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EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1924

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EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1924

INTRODUCTION

Scientific exploration and field-work has from the beginning formed an important phase of the Institution's work in the "increase of knowledge." This pamphlet serves as a preliminary announcement of the work along these lines accomplished during the past calendar year, 1924. The accounts are written and the photographs taken for the most part by the field workers themselves, and the scientific results of many of the expeditions will later be presented fully in the various series of publications of the Institution and its branches. With the very limited funds at its command, the Institution is unable to finance many major expeditions, but it endeavors to cooperate in this work, whenever possible, with other institutions, by furnishing men, materials, etc. The many expeditions initiated or cooperated in by the Institution during the 79 years of its existence have resulted in many important additions to knowledge as well as in valuable and instructive material for exhibition to the public in the U. S. National Museum.[1]

GEOLOGICAL EXPLORATIONS IN THE CANADIAN ROCKIES

Secretary Charles D. Walcott continued geological field-work in the Canadian Rockies of western Alberta for the purpose of completing his reconnaissance study of the pre-Devonian formations north of the Bow Valley.

The field season was most unfavorable owing to cold and stormy weather (see figs. 2, 3) that made it difficult and often impossible to work on forty-two days of the season. Eighteen camps were made while on the trail (see figs. 3, 10), and collections of fossils from typical localities were obtained. Incidentally, the party succeeded in getting a fine pair of mountain sheep and a black-tailed deer for the National Museum. At a beautiful but stormy camp just below Baker Lake the Lyell larches were scattered in clumps on the slopes a little below tree line (fig. 4), and wild flowers occurred in profusion about the small lakes south of the camp (figs. 18, 19). Mrs. Walcott made water-color sketches of sixteen flowers new to her collection.

[1] See Report on Cooperative Educational and Research Work Carried on by the Smithsonian Institution and its Branches, Smithsonian Misc. Coll., Vol. 76, No. 4, 1923.

FIG. 1.—A panoramic view supplementing figures 7 and 13. It includes on the left Fossil Mountain and then Upper Red Deer Canyon Valley, with Oyster Peak and Ridge, Cotton Grass and Tilted Mountain Cirques, Tilted Mountain, Sawback Range Ridges, and Brachiopod Mountain to the southeastern end of Baker Lake. (C. D. Walcott, 1924.)

FIG. 2.—North end of Oyster Mountain near head of Red Deer River Canyon Valley after an August snow squall, northeast of Canadian Pacific Railway, Alberta. (C. D. Walcott, 1924.)

FIG. 3.—Walcott Camp, beside Upper Baker Creek, a short distance below Baker Lake, on a snowy morning. Eight miles (12.9 km.) in a direct line northeast of Lake Louise Station, on the Canadian Pacific Railway, Canada. (Mary V. Walcott, 1924.)

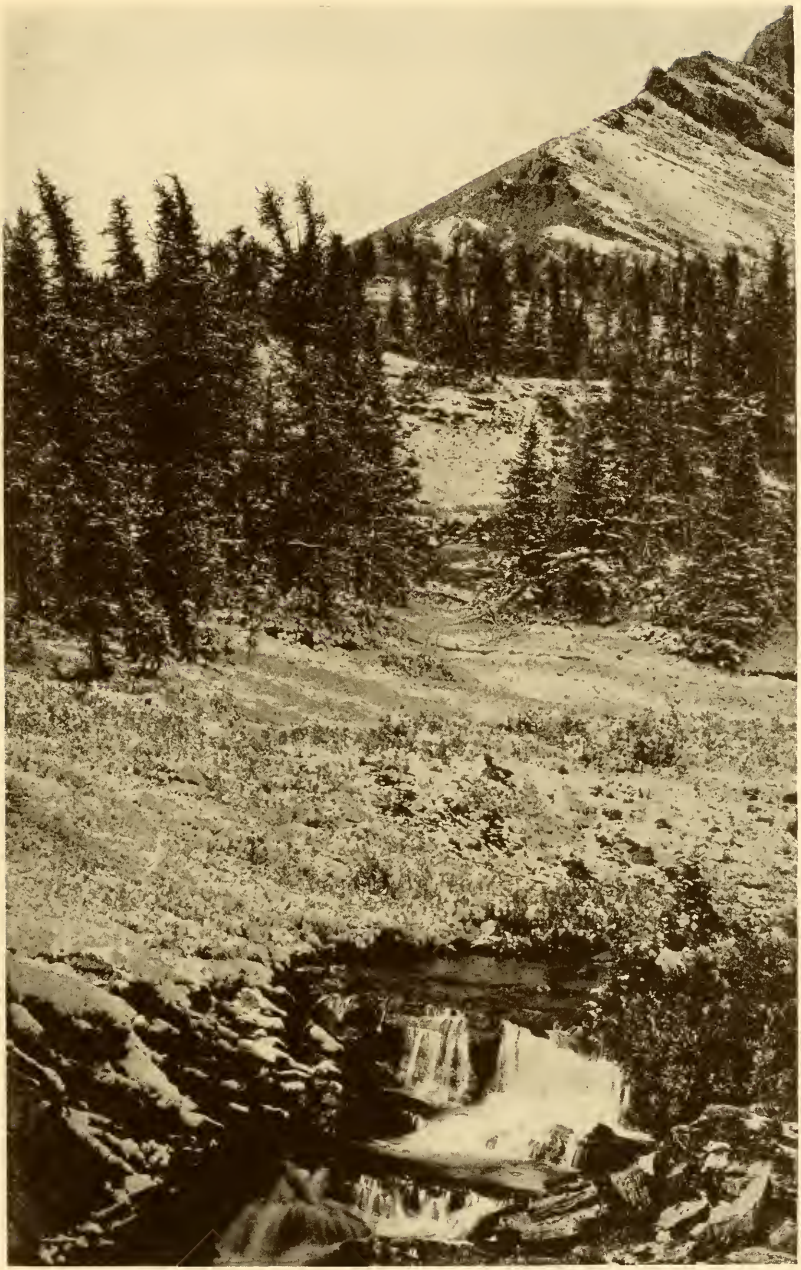

FIG. 4.—Outlook from camp east of Baker Lake. The Lyell larches extend up the slope to tree line. (C. D. Walcott, 1924.)

FIG. 5.—Cotton grass tufted seed heads from Cotton Grass Cirque.
(C. D. Walcott, 1924.)

FIG. 6.—Enlargement of cotton grass seed heads from Cotton Grass Cirque.
(C. D. Walcott, 1924.)

FIG. 7.—Tilted Mountain Cirque with Upper Cambrian strata of the Bosworth Formation tilted up against horizontal Devonian limestones near the head of the cirque. Upturned Upper Cambrian Lyell limestones on the right. (C. D. Walcott, 1924.)

The main objective was to find fossils in the great Lyell limestone[1] in order to determine its position in the scheme of classification. Many attempts have been made during the past six years, but without success, as the thick-bedded, coarse magnesian limestones were uniformly unfossiliferous except for the presence of a few

FIG. 8.—Tilted Mountain Falls, west foot of Tilted Mountain and northeast of Lake Louise Station, on the Canadian Pacific Railway, Alberta. Water flowing over thick-bedded magnesian Upper Cambrian Lyell limestones. (C. D. Walcott, 1924.)

casts of worm trails and the cylindrical structures supposedly built up by the secretions of algal growth, both of which may occur in sedimentary formations from the pre-Cambrian to the present day. In measuring a section from Fossil Mountain (fig. 1) eastward into Oyster Mountain, the Lyell limestones were found to form the main north and south ridge, and in two large, glacial cirques cutting

[1] Smithsonian Misc. Coll., Vol. 72, No. 1, 1920, p. 15.

deep into the ridge, the base of the Lyell was uncovered (fig. 1), as well as the oolitic limestones and shales of the Bosworth formation[1] that are so finely exposed in Mt. Bosworth on the Continental Divide above Kicking Horse Pass near Wapta Lake. The most northern cirque was named Cotton Grass from the presence of large areas of the beautiful cotton grass tufted seed heads (figs. 5, 6). The southern cirque (fig. 7) almost cuts through Tilted Mountain and bears its name. Mountain sheep have a trail up the

FIG. 9.—Rocky Mountains Park warden cabin, on Panther River, opposite the mouth of Snow Creek. (C. D. Walcott, 1924.)

cirque and over into Douglas Lake Canyon valley and onto the northern ice and snow fields of Bonnet Peak. In figure 7 the Lyell limestones, with the more readily eroded Bosworth beds below, were pushed eastward and the latter are tilted up against the horizontally-bedded massive Devonian limestones, forming the broadly and smoothly rounded mountain at the head of the cirque. We followed the brook running out of the little glacial lake in the bottom of the cirque in its course westward over the ledges of Lyell limestones to the falls, where it slides and falls into the canyon valley of upper Baker Creek (fig. 8) but everywhere the same hard, thick-bedded,

[1] Smithsonian Misc. Coll., Vol. 53, No. 5, 1908, p. 205.

light gray limestone extended in all directions until near the edge of the sloping cliffs above the canyon valley, where long narrow strips of trees and grass covered spaces occurred between the north and south ledges. Another approach was made from the south side of the brook, and an outcrop of a few thin layers of bluish-gray limestone was encountered on a small, rounded, glaciated ridge of the

FIG. 10.—Camp on north slope of Burgess Pass, B. C., from which the Burgess shale quarry was worked for several years. This is a typical camp where grass for horses, firewood and water are close at hand. (C. D. Walcott, 1924.)

magnesian Lyell limestone. These bluish-gray layers were interbedded in the Lyell, and contained fragments of Upper Cambrian trilobites. Returning another day, the thin band of bluish-gray limestone was traced to the brook and in a small narrow canyon two bands of shale and bluish-gray limestone were found a little lower in the section. The lowest band was rich in fragments of trilobites that later were found to be closely related to Upper Cambrian Franconia trilobites

FIG. 11.—Mountain sheep at a salt lick in the Red Deer River below the "Falls" near mouth of McConnell Creek. The party brought in three fine sheep heads and skins for the National Museum collections. (Mrs. Mary V. Walcott, 1924.)

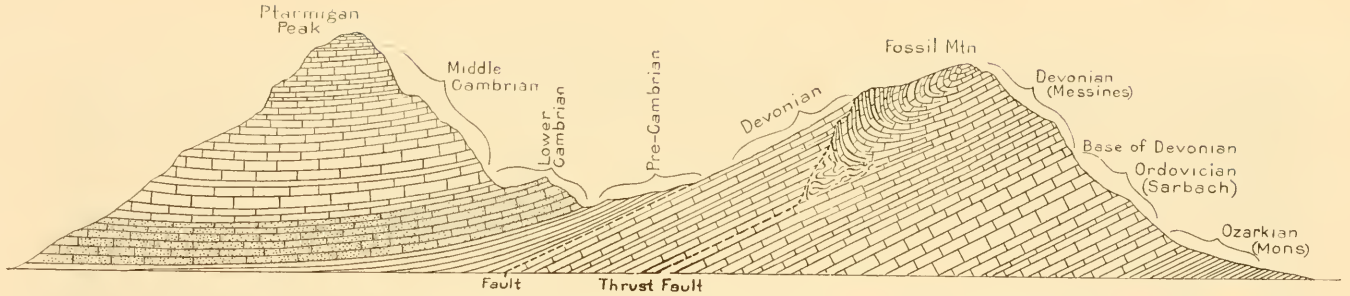

FIG. 12.—Diagrammatic section of the geological formations occurring in Ptarmigan Peak and Fossil Mountain (see fig. 15) illustrating the position of the strata and the over-thrusting of the Ptarmigan Peak pre-Cambrian sandy shales on the Devonian limestones.

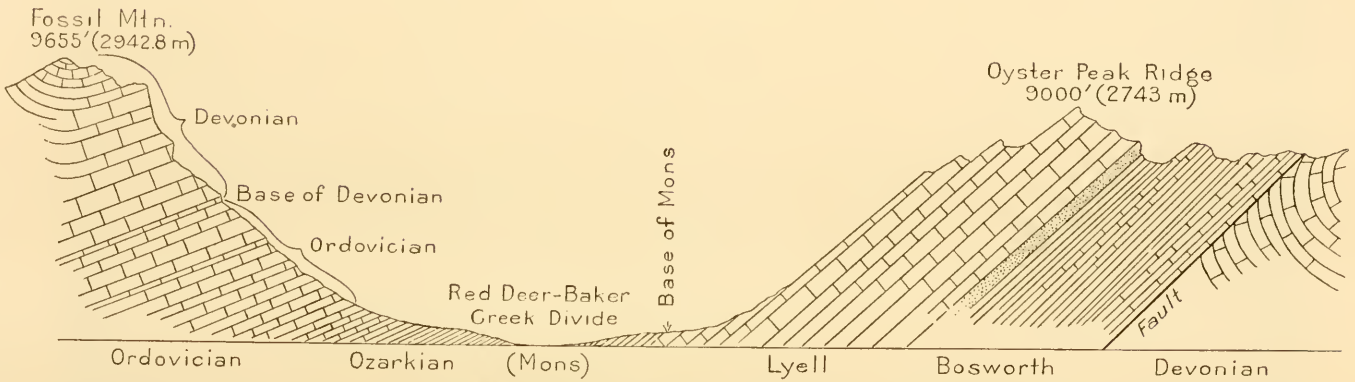

FIG. 13.—Diagrammatic section of Fossil Mountain across Red Deer-Baker Creek Divide and the north side of Cotton Grass Cirque, Oyster Peak Ridge. This section was measured and studied in 1924 and the left half of the panoramic view, figure 1, illustrates its character as seen by the camera.

FIG. 14.—Cliffs on the north side of the Upper Clearwater River, in which the pre-Devonian section is similar to that of Fossil Mountain. D = Devonian, S = Sarbach of the Ordovician, M = Mons of Ozarkian, and L = Lyell of Upper Cambrian. (C. D. Walcott, 1924.)

FIG. 15.—Panoramic view of east and south face of Fossil Mountain; on the right Ptarmigan Peak with its basal beds thrust over onto the limestones of Fossil Mountain in the center, and on the left the end of Brachiopod Mountain with a great mass of limestone that has broken away from the mountain. Baker Lake in central foreground is 8 miles (12.9 km.) east of Lake Louise Station. (C. D. Walcott, 1924.)

from Wisconsin, and the fauna of the upper band was found to be of the same type as the fauna of the St. Lawrence member of the Trempealeau formation of Wisconsin. With these two faunules definitely located in the upper portion of the Lyell limestones, we now know that the latter are of Upper Cambrian age, and thus is brought to a successful conclusion a search conducted for four field seasons

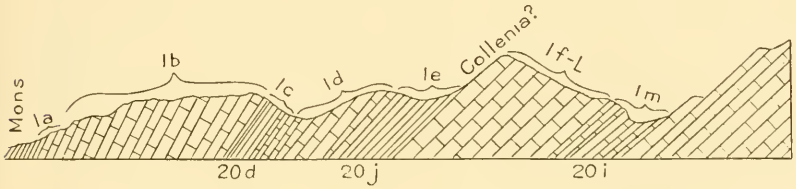

FIG. 16.—Diagrammatic section of the Upper Lyell at Tilted Mountain Falls (see fig. 8). 1^a = Arenaceous beds at contact of Lyell and Mons formations; 1^b, 1^d, 1^{f-l}, gray magnesian limestones; 1^c, 1^e, 1^m, fossiliferous bands of shale and gray limestone. (C. D. Walcott, 1924.)

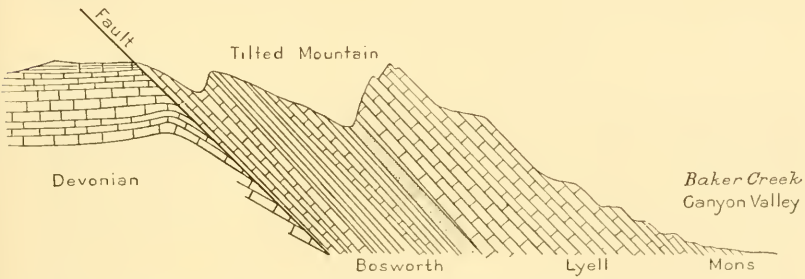

FIG. 17.—Diagrammatic section of Tilted Mountain interpreting the geologic structure, as shown by fig. 7. (C. D. Walcott, 1924.)

to determine the position of Lyell limestones in the Upper Cambrian series of the Canadian Rockies.

With the Lyell question out of the way, further collections were made from the Ozarkian upper Mons limestones of Fossil Mountain before going to Wild Flower Canyon. The latter is referred to in the account of exploration in 1921.[1] It heads on Johnston Creek Pass and extends in a northwesterly direction to where it joins Baker Creek Canyon. The gray limestones of the Mons formations form the high ridge on its northeast side and in these were collected many

[1] Smithsonian Misc. Coll., Vol. 72, No. 15, 1922, pp. 8, 9.

FIG. 18.—Arrow-leaved Coltsfoot (*Petasites sagittata*) from Burgess Pass, British Columbia. (Mrs. Mary V. Walcott, 1924.)

FIG. 19.—Sweet Androsace (*Androsace carinata*) from Baker Lake, Alberta. (Mrs. Mary V. Walcott, 1924.)

specimens of the upper Mons faunules. Early in September, the party crossed to the head of the Red Deer River and followed it down to where it breaks through the eastward-facing cliffs of Devonian limestone which have been thrust eastward over onto the sandstones, shales and limestones of the Cretaceous formations of the "foothills." It was expected to secure some fine photographs of interesting structural geology but the continuous cloudy and rainy weather prevented. On the ridge between the Red Deer and Panther Rivers at Snow Creek (fig. 9) a very fine pair of sheep was obtained and

FIG. 20.—Cricket, faithful 21-year-old saddle horse, the wisest one of the bunch of horses. She is waiting for a crust of bread. (C. D. W.)

unusually fine trout were caught below Eagle Pass north of the Red Deer River, also in Baker Creek earlier in the season. As hunting and fishing are only incidental to the geological work and Mrs. Walcott's wild flower studies, it is only on rainy days or after the day's work is over that the men indulge in sport. At a "lick" beside the Red Deer River, many mountain sheep were seen (fig. 11) and on the trail, moose, deer, goats, and smaller mammals were met with, especially about Baker Lake and in the Red Deer Canyon.

Some progress has been made the past eight field seasons towards a better understanding of the pre-Devonian geological formations and

their contained faunas in the Canadian Rockies, but there is a great opportunity for the young, vigorous geologist and paleontologist to add to knowledge of them for many years to come, especially between the Canadian Pacific Railway and the Arctic Ocean.

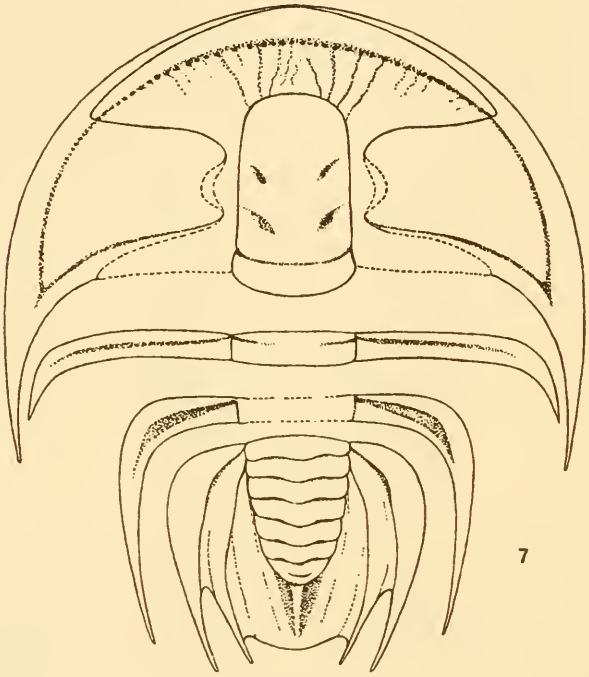

FIG. 21.—*Kainella billingsi* (Walcott). This large, fine trilobite loses its former generic name *Hungaia*,[1] as a species referred to *Hungaia* was published in a list of Upper Cambrian fossils in 1914 as *Hungaia magnificus* Billings.[2] The genus *Kainella* is now proposed with the species *billingsi* Walcott as the genotype. Other species occur that will be described in a subsequent paper. The name *Kainella* is derived from Mount Kain (9,392 feet, 2,862.7 m.), which was named after Conrad Kain, a noted Swiss guide and Alpine climber. It is located southeast of Billings Butte and Robson Peak, British Columbia, Canada.

As in previous years, assistance was freely given by Commissioner J. B. Harkin and the members of the Canadian National Parks Service, and the officials and employees of the Canadian Pacific Railway. The expedition was greatly aided by grants from the O. C. Marsh and Joseph Henry endowment funds of the National Academy of Sciences.

[1] Smithsonian Misc. Coll., Vol. 75, No. 1, 1924, p. 37, fig. 7, p. 38.
[2] Loc. cit., Vol. 57, No. 13, 1914, p. 351.

GEOLOGICAL FIELD-WORK IN TENNESSEE

In the field season of 1924, R. S. Bassler, curator of paleontology, U. S. National Museum, continued geologic work in Tennessee commenced several years ago in cooperation with the Geological Survey of Tennessee under the direction of State Geologist Wilbur A. Nelson. In previous seasons the geology and paleontology of the Central Basin were studied, followed in 1923 by an investigation of the eastern portion of the surrounding Highland Rim. In 1924 the Highland Rim work was carried northward to the Kentucky-Tennessee boundary where an area of about 125 square miles comprised in the Lillydale quadrangle of the Cumberland River district was mapped in detail. The primary object of this mapping was an economic one for the geologic structure of the region gives it oil possibilities. This area is far from railroad facilities and transportation is by the Cumberland River, when high enough, automobile sometimes, but most often by horseback. The method of transporting gasoline is shown in figure 22.

The Highland Rim of Tennessee is the plateau area averaging a thousand feet elevation surrounding the Central Basin. It is usually so flat that the underlying rocks are seldom exposed but in the Lillydale quadrangle the Cumberland River and its tributaries have cut so deeply into the Rim that the topography is very rough and the strata are exposed at frequent intervals. Here the exposed strata range in age from the Catheys (Trenton) limestone of the Middle Ordovician to the Cypress sandstone of the Chester group near the close of the Mississippian. The Catheys limestone and the succeeding Leipers limestone of Upper Ordovician age are followed directly by the Chattanooga black shale of Early Mississippian time, all Silurian and Devonian strata being absent. The black shale formation is only 20 feet thick in this area but it is so widely distributed that the geologic structure of the region is best determined by its outcrops. All of the strata here are essentially horizontal, but by plotting the elevation above sea level of the base of this black shale from outcrop to outcrop and connecting the places of equal elevation, thereby forming a structure contour map, no less than 20 small but distinct dome-like uplifts were discovered in this quadrangle alone. The formations above and below the black shale exhibit this same structure but the dip is usually so slight as to be almost imperceptible (fig. 23). Some of the domes formed by the uplifted strata (fig. 24) are known to be

FIG. 22.—Transportation methods along Upper Cumberland River, Celina, Tennessee. (Photograph by Bassler.)

FIG. 23.—Slightly dipping Upper Ordovician limestone, Clay County, Tennessee. (Photograph by Bassler.)

FIG. 24.—Part of an oil structure along Kettle Creek, northern Tennessee. (Photograph by Bassler.)

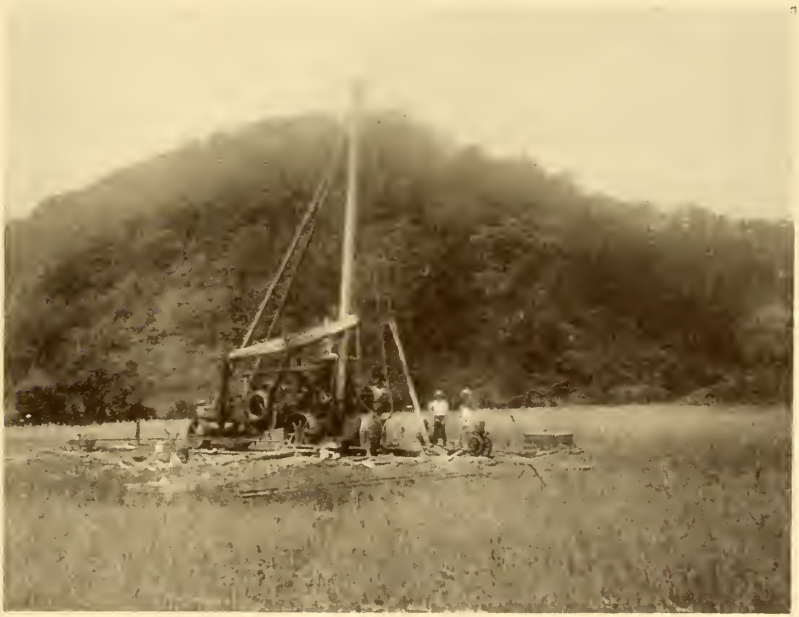

FIG. 25.—Drilling for oil, Neely's Fork, Clay County, Tennessee. (Photograph by Bassler.)

oil reservoirs and drilling is being actively pursued on such areas (fig. 25).

From a paleontological standpoint, the Mississippian formations following the black shale were of highest interest. Usually in Tennessee the rather unfossiliferous Fort Payne chert of Keokuk age succeeds the Chattanooga black shale but in parts of the Lillydale quadrangle two intervening formations were discovered. These were: first, the Ridgetop shale of Kinderhook age reaching a thickness of 200 feet, and second, the richly fossiliferous New Providence shale

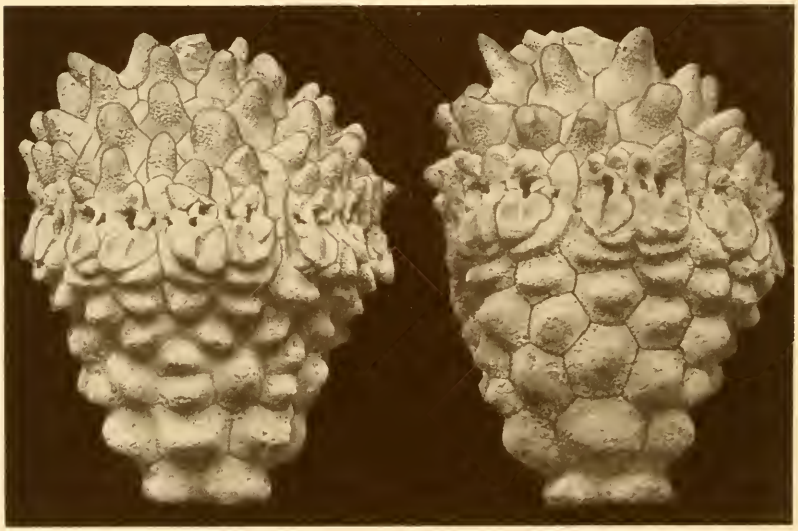

FIG. 26.—*Batocrinus springeranus* Bassler, a new species from the Lower Keokuk, Overton County, Tennessee; slightly less than natural size. (Photograph by Bassler.)

of Burlington age noted particularly for its crinoid fossils. Detailed mapping showed that these two formations were not deposited over a wide area but that they occupied ancient embayments of the sea surrounding the Cincinnati anticline. The succeeding strata in the quadrangle are of Keokuk, Warsaw, St. Louis and Chester age and show a more uniform, widespread development. The Keokuk limestone, however, exhibited different characteristics from its usual development in Tennessee as the Fort Payne chert, but the relationships between these strata will have to be determined from future studies of a more extended area. Paleontologically this formation in the

Lillydale quadrangle was of particular interest in that the basal beds afforded a splendid fauna of crinoids many of which are new to science. One of these new species, named in honor of the eminent specialist, Dr. Frank Springer, is illustrated herewith (fig. 26).

GEOLOGICAL FIELD-WORK IN THE ROCKY MOUNTAINS

During August and September, 1924, Dr. Charles E. Resser, associate curator of paleontology, U. S. National Museum, under the direction of Secretary Charles D. Walcott, continued the study of the Cambrian formations in the Rocky Mountains, using the Ford truck and camp equipment purchased the previous season. He was accompanied and ably assisted by Mr. Robert S. Bassler, of Washington, D. C.

At the invitation of Prof. L. A. Keyte, Colorado College, Colorado Springs, Colorado, the first stop was at that place and several days were spent studying the lower Paleozoic beds along the Rocky Mountain front. Under Professor Keyte's guidance and with his automobile, no delay was experienced in locating fossiliferous outcrops and securing good collections. During the past few years this region has yielded many very excellent Ozarkian fossils, new to our study series.

Work was continued in Logan Canyon, Utah, to ascertain whether any beds of Ozarkian age, which occur 30 miles to the south in Blacksmith Fork Canyon, outcrop at this place. A snowstorm prevented the completion of this task the previous September, but this year it was found that the lower beds sought are not present.

Camp was then moved by rapid stages to the Cooke City Ranger station in the extreme northeastern corner of Yellowstone National Park. A most excellent section exposing most of the Cambrian formation present in this part of the Rocky Mountains (Absaroka Mountains) was measured up Republic Creek, south of Cooke City, Montana. Cooke City is a small community which came into existence upon the discovery of silver ores in the surrounding mountains. It can be reached by only one road which enters the Yellowstone Park at Gardner, Montana, and branches off of the "Loop System" of roads at Camp Roosevelt, following first the Lamar River past the Buffalo Ranch, and then up Soda Butte Creek, a total distance of more than 70 miles. On all other sides high mountains hem it in and since the ores have never proven rich enough to compensate for the town's isolation, the mines are undeveloped and the population is sparse. The road to Cooke City traverses the best of the mountain

scenery in Yellowstone Park. One member of the Cambrian series of beds is always massive and since Soda Butte Creek has cut into a gently dipping fold, this massive limestone rims the valley. Every stream, permanent and temporary, falls over this layer, usually in a very narrow canyon, adding very much to the picturesqueness of the region. Indeed, Cooke City is coming to be a favored tourist resort. Immediately above the massive limestone just mentioned, the beds become shaly, and from these were secured an entire Cambrian crinoid of which no complete individual had previously been discovered in rocks as ancient as these. However, the fossils obtained from this

FIG. 27.—Jackson Lake and Mt. Moran. The Grand Teton visible to the south. The dead timber along shore is caused by flooding when dam fills. (Photograph by Resser.)

excellent section were few in number compared to what might be expected from such a group of Cambrian beds, due to their deposition in shallow water. At many places the rocks are composed almost entirely of fossil fragments which had been ground up by the waves prior to preservation.

A brief trip was made into the south end of the Gallatin Range, to secure a few fossils in order to determine the relationship of the Cambrian beds present here to those in the Absaroka and Teton Ranges.

Work was next continued in the Teton Mountains, which are in many respects the most magnificent in the United States, rising as they

do into sharp, steep peaks more than 7,000 feet above the deep Jackson Lake. A dam has been built at the former outlet of the lake, impounding the flood waters to a depth of 39 feet, thus preserving an enormous quantity of water for irrigation in the Snake River Valley, 300 miles away. The Teton Mountains, due to their ruggedness, and the extensive lakes at their base, proved more than ordinarily difficult to work from an automobile. They present, however, many interesting and some unique geological problems. This range consists of highly tilted Archaean rocks on the eastern face overlain from

FIG. 28.—View south from Glen Eyrie, Colorado, showing the strata folded during building of Rocky Mountains, now weathered into upright forms. Garden of the Gods visible in distance. (Photograph by Resser.)

the west by much less steeply inclined strata which include Cambrian, Ordovician and younger series. A six-inch layer of relatively pure iron ore was observed near the base of the Cambrian series. At all points in the range visited this season it was found that the fossils had also been broken before being buried.

The highway across Teton Pass, by which one leaves Jackson Hole, going south and west proved exceedingly steep but highly interesting and of great beauty. The drainage of Jackson Hole escapes through the Grand Canyon of the Snake River, cut more than a half mile deep into the mountain wall closing in the south end of the valley, for which reason the road cannot follow along it.

FIG. 29.—Entrance to Williams Canyon, on road from Manitou Springs to the Cave of the Winds. Several feet of beds at the roadway are Cambrian, the remainder Ozarkian. (Photograph by Resser.)

FIG. 30.—Republic Creek, south of Cooke City, Montana. Characteristic outcrop of the massive Cambrian limestones in the narrow creek canyons. (Photograph by Resser.)

The past season was the hottest and driest ever recorded for the western part of our country, in consequence of which snow banks that had never been known to disappear, melted away. Most of the mountain streams had little more than a fourth or half of their normal flow and the roads became almost impassable at places because the soil, having turned to soft dust, was blown away leaving large stones exposed. Difficult travel was consequently encountered at many places.

The latter part of the season was spent in continuing the study of various parts of the great Wasatch Range, to determine the stratigraphic position of the beds from which some of the earliest collections of fossils were made by exploring parties sent out previous to the settlement of the country.

GEOLOGICAL FIELD-WORK IN MARYLAND AND CONNECTICUT

Mr. Earl V. Shannon, assistant curator, division of physical and chemical geology, U. S. National Museum, made several short trips into Maryland during the year to visit mineral localities in that state. The most noteworthy was that made in May to Cecil County, where several feldspar quarries and the historically famous locality known as the State Line Chrome Mine were visited. Much material was collected for study. The reopening of the Chrome Mine during the war made available on the dump a quantity of freshly mined rock and a fine series of specimens of chromite, magnesite, kammererite and especially of the precious green serpentine known as williamsite was obtained.

In October, Mr. Shannon made a beginning in the cooperative work with the Geological and Natural History Survey of Connecticut leading toward the publication of a work on the mineralogy of that state. Between two and three weeks was spent in a highly successful collecting trip. A beginning was made in the southeastern corner of the area, including a visit to many of the quarries, mines, and road cuts in Groton, Stonington and Waterford. At the Mason's Island quarry in Stonington, numerous pegmatite dikes occurring in the gneiss were studied and some of them were found to contain notable quantities of primary magnetite. In places biotite-rich streaks in this quarry were found to contain golden-brown stilbite, and in one end of the quarry a quartz vein was located which furnished associated specimens of garnet, epidote, and stilbite. In Salter's quarry in

FIG. 31.—Salters Quarry, Groton, Connecticut. A typical stone quarry like hundreds in New England, any one of which can be depended upon to furnish much interesting mineralogical material.

FIG. 32.—Hungry Hill iolite locality, Guilford, Connecticut. The photograph shows Messrs. Alfred E. Hammer and Warren E. Mumford standing on what is probably the best locality for iolite in North America, if not in the world.

Groton, specimens and notes on peculiar diorite-pegmatites, older than the Westerly granite sills, were obtained and other pegmatites of interest were observed intruding the Mamacoke gneiss which is quarried in the Goos, Flatrock and other quarries in Waterford. One day was spent in examining the various outcrops, cuts, and quarries along the shore line branch of the New York, New Haven and Hartford Railroad from Saybrook Junction to Nantic. Another was spent at the Falls of the Yantic, in Norwich, a famous locality for minerals obtained early in the last century and but little known since. No iolite nor corundum were found, but sillimanite was located in quantity in

FIG. 33.—The main pit of the mine at Long Hill in Trumbull, Connecticut, probably the first tungsten mine of America. While never commercially successful as a tungsten mine and the source of more than one "wildcat" project, this is now a famous mineralogical locality.

a schist in a railroad cut, and plenty of monazite specimens were obtained from pegmatite blocks in fence walls in the neighborhood.

The latter part of the trip was spent at Branford as the guest of Mr. Alfred E. Hammer, who is particularly well informed regarding the local geology and mineralogy and the history of mining in his vicinity. In company with Messrs. Hammer and Warren E. Mumford, metallurgist for the Malleable Iron Fittings Company of Branford, many of the important localities were visited. These included the iolite and garnet-vesuvianite ledges in Guilford, the jail spar quarry, the spessartite ledge and other feldspar quarries in Haddam, and the Gillette quarry on Haddam Neck, where many remarkable minerals

were found. In Middletown the old lead mine, famous as a source of metallic lead for bullets in Revolutionary days, was examined. The Cheshire barite-copper mine and the trap quarry on Mt. Carmel were visited, and the last trip of the season included a visit to the now famous mineralogical locality of the tungsten mine at Long Hill in Trumbull. On this trip the old Booth-Curtis bismuth mine in Monroe, long a source of native bismuth specimens, was located, but too late to secure extensive collections.

GEOLOGICAL FIELD-WORK IN NEVADA

During the four months, June to September, Dr. W. F. Foshag, assistant curator of mineralogy, U. S. National Museum, worked in

FIG. 34.—Walker Lake, Nevada, showing the old shore lines of Lake Lahontan.

cooperation with one of the U. S. Geological Survey field parties in the mapping of the Hawthorne quadrangle, western Nevada, making a special study of the mineralogy and ore deposits of the area. Besides Paleozoic and Mesozoic sedimentary rocks, Cretaceous granites and Tertiary lavas, the area embraced a number of interesting lake beds of Miocene, Pliocene and Pleistocene age, in which were found the remains of fishes, fresh water gastropods, plants, and the bones and teeth of horses, camels, mastodon, and rhinoceros. A reported occurrence of artifacts in the beds of the extinct lake Lahontan, Pleistocene

FIG. 35.—Collecting camel bones, Lahontan gravels, Walker Lake.

FIG. 36.—Wind pot holes.

in age, was visited and examined in detail. Flakes of obsidian such as are found in abundance throughout this area were noted but no ancient artifacts or other evidence of Pleistocene man were found.

Some time was devoted to a study of ore deposits of the region including those of the historic old camps of Candelaria and Aurora and also those more recent. The mercury deposits of the Pilot Mountains were studied in some detail and interesting collections made. The quadrangle is unusually rich in minerals and much material was collected for study. This came largely from the mines and prospects of the region, but some unusually fine material was also recovered from the muds of the "playa" lakes.

FIELD-WORK OF THE ASTROPHYSICAL OBSERVATORY IN CHILE, ARIZONA, AND CALIFORNIA

The Astrophysical Observatory continued its work on the sun's heat and the variations of it. More and more interest is being expressed in this work because it promises to be a basis for advances in weather forecasting. At first sight, the problem is very simple. As the temperature and rainfall of the earth depend on the sun's heat, a change in the sun's heat must modify temperature and rainfall. Actually, however, the effects are highly involved.

To explain the matter briefly, there are always certain regions of high and others of low barometric pressure. These are centers of atmospheric circulation. The word circulation is indeed more expressive than we often think, for the wind directions bend around these centers of circulation. Meteorologists speak of cyclones and anticyclones, meaning the great rotary tendencies of the winds over areas hundreds of miles in diameter, associated respectively with barometric lows and highs. Such being the case it depends at least partly on the observer's position, relative to one of these atmospheric centers of circulation, whether his weather is warm or cold. For winds from warmer latitudes tend to make warm weather, and winds from colder ones cold weather.

If, now, the effect of increase of the solar heating acting upon the highly complex surface of the earth, with its mountains, deserts, oceans, etc., should tend to displace an atmospheric action center (toward the pole, for instance) a station which previously received prevailingly tropical winds might afterwards receive prevailingly polar winds, and thereby be *cooled,* not *warmed,* by the supposed increase of solar heat. Another station, a few hundred miles away, might experience the very opposite effect from the same cause.

On such grounds we have not to expect any simple or easy solution of the problem of the influence of variations of the sun on our weather. Apparently there is only one way to proceed. It is to observe diligently and accurately for years the sun's changes of radiation, and then, with the basis of fact so laid, examine the behavior of atmospheric pressure, temperature and rainfall at a great number of stations over all the world, at all times of the year, in order to work out at last the exact dependence of weather on solar changes.

This is a very large program. The Astrophysical Observatory began with it in 1902, when it commenced to observe the solar radiation in Washington. But the atmosphere in Washington was loaded with clouds, smoke, dust and humidity. It was necessary to remove to a purer sky. Since then stations have been occupied as follows: Mt. Wilson, Calif., during summer and autumn, 1905 to 1920; Mt. Whitney, Calif. (the highest mountain of the United States outside Alaska) on several days in 1908, 1909, and 1910; Bassour, Algeria, in summer and autumn 1911 and 1912; Hump Mountain, N. C., almost a full year beginning May, 1917; Calama, Chile, July, 1918, to July, 1920; Montezuma, Chile, August, 1920, to the present time; Mt. Harqua Hala, Ariz., October, 1920, to the present time.

During all this time better and better methods have been developed, obstacles to accuracy overcome, and new sources of error recognized and avoided. The body of experience which has thus come to the members of the staff is unique, and a very great asset. There is, indeed, the highest necessity for it. The results of Mr. H. H. Clayton, who has attempted with much success to unravel the effects of solar changes on the weather, indicate that variations of the sun as small as 0.5 per cent, or 1/200 of the whole solar output, produce well recognizable effects. Changes greater than 3 per cent do not often occur, though once in a great while they go even higher than 5 per cent. Observing, as we do, at the bottom of a sea of atmosphere, loaded more or less with variable elements, like dust, water vapor, etc., it is very difficult to reach a high enough standard of accuracy to reveal surely changes as small as these.

During the past four years, with the newest methods of observation and computation, our two observing stations in Arizona and Chile each determined the sun's heat on upwards of 70 per cent of all days. Taking all fairly good days when both stations observed, the average deviation of these independent measures, made over 4,000 miles apart and reduced independently for atmospheric losses, is about 0.5 per cent. During October, 1923, however, both stations reported almost every day, and the average daily difference was less than 0.2 per cent.

It would be highly advantageous to have another pair of stations located, if possible, in well separated cloudless regions where the months December to March are more favorable.

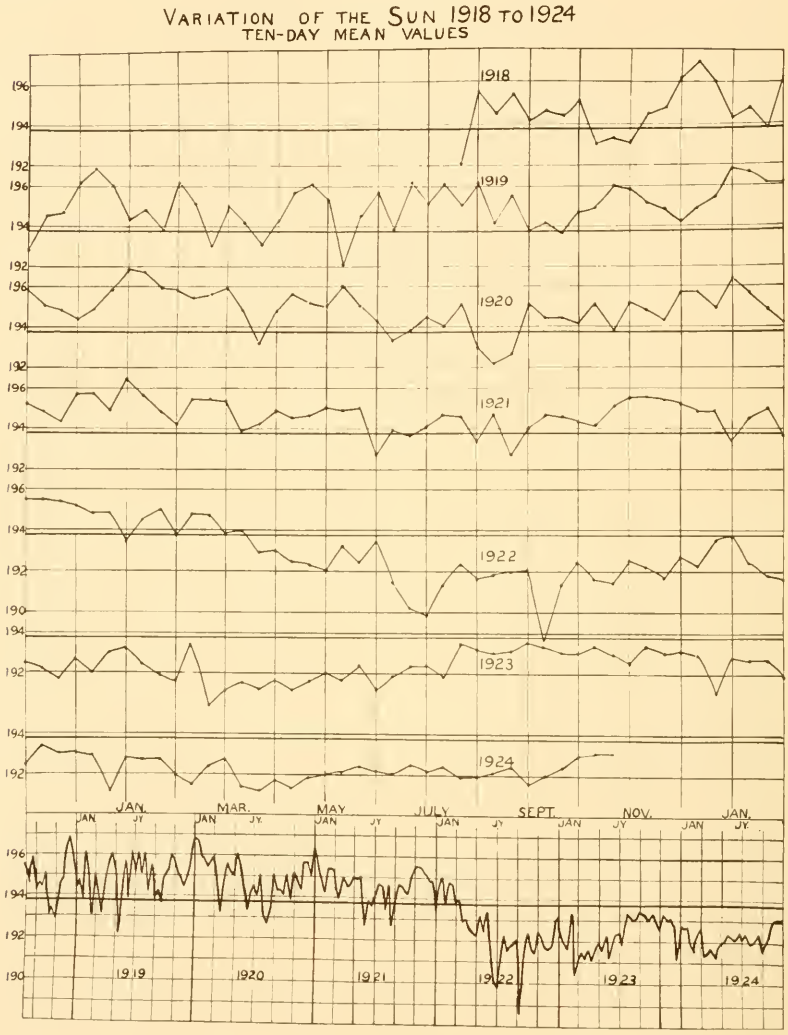

FIG. 37.

On the whole, the solar heat appears to have been continuously below the normal for the past 2½ years. Of late months the tendency to rise has become apparent, so that it seems likely that higher values

will soon prevail again. We had hitherto noted an association of higher solar radiation with greater sun-spot activity. (See fig. 38.) As we have now passed the minimum of sun-spots, and greater solar activity is to be expected in the next years, the rising tendency of the solar radiation is not surprising.

During the past year, the Institution has received each morning telegrams from Arizona and Chile giving the solar results of the preceding

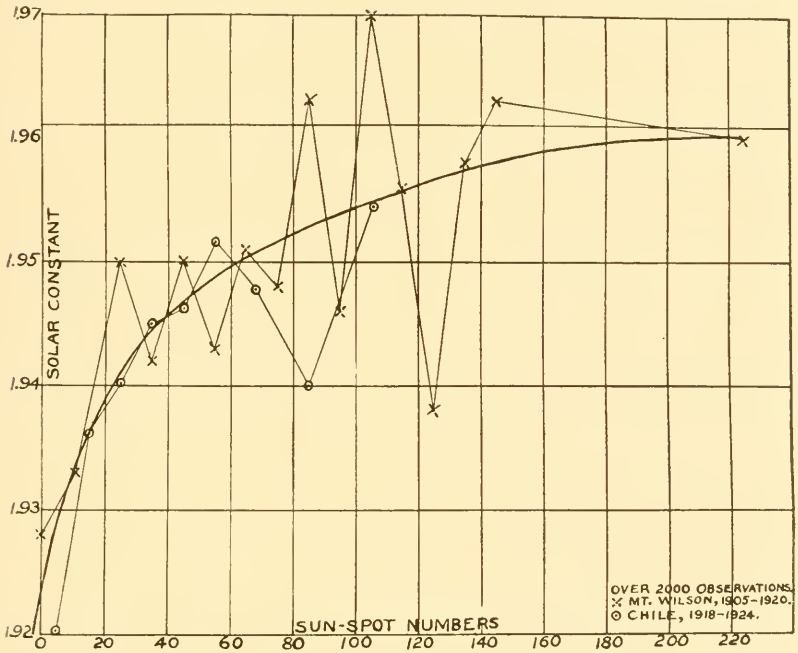

FIG. 38.—Increased solar activity brings higher solar-constant values.

day, and has forwarded the combined result by telegraph to Mr. H. H. Clayton in Massachusetts. Mr. Clayton has returned to the Institution on the same afternoon a letter giving forecasts for the temperature of New York City several days in advance. Mathematical methods, independent of personal bias, show that these forecasts indicate some degree of real prevision, based on the solar observations, even to 5 days in advance. These investigations are supported by Mr. John A. Roebling. A continuation of them is intended.

Interesting results were secured in quite a different field. Dr. Abbot employed a Nichols radiometer in connection with the 100-inch reflect-

ing telescope of Mt. Wilson Observatory. He not only could observe the heat of the brighter stars, but, separating this into a long spectrum,

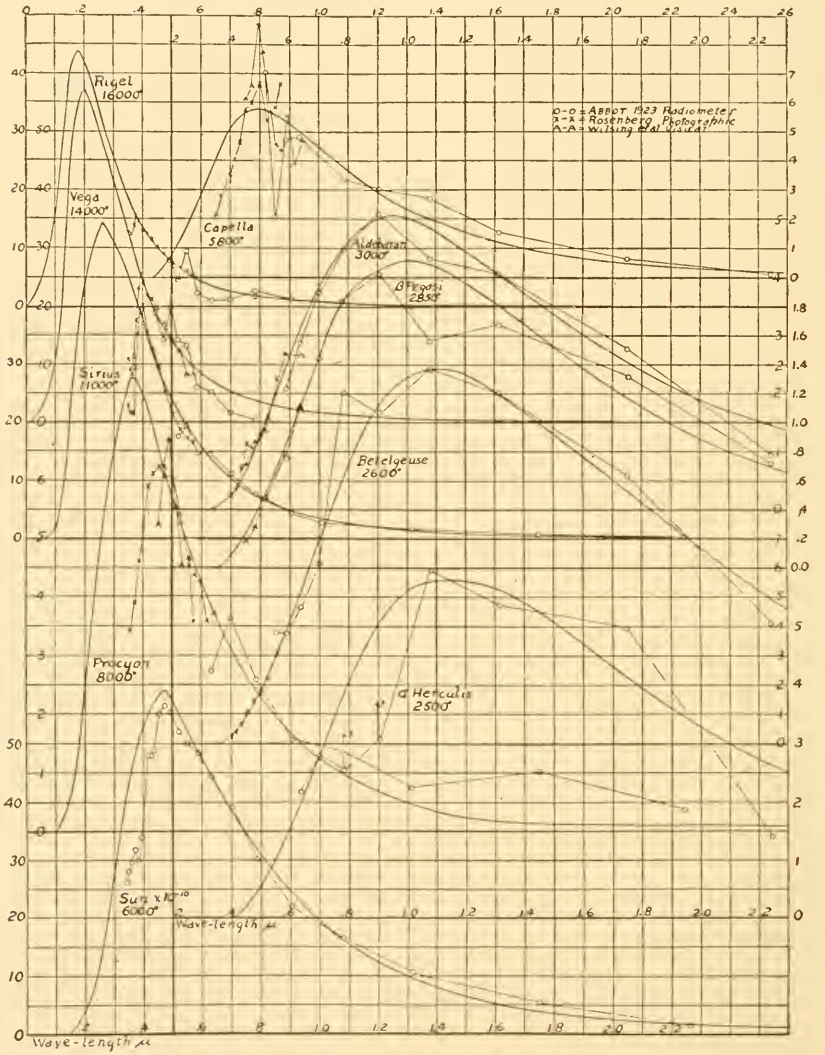

FIG. 39.—Normal energy-spectrum curves and corresponding black-body curves. Various scales of ordinates; two scales of abscissae.

he obtained fairly accurate measurements of the heat of the different colors, and even far into the infra-red. In this way curves were drawn

indicating the spectral distribution in the radiation of blue, white, yellow and red stars, and estimates of their probable temperatures were made. From these results and the results giving the total amounts of heat they send compared to the sun, estimates were possible of the diameters of the stars observed.

A summary of these results follows, in which the diameters he estimated are compared with the values found in other ways by Michelson's interferometry methods, and by Russell from photometry. It is hoped to improve the sensitiveness of the radiometric devices sufficiently to make possible a study of much fainter stars.

STELLAR TEMPERATURES, RADIATION, AND DIAMETERS

Star	Absolute temperature C.	N* Unit=10^{-11}	Parallax	Diameter ⊙ = 1†		
				Radiometer	Interferometer	Russell
Sun	6,000°	....	.....	....	....	....
β Orionis ..	16,000	3.20	0".007	20.	....	28.
α Lyrae	14,000	6.10	0 .130	2.0	....	3.0
α Can. Maj.	11,000	6.60	0 .370	1.2	2.0	....
α Can. Min.	8,000	1.24	0 .315	1.1	....	1.6
α Aurigae ..	5,800	2.20	0 .071	13.	....	9.
α Tauri	3,000	2.54	0 .053	70.	39.	....
β Pegasi ...	2,850	1.11	0 .026	94.	82.	....
α Orionis ..	2,600	7.90	0 .017	510.	280.	....
α Herculis..	2,500	3.60	0 .007 0 .013	900. 480.	....	230.

* N = Ratio of stellar to solar radiation outside earth's atmosphere.
† To express in kilometers, multiply by 1.42×10^{6}. To express in miles, multiply by 0.865×10^{6}.

ZOOLOGICAL EXPLORATIONS IN WESTERN CHINA

For several years the Rev. David C. Graham, of the West China Mission of the American Baptist Foreign Mission Society, has been collecting natural history material in the vicinity of his station at Suifu, in the province of Szechuen, and sending his specimens to the U. S. National Museum. At times his activities have led him further afield, and last year (1923) he conducted a successful trip to Tatsienlu, a locality several days' journey to the northwest of Suifu.

Tatsienlu is an important spot for naturalists through being the type locality for many species brought to light by earlier travellers. It was visited by the Abbé Armand David about the year 1869, by Prince Henri d'Orleans in 1890, and by A. E. Pratt in the same year, followed in 1894 by a Russian explorer, G. Potanin. Ernest H. Wilson

and W. R. Zappey were there in 1908, the former interested in botany and the latter in zoology. In 1913, a German traveller, Walter Stötzner, made collections in various parts of Szechuen, including Tatsienlu and vicinity. The above incomplete list of visitors who have made this place a collecting ground will suffice to stamp the region as one fairly well known to naturalists. Nevertheless, the locality was all but unrepresented in the U. S. National Museum collections, and the material sent in by Mr. Graham was received with no little gratification.

After finishing his trip to Tatsienlu, Mr. Graham contemplated a visit to Moupin, the scene of some of David's early work and also a type locality of note, but the presence of bandits in that district caused him to look elsewhere for the moment and he decided upon Songpan (or Sungpan), in the northern part of the province, reasoning that a visit to this district would result in the gathering of many species not common to the regions he had already explored. This trip was projected at the end of the year 1923 and began to assume shape in May of the year 1924, when the Smithsonian Institution with the approval of Dr. W. L. Abbott, transferred to him the collecting outfit of the late Charles M. Hoy, who had been operating in the province of Honan.

Songpan was first visited by an Occidental in 1877, when the late Captain W. J. Gill reached it, according to Ernest H. Wilson, who was there on several occasions, the first time in 1903, during his botanical travels in Szechuen. Berezowski spent several months at Songpan in 1894, and Stötzner collected specimens there in 1913. Wilson writes that since Gill's entry into the city "several foreigners have paid visits, and missionaries of Protestant denominations have made abortive attempts to establish stations there."

While Songpan was the objective of Graham's proposed journey, it was not so much the actual city as the general region that attracted his attention. He had heard that good collecting ground existed in its vicinity, hence looked forward to it as a trip worthy of trial. During the latter part of May and early June he made himself familiar with the new outfit and carried out his plans and preparations for the long, rough trip. The distance from Suifu to Songpan in a straight line is probably not much over 240 miles, but by the route travelled would be nearer 400 miles, partly by water, but chiefly by land, and to keep the cost of the trip within his original estimates, Mr. Graham planned to walk over practically all of the overland part of his journey.

Preparations were completed for the trip by the 22d of June, and at daybreak on the morning of the 23d, Mr. Graham and his party, consisting of several Chinese carriers, helpers, skinners, etc., embarked by boat from Suifu. They touched at various minor towns and hamlets by the way, collecting specimens at every opportunity, and reached Kiating, the first place of importance, on the 29th. Frequent and heavy rains fell almost daily, but the party succeeded in registering specimens from point to point throughout the journey. From Kiating to Chengtu Mr. Graham's party had an escort of four soldiers, and beyond Chengtu the escort consisted of double this number, who had neither guns nor swords for defense; yet, withal, the party got through in safety. Chengtu was reached on July 2, after daily stops at small towns and villages. Mowchow, the next place of consequence, was reached on the 9th, the country for some miles on either side of it being semi-arid in nature; apparently for the time they had passed out of the region of heavy rains.

The Graham party arrived at Songpan on July 14, after a strenuous journey of twenty-two days. During his stay at this place, Mr. Graham found the city was devoid of foreigners, and the native officials would not permit him to venture out of its limits except to the east and south.

In a letter dated September 3, 1924, Mr. Graham writes:

> The Songpan trip has been taken, and we are safely at Suifu with 50 boxes of specimens, most of which are about ready to be mailed by parcel post.
>
> This has been a harder and rougher trip than the one to Tatsienlu or any other previous trip. It is much harder to secure food and other necessities around Songpan than at Tatsienlu. There were times when we could purchase no fruit, vegetables, eggs, or meat. At Songpan it was impossible to go west or north, where large mammals are found in abundance, so that the only place we could go was east to the Yellow Dragon Gorge. Even there we had to have an escort of six Chinese soldiers and had of course to pay all their expenses.

Continuing, he writes:

> The reason we could not go north of Songpan or west of that place was that the Bolotsi aborigines are so savage and so inclined to murder and brigandage that the Chinese can not control them and are afraid of them, and the officials could not protect us in those regions. . . . . Just before we returned from Songpan, the Bolotsis attacked a company of Chinese soldiers, killed several of their number, stole several rifles, and drove the scared and defeated soldiers back to their barracks. I have not heard that the Chinese have dared to go into the Bolotsi country with a punitive expedition.
>
> The catch of mammals is not large. We are very sorry about this. It is due primarily to the fact that the mammal-catching districts around Songpan

were closed to us. Yellow Dragon Gorge was a fine place for birds and insects, but a great festival had just been held there, in which aborigine and Chinese hunters from all directions had joined in the chase, and wood cutters were busy in the woods cutting timber for the new temples that are being constructed. The mammals had been scared away.

In addition to the material collected on the Songpan trip, Mr. Graham had native collectors at work in other districts, about whose activities he writes:

This year's catch is bigger than that of last year. There are 50 boxes of specimens on hand, and I expect to send them off by parcel post as early as possible. Besides the 50 boxes just mentioned, there is the entire catch of the netter Ho for at least three months, who has been collecting about Beh Luh Din, Chengtu, and Kuanshien during the summer, and specimens now being secured by two collectors on Mt. Omei, one at Shin Kai Si and one on the higher altitudes.

The material obtained on the Songpan trip included about 5,000 insects, of which the two-winged flies and butterflies and moths constituted an important element, many of them being either new to the Museum or new to science. The birds, 558 in number, were received at a late date, and have not been fully examined, though to date about a dozen species new to the Museum have been detected.

About 250 mollusks and a lesser number of mammals, fishes, reptiles and batrachians, earthworms, plants, etc., comprise the remainder of the shipment.

VISIT OF MR. GERRIT S. MILLER, JR., TO THE LESSER ANTILLES

During February and March, 1924, I visited the Lesser Antilles, more for the purposes of vacation and of getting a personal impression of the islands than with any plan for definite research. Two weeks were spent on Barbados and a month on Grenada; while each of the principal islands was visited for a few hours during the southward and return voyages. Some miscellaneous collections were made, chiefly of ferns, cacti, and lizards.

Much detailed work in zoology and botany remains to be done on the islands of the Lesser Antillean chain. As a striking illustration of this fact, it may be mentioned that, in a group of plants so conspicuous as the cacti, and so well monographed as these have recently been in the elaborate work of Dr. N. L. Britton and Dr. J. N. Rose, nine species (7 genera) were found growing wild on Grenada, from which island these authors had actually examined only two. One of the common Grenadan cacti was described in 1837, but had remained

FIG. 40.—Market, St. Kitts—mostly vegetables and fruit. The Island of Nevis appears dimly in the background.

FIG. 41.—Market, St. Vincent—whale blubber.

FIG. 42.—Market, Barbados—pottery.

FIG. 43.—Harbor of Charlotte Amalie, St. Thomas.

FIG. 44.—Basse Terre, St. Kitts. Lighters coming out to the steamer. At only two islands (St. Thomas and St. Lucia) is the water of the harbors deep enough to permit large vessels to dock.

FIG. 45.—Ruined sugar mill, Montserrat. Ruined windmills—abandoned in favor of modern machinery—are as characteristic of the Lesser Antillean landscape as the old watch towers are of that of the Mediterranean coast of Europe.

FIG. 46.—Sulphur vent, Montserrat, near left base of the mountain shown in fig. 45. This vent is now increasing its area, and killing many trees, which had grown to large size near it.

FIG. 47.—Street near botanical garden, Roseau, Dominica.

FIG. 48.—Pointe-a-Pitre, Guadeloupe. On account of quarantine regulations, no closer approach to the town was allowed during the winter of 1923-24.

FIG. 49.—Bridgetown, Barbados.

FIG. 50.—Avenue of palms and Casuarina, Barbados. Young sugar cane in foreground.

FIG. 51.—Negro fisherman searching for crabs, eels and rock inhabiting fish at Atlantis, windward side of Barbados. The peculiar undercutting of the rocks is often seen along this part of the coast.

FIG. 52.—Cactus (*Cereus grenadensis*) on Glover's Island, off south coast of Grenada. Unlike *Cereus hexagonus*, this species appears to branch naturally.

FIG. 53.—Cactus (*Cereus hexagonus*) on hill above St. George, Grenada. The branching of this plant seems to be chiefly due to injuries. When growing in protected situations among trees it forms simple columns 30 feet high.

FIG. 54.—Cactus (*Acanthocereus pentagonus*) on rocky shore of Glover's Island, off south coast of Grenada.

" lost " until, under the guidance of Dr. J. N. Rose, I " rediscovered " it; yet the plant flourishes at the roadside within a few hundred yards of the fine botanical garden in the suburbs of Saint George. For the convenience of anyone who might be interested in doing some field-work on these Islands, attention may be called to the ease with which they can be reached. The boats of the Quebec Steamship Company maintain a service from New York to Barbados, touching at the islands of St. Thomas, St. Croix, St. Kitts, Antigua, Guadeloupe, Dominica, Martinique and St. Lucia, and remaining at each for a period which depends on the quantity of cargo to be handled, but which is usually from three to ten hours. As the islands are small and the roads on most of them are good, there is usually time to get a fair general idea of topography, forests and cultivation during the vessel's call, particularly when it is remembered that points of special interest can be seen again on the return voyage. From Barbados the passage to St. Vincent and Grenada is made by the Royal Mail boats plying between St. John, New Brunswick, and Demarara, British Guiana, by way of Bermuda, the Lesser Antilles and Trinidad. There is also a line directly from New York to Grenada and Trinidad, but this gives no opportunity to see other islands. On the return voyage inconvenience may be experienced in obtaining passage owing to the number of " round trippers " with whom the boats are sometimes crowded; and for the same cause travel between neighboring islands is not always easy.

The appended photographs show characteristic scenes.

GERRIT S. MILLER, JR.

EXPERIMENTS IN HEREDITY AT THE TORTUGAS

In continuation of the heredity experiments in the Tortugas conducted under the joint auspices of the Smithsonian and Carnegie Institutions, Dr. Paul Bartsch visited Cuba from May 27 to May 30 this year, in order to add a spirally striated Cerion element to the Cerion colonies established at the Tortugas. Thanks to the good offices of Dr. Carlos de la Torre, of the University of Havana, he was able to secure a sufficient series of a strongly spirally striated new species of Cerion belonging to the *Cerion johnsoni* group at Mariel, where also a large number of *Cerion sculptum*, likewise, though less strongly spirally striated, were gathered. In addition to these, *Cerion mummia* from Marianao and *Cerion chrysalis* from Cabanas Fort and *Cerion tridentata* from Rincon de Guanabon were collected and planted at the Tortugas. The last is peculiar on account of the internal lamellation of the aperture, thus adding another element to our experiments.

On June 1 a visit was paid to the hybrid Cerion colony on Newfound Harbor Key. This was found to be in a flourishing condition and 100 specimens were taken to Washington for record and dissection. From June 2 to June 15 was spent at the Tortugas where the various Cerion colonies which have been established there were studied and new ones added. All the colonies were found to be doing well, excepting that of *Cerion uva* from Curaçoa, which is on the verge of extinction.

Fig. 55.—Four of the six island groups.

We gathered a number of *F2* Florida-grown specimens of *Cerion crassilabre,* which show no measurable differences from those of the check series of the *F1* Florida-grown generation, thus again confirming our finding with the other races of transplanted Cerions, that changed environmental factors have no appreciable influence upon the *F1* and *F2* generations of the transplanted material.

A large series of offsprings of the mixed colony of *Cerion casablancae* and *Cerion viaregis* (Colony I) were gathered and taken to Washington to be carefully studied for a possible cross.

New Colonies of Cerions Established This Year

500 *Cerion mummia* from the point at Miramar, Cuba.
500 *Cerion chrysalis* from near Cabanas Fort, Cuba.
500 *Cerion sculptum* from near the lighthouse at Mariel, Cuba.
125 *Cerion* new species, young specimens from a little east of the point at Mariel, Cuba.
500 *Cerion tridentata* from Rincon de Guanabon.

These were planted on the west and north side of the parapet at Fort Jefferson on Garden Key, each duly marked with a stake and tag.

Our failure in the past to grow Cerions in cages at the Tortugas caused us to try isolating them on little islands this year. Mr. Mills inclosed four 6 x 6 ft. areas with a concrete trench, a cross-section

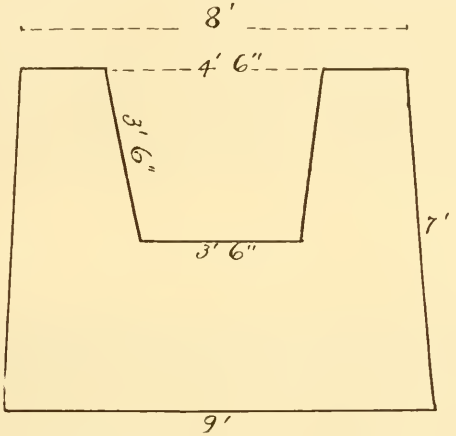

Fig. 56.—Cross-section of concrete trenches.

of the construction of which is shown in the accompanying diagram (fig. 56). Two additional areas of the same size were subdivided by a similar median septum which yielded four almost 3 x 3 ft. islets. The simple trenches require each some nine pails of water and the compound correspondingly more. Arrangements have been made with Mr. Charles Johnson, keeper of the Tortugas lighthouse, to keep these trenches filled with water. Evaporation at the Tortugas is great and it will be necessary to replenish the loss of water almost daily. For this purpose a pump has been installed in the middle of the battery of islands which will make this a comparatively easy daily task.

The inclosed areas have been planted each with a Hymenocallis plant and a few such grasses as are favored by Cerions, likewise a few added fragments of coconut pediole fibers; in other words, all things

FIG. 57.—Good's pompano (*Trachinotus goodi* Jordan and Evermann).

FIG. 58.—A group of Grey Snappers (*Neomænis griseus* L.) swimming in an aisle between massive coral heads.

favored for attachment by Cerions. These islands are placed south of the laboratory and east of the men's quarters. They have been stocked with:

1. 25 *Cerion incanum* and 25 *Cerion* new species
2. 25 *Cerion incanum* and 25 *Cerion chrysalis*
3. 25 *Cerion incanum* and 25 *Cerion mummia*
4. 25 *Cerion incanum* and 25 *Cerion tridentata*

5 and 6. In each compartment a two-thirds grown individual of *Cerion incanum* and *Cerion viaregis.*

On June 15, during the return trip to Key West, Man and Boy Keys were visited. The Boy Key colony has in part survived the burning of last year, but that on Man Key has again been burned over and it is questionable if any living thing is left in it.

Thanks to the authorities of the United States Bureau of Fisheries, some plantings were made within the compound of the Fisheries station at Key West where our colonies will be safe from burnings. Two colonies were established here on the opposite extremities of the seaside leg of the grounds. They consist of 500 specimens each of *Cerion viaregis* and *Cerion incanum,* and 500 each of *Cerion tridentatum* and *Cerion incanum,* respectively.

In addition to the work done at the various stations on the Florida Keys and Cuba, twenty of the hybrid Cerions from the Newfound Harbor colony have been dissected at the National Museum by Miss Mary E. Quick, under the direction of Dr. Bartsch. These show most remarkable changes in anatomic character. It is planned to make a greater number of dissections of these hybrid Cerions in order to determine the range of changes produced by hybridization.

While at the Tortugas, Dr. Bartsch exposed 1,200 feet of moving picture film with his undersea camera, photographing denizens of the coral reef. He took the precaution this year to place the camera upon a tripod, which has eliminated the seasickness-producing effects obtained during similar efforts last year when the camera was held freely in the hands while working in a rather rough sea. The negatives since developed are quite satisfactory.

As in previous years a full record of the birds seen from day to day was kept and added to the list recorded in the past. This has yielded so far not only a large series of notes on the avian population of the Florida Keys and the breeding habits of local forms, but much information on bird migration.

INSECT COLLECTING EXPEDITION IN THE PACIFIC COAST REGION

On May 31, 1924, Dr. J. M. Aldrich, associate curator of the division of insects, U. S. National Museum, left Washington on a western trip for the purpose of examining type material of insects in certain museums and collecting the two-winged flies in localities of especial interest in the Pacific Coast region.

The first official work was done at the University of Kansas, where some types of muscoid flies were examined. Next, a stop for collecting was made at Redlands, California, and two days were spent

FIG. 59.—Coast of Oregon, near California line.

in the San Bernardino Mountains with Dr. Frank R. Cole. This mountain range is somewhat isolated in position, but includes in its fauna some of the northern species of flies as well as some known from Mexico. An entirely different fauna is that of the lower San Joaquin Valley where the next stop was made at the town of Newman. In this vicinity the dry weather had made the collecting very poor, except along the banks of the San Joaquin River; but here some insects of unusual interest were obtained, including one genus new to the National Museum.

Two days were spent in the Academy of Natural Sciences in San Francisco, examining types and assisting to some extent in determining material for the museum A brief visit to Stanford University permitted the examination of some interesting type material of parasitic flies occurring on birds and bats.

From Oakland, California, the trip was made by automobile to Eureka and on up the coast into Oregon as far as Marshfield. Along this route the extremely dry season made the collecting very poor except in the vicinity of Marshfield, where the climate is comparatively humid and the collecting was much better. Two days were spent here with very good results. At Corvallis, Oregon, some type material was examined in the collection of the Agricultural College.

In the vicinity of Spokane, Washington, considerable collecting was done for two or three days, resulting in additions of some value but not of exceptional rarity.

FIG. 60.—Coast of Oregon, near California line.

Near Moscow, Idaho, the mountain locally known as Mount Moscow was visited on several days and some important material obtained. This mountain is the type locality for a considerable number of new species of insects. At Kendrick, Idaho, the greatest rarity of the trip was discovered, about 20 specimens of a fly which was originally described in 1877 from streams in Marin County, California.

Two days were spent in collecting at Summit, Montana, and at the Glacier National Park railroad station, a region from which very few flies had previously been obtained for the National Museum.

The illustrations shown (figs. 59, 60) are from photographs taken along the Pacific Coast in southern Oregon, where a very good highway winds in and out of the forests, frequently following the bluffs along the ocean.

BOTANICAL EXPLORATION IN PANAMA AND COSTA RICA

With the cooperation of the government of the Panama Canal, botanical field-work was undertaken in 1923 in the region of the Zone by Mr. Paul C. Standley, associate curator of the division of plants, U. S. National Museum, with the object of obtaining collections and data for a report upon the plant life, which it is planned to publish in the near future. Part of November, December, and most of January were spent in botanical exploration in and near the Zone. Nearly all parts of this area were visited, and 7,000 numbers of plants were obtained, represented by about twice as many specimens. These collections are now being studied and have been found to contain a number of species new to science, besides many not collected previously in the area.

The vegetation of the Zone is typical of that existing in Central America at low elevations, but it is here possible to study in close proximity the floras of the Atlantic and Pacific slopes, these floras being sharply differentiated in Central America because of differences in the climates of the two watersheds. The Pacific slope has well defined wet and dry seasons; on the Atlantic slope there is usually plentiful moisture throughout the year.

Although the original vegetation of the Isthmus of Panama has been greatly modified in many places because of long occupation by man, and especially because of operations incident to the construction and management of the Canal, there remain near the Canal extensive areas of virgin forest whose animal and plant life is of great interest. Advantage has been taken of this fact to establish recently a station for tropical scientific research on Barro Colorado Island in Gatún Lake, the island having been set aside for the purpose by the Governor of the Canal. Upon this island, largely as a result of the energy and enthusiasm of Mr. James Zetek, there has been constructed this year a laboratory building with accommodations for students, and trails have been cut to make the virgin forest, which covers several hundred acres, available for study.

The most striking botanical feature of the Canal Zone is doubtless the orchid garden formed by Mr. C. W. Powell of Balboa. In this collection Mr. Powell has assembled orchid plants from many parts of Panama, and he has in cultivation nearly all the species known to occur in the Republic. During the last ten years he has found over 300 species, about three times as many as were known previously from Panama, and many of them have proved to be forms unknown to orchid students.

FIG. 61.—Orchid garden of Mr. C. W. Powell, Balboa, Canal Zone.

FIG. 62.—*Cattleya dowiana*, native of Costa Rica, probably the finest orchid of Central America. Sepals and petals pale buff; lip deep crimson with golden veins

FIG. 63.—A patio of a Costa Rican home. Nearly all Central American houses are built about a courtyard, which is beautifully decorated with orchids, ferns, and other plants, making a delightful place in which to live. The tile floors of the corridors are frequently very elaborate and handsome. (Photograph by M. Gómez Miralles.)

FIG. 64.—*Cattleya skinneri* in Costa Rica, one of the handsomest of Central Amer can orchids. Flowers purple. (Photograph by M. Gómez Miralles.)

FIG. 65.—Method of growing the chayote (*Sechium edule*) in Costa Rica. The chayote, a relative of the cucumber, which it somewhat resembles, is one of the popular vegetables of tropical America. (Photograph by M. Gómez Miralles).

FIG. 66.—View along the Reventazón River, Atlantic lowlands of Costa Rica. The tall cane at the right is much used in the construction of houses. (Photograph by M. Gómez Miralles.)

At the end of January, Mr. Standley proceeded to Costa Rica, remaining there until the middle of April, when he returned to Washington. Costa Rica is botanically the richest part of North America. In the highlands, where the climate is temperate rather than tropical and where there is a heavy rainfall, the vegetation is extraordinarily luxuriant, and the variety of plants bewildering. Although large collections already have been made in Costa Rica, it will require many years of intensive exploration to gain an adequate knowledge of the plant life.

Mr. Standley's collection consists of 8,000 numbers of plants, many of which will doubtless prove to be new. Special attention was given to the orchids, of which about 1,500 numbers were obtained. These are now being studied by Mr. Oakes Ames, through whose interest the work in Costa Rica was undertaken. Of orchids Costa Rica possesses probably a larger number of species than any other portion of the American tropics of equal extent. Over 1,000 species have been reported from this small Republic, and it is certain that many more await discovery. While most Costa Rican orchids, like those of other countries, have inconspicuous flowers, some, such as the Cattleyas, are of unsurpassed beauty.

Visits were made to the Volcano of Poás, celebrated for its great crater, which contains a lake that erupts frequently; to the Volcano of Turrialba, whose forests are noted for their wealth of ferns; and to many other rich localities in the central highlands.

A short visit to the comparatively arid Pacific coast proved that the flora of this part of Costa Rica is relatively meager and uninteresting. Several visits were made to the wet lowland forests of the Atlantic watershed, where the vegetation is even more luxuriant than in the mountains and the species are almost equally numerous. Little is known of the plants of the Atlantic lowlands of Central America, although it is probable that no other region will better reward exploration.

BOTANICAL WORK IN SOUTHEASTERN NEW MEXICO

During part of August, 1924, Mr. Standley was detailed for field-work as a member of the Carlsbad Cavern Expedition of the National Geographic Society. This expedition, under the direction of Dr. Willis T. Lee, was engaged this year in a detailed survey of the Carlsbad Cavern, recently set aside as a national monument, and of its surroundings. The cavern is noteworthy because of its large size and lavish decorations, and is one of the most notable of the

many remarkable natural features of the State of New Mexico. Mr. Standley made a study of the plants of the plains and hills near the cavern, an area possessing a great variety of cactuses and other characteristic desert plants of the Southwest. Visits were made also to the canyons of the near-by Guadalupe Mountains. This range, partly in New Mexico and partly in Texas, has at its southern end Signal Peak, the highest point in the latter State, about which it has been proposed to establish a State park. The Guadalupe Mountains are comparatively unknown botanically, and numerous species were found that had not been collected previously in New Mexico. One of the interesting features of the vegetation of these mountains is the profusion of the Venus-hair fern (*Adiantum capillus-veneris*), a species rare in the Southwest but here abundant everywhere along the small streams.

After completion of the field-work in the vicinity of the cavern, a trip by automobile was made to El Paso, Texas, passing the southern end of the Guadalupes. From El Paso the route was followed to Las Cruces, New Mexico, and thence over the picturesque Organ Mountains and past the White Sands, a vast expanse of gypsum sand, almost pure white, resembling great drifts of snow. The White Mountains also were visited, and the road was followed to Roswell and Carlsbad, thus making it possible in a short time to gain a general impression of the varied types of vegetation covering a large area of characteristic desert and mountain country of southern New Mexico.

BOTANICAL EXPEDITION TO THE CENTRAL ANDES

During the summer and fall of 1923, Dr. A. S. Hitchcock, botanist in charge of systematic agrostology, Bureau of Plant Industry, Department of Agriculture, and custodian of the section of grasses of the U. S. National Museum, visited Ecuador, Peru, and Bolivia for the purpose of studying and collecting the grasses. He left New York May 25 and arrived at Guayaquil June 16, making a short stop at Port au Prince, Haiti, and at Buenaventura, Colombia, and a stay of several days at Panama.

The work in Ecuador was done in cooperation with the New York Botanical Garden and the Gray Herbarium of Harvard University, and these institutions shared in the specimens obtained. Therefore in this country the collections included all families of flowering plants. Several localities on the coastal plain were visited, after which collections were made in the vicinity of Huigra, a town on the railroad

at 4,000 feet elevation. Headquarters was then transferred to Quito, the capital, at 9,500 feet elevation. The only important railroad in Ecuador runs from Guayaquil to Quito, crossing the coastal plain for about 100 kilometers and then ascending through one of the valleys to the Sierra or central plateau over a pass about 10,000 feet. The train

FIG. 67.—Angel's trumpet (*Datura arborea*), a small tree about 8 feet tall with white flowers about 8 inches long. A native plant frequently cultivated for ornament in the Andes.

takes two days to make the trip, stopping overnight at Riobamba. Quito is rather cold, but Riobamba and Ambato have a very salubrious climate.

An overland trip was made from Quito to Tulcán on the Colombian border, occupying about a week. Another trip taking about three

FIG. 68.—A country road near Ambato. A species of Agave is commonly used as a hedge plant. Dr. Hitchcock's horse stands in the foreground with a McClellan army saddle taken from Washington. The uncomfortable native saddles are used with heavy pads of sheep's wool.

FIG. 69.—A street of Lima, a fine, modern city, in which the architecture, as in all South American cities, is essentially that of continental Europe

weeks was made from Guayaquil to Santa Rosa by boat and by mule to Portovelo, a gold mine in charge of Americans, to Loja, the southernmost town of importance in Ecuador, and then north through Cuenca, the third city in size, and on to Huigra. A short journey of four days was made into the Oriente from Ambato to Baños and on to Cashurco near Mera. The last collecting was done on the great peak of Chimborazo, ascending to snow line at about 16,000 feet.

Leaving Guayaquil October 11, Callao was reached October 17. In Peru two chief regions were visited, the first being the central plateau east of Lima. A railroad runs from Lima to Oroya (12,000 feet) and north to Cerro de Pasco (14,300 feet). This road is a

FIG. 70.—Atocsaico Ranch, near Junín, Central Peru. The ranch is on the great central plateau at about 13,000 feet and is mainly devoted to sheep-raising. The region lies above tree line, but provides excellent grazing.

marvelous piece of engineering, going over a pass at nearly 16,000 feet, and provided with numerous tunnels, bridges, and switchbacks. A side trip was made down the east side to Colonia Perené, a coffee plantation at 2,000 feet, and another to the Atocsaico Ranch, near Junín, at 13,000 feet, where there is excellent grazing the year around for 35,000 sheep and 1,100 cattle. Cerro de Pasco, on account of the altitude, is a cold bleak place. Here grows the curious moss grass (*Aciachne pulvinata*), covering entire hills with hard compact rounded tussocks. From here a trip was made to La Quinhua, a gold mine at a lower altitude, and another to Goyllarisquisca, a coal mine, also at a somewhat lower altitude, where the collecting was very good.

FIG. 71.—A quarry from which the Incas obtained stones for the great fortress near Cuzco.

FIG. 72.—A portion of a wall in the great Inca fortress near Cuzco. The stones are fitted with great exactness, but without mortar. A drainage opening is shown in center. The corner stones are rounded and the wall slopes a little. The Incas had no beasts of burden (the llama will carry 75 pounds, but will not pull in harness) and no metal tools. Some of the large stones weigh many tons.

The second region visited in Peru was reached by the Southern Railway from Mollendo on the coast. The first day takes one up to Arequipa at 7,500 feet, where a few days were spent. The second day takes one to Juliaca, and the third to Cuzco. A few days were spent at a new Government experiment station at Chuquibambilla (13,000 feet), north of Juliaca. This station is well-equipped and is devoting its attention chiefly to sheep-raising.

From Cuzco (11,500 feet) a trip was made down the valley northward to Ollantaytambo over a new railroad which ultimately will reach Santa Ana, head of navigation on the Urubamba river. At

FIG. 73.—Mules loaded with coca leaves at Ollantaytambo, Peru, on the way to Cuzco from the lower altitudes. Coca leaves are chewed with a paste of ashes by the Indian men to prevent fatigue. The leaves are largely exported for the production of cocaine. The growing of the coca bush is an important industry of the montañas of Peru and Bolivia.

Ollantaytambo and at Cuzco there are fine examples of Inca architecture, now in ruins, but showing the remarkable stone walls in which the irregular stones are fitted with great accuracy but without mortar.

On going to Bolivia from Cuzco the traveler returns on the Southern Railway to Juliaca, there takes a branch line to Puno on Lake Titicaca, crosses the lake by night on a comfortable little steamer to Guaqui, and then goes by rail to La Paz.

Lake Titicaca, the largest lake in South America and the highest for its size in the world, is 130 miles long, 3,200 square miles in area, and as much as 900 feet deep. The railroad from Guaqui

passes over a high plain, gradually ascends from 12,500 to 13,500 feet, then abruptly descends into a bowl or valley to La Paz at 12,000 feet. It is a very striking experience to come suddenly to the edge of the plain and look down 1,500 feet on the beautiful city below.

From La Paz a four-day journey by mule was made to the great mountain mass, Illimani, about 25 miles nearly east of the city. This snow-capped mountain is a beautiful sight from La Paz and dominates the landscape much as do Rainer and Shasta in this country. The peak is about 22,000 feet in altitude (6,619 meters) but was ascended only to snowline, about 16,000 feet.

A second journey from La Paz was to the Yungas, a region in the montañas (forested region) north of the city but on the Amazon slope of the Cordillera. The trip was made in company with Dr. Otto Buchtien, the well-known German botanist, long resident in Bolivia, who has done so much work on the plants of that country. A railroad takes one over a pass at about 15,000 feet to Pongo (about 12,000 feet), the present terminus of the road which is under construction into the Yungas. Through the courtesy of the director of the railroad, mules were furnished for a week's travel down through the provinces of Nor-Yungas and Sur-Yungas to Chulumani and Coroico. This region is the center of the coca industry of Bolivia. The leaves of the coca shrub (not to be confused with cacao or chocolate tree, nor with the coconut palm) are much used by the Indians as a stimulant. The leaves are mixed with a paste of ashes and chewed. The leaves also form an important article of export as they are the source of the drug cocaine.

After leaving La Paz a journey was made to Cochabamba, a rich agricultural district toward the east on the slope from the main Bolivian plateau. The last expedition was made through the aid of the Ulen Contracting Corporation which is constructing a railroad from Uyuni in southern Bolivia on the main line from La Paz to Antofagasta, Chile, to Villazon on the Argentine border where it will join the Argentine system. The road is now in use as far as Atocha and ultimately will complete the line from La Paz to Buenos Aires. Ten days were spent on a mule-back round trip from Atocha to La Quiaca, the northernmost town in Argentina.

The return home was made from Antofagasta, arriving in New York February 16, 1924.

The region visited consists topographically and climatically of three main divisions. There is a coastal plain mostly not more than 100 miles in width extending all along the coast. In northern Ecuador

FIG. 74.—A glacier on Illimani, altitude about 16,000 feet. Illimani, lying about 25 miles nearly east of La Paz, is a dominating feature of the landscape like our Rainier or Shasta. This and Sorata or Illampu, 40 miles to the north of La Paz, are both nearly 22,000 feet (6,619 and 6,645 meters).

FIG. 75.—In the heart of the Andes or Cordillera Real. On the way to the Yungas, a region on the Amazon slope north of La Paz. This is in the montaña (wooded mountain slopes) and is the center of the coca industry of Bolivia. Altitude about 5,000 feet.

this plain has an abundant rainfall but becomes drier to the south and in Peru is a desert. In Ecuador the chief crops are sugar and cacao. In Peru the agriculture is confined to the valleys that can be irrigated from the mountain streams. Here the crops are sugar, cotton, grain, and alfalfa. The temperature of the coastal plain is modified by the Humboldt current which sweeps up from the cold Antarctic regions and the coastal cities of Peru are much cooler than those of the Atlantic coast in the same latitude.

The central part of Ecuador and Peru is occupied by the great Andes mountain system, the Cordillera. In a general way the system

FIG. 76.—A herd of llamas at Atocha, southern Bolivia. The Bolivian plateau increases in aridity southward. The vegetation of the mountains in the background of the scene is very sparse. The foreground is a river bed that is dry, except after the infrequent hard rains.

consists of two chains with a plateau between. In Ecuador the plateau is divided into several valleys by cross ridges. In the valleys at altitudes from 8,000 to 9,500 feet lie the chief cities, such as Tulcán, Ibarra, Quito, Ambato, Riobamba, and Cuenca. In Peru the plateau is at a greater altitude. South of Cuzco (11,500 feet) it broadens into a wide area embracing all western Bolivia, the plateau being mostly 12,000 to 13,000 feet elevation for 400 miles and more than 100 miles wide. Most of the region above 12,000 feet is devoid of trees and the plain increases in aridity southward. The southwestern part of Bolivia is a desert. The plains and slopes above tree line in Ecuador are called páramos and the region is called the Sierra. They are

subject to cold winds which make travelling uncomfortable. In Peru the treeless plateaus are called punas. Many mountain ranges rise above the plateau and snow-capped peaks are numerous. The best known peaks in Ecuador are Chimborazo and Cotopaxi, more than 20,000 feet in altitude. The height and massiveness of the mountain system in central Peru is indicated by the altitude of the pass on the railroad from Lima to Oroya in the central plateau mentioned above.

In Peru and Bolivia there is little in the way of crop production on the puna, but where there is sufficient rainfall the stock-raising industry flourishes. The grazing on the puna of Peru is in the main excellent and large numbers of sheep are raised. In the valleys falling from the plateau agriculture at once begins and crops of beans (habas, the broad bean of Europe) and barley are first seen; somewhat lower are found alfalfa, corn, potatoes, and wheat.

The third primary region is the montaña, a name applied to the wet forested slopes of the Andes on the east. In Ecuador the slope is abrupt on the eastern chain of the Cordillera and soon passes into the Oriente or great rain forest of the Amazon valley. In a general way this montaña region extends through eastern Peru to the Yungas of Bolivia. Beyond that it merges into the Chaco of eastern Bolivia, which is a drier region of scant forest and grassy plains.

The botanical results of the trip have been very satisfactory. A large collection of grasses was made, which will form the basis of an account of the grass flora of the three countries visited. Already several new species have been described from the general collections made in Ecuador.

ARCHEOLOGICAL EXPEDITION TO CHINA

During the winter of 1923-1924, the Expedition sent to China under the joint auspices of the Freer Gallery of Art and the Museum of Fine Arts, Boston, carried on successful investigations at I Chou, in the province of Chihli, and at several localities in the province of Shensi. I Chou is built on the site of an ancient city, perhaps that of Yen Ching, and while there Mr. Carl Whiting Bishop, in charge of the expedition, traced portions of old earthen walls of considerable size, lying to the southwest of the present city. To the east of I Chou, groups of many large, uncovered mounds rise from the flat plains; these were inspected as were also some of the many potsherds and fragments of tile and pottery found on the surfaces of the mounds themselves. Later, Mr. Bishop made a survey of the locality by

FIG. 77.—General view of the Wang Fên Wa mound, looking southeast.

FIG. 78.—Pottery stove retaining traces of glaze; purchased from looters of the Wang Fên Wa tomb, and said to have been found there.

FIG. 79.—Pair of vases purchased in Yü-ho Chên; said to have come from tomb between Wang Fên Wa and the Hsiung Chia T'ai-tzŭ.

aeroplane, in order to determine more accurately the extent and general plan of the ancient site.

In Shensi, the members of the field staff visited the Western Han (206 B. C.–A. D. 25) capital of Ch'ang-an, securing sufficient data

FIG. 80.—Brick cist in which pottery was found; pottery *in situ*. Wang Fên Wa tomb.

while there to make a fair reconstruction of the ancient city. In the same province they inspected also, two large mounds of the usual truncated pyramidal form, ascribed to early Han emperors; the supposed tomb of the emperor Ch'in Shih Huang-ti (221-210 B. C.), and the tombs of the famous emperor Han Wu Ti (140-87 B. C.)

and his general Ho Ch'ü-ping. The tomb of Han Wu Ti is an unusually large one, measuring 278 yards at its base and presents opportunities of great archeological interest, as does also that of General Ho Ch'ü-ping, where Mr. Bishop saw not only the well-known stone figure of a horse trampling on a recumbent warrior, but examined also several other partially exposed stone sculptures of the early Han period. Photographs, and scale plans of several of the tombs and temples in this vicinity were made.

The first actual excavation work conducted by the Expedition, was begun in the spring of this year at Yü-ho Chên, about 17 miles west of Hsin-yang Chou, in the province of Honan. This specific undertaking has an added significance archeologically, in that it is the first work of the kind to be conducted in China by any foreign government in cooperation with the Chinese authorities. At Yü-ho Chên, two tombs of the Han dynasty (206 B. C.–A. D. 221), were excavated; the work revealed interesting data on ancient tomb construction and brought to light Chinese cultural objects dating from prehistoric times to the Han period. Specimens in metal, stone and pottery were found in the tombs; chariot-fittings, mirrors and arrow-points of bronze; one or two gold rings; cast-iron implements; a stone axe and parts of stone doors and lintels; a jade chisel; slate arrow-heads, and a number of pieces of ancient pottery—some intact, some fragmentary—among them a kind of glazed pottery which, if it be of Han production, is a type hitherto scarcely known to us.

In August, the Yü-ho Chên finds were exhibited for one day, under Mr. Bishop's direction, at the Historical Museum in Peking; between 5,000 and 6,000 visitors attended the exhibit.

In the early autumn Mr. Bishop, together with Dr. Barbour, professor of geology at Peking University, and Dr. Tegengren, a Swedish mining geologist, examined a mound at Peitaiho, on the gulf of Chihli, which discloses evidences of what Mr. Bishop believes may be a Han dynasty naval base or fortress; one of three which are said to have been built at that time, and of which two only have been located.

A satisfactory report on the purchases made in China during the past year cannot be prepared at this time, for, until a more detailed examination of the objects shall have been made, definite information with regard to age, provenance and type will not be possible. The purchases include Buddhist stone sculptures, Chinese pottery and bronzes, and, among the last named, a collection which we believe has come from Shou Chou, the last capital of the Kingdom of Ch'u, which was destroyed in 223 B. C.

FIG. 81.—Looking south from rear of tomb at the Wang Fên Wa, showing portions of front walls, stone door-sills, and, above, brick cist in which pottery was found.

FIG. 82.—Bronze objects from the Lei Ku T'ai; arrowpoint probably not associated with interment. (Yü-ho Chên.)

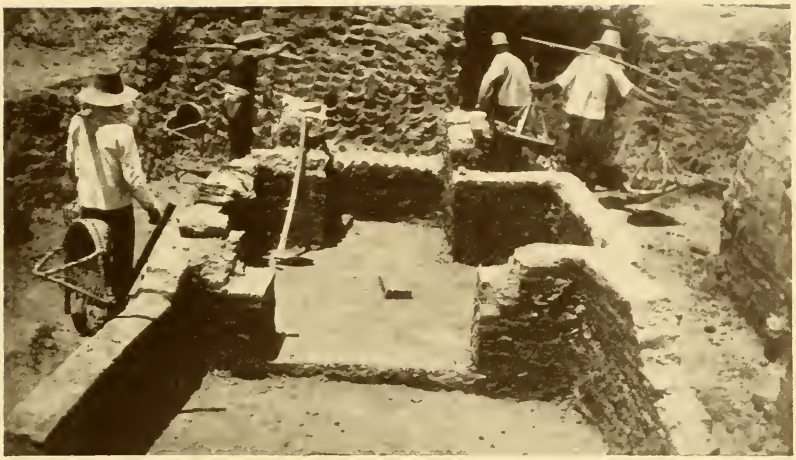

FIG. 83.—The Lei Ku T'ai mound: Tomb I, ready for measuring.

FIG. 84.—Western end of Tomb I, Lei Ku T'ai.

FIG. 85.—Mr. Tung getting out pottery found in the tombs at the Lei Ku T'ai mound.

FIG. 86.—Tombs I and II, Lei Ku T'ai; beyond, barley harvest in progress.

Important as the archeological work of our Expedition has been, a summary of the year's activities in China should include a statement concerning the perhaps still more gratifying success we have had in accomplishing what was the fundamental object of our Expedition; namely, the establishment of a cooperative agreement between ourselves and the Chinese authorities with regard to archeological research. This agreement establishes for the first time, a mutually beneficial relationship between Chinese and Western archeologists, which will prove to be, let us hope, a dignified working basis for more enlightened scholarship and valuable scientific research in this increasingly important field. The cooperative agreement between ourselves and the Chinese authorities was confirmed by the unsolicited appointment of Mr. Bishop as Honorary Advisor in Archeology to the Historical Department of the Chinese government, and, later, by the permissions granted to our Expedition, not only by the Governor of Shensi and the Director of Education for Honan, to excavate within their respective provinces, but also by the Ministry of Education, to excavate anywhere in China.

ETHNOLOGICAL AND ARCHEOLOGICAL RECONNOISSANCE IN ARIZONA

During August and September, Dr. Walter Hough, head curator of anthropology, U. S. National Museum, carried on ethnological and archeological reconnoissance work in Arizona. Revisiting the White Mountain Apache after an absence of several years, effort was made to ascertain the present status of these Indians in comparison with their condition and attitude towards innovations some years ago. Measures adopted for the welfare of the Indians give imperceptible results for a period; then the innovation is gradually accepted and finally reaches the effective stage among the larger number of Indians. In this way schools, hospitals, etc., slowly enter the consciousness of the Indian. Attempts to hasten matters unadvisedly in the past have resulted in disastrous failure, blocking the orderly course of reforms. More basic and perhaps more important is the extension of commerce and the consequent realization by the Indian of the value of money. Last year two prominent Apaches occupied American type houses. This step appears to mark the abandonment of the miserable, unsanitary tipi of brush which has held back the Apache during all his generations.

Among the Hopi it is becoming apparent that changes are in progress that will profoundly affect the persistence of this Indian group.

The young men are qualifying as artisans and necessarily the work entails a permanent absence from the pueblos. Most of them are employed in the mechanical work of the Santa Fe railroad. They

FIG. 87.—A combination of old and new. Hopi Indian, Walpi, Arizona.

receive large wages and are much esteemed for their skill. The result of this on the integrity of pueblo life is on the eve of becoming disastrous, as the older people are left on their own resources without able help. This phase in the history of the Hopi was unexpected as a disintegrating element. No one suspected that the Hopi would be

caught in the industrial maelstrom, especially as the Rio Grande Pueblos never progressed in this direction.

The archeological results of the reconnoissance were the location of several hitherto unidentified ruins, notably a large ancient settlement of apparently pre-pueblo age about five miles from Whiteriver, Arizona. A careful examination was made of the numerous picture writings on the rocks in the vicinity of Holbrook. Most interesting of these depictions was a group of snake dancers clothed in archaic costume.

FIG. 88.—Apache house, Oak Creek, Arizona.

On the journey Dr. Hough made a careful inspection of museums at Santa Fe, Los Angeles, Pasadena, San Francisco, Salt Lake City, and Denver.

MARSH-DARIEN EXPEDITION

Mr. R. O. Marsh continued during a part of 1924 his work of exploration in hitherto almost unknown regions of the Isthmus of Darien. A considerable party of scientific men accompanied the expedition, among them Mr. John L. Baer, who was deputed to care for the anthropological work on the part of the Smithsonian. The Expedition experienced a great misfortune in the sudden illness of Mr. Baer while proceeding up the Chucunaque River. He was transported

FIG. 89.—Chocó Indian house with open sides.

FIG. 90.—Chocó Indian man and woman.

1 2 3

FIG. 91.—1, Tule (San Blas) Indians; 2, Tule girl in native costume; 3, Tule loom.

immediately to the Coast, but the illness terminated fatally on May 28, the Institution being advised by the Navy Department of Mr. Baer's death.

The route followed was from Balboa to San Miguel Bay, through Darien Harbor and up the Tuyra River to the village of Real. There a change was made to smaller boats and the Rio Chucunaque

FIG. 92.—Tule Indian women in native dress.

ascended to Yavisa, near which a permanent camp was established. A visit was made to the Chocó Indians, who occupy the middle river valleys above tidewater, and to the Cuna, who live in the higher river valleys and mountain districts. The Chocó have a local government, live in large, well built community houses, and subsist on rice, bananas, plantains, corn, and yucca. They are expert fishermen, diving into

deep pools and catching certain kinds of rock fish in their hands. Their religion is a form of primitive belief in the influence of good and bad spirits. Mr. Marsh observes that they are a happy, careless, childlike people, friendly if well treated, very Polynesian-like, wearing breech-cloths, but decorated with beads, silver earrings, and wrist bands, and wreaths of gay flowers.

FIG. 93.—Tule Indian children.

The Cuna have a higher culture than the Chocó, are monogamous, have hereditary chiefs, families have separate houses, and large houses are used for tribal meetings and ceremonies. They raise long staple tree cotton, dye and weave cotton into cloth and hammocks, grow corn, plantains, bananas, yucca, coffee, chocolate and sugar cane. They are adepts with the bow and arrow and blowgun.

FIG. 94.—Chepu, Marguerite, Olo: Tule (San Blas) Indians.

FIG. 95.—Along the Caribbean coast. Tule (San Blas) Indian village and canoes.

The party proceeded up the Chucunaque River with great difficulty owing to barriers of drift logs, at last reaching the Cunas Bravos, who were regarded as hostile. The Cunas Bravos are agriculturists and exhibit a lower degree of culture than the Cunas of the lower river. The chief of the Cunas Bravos spoke good English, having as a young man shipped at Colon on an English vessel and in 12 years had sailed over half the world. It was at this point that John L. Baer became sick.

Activities were next transferred to the San Blas Indians, who inhabit a long stretch of the north coast of Panama. These Indians, who number approximately 40,000, have always kept aloof from the white man, realizing that contact with other races would work their undoing. Amicable relations were established with them and many interesting specimens of their arts and industries were collected for the National Museum. The San Blas Indians have an advanced social organization, with a ruler who could perhaps be properly classed as a king. Through the San Blas, Mr. Marsh came in contact with hundreds of "white Indians" whose presence in Panama has been known for a long time, but who have not been examined by scientific observers. Individuals brought by Mr. Marsh to the United States have been carefully examined and tentatively stated, before field studies go more fully into the matter, to present a form of albinism. Mr. Marsh states that light brown Indians having one white parent reproduce white, light brown, and dark brown children. The San Blas segregate the white children at the age of puberty, and from such information as was furnished it is estimated that one thousand individuals exist in the San Blas region. Mr. Marsh states that the San Blas Indians are capable of assimilating the essentials of modern civilization, and believes that these Indians should be given the chance to develop without contact with alien blood.

ARCHEOLOGICAL INVESTIGATIONS AT PUEBLO BONITO, NEW MEXICO

Throughout the summer months of 1924, Mr. Neil M. Judd, curator of American archeology, U. S. National Museum, continued his investigation[1] of Pueblo Bonito, a prehistoric Indian village in northwestern New Mexico, under the auspices of the National Geographic Society. In these researches there were employed ten white men, six of whom were technical assistants to Mr. Judd, and thirty-seven

[1] Smithsonian Misc. Coll., Vol. 72, Nos. 6 and 15; Vol. 74, No. 5; Vol. 76, No. 10.

FIG. 96.—Upon conclusion of the 1924 excavations, Pueblo Bonito with its 350 ground-floor rooms, its 30 ceremonial chambers, its numerous alcoves, passageways and architectural vagaries presented a most fascinating panorama. Exposed for the first time since its abandonment 1,000 years or more ago, Pueblo Bonito seems almost alive at times, echoing the songs of its vanished builders. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

Indian laborers. The explorations of 1924 mark the fourth season of the five-year Pueblo Bonito project, inaugurated in 1921 after a thorough reconnoissance of the entire Chaco Canyon region.

During the years 1921-1923 the Expedition completed the excavation of the eastern and northern portions of Pueblo Bonito. It is in the former section of the ruin that those dwellings last constructed are to be found; in the northern section are slightly earlier houses erected above the razed walls of part of that original settlement which preceded and formed a nucleus for the great communal structure now known as Pueblo Bonito. In 1924 the Expedition confined its principal activities to the western half of the ruin where rooms of both early and late construction exist. From these much new data were obtained.

As one result of the past season's explorations, it is now reasonably certain that no more than two major periods of occupancy are present in the ruins of Pueblo Bonito. These were contemporaneous throughout many successive generations and yet one was pioneer to the other. During the second period, three separate types of masonry were evolved. The culture of the original Bonitians appears to have been quite distinct; the masonry of their dwellings, the form and furniture of their ceremonial rooms and perhaps even their daily life differed from that of their later associates.

In that portion of the pueblo recently excavated are to be seen rectangular dwellings whose walls were constructed both with hard, laminate sandstone and dressed blocks of similar but more friable material. These rooms adjoin and even encompass earlier habitations in which broad, thin slabs of sandstone were utilized with abundant quantities of adobe mud as the characteristic building material. The earlier dwellings were built on a much lower level of occupancy; the later structures are especially noteworthy for the perfection and symmetry of their masonry, the trueness of their corners and the uniform regularity of their dimensions. Kivas associated with these latter dwellings are, for the most part, of smaller diameter than those observed elsewhere in the ancient village.

Among the older habitations excavated last season were four rooms which had been utilized as burial chambers. A majority of the 71 bodies interred here had been placed upon burial mats and were accompanied by mortuary offerings, including basketry and earthenware vessels. Such personal ornaments as were worn by the deceased at the moment of death were not removed. Whether the burials represent the first or second period of occupancy is a question still undetermined. But a curious fact in connection with these interments

FIG. 97.—Dwellings of the older portion of Pueblo Bonito were characterized by rude masonry, heavily plastered with mud, and by secondary supports for the ceilings of first story rooms. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

FIG. 98.—Disturbed burials and mortuary offerings on one of the older rooms of Pueblo Bonito. Prehistoric vandals had ravaged each of the burial chambers. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

is that most of them were disturbed during prehistoric times. It is quite apparent that enemy peoples had entered the rooms and ruthlessly disarranged the bodies, perhaps in search of turquoise and other treasures highly prized by primitive peoples of the Southwest. With the cultural objects recovered by the Expedition are many jewels of such exquisite beauty and artistic merit as to have proven entirely irresistible to those aborigines not related to the former inhabitants of Pueblo Bonito.

In the large number of earthenware vessels collected from these four burial chambers and elsewhere two outstanding types of ornamentation appear. Although these types were frequently found directly associated with each other, one is thought to belong essentially to the original Bonitians while the other is believed more characteristic of their neighbors of the later period. Chronologic studies made in the two principal refuse mounds and about the outer wall of the pueblo illustrate a gradual development of local pottery technique throughout the entire period during which Pueblo Bonito was inhabited. But a certain perplexity still obtains in the evidence relating to this ceramic material. This doubt is due mainly to the fact that the later arrivals were obviously the first to abandon the village and that all serviceable utensils they left behind were subsequently salvaged by those families which still clung to their ancestral home, the older or pioneer section of Pueblo Bonito.

Several of the baskets recovered from the four burial rooms are of types rarely, if ever before, recovered from prehistoric ruins other than cliff-dwellings. Shallow, elongated trays of unusually fine weave and deep, cylindrical baskets of rather coarser fabric are included in the collection. In addition, there were obtained bifurcated baskets such as have been found heretofore only in cave villages of northeastern Arizona and southeastern Utah. Three of the earthenware vessels in the season's collection simulate the general form of these two-legged affairs of unknown import.

The Expedition of 1923 uncovered a puzzling network of foundation walls on the outer northeast side of the great ruin. This series was still further exposed during the past summer and it is expected that the remaining portion will be brought to light in 1925, the final year of the Pueblo Bonito project. The fact that these interlacing walls lie buried under many feet of blown sand makes their exposure a slow and arduous task. The studies already pursued in this area suggest that these foundations were prepared, but never utilized, for a contemplated and sizable addition to the village.

FIG. 99.—Pueblo Bonito kivas are always subterranean or surrounded by walls to simulate the subterranean position required by prehistoric religious conceptions. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

FIG. 100.—Excavating one of the major kivas of Pueblo Bonito. The flat roof of the subterranean room, 44 feet in diameter, had been supported by four wooden pillars. (Photograph by O. C. Havens. Courtesy of the National Geographic Society.)

FIG. 101.—The ancient potters of Pueblo Bonito ornamented their food bowls with a wealth of geometric design. The vessel at the lower right is 6½ inches in diameter; others in the collection vary from 2 inches to 13 inches. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

FIG. 102.—Pitchers from prehistoric Pueblo Bonito. The duck-shaped vessel in the lower row is 5¼ inches high. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

FIG. 103.—Cylindrical vessels bearing the hachured ornamentation characteristic of the later period of occupancy at Pueblo Bonito. The vase at the right is 11½ inches high. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

FIG. 104.—Water jars are among the rarest of Bonitan antiquities. These two vessels are probably related to the earlier period of occupancy for their ornamentation differs noticeably from that employed by potters of the later period. (Photograph by Charles Martin. Courtesy of the National Geographic Society.)

Among the many interesting discoveries made in 1924 is one which affords some conception of the community pride which prevailed during the heyday of Pueblo Bonito. The two principal refuse mounds, where floor sweepings and other trash was deposited, were each surrounded by stone walls. These were increased in height as the mounds grew in elevation. Their obvious purpose was to prevent scattering of ashes and light debris before the tireless canyon winds. Two flights of stone steps were later constructed over the northern wall of the east mound to facilitate access to its summit.

Other walls whose intended function remains unsolved were also exposed during the summer. One of these, at no point more than two feet high, extends in a northeasterly direction a distance of 500 feet from the outer southeast corner of the ruin.

Explorations in Pueblo Bonito were brought practically to completion by the 1924 Expedition. There remain for next year additional chronologic studies and minor excavations, the fundamental purpose of which will be to explain certain still doubtful matters of prime importance. It is already evident that Pueblo Bonito was occupied throughout a much longer period than was originally suspected. Amalgamation of the two distinct groups that comprised its later population resulted in a prehistoric village whose fame reached the remotest corner of the Southwest. During the period of its greatest affluence, Pueblo Bonito was undoubtedly a center at which representatives of many unrelated tribes met for barter and trade. Evidence has been obtained that the Bonitians engaged in commerce with primitive peoples of the Pacific Coast and even so far distant as the valley of Mexico; indeed, there seems to be no cultural area in the Southwest of comparable antiquity whose members were not attracted to Pueblo Bonito. The current explorations of the National Geographic Society, therefore, have a direct bearing upon the distribution of ancient Pueblo peoples. With a considerable portion of its unwritten history recorded; with the years of its construction determined with reasonable accuracy—a former hope that seems more and more within the realm of possibility—Pueblo Bonito is destined to become a yardstick, so to speak, by which the culture of other prehistoric southwestern ruins may be gauged. As Pueblo Bonito was the most influential village yet discovered in the Pueblo area of pre-Columbian times so is it today the most important ruin in that area—a ruin which holds the key to many secrets that have long puzzled American archeologists.

PREHISTORIC ABORIGINAL CULTURE OF THE GULF STATES

Of the aboriginal culture areas within the boundaries of what is now the United States, there are two which, although related, are widely diverse. One of these lies in the four States, Colorado, Utah, New Mexico, and Arizona, the other formerly extended over portions of the Gulf States, Florida, Georgia, Alabama, Mississippi, Louisiana, or practically the Lower Mississippi Valley, Georgia, and Florida. In both these areas there was an aboriginal culture prehistoric and thoroughly Indian, which was on the decline when the region was first visited by white men. Each area was inhabited by Indians speaking different languages or dialects, but who had cranial similarities, like means of obtaining a food supply, related social customs, rites, and mythology. Ethnologists may have different opinions as to which culture reached the higher development, but they generally agree that we need more accurate knowledge of both to form a final judgment of their character.

The amount of scientific research that has been devoted to these two culture areas is quite unequal. The pueblo field has attracted so many investigators that they far outnumber those studying all other culture areas in the United States. Notwithstanding the fact that the archeology of the Gulf States is as attractive as that of the Pueblos, it has few votaries, possibly because the Pueblo culture has survived less changed into modern times. The prehistoric culture of the Gulf States may be termed Muskhogean, from the dominant tribe of the Creek confederacy, though it is not limited to people speaking any one language.

The southwest area has long been a favorite subject of study for members of the Bureau of American Ethnology. The Smithsonian was not only a pioneer worker in this area, but also for many years the sole investigator. Of late, however, this field has attracted many field workers and is now in good hands, producing annually many discoveries.

The southeastern area, although not wholly neglected since the epoch making work of Clarence B. Moore, is now making strong appeals for archeological investigation which have attracted members of the Bureau of American Ethnology. The Chief has inaugurated a new plan of work in this area, the first step being a determination of the aboriginal culture of Florida and an adequate diagnosis of its character and horizon. On the south and east, boundaries of the Muskhogean culture are limited by the Gulf of Mexico and the Atlantic Ocean; its extension northward and westward is more difficult to discover.

WORK IN FLORIDA

Archeological work in Florida was begun at St. Petersburg, Tampa Bay, in the winter of 1923-1924. It was discovered that the prehistoric

FIG. 105.—View of a road on Weeden Island, St. Petersburg, Florida, showing semi-tropical vegetation. (Photograph by Beck.)

inhabitants of the Everglade region and the Florida Keys showed scant evidences of a relationship to the Muskhogean culture, but from Tampa Bay north into the other Gulf States, archeological data supported linguistic evidences of Muskhogean influences.

Following the above-mentioned plan, Weeden Mound, near St. Petersburg, was excavated by the Chief, assisted by Mr. M. W. Stirling, through the kindness of Mr. E. M. Elliott and the Boulevard and Bay Land and Development Company. These investigations, preliminary results of which were published last fall,[1] reveal that the culture of northern Florida was in prehistoric times different from that of southern Florida.

The character of the objects obtained from Weeden Mound, as shown in the above-mentioned pamphlet, indicates that the former inhabitants of this site were allied to the so-called Lower Creeks who once lived on the Chattahoochee and Flint rivers in Georgia. These were of the same race as the Upper Creeks, denizens of the Tallapoosa and Coosa valleys in Alabama, and as the Creeks were the most numerous representatives of Muskhogean culture they may be regarded as typical of it. The archeological relation is mainly determined by the designs on the pottery, which in the case of the ceramic objects from the Lower Creeks collected on the Chattahoochee and Flint, figured and described by Mr. Clarence B. Moore, and those from Weeden Mound are practically identical. In both localities pottery designs are outlined by pitted or perforated lines, which designs and technique occur also on pottery found at Tarpon Springs, Crystal Springs, and at various other localities northward on the west and northwest coast of Florida.

There is a similarity in mortuary practices throughout the greater part of the Muskhogean culture area which occurs also in the Weeden Mound. The actual method of burying the dead among the Upper Creeks, as shown by the Graves collection at Montgomery where the skeletons were placed in urns (figs. 112, 113), is unlike that at Weeden Island, where they were free or placed in baskets. Urn burial has not been recorded among the Lower Creeks but a secondary interment or burial of skeletons in urns after the flesh had been removed has been found in the islands on the Georgian coast. Bunched burials occur throughout the whole Muskhogean area. So far as we at present know, urn burial (fig. 114) is a localized development found in different localities in the Gulf States but the bunched secondary burial of skeletons is a general feature in this culture.

The cluster of mounds on Weeden Island near St. Petersburg is easily distinguished and its site has been lately designated Narvaez Park from the Spanish leader of the expedition in the sixteenth century that ended so disastrously. On the largest mounds of this

[1] Smithsonian Misc., Coll., Vol. 76, No. 13, 1924.

cluster formerly stood Mr. Weeden's house, but earlier the Indians used it as an eating place to which they brought their canoeloads of shellfish, cooked the mollusks and ate the soft parts, throwing away the shells. Mr. Weeden's old home has now been torn down and a pavilion erected on its site. Previously a trench was run into this mound but it revealed little besides shells alternating with layers of black sand, discolored by decomposed vegetable soil. A few fragments of pottery rewarded excavation in this mound but it was singularly poor in artifacts of any kind.

FIG. 106.—Flexed burial, lower layer, Weeden Island, Florida. (Photograph by Beck.)

The conclusions arrived at by studies of this large mound were that, while its top may have served as an observatory or even the site of a building like a chief's house, it was essentially a kitchen midden composed of rejected shells or whatever human artifacts may have been lost in it by the aborigines. Almost every village site in the Gulf States culture area has a mound larger than the rest and dominating it, which was used as the foundation of the houses of the chief or of the temple in which, in some cases, the fire was kept continually burning. Such mounds were Cahokia in East St. Louis, Mo.,

and Etowah, near Cartersville, Georgia. This dominating mound is here designated the Acropolis.

Dr. Fewkes made trial pits in various other mounds of the Weeden cluster and among other elevations found a low mound of sand in which grew a few trees and scanty plants but showed no considerable number of shells. It gave promise of a much greater reward and to it the main work was devoted through the winter and early spring of 1923-24. It was found to be a burial mound concealing numerous human skulls, much pottery, and other objects of various kinds. The most striking specimens were secondary burials of human bones, of which 440 bunches were found.

These remains followed the almost universal aboriginal burial customs among people of the Gulf States. After death the bodies were allowed to decay and the flesh removed from the skeleton by "bone pickers" after which the large bones and crania, done up in bundles, were in due time placed in heaps and covered with earth, forming a mound over a dune of coral sand.

According to contemporary writers, one custom of the ancients in preparing the "bundles" for burial after flesh had been removed was to paint the skulls with vermilion. Dr. Fewkes verified this custom at Weeden Mound, for he found the paint, now in some instances dry dust, and readily removed from the bones with a brush. The skeletal material was in a very fragile condition and fell to pieces almost at the least touch.

It was noticed that a cross section of the mound exposed by a trench through it, revealed a stratification composed of two marked layers of finest sand through which are darker narrow seams of black or dark brown color. The difference between these layers is mainly indicated not by the color but by the contained pottery. The upper layer is capped by a thin superficial covering of sand which represents the modern deposit. Below it is the thick upper stratum in which were found specimens of decorated pottery, either in fragments or whole pieces, the latter in one or two instances cached. Two views of a fine bowl are shown in figure 108, *a* and *b*. The whole pieces are invariably artificially pierced by an irregular opening in the bottom by which the bowl or jar was "killed," evidently to allow the escape of the breath body or life of the bowl. In a lower layer, the pottery is coarse, undecorated, and scattered. It contained also a few implements and utensils made of shell. It would appear that the lower layer was used as the burial place of the archaic Floridian

FIG. 107.—Circular stone disk with eccentric perforation, popularly called an anchor, presented by Mr. and Mrs. Griner, Caxambas, Florida.

FIG. 108.—Two views of bowl with incised and relief decoration, from Weeden Island, St. Petersburg, Florida. Restored from fragments.

(*a*) Shows conventionalized figure of a bird.
(*b*) Figure on side at right angles to *a*.

people and from its general facies Dr. Fewkes allies it with the lower layer that has been recorded in Cuban and other West Indian Islands.

Only in rare instances is the pottery of the upper stratum painted, but almost every fragment is decorated with designs whose outlines consist mostly of rows of pits, in rare instances accompanied with relief decorations (fig. 108). Little resemblance appears in the designs on the decorated pottery from Weeden Island to those on the pottery of the Tainan inhabitants of the West Indies, but the likeness of utensils from the lower layers on these islands and on the peninsula of Florida is striking.

Dr. Fewkes found no specimens of European provenience in the Florida mound half excavated by him at St. Petersburg, which indicates that the village sites were pre-Columbian. A food bowl of coarse, undecorated black ware was found on top of the lower layer and probably is a survival of the archaic population.

From the designs depicted on the pottery in the upper layer at Weeden Mound and comparison with that described from mounds on the Chattahoochee and Flint rivers of Georgia and other Gulf States, Dr. Fewkes regards this pottery as not only characteristic but as belonging to the highest type of ceramics in the Muskhogean culture area.

WORK IN ALABAMA AND TENNESSEE

When the Wilson dam over Tennessee River at Muscle Shoals, northern Alabama, is finished, the back water of the river will flood a considerable section of its banks, covering several prehistoric mounds and permanently concealing them. In order to rescue a typical collection from these mounds before their submergence, the Bureau allotted to Mr. Gerard Fowke a small sum of money for the excavation of a kitchen midden and sand mound at the mouth of Town Creek, a few miles from Courtland. In the sand mound Mr. Fowke found human burials and accompanying mortuary objects. The most important discovery at this mound consisted of three rare copper reel gorgets, only a few of which have thus far been found.

On his trip to Muscle Shoals to inspect the work, Dr. Fewkes found several typical mounds higher up on the river banks which would well repay excavation. The largest of these (fig. 110), which is here called the Acropolis, was the foundation of a sun-fire temple. It lies in full sight of the Florence-Sheffield road and has long been a landmark, as it is probably one of the highest mounds in the Valley of the Tennessee. The present owner of this mound is thoroughly

alive to its value as an asset to the two cities, Florence and Sheffield, and has opposed efforts to cart it away for roads. Its value as a

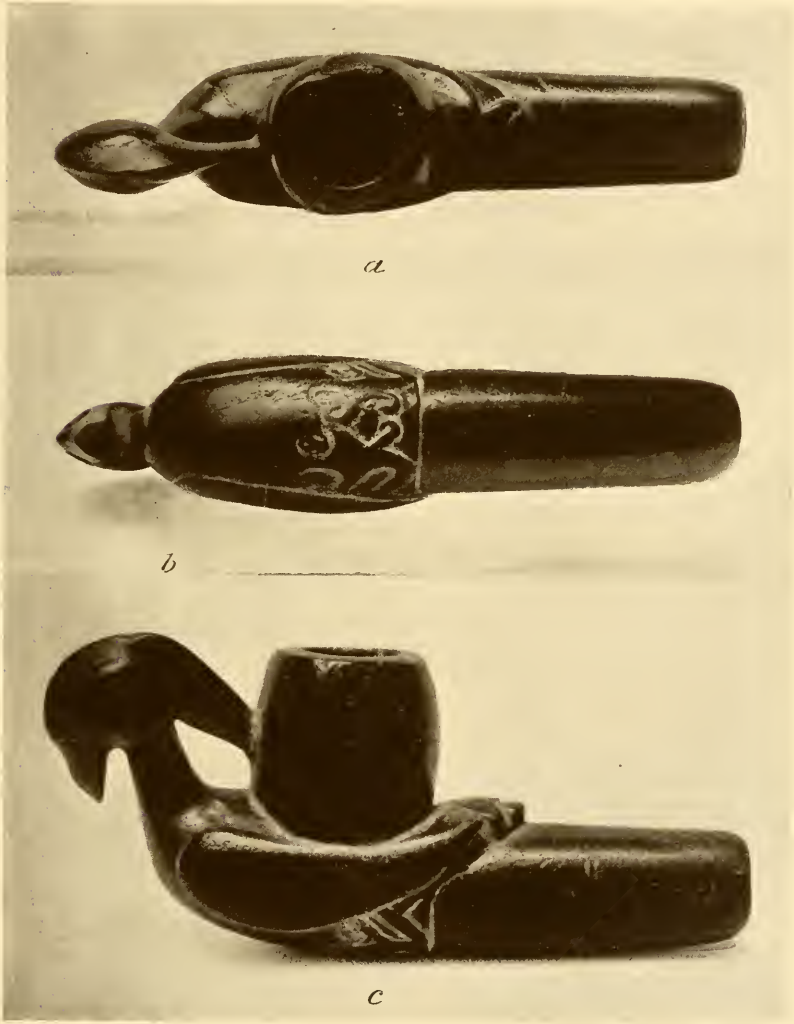

FIG. 109.—Steatite pipe, found by Weil Harris near Hyde's Ferry, on Cumberland River, about seven miles below Nashville.

(*a*) From above. Length 10″.
(*b*) From below. Width 2¼″.
(*c*) Side view. Height 2¼″.

landmark is much greater than the value of the contents for building causeways or roads.

FIG. 110.—Large mound on side of road between Sheffield and Florence, Alabama.

Mullett

FIG. 111.—(*b*) From photograph of a Catawba bowl in collection of Wm. T. Thackston, Greenville, S. C. Published by permission of owner. (*c*) Raised figure on pottery fragment from Weeden Island, Florida.

Dr. Fewkes visited the battlefield at Shiloh and inspected the remains of an aboriginal village now indicated by mounds. The beautiful pipe excavated years ago from one of these elevations he regards as the finest art product of the old Muskhogean culture. Four life size illustrations of this pipe, from *Records of the Past,* July, 1902, represent a kneeling human figure, black in color, whereas the original color is brown.

The shell mound at Town Creek yielded many specimens but they indicate a lower cultural condition than the village cluster on the Shiloh battlefield, as might be inferred from the character of the food supply.

In November Dr. Fewkes made a trip to Montgomery, Alabama, in order to locate prehistoric mounds and study the collections made near that city. He also desired to familiarize himself with the energetic work of the Alabama Anthropological Society. The visit was brief but he enjoyed the privilege of inspecting several collections of antiquities and was guided to several mounds by Mr. Peter A. Brannon, President of the Society, and other members, to whom he owes many thanks.

Montgomery is situated near the heart of the Upper Creek country and the collections of aboriginal objects made in the neighborhood of that city contain several unique Indian objects not yet described. Among these may be mentioned the burial urns of the Graves collection. Figures 112-114, published by permission of Mr. Graves, show a number of these bowls, vases, and jars used in urn burial. After death the flesh was allowed to decay and, having been removed, the bones were put in a deep vase and covered with a flat food bowl that was ultimately inhumated. The cemetery where these urns occur was situated in a corn field in which was a circular saucer like depression called by the negroes an " Indian talk house," evidently an ancient council house. An excavation of this subterranean room would probably yield what is much needed, a knowledge of architectural details as well as archeological treasures. While several of these urn burial vessels are rude undecorated pottery, there are others whose surface was incised with ornamental designs of a geometrical form. As a rule this pottery is inferior to that found at Weeden Island or on the Black Warrior River. Mr. Graves' collection also contains several unpublished shell disks decorated with finely incised naturalistic designs which are characteristic of early Creek symbolism.

On his visit in Montgomery, Dr. Fewkes was enabled to make several excursions to numerous prehistoric village sites. Among the

FIG. 112.—Burial urns from Pintlala Cemetery, Lowndes County, Alabama.

(*a*) From Cemetery, Cowles Lake, Elmore Co., Ala. Tuckbathie Bend, Tallapoosa River. Diam. 12″ x 8″. Inverted over chest of human skeleton. Graves collection.
(*b*) Collected by E. M. Graves and Dr. R. P. Burke. Diam. 12″ x 7″. Found 30″ below surface, inverted over knees of human skeleton.
(*c*) Collected by E. M. Graves and Dr. R. P. Burke. Urn 18¾″ x 13″. Inverted when found; full of ashes and bones showing influence of fire. Side of jawbone of carnivorous animal. Possibly cremation. Buried 36″ under surface. Graves Collection.
(*d*) Urn from Graves Collection.
(*e*) Design on cover rim.

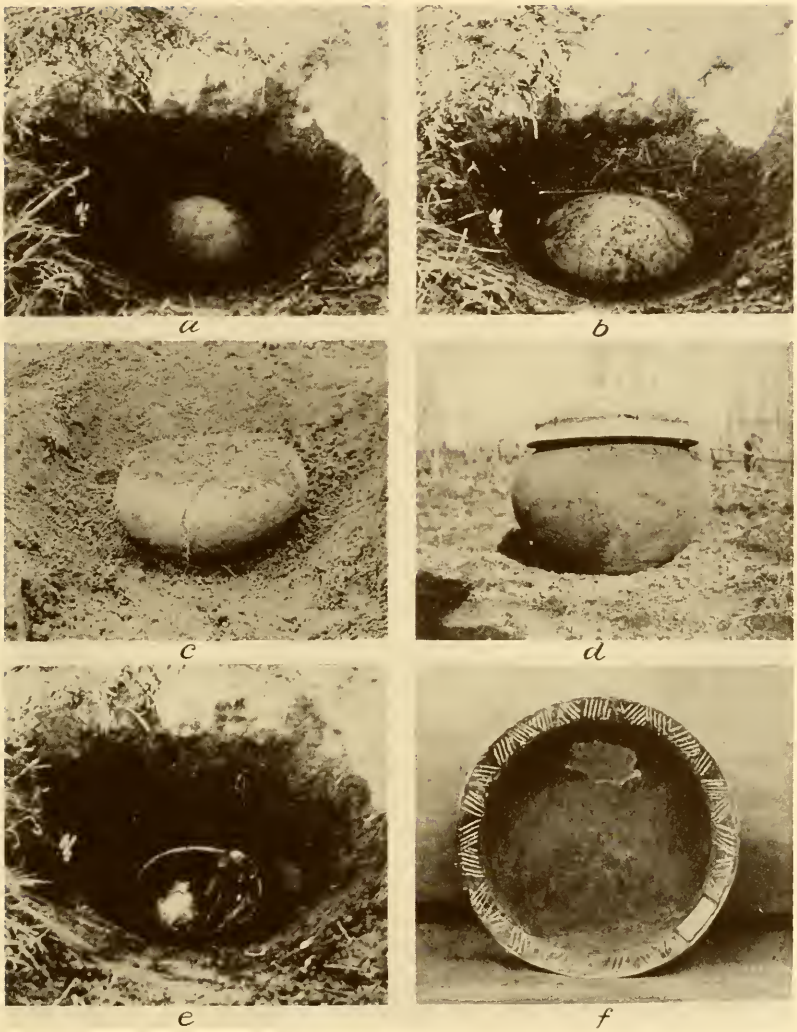

FIG. 113.—Burial urns from Pintlala Cemetery, Lowndes County, Alabama.

(*a*) Diameter 20″ x 14″. Contents, two adults and one adolescent. Buried 36″ to 40″ deep. Double cover. Eagerton Collection.
(*b*) Same as (*a*).
(*c*) Collected by E. M. Graves and Dr. R. P. Burke. Diameter of urn 24″ x 14″; covered by broken fragments of pottery. Contents, traces of child's skeleton, charcoal and ashes. Brannon Collection.
(*d*) Collected by E. M. Graves and Dr. R. P. Burke. Diameter of urn 18″ x 6″; diameter of cover 15″. Contains fragments of child's skeleton and 12 beads. Burke Collection.
(*e*) Burial urn with bones.
(*f*) Cover of urn (fig. *d*) with incised decoration on rim.

FIG. 114.—Burial urns from Pintlala Cemetery, Lowndes County, Alabama. (*a*) and (*c*) collected by E. M. Graves and R. P. Eagerton, Graves' collection; (*b*) and (*d*) collected by E. M. Graves and Dr. R. P. Burke, Burke collection.

(*a*) Diameter 14″ x 10″; cover 14¼″ x 6″. Contents, fragments of child's skeleton.
(*b*) Diameter 12″ x 7″; cover 14¼″ x 6″. Contents, remains of small infant. Buried two feet deep.
(*c*) Diameter of urn 15″ x 10″; cover 14″ x 6″. Contents, child's skeleton; associated with it, shell gorget and clay image of a woman 5½″ high.
(*d*) Diameter 14″ x 10″; cover 14″ x 6″. Contents, part of skeleton of adult. Lower vessel has columnar ridges on neck.
(*e*) Plowed up by Dock Groves, who gave it to Chas. and Ed. Hinderer, who later presented it to E. M. Graves. Contents, remains of two adults, one child.
(*f*) Urn with four handles.

most interesting was to the site of old Tuskegee and Fort Toulouse where William Weatherford surrendered to General Jackson at the close of the Creek war. The Indian settlement, Tuskegee, was most picturesquely situated at the junction of the Coosa and Tallapoosa rivers, together forming the Alabama River. Several other mounds situated near Montgomery were visited, including one at the ford where it is claimed De Soto crossed the Tallapoosa.

Dr. Fewkes examined several Indian sites and mounds of size near Nashville and Lebanon under guidance of Mr. P. E. Cox, State Archeologist of Tennessee. The most instructive were large mounds near which are stone walled graves that had never been opened. The excavation of one of these is now being made by the Bureau under supervision of the Chief. At Lebanon a rare form of bird-pipe made of steatite shown in the accompanying figure (fig. 109) was purchased for the Museum. The large mound at Lebanon is situated in a corn field and surrounded by a low embankment of earth and accompanying moat, indicating a fortification. The most remarkable object seen on the visit to this mound is the stone idol shown in figure 116. This idol was ploughed up a short distance from the base of the mound, suggesting that the elevation was formerly a temple or house of a chief, upon which it once stood.

In a determination of the Muskhogean culture area as fixed by the archeologist, we find traces of it in South Carolina, somewhat modified on account of the peripheral situation. Although little is known of the prehistoric pottery of South Carolina, Dr. Fewkes has obtained a photograph of a bowl (fig. 111) owned by Mr. Wm. J. Thackston, Jr., which is supposed to be ancient Catawba ware and shows Muskhogean influence. Dr. Fewkes examined several fine bowls of this ware decorated with figures of the sun and winged or plumed serpent, often conventionalized into incised geometric designs. These clearly indicate sun worship, a pronounced feature of the Muskhogean culture. The design on this Catawba bowl suggests parts of a highly conventionalized serpent.

A most instructive excursion near Montgomery was a visit to the Pintlala Creek cemetery in Lowndes County, Alabama, where the burial urns collection was found. These urns have been figured and described by Mr. Graves in *Arrow Points*, Vol. 6, No. 8. Additional figures of burial urns from islands off the Georgia coast and elsewhere have been given by Mr. C. B. Moore who has treated the subject of urn burials in a special article.

FIG. 115.—Pottery idol found with urn (*c*), fig. 114. Collection E. M. Graves, Montgomery, Alabama. Height, 5½ inches.

FIG. 116.—Stone idol found at the base of a large mound near Lebanon, Tennessee, by Mr. Ray Sellars. A photograph of the specimen published by permission of owner.

FIG. 117.—Excavators at work on shell mound at mouth of Town Creek, near Muscle Shoals, Colbert County, Alabama.

Although the visits of Dr. Fewkes to Tennessee and Alabama were much limited in time they have called attention to one or two instructive problems which await new observations for solution. Urn burial appears not to have been mentioned in the extended accounts of mortuary customs found in early documentary and historical descrip-

FIG. 118.—Prehistoric objects from Kittitas County, Washington.

(*a*) Pipe. Length 1⅞″; diameter ¾″.
(*b*) Enlarged incised decoration of pipe (*a*).
(*c*) Stone pipe. Length 4½″; diam. ¾″. Diam. of ferrule at one end 1⅛″.
(*d*) Carved bone ornament or implement. Length 6½″. Diam. at wide end 1″.

tion of the Creeks. We know the bunched skeletons were placed in baskets for the bone house and later removed and buried in mounds, and may readily suppose the urn took the place of the basket, but are we justified in this supposition? Furthermore, as urn burial is not the common method of disposal of the dead, this exceptional custom

may have been used only for chiefs or priests. If so we have an explanation of its occurrence around the council houses. A large number of infants were buried in urns.

It seems evident that there were local differences in artifacts, especially ceramic symbols, in different localities or areas dominated by the Muskhogean culture which may be a parallelism with what occurs in the pueblo region, but this means renewed field-work to discover the ceramic facies of each area of population in the Gulf States.

The relation of the Muskhogean and Pueblo areas calls for archeological work west of the Mississippi along the Red River where many mounds have been reported. Until knowledge of the archeology of this area is more exact, theories of the relationship of these two culture areas to each other and of both to Old Mexico are futile.

During the past year Dr. Fewkes has received from the State of Washington two characteristic straight tube pipes of a variety which is interesting in a comparative way in studying the large steatite pipe collected by him at Lebanon, Tennessee. With the same collection came also an engraved bone object of unknown use. These objects are shown in figure 118.

REPAIR OF MUMMY CAVE TOWER IN THE CANYON DEL MUERTO, ARIZONA

During the past year, Mr. Earl H. Morris, at the request of the Chief of the Bureau, did some necessary repair work on the famous Tower of the Mummy Cave House in the Canyon del Muerto. This tower is approximately 30 feet high, and 11 feet 3 inches wide, and once contained three rooms. All woodwork on the first ceiling has been torn out, only the haggled ends of a few of the supports remaining embedded in the walls.

The cleanly peeled poles which supported the second ceiling are in place, and the third ceiling—or roof—is intact, presumably because of the difficulty which would have attended its removal.

Covering the supporting poles, there is a closely-laid layer of peeled willows. Probably it is one of the most handsome ceilings remaining in any ruin in the Southwest, its only rivals being the coverings of one or two rooms in the north side of Pueblo Bonito.

For an unknown length of time the Tower has been in a dangerous condition, due principally to its undermining by the elements. Originally there was a retaining wall rising from the very brink of the

ledge in front which held in place the fill of loose rock and refuse upon which the House of the Tower stands. Eventually all but the eastern end of this wall collapsed—probably because of the insecure foundation afforded by the abruptly sloping rock, and much of the material behind it poured down over the cliff. As time went on, the not infrequent winds which sweep past the cave with unbelievable

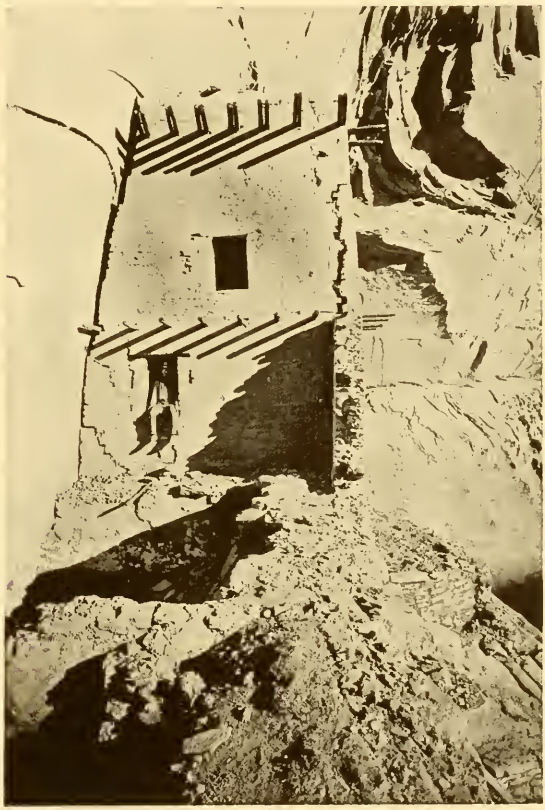

FIG. 119.—Tower from the west. New retaining wall at lower right-hand.

force whipped out the dust and smaller particles of rock until the southwest corner of the Tower was undermined more than three feet and the wall thence eastward almost to the opposite corner to a lesser degree.

As the Tower stood in the fall of 1924, the east wall was firm and secure, being bedded on the ledge to within 1½ feet of its outer end.

The west wall had settled considerably, more toward the outer end than near the cliff, and at the top the wall had leaned away from the latter fully eight inches. The front wall had split away from the west wall, and the entire southeast corner had fallen except for a short distance at the very top. Evidently the upper half of this corner had come down since Mindeleff made his report of the site (16th Annual Report, Bur. Am. Ethn., p. 114).

As for the cracks in the west wall, they were noticeably wider in November, 1924, than they were a year previous. The condition of the unconsolidated mass beneath the front wall was such that the removal of half a dozen shovelfuls of earth would have loosened the large block just beyond its western end, the temporary wedging of which, alone, had prevented the entire collapse of the masonry. In addition to the periodic action of the wind, each visitor who passed from the eastern to the western part of the cave detached a portion of the loose mass below the wall farther down the slope, and sent clods and pebbles rattling over the cliff. Thus before many years it was inevitable that the block would have been loosened, and the Tower would have gone down to its destruction. Hence it was considered that the first remedial effort should be centered upon providing a secure foundation for the ancient masonry.

To this end Mr. Morris and his party devoted November 11 to 14, inclusive. The force consisted of three white men and six Indians, with a seventh on the last day. There was no difficulty in obtaining stone, as plenty of it from fallen walls was strewn down the slope at the west end of the eastern section of the cave. Satisfactory adobe was found only in the stream bed several hundred yards away. Owing to the arduous climb, the Indians were scarcely able to provide enough material to keep the masons busy. During the five days, buttresses were built beneath and enclosing the large blocks under the west end of the Tower, and under the undermined portion of the latter, continuing back to the limit of undermining, and extending well forward of the masonry. At the junction of the two, wedges were driven to knit the new work firmly to the old. From the east end of the buttress a retaining wall was built to connect with the remnant of the old one on the brink of the ledge, and the space behind it was filled, thus providing a platform instead of the former steep slope at the southeast corner of the Tower.

The total length of walls built was 26½ feet, and their average height was 4½ feet. The thickness of the buttresses varied with the space they were to occupy. From a minimum of 1½ feet, they ranged to a

FIG. 120.—Looking west along the Tower at the beginning of repair.

FIG. 121.—New foundation of Tower from in front. All masonry below dark lines is portion of repair work.

maximum thickness of 5 feet at the point where the wall was most deeply undermined. In bedding the masonry, the ledge was swept free from dust, and where it sloped abruptly it was chipped away to provide a secure attachment of wall to cliff.

It was Mr. Morris' original idea to use cement instead of adobe for mortar. However, it was found possible to obtain the same quality of clay used by the original builders, which is as hard as brick when dry, and it was decided to use this material, thus avoiding the expense of freighting cement from Gallup, New Mexico, 100 miles distant.

Although the foundation placed beneath the Tower should remove all danger from settling, other protective measures would be highly desirable. The front wall was not perpendicular when constructed. Up to the level of the second ceiling it sloped slightly outward, and thence upward leaned toward the cliff. Since it has parted from both side walls, the maximum strain falls at the point of greatest protuberance. Gravity, augmented by the tendency of high winds to produce a swaying motion, might cause the wall to buckle at the point of greatest stress and to topple outward. Rods with turnbuckles, anchored in the cliff with expansion belts and passing through plates on the outer side of the masonry, would prevent failure of this nature. It was hoped that these could be installed within the limits of the amount expended for protection in 1924, but this was not possible. In addition to the placing of the rods, the Tower should be further strengthened by the rebuilding of the southeast corner and its careful bonding to both the front and east walls. It is to be hoped that provision for this work can be made in the near future; for the Tower, which is one of the finest gems of aboriginal architecture in the entire Southwest, thus treated, would be preserved beyond doubt or question for centuries to come.

Besides the partial repair of the Tower, a breach was filled farther along the wall which continues westward therefrom, and a foundation was built beneath the high front wall of a room near the western end of the east cave.

STUDIES ON THE TULE INDIANS OF PANAMA

ETHNOLOGICAL AND LINGUISTIC STUDIES

The bringing of a party of eight Tule Indians from Panama to Washington in the middle of October by R. O. Marsh, mining engineer and explorer, has afforded J. P. Harrington, ethnologist of the Bureau of American Ethnology, the opportunity to make an

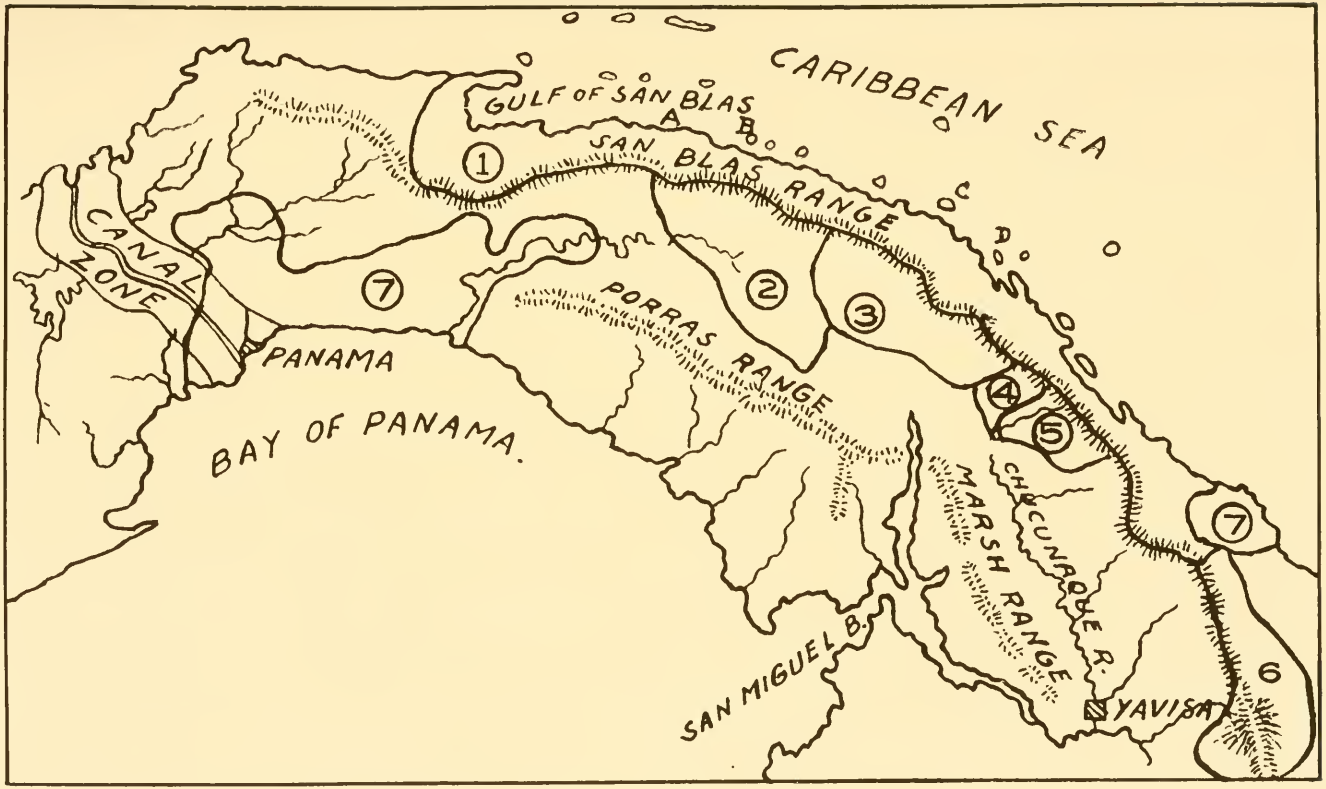

FIG. 122.—Map showing the tribal divisions of the Tule Indians of Panama. (1) Costeño, or Coast Tule. (2) Madungandidola, headwaters of Rio Bayano. (3) Wala. (4) Mardidola, headwaters of Rio Chucunaque. (5) Inakunalilele, or Mountain Cuna. (6) Argidola, about Tacarcuna Mountain and at headwaters of Rio Tanela and Rio Arquía. (7) Negroid population. A. Yantuppu island. B. Tigandikki island. C. Agligandi island. D. Ustuppu Island.

extensive study of the ethnology and language of this little known tribe, said to number some 50,000 souls.

The Tule Indians, also known as Cunas, Comogres, and San Blaseños, live along the Caribbean coast of Panama from Murru (San Blas Point) to Armila (Port Obaldia), a distance of 120 miles. They still have their own tribal government from Kwibgandi to Cacardía, a strip of coast 30 miles in length. They formerly held the coast from the region of Eskarban (Port Escribanos), 15 miles west of San Blas Point, to include the delta region of the Rio Atrato, a strip of coast 220 miles long. The tribe also holds the San Blas range, which parallels the coast at a distance varying from 5 to 20 miles, from San Blas Point to the region about Tacarcuna Mountain, including portions of the Pacific slope of the range. The linguistically related Coiba held the isthmus to the west, including Colon and Panama. The linguistic stock to the south was the Chocó Indians, who now inhabit much of the Savana, Chucunaque and Tuira river drainages.

The tribe, according to the informants, is divided into six sections as shown on the accompanying map (fig. 122.) The Negroid population is closing in on the Indians and will soon work their extinction.

The Tule language has, with the Chocó, the distinction of being the most southerly Indian language of North America, and with the Huaimi of Panama that of extending from the Atlantic to the Pacific coast.

The informants are: (1) James Perry, Alice Perry and Margarita Campos from Yantuppu (A of map), a small island in front of Nargana, 22 miles east of San Blas Point; (2) Niga (Felipe) from Tigandikki island (B of map), 31 miles east of San Blas Point; (3) Igwa Nigdibippi, who is chief over 20 islands, and Olo Piniginya from Agligandi island (C of map), 64 miles east of San Blas Point; (4) Alfred Robinson and Tcippu from Ustuppu island (D of map), 71 miles east of San Blas Point. Alfred's father is Nele, chief of the island.

Three of the party, Margarita, Olo and Tcippu, are examples of Ibegwa or White Indians, of whom Wafer writes in 1699: "There is one complexion so singular among a sort of people of this country, that I never saw or heard of any like them in any part of the world. They are white and there are of them of both sexes. Their skins are not of such a white as those of fair people among Europeans, but 'tis of a milk white, lighter than the color of any Europeans, and much like that of a white horse. For there is this further remarkable

in them, that their bodies are beset all over with a fine short milkwhite down, which adds to the whiteness of their skins. They are not a distinct race by themselves but now and then one is bred of the coppercolored father and mother." The little island of Ustuppu has ten of these White Indians on it.

The Tule say that their ancestors used to live around the base of Tacarcuna Mountain, west of the mouth of the Rio Atrato, the highest peak in their territory, and that they spread from there up the San Blas range and coast. It was at that mountain that God, Olokkuppilele, created the Indians.

The language exceeds in softness and beauty the melodious Castilian. It has no sounds that do not ocur in English. Its sounds are only 17 in number, a e i o u g ŋ d c s l r n b m w y. These occur single or double, as in Finnish, thus securing the required number of syllables for the formation of words; *e. g.*, kwālu, potato, but kwallu, grease.

The Indians know hundreds of place-names of the coast and mountains. Chief Igwa has prepared a large map showing these places.

The large collection presented by Mr. Marsh to the National Museum has afforded unusual opportunity for investigation of material culture. The sociology and religion of the Indians have formed fruitful fields of study. To assist the work the Dictaphone Corporation has installed machines for recording texts and songs.

The vocabulary comprises names of places, persons, parts of the body, sociological terms and other data. Dictaphone records of extended discourse have been made which will serve as the basis for further study of the language.

In 1914 Mr. Harrington made a six weeks study of this language at the Southwest Museum in Los Angeles, California, the informant being a Tule boy who was brought from Panama Harbor to San Pedro on a private yacht. This work was conducted through the kind interest of Dr. Hector Alliot, then director of the nuseum.

STUDY OF THE TULE INDIAN MUSIC

A remarkable opportunity for the study of primitive music was afforded by the presence in Washington of a group of Tule Indians from the Province of Colon, in Panama. This study was made by Miss Frances Densmore. The Indians were brought to the United States by Mr. R. O. Marsh and became known as "white Indians" because of the fair skin of certain individuals. A frequent occurrence

of fair-skinned individuals in this tribe was noted by Wafer, who wrote concerning them in 1699. It is not unusual for parents of normal Indian coloring to have children with skin of a peculiar milky whiteness, blue eyes and pale yellow hair, the skin, in many instances, showing irregular blotches of light brown. A family may contain both dark and fair children. The group brought by Mr. Marsh comprised five adults, all of whom were dark in color, and three children who were fair. The study of their music was carried on entirely with the adult members of the group during November and December, 1924, and was made possible by the courtesy of Mr. Marsh.

VOCAL MUSIC

Among the Tule Indians brought to the United States was a chief named Igwa Nigdibippi who had made a special study of the tribal songs. If he were a member of our own race he would be termed a man of practical intelligence and artistic culture. The head chief of the Tule is an old man, and on his death Igwa may be elected as his successor. In view of this possibility Igwa is cultivating his knowledge of the geography of the region with its irregular coast line and hundreds of islands and "keys." He draws maps which show the location of the villages, indicating the approximate number of inhabitants in each. His care and ability in this work added weight to his statements concerning the music of his people, who do not adopt any songs from neighboring tribes but maintain their own musical customs. Associated with him in giving information were James Perry and his wife, Alice Perry, and Alfred Robinson who acted as interpreter. These three did not give the Indian names by which they are known at home, and the names here presented have been recently acquired. The recording of the songs was done entirely by the chief, a dictaphone being used for that purpose.

The singing tone used by the Tule chief was somewhat different from that used by the Indians of North America. It was even more artificial, with a "pinched," forced quality not particularly pleasing to the ear and impossible to describe in an accurate manner. The Tule songs are without instrumental accompaniment in our use of that term. The flute and rattle are sometimes played while the people sing and dance, and the singers sometimes clap their hands, but the flute and rattle do not seem to have either a melodic or a rhythmic relation to the song. No form of accompaniment was desired when the songs were being recorded and it was said that the voice was entirely alone in the "songs with stories." The flute was played dur-

ing the prolonged tones of the wedding music which occurred at regular intervals.

In this, as in all Indian tribes, it was impossible to obtain a verbal description of the music. It was necessary to record songs, study the records, and question the people concerning them. The first song recorded was about seven minutes in duration. When it was finished the chief was asked to explain the words. These words were highly poetic and contained an entire narrative, working up to a climax and

FIG. 123.—James Perry blowing conch shell trumpet.

ending in a conclusive manner. The song related that a group of young girls walked among the bright flowers, a young man appeared, and later was shot by a jealous rival. Another song was requested and the chief sang of a race between several canoes (dugouts) equipped with sails. In this song a storm arose, followed by a calm and a favoring breeze, the song ending with the wedding of the captain who won the race, while the sailors danced at the wedding. From these examples it was evident that the words of Tule songs afforded as much pleasure as the melody.

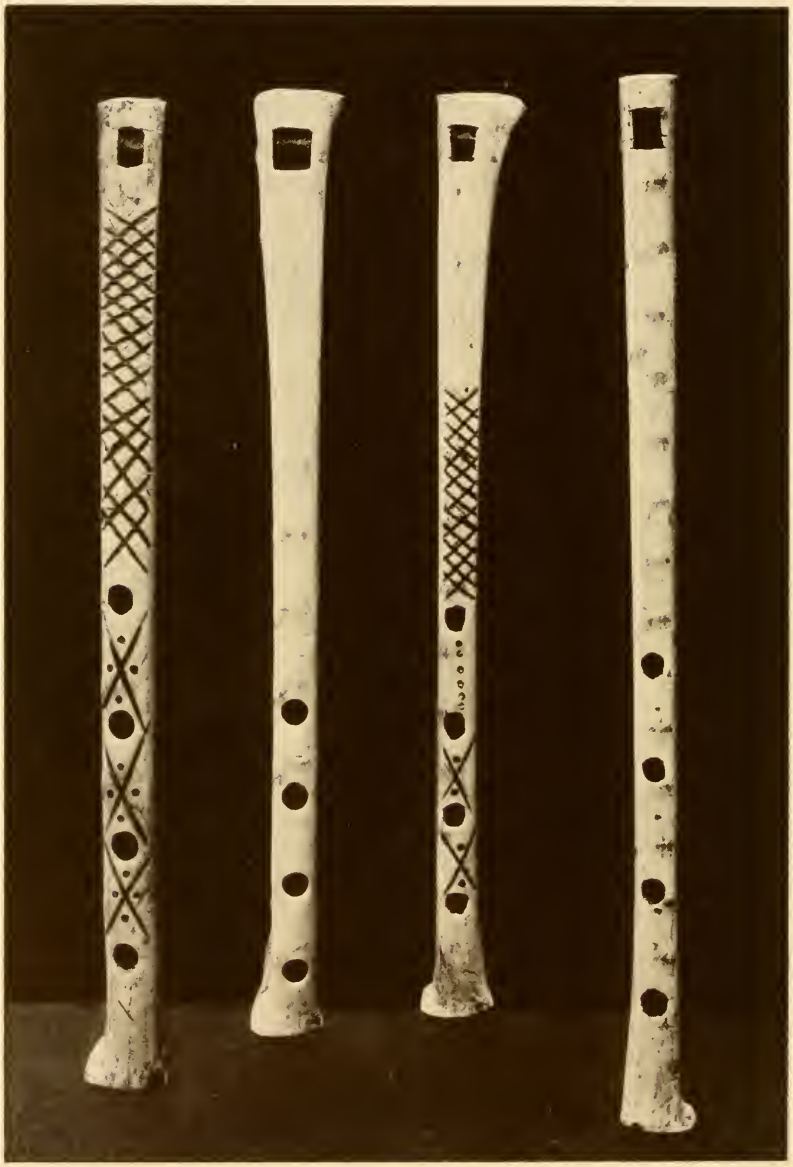

FIG. 124.—Whistles made of wing-bones of pelican and buzzard.

The chief was asked whether his people used music in the treatment of the sick, and he responded with a song for the cure of headache, containing the following words:

I bring sweet-smelling flowers and put them in water,
I dip a cloth in the water and put it around your head,
Then I bring a comb, part your hair smoothly and make it pretty,
Everyone comes to see you get better,
And I tell you that you will never be cold again.
Go to sleep and dream of many animals, mountain-lions and sea-lions,
You will talk with them and understand what they say,
When you wake you will be a doctor, like me.

It was said that a doctor "received his songs in dreams," and sang when preparing his most difficult remedies. He did not shake a rattle, nor make any commotion when treating a sick person, as is frequently done by the Indians of North America. The chief expressed the opinion this would increase the illness of the patient.

Certain songs were sung after the death of a man, and in these songs the man's spirit was directed on its way to a "happy place." Such a song was recorded and may be summarized as follows; in this portion of the song the sick man speaks to his wife.

The fever returns. I drink the medicine and throw it on my body.
The fever grows worse. I am going to die.
My breath grows difficult, my face is pale,
The medicine does not help me. I am going to die.
Talk to my two children about me, after I am gone.
I leave the cocoanut farm for my children.
After I die you will go to the cocoanut farm and take the children with you,
There you will think of me.
If people go to our cocoanut farm and cut the trees
You must track them and find who did it.
I am leaving the plantain farm.
There will be plenty of property for the children.
I leave the small fruits, the mangoes, the bananas and other fruits,
Think of me when you gather them.

The song then mentions his skill in hunting and fishing, enumerating the results as he had named the fruits on his farms. He tells his wife to marry again in a short time, then dies, and the remainder of the song concerns the directing of his spirit on its way.

The principal social event of the Tule is a wedding, to which the people come from all the villages. They dance and sing for several days, according to the wealth of the bride's father who provides the entertainment. The writer first obtained a full and detailed account of the wedding customs, and then asked for a wedding song. When this had been recorded she asked for a translation of the words.

The reply was: "He sang just what we *told* you. He sang how the father gets the presents ready, the chief tells the people, the chief musician makes a new flute to play at the wedding, and everybody sings and dances just like we told you. He *sings* that in the *song*."

The custom of singing to secure success in games is common among the North American Indians but absent in the Tule. Descriptions of five games were obtained but it was said that games were played only by young boys. The Tule are a hard-working people, living on the islands, or keys, and cultivating ground on the main land, going thither in the early morning and returning at night. A man's wealth depends on his efforts to push back the jungle and keep it back, thus enabling trees to grow from which he can sell the fruit.

The test of a song, as recorded among the North American Indians, has been a comparison between records made at intervals by the same or other individuals. In accordance with that method of work the writer asked for a repetition of the song concerning the canoe race, after a period of a few days. On comparing the two renditions of the song there was found to be only a general resemblance in the melodies. It may be recalled that, among the North American Indians, the repetitions of a song by the same or another individ often are absolutely exact, instances having been noted in w renditions by one person at intervals of several months were ide even in pitch and tempo.

Tule songs are a form of primitive music that, it is believed, has not hitherto been described. Vocal proficiency, among the Tule, consists in improvising melodies instead of repeating them with exactness, yet songs are "learned," and each song recorded has a distinctive character. For instance, the song for relief of headache is a soothing melody, and a song concerning eight articles has a recurrent phrase when each, in turn, is mentioned. The general character of the songs is gentle and pleasing. They have a compass of three to six tones, though the melody is usually within a compass of five tones. Nine songs have been transcribed, either wholly or in part. They contain measures of two, three, five or seven beats, occurring in irregular order and probably determined by the accented syllables of the words. The songs bear no resemblance to chants but consist of short melodic phrases of equal length, each concluding with a prolonged tone. The substance of the words is established but it seems probable that the identical words are not repeated. This would be exceedingly difficult in songs of such length, and, if done, would

tend to create a rhythmic pattern in the melody, causing it also to be repeated with exactness.

The chief said that he began the study of songs when he was ten years old. The first song he learned was the first he recorded for the writer. He gave the name of the man who taught him, saying it took him a long time to learn that first song. Seven years later, this man having gone away, he went to another from whom he learned about 30 songs. First he learned miscellaneous songs, and later learned those sung when preparing medicines and treating the sick, though he is not a doctor. Recognized standards of music were further shown by the statement that certain persons were "good singers" while others "could not sing."

INSTRUMENTAL MUSIC

No drum is used by the Tule, neither do they pound upon a pole or other object. In this respect they are unique among primitive people. A neighboring tribe uses a tall wooden drum with a hide stretched across one end, but the Tule have never adopted this instrument. The statement concerning the absence of a drum was confirmed by Major H. B. Johnson, formerly a Lieutenant of the Black Watch, B. E. F., whose acquaintance with these people extends over three years. Major Johnson went to Panama with a British expedition in 1921 and became especially interested in the Tule. He was also a member of the Marsh Expedition in 1924.

The musical instruments used by the Tule are the conch-shell trumpet, bone whistle, pan-pipes, flute and gourd rattle. The first named is made by piercing a mouth-hole in the tip of the shell. The only variety used in this manner is the *Casis cameo* Stm. (fig. 123). This instrument, with its far reaching tone, appears to have been used only as a signal.

Whistles are made of the wing-bone of the pelican and king buzzard. They have four finger-holes and are decorated with lines burned with a hot iron (figs. 124, 125). These, as well as the other instruments illustrated, are in the Marsh Collection at the U. S. National Museum.

The pan-pipes are made of a different, smaller reed than the flutes. A set consists of two parts, each of which has three or four reeds bound together with a cord, and the two parts are connected by a cord nine or more inches long. In the two sets under observation the shortest reed is $4\frac{1}{2}$ inches, and the longest $14\frac{1}{2}$ inches, in length. It was said that pan-pipes in the native villages frequently contain reeds

FIG. 125.—Igwa Nigdibippi playing bone whistle.

FIG. 126.—Igwa Nigdibippi and Alfred Robinson playing pan-pipes.

two or three feet long. Such reeds would give a deep, resonant tone. The instrument has a surprisingly loud tone, resembling that of a steam calliope, though it can be played with a moderate tone. It is

FIG. 127.—Igwa Nigdibippi playing flute and rattle.

played for dancing and for "serenading the girls." Two sets are usually played together (fig. 126), one player sounding one tone and the other the next tone, alternating in this manner throughout the

performance, and improvising the melody. Only one of the Indians present in Washington was an expert player on this instrument. In order to show the full capacity of the pan-pipes he played alone, giving a performance marked by a rapid succession of high and low tones

FIG. 128.—Gourd rattles used by Tule Indians.

suggesting that on a concertina, he also gave interesting rhythms on a single tone—rhythms that might be indicated by "dots and dashes." It is probable that two expert players, at home, would show this skill and variety when playing the alternating-tone melodies above described.

FIG. 129.—Alice Perry in native costume.

The Tule flute is of a type which, it is believed, has not been observed elsewhere. It has two finger-holes but no " whistle opening " and is held inside the cavity of the mouth, possibly touching the roof

Fig. 130.—Tule women at home.

of the mouth. For this reason the term " mouth flute " seems applicable to it (fig. 127). The specimen under observation is 24½ inches long and the finger-holes are respectively 5 and 6 inches from the lower end. The pith is removed from the reed and the opening

flushed with water to remove all shreds, after which the holes are burned with a heated iron and shaped with a sharp knife. The implement used in removing the pith is the stiff quill of a tail feather of the wild turkey.

The player usually shakes a gourd rattle with his right hand, fingering the flute with his left hand. The music at weddings is provided chiefly by two flute players, each with a gourd rattle, one being the Chief Musician who is accorded great honor, while the other is his assistant. The melodies played on the flute were simple and pleasing. Dictaphone records of the music of the flute and pan-pipes were made and transcribed in musical notation. The former intrument produced the tones of the minor triad on E flat, and the latter had a compass of seven tones. In one instance the melody played on the pan-pipe was based on G flat, and in another it was based on G.

The gourd rattle of the Tule is of the usual type, a round gourd being pierced by a stick which forms the handle, but differs from the rattle of North American tribes in that the gourd is often fastened to the handle by a cord that passes through it (fig. 128). Two types of gourd rattle are in use, one by the men and the other by the women. The former, used in connection with the flute, is not large in size but contains rather heavy pebbles. The latter is of two sorts, one being used by the women when dancing and the other "to put the babies to sleep." Information concerning these rattles was given by Alice Perry (fig. 129). The woman's dancing rattle contains many small pebbles, one being shown as the large, decorated rattle in the accompanying illustration. The second named is a smaller rattle (in the illustration) and contains numerous small pebbles and one rather large pebble. When this rattle is shaken the first resultant sound is that of the small pebbles, this is followed by the rolling of the larger stone which, continued steadily, has a peculiarly soothing effect. The Tule, like other tribes, have songs which are sung by mothers to put the children to sleep, but this is the first instance known to the writer in which Indians use instrumental music for this purpose.

The native dress of the women, with a glimpse of native environment, is shown in figure 130, a picture taken ten or more years ago. Attention is directed to the heavy necklaces of silver coins and the armlets and anklets of beads. The cotton tunics are decorated with appliqué designs of material in a contrasting color, the work being done with neatness.

RESEARCHES ON THE BURTON MOUND AND ON THE KIOWA INDIANS

The beginning of the year found Mr. John P. Harrington, ethnologist, engaged in the excavation of the principal village of the Santa Barbara Indians, known to them as Syujtun, to the early Spaniards as El Puerto de Santa Bárbara, and in more modern times as the Burton Mound. The great mound which marks the site is situated on the Santa Barbara waterfront, a block west of the principal wharf, on property now belonging to Mr. Ole Hanson and to Mr. Charles Frederick Eaton. The old village site has always been the most prominent feature of the Santa Barbara beach, and is most famous in Santa Barbara Indian and Spanish history, but had never been excavated to any extent previous to the present work.

The great village of Syujtun was mentioned four times in the Cabrillo account of 1542. Father Crespi writing in 1769 mentions its population as comprising 500 souls. With the establishment of the Santa Barbara Mission in 1782 the inhabitants were removed to the adobe cuarteles provided for them at the mission. The mound became the "beach ranch" of the Franciscans, later the site of the ranch house of Joseph Chapman, and more recently the property of Lewis T. Burton. In 1901 Mr. Milo M. Potter built a large hotel on the mound. In 1921 the hotel, which had been purchased by the Ambassador Hotel Corporation, burnt, thus releasing the site again for scientific study. Through the kind offices of Mr. George G. Heye, director of the Museum of the American Indian, money was raised for excavation of the mound by joint arrangement with the Bureau of American Ethnology.

The results of the excavation of the Indian town of Santa Barbara proved rich and interesting beyond expectation. The collection, which comprises more than seven thousand specimens, includes many large and showy pieces, such as steatite ollas, mortars and metates. Some of the graves were lined with slabs trimmed from the bones of whales. Quantities of the mother-of-pearl pendants and ornaments of the Indians were obtained, as well as shell beads of many types. The bodies were mostly in crouched position with the head to the north. In addition to the cemetery, many old wigwam sites were explored and the outline of the whole settlement slowly and laboriously traced. In the reef rock or coquina layer of the lower levels of the mound were found embedded two skeletons which have been reported upon by Dr. Bruno Oetteking, Physical Anthropologist of the Museum of

FIG. 131.—Santa Barbara, California, in 1828, showing the Burton Mound in the foreground (directly back of ship). Earliest extant picture of Santa Barbara.

FIG. 132.—The Burton Mound in 1897. (Painting by Alexander F. Harmer.)

the American Indian, and on which further studies are now in progress. The coast of California has undoubtedly been inhabited continuously for a long period, and the mound forms one of the best monuments for the study of a stable Indian culture. Associated with Mr. Harrington in this work are Professor D. B. Rogers, formerly of the University of Kansas, and Mr. G. W. Bayley.

At the beginning of February Mr. Harrington returned to Washington, D. C. On April 15 opportunity was afforded for further study of the Kiowa tribe by the coming to Washington of Eimhå'ä (Delos

FIG. 133.—Metacarpal needles from Burton Mound. These occur ready-made, except for boring and rounding the head, in the fetlock of the California mule deer. One of the most unique discoveries among the artifacts.

K. Lonewolf), adopted son of the former head chief of the tribe, and Seitmânte[n] (George Hunt), one of the chief men of the tribe. Work with them was continued until May 21, yielding a great mass of ethnological and mythological material.

The true inner history of the suppression of the Kato or Sun Dance of the Kiowa was secured. The ethnological data of Mooney's Calendar History of the Kiowas were corrected. The myths obtained are without exception pretty and well told. They are as follows:

(1) The Seven Star Girls. This myth accounts for the huge pillar of rock known as the Devil's Tower, 20 miles southeast of Sun Dance,

FIG. 134.—Eimhå'ä, "Rescuer" (Delos K. Lonewolf), Kiowa informant.

FIG. 135.—Seitmânten, "Bear Paw" (George Hunt), Kiowa informant.

Wyoming, and takes us back to the ancient period when the Kiowa held the Black Hills. The girls became the Pleiades. (2) Seindei (the culture hero) Jumps across the Missouri River. (3) Seindei and the Bear. (4) Seindei and the Quails. (5) Seindei and the Four Pemmican Brothers. (6) Seindei Meets Whirlwind Girl. (7) Seindei Invites the Woodpeckers. (8) How Crow Became Black. (9) The Loosing of the Buffaloes. A remarkable story of how Seindei visits the keeper of the buffaloes. (10) Seindei and the Prairie Dogs. (11) Seindei and Coyote. (12) Seindei and the Rabbit. (13) Seindei and the Turkey. (14) Seindei and the Mountain Ghosts. Seindei induced the Mountain Ghosts to take out their hearts and to lay them in a pile when they visited a place where they were likely to become scared. In this way he eliminated these powerful demons from the earth.

Old hunting and fighting stories were also obtained, including a long account of a raid in Mexico.

ETHNOLOGICAL RESEARCHES AMONG THE FOX INDIANS, IOWA

Dr. Michelson left Washington towards the close of May and proceeded to Tama, Iowa, to renew his researches among the Fox (Meskwakie) Indians. He devoted especial attention to the various gens festivals, for example, the White Wolf Dance of the War Gens. Some texts on a number of sacred packs were translated. A good deal of general ethnology was obtained in both syllabary texts and translations. Some of this included the regulations of various gentes and societies. Additional information on the White Buffalo Dance and mortuary customs and beliefs was secured in time to be incorporated in the 40th Annual Report of the Bureau of American Ethnology (now in galley-proof). In his spare time Dr. Michelson gathered quite a little Winnebago and Potawatomi ethnological data from the small group of each of these tribes which habitually stays at Tama with the Fox. The data on the first largely corroborates that given by Dr. Radin in the 37th Annual Report of the Bureau of American Ethnology, and in some instances supplements it. The data on the Potawatomi is important as showing that among this tribe there are close correspondents to the Fox gens festivals. Towards the close of June Dr. Michelson returned to Washington.

A brief explanation of some of the ethnological data in the preceeding paragraph may not be inappropriate. The Foxes are organized in a number of exogamic totemic groups. These groups are named after animals for the most part, *e. g.*, Bear, Wolf, Eagle. Male

members of these groups had a special hair-cut, appropriate only to their own groups. Personal names showed to which group the owner belonged; however, occasionally a person might be named

FIG. 136.—Fox mat of rushes, used for exterior of wigwams, etc., being made by Mrs. Charley Keyosatuck. (Photograph by Michelson.)

by another than his or her father; in this case the person would have a personal name appropriate to the gens of the namer, but would belong to the gens of his or her father unless it had been stipulated at the time that the person should belong to the gens of the namer.

These various gentes owned one or more sacred packs (not to be confused with individual personal packs) connected with an appropriate ritual and dance; also they had special songs to be sung the night

FIG. 137.—Fox bag made of bass-wood, in the process of construction (Photograph by Michelson.)

preceding the burial of the dead, and one or two special features in burial customs. At least two possessed definite paints appropriate to themselves (Bear gens, green paint; War gens, red paint). Some of these gentes had subdivisions, and in such cases one of the sub-

divisions ranked higher than the other or others. Thus the Bear gens is composed of the Black Bears and Yellow (Brown) Bears; the tribal chieftainship was in the Black Bear division of Bear gens. This is why some Fox Indians objected to Pushitoniqua (the last chief recognized by the federal government), because he was of the wrong division of the Bear gens. The sacred packs were used especially in war. With appropriate songs and rituals one could become invisible; the bullets of the foe would not hit their mark; wide rivers would become narrow so one could retreat if hard pressed by the foe; etc. The packs are supposed to be acquired by fasting in the wilderness when various manitous would take pity on those fasting and bestow blessings.

FIG. 138.—Fox bark-house of elm. Harry Lincoln is standing at the door-way. (Photograph by Michelson.)