After our work on top of the butte several artifacts were discovered below it in the banks of Spring Creek, 300 yards to the north, in association with the remains of an extinct species of bison.[2] This discovery, made by a paleontological field party of the University of Nebraska, may add a still earlier chapter to the human record at Signal Butte. Thus the story, written with the tools of generations of men from the Ice Age to the present, is at last being read by the paleontologist and anthropologist of today.

[2] Science Service, Research Announcement No. 140, Aug. 8, 1932.

STUDYING THE ARIKARA AND THEIR NEIGHBORS ON THE UPPER MISSOURI

By W. D. STRONG
Ethnologist, Bureau of American Ethnology

In July, 1932, at the close of the Signal Butte excavations, the combined Bureau of American Ethnology and Santa Fe Laboratory of Anthropology field party moved 400 miles northeast to the vicinity of the Grand River in northern South Dakota. A historic Arikara village, designated as the Leavenworth site, which had been abandoned by the Arikara in 1833, 10 years after it had been bombarded by Colonel Leavenworth and his allies (fig. 74), was chosen for excavation. A survey map of the site revealed over 150 lodge circles about equally divided into two contemporaneous villages on either side of a small creek, but it must be remembered that not all these houses were occupied at the same time.

We completely opened four houses, two on each side of the creek, the floor plans (fig. 75) agreeing well with ethnological accounts. The Arikara earth lodge differs from that of the historic Pawnee in retaining the four-post central foundation and in lacking any outer or third row of posts. Entrance passageways were present in all four lodges. Particularly interesting was the large medicine lodge in the upper village (fig. 75) which conformed in detail to the rather elaborate symbolism of the present-day Arikara. A number of refuse heaps were trenched and several of the numerous caches or corn cellars opened. An interesting representation of both aboriginal and white contact material was obtained. The occasional blending and substitution of old and new ideas is shown in several of the pieces illustrated (fig. 77).

Work having been well started at the Leavenworth site, Mrs. Strong and I went north to Nishu in the Fort Berthold Reservation, N. Dak. Here, from August 1 to 6, the Arikara held their Mother Corn and allied ceremonies. The sage dance, a picturesque purification rite performed by members of the medicine societies, occupied the first three nights. One who has witnessed this dance in the fire-lit lodge redolent with the smell of purifying sage is not likely to forget it. Late evenings were filled with song contests between the societies, usually culminating with feasts. Pervading all was a wealth of ritual involving tobacco offerings, food offerings, and the burning of sweetgrass incense. Later in the week, after elaborate ceremonies, the sacred

FIG. 74.—One of Colonel Leavenworth's unexploded howitzer shells in floor of an earth lodge. The Arikara claim their young men gained war honors by removing the fuses before such shells could explode.

FIG. 75.—Floor plan of an Arikara earth lodge, Leavenworth site. Sacred rock and medicine lodge pit in left background.

FIG. 76.—Two members of the Owl society passing the sacred cedar and stone before the medicine lodge at Nishu. The man on the right is priest of the last functional Arikara sacred bundle.

FIG. 77. Historic Arikara artifacts, Leavenworth site: *a*, potsherds; *b*, *c*, *d*, *e*, brass, iron, flint and bone arrowheads; *f*, shell beads; *g*, antler point; *h*, antler powder measure (?); *i*, *j*, grizzly tooth and eagle claw pendants; *k*, *l*, stone and iron knife blades; *m*, notched rib; *n*, bone awl.

FIG. 78.—Artifacts from Rygh site (Protohistoric Mandan ?): *a*, potsherds; *b*, catlinite pipe; *c*, bone whistle; *d*, bone ornament; *e*, *f*, *g*, bone and copper awls; *h*, bone fish hooks; *i*, combination flesher and knife handle; *j*, *l*, antler and flint arrow points; *k*, bone objects of unknown use.

"grandmother" cedar tree was planted before the eastern entrance to the lodge. Next to it was "grandfather" rock, now painted red with a black belt (fig. 76). That evening the beef dedicated to Mother Corn was killed and prepared, exactly as in the olden days when a fat buffalo cow was thus offered by a successful hunter.

The next morning marked the climax of the week. After smoke offerings, prayers, and the burning of incense, the only sacred bundle still functioning was opened before the altar. The sacred bundle forms the very soul of Arikara religion, and only a priest versed in all the complex lore pertaining to each bundle may open it. It is impossible to observe such a bundle and its varied contents without appreciating its antiquity. The writer was particularly struck by the inclusion of at least six skins of the extremely rare Carolina parrakeet and what appeared to be the skin of an ani, a southern bird which occurs rarely north of the Gulf of Mexico.

There followed many songs pertaining to the bundle, sung in honor of Mother Corn, symbolized by a cloth-wrapped stalk of green corn. Later, people brought many presents to certain distinguished old men, who proceeded to bless the children of the donors and to give them honorable names. Particularly favored as name-givers were four fine old warriors, Red Bear, Little Sioux, Bear's Belly, and Running Wolf. These men had served as scouts for Gen. George A. Custer prior to the fatal day of June 25, 1876, when, against their advice, he led his command into the valley of the Little Big Horn. Symbolic dances were next performed, in which both men and women participated, depicting the planting of the corn, the hunting of the buffalo, and triumphs over their enemies in vivid pantomime. The ceremony culminated with carrying the Mother Corn to the "Holy River," as the Arikara term the Missouri, where the carriers waded in waist-deep and offered last prayers to the corn spirit. The symbolic corn stalk was then tossed into the stream to float down past all the ancient Arikara villages, carrying messages from the living to the dead.

After leaving the Leavenworth site, we conducted stratigraphic studies in the refuse mounds of another village across the river. From its arrangement and its pottery and artifacts, this site appeared to be of Mandan origin (fig. 78). From the presence of a few evidences of white contact it was evidently occupied into the protohistoric period. As was true in Nebraska, the protohistoric period on the upper Missouri River appears to have been considerably richer than the early historic period (compare figs. 77 and 78). Ten other villages were carefully surveyed and their refuse heaps sampled. In addition, a map of the numerous sites along this section of the Missouri was prepared.

TRAILING THE MOUND BUILDERS OF THE MISSISSIPPI VALLEY

By WINSLOW M. WALKER
Associate Anthropologist, Bureau of American Ethnology

The mound-building Indians of the Mississippi Valley formed the subject of my investigations during the fall of 1932. Starting at Aztalan, Wis., accompanied by my father, Edwin F. Walker, also an archeologist, I traced their work down past the Cahokia group in Illinois and through the great valley almost to its mouth, conducting extensive excavations in Louisiana. After finishing this work, we again took to the road and visited notable mound sites near Natchez, Miss., Moundville, Ala., and Etowah, Ga., making in all a tour of nearly 4,000 miles.

An important stop was made in Arkansas, where two weeks was spent, under the guidance of Senator John Quarles of Helena, in ascertaining that all Quapaw village sites visited by the early French explorers had been claimed by "Ole Man River." So we cannot say definitely whether these Indians ever were mound builders. But Col. John R. Fordyce, of Hot Springs, has four Spanish halberds found near mounds in Arkansas, which fact corroborates statements in the De Soto narratives that in 1541 Indians were still building mounds.

Excavations on the great mound at Jonesville, La., began where the steam shovels left off after removing the dirt almost to street level in order to build a nearby bridge approach. Obviously we could not expect to find much in such a remnant of a mound formerly 80 feet high, perhaps the highest in the South; but we were intrigued by the mystery of those extensive layers of cane which appeared in irregular lines and patches over the scraped surface. Truckloads of this cane had been removed in cutting down the mound. Nowhere else, so far as known, has such a feature ever been found in an Indian mound.

We began carefully to lay bare the cane at the southern end of the block and to follow it down to its starting point. It consisted of pieces of swamp cane, trimmed and split, laid side by side, and crossed at right angles by other layers, but not interwoven; the whole as beautifully done as veneered woodwork. These great sheets of cane evidently were not used as a floor, for while we sometimes found them laid horizontally, more often they were sloping, again nearly vertical,

FIG. 79.—Great Mound, Jonesville, La. Photograph by G. V. Cotton, about 1922 or 1923.

FIG. 80.—Great Mound, Jonesville, La. South wall of cross trench showing five layers of cane.

FIG. 81.—Southern end of Great Mound; uncovering earlier mound. Note pile of logs, slope of earlier mound behind first workmen, line of posts in top trench in center, workmen brushing bark slabs on slope.

FIG. 82.—Great Mound, Jonesville, La. Tops of posts in position show through slope of earlier mound.

or even in wavy lines. Near the center of the mound cane sheets appeared in five successive layers, varying from 1 to 20 inches in thickness, and separated by carefully packed-in layers of clay. The highest part of the mound had towered originally 75 feet over this section.

The base of the mound lay from 4 to 6 feet below the present surface. Beneath it was undisturbed sandy loam, showing in places indications of fire where the vegetation had been burned prior to the mound's erection. Clays of various shades from red to blue were the building material used. We could see clearly how the large chunks had been fitted together to produce the slope, because they came away along definite lines of cleavage. What the method of transporting them had been we could only guess; probably the earth had been carried in skins, as we found no basket impressions on the clay. We did, however, discover a few isolated pieces of very thin matting, too fragile to have been used for lifting such heavy clay.

Close to the southern border of the mound, at what seemed to be the edge of an earlier mound, we uncovered a series of 14 posts set in a line only a few degrees off due east-west. They were of cypress, gum, and locust, cut off at the ends by a blunt-edged tool, probably a stone ax. Most of the tops had rotted away, but many of the butts were still firmly in place, 3 feet down in the undisturbed sandy loam, tamped with clay. Two logs had been piled against the outer side of the posts and a few feet beyond them was a pile of nine more logs. Near the westernmost post a human skull was found crushed into the clay, the only human remains discovered. The great mound was built over all of this.

On the slopes of the earlier mound were slabs of wood split or hewn, trimmed into boards found lying side by side; some east and west, others north and south. Two building periods of this mound were indicated by stumps of trees that had grown on an upper level littered with ashes, charcoal, animal bones, and fragments of pottery.

Trenches were extended across the 300-foot block both ways, disclosing the base of the great mound as about 180 by 225 feet, nearly the same as William Dunbar's estimate in 1804. At the outer edges of the mound were seen deposits left by successive overflows. No indications of buildings or tombs were found: yet the cane composing the sheets had been placed almost exactly east and west or north and south, marking it, undoubtedly, as something put there for a special purpose.

FIELD-WORK AMONG THE IROQUOIS INDIANS OF NEW YORK AND CANADA

By J. N. B. HEWITT
Ethnologist, Bureau of American Ethnology

To resume his ethnological studies among the members of the former Six Nations of Iroquois Indians dwelling on the Grand River Grant, near Brantford, Ontario, Canada, and in New York State, the writer left Washington in May, 1932. His researches began with a study of the present status and effectiveness of the clan form of governmental organization, based as it is on the fundamental unit of blood kinship, the ohwachira (or uterine brood or family), for without the integrity of this organic unit the Iroquois clan cannot function normally, if at all. And the structure of which it is an organic unit becomes inevitably disorganized as a consequence.

This slow process of disintegration of the organic units of the institutions of the League of the Iroquois was long manifest to people and leaders, but no one was inspired to devise and to apply remedial measures to check the decay and to reconstitute the ancient integrity of these forms of discipline. The result was inevitable. There came a day when form and spirit had left the regulations, the ordinances, and the laws of the League, and so only futile and clumsy substitutes were unwittingly put forward, and the process of disintegration was not checked. The people murmured, and among them dissentions grew apace, and bitter factional struggles became frequent, often resulting in violence. As a result the Canadian Government found it necessary to end this intolerable condition by abrogating the institutions of the League of the Iroquois in 1924. The discipline and authority of the ohwachira and the clan have become quite forgotten and so today do not maintain any effective guidance in social and political affairs on any Iroquois reservation.

Before the institution of the League of the Iroquois by Deganawida and his co-workers, blood feuds, maintained and governed by the grim law of requital in kind, commonly called the *lex talionis,* were causing untold grief and haunting fears among the people by the multiplying deaths of blood kindred, which checked any rapid increase of population. Deganawida and his astute advisers, realizing that no community or organized society can prosper and be contented living under such ill-omened conditions, enacted the law of atonement

FIG. 83.—The late Chief John Arthur Gibson, a Seneca of the Grand River Six Nations of Iroquois. He dictated in Onondaga and Mohawk to Mr. Hewitt the texts remarkable for completeness and authenticity relating to the League of the Iroquois and to the New Year Festival, with their rituals.

FIG. 84.—The late Chief James Jemeison of the Cayuga of the Six Nations of Iroquois, Grand River, Ontario, Canada, who became well-to-do in farming, having under cultivation two large farms; he was also the founder of the Six Nations Agricultural Society on his reservation.

FIG. 86.—The late Ex-Chief Joseph Jacobs of the Cayuga. He was the last of the passing generation to retain the authentic tradition of Djigo"sa"sēē', the Virgin Mother of Deganawida, the founder of the League of the Iroquois.

FIG. 85.—Ex-Chief Joseph Logan of the Cayuga, who in 1930 was one of a large delegation of the Six Nations of the Iroquois of the Grand River, Ontario, Canada, which visited London, England, to place before King George V pleas for an adjudication of many tribal grievances.

which abrogated for the tribes of the League of the Iroquois the *lex talionis,* the law of blood revenge.

The late Chief John Arthur Gibson dictated a lengthy text in the Onondaga dialect embodying in great detail the law of atonement, which clearly shows the means adopted by Deganawida and his counselors to nullify the age-old *lex talionis,* that is to say, the grim law of requital in kind in homicides. The contents of this remarkable law of atonement are so unique that the writer devoted much time to a study and analysis of the law. It deals with ohwachira (or uterine families) as the interested parties and the federal council of the league as the court of last resort, and so its enforcement was an intricate procedure, which must be studied to make clear the full intent of this law of atonement in homicides.

From time immemorial the blood feud had existed among the Iroquoian tribes. It was an ever-present cause of the killing of persons, the loss of whom the several communities could not well afford. Various remedial measures were in vogue to check this cause of the loss of valuable lives. Within the jurisdiction of the Iroquois tribes the blood feud involved groups of persons, ohwachira, but not individuals, because the ohwachira (the uterine kin) was the simplest and smallest legal person. The individual in tribal law did not exist outside of the ohwachira in which he was born.

The writer's study of the law of atonement for homicides in the blood feud disclosed some essential differences between it and the antecedent and contemporary measures in vogue among the Huron and other tribes for terminating blood feuds. Unlike these measures the law of atonement promulgated by Deganawida and the federal council of the league fixed the amount of the compensation for a homicide and made it the legal tender in such cases, thus limiting measurably the impulse to excess in taking revenge.

This excellent result was achieved by the device of setting a legal price on the life of a man and on that of a woman. The price set on the life of a male person was 10 strings of shell or wampum beads, each 5 hand-spans long. The legal tender, therefore, for the atonement for the slaying of a male person by a male was fixed at 20 such strings, because by the rights and obligations of the blood feud the life of the slayer was forfeited to the kin of the slain person, and so it had to be retrieved. The price set on the life of a female person was appraised at double that of a male person, namely, 20 strings of shell or wampum beads, each 5 hand-spans in length, so that for the killing of a female person by another female person the legal tender in such case to be offered by the ohwachira of the murderess to the aggrieved ohwachira was therefore fixed at 40 such strings.

FIELD-WORK AMONG THE MISSION INDIANS OF CALIFORNIA

By J. P. HARRINGTON
Ethnologist, Bureau of American Ethnology

Just as the holy of holies at the center of the Mission Indian temple was surrounded by an enclosure and outside this by a still larger enclosure to keep the Indian throngs of the fiesta from penetrating too closely to the sacred secrets of religion, so the dwindling core of language, custom, and ceremony of these Indians has become hidden by a double barricade of acquired American and Spanish culture, making access to it difficult. But our recent field-work has succeeded in penetrating to the very core, resulting in one success after another in the obtaining of rare information. This information was obtained using the native languages as the vehicle of record, thus securing ethnological and linguistic material at the same time.

At Rincon Indian Reservation an Indian temple similar to that described by Fr. Antonio de la Ascension as having been discovered by the men of the Viscaíno expedition on Santa Catalina Island was visited and studied. This temple ground, just northeast of the house of Chief Juan Sotelo Calac (see fig. 87), measures 38 feet from north to south, and 58 feet from east to west. The fire pit, 4 feet in diameter, has three stone potrests and is at the exact center of the ground. When mantled for ceremony a brush fence is built about the northern half of this temple only, a steep rise in the ground forming the southern boundary. The temple was always elliptical, with its long axis extending east and west. Photographs of this temple, taken in dismantled condition, and again when a fiesta was in progress, are reproduced as Figures 87 and 88.

The last old Indian house still standing in all the coast region of southern California was found above the rancheria of Kuuki in a little-known part of Palomar Mountain. It is of the type built of poles and slabs of the bark of tovót, *Libocedrus decurrens* Torr., incense cedar, and according to the informants presents the same appearance that it did some 30 years ago. The house is shown in Figure 90.

Rare information was obtained as to how these Indians used to brand themselves with various designs and also cauterize sores by

FIG. 87.—Wamkic, Indian temple, at the house of Chief Juan Sotelo Calac, Rincon Indian Reservation, Calif., in dismantled condition. Photograph by J. P. Harrington.

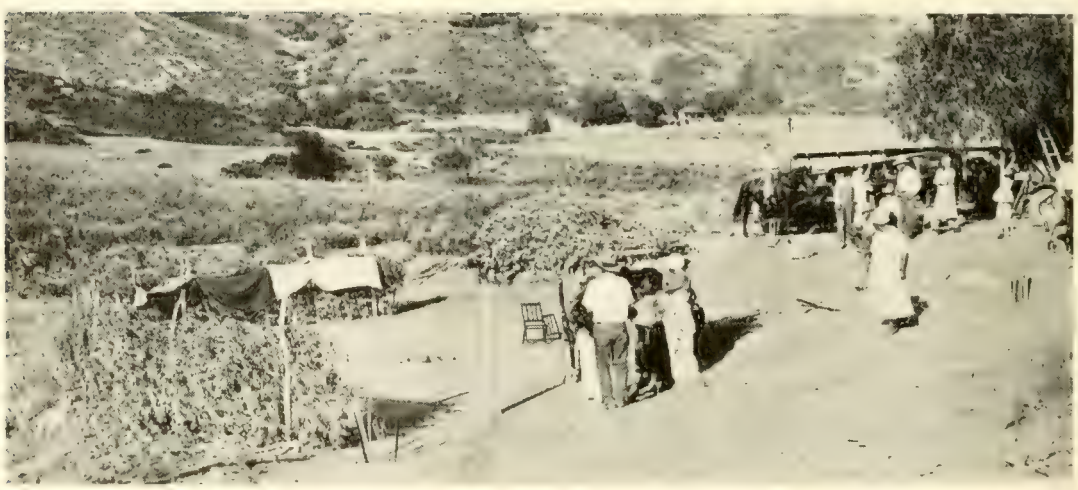

FIG. 88.—Wamkic, Indian temple, at the house of Chief Juan Sotelo Calac, Rincon Indian Reservation, Calif., fixed up and consecrated for religious fiesta. Photograph by J. P. Harrington.

FIG. 89.—Chief Juan Sotelo Calac, Rincon Indian Reservation, Calif., and his wife, Mrs. Carnaciona Calac. Photograph by J. P. Harrington.

FIG. 90.—The last Indian house in the coast region of southern California, on top of Palomar Mountain above Kuuki rancheria. Photograph by J. P. Harrington.

using the dried and pounded up leaves of *Artemisia vulgaris* L. var. *heterophylla* Jepson, California mugwort (Spanish, estafiate). The leaves, silvery underneath, become dry and shriveled in the early summer, and were pounded on the anvil stone to make a spongy fuzzlike material, which was laid on the bare skin of the Indian to form the desired pattern, and was lighted. The pain was intense, as the burning reached the skin, but it was borne without a wince or murmur. The brand resembled a cattle brand and adorned the person for life.

New data were also obtained on the similar custom of tattooing. The pattern was pricked with a cactus or other thorn, or a sharp flint fragment, and the green leaves of either one of two species of *Solanum, S. douglasii* Dunal, a perennial, or *S. nigrum* L., an annual, both called black nightshade in English and chichiquelite in Spanish, were pounded up to a salvelike mass and rubbed in the bleeding wound. A permanent bluish black tattoo was the result.

The chief diety of the Mission Indians of the coast region was the God Chingichngich, a strange Indian prophet and religious leader who was born at the village of Puvú', which with its old spring lay just downslope from the tennis court at the Fred. H. Bixby ranch in the southwest corner of Los Angeles County, on the northern bank of the New San Gabriel River and only a little over 2 miles inland from Seal Beach. He was of lowly birth and his real name, by which he was called in childhood, was *Wiyaamot. After he became a religious leader, he taught the people that they should call and invoke him by the name Chingichngich. He has three epithets: (1) Sza' uura, meaning lowly person, applied to him to bring out his lowly birth. (2) Toovit, *Sylvilagus bachmani cinerascens* (Allen), California brush rabbit. This tiny rabbit was the first man who ever sang in the world, and this epithet was applied to the prophet when he had already become a religious teacher and was no longer a common person. (3) Kwá" owar, a very sacred name applied after Chingichngich had ascended to heaven, whence he watches our deeds and punishes the one that does not obey his commands by having poisonous and fierce animals or plants or minerals do injury to him.

The Mission Indian calendar was determined to have only six double months, of two moons each, and not eight as has been stated in the books. The seventh and eighth double months were renamings by the dying Woyóot of months which he had already named the year previous. The key to this solution lay in printed documents, and also in the memory of the oldest Indians.

ANTHROPOLOGICAL STUDIES IN OKLAHOMA AND IOWA

By TRUMAN MICHELSON
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The field season of 1932 was devoted to anthropological researches among the Arapaho, Cheyenne, Kickapoo, Kiowa, Sauk, and Fox. As I have stated previously (Bull. 105, Bur. Amer. Ethnol., p. 104), the Kickapoo have a religious performance at night which in name corresponds to the Fox Wâpanōwiweni (wâpanōyiwagi =Fox wâpanōwiwagi) but of which further details were unknown. By good fortune I found a Kickapoo informant who had witnessed the performance among the Kickapoo of Coahuila and who gave a very good account of it. In connection with the ceremony the trick of jamming one's arm in boiling water without injury still persists in Mexico, whereas in Oklahoma this has been lost.

The work among the Sauk was confined to witnessing a part of the celebrated Metäwiweni (medicine dance; mystic rite would be a close rendition), which I had never seen previously. I was fortunate enough to witness the "shooting" portion thereof, in which the members "shoot" each other with the otter-skin bags and gourd-rattles, with the result that the "victim" falls on his face apparently unconscious and then recovers. There was only one exception; a lively old gentleman when "shot" cried out and staggered but did not fall, and then recovered amid the plaudits of the crowd. I heard one Sauk say, "He's powerful; they can't put him down." One woman (apparently the novitiate) beat a drum and carried it, both of which are unheard of among the Fox Indians. I was not allowed to be very close and so could hear only portions of the prayers. At present it seems hardly probable that a full account of the Sauk ceremony can be obtained owing to the conservative character of the members; so we must fall back upon the more or less fragmentary accounts of the older writers, such as Forsyth, Beltrami, Stanley, and of Skinner in more recent times. Yet if we pool all these sources we have ample evidence to identify the Sauk Metäwiweni in the main with the Ojibwa Midäwiwin (Grand Medicine Society).

The object of the work among the Kiowa was to obtain certain sociological data. The Kiowa were willing informants, and a number of personal narratives were obtained; from them it is easy to recognize the tremendous power a Kiowa male has over his sister, even if she

FIG. 92.—Harry Davenport, Sr., a Fox Indian born in 1847.

FIG. 91.—An aged southern Arapaho. Photograph by Michelson, 1932.

FIG. 94.—Fox Indian. Photograph by Michelson, 1932. The war bonnet, though popular with the younger generation, does not represent old Fox culture; similarly the tipi.

FIG. 93.—Sam Peters, of mixed Sauk and Fox descent, in ceremonial attire.

were widowed. It is clear enough that Kiowa sociology, by and large, is too close to that of other Indian tribes of the Great Plains to have arisen independently.

The work among the Cheyenne was to gain an insight into their mythology, and to a less extent their sociology and linguistics. I was fortunate enough to have as my assistant Mack Haag, who had been so useful in previous years. It should be noted that the military societies of the Cheyenne are ungraded, to that extent resembling those of the Dakota, rather than those of the Arapaho. Yet historically the Cheyenne have been long and intimately associated with the Arapaho. The divergent Algonquian character of the Cheyenne language is due primarily to the operation of a very complex character of phonetic shifts which are of wide application. The remarkable "high tone" of some syllables is not an archaism as some might suspect; it is due entirely to the mechanical sound-shifts alluded to above.

Among the Arapaho linguistics and sociology were prime objects of investigation. I again obtained the services of Rowlodge, who recorded the personal narrative of a Southern Arapaho woman aged 78. Upon examination it appears that very little of this is purely personal. The tribal pattern is obvious everywhere; and with few changes it might have been the narrative of any elderly Arapaho woman.

In July, I went among the Foxes of Iowa to obtain new sociological and ceremonial data. Of course any present-day study of Fox society must always labor under two handicaps: (1) the Foxes, except for the fight with the Comanche, Kiowa, Cheyenne, and Arapaho in 1854, have been uniformly peaceful for a hundred years; Fox history shows that they were a proud, formidable fighting nation, whereas it is impossible now for anyone to win military honors, have scalp-dances, etc.; (2) deer and buffaloes no longer exist in Iowa and the economic life of the Foxes is thereby altered. Hence it follows that the chief former occupations of Fox men—war and the chase—are gone, and they have had to find modern substitutes for them. Alas! there is nothing that can replace the former military glory. Furthermore, owing to the fearful losses by disease, especially small-pox, cholera, and in recent years influenza, the whole scheme of exogamy of gentes has gone. The festivals appurtenant to the special gentes, however, have survived with great vigor. The system of consanguinity has remained intact, and for the most part the varying attitudes this implies; though it is true that the taboos among the younger generation have partially begun to break down, and they now pronounce personal names which they should not in given circumstances. Truly remarkable has been the change in this people from the time I first visited them in 1911 to the present time.

RECORDING SEMINOLE SONGS IN FLORIDA

By FRANCES DENSMORE
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A study of the music of the Seminole Indians in Florida was continued by the writer during 1932, as a part of her research in the music of the American Indians for the Bureau of American Ethnology. During January the work was conducted in several camps within a radius of 45 miles of Miami. The various activities of the people were seen and photographed, and specimens were purchased.

In the Seminole village near Dania the process of making "coonte flour" was seen. This flour, made from the root of *Zamia floridana*, is the staple vegetable food of the Seminole. The root is grated, mixed with water, and strained through a cloth, the flour being rubbed smooth between the fingers. Specimens of the plant and three grades of the flour were obtained. James L. Glenn, financial clerk in charge, Seminole Agency, Dania, extended his cooperation.

The dug-out canoe is the only means of transportation in the Everglades. An expert canoe-maker had two canoes in process of construction. These were photographed and several models of canoes were obtained, including an old type that the Seminole used in the salt water many years ago. This model, made by Billie Motlo, one of the oldest men of the tribe, was equipped with a mast and sail, the rigging being of twine made from grass.

The leader of the singing among the Seminole living in the Big Cypress Swamp is Panther (fig. 95), commonly known as Josie Billie, who also treats the sick. He recorded 75 songs of the corn and hunting dances as well as the alligator, catfish, quail, screech owl, and other dances. This did not approach the number of songs which he knew. He also related tribal stories, singing their songs, and interpreted ancient legends related by Billie Motlo. This was a part of the work done at the Musa Isle Trading Post and was made possible by the courtesy of Mr. and Mrs. B. L. Lasher.

The death of John Tiger, one of the old men of the tribe, occurred in January. He had been friendly toward the writer and had given her some leaves from his medicine bag saying that, in old times, he "gave some of this to the boys when they took a canoe out alone in deep water, so they would be safe." After the death of John Tiger, his wife (fig. 96) went into the depths of the Everglades and remained during the time appointed for isolation and mourning.

FIG. 96.—Mrs. John Tiger.

FIG. 95.—Panther (Josie Billie).

FIG. 97.—Portion of New Camp Florida. Photographed by Miss Densmore.

FIG. 98.—Portion of Charlie Cypress' hunting camp. Photograph by Miss Densmore.

In February, a trip was made to several camps in the interior of the Big Cypress Swamp under the escort of W. Stanley Hanson, of Fort Myers. Five camps were visited and photographed. In a camp near Immokalee, Wilson Cypress was seen mending an ox-yoke, having detached the oxen from a crude conveyance in which his family were traveling. This is a "stop camp" for any Indians passing by. Owing to the exceedingly dry season it was possible to make the trip into the Cypress Swamp by automobile; the camps are usually reached only by canoe or ox team.

New Camp Florida is located on a large hammock surrounded by custard-apple and other trees. A vacant dwelling in this camp is shown in Figure 97. Adjoining it, on the right, was a garden in which, according to Seminole custom, the ground was practically uncleared. In this garden were taro and mulberry trees that had been set out and wild banana trees and pawpaws. Sugar cane, corn, pumpkins, and other crops had been harvested. Old Camp Florida, next visited, has been abandoned since a death occurred in it, about 1927. The most remote camp seen was Charlie Cypress' hunting camp, which contained no permanent dwellings (fig. 98). Under a canvas shelter a woman was sewing, and Mrs. Richard Osceola was mixing bread for the evening meal. She consented to turn from her work while the photograph was taken. The last camp visited was Charlie Dixie's hunting camp, in which there were neither platforms nor shelters. The small children in this camp wore no clothing.

Continuing her journey the writer went to Brighton, on the "Indian Prairie" northwest of Lake Okeechobee, and thence south into the cabbage palm country, visiting the three camps in this group. This region is the abode of the Cow Creek Seminole. The leader of the singing in their dances is Billie Stuart, who recorded 125 songs without hesitation. These included 17 songs attributed to the Caloosa. At this location valuable assistance was rendered by Mrs. Eliza Fielden.

An abandoned village site and an old burial ground near Fort Lauderdale were visited and photographed, after which the work near Miami was resumed. Several exhibition dances and two public Seminole weddings were attended.

A large collection of specimens was obtained for the United States National Museum, including old turtle-shell and coconut-shell rattles and a cane flute of a type which, it is believed, has not hitherto been observed.