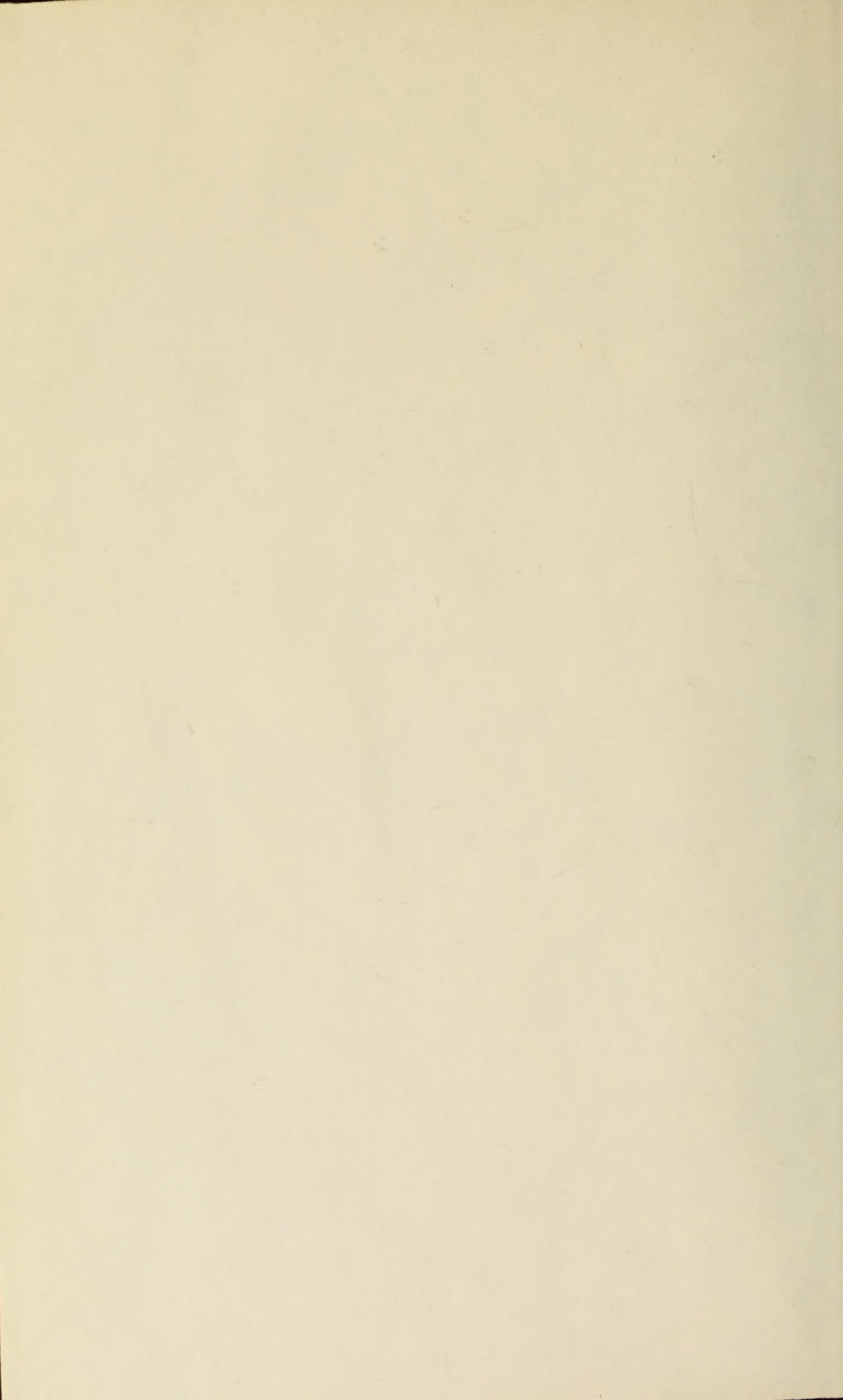


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NATURAL HISTORY

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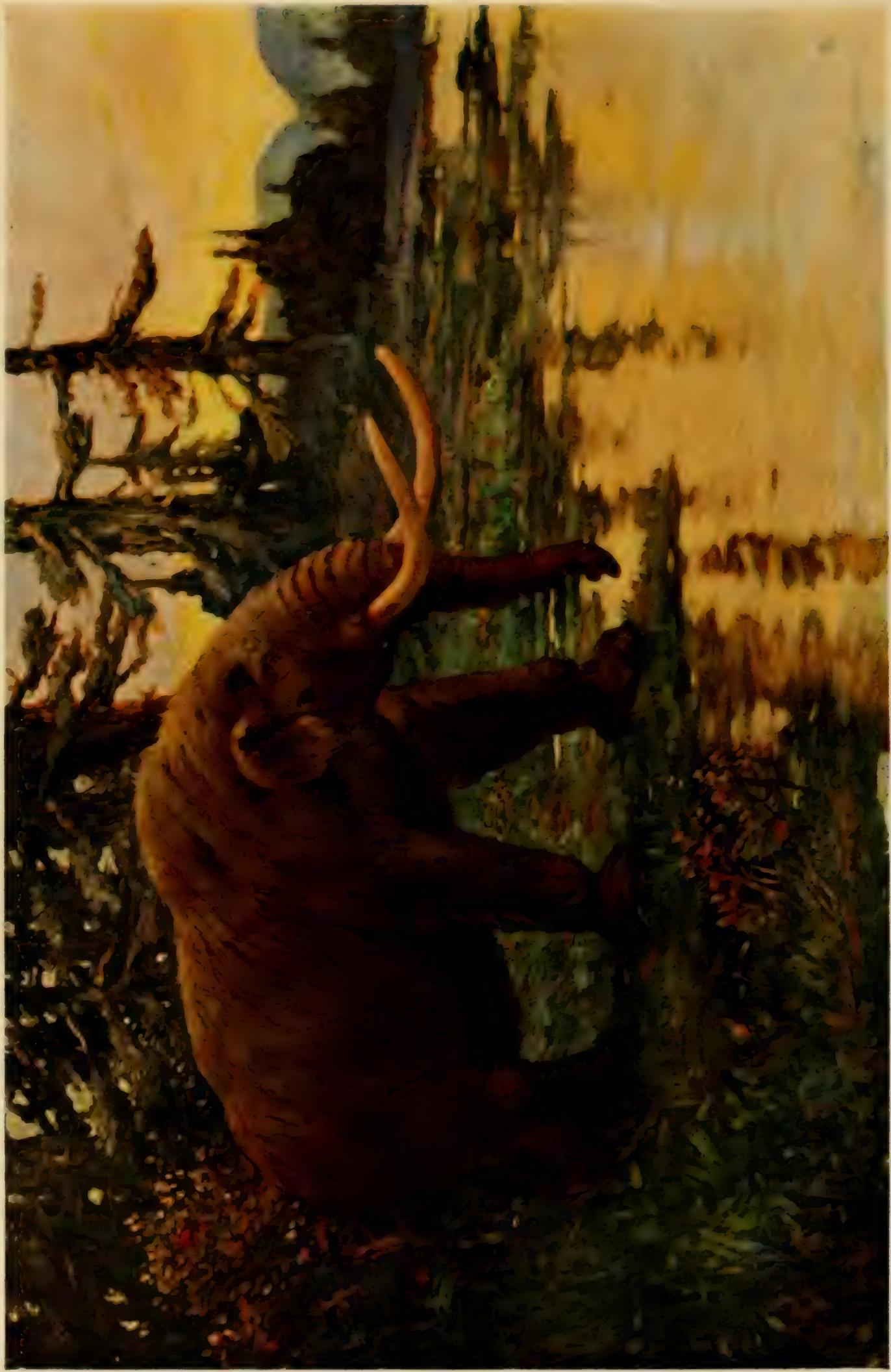
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THE FINAL RESTORATION PORTRAIT OF THE WARREN MASTODON.—It represents the animal as he appeared in life just before he sank into the shell-marl basin, six miles northwest of Newburg, between 20,000 and 30,000 years ago. The painting was executed by Charles R. Knight in 1908, under the direction of Henry Fairfield Osborn. In the right distance is the north gap in the Hudson River Highlands, Storm King mountain on the right and Break Neck on the left. In the foreground is one of the shallow sheets of water covering the shell-marl in which the remains of the animal were so perfectly preserved.

The flora of the forest corresponds with the description of Professor Asa Gray in letters addressed to Doctor Warren, describing the contents of the mastodon's stomach: "On examination by the microscope, the fragments present the aspect of the terminal bough of coniferous trees . . . from the structure of the woody fibre, they were boughs of pine or spruce of some sort, and they minutely agree with the wood of hemlock spruce; so that this is very probably the species they belonged to, but there is no certainty of it."

NATURAL HISTORY

VOLUME XXIII

JANUARY-FEBRUARY, 1923

NUMBER 1

Mastodons of the Hudson Highlands

BY HENRY FAIRFIELD OSBORN

President of The American Museum of Natural History

One of the greatest treasures of the American Museum is the unrivaled skeleton of the fossil proboscidean known as the WARREN MASTODON. The present article gives the fullest and most authentic history of this specimen which has ever been published, thanks to the testimony of several eyewitnesses who have kindly written to the author and to others.

THE WARREN MASTODON, found in 1845, was the fifth in a series of discoveries of mastodon skeletons, beginning with Peale's first skeleton of 1799, which like the WARREN MASTODON was found in Orange County, New York. The first reference to mastodons along the Hudson was, however, as early as 1705.

The following table relative to early discoveries of the mastodon has been compiled from *The Mastodon Giganteus of North America*, which Dr. John Collins Warren published in 1852:

- 1705.—First mention of finding mastodon remains near Albany.
- 1714.—First published account of two teeth and a thigh bone found at Claverack, on the Hudson, thirty miles south of Albany.
- 1799–1801.—Peale's first skeleton, found on John Masten's farm, Orange County, New York. See Warren, Plate I, upper left-hand figure. Exhibited in London; in Peale's Museum, Philadelphia; and then disappeared.
- 1802.—Peale's second skeleton, "Baltimore Skeleton," purchased by Doctor Warren in 1848, dismantled. A very large jaw, described by Doctor Warren. See Warren, Plate I, upper right-hand figure.
- 1840–43.—Koch's "Missourium," a composite of several specimens found near Kimmswick, Missouri. Remounted by Richard

Owen, in the British Museum. See Warren, Plate I, lower right-hand figure.

1844–45.—"Cambridge mastodon," found near Hackettstown, Warren County, New Jersey, twenty miles from Newark. See Warren, Plate I, lower left-hand figure.

1844.—"Shawangunk Skull," found near Scotchtown, Orange County, New York; now in the American Museum. Warren Collection.

1845.—The WARREN MASTODON in the American Museum, found on the Brewster Farm, Orange County, New York. See Warren Memoir, Vignette; also Plate I, center figure; also Plates IV to XXV.

In *An Outline History of Orange Co.*, by Samuel W. Eager, published in 1846–47, only a year after the discovery of the Warren Mastodon, is found the following quaint narrative of the succession of discoveries in Orange County, and an interesting reflection of the scientific opinions of the middle of the nineteenth century.

"We cannot, without disrespect to the memory of a lost but giant race, and slighting the widespread reputation of old Orange as the mother of the most perfect and magnificent specimens of terrestrial animals, omit to tell of the mastodon. Contemplating his remains as exhumed from their resting place for unknown ages, we instinctively think of his great and lordly mastery over the

EXCAVATION OF THE PEALE
MASTODON

In 1799 there was discovered on the farm of John Masten, near Newburg, New York, the skeleton known as Peale's first mastodon. The exhumation of this skeleton, portrayed in the painting, was carried on in the year 1801. The principal figure in the foreground is Dr. Charles Willson Peale. The other two figures assisting him in holding the scroll are probably Titian and Rembrandt Peale.

This photograph shows at work twenty-one men and two boys of the twenty-six who were engaged under the direction of Doctor Peale. The elaborate machinery that occupies the center of the picture consists of a continuous bucket chain with a long trough. It was designed by an ingenious millwright to keep the excavation free of water. A number of the male onlookers and even some of the workmen wear tall beaver hats as part of the quaint dress of the period. The whole scene, painted after the manner of other scientific portraits of the day, is a delightful reminiscence of the country life along the Hudson one hundred twenty years ago.

(After photograph of the painting by Rembrandt Peale, belonging to Mrs. Bertha White, now deposited in the Museum of Fine Arts, Boston, Massachusetts. Photograph loaned by Mr. H. F. Thompson)



beasts—of his majestic tread as he strode these valleys and hill-tops—of his anger when excited to fury—stamping the earth till trembling beneath his feet—snuffing the wind with disdain, and uttering his wrath in tones of thunder,—and the mind quails beneath the oppressive grandeur of the thought, and we feel as if driven along by the violence of a tornado. When the pressure of contemplation has subsided and we recover from the blast, we move along and ponder on the time when the mastodon lived,—when and how he died, and the nature of the catastrophe that extinguished the race; and the mind again becomes bewildered and lost in the uncertainty of the cause. Speculation is at fault, and our thoughts wander about among the possible accidents and physical agents which might have worked the sudden or lingering death of this line of terrestrial monarchs.

“Upon these subjects, wrapt in the deep mystery of many ages, we have no fixed or well-considered theory; and if we had, the limits of our paper would forbid us to argue it up before our readers, and argue down all hostile ones. But we may briefly enquire, whether the cause of the death and utter annihilation of the race, was one great overwhelming flood which submerged the earth and swept down these animals as they peacefully and unsuspectingly wandered over the plains and hills around us. Or was it some earthquake convulsion, full of sudden wrath, which tore up its strong foundations and buried this race among the uplifted and subsiding mass of ruins; or was it some unusual storm, black with fury and terrible as the tornado, which swept the wide borders of these grounds, and carried tree and rock and living mastodon in one unbroken stream to a common grave, or was it the common fate of nations, men and every race of created animals of water, land or air, which overtook and laid the giants low? that by the physical law of their nature, the decree of heaven, the race started into being—grew up to physical perfection—and having fulfilled the purpose assigned by their

creation, by a decrease slow, but sure as their increase, degenerated in number, and gradually died away and became extinct. Or was it some malignant distemper, fatal as the Egyptian murrain, which attacked the herd in every locality of this wide domain—sending its burning poison to their very vitals—forcing them to allay an insatiate thirst and seek relief in the water ponds around them, and there drank, and drank, and died? Or was it rather, as is the general belief in this community, that individual accident, numerous as the race, befell each one, and in the throes of extrication sank deep and deeper still in the soft and miry beds where we now find their bones reposing?

“We have thus briefly laid before our readers all the causes which we have heard assigned for this remarkable, ancient, and wide-spread catastrophe, and leave them to the speculation of others, while we wait for time and the developments of geology to uncover the cause.

“But when did these animals live and when did they perish, are questions equally wrapt in profound mystery, and can be answered only when the true cause of their death is found. In the meantime we ask, were they pre-Adamites, and did they graze upon the fields of Orange and bask in the sunlight of that early period of the globe?—or were they antediluvian, and carried to a common grave by the deluge of the Scriptures?—or were they postdiluvian only, and till very recent periods wandered over our hills and fed in these valleys; and that now some wandering lord of the race, an exile from the land of his birth on the banks of the great father of waters, is gone in silence and melancholy grandeur to lay himself down and die in the yet unexplored regions of the continent? On the points of vital interest in solving the great question of time and mode of death, we hazard no conjecture. Among geologists the opinion is fast gaining ground, that the epoch of the appearance of the mastodon on earth was about the middle of the tertiary period,—and that he was here ages before

man was created,—that before that epoch warm-blooded terrestrial animals had not appeared. The period of their extinction is thought to be more doubtful, but probably was just before the creation of the human race.—Geologists think there is no evidence sufficient to establish the fact that man and the mastodon were contemporary.—Time and further investigation may explain the mystery.¹

WHEN FIRST FOUND

“The remains of the mastodon were first found in this State, near Albany, probably as early as 1705, as appears from the letter of Gov. Dudley to the Rev. Cotton Mather, of July 10, 1706—a copy of which is furnished and worth reading.² The accounts which state it to have been in 1712 are erroneous—taking, probably the date of Cotton Mather’s letter (of that date) upon this subject to Dr. Woodward, as the date of the finding. They were next found by Longueil, a French officer, on the Ohio River, in 1739. In 1740 large quantities were found at Big Bone Lick, in Kentucky, carried to France and there called the “Animal of the Ohio.” Since which many have been found in various parts of the Union.

“No locality,³ except the Big Bone Lick, has contained a greater number of these remains than Orange County. The first were discovered in 1782, about three miles south of the village of Montgomery, on the farm now owned by Mr. Foster Smith. These bones were visited by Gen. Washington and other officers of the army while encamped at Newburgh in 1782–3. The Rev. Robert Annan, who then owned the farm, made a publication at the time, describing the bones, locality, etc., which caused Mr. Peale subsequently to visit this county.

“In 1794 they were found about five miles west of the village of Mont-

gomery, just east of the residence of Archibald Crawford, Esq., and near the line of the Cohecton turnpike. In 1800 they were found about seven miles northeast from Montgomery, on or near the farm of Dr. George Graham. In 1803, found one mile east of Montgomery, on the farm now owned by Dr. Charles Fowler. These were the bones dug out by Mr. Peale of Philadelphia, in 1805 or 6,—and the writer, then a boy at school in the village, saw the work in progress from day to day. In 1838 a tooth was found by Mr. Daniel Embler, of Newburgh, on or near the farm of Samuel Dixon, Esq., of that town. In 1844, found eight miles southwest from Montgomery, on the farm of Mr. Conner, near Scotchtown, in Wallkill. In 1845, found about seven miles east of Montgomery, on the farm of Nathaniel Brewster, Esq.; and, in the same year, on the farm of Jesse C. Cleve, Esq., in Hamptonburgh, about twelve miles southeast of Montgomery. They were also found in the town of Goshen some years since, but the time and locality we do not know. There have been at least a dozen findings of these bones in the County. From these enumerations it would appear as if the village of Montgomery was the center of the circle of these various findings.

“The animal [the skeleton found on the farm of Nathaniel Brewster and subsequently known as the Warren Mastodon] was supposed to be of great age—judging from the length and size of the tusks, and from the fact that some bones, which in young animals are separate, in this had grown firmly together.

POSITION OF THE BONES WHEN FOUND

“Having measured the giant, let us inspect the place where found, uncover his resting place and observe his position in death. Mr. Brewster was digging out marl, and his workmen came upon the skeleton, every bone of which they succeeded in exhuming. Though wanting some of the toes of the fore-foot, we believe they were found and carried away in the pockets of some of the early visitors. Like all others

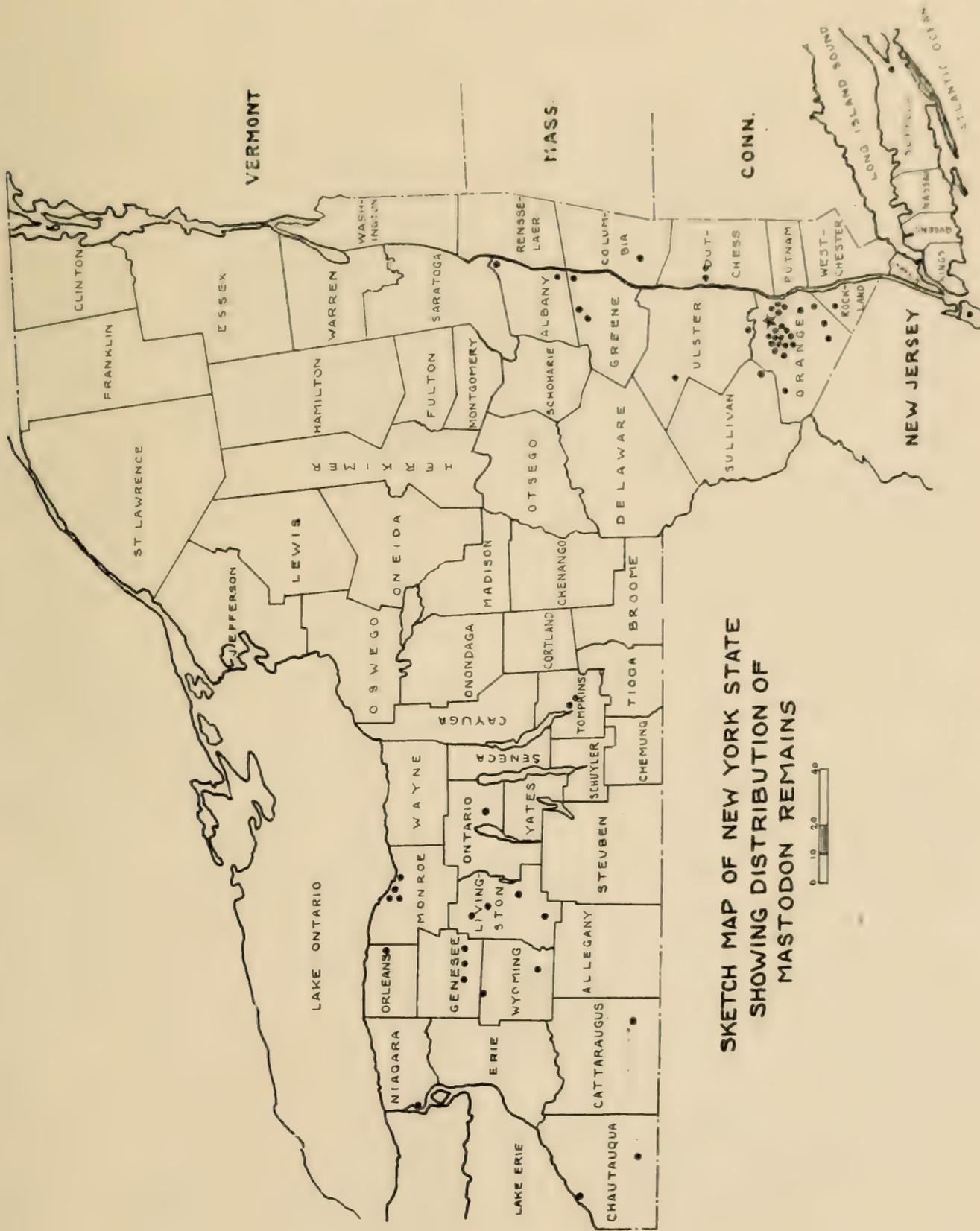
¹The reader is referred to an article entitled “Did the Indian Know the Mastodon?” by Jay L. B. Taylor, *NATURAL HISTORY*, 1921, pp. 591-97; also to the article by William B. Scott “On American Elephant Myths,” *Scribner's Magazine*, 1887, p. 469.

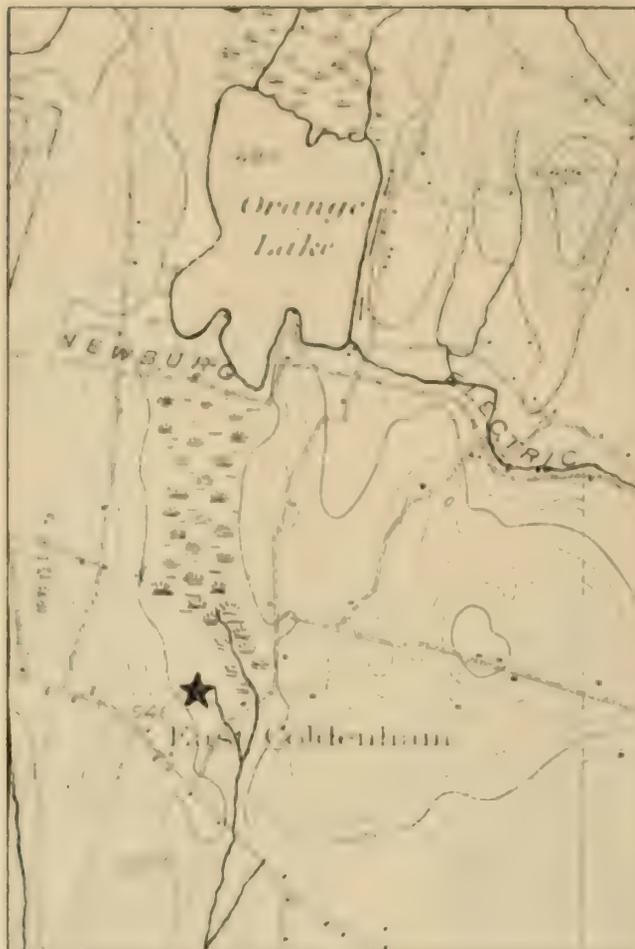
²This letter is not reproduced in the present article.

³Remains indicating 300 animals were found at Kimmswick, Missouri.

DISCOVERY SITES OF
MASTODONS IN
NEW YORK

This map, taken from that which appears in the article entitled "Mastodons of New York," by Dr. John M. Clarke (New York State Museum, *Bulletin 69*, published 1903) shows, by the concentration of the dots just north of the Hudson River Highlands in Orange County, how numerous are the mastodon remains in that area. The site where the Warren Mastodon was discovered—formerly known as the Nathaniel Brewster Farm but now called the Sycamore Farm—is indicated on the map by a star





The Warren Mastodon was discovered on the site marked by the star, in the valley south of Orange Lake and about two hundred yards north of the Cochection Highway at East Coldenham. The skeleton was at first known as the Brewster Mastodon because of the fact that the farm on which the find was made was the property of one Nathaniel Brewster, a grandson and namesake of whom is now the owner of the land. Reproduced from the Newburgh Quadrangle Topographical Survey, State of New York, United States Geological Survey, edition of September, 1903, reprinted September, 1910

in this County, these were found in a peat formation, but of very limited extent, between two slate ridges. They were six feet beneath the surface—yet so deep was the peat below that its bottom could not be reached with an iron rod of several feet in length. The animal was thus held in suspension, and as the spot was wet and spongy, never dry perhaps from the time he entered, it caused their perfect preservation.

“Beginning at the bottom, the following were deposits which from time to time filled up the pond:

- 1, Mud, more than ten feet,
- 2, Shell Marl, three feet,
- 3, Red Moss, one foot,
4. Peat, two feet.

The bones laid below No. 3 and occupied nearly the position the animal did when alive, and the whole position that of one mired. If there ever was one that came to his death in that way, this is the one.

“In Godman’s Natural History, article Mastodon, is recorded an instance of the same kind [the preservation of stomach contents], and puts the fact beyond all question, that the contents of the stomach of the Brewster [Warren] mastodon was found. The animal was dug up in Wythe Co., Va., and the stomach found,—the contents carefully examined, and found to be in good preservation. They consisted of reeds half masticated—of twigs of trees, and of grass or leaves.

We have made free use of the article written by Dr. A. J. Prime, of Newburgh, and found in the American Quarterly Journal of October, 1845, and various newspaper publications made by the same gentleman.”

Thus ends our quotation of the quaint narrative of Samuel W. Eager.

OTHER REMINISCENCES OF THE DISCOVERY

The American Museum is indebted to Mrs. George F. Elliott of Westfield, New Jersey, for the following reminiscence of the discovery, contained in a letter of March 21, 1906, addressed to the late J. Pierpont Morgan, the donor of the Warren collection to the American Museum. Mrs. Elliott writes:

“I was much interested on reading in this morning’s *Tribune* of your recent purchase of the American mastodon from the Warren heirs; interested firstly, because it will now be given to the public; secondly, because it was found on, or in, my grandfather’s farm in East Coldenham, six miles west of Newburgh, on the Newburgh and Cochection turnpike. As a child I distinctly remember the excitement that prevailed in the neighborhood at the find and during the time it was on exhibition in my grandfather’s barn.



I was present at
 the original discovery
 of the Harven Mastodon
 discovered in 1875
 and assisted in the
 Exhibition of same

J. A. Brownwell
 M. G. Bain

Sept 25th 1907 Mich



THE WARREN MASTODON IN SITU

Vignette showing the Warren Mastodon as it was stretched out when originally discovered about six miles northwest of Newburg and about one mile south of Orange Lake. The vignette, which appeared originally in color on the title page of Doctor Warren's *Mastodon Giganteus of North America*, is designed to show the succession of strata under which were found the skeletal remains. Usually all these strata were covered during the wet season with a depth of water varying from one or two feet to six or eight feet, but during the unusually dry season of 1845, the year of the discovery of the skeleton, the area had almost dried up. According to Doctor Warren, the position of the extremities shows that the animal, at the time of its destruction, was making strong efforts to extricate itself from the abyss into which it had plunged. Beneath the body and limbs is a stratum of clay but the body was embedded in light-colored shell-marl, which incased the head, the right anterior limb, spinal column, part of the ribs, pelvis, and the tail. Above the shell-marl was a layer of red moss of a pinkish color; the top layer was of dark-colored peat a foot or two in thickness; above this in ordinary seasons was the depth of water already referred to



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On Saturday, August 19, 1922, the writer visited the locality where the Warren Mastodon was discovered and had the good fortune to meet Mr. Nathaniel Brewster, the grandson of the original owner and excavator of the skeleton, who with his daughter, Miss Brewster, gave the writer a most courteous reception.

Mr. Brewster pointed out the original boxes, excellently constructed, in which the skeleton was originally packed and transported from place to place for exhibition. Although a small boy at the time, being only three years of age, he distinctly recalls placing his little fist in the eye socket of the mastodon skeleton. He also recalls the spot where the mastodon was found, now buried beneath a pond of considerable size. On September 6, 1922, Mr. S. H. Chubb visited the site with his excellent camera and photographed Mr. Brewster pointing to the spot in question (see lower picture; the upper picture shows another view of the same locality). The relation of the site to its environment is shown in the map on p. 8

It was wired and set up on the premises. Doctors Warren, Hitchcock, Blackman, and Prof. Silliman were all there at times. The location where it was found was in a depression or sort of basin of marl, which they were taking out for improving the land elsewhere. The head was struck first, for the animal was standing erect, as it had sunk in the soft marsh. Even the contents of the stomach were intact, consisting of twigs as large as a man's finger, and were gathered in a bushel basket. The tusks were also perfect when found, but crumbled on coming in contact with the air. There is a brooch in the family with the head in 'profile' of one of my uncles carved on it, made from a piece of the outside of these tusks; there is also a part of a tooth that broke off after it was set up. My oldest brother, who now occupies the homestead, has much interesting data in connection with it, also an engraving of the different strata of soil in which it was found, with a cut of each separate bone, and would furnish you, no doubt, with anything of interest to you in connection with it. It was sold to Doctor Warren by my father while he had it on exhibition either in Hartford or in New Haven."

Another reminiscence is that contained in a letter received at the American Museum on August 16, 1907, from Mr. W. M. Nelson of Equinunk, Wayne County, Pennsylvania, who writes:

"So far as I know, I am the only living man today¹ who saw the skeleton of the animal taken from the marl pit on the farm of Nathaniel Brewster, six miles west of now Newburgh City, where the road runs north to Orange Lake. I saw the entire skeleton taken out and bones wired together by Doctor Prime, of Newburgh, in Mr. Brewster's barn. This was done in sections so it could be set up and taken down and shipped in the boxes as freight. It was on exhibition about the country by Wm.

¹Another survivor is Mr. Nathaniel Brewster, a grandson of the owner of the farm at the time of the discovery, who is shown on p. 11 pointing to the spot from which the skeleton was recovered.

Brewster and Clinton Weeks, son and son-in-law of Mr. Brewster.

Squire Eager's history of Orange Co., New York, gives the dimensions of the skeleton as follows: length of skeleton 33 feet; skull between eyes 2 feet, 1 inch; length of skull 3 feet, 10 inches; number of bones 220; ribs, 20 on each side. Total weight of bones, 1995 pounds. . . . The mastodon's backbone was found about 5 feet below the surface in the marl pit. Every bone was found and wired, except one toe bone, about the size of an egg. I was a boy some 16 or 18 years old at the time and took it all in. I remember nothing about Professor Warren. Doctor Prime wired the bones together and I saw him most every day at the work of setting up the skeleton. I do not know whether this history is of any interest to you now, but it will hold water, so far as my memory is concerned."

The above reminiscences may be supplemented with the account of the discovery gathered from the memoir by Doctor Warren published in 1852:

"The summer of 1845 had been unusually dry; many small lacustrine deposits were exposed by the drought, and their contents removed to fertilize the neighboring fields. The spot above described, though usually covered by a small quantity of water, had been left dry (an occurrence never known before); and Mr. Brewster, wishing to avail himself of its contents, had employed a number of laborers to remove them. The men had dug through a thickness of two feet of peat-bog, a layer of red moss about a foot thick, and then fell upon a bed of shell marl (*vide* Vignette).¹ After raising about a foot of this, they struck on something hard; and a question arose whether it was a rock, a bone, or some other substance. Night approaching, it was necessary to intermit their labor until the following day.

"Mr. William C. Brewster, son of the proprietor, and Mr. Weeks, his son-in-law, with assistants, in the presence of a

¹The vignette is reproduced on p. 10 of the present article.

large number of persons, neighbors and travellers, proceeded to examine the object of their curiosity. The stroke of a spade brought up a portion of bone, and everyone was then willing to believe they had discovered the last retreat of one of the ancient mastodon inhabitants. The labor of exhumation then proceeded rapidly; and the part struck was ascertained to have been the summit of the head. This, being uncovered, disclosed to the eyes of the spectators the full extent of the cranium, which was four feet in length. The lower jaw was distorted a little toward the left side. The bones of the spine, tail, pelvis, and ribs, were successively found, for the most part in their natural relation to each other. The anterior extremities were extended under and in front of the head, as if the animal had stretched out its arms in a forward direction to extricate itself from a morass, into which it had sunk. The posterior extremities were extended forward under the body. The tusks lay with their convexities outwards, their anterior extremities opposed to each other nearly meeting; and thus the two tusks, taken together, described a large part of a circle. (*Vide* Vignette.)

“At the end of the second day’s labor, the whole of the skeleton had been obtained, with the exception of the posterior part of the sternum, a few bones of the feet, and a number of the caudal vertebræ, some of which were recovered afterwards. The bones were in an almost perfect state of preservation. They were not black, like most of the mastodon bones, but of a brown color, like those of a recent human skeleton, which had been in use a considerable time. It is worthy of remark, that no mastodon bones but those belonging to this individual, and no other bones excepting two or three of animals recently entrapped in the mire, were found in this deposit.”¹

“Doctor Prime, who was present, describes its appearance as follows:— ‘In the midst of the ribs, embedded in the marl and unmixed with shells or

¹*The Mastodon Giganteus of North America*, by Dr. John C. Warren, pp. 5 and 6.

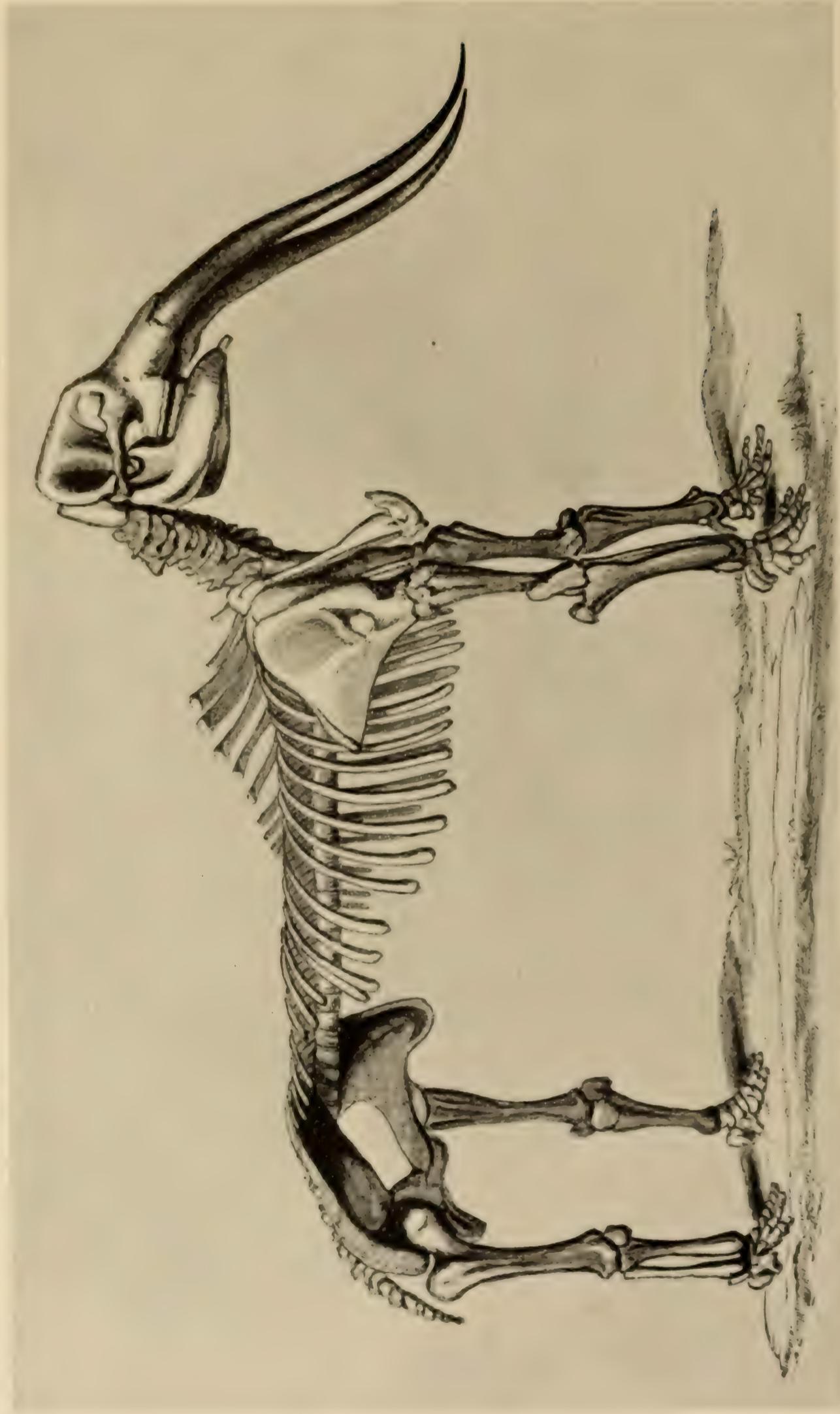
carbonate of lime, was a mass of matter, composed principally of the twigs of trees broken into pieces of about two inches in length, and varying in size from very small twigs to half an inch in diameter. There was mixed with these a large quantity of finer vegetable substance, like finely divided leaves; the whole amounting to from four to six bushels. From the appearance of this, and its situation, it was supposed to be the contents of the stomach; and this opinion was confirmed on removing the pelvis, underneath which, in the direction of the last of the intestines, was a train of the same material, about three feet in length and four inches in diameter.’”¹

TOUR OF EXHIBITION

Owing to the fact that the bones were buried in a pure shell-marl layer, they were, when found, in a perfect state of preservation; of light brown tint, not of the dark brown or nearly black tint of the mastodon skeletons exhumed from swamp muck, which are discolored by decaying vegetable matter. As narrated by two eyewitnesses, the skeleton was wired together and set up in such form that it could be exhibited for three or four months during the years 1845 and 1846, in the city of New York and in several New York and New England towns. Luckily, it does not appear that any of the parts were lost during this period of exhibition and travel.

The excellently made boxes in which the skeleton of the Warren Mastodon was transported from point to point for exhibition still remain in the possession of Mr. Nathaniel Brewster. The impression which the mastodon made on observers in the city of New York is shown by an extract from the journal of one of the pupils of the New York Institute for the Deaf and Dumb, October 16, 1845:

¹*Idem.*, p. 144.



THE WARREN MASTODON AS IT WAS MOUNTED SHORTLY AFTER ITS DISCOVERY

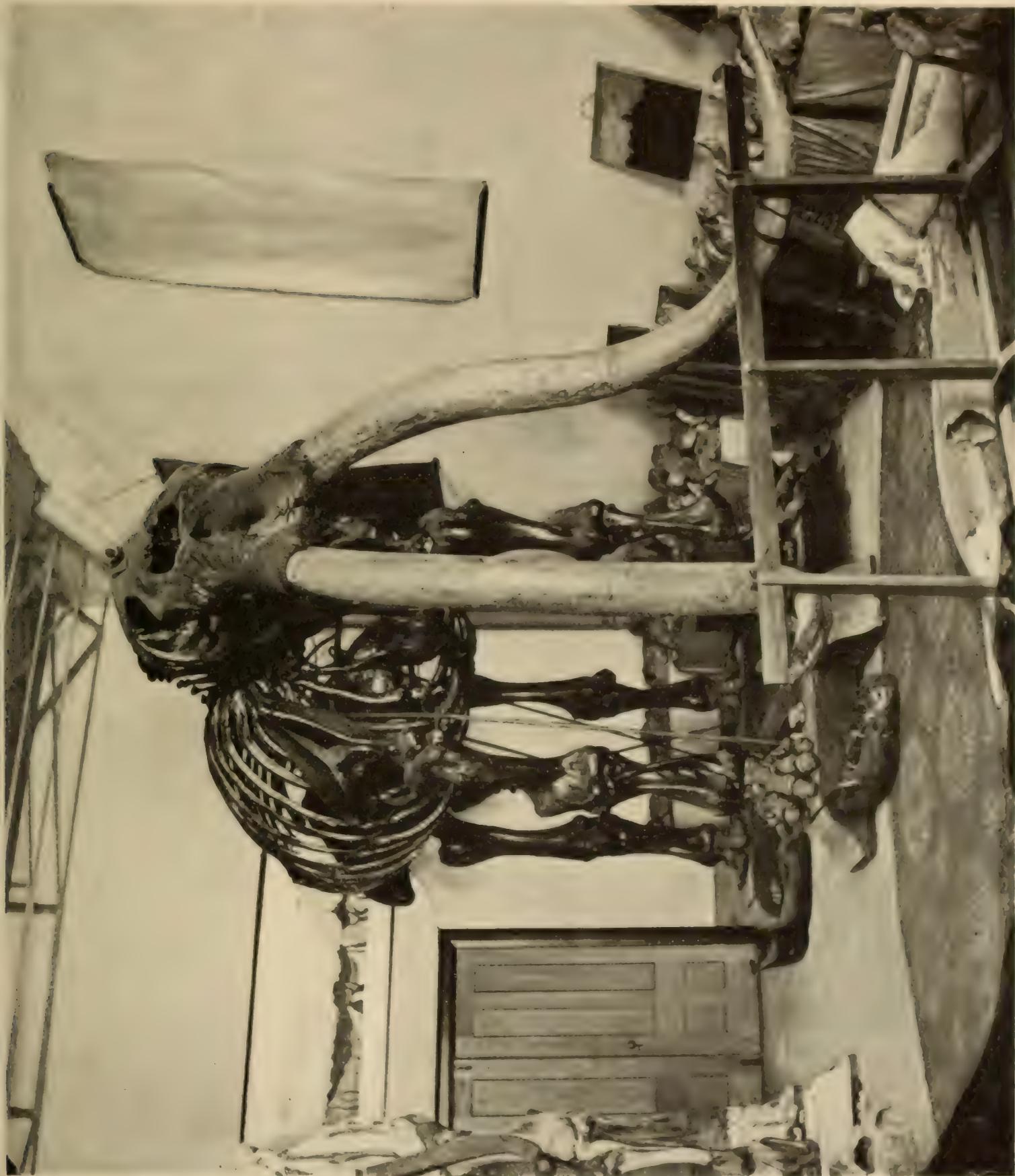
The figure is reproduced from the *American Journal of Agriculture and Science*, Volume II, Number 2, conducted by E. Emmons, Albany, and A. J. Prime, Newburg. In their article, "The Great American Mastodon," Messrs. Emmons and Prime remark: "The skeleton has since been arranged and set up, and this has been done with great care and the strictest attention to the articulating surfaces of all the bones, which we believe has not been the case with others which have been put together"

THE WARREN MASTODON
AS REMOUNTED IN 1849

For fifty-seven years, that is from 1849-1906, the Warren Mastodon, remounted as shown in the picture, was exhibited in the Warren Museum in Boston. In 1906 it was acquired, thanks to the generosity of the late J. Pierpont Morgan, by the American Museum.

The skeleton, as here depicted, is covered with heavy black varnish. The imitation tusks are made of papier-maché and were so lengthened as to sweep the ground and curve outwards at the extremities. The chest and backbone were raised two feet above the top of the shoulder blade, or scapula, and as a result the natural height of the animal was increased from nine feet to twelve feet. Beneath the Warren Mastodon are tusks and grinding teeth of other specimens. Around the base of the walls are many vertebrae of the giant *Zenopsis*, the arctic fossil whale of southern United States.

As photographed in the interior of the Warren Museum, 92 Chestnut Street, Boston.



"Having been kindly invited by the proprietors of this wonderful exhibition, we went up into the Minerva Rooms, 406 Broadway, and looked at the American Mastodon, one of the greatest curiosities in the world, according to my imagination. We steadily gazed at it with much astonishment. The bones of it are articulated together or fastened to each other by iron nails so as to form a skeleton, and it is now exhibited in this city. Two long artificial tusks measuring ten and a half feet in length are fixed into the skull; the old tusks of nature are almost corrupted, and it is said that they were found entire in the skull when first discovered, but they have fallen in pieces so that they cannot be made fast. The large vertebræ of its spine or backbone gradually increase in size from the extremity of the tail to the head. We could stand below the long ribs. We examined the legs and bony toes with great curiosity. The whole bones weigh 2002 pounds but they must have weighed 20,000 pounds when it was living. The skeleton measures 29 feet in length, and the height of its head, 12 feet, that of its back, 10 feet, and the width of the pelvis, 6 feet.

"The skeleton, which has been brought to this city for a show, was found in a marl bed on a farm at Newburgh, of New York. I am very proud of that skeleton first discovered in this state.

"It is supposed that this animal on walking along the marl bed, sunk into it by its legs adhering closely to the marl and it was drowned. It remained in it for a long time. Previous to the discovery, nobody knew the place where it was buried. We should be thankful to the proprietors who found it and took great pains to fix the bones firmly into a skeleton. What a wonderful success!! It leads us to admire the power and wisdom of our Almighty Maker who made the largest of animals."

DOCTOR WARREN ACQUIRES THE MASTODON

Fortunate was its purchase in 1846 by Dr. John Collins Warren, professor of anatomy in the Harvard Medical

School, who paid \$5000 for it. Doctor Warren, who about this time became president of the Boston Society of Natural History, had the skeleton transferred to Boston, where it was mounted under his direction by Dr. N. B. Shurtleff; this was its second mounting. It was exhibited to Sir Charles Lyell, the distinguished English geologist, who made a tour of the United States during the years 1841-45; also to Professor Jeffries Wyman, founder of the Museum of Comparative Anatomy, Harvard Medical School; also to Professor Louis Agassiz, who was called to Harvard University in the year 1848.

The teeth of the mastodon had been known in America since 1705 and in Europe ever since Longueil, a French officer, brought them back from the banks of the Ohio River in 1739; they had been examined and described by the great French naturalist of the period, Buffon; they had been assigned the specific name of *Elephas americanus* by the American naturalist, Kerr, in 1792; they had been falsely confused with those of the woolly mammoth of Siberia by Blumenbach, who gave this animal the name of *Mammul*; they had finally, in 1806, been properly christened 'mastodonte' by the great French naturalist, Cuvier; yet the actual structure and proportions of the mastodon still remained unknown. Consequently the discovery and mounting of the Warren Mastodon skeleton was a really great event in the science of palæontology; it rendered possible for the first time a knowledge of the complete animal. It appears, however, that Doctor Warren was not satisfied with the mounting by Doctor Shurtleff, nor with the security of the building where the skeleton was first exhibited in Boston, because in 1849 the masto-

don was remounted by Mr. Ogden under Doctor Warren's direction and placed with other collections in the especially erected fireproof building at 92 Chestnut Street, Boston, which soon became famous as the Warren Museum. It was at this time that the skeleton received its coat of black varnish, was raised two feet above its natural height, and was provided with the enormous pair of papier-maché tusks.

From 1849 to 1906 the skeleton remained in the Warren Museum in the condition shown in our photograph on page 15. Professor Warren became intensely interested in adding to his museum other specimens of the mastodon, especially those discovered along the west bank of the Hudson River, and also in securing specimens from England, France, and Germany, for purposes of comparison. Thus his collection was enriched by the acquisition of the superb head of an old bull mastodon found near the Shawangunk Mountains, and hence known as the Shawangunk head; this is one of the largest, if not the largest, bull mastodon head ever found. Through active correspondence with Professor Jean Jacques Kaup, Doctor Warren secured casts of all the specimens that Professor Kaup had discovered near Eppelsheim not far from Worms in Germany, namely, *Mastodon longirostris* (signifying long-jawed mastodon) and *Dinotherium giganteum* (signifying the terrifying giant beast), animals which at the time aroused the wonder of Europe. Thus there were soon gathered in the Warren Museum numerous specimens from different parts of the world—North America, Europe, and Asia—bearing on the history of the proboscidean order. Doctor Warren devoted his spare time for six years to the study of

these animals, and in 1852 issued a splendid monograph entitled *The Mastodon Giganteus of North America*. In April, 1908, the autograph copy of this precious publication, with marginal annotations in Doctor Warren's handwriting, was presented to the Osborn Library of the American Museum, together with *The Life of John Collins Warren, M.D.*, in two volumes, by Dr. Edward Warren.

REMOVAL TO THE AMERICAN MUSEUM

The writer of the present article had for years longed to secure this famous specimen for the American Museum but never dreamed that it would be possible to obtain it. It appeared that the entire Warren collection was entailed in the will of Doctor Warren and that the heirs were not at liberty to dispose of it until the decease of the last of the immediate descendants. The writer was greatly surprised, therefore, when he received a letter from Dr. Thomas Dwight of the faculty of the Harvard Medical School, indicating that the entail was at last closed and that the collection might be offered for sale under certain conditions. This letter came on a Friday afternoon and the writer left the same evening for Boston, arriving in Doctor Dwight's study on Saturday morning; he accompanied this distinguished anatomist to the old Warren Museum on Chestnut Street to view the famous skeleton for the first time. The black varnish appeared to present an obstacle, but some vigorous scratching with a penknife revealed the rich light-brown color of the bone beneath. A friendly interchange of opinions with Doctor Dwight ensued; a valuation was agreed upon for the entire collection, but there was still little thought in the writer's mind that it could be secured by the

American Museum. On the Monday following, the prince of museum benefactors, Mr. J. Pierpont Morgan, authorized by telephone an offer of \$30,000. This offer was immediately accepted and a few days later Dr. William Diller Matthew went to Boston to pack up the entire Warren collection, covered as it was with a half century of Boston dust. The collection was carefully inventoried, and with it came several valuable photographs and pictures, which are reproduced in the present article.

THE FOURTH MOUNTING OF THE WARREN MASTODON

In removal all the original framework was left in Boston, only the bones being packed; in this separated condition the precious skeleton, covered with its thick coat of black varnish, reached New York, its native State, in safety. The first question which arose in our minds was whether it would be possible to remove the black varnish; this was answered through a series of experiments which resulted in the construction of special vats large enough to contain the longest and broadest bones, such as the thigh bones, the hip girdle, and the skull. Many weeks of immersion in pure benzine were necessary before the black varnish began to dissolve. This treatment was followed by vigorous scrubbing with pure spirits of alcohol, and one by one the bones emerged from this prolonged and very expensive bath in all the purity and beauty of color that characterized the skeleton when it was exhumed by Doctor Prime in 1845.

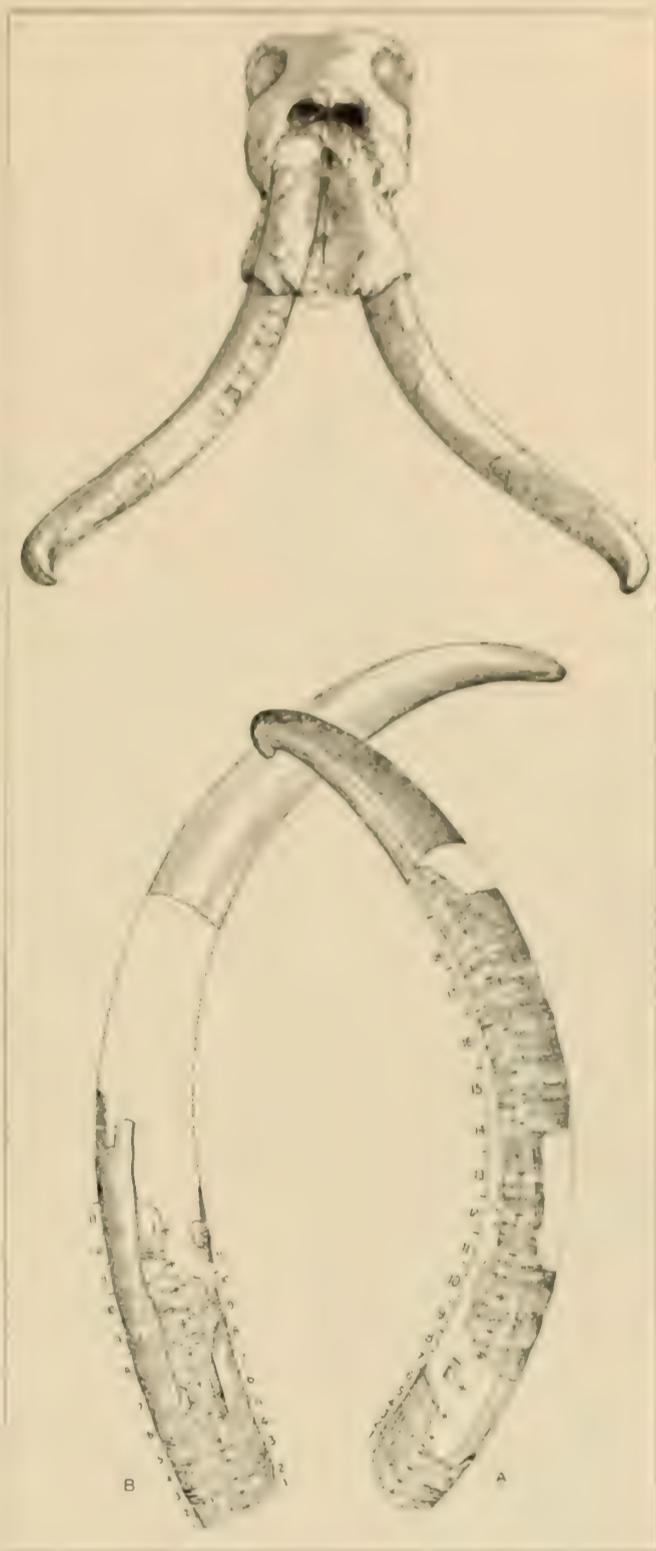
There still remained the problem of the tusks, which are invariably the most vital part of buried skeletons of the great proboscideans of the past. It appears that the original tusks could

not be preserved entire by the methods then known. The discoverers were unable to prevent them from splitting, warping, and falling to pieces, especially at the butt. In order to preserve what could be saved intact, the butts of the tusks, already hopelessly split and warped, were sawed off under Doctor Warren's direction, and only the tips, about three feet in length, were treated and preserved. The butts, fallen into fragments, but still lying undisturbed in two of the original boxes used for transporting the skeleton, were found in the Warren Museum when the skeleton was repacked to be sent to the American Museum. The tips, treated with preservatives, were still intact in another box; but neither had been used apparently for measurements in making the papier-maché restorations fitted to the skull in the Warren Museum. This documentary evidence certainly was not used by Professor Warren, because in his three restorations he unfortunately accepted the erroneous original reports that the tusks as found were more than eleven feet in length; they were so described and illustrated by him in the entirely impossible position shown in the photograph on p. 15.

When the Warren collection reached the American Museum, it was very carefully looked over in a search for remnants of the original tusks, and finally the fragmentary fossil ivory was found, but inasmuch as most of the original records had been lost and no use of these materials had been made by Doctor Warren, it remained to be proved that the fragmentary butts of the tusks really belonged with the skull. The piecing together of these butts required several months of most ingenious and patient work on the part of one of our preparators, Mr. Charles

Christman. The ends of each tusk were perfectly preserved, but there was no connection between these tips and the reconstructed butts of either tusk. Fortunately, when the butts of the tusks were sawed off, a single splinter of bone broke off, and finally this splinter was found to fit exactly to a fragment of the butt. There was great rejoicing in the laboratory when the relationship of these two fragments was discovered, because it enabled us to determine positively the length of the tusks as 8 feet, 7 inches.

The rebuilding of the tusks, which required several months of most patient work, had two very important results: in the first place, it enabled us to place them properly in the sockets of the skull and to prove for the first time the exact relations of the mastodon ivories; secondly, a very painstaking examination of these tusks led to an important and most interesting discovery, namely, that it was possible to determine very closely the age of the Warren Mastodon. The ivory exhibits a series of growth rings which, counted from tip to base, seems to prove that the Warren Mastodon was perhaps thirty years of age at the time it sank into the bed of marl near Newburg. The right tusk included at least twenty-eight of these segments. The growth rings are shortest near the tip of the tusk when the animal is young, and increase in length from the tip toward the middle of the tusk, but not in a regular ratio. These growth rings do not correspond exactly in the opposite tusk, but in both tusks they are longest in the middle region. Nine smaller rings are in the lower part. The writer's theory regarding these growth rings is that during the summer season, when all the conditions of life were favorable, and



In repairing the tusks of the Warren Mastodon, it was found that the outer sheathing of the ivory (dentine) was in large part absent; the inner sheathing exposed a series of concentric constrictions and expansions which were observed to be approximately symmetrical on the two sides, as indicated by the two series of + signs in the lower figure. In the second place, it was noted that the intervals between these constrictions are broader in the middle stages of the growth of the tusk and narrower in the mature or later stages of its growth. On the hypothesis that these are actual annual increments of growth, the right tusk (A) consisted of about twenty-eight segments, which, allowing for the period of milk teeth and for the part worn off at the tip, would assign to the Warren Mastodon an age of perhaps thirty years



THE WARREN MASTODON AS REMOUNTED IN THE AMERICAN MUSEUM IN 1908

The skeleton is so complete that the only restorations or replacements which have been necessary are the following: caudal vertebrae 1-14, 16-28; all the terminal phalanges of the left forefoot except digit iii; and phalanx 2, digit iv, of the right forefoot. The following bones are introduced from other individuals: two posterior sternal bones, phalanx 2 on digits ii, iii, and v

MEASUREMENTS OF THE WARREN MASTODON

Length, base of tusks to drop of tail	14 ft. 11 in.	Meters	4.55
Height to top of spines of back at the shoulders	9 ft. 2 in.		2.80
Tusks: Length of right tusk, on outside curve	8 ft. 6 in.		2.59
Length of tusk exposed	7 ft.		2.14
Thigh bones: Length of right	3 ft. 5 in.		1.05
Length of left	3 ft. 6½ in.		1.08
Pelvis or innominate bones: width	6 ft.		1.83



MODEL OF THE WARREN MASTODON BY CHARLES R. KNIGHT

This reconstruction made by Mr. Knight under the direction of Prof. Henry Fairfield Osborn, 1912-14, is one of a series of models of the extinct and living elephants, and of the mastodons, made to a uniform scale of 1 1/2 inches to the foot, or a 1/4 scale. The heights of these animals in descending order are as follows:

Imperial mammoth, *Elephas imperator*,
 African elephant, *Loxodonta africana*,
 Indian elephant, *Elephas indicus*,
 Jeffersonian mammoth, *Elephas jeffersonii*,
 Woolly mammoth, *Elephas primigenius*,
 American mastodon, *Mastodon americanus*,
 Pigmy African elephant, *Loxodonta pumilio*.

13 feet, 6 inches
 11 feet, 8 1/2 inches, record of Rowland Ward
 10 feet, 6 inches, record of Rowland Ward
 10 feet, 6 inches, type specimen, American Museum
 9 feet, 6 inches, type specimen of western Europe
 9 feet, 2 inches, as measured from the Warren Mastodon
 6 feet, 2 inches, height of specimen in the New York Zoological Park



GROUP OF AMERICAN MASTODONS ALONG THE MISSOURI RIVER IN KANSAS

This restoration was made by Mr. Charles R. Knight, in 1920, under the direction of Prof. Henry Fairfield Osborn. There are two mastodon bulls, a cow, and a calf in the scene

GROUP OF AMERICAN MASTODONS ALONG THE MISSOURI RIVER IN KANSAS

There are two

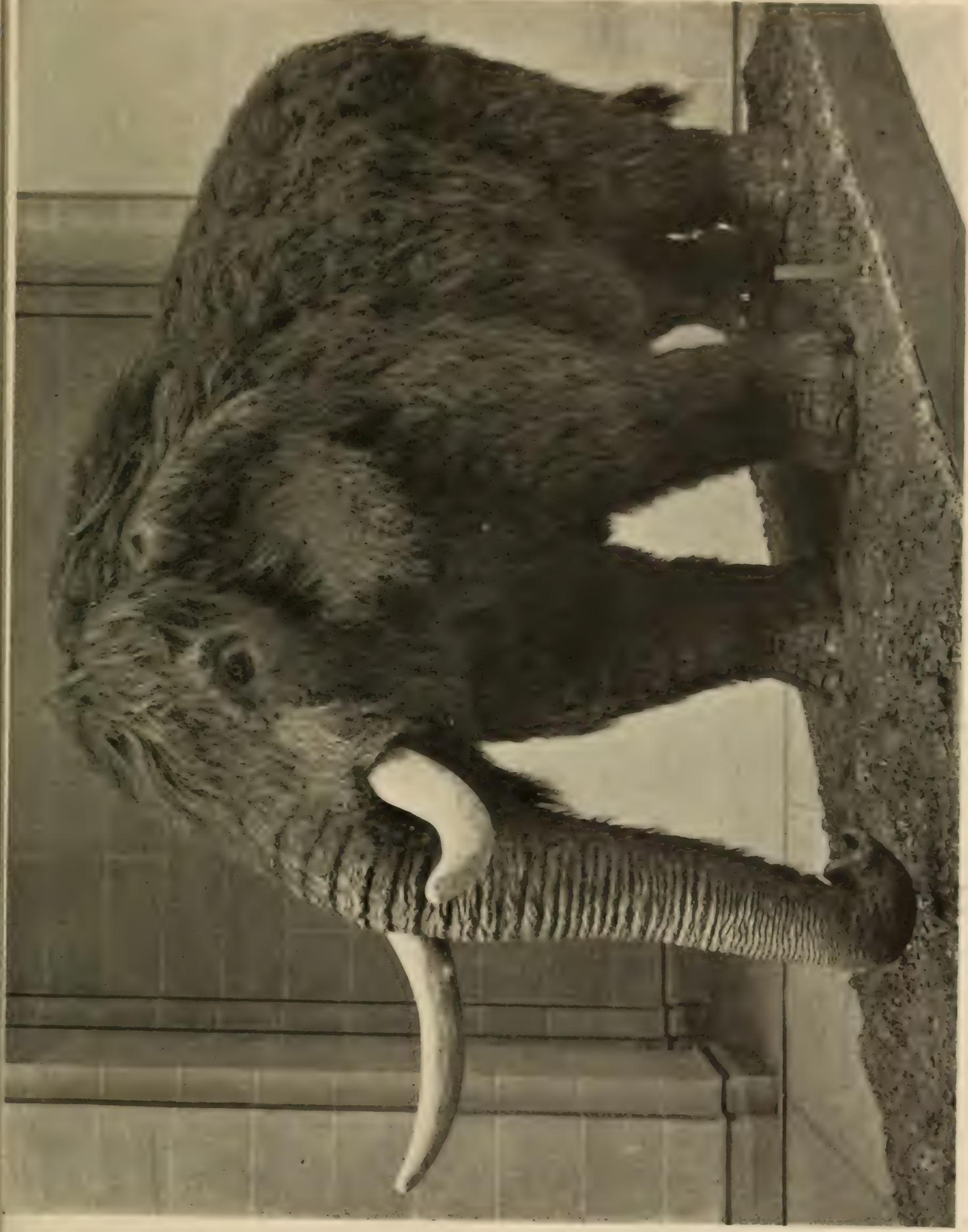
Castro.

This restoration was made by Mr. Charles R. Knight, in 1920, under the direction of Prof. Henry Fairfield Osborn.

"THE COHOES MASTODON" AS HE APPEARED IN LIFE

This restoration is based on the most careful study of the muscular anatomy and proportions of the animal as derived from exact measurements of the skeleton, aided by comparison with the external form, skin texture, and other details in living elephants. The American mastodon had a coat of hair which somewhat resembled the hair of present-day elephants, though very much thicker and longer. The animal was thus adapted to the low temperature which prevailed in this region at the breaking-up of the Ice Age. It was a very distinctive member of the New York fauna of a few thousand years ago when mastodons may have roamed the swampy regions in herds comparable in number to those of the buffalo on the western plains fifty years ago. Parts of more than one hundred skeletons have been discovered in this state. This is the only life-size scientific restoration that has been made of the American mastodon.

Executed, under the direction of Dr. John M. Clarke, by Messrs. Noah T. Clarke and Charles P. Hohenberg for the State Museum at Albany in 1921-22



perhaps during the rutting period, when tusk growth was hastened by internal secretions from the reproductive glands, the growth of ivory was very rapid, the maximum growth in the 17-18 ring being 108 centimeters, or $4\frac{1}{4}$ inches, perhaps the maximum growth of a favorable season at the most vigorous reproductive period of life. The Warren Mastodon is an adult but not an aged specimen; the skeleton is apparently that of a younger animal than the one represented by the Shawangunk head. Some estimate the maximum age of the American mastodon at between thirty and forty years,—less than half the life span of the elephant, which attains more than one hundred years.

It was very important to make another correction in mounting this animal, namely, to ascertain its exact height at the shoulders. The temptation of preparators has always been to make both mastodons and elephants much larger than they actually were in life by raising the chest portion high above the tips of the shoulder blades. In order to determine this much-mooted question, our preparator at the time, Mr. Adam Hermann, spent a day on the back of Gunda, then the favorite riding elephant of the Zoological Park; placing his two thumbs on the tip of the spine and his two index fingers on the tip of the shoulder blades,

he was able to note that the shoulder blades are on practically the same level as the summit of the spine. This observation enabled us to determine positively that the height of the backbone of the Warren Mastodon at the tip of the spine is 9 feet, 2 inches above the ground, whereas the length of the animal from the skull measured at the very base of the tusks to the droop of the tail is 14 feet, 11 inches, practically 15 feet. Thus the length of the animal's body is 6 feet, 9 inches greater than its height at the withers. Its proportions are thus totally different from those of any species of elephant. The long, low body is correspondingly broad, with an immense spread of six feet across the hips or pelvis. It is to emphasize the long, low, and broad proportions of the American mastodon, that the accompanying restorations were made by Charles R. Knight, under the writer's direction.

The reader who is interested to learn more about this subject is referred to works by Warren and others in the Osborn Library of the American Museum of Natural History, and especially to an article by Dr. John M. Clarke entitled "Mastodons of New York. A List of Discoveries of Their Remains, 1705-1902," in the Report of the State Paleontologist, 1902, New York State Museum, Bulletin, 69, p. 921.

Primitive Fishery Methods in Lake Titicaca

By R. E. COKER

Professor of Zoölogy, University of North Carolina

HIGH in the Andes, at a level only about two thousand feet lower than the top of Pike's Peak, lies a large body of water nearly one third the size of Lake Erie. This is appropriately termed by Neveu-Lemaire,¹ "the most remarkable sheet of water on the globe." Through it passes the boundary line of Peru and Bolivia. Since the Chile-Peruvian war of 1879-83, Bolivia, the ally of Peru in that struggle, has enjoyed no seaport, and until recently had no direct railway outlet to the coast. Her import and export trade was conducted mainly by boat across the lake from the Bolivian port of Huaqui to the Peruvian port of Puno, where there was a railway connecting with Mollendo on the sea. So important was this commerce that enterprising capitalists found it practicable to have large lake steamers constructed in "knock-down" form and conveyed by ships and rail to Puno, where they were assembled and launched. Thus we find large and well equipped modern steamers plying the waters of Titicaca in company with the crude reed craft, or balsa, of a type that may have been in use for thousands of years.

The importance of Titicaca is not a recent development. Before the Spanish conquest the earlier civilization was centered in this basin, and the islands and shores of Titicaca were thronged with cities or villages. Though the fish life in the lake is limited, it is probable that fishing has

been pursued by the methods now in use for many centuries, perhaps for milleniums.

Lake Titicaca is in the center of its own plateau basin, which is without connection with either the Atlantic or Pacific drainage. Around it, in fact, are some of the highest peaks of the continent, rising above twenty thousand feet. The lake proper has generally precipitous shores and its greatest depth is barely more than nine hundred feet.

Both the plant and the animal life in the lake are remarkably limited in variety, but the bays and marshy regions are richly supplied with the few native forms.² About ten species of fish, three of Amphibia, scarcely more than twenty of small Crustacea, and a very few of small mollusks, sponges, aquatic insects, and parasites have been discovered, all of which are found almost exclusively in the shallow bays or close to the shore. Only two genera of fishes are represented in the lake: *Trichomycterus*, including small catfish known as "suchi" or "bagre," and *Orestias*, a genus of top minnows, peculiar to high altitudes. The fishes are all small, but they occur in great abundance in the bays and several of them are most delicate and palatable as food.

The fishermen near Puno are the native Aymará Peruvians, primitive in their customs and, apparently, harboring a deep-rooted suspicion of the whites; those of the pueblo of Chimú, though living within sight of the capital

¹Neveu-Lemaire, M. *Les Lacs des Hauts Plateaux de l'Amérique du Sud* (Mission scientifique, G. de Créqui Montfort et E. Sénéchal de la Grange) 197 pp., XVIII Pls., 41 text figs. Paris, 1906.

²Coker, R. E. "Lake Titicaca—'The most remarkable lake of the world,'" pp. 174-182. *Internationale Revue*, Band IV. Leipzig, 1911.



The fishing device shown in this picture is known as the *caincha*. It consists of two converging fences of *titora* reeds that protrude above the water, and a framework (*cupo*) holding a net that is fitted into the point of the incomplete V.

On the shore in the background is a village. Some of the huts, close to the base of the mountain, may be distinctly seen; others are higher up on the rocky wall

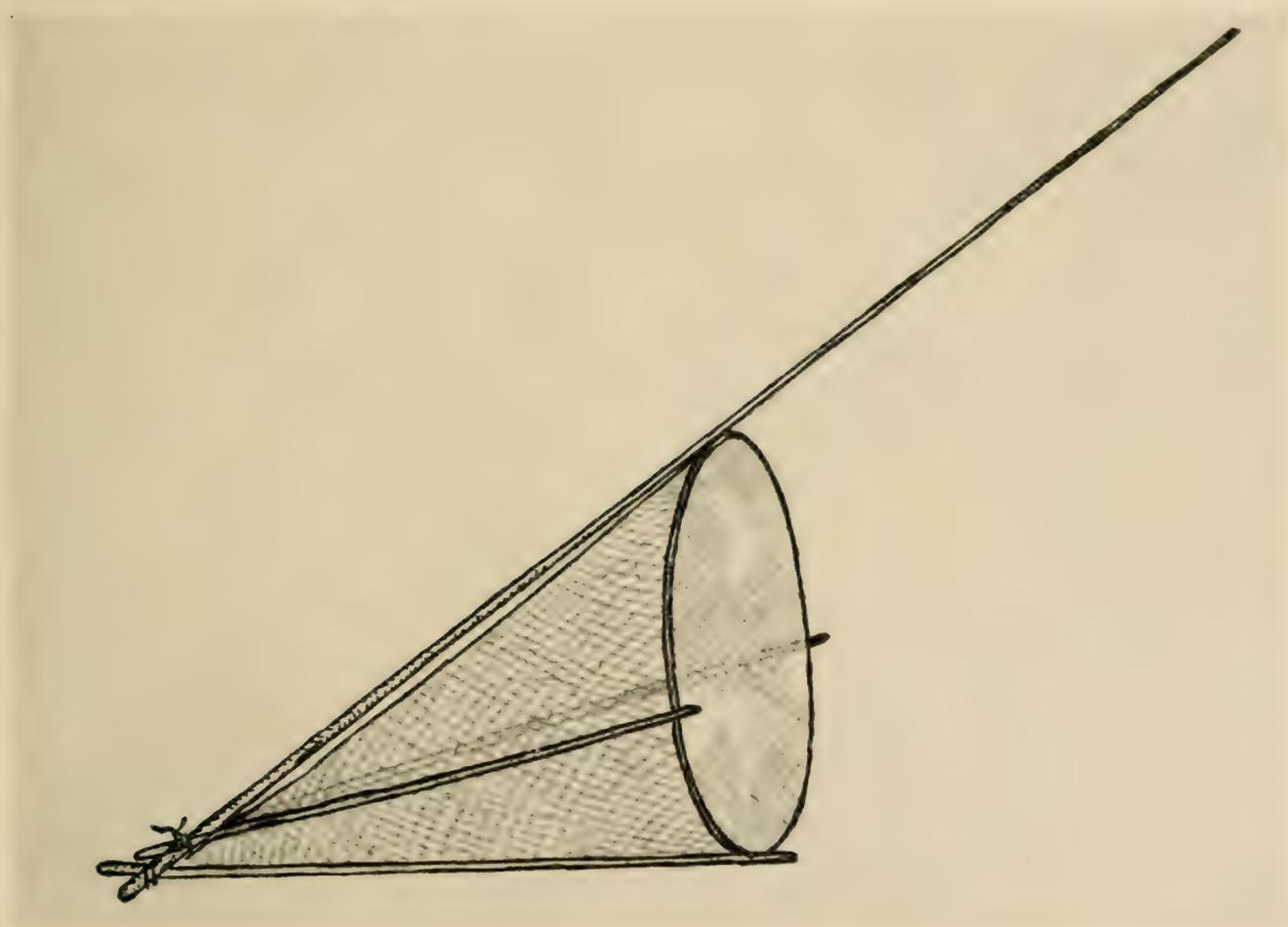
of the Department at Puno, seem entirely unacquainted with the Spanish language. The few that I talked with through an interpreter, on the occasion of a brief visit several years ago, refused persistently to give information or to part with a piece of apparatus I desired, even though I offered a pecuniary reward in advance. At the suggestion of a gentleman from Puno, I forced a coin into the unwilling hand of a native, with a surprising but gratifying effect that prompted me to repeat the experiment. The recipient of a coin would bring out and deliver a desired article or answer questions freely, but only until the worth of the coin was exhausted; it was, therefore, necessary to renew the donation at intervals during the conversation. It must be

left to the ethnologist to explain this remarkable combination of an obstinate unwillingness to bargain with a determination to give for value received a fair return—and no more.

The best contrivances for taking fish are the *caincha* and the *ccana*, as the pound and the dragnet are known in the native Aymará language. The *caincha* is an interesting sort of pound, composed of two fences of *titora* (a bulrush) and a net attached to a conical frame. To form the fences the *titora* reeds are placed side by side and fastened together at the bottom by a line woven among the reeds. When in use, the line is securely staked to the bottom, while the buoyancy of the reeds holds them in a vertical position. In the trap observed, the longer fence was



A diagram, from a field sketch by the author, of a *caincha*, with the *cupo* in place at the point of convergence of the sides of the *caincha*. The arrows indicate the direction of the movement of the fish from the time of its entry into the fenced area until its capture in the *cupo*



The *cupo* (with net) used to take fish that have been induced to swim into it by the weir of the *caincha*. The diagram was prepared by J. V. Greene from field sketches by the author. According to the recollection of the author the hoop of the *cupo* was between ten and fifteen feet in diameter

set nearly at right angles to the beach, while the other, which was much shorter, was placed at the outer end in such a way that the two fences constituted a sort of funnel with a long and a short side. Thus a simple weir was formed: the fish, swimming along the shore, would pass the shorter barrier but would be turned outward on encountering the long arm of the weir, which reached nearly to the shore, and would thus be directed into the small opening between the two fences.

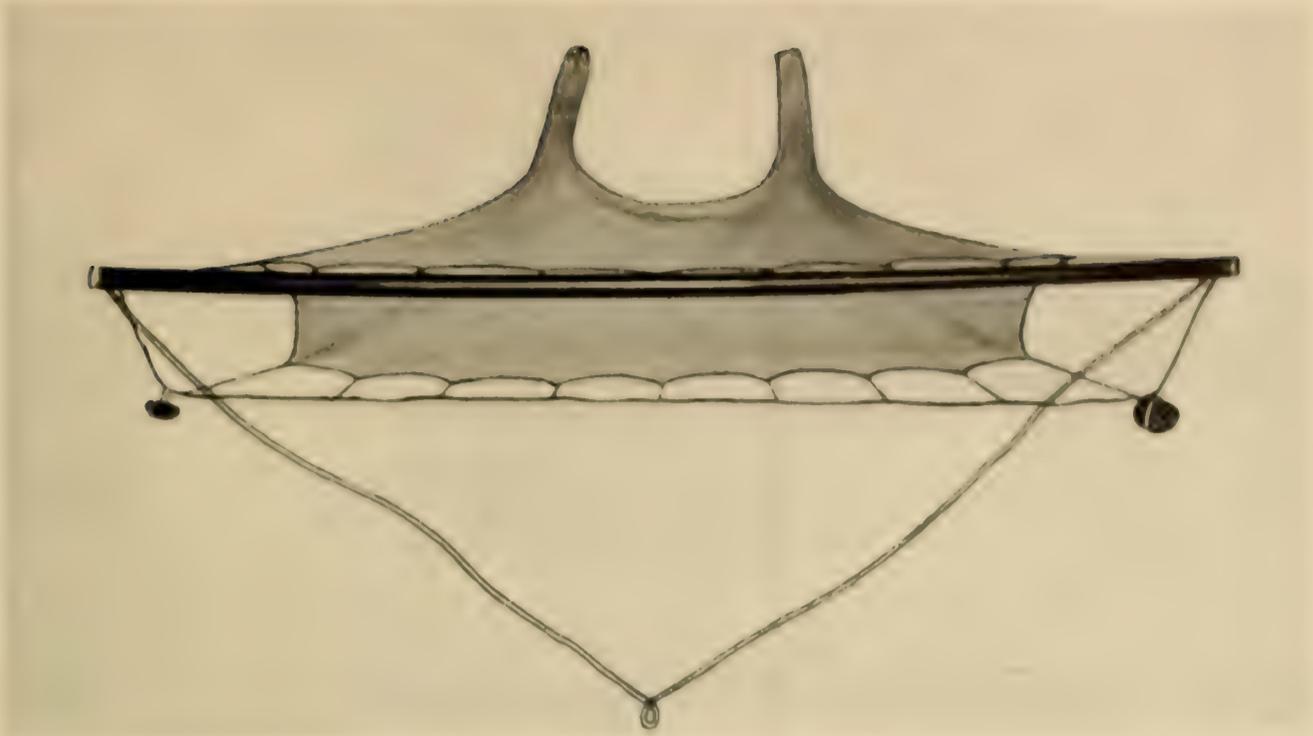
The net used to cover the opening of the trap is primitive and peculiar. It is not in evidence at all in the photographic illustration, but is diagrammatically represented in the sketch on the opposing page. It consists of a deep bag net hung from a very large wooden hoop secured to a long pole. The ring stands out at right angles to the pole, being supported by three smaller braces, which extend from the base of the main pole to different parts of the circumference of the hoop. With the pole in vertical position, the ring or circular mouth of the net is horizontal, but, if the pole be allowed to fall, the mouth of the net may be made to fit against the opening of the trap. After a suitable interval the pole is raised to a vertical position; the fish may then be removed from the net, and the trap again lowered for another catch. While suggesting a pound net when seen from the surface of the water, the *caincha* is essentially a simple combination of a weir and a dip net. The operation is carried on from balsas, which are moored by strong lines that extend out in various directions from the mouth of the pound and are permanently anchored with heavy stones; a single buoy from one of these mooring lines may be seen in the right foreground of the illustration on

p. 26. The frame of the net (*cana*) is called a *cupo*.

One of the interesting nets used by the indigenous fishermen in this lake is the *ccana*—the spelling here adopted reproduces as nearly as possible the pronunciation of the Aymará word, beginning with the sound of hard *c*, repeated without the intermediation of a vowel sound. The *ccana* is a sort of trawl net which is dragged on the bottom, and may be used either near the shore or, as my informant said through an interpreter, “where the bottom can not be seen.” It is dragged from balsas for “bogás” and “suchis.” The net has a large mouth kept open by a cross pole, on which its top is stretched, and by stones attached to the lower edge of the circumference. The net does not taper backward to a single cod end, but possesses the striking feature of being extended behind by two rather long and slender cylindrical bags, in which apparently the fish are practically trapped. In form and use it is essentially a primitive beam trawl with features of a trap. Either the indigenous Peruvians have not learned to complete the frame of the trawl or else they have found that the apparatus served more effectively without such support. The net collapses, of course, when brought into a vertical position. The *ccana* examined and made the subject of the accompanying illustrations¹ was 2.2 meters long, with a mouth 6 meters in circumference, the opening being about 2½ meters (8 feet) in width.

The *uisi-cibiña* is a dip net with a long handle that may be pushed ahead

¹The illustrations are retouched photographs of a net obtained by the writer at Chimu and now deposited, by courtesy of the Davenport Academy of Sciences, in the American Museum of Natural History. The net was staged in Washington for photographing, but nothing was added to the apparatus except the beam.



The *ccana* is a trawl net In the upper picture it is shown in position for use; in the lower picture it is pendent



These marshes, or *totorales*, of the Bay of Puno, Lake Titicaca, abound in small fish and Crustacea



The picturesque reed craft, or balsa, of Lake Titicaca is the representative of a type antedating the discovery of America

on the bottom. Dr. Garman¹ has described the use of this net as follows: "Armed with this the Indian glides back and forth along the beach late in the evening, when the hungry siluroids [catfishes, or suchis] come close to the water's edge to feed, occasionally dropping the net quietly down so as to cut off its retreat and then with a jerk throwing an unwary fish far out of the water. It is said that these nets are also used in fishing by torchlight from balsas."

My informant described a sort of trap that I was unable to see. It was evidently identical with the trap which Garman described in the following words: "The pot is a short cylinder of open basket-work with one end rounded and closed, and with a gate in the other, like that of the lobster pot, which admits the fishes but prevents their egress. Considerable ingenuity is displayed in the structure of these baskets. The warp is of single stems of a smooth, stiff, wiry grass; the woof is made by wrapping several small stems with split straws, making rolls which are bound to the stems of the warp, on the outside, by passing one of the straws which bind the roll around each stem at the proper distance from each other. The spaces in the warp are determined by the size of the fishes desired; those in the woof by the strength of the materials. Such traps are used as are lobster pots."

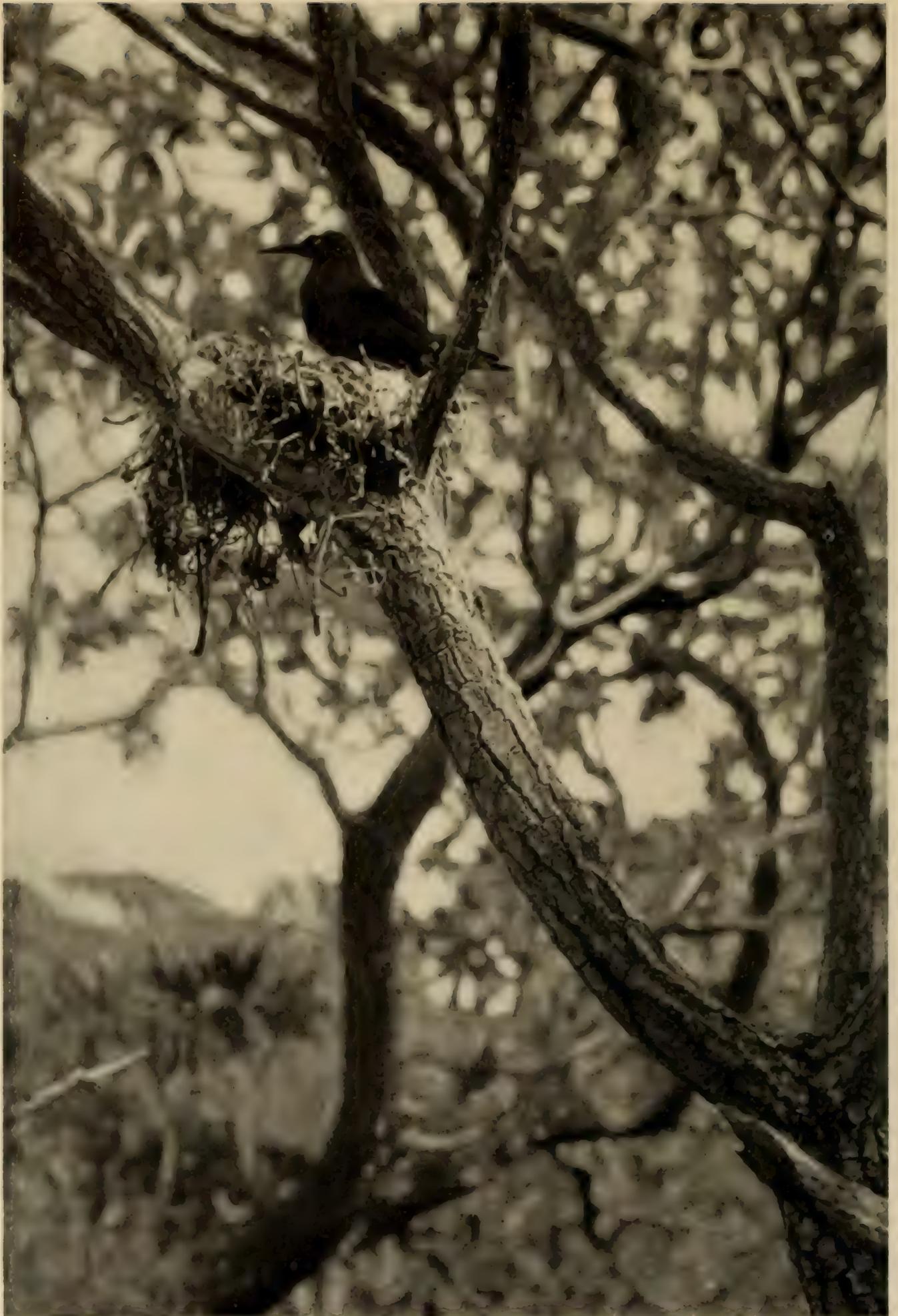
Another form of apparatus described by native fishermen is a trap of mats of

titora rushes which is dragged in the water on the beaches; the trap is closed as it is hauled on to the beach. A method of fishing mentioned by other writers involves the use of a three-pointed spear attached to the end of a steering paddle; in the very transparent water of this lake in the skies the fish may be distinguished at a depth of fifteen feet or more. I could not by inquiry learn of the use of a casting net or of any form of hook, and these implements seemed not to be known to the indigenous fishermen of that locality, although the fishhook, at least, formed a part of the tackle of the autochthonous Peruvians of other parts. The native vegetable poisons, generally called *barbasco*, are used to stupefy fishes, especially in sluggish rivers, or in artificial *pozos*, or pools, excavated along the margins of the rivers.

The picturesque floating craft, the balsas, of Lake Titicaca are well known. Two large bundles of *titora* rushes, five or six meters in length, bound tightly and secured together, constitute the body of the craft, while slender bundles laid above these and attached to the outer margins form the sides. The balsas are propelled by paddle or sail, the sails being made also of *titora* rushes woven together in somewhat the fashion of a Venetian blind.

The fishery of today in Titicaca is but a relic of that which must have existed there when the greatest civilization of the American continent centered about its shores; yet the methods now employed are doubtless the same as were practiced in Inca and pre-Inca times.

¹Agassiz, Alexander and Garman, S. W., "Exploration of Lake Titicaca." *Bulletin* of the Museum of Comparative Zoölogy at Harvard College, in Cambridge, Vol. III, No. 11 (1. Fishes and Reptiles, by S. W. Garman, pp. 273-278). Cambridge, Massachusetts, 1876.



A LESSER NODDY OF OENO ISLAND

At the time when the Whitney Expedition visited Oeno, the lesser noddies were just through nesting, but the young bird here shown was not quite able to fly and so was forced to sit for its portrait

The Voyage of the "France"

A LATER-DAY TRIP TO THE SCENE OF THE "BOUNTY" MUTINY
AND TO OTHER ISLANDS OF THE SOUTH PACIFIC

BY ROLLO H. BECK

Leader of the Whitney South Sea Expedition

AFTER being dependent for more than a year on local trading vessels that call irregularly at many of the Polynesian islands for cargoes of copra, we came to the conclusion that the work of collecting birds could be done far more quickly and thoroughly if the Whitney South Sea Expedition had a vessel of its own. Several schooners were offered at prices beyond their value but finally one better than I had hoped for was brought to my attention, and a cable to the American Museum resulted in its purchase.¹ While the name "France" was not so typically local as "Anapoto," "Tamorre Moorea," or "Vahini Tahiti," the designations of other craft that were in the market, the vessel itself excelled them all in its seaworthiness and it offered the further advantage of probable exemption from heavy repair bills in the near future. With a change in the arrangement of the cabin and the addition of a few shelves and a table in the hold, the "France" was ready for sea, though before turning her over to the American Museum, the owners found it necessary to replace the rudder and rudder box, which had been damaged by shipworms² during a year's use in the Marquesas, where facilities for painting and cleaning the bottom had not been available.

As the hurricane season was in full swing when we were ready to leave on our initial cruise, it was deemed advisable to run south out of the track of

¹See NATURAL HISTORY, January-February, 1922, p. 88.

²See NATURAL HISTORY, July-August, 1922, pp. 378-79.

possible storms and then work out to the easternmost end of the cluster of islands that are included under the term Polynesia. Ravaivai Island, our first stop, three hundred miles southeast of Tahiti, yielded several specimens of wedge-tailed shearwaters (*Puffinus pacificus*) and gray ternlets (*Procelsterna cinerea*), desirable species



An ancient stone figure hidden away in a forest on Ravaivai Island

that we had not found on our first visit the year before, while Rapa Island, five hundred miles south of Ravaivai, gave us a fine series of white-breasted petrels (*Fregetta grallaria*) and their eggs. At Rapa we were surprised to see several of the Christmas Island

shearwaters (*Puffinus nativitatis*), which were captured by means of steel traps placed in burrows where young birds were located. We had not observed this species since leaving the vicinity of Christmas Island, more than 1500 miles to the north, but a few days later at Bass Rocks, 40 miles to the south of Rapa, we again noted it. Rapa also yielded a couple of dozen additional specimens of the wary little black rails (*Porzanaoidea* sp.?) which we had heard often at Tahiti and Moorea, but which on those islands kept so securely hidden in the thick grass and ferns that a capture was very seldom accomplished. At Rapa these birds feed largely in the cultivated taro beds where the small snails that figure in their diet are abundant.

Our especial desideratum at Rapa was a large bluish shearwater, two specimens of which we had obtained the year before, but we found none on this occasion. At Bass Rocks, however, only an hour's flight away, this bird was the predominant species and we collected as many specimens of it as we needed, lying off in our small boat to the leeward of the Rocks. Here we secured also a couple of specimens of another small shearwater not met with elsewhere, and were greatly interested in noting the absence of the white-breasted petrel and the neglected petrel (*Pterodroma neglecta*), two common species of oceanic birds that are found on Rapa near by, the shores of which can be easily discerned from Bass Rocks. On account of a strong wind and a rough sea we found it impossible to land on the precipitous rocks, a half dozen of which, scattered over a couple of miles of ocean, form the group collectively termed Bass Rocks. Our inability to land prevented us from obtaining a series of sooty terns which

we wanted, for an adult and a couple of young birds, brought down from high in the air, apparently belonged to a larger variety than the Christmas Island birds that we had caught by hand when visiting that locality. After five hours in the small boat off Bass Rocks we returned aboard the "France" and headed eastward, favored by a fair wind that carried us a hundred fifty miles before it petered out.

For the next two weeks we had light winds most of the time but on the twelfth of March, thirteen days after leaving Bass Rocks, Pitcairn Island appeared on the horizon and we neared the landing place simultaneously with a large English steamer that was bound for New Zealand. Three boats loaded with natives and island produce immediately drew alongside the steamer, which stopped for an hour before resuming its course, whereupon the natives, who had sold their melons, corn, and chickens, came to our craft, and several of them who had known members of our crew in Papeete, stepped aboard to renew acquaintance. Permission to collect having been granted by the governor, our small boat was lowered, and we went ashore in company with the descendants of the famous mutineers of the ship "Bounty," who settled on Pitcairn in 1790 and were not heard of for forty years. At the end of that time an American ship touching at the island discovered them in place of the seals, that were the object of search. These mutineers married native women but their descendants show very little of Polynesian strain in their ancestry.

Since the opening of the Panama Canal, steamers on their way from England to New Zealand frequently stop at Pitcairn to exchange clothing



Bass Rocks, jutting sharply up out of the water about forty miles from Rapa Island, are far less dangerous to ships than the lowly coral atolls a few hundred miles to the northward



The principal occupation of the men of Rapa Island is to sit on a rock several hours a day, holding a fishing pole until a mess of fish has been captured. The old pilot of Ahurei Bay, pictured above, had cushioned his seat with a few handfuls of long coarse grass gathered near by



THE NEST OF THE WHITE-BREADED PETREL.

Many of the nests of this species on Rapa Island were found under thick bunches of dry grass and in such cases it was necessary to enlarge the entrance before a picture could be taken



A YOUNG FRIGATE BIRD ON TENARARO ISLAND

With beak wide open it awaits eagerly the return of its parent carrying freshly captured fish. Although the mother bird is not shown in the picture, the attitude of the young betrays her proximity



The neglected petrel on Ducie Island was usually found nesting close by the trunk or large limb of a fallen tree



The petrels of Ducie Island had begun nesting only a short time before the Whitney Expedition visited this locality, but long search revealed one or two young birds of the short-billed species and one of these is reproduced above

and foodstuffs for the island produce. Potatoes, watermelons, and corn of very good quality were in season when we called in March, and a little later in the year oranges are a source of considerable income. We bought twenty chickens at the rate of a shilling and a half each and exchanged some rice for water, which was conveyed to the landing place in wheelbarrows from a spring on the far side of the island, a distance of more than a mile. A little warbler (*Conopoderas vaughni*) was the only land bird present and the larger sea birds were conspicuous by their absence, as they have been hunted for food since the settlement of the island 130 years ago.

A couple of days' collecting at Pitcairn sufficed and we left for Ducie Island, an uninhabited atoll several degrees farther east. Ducie proved a collecting field *par excellence* for red-tailed tropic birds (*Phaëthon rubricaudus*), as well as for neglected and for short-billed petrels (*Pterodroma parvirostris*) as all three were nesting on top of the ground and we had merely to walk or crawl about under the low bushes and trees to gather all the specimens we wanted. At Juan Fernandez Island, of Robinson Crusoe fame, off Chile, I had been able to find a few eggs of the neglected petrel on narrow ledges along the high cliffs, and at Christmas Island the short-billed shearwaters nested usually under the concealing dead palm leaves, as did the Christmas Island shearwaters, a few of which still lingered at Ducie, although their nesting season had long passed. Out of a dozen species of shearwaters, the eggs of which I had collected during the last twenty years, these three were the only kinds that nested on top of the ground, the remainder being burrowing birds. But instead of occasional

nests, which had been my usual experience, at Ducie there were literally hundreds, each containing but one egg, and we believe that 30,000 would be a very conservative estimate of the breeding Tubinares. Every afternoon about four o'clock the space above the trees reminded one of the front of a beehive on a warm spring day in prune-blossom time in California, for thousands of birds would circle overhead, chasing one another and dropping to the ground to waddle along to the spot selected for a nest. Before the egg was laid both birds were present at the nest, but after it was deposited only one bird was to be found on guard. The tropic birds, many with pink-colored feathers, hollowed out nests in the sand under the bushes along the outer edge of the wooded part of the island, for their legs were poorly adapted to walking, whereas the shearwaters would traverse a hundred yards, if necessary, to gain an open place before taking wing. Many of the latter surprised me by climbing up sloping tree trunks into the tips of the branches in order to take their plunge into the air.

The most astounding nesting habit observed was that of the fairy tern (*Leucanous albus*) in placing its single egg on top of a narrow limb with no trace of a nest, and hatching it in that precarious position. That this bird really survives the perils of infancy is evidenced in nearly every island by the abundance of the species.

At Ducie we started eating freely of the fish that are easily caught on and near the reef, until the cook and mate were laid up in bed and several other members of the party complained of not feeling well, and then fishing was tabu till we reached Henderson Island. After proving to our satisfaction that

the Henderson fish were not poisonous, we salted and dried several hundred pounds, with such good results that when we sampled our store, it was found as palatable as the Alaska salmon, with which we were well supplied.

In the way of birds Henderson yielded a rail, a dove, and a warbler, as well as the usual sea birds, but travel over

they chose to remain close by the landing place till our departure. Future visitors should have less trouble than we cutting trails through the tangled vines and shrubbery if the goats use their freedom to good advantage in nibbling their way to the interior.

Four days after leaving Henderson we arrived at Oeno Island, which has



In the Tuamotu Islands the single egg of the fairy tern is usually laid on a branch of the *tohunu* tree. No nest is constructed, the egg being placed in this hazardous position without other support than that furnished by the limb itself

this island proved so difficult that most of our collecting was necessarily done near shore. As Henderson is a raised coral island instead of being of the usual low atoll type, the surface of hard coral rock is broken in places by sharp, jagged, pinnacle-pointed masses that are far more difficult to traverse than the reefs over which we made our way before stepping on to the sandy beach above high-water mark. The last three of the ten goats purchased for food in Rapa we liberated on Henderson, but

proved one of the most deadly islands of Polynesia in point of shipwrecks, for it lies close to the track of sailing vessels bound from the Pacific coast of North America to the west coast of South America and, having an extended reef off the eastern end, is doubly dangerous. The shores of the low atoll were lined with weather-worn lumber from one of the latest wrecks, and the keel of one large vessel still lies on a sandy islet a mile within the lagoon, with an anchor stock showing

on the reef, where an attempt had been made to stop the headway of the doomed ship. We found on Oeno that some of the blue-faced boobies (*Sula dactylatra*) were wiser than most of their kind on other islands, for they had selected the shade of a tree or bush for a nesting site, whereas the glaring white beach is the usual home site selected by this species.

In addition to the Ducie Island shearwaters we encountered again the blue shearwaters that had been so common at Bass Rocks. But instead of high cliffs on which to build their nests, as at Bass Rocks, at Oeno there was only a low fern-covered flat a dozen feet above the sea level. Many sea birds were resident here, and a week slipped by in short order. The last day of our stay our sailors were caught in the breakers on the reef and their boat was overturned by an extra large swell. The schooner had stood out to sea on a short tack and the crew were obliged to remain in the water more than three hours till the ship made her inward tack. By good fortune not a shark approached them, though at other islands the sharks had kept us close company.

Mangareva, the seat of government for the eastern Tuamotu, was a pleasant change from the desert islands to the eastward, and with its neighbors, all within the same reef, kept us busy for more than two weeks. That there had been a much greater population at an earlier date is evidenced by the old, crumbling stone houses encountered everywhere about the shores. Although there are now only about 500 people in the Gambier group, as the five inhabited islands are called, about 19,000 formerly lived there. A convent that housed hundreds of girls in years past is today covered by the growths of

the encroaching jungle and will soon be a thing of memory only. The cathedral is handsomely decorated about the altar with thousands of pearl shells and is larger in appearance than the cathedral at Papeete, though the congregation does not remotely rival that of Papeete in numbers. On one of the small uninhabited islands where goats were kept, the surprising capture of a rail was made. There was hardly any cover on the island for a bird with the ordinary habits of the rails as we knew them in Polynesia, but a few had managed to exist in spite of the destruction of vegetation. On Mangareva itself we obtained a fair series of the yellow-billed tropic bird (*Phaëthon lepturus*), a species that nests in the mountains in preference to the coral atolls favored by the red-tailed.

The day before we left the Gambier group the sailors gathered a few boxes of oranges and lemons, which were given us for the picking, as they were going to waste under the trees. The lemons were placed in dry sand and kept in good condition until we reached Papeete nearly two months later, but the oranges did not keep so well and were disposed of in less than a month.

Marutea Island was the next place visited and here the native sandpiper (*Aechmorhynchus parvirostris*) was found on several motus, little islets on the ring of coral. A northerly wind that started before we left Mangareva made boating difficult, and one of the workers on the island, while helping to launch our boat in a heavy swell, was knocked unconscious and would have drowned had not a companion dived after him and pulled him from the water to the boat, which had just escaped from a curling breaker. The plantation on this island was provided with several carts used ordinarily in



On many of the Pacific islands the *Pandanus* is one of the commonest trees. Thick groves occur in many places but not infrequently single trees stand out from their neighbors and especially is this the case along the shore. Note the curious prop roots that are massed about the lower part of the stem

the picking of coconuts and in transferring the copra from the drying ground to the warehouse. We landed our small sailboat one morning and carted it in one of these conveyances across the island to the lagoon, where we used it in exploring the farther end of the atoll. At Turei Island, a few days later, we sold this boat, which was not particularly suited to our needs, to a native whose own boat had been wrecked.

The four islands of the Acteon group, fifty miles to the westward of Marutea, varied greatly in their bird life, although in regard to food and living conditions they seemed to be similar. Not one of these islands was inhabited, although our chart lists them as populated by hostile people. Tenararo, the smallest and most western of the group, had birds in abundance, and on one occasion when stopping in the course of a stroll, I counted fourteen of the little sandpipers sitting on a dead tree close beside me. As a rule any sandpiper that observed us walking in its direction would fly to meet us, being in this respect different from most of the other birds we encountered. At Tearunga and Vahanga, but a few miles to the eastward, the sandpipers and doves were very scarce, and we spent only a couple of weeks in this vicinity, sailing thence to Vanavana Island.

Here we were pleasantly surprised to find the ground doves (*Gallicolumba pectoralis*) in large numbers but extremely concentrated in one clearing where coconut trees had been grown. After the larger trees had been chopped down the vines and weeds quickly overran the place and the doves found it so much to their liking that they abandoned the undisturbed forest and congregated in a spot only a few hundred yards in radius. The island is not more than two miles in circumference and more than a third of it is bare of cover, so the doves have a slim chance of holding their own if the dozen inhabitants continue clearing the jungle and killing the birds for food. Eight months had elapsed since a vessel had called, and fish, birds, and the fruit of the *Pandanus* had been the sole means of sustenance available to the islanders for some time.

At Tureia Island, about forty miles from Vanavana, we found a small settlement of pleasant people, with an obliging priest who spoke excellent English and who was slowly repairing his hurricane-wrecked church. At this island we encountered the warbler again, our last specimen having been taken at Henderson, six hundred miles to the eastward. Why the intervening islands were devoid of this bird is puzzling, for these islands are equally suitable apparently as a habitat; it is reported that Mangareva at least was not without the warbler formerly. But the distribution of the avian fauna is puzzling with respect to other species as well.

After working over Ahunui and Paraoa, a hundred miles westward of Tureia Island, I went ashore at Nengo Nengo Island, our last stop before starting for Papeete. There I strolled into a colony of nesting frigate birds, as I had done on twenty islands in the past twenty years, but instead of the species that had inhabited the twenty—some of them west and some of them east of Nengo Nengo—I was delighted to find at last the long-looked-for lesser frigate bird (*Fregata ariel*). A colony of a hundred pairs were nesting on low shrubs, most of them not more than a

couple of feet above the ground, and I had no difficulty in getting a dozen birds for specimens, though they were not as tame as the majority of the other species when at their nests. In this colony I saw but a single bird with immature plumage. The males of the lesser frigate birds are recognizable at a long distance by the two white patches on the abdomen. In higher shrubs about the frigate colony were many old nests of noddy terns, and sitting on the ground near them, the young noddies that had been unapt at their fishing lessons were waiting for their parents to bring fish, but most of them had had long waits, judging by the very poor condition that those collected exhibited.

With a favoring wind we bore away from Nengo Nengo for Papeete and arrived inside the pass at that port a few minutes after midnight on the morning of the Fourth of July, having visited more than twenty islands on the five months' trip, over half of which had never been trodden by a collector before. After painting and cleaning the vessel and getting a fresh stock of provisions we headed out to the eastward to visit other unknown atolls and secure before their extermination examples of their dwindling fauna.



MR. W. HENRY SHEAK AND HIS PET CHIMPANZEE, JOE

Joe showed a high degree of intelligence. He learned, among other things, to wipe his nose with a handkerchief, to brush his hair with a hairbrush, to clean his clothes with a whisk broom, and to eat with a spoon as well as any little boy or girl. In carpentering he was not inexpert. He could bore holes with a brace and bit, use a handsaw with considerable skill, remove screws with a screw driver, and pound nails with a hammer

Anthropoid Apes I Have Known

BY W. HENRY SHEAK

Lecturer on Natural History Subjects

WHICH of the great apes resembles man the most? This is the question I am frequently asked. Dr. Henry Alleyne Nicholson, professor of natural history at the University of Aberdeen, asserts that "the gorilla is now regarded as the most human of the anthropoid apes." But, as a matter of fact, it is very difficult to say which is the most human, for one of them may resemble man in certain characters, while another approaches him in respect to other characters, and a third evidences close relationship to him through a third set of characters. For instance, the gibbon resembles man more than does any other ape in respect to its upright carriage. The orang-utan resembles man in the absence of the superciliary crests, prominent bony ridges which protrude out over the eyes and so disfigure the face of the gorilla, and are prominent in the chimpanzee; in the form of the cerebral hemispheres, the forehead of this ape rising straight and perpendicular from the eyes, while that of the other anthropoids retreats considerably; and in the number of ribs, there being twelve pairs as in the human skeleton, while in the gorilla and chimpanzee there are thirteen.

The gorilla resembles man more than do any of his cousins in the strength and development of the legs. He is most like man also in the structure of the pelvic bones.

The chimpanzee is most like man in the relative size of the brain and in its convolutions, though not in the finer details of brain construction; in the face, this being smaller in proportion to the size of the cranial region of the

head than in the other apes, and more human in its expression; and in the formation of the ear, which, while relatively much larger than the human ear, closely resembles it in its modeling. The large size of the chimpanzee's ear is, doubtless, due to the fact that in his native African forests the leopard is his formidable enemy and his auditory organ must be so developed that it may catch the faintest rustle of leaves made by this great stealthy cat prowling among the branches. The ear of the orang is proportionately as much smaller than the human ear, as the ear of the chimpanzee is larger. This is probably because there are no large predatory animals in Sumatra or Borneo. True, the python sometimes makes a meal of a baby ape, but the adult orang is not afraid of this monster serpent. So man is really his only dangerous enemy, and the orang has not been in conflict with civilized man, the only one who cares to capture him, a sufficient time for the association to produce any change in the anatomy of his ear. Again, the chimpanzee is most like man in the structure and conformation of the hand. The hand is very long and slender, and the thumb is set much farther back than in man, so that the distal end does not reach beyond the knuckles of the other fingers, but otherwise it is very human.

If I were asked to decide which of the apes had the larger number of close resemblances to man, I should have to cast my vote for the chimpanzee.

Of the great apes the gibbon is the most arboreal. His entire life is spent in the tree tops. In traveling through the forest, he does not come to the

ground, but swings from limb to limb by means of his long, powerful arms, using his feet very little to aid in progression. In this way he travels very rapidly, easily outdistancing the hunter, impeded as the latter generally is by dense undergrowth. Yet, notwithstanding this extreme development to an exclusively arboreal life, the gibbon, as I have already intimated, walks upright more readily and with greater ease than any other ape. I have seen the white-handed gibbon (*Hylobates lar*) in the Philadelphia Zoölogical Garden run and walk as erect in carriage as a man and without any help from his hands.

The Philadelphia Zoölogical Garden holds the world's record for keeping a gibbon alive in captivity. The specimen—the *Hylobates lar* alluded to in the previous paragraph—was received July 27, 1906, and hence has been in the collection for more than fifteen years. A record of four years and three months, attained by a gibbon in the London Zoölogical Garden, ranks second to the case just mentioned. The gibbon in the Philadelphia Zoölogical Garden has never shown much affection for his keeper, William Quigley, a man of intelligence and a close observer, who has had charge of the ape ever since the latter's arrival. Mr. Quigley tells me that it is not safe to turn one's back on this animal when in the cage with him, for he is inclined, even after all these years, to jump on a human intruder and bite him. He has never shown any of the friendliness or desire for human companionship so common with the orang-utan and the chimpanzee. Neither has he manifested any remarkable intelligence.

One of the most interesting habits of this ape is the daily utterance of a series of calls or notes, commonly

denominated "singing." They are sad and plaintive in tone, not unlike the cooing of the mourning dove, but much louder and in a higher key. On a clear, frosty morning in autumn I have heard him at a distance of more than a mile. He usually begins his "singing" about 8:30 A.M. and continues for about half an hour. On dark, gloomy days, he is more likely to "sing" at unusual times than on clear, sunny days. Once I observed he did not begin his "concert" till about 9:30 and then kept it up until nearly noontime. He has been known to sing in the late afternoon or early evening, when the day was dark, but rarely twice on the same day. The presence of people about the cage does not seem to interfere with his "singing."

Mr. Quigley says that before the death of a female *Hylobates*, which was secured at the same time as the male but which lived only about fourteen months, they both "sang," and that she was the better "singer" of the two. In closing a note she would do so with a quaver, coming down gradually to silence, while he stopped abruptly. At her death he ceased "singing," but after several months resumed the practice. I am inclined to think that these notes are the love calls of the species. I have found the gibbon always very restless while "singing," swinging from rope to rope along the top of the big cage, from one end to the other, running along the shelf in front of the window ledges, pausing for half a minute at one window, then hurrying to the other, peering longingly out, and listening, as if anxiously looking and calling for someone, and expectant of a response.

Mr. H. C. Raven, an experienced collector, and long associated with Dr. W. L. Abbott in his work in the East Indies and other regions, says that the

notes of the gibbon are among the "characteristic sounds of the Bornean forest." He tells me that in the wild, free state, both the male and the female indulge in this morning serenade.

Since the gibbon of the Philadelphia Zoölogical Garden has lived such an unusually long time in captivity, never missing a meal, and has gone for twelve years without having so much as a cold—an attack of dysentery in the summer of 1921 being his only illness in all that time—the reader may be interested to know the diet prescribed for him by the Zoölogical Society. The first thing in the morning he is given an orange and a dish of tapioca and rice cooked together. His lunch, at half past eleven, consists of a slice of bread. Toward the end of the afternoon comes dinner, when the rice and tapioca are repeated, and a medium-sized banana and a cup of sterilized milk containing a teaspoonful of lime water is added to the bill of fare. He is never given any water to drink. This is his daily diet. It is never changed one iota. No direct current of air is ever permitted to blow on him, unless the day is warm and pleasant, but the two windows of the small mammal house which open into his cage, are arranged with double sashes, and are so adjusted that the air is always kept fresh and pure.

Frequently I have had men tell me of the interesting gorillas they saw in some traveling menagerie. On being asked how long a tail these gorillas had, the answer would almost invariably be, "fifteen to eighteen inches." As a matter of fact, no anthropoid ape has any external tail. Indeed the gorilla is a little farther removed from the tailed state than we are. In the human coccyx, which corresponds to the caudal appendage of the tailed monkeys, there are four vertebral bones,

more or less amalgamated or ankylosed. But in the gorilla there are only three of these in the normal adult. These simians, advertised as gorillas, have been baboons.

So far as I know, beyond all question, only four gorillas have ever reached America alive. The first one was brought over by Edwards Brothers in 1897. It reached Boston on Sunday, May 2, and died May 7. It was never on exhibition. Doctor Hornaday's daughter happened to be in Boston at the time and he telegraphed her to go to see the rare and interesting animal, which she did, reporting her impressions to her father. The specimen was a young male, a mere infant, and came over from Liverpool with a young female chimpanzee, to which he had become much attached on the voyage. He had been eating fairly well, but the little chimpanzee was suffering with pneumonia when they arrived, and two days later she died. After this he became listless, refused to eat, and on the fifth day after arriving he, too, died. The body was sold to Professor Burt Wilder of Cornell University, and the skin, skeleton, and brain are still on exhibition in the museum of that institution.

The second gorilla and the third were brought to the United States by the late Professor R. L. Garner for exhibition in the New York Zoological Park. The first of the two was a young female and was on exhibition in the park from September 23 to October 5, 1911, when she died. She would eat only two kinds of food, plaintains and the young stocks of plaintain and banana plants. She refused to touch bananas, oranges, grapes, bread, or any of the other articles of diet so readily eaten by the chimpanzee and the orang-utan. It was impossible to keep her alive in this

country. She measured 34 inches in height and the stretch of her arms from tip to tip of the middle fingers was 47 inches. Doctor Hornaday thought she must have been between two and three years old and Professor Garner was of the opinion that she was one of the largest gorillas ever captured, as usually the gorillas taken are small babies only a few months old.

Profiting by his first experience, Professor Garner kept his second specimen in Africa until she had learned to eat "civilized food," as Doctor Hornaday said, and in consequence they were able to keep her alive from August 24, 1914, when she reached New York, until August 3, 1915. This gorilla was named Dinah. She was of a more amiable disposition than the first specimen, ate rather freely, permitted herself to be handled and dressed in human clothes, and pushed about in a baby carriage. But the "civilized food" did not in the end agree with her. She died from starvation and malnutrition, complicated with rickets and locomotor ataxia.

The fourth instance is that of the gorilla known as John Daniel. When about three years of age, this gorilla was shipped to England and six months later came into the possession of Miss Alyse Cunningham, of London, under whose tuition he made extraordinary progress. After about two months it was possible to give him the freedom of the house. He had his place at the table, opened doors by turning the knob, and unbolted windows, raised them, lowered them again, and locked them, turned on the lights when entering a dark room, sponged himself when bathing, and adapted himself in many other ways to his urban environment. He became deeply attached to Miss Cunningham, and when later it was found necessary to sell him and he was

sent to New York, he became ill from homesickness and died before Miss Cunningham, who was summoned by cable, had time to reach him.¹

The orang-utan is not nearly so good an animal for exhibition purposes as is the chimpanzee. Unlike the chimpanzee, he is not always inventing some new way to amuse himself or to accomplish some of his purposes, or engaged in mad and frantic activity. He is slow and deliberate, sedate and dignified. But though he may sit in a corner of his cage, motionless and voiceless, his bright little eyes see everything that is going on about him.

Indeed, I have found him a very keen observer. In 1907 I was traveling with the Gus Lambrigger Animal Show as naturalist and lecturer. Our star attraction was a young orang-utan. One afternoon when I was standing in front of his cage, he left his place in the farther corner, came over to the front, and, stretching his arm through the bars, put his hand on my shoulder. At first I could not imagine what was engaging his attention, but when he took his hand away I discovered there was a tiny knot in the thread of the seam of my coat, and he was trying to get it. I had not noticed it before, but his sharp eyes had seen it from the back of the cage.

Old specimens are savage and morose, but the young are gentle and affectionate, becoming much attached to their human companions. I have seen young orang-utans in the New York Zoological Park following their keeper about on the lawn, and when in sport he attempted to run away from

¹For a fuller account of John Daniel the reader is referred to the article entitled "A Gorilla's Life in Civilization," by Alyse Cunningham, *Zoological Society Bulletin*, 1921, pp. 118-24. The ape, mounted in realistic attitude, is now in the American Museum. A picture of the mount appeared in *NATURAL HISTORY*, 1921, p. 655, with an accompanying note. An earlier note regarding this gorilla appeared in the same publication, 1921, p. 210.



JOHN DANIEL

This is the gorilla that, under the tuition of Miss Alyse Cunningham, of London, made such remarkable progress in adapting himself to the mode of life in a city house. The picture is reproduced by courtesy of Dr. William Hornaday, from the *Bulletin* of the New York Zoological Society, September, 1921

them, they hurried after, now and then putting their heads to the ground and turning a somersault in an effort to accelerate their speed.

One afternoon, when with the Lambrigger Animal Show, I had finished a



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This orang-utan wears, with an air of full assurance, the overalls of a laborer, and grips his pipe like an inveterate smoker. He was an animal of unusual intelligence. On one occasion, to recover a nut which had rolled beyond his reach, he took off a sweater he was wearing and, passing it through the bars, used it to draw the nut little by little toward the cage.

lecture and had sat down in a chair in front of the stage or platform on which the small portable cages were arranged. I was at some distance from the orang-utan's cage. Presently, however, I felt two hairy arms enfold my neck and a

strawberry-blond youngster climbed over on my lap and proceeded to make himself very much at home. The ape had opened the cage door himself and had walked along in front of the other cages till he was behind me. When I was with the Edwards' Animal Show in New York, we had a baby orang-utan and a big chimpanzee we called Sallie. Sallie soon learned she could frighten the little fellow by stamping her feet and screaming. One morning she started this noise, whereupon the orang-utan turned and ran to me, climbing into my lap and snuggling up to me, as if seeking protection from the great ugly, black beast, that he doubtless thought Sallie to be.

I have seen the orang-utans in the New York Zoological Park sitting at table, drinking out of cups and eating from plates, using spoons, knives, and forks, but not with the same readiness and ease with which the chimpanzee learns to do these things. There is, however, one accomplishment of the orang-utan I wish to emphasize, for in this he is an adept. It is using a blanket to cover himself. I have never seen an ape so young that he was not able to take a blanket and pull it over himself, without any previous teaching. This accomplishment seems to be an inherited habit or instinct. In their native country these apes probably cover themselves with large leaves.

At one time, when with the Edwards' Animal Show, we had a big orang-utan who was unusually intelligent. He learned all the coins from the silver dollar down to the copper cent and rarely made a mistake in picking out the coin asked for. On a certain evening he was given some English walnuts, and ate all but one, which dropped outside the cage and rolled just beyond his reach. His

appetite was satisfied and he made no special effort to get this nut. The next morning, however, he was hungry, and tried to reach it with his long arms. But it was a little too far away. After some minutes of silent thoughtfulness, he tried to roll some of the straw on the bottom of his cage into a sort of wand, by means of which he might reach the nut. But the straw was too much broken. Then there was another period of silent thoughtfulness. At length he began taking off his sweater. We wondered why he was doing this, as he was not in the habit of undressing himself unless we gave him permission to do so. Slowly and deliberately he unbuttoned the garment and drew his arms out of the sleeves. Then, pushing the sweater out through the bars of the cage, he swung it forward till it dropped over the nut, and gently drew it towards him, repeating this procedure until the nut was within reach. Thereupon he took the coveted morsel, cracked it, ate the kernel, then as carefully and deliberately put the sweater on again.

Of all the anthropoids, I have found the chimpanzee the most lovable. You cannot but feel he returns your affection as truly and sincerely as a human child. I have seen a young chimpanzee, on being taken from the shipping box in which he came to America, throw his arms about the neck of a man he had never seen before and hug him affectionately. I once had a little fellow who would snuggle up to me, then take my arm and put it about him. I had another, a big specimen, who frequently wanted to kiss me, and always on the lips. This, in spite of his good intentions, was not always a pleasant experience, for usually his lips were not very clean. I have known chimpanzees so attached to their keeper that they

would fight for him, attacking another man or even one of their own species.

My introduction to Mr. Joseph Edwards of the Edwards' Animal Show, was unique and characteristic. I had come to the menagerie in the absence of the proprietor. One evening, two or three weeks after I had entered on my engagement, I was lecturing on the four-year-old chimpanzee, who was sitting on a little chair on the stage. Just as I was finishing my talk, she gave utterance to a half dozen ecstatic, bark-like notes, and rushing across the stage past me, threw her arms in an exuberance of delight about the neck of one who was a stranger to me. I needed no further introduction. She had not seen Mr. Edwards for four or five weeks, and others had been feeding her, yet her greeting was one of the deepest affection.

To me one of the most remarkable things about the chimpanzee is the fact that he understands how to express affection and gratitude by hugging and kissing without being taught. This can only mean that these modes of expression are very, very old in the primate group. Indeed, they may not be confined to the primates. The elephant, though far removed genetically, has a similar mode of expression. I once had a large female of the Indian species who was very fond of me. Not infrequently when I was passing near her, she would reach over, take me by the arm, pull me up close to her side, and put my hand in her mouth, giving my fingers a gentle squeeze with her lips. It was her way of showing affection. The dog's habit of licking the face or hand of his master is well known. Kissing may be as old as the tactile sense.

The kiss of the chimpanzee is not a smack of the lips, but a lingering, caress-

ing touch of the lips to the bare neck of the keeper, to his hand, or to his shoulder, and frequently accompanied by a gentle pressure from the teeth. The way these apes commonly greet each other in captivity, and I presume in a state of freedom as well, is by an embrace—by throwing the arms about the neck or shoulders and giving a gentle squeeze. I have seen a large female chimpanzee, which had been some time in captivity, rush up to a smaller specimen newly arrived with cries of delight, and give the newcomer a gentle hug. I have seen this same big chimpanzee greet a baby orangutan in the same way.

This ape has the most fully developed sense of gratitude of any animal I know. He just must thank somebody for every esteemed favor. If he cannot get to the one who does him the favor, he will hug someone else. One afternoon, Sally, the big female chimpanzee mentioned above, saw the keeper approaching with a large bunch of grapes, a fruit of which she was inordinately fond. She began screaming with delight. He came only to the guard rail and handed the grapes across. She could not reach him from the stage, so she turned and threw her arms about me. One night, when she was very tired, she noticed the Senior Mr. Edwards getting out her sleeping box. She gave forth two or three long-drawn-out notes, followed by sharp, quick, truncated barks of delight, rushed to her master and hugged him frantically, turned to me and hugged me till she almost choked me, then hurried over to a negro at the end of the stage and hugged him too.

On the other hand, the chimpanzee will sometimes become angry and attack. The habit of these apes to cling together and fight for each other

makes it necessary for the keeper always to be on his guard. His intentions toward one ape may be misinterpreted by another and he will have both of them on his hands. One morning in Chicago I was giving an exhibition with Joe, a young chimpanzee of remarkable intelligence and usually very good-natured. But on the occasion in question he had a cold and was not in the best of humor. He refused to do what I asked and began screaming. Mike, a big burly brute, gave his well-known war cry and came for me like an enraged tiger. Fortunately the little fellow was between Mike and me, and a chair served as an additional obstacle. As a result I had time to seize a small stick which I had been using as a pointer and to give Mike two sharp cuts across the face, which turned him; but it was only by the greatest dexterity that I saved myself from the great jaws of the savage beast.

In general the chimpanzee is, however, very good-natured and obedient, ready and anxious to do what is asked so far as he comprehends. In Peoria, Illinois, I had a little chimpanzee named Adam, who made his public appearance in a gocart. As I was answering some question, my attention was withdrawn from him for a few minutes. The little fellow seized the opportunity to climb out of the cart and, when I noticed him, was stealthily making off. I said in a quiet but firm tone, "Adam, get right back in here." Without the slightest hesitation, he returned and climbed into the gocart. A bystander exclaimed, "Well, he obeys better than my kids!"

Adam was one of the best-natured, most peace-loving animals I have ever known. One evening I was alone in the menagerie. Everybody else had gone



FOUR OF MR. SHEAK'S CHIMPANZEE FRIENDS

Content, though crowded, these four apes present the pleasant side of chimpanzee clannishness. These animals are not merely passively friendly, however; on occasion they will fight for one another. Mr. Sheak had a narrow escape one time from the fierce attack of Mike, the big ape on the extreme right, who rushed at him in response to a scream that Joe, the ape next in order, gave forth. The two apes huddled at the lower end of the cart are not mentioned in the text. One of them, the ape next to Joe, was with Mr. Edwards for nearly ten years, and on the road most of that time. She probably holds the world's record for longevity of the chimpanzee in a traveling menagerie

out to dinner. I was sitting near the chimpanzee cage writing a letter, when a large savage female began screaming in angry tones. A few minutes earlier the apes had been fed potatoes boiled with the skins on. She had swallowed hers greedily and was now reaching for

spoon through the bars. One day when she was thus engaged in feeding a pair of gray spider monkeys, Mr. Edwards appeared with a bunch of grapes. Immediately she began stamping her feet, screaming, and making a frightful noise, which drove all the other simians



Joe is posing for his picture, his eye fixed upon the young photographer, while Darwin looks down from the frame on the wall

little Adam's share. She was afraid to take it from him by force while I was so near; but to my utter astonishment the little fellow broke his potato in two and gave her half of it.

Most chimpanzees are, however, not so willing to divide. Sometimes Sally, when she had eaten all the rice she cared for, would feed what was left in her dish to the little monkeys in a cage near her, dipping the contents out, a spoonful at a time, and handing the

to the farther end of the cage. On receiving the grapes she again turned toward them and gave two or three savage barks. She was perfectly willing to divide the rice, which she did not want herself, but not the grapes, which she did want. When Joe was given two apples and told to present one of them to his little sister, he would, if one was larger than the other, invariably hand her the smaller one, keeping the larger for himself, but if they were about the

same size, he would take a good bite or two out of one of them, then hand that one to her.

No animal below man possesses a higher degree of intelligence than the chimpanzee, if, indeed, any equals him. The orang-utan approaches him very closely in intelligence. The psychology of the gorilla is almost unknown to us, but we judge from the relative size of the brain and its convolutions that he ranks very high intellectually. We have no reason to believe, however, that he surpasses his smaller cousin.

Joe was one of the most wonderful animals I have ever known. We made no special effort to teach him anything, but he was a close observer and a persistent imitator, and picked up many clever tricks. He learned to wipe his nose with a handkerchief, brush his hair with a hairbrush, clean his clothes with a whisk broom, drink out of a cup, eat with a spoon as well as any human child, bore holes with a brace and bit, use a handsaw quite dexterously, take screws out of the guard rail with a screw driver, drive nails with a hammer and pull them out with the claw of the hammer, and to play on a toy piano and on a mouth harp.

Joe was full of mischief and dearly loved to tease a little Mexican dog that usually slept near his cage. He would reach out and give the dog a pinch,

then quickly jerk his hand back before the canine could nip him. In this way he kept the dog in a constant state of irritation and always ready for a fight. One day Mr. Joseph Edwards came into the room with some oranges and laid one under the dog's nose, wondering how Joe would solve such a problem. But it was no problem at all for Joe. He got the hammer, poked the handle through the bars till he got the dog to biting at it, then gradually worked the dog away until he could safely reach the orange with his other hand.

In Kansas City we kept the chimpanzees in a very large cage, almost the size of an ordinary bedroom. We had some ropes attached to the roof of the cage by bolts with a ring in the lower end. One of these bolts came out and fell to the floor. Mr. Joseph Edwards got in the cage, picked up the bolt, handed it to Joe and said, "Now you get up there," pointing with his finger, "and put this bolt through the hole, and hold it there till I fasten it." The little ape climbed to the top of the cage, holding on by one of the other ropes, inserted the bolt in the hole, and held it till Mr. Edwards climbed on top and made it fast. The head keeper, who was standing near me, expressed the thought and feeling of all of us when he exclaimed, "By George, that's going some!"

"The Minds and Manners of Wild Animals"

AN APPRECIATION OF DR. WILLIAM T. HORNADAY'S LATEST BOOK¹

By WILLIAM BEEBE

Director of the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana

SINCE the time of Noah interest in animals has never flagged, and from a certain afternoon in the Garden of Eden up to the most recent pronouncements of W. J. Bryan animal psychology has been an important factor in the life of mankind. Dr. William T. Hornaday has marshalled all the more important observations he has made during a long and intensively observant life, on the minds and the manners of animals, and has used them as morals, as texts, as examples, either delicately to suggest some hypothesis, or with sledge-hammer blows to force home some vital truth in the relations of animals and mankind on the earth today.

To those of us who have been associated with Doctor Hornaday for the two decades of his splendid administration of the New York Zoological Park, many of these pages will appear as memoirs of the doings of certain furry quadrupeds and feathered bipeds; there are chapters which, in faithful delineation of character, could be entitled "The Mirrors of the Zoological Park." To the general reader the book will appeal with all the charm of absorbing animal stories and anecdotes, which at the same time are logically bound together, dignified and clarified by the context of direct application.

Doctor Hornaday has the courage of his convictions and has covered the entire range of psychology of the higher vertebrates, with mammals as the dominant interest.

On the first page we learn his

attitude toward evolution: "To the inquirer who enters the field of animal thought with an open mind, and free from the trammels of egotism and fear regarding man's place in nature, this study will prove an endless succession of surprises and delights." Three pages later his estimate of mechanism is revealed: "Brain-owning wild animals are not mere machines of flesh and blood, set agoing by the accident of birth, and running for life on the narrow-gauge railway of Heredity."

In the first part of the volume temperament, individuality, language, and the rights of wild animals are discussed. The second chapter, on temperament, is one of the best and most suggestive in the book, and in my estimation furnishes one keynote to animal psychology. Six general types of temperament are recognized: morose, lymphatic, sanguine, nervous, hysterical, and combative. The gorilla is "either morose or lymphatic," the orang-utan "sanguine, optimistic, and cheerful," and the chimpanzee is "either nervous or hysterical." This specific individuality or temperament is evident from mammals to ants, and is the necessary concomitant of the inability of any animal to think "I am I."

Out of the abundance of his experience, Doctor Hornaday gives for the first time lists of bears, deer, and the pachyderms, based on this important phenomenon. Here is a new angle on behemoth: "*Every Hippopotamus, either Nile or pygmy, is an animal of serene mind and steady habits. Their*

¹Published, 1922, by Charles Scribner's Sons

appetites work with clock-like regularity, and require no winding. I cannot recall that any one of our five hippos was ever sick for a day, or missed a meal. When the idiosyncracies of Gunda, our bad elephant, were at their worst, the contemplation of Peter the Great ponderously and serenely chewing his hay was a rest to tired nerves. . . . It may be set down as an absolute rule that hippos are lymphatic, easy-going, contented. . . ."

And now may I register my strongest objection to Doctor Hornaday's volume, a mere matter of words but none the less important? On page 151 he credits a wild *Ovis nelsoni* with "a reputation for quick thinking, original reasoning and sound conclusions." Now, if I were writing a biography of Doctor Hornaday himself, and taking into consideration all the intricate planning, the able achievement, and the complex intellectual correlation by which he has brought into being and sustained our great Zoological Park, these are exactly the words I should use. And I object to the same unqualified phrases being applied to a wild sheep because it lies down in token of surrender when trapped, and does not try to fight its captor. If these terms *are* applied to the sheep, I demand some superlatives appropriate to the man, and for them I search my dictionary in vain. I hasten to add for the benefit of Mr. Bryan and the Kentucky legislature that my arguments imply no mental hiatus, any more than physical; I have seen a drop of water and I know the ocean is made up of a multitude of similar particles, but I prefer the word *ocean* to *drops*. The paucity of the English language is such that we cannot afford to stretch to the breaking point such splendid words as reason and intel-

lectual unless we qualify the extremes.

We cannot but admire Doctor Hornaday for his high, generous estimate of the animal mind, and his chapters on the elephant, the chimpanzee Peter, and Major Penny's gorilla offer many surprises. To me the chapter on language is the most interesting, and as there is no attempt to endow animals with talk or speech, every statement is conservative, reasonable, and accurate. This chapter should be enlarged to a full volume along the lines laid down by Doctor Hornaday. With few exceptions other writers have given way to the temptation to Anglicize the calls and songs of wild creatures, with very sad results. The various cries and emotional vocalizations of apes and monkeys make intensely interesting reading. The paragraph on page 30 beginning "Of all the monkeys that I have ever known, either wild or in captivity, the red howlers of the Orinoco, in Venezuela, have the most remarkable voices, and make the most remarkable use of them," is of particular interest at this very moment, for as I write these words in the interior of British Guiana, a chorus of these monkeys comes full strength across the water, and, as Doctor Hornaday continues, "The great volume of uncanny sound thus produced goes rolling through the still forest far and wide."

The second part of the book contains twelve chapters dealing with such subjects as "The Brightest Minds Among Animals," "Keen Birds and Dull Men," and special treatments of the higher apes, elephants, bears, ruminants, rodents, birds, serpents, and the "Training of Wild Animals." For cunning in self-preservation, Doctor Hornaday awards the palm to the common brown rat; for strategy to the

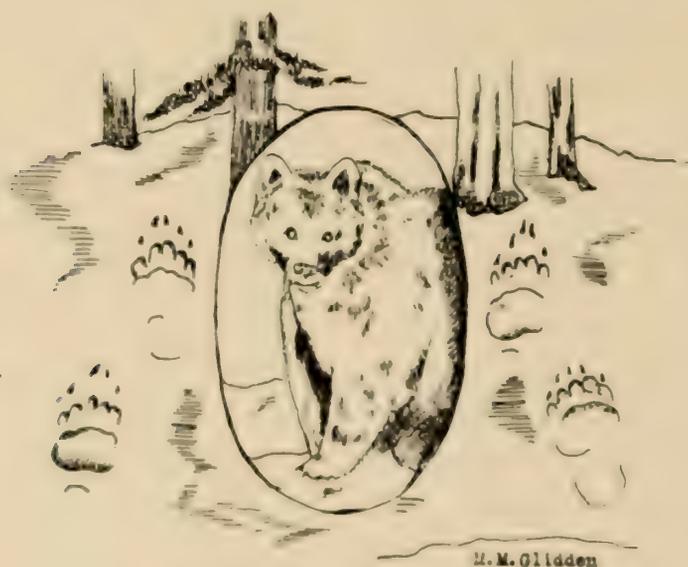
musk ox, while he considers the silver-tip grizzly bear as being the "brightest North American animal," and sets forth excellent reasons for his choice.

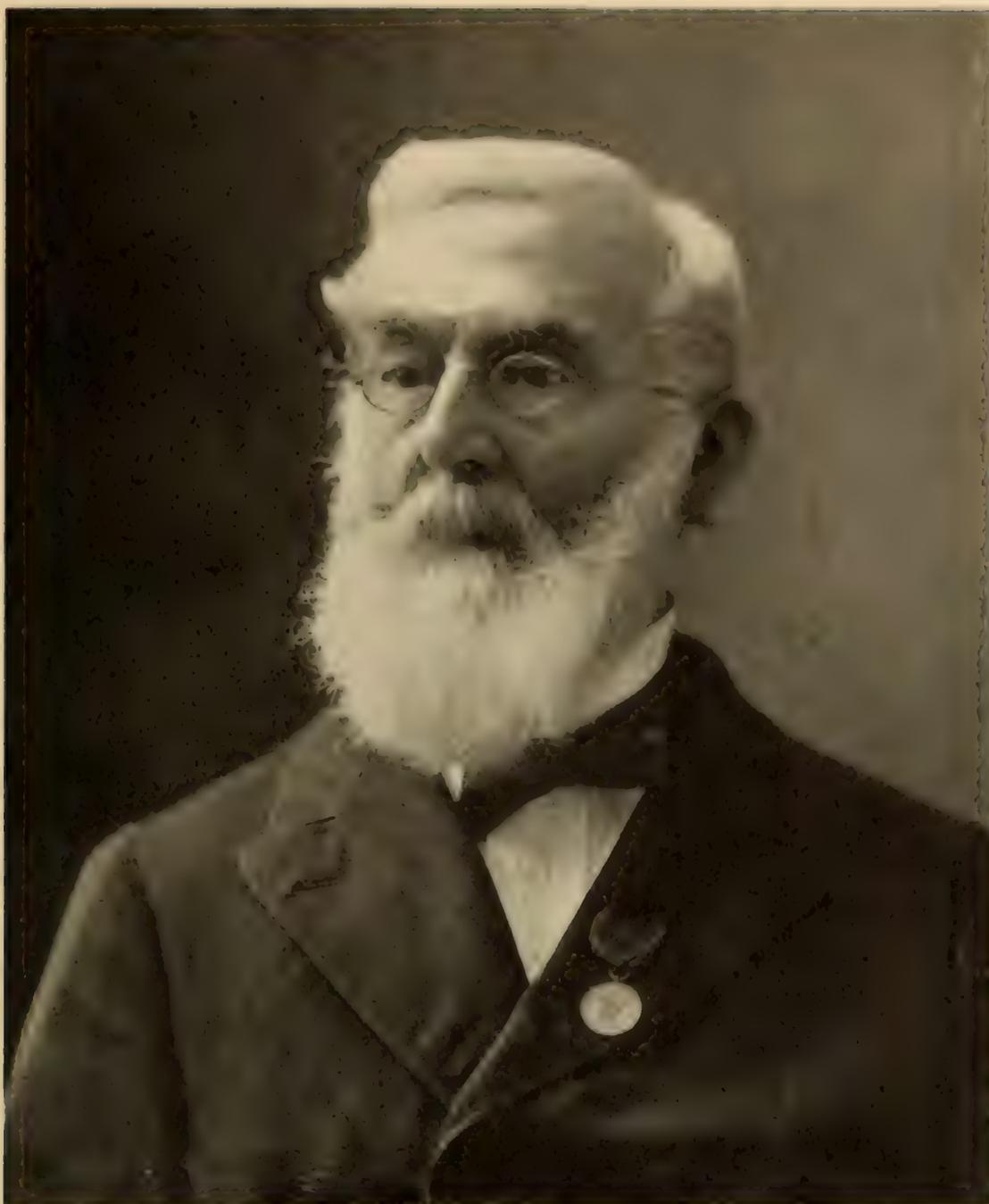
The Higher Passions form the subject of the third section,—morals, laws of the herd, plays and pastimes, and courage. Finally the Baser Passions such as fear, crime, and fighting, are considered.

I am glad that Doctor Hornaday gives rather a low place to avian mentality. Many years ago, influenced by some well-written, plausible volumes, I expected great things of birds, but in the interim I have had to modify my ideas, until I am compelled to place birds hardly above reptiles and fish.

Under the three successive chapters devoted to Play, Courage, and Fear, a splendid array of anecdotes and of striking examples is marshalled. The illustrations have been chosen with judgment and care, and ably sustain their share in the presentation of the subject.

Throughout the work there runs a continuous undercurrent of a plea for better and more intelligent relations between man and the animals which still survive on the earth. Many people will read this volume with interest only in the more exciting anecdotes; they will skip here and there, and throw it aside, turning thence to the sensational parts of a newspaper and neglecting the editorials. To other more worthy readers, for whom the volume is really intended, there will stand out three forceful theses, the successful presentation of any one of which would make the book worth while: first, a body blow to the passing phase of anti-evolution talk; second, an appeal for moderation in the sportsman, and excess in the conservationist; and third, a plea for a sane, intelligent interest in the lives and activities of animals, as a healthful distraction from the egotistical and anthropomorphically narrow confines of thought of the majority of human beings.





James Hall

“James Hall of Albany”—A Review

By GEORGE F. KUNZ

Research Associate, Gems, American Museum

DR. JAMES HALL, who was born at Hingham, Massachusetts, September 12, 1811, and who died at Echo Hill, near Bethlehem, New Hampshire, on August 6, 1898, at the advanced age of very nearly eighty-seven, was for a period of more than sixty years preceding his death the most industrious and constructive of our American geologists. An account of his life and work has now

been ably written by his former first assistant, Dr. John M. Clarke, who from 1898 until the present time has been Doctor Hall's able successor as palæontologist of the New York State Geological Survey, and since 1904 has been director of the State Museum at Albany. Doctor Clarke's book,¹ a

¹*James Hall of Albany, Geologist and Palæontologist, 1811-1898*, by John M. Clarke; 565 pages, 11 plates, and frontispiece portrait. Published 1921, by S. C. Bishop, 2 High Street, Albany, N. Y.

review of which by the present writer appeared also in the *New York Times* (Sunday, September 3, 1922), is of the greatest interest to the entire geological world, but especially to all the members and friends of the American Museum of Natural History, for this institution shelters Hall's great collection of fossils, purchased by the Museum in 1875. The collection embraces 80,000 specimens, which constitute the broadest basis for the study of Palæozoic geology, and which were the foundation of the magnificent volumes of the *Geology of New York* produced by Hall.¹ More than one third of all known specimens were figured therein, either as specimens new to science or as new and interesting occurrences. Careful drawings of them were made and reproduced in a vast number of the finest lithographic and copper plates of their time. Indeed, any geologist wishing to study Palæozoic geology, whether American or foreign, will find it impossible to do so without the volumes of the *State Survey of New York*² or, to be more accurate, unless he studies the wonderful examples of the earliest known fossil remains of either plants or animals, now in the American Museum of Natural History and in the collection of the New York State Museum at Albany, New York.

When this great collection had been acquired, Dr. Albert S. Bickmore, who was the originator of the idea of a great natural history museum for the city of New York, head of the original administrative staff of the American Museum

of Natural History, and also a member of the scientific staff, invited the present writer, jointly with Dr. C. Frederic Holder, who was the assistant to Doctor Bickmore, to aid in the packing and transportation of the Hall collection. The final shipment by train consisted of an entire carload; for the second shipment by water, an entire hay barge was required.

This collection of 80,000 specimens contained no less than 6400 types. In the New York State Museum, Doctor Clarke tells us, there are at present 10,000 type specimens, Hall's types totaling 4833, while those of later date number 5239. Dr. Philip S. Smith, acting director of the United States Geological Survey, writes: "From a careful estimate of the Palæozoic type fossils that have accumulated in the U. S. National Museum as a result of the activities of the U. S. Geological Survey, it appears that there are about 18,000 specimens including plants, invertebrates, and vertebrates that may be considered types for the reason that they have served as the basis of specific descriptions and for the most part have been figured. Possibly as many as 6000 species are represented, but it is not practicable, without expending more labor than the importance of the question would seem to justify, to determine how many of these were described as new. It is the custom to treat all figured specimens as types whether they belong to new species or old ones."

Hardy, industrious, zealous—at times over-zealous—and in spite of many serious disputes and differences, Hall rendered great and indispensable service. In a way his activity paralleled that rendered by the great Barrande to the geology of Bohemia. Whatever may be said about the dic-

¹Doctor Hall's smaller papers, in octavo form, were scattered through the New York State Museum reports, the reports of the State surveys, various scientific periodicals, etc., but as a rule they were very brief and the number of printed pages did not exceed 2500. Thus his total output of geological material may be set down as between 10,000 and 12,000 pages.

²Lindström of Sweden wrote Doctor Hall in 1898 "Your Palæontology of New York will be consulted for ages to come by many generations of Palæontologists, American and European," and Prof. James D. Dana stated "Without your labors the geology of the North American Continent could not have been written."

tatorial methods used by Hall in his work, we should allow him the same latitude in this respect that we accord the great captains of industry who have built up their wonderful enterprises with just as little regard to the opposition they have encountered. We must judge Hall not by any standard of conciliatory scholarship, but by the thoroughness and importance of the work he accomplished so successfully on the New York Geological Survey.

The salient feature of Doctor Hall's life work was his unswerving devotion to the great task he had set himself, that of making known to the scientific world, in the broadest and most comprehensive way, the unique significance of the territory of New York State in the history of the geology of the world. This great life work has been most convincingly presented by Doctor Clarke, and he has made of his book a truly representative volume. He himself says: "I have tried to set down the story of an unusual man. I hope that it may find a place among the monuments he raised to his science."

Senators Daniel P. Wood and Chauncey M. Depew, Theodore Roosevelt, and the late James W. Husted were Doctor Hall's valiant friends in assuring funds for this greatest of state surveys, thus overcoming very strong opposition. The opportunity of making known the preëminence of New York State from a geologic standpoint was assured through the foresight of its legislators in sustaining financially the production of the great descriptive series of volumes by Doctor Hall and Doctor Clarke, in which its marvelous Palæozoic remains were so splendidly figured.

A tablet has been erected to Doctor Hall's memory in Letchworth Park, overlooking the Genesee. This tablet to our great American geologist parallels in significance that which was erected near Prague to the memory of Barrande.

It is interesting to know that the scene of much of Hall's geological survey has been rendered accessible to citizens of New York State and of the country through the generosity of Mrs. John Boyd Thatcher, manifested in the gift to New York State of the John Boyd Thatcher Park. Here, in a stretch of three miles along the rim of the famous Heilderbergs, we have before us, in a wonderfully impressive way, the series of strata from which Hall secured the splendid fossils which he described in such masterly style. With the rapid growth of our enterprising nation, study is being devoted more and more ardently to its historic beginnings, and it is only natural that in the course of this study our thoughts should be carried back to the formation of the continent on which this great development of civilization has been brought about.

Doctor Clarke presents the mass of facts he has assembled in so clear and graceful a literary style that the story of Hall's life and of the wonderful period of the world's history to which he devoted his studies reads like the romance of a great author. The volume is one of unusual interest to the general reader, and ought to have a place in every collection of Americana, for it has bearing not only on the fundamental formations of New York State but also on those of the entire continent—we might, indeed, say of the entire world.



A whale shark, caught on the bow of a 17,000-ton steamer. This picture is from a photograph supplied by Captain Charles H. Zearfoss, the master of the vessel, and retouched by Mr. William E. Belanske under the supervision of Dr. E. W. Gudger

An Extraordinary Capture of the Giant Shark, *Rhineodon Typus*

By E. W. GUDGER

Associate in Ichthyology, American Museum

ON JUNE 2 there called at the department of ichthyology, American Museum, Mr. C. F. Krauss of San Francisco, who related the story of the capture of a shark such as had never been told before. The incident had occurred during a voyage of the Munson liner "American

Legion," along the eastern coast of South America, and Mr. Krauss had come to the Museum in the belief that his report of the event would be of interest and also to seek information as to the identity of the shark.

Mr. Krauss told the members of the department that on the early morning

of May 19, 1922, while somewhere north of Rio, the ship had struck a giant shark about one-third of the distance back from the snout toward the tail. So perfectly balanced was the fish, that it had hung on the bow for several hours and was finally detached only with some difficulty. He said that the fish was about thirty feet long and covered with yellow spots about the size of a silver dollar, and that the ship's people called it "leopard shark" and "tiger shark" on account of these spots.

From the description of Mr. Krauss I was satisfied that the fish was a *Rhineodon*, well-named "whale shark" because of its great length and bulk. However, he suggested that I write the master of the vessel, Captain Charles H. Zearfoss, for data. This I did and presently I received from him two photographs (copies of which were also brought later by Mr. Krauss) and a letter which left no possibility of doubt that the shark was, as surmised, a *Rhineodon*.

Captain Zearfoss's very definite and clear-cut statement of this extra-

ordinary happening is as follows:

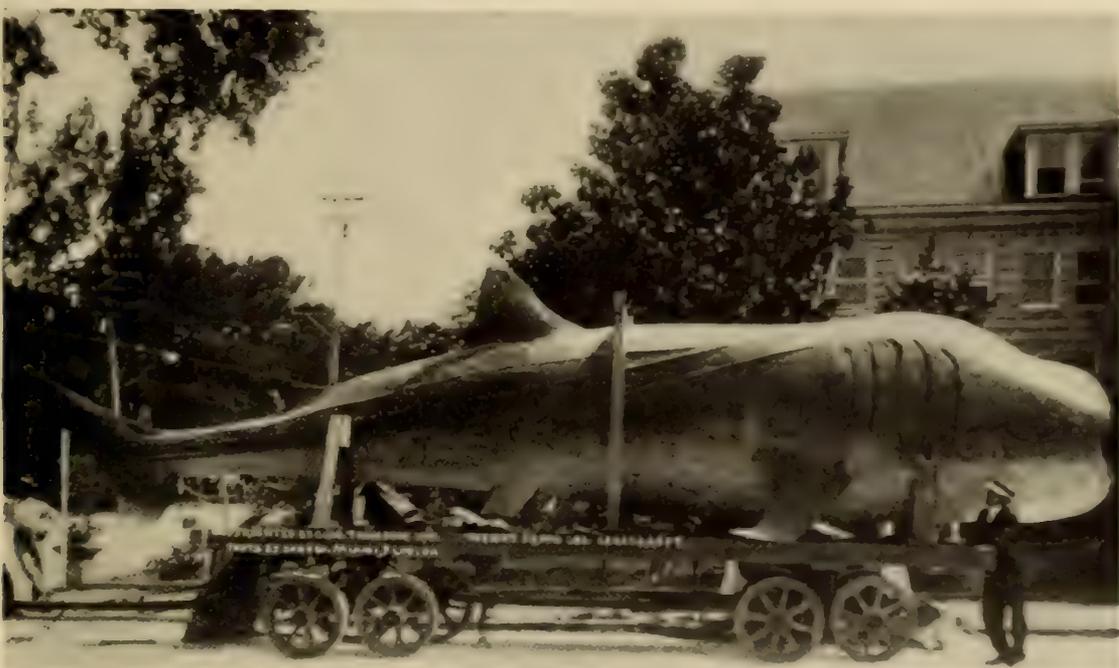
Some time during the morning of May 19, while this vessel [the steamship "American Legion"] was crossing over the banks which lie northeast of the Abrolhos Light in Lat. $17^{\circ} 57' S$ and Long. $38^{\circ} 41' W$, a shark in attempting to cross our bow was struck by our stem. The speed of the ship through the water then held it doubled round our bow.

There was no shock (except to the nerves of the fish) and its presence was not discovered until daylight.

During the morning an attempt was made to lift the body out of the water, but without success, and later the ship was stopped and backed, when the shark was washed clear and immediately sank.

The shark was struck immediately behind the last gill and hung with eight feet of head and gills on our port side and about twenty-two feet of body on our starboard side.

To Mr. Krauss and Captain Zearfoss I am indebted for the data which enables me to set before the readers of *NATURAL HISTORY* the most extraordinary instance known to me of shark fishing. Surely no one before ever used, for the purpose of spearing a fish, a 17,000-ton steamer.



A whale shark captured in 1912 by Captain Charles Thompson and mounted by Mr. J. S. Warmbath. The huge proportions of this fish dwarf by comparison the man who is leaning against the truck. After Townsend, 1913.



A POLYNESIAN FISHERMAN

The Racial Diversity of the Polynesian Peoples

By LOUIS R. SULLIVAN

Assistant Curator, Physical Anthropology, American Museum

THE racial origin and relationships of the Polynesians have been the subject of much speculation and discussion. Earlier students of anthropology not only emphasized their uniformity in culture and language, but also used them as a standard example of a remarkable uniformity of physical type extending over a greatly diversified habitat. They are described as being almost identical in physical appearance from Hawaii to New Zealand and from Samoa to Easter Island.

The more intensive work of recent years has led, however, to a modification of the statements maintaining a uniformity of culture and language. Several major and countless minor migrations have been hypothesized to account for differences or similarities in these respects. In the main, these migrations have been attributed to different groups of the same race. There is, however, a growing tendency to regard the Polynesians as a mixed people. But here again a majority of the students seem to feel that the fusion has taken place outside of Polynesia and before migration into that region. There has also been a great diversity of opinion as to what are the component elements. Melanesian, Negrito, Indonesian, Proto-Armenoid, Alpine, Malay, and Australoid mixtures have been suggested as the possible causes of diversity of physical types in Polynesia. But, in the main, these explanations must be regarded merely as suggestions. To hold an opinion, even if it be a correct one, does not advance

science. It is only when the basis for that opinion is analyzed and demonstrated to one's colleagues that that opinion becomes a contribution to science.

Of those who believe that the Polynesians are a mixed people there are few who have taken the trouble to publish the evidence which converted them to that view. The most noteworthy of the contributions that have come from those who have made a detailed study and analysis of the available data is that of Professor Dixon of Harvard University. On the basis of the published craniometric data he proposes four types, which he names in terms of their characteristic brain case and nasal opening forms; a brachycephalic, hypsicephalic, and platyrrhine type; a dolichocephalic, hypsicephalic, and platyrrhine type; a dolichocephalic, hypsicephalic, and leptorrhine type; and a brachycephalic, hypsicephalic, and leptorrhine type. All of these types have high brain cases (are hypsicephalic). Two are long-headed and two are short-headed. One each of the long-headed and short-headed types is narrow-nosed; the other is wide-nosed. These types are tentatively identified as Negrito, Melanesian, Caucasian, and Malay.

Now while there was and is some doubt whether these types as named are all to be found in Polynesia in sufficiently large numbers to be regarded as factors in the history or prehistory of that area, there is no doubt of the physical diversity that

their proposal implies. Professor Dixon does not claim that these elements or types entered Polynesia as pure types or by separate migrations. He does not say which type is the true Polynesian and makes no effort to identify any of his types with specific migrations. He made it clear that many more data were needed to throw light on these phases of the problem.

At the time of Professor Dixon's publication very few detailed studies on the living Polynesians were in existence. Through the generosity of Mr. Bayard Dominick the Bernice Pauahi Bishop Museum of Honolulu has been enabled through expeditions to help remedy this deficiency. These Dominick Expeditions have supplied data from Samoa, Tonga, the Marquesas, Rapa, and Hawaii. In Samoa and Tonga the studies were made by E. W. Gifford and W. C. McKern; in the Marquesas, by E. S. Handy and Ralph Linton; and in Rapa, by J. F. G. Stokes and R. F. Aitken. The American Museum of Natural History was invited to assist in the planning and carrying out of these expeditions. The department of anthropology of this Museum has been responsible for the somatological part of the surveys and donated my services to make a study of the Hawaiian people and to analyze all of the anthropometric data contributed by the anthropologists above mentioned. The physical anthropology of this project has been throughout a coöperative study. Each of the men named has generously turned over to me his field notes on this phase of the subject in the hope that uniformity in analysis and interpretation might result in a contribution of greater value to Polynesian anthropology than would a series of independent and uncorrelated efforts.

The records from Samoa, Tonga, Marquesas, and in part those from Hawaii have been analyzed. So far I have succeeded in isolating two physical types, each of which is still represented by large numbers of individuals. I have tentatively called these types Polynesian and Indonesian. Their characteristics are indicated in the accompanying table.

The unsuspected presence in large numbers of this Indonesian type in Polynesia explains the often expressed opinion that the Polynesians and Indonesians are closely related types. An unfortunate confusion in terminology has done much to keep this opinion alive. One group of anthropologists has called a type in Indonesia which resembles the Polynesians, Indonesian. The other group has called a type in Polynesia which resembles the Indonesians, Polynesian. On any other basis than this there can be no reason for assuming a close relationship between the two types. From the characteristics listed in the table, it will be seen that the Indonesian is the antithesis of the Polynesian in nearly every detail.

The Polynesian is usually described by students of Polynesia as Caucasian in origin. It must be admitted that when the Indonesian traits are removed, the Polynesian is strikingly Caucasoid in appearance. If this is merely a parallelism in development, as some imply, it is most certainly a remarkable parallelism. At this time it is impossible to determine the exact place of the Polynesian in the human family. The available data seem to indicate that the Polynesian is a type intermediate between the Caucasian and the Mongol. At present I am inclined to believe that it is an offshoot from the primitive Mongoloid stem

POLYNESIANS

1. Light brown skin
2. Wavy hair of medium texture
3. Medium beard development
4. Medium body hair development
5. Moderate frequency of incisor rim
6. Lips of average thickness
7. Moderately long heads
Average cephalic index 77-8
8. Tall, average stature 171 cms.
9. Very high and moderately wide faces
Average facial index about 90
10. Very high but very broad noses
Average nasal index about 75
11. Nostrils oblique
12. Nasal bridge elevated more than average
13. Chin fairly well developed
14. Eye fold absent
15. Often lean and lank when unmixed
16. Platymeric (shaft of femur flat)
17. Platychemic (shaft of tibia flat)
18. Platolenic (shaft of ulna flat)

INDONESIANS

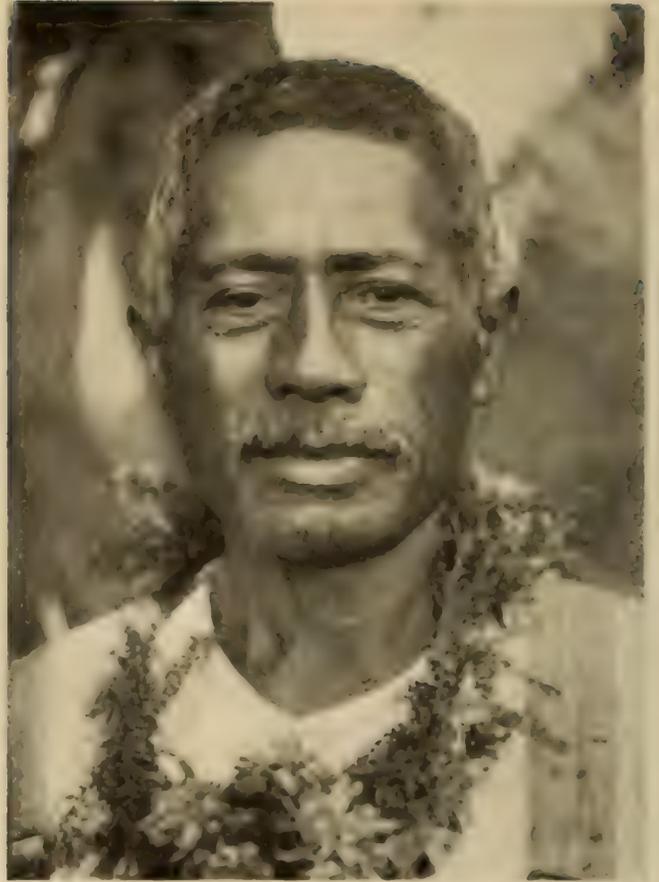
1. Medium to dark brown skin
2. Wavy hair
3. Scant beard development
4. Scant body hair development
5. Incisor rim absent
6. Lips above average in thickness
7. Short heads
Average cephalic index about 81-2
8. Shorter stature, average uncertain
9. Very low, broad faces
Average facial index about 80
10. Very low and very broad noses
Average nasal index about 87-8
11. Nostrils transverse
12. Nasal bridge low
13. Chin somewhat below average
14. Incipient eye fold
15. Heavy with short necks
16. { Skeletal characters uncertain.
17. { but not so flat as
18. { Polynesians

close to where the Caucasian stock arose. Egotistically we may regard the Polynesian as a somewhat unsuccessful attempt of nature to produce a Caucasian type. That the Polynesians are closely related to the Caucasoid stock there can be no doubt. Some such type as this must have given rise to the Caucasian. Descendants of this or a closely related stock pass for Caucasians in Europe today. The final classification of the Polynesians is somewhat dependent upon the systematic position of certain American Indian groups, the Aino, and certain other Caucasoid or pseudo-Caucasian types in Malaysia and Asia. Their relationship to the Aino is pretty clearly indicated.

The affinities of the Indonesian element in Polynesia are also somewhat uncertain. The Indonesian is usually looked upon as Mongoloid but in this study its Negroid characters are

emphasized. Although the hair of this Indonesian element is only moderately waved, other characters, such as the very low broad nose with transverse nostrils, the very low broad face, the thick lips, and the dark glabrous skin are Negroid. Tentatively the Indonesian may be accepted as a somewhat doubtful Mongoloid type diverging strongly in the direction of the Negro or Negrito. It is possible that this type is identical with that described by Professor Dixon as Negrito, though this is by no means certain; but if not, there are two brachycephalic, platyrhine types in Polynesia. This type, whether represented by skeletal remains or by living individuals, has often been mistaken for Melanesian and Negrito not only in Polynesia but also in Indonesia.

The Polynesian type is found throughout Polynesia. The distribution of the Indonesian type is not so



TYPES APPROACHING THE POLYNESIAN NORM
(Some of these are typical in that they have short heads)



TYPES APPROACHING THE INDONESIAN NORM

well known. It occurs in Samoa, but is pretty well intermingled there with other strains so that it is difficult to determine what proportion of the population it forms. In Tonga it is very important and less mixed. It is more concentrated in Haano of the Haapai group than in the southern islands of this archipelago. In the Marquesas it is a very important element in the population, but is confined for the most part to the northwestern islands of Uauku, Nukahiva, and Upu. In Hawaii it is important but pretty thoroughly interpenetrated with the Polynesian element as well as the modern immigrant population of these islands.

From the frequency and distribution of these two quite distinct physical types in Polynesia, it is clear that they must have entered the Pacific at different times and possibly by independent routes. Certainly they must have had different languages and cultures. The next problem in Polynesian anthropology is to associate these two physical types with their proper linguistic and cultural elements, to determine what each has contributed to the past and present cultures of Polynesia, and to determine which type was the predecessor in Polynesia.

At first glance this seems simple enough, but further study makes it evident that no generalizations can be made at present. In the Marquesas Doctor Handy has found differences in language and culture which correspond roughly to the distribution of the two physical types. It may also turn out that the first type to enter Polynesia was not necessarily the first type throughout the whole of Polynesia. The present distribution of the two types, so far as I can determine it, lends itself to two interpretations. The

Polynesians are to be found in all parts of Polynesia. The Indonesians are not at present to be found in all parts of Polynesia, nor indeed in all parts of the island groups in which they occur. Are the Indonesians late arrivals, not yet spread throughout the whole of Polynesia, or were they the first comers to the islands in which they are now found? Physical anthropology alone cannot answer this question. The corroborative evidence of archæology and ethnology will be needed. The fact that the Indonesian element is so poorly represented in the skeletal remains to which I have had access inclines me to regard the Indonesians as recent arrivals. Yet it is possible that they were the first arrivals in Polynesia or at least in certain parts of Polynesia. The Indonesians rather than the Melanesians may be the short dark predecessors of Polynesian tradition. The order of arrival may vary from group to group. These then are questions for the future.

In addition to these two types there is a Melanesian element in certain parts of Polynesia. Melanesian influence is naturally strongest in the south and west. It is present to some extent in Tonga and has also been described in New Zealand and Easter Island. On the whole, the Melanesian physical element in Polynesia has been exaggerated. The influence of the Polynesians on Melanesia has been greater than that of the Melanesians on Polynesia.

None of these types accounts for the extreme degree of brachycephaly or short-headedness characteristic of certain parts of modern Polynesia, notably Tonga, Samoa, Tahiti and near-by groups, Hawaii, and, to a lesser extent, the Marquesas. The Indonesians are only very moderately brachycephalic. But in the groups named indices of 90

and above are frequent. It is to this element of the Polynesian population that Professor G. Elliot Smith has referred as Proto-Armenoid. It corresponds to Dixon's brachycephalic, hypsiccephalic, leptorrhine type. This element has also been described as the true Polynesian by some students. Others have referred to it as Indonesian. It is perhaps the most Caucasoid element in the population. So far I have not been able to associate a sufficiently large number of distinctive characters with this undoubtedly artificially shortened head to warrant its isolation as a separate type. I accounted for it at first by calling it a Polynesian type with an artificially flattened occiput. Its classification as Polynesian is still an open question and further research may prove it to be indeed a distinct type. Strangely enough it is not an important element in the skeletal material. Again, this leads me to believe that either artificial flattening is a new custom or that the type has arrived only recently in Polynesia. Only in Tongan skeletal remains is the type a dominant element.

So far then these studies confirm the impression that the Polynesians are a mixed people. In addition to any Melanesian element that may occur, there is the Polynesian type, which

approaches the Caucasian type, and the Indonesian type, which approaches the Negro or Negrito type. Both may be divergent Mongols. As yet it is uncertain whether the extremely short-headed types are Polynesians with artificially deformed heads or another element in the population of Polynesia. It is certain that the short heads are due to some extent at least to artificial deformation.

In brief, like Professor Dixon, I recognize four elements in the population of Polynesia. Unlike him I do not call them Negrito, Melanesian, Caucasian, and Malay, but Indonesian, Melanesian, Polynesian, and Polynesian(?) with deformed head. The Polynesian and Indonesian types are by far the more numerous and important elements of the population. The sequence of all of these types is yet to be determined. There is still much to be learned about the physical characteristics, racial origins, and affinities of the population of Polynesia.¹

¹Detailed reports on the physical anthropology, archaeology, and ethnology of the Polynesians will be found in the current publications of the Bernice P. Bishop Museum, Honolulu, Hawaii. Doctor Dixon's article appeared in the *Proceedings of the American Philosophical Society*, Volume IX, No. 4, 1920, p. 261. Te Rangi Hīrea (Doctor R. H. Buck), himself a Maori, is publishing serially an important somatological study of his race in the *Journal of the Polynesian Society*, Volume XXI, 1922. In addition to the standard and approved anthropometric results, Doctor Buck discusses the linguistic and traditional evidences or explanations of diversity in physical type.



Photograph by R. M. Overbeck

AN IMPROVED TRAIL SWITCHBACKING OVER THE DIVIDE OF THE QUIMSA CRUZ

Bolivia's Least Known Mountain Range¹

By EDWARD W. BERRY

Professor of Paleontology, Johns Hopkins University

HERE is mystery and romance for us in a region that has remained practically unchanged for a thousand years, and in far distant peaks rarely visited by white men, which I suspect is an inheritance from that remote past when the successive waves of human emigration diverged from Central Asia during the Old Stone Age. Such a region is the Quimsa Cruz Range, or Nevados de Quimsa Cruz, as it is known locally, in the eastern Andes of Bolivia. From La Paz the serrated peaks of this range form the sky line to the southeast beyond Illimani, of which they are the southward continuation. Often when in that city I looked at their serried ranks—for they are plainly visible in the clear air although about fifty miles away—and wondered what sort of a country their spirits guarded. I had heard of Choquetanga, Suri, Quime, and Inquisivi, and many tales of abulous tin mines and tropical, mist-covered country beyond, but delayed making the trip because of a "flu" epidemic among the valley Indians with whom it would be necessary to associate.

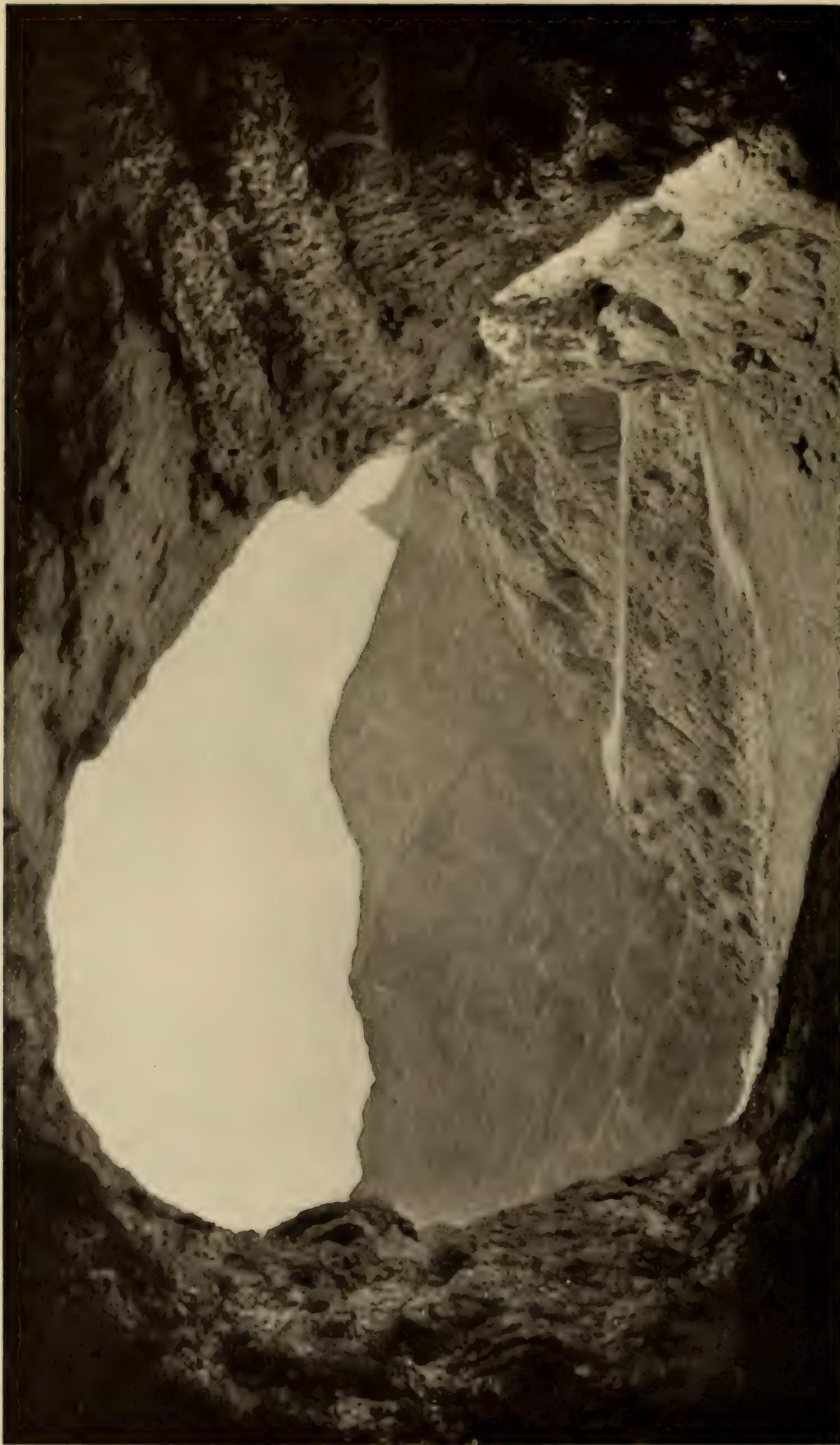
There are many peaks in the Andes that rise to heights of more than 20,000 feet, and although these mountain slack a certain beauty when compared with the Alps or the Rockies because of the total absence of vegetation anywhere except on their eastern flanks facing the Amazon Basin, this deficiency is offset to a certain extent by the wonderful clearness of the atmosphere in that arid climate and by the coloration of

soil and sky that goes with aridity. When it is recalled how seldom a peak like Mount Stephen or Robson Peak in the Canadian Rockies is free from clouds, the way the Andean peaks stand out in all their majestic proportions can be fully appreciated.

The most beautiful stretches of Andean scenery are nearly all remote from the traveled paths. There is, however, one exception to this statement—the Cordillera Real—and no range more fittingly deserves the term royal. It is close to Lake Titicaca and La Paz, on the familiar loop from Mollendo up to La Paz and down to the waiting steamer at Arica¹ or Antofagasta. When the tourist agencies that are now advertising South American trips learn to use the day steamers on the lake instead of the night boat, the interest of the trip will be enhanced a thousand-fold, for the two most beautiful mountain masses in the world are Sorata at the northern end and Illimani at the southern end of the Cordillera Real, both more than four miles in height and with wonderful snow fields and glaciers.

A trip by mule-back over the Cordillera Vilcapampa in southern Peru and down to Sandia takes one through magnificent scenery, and the old volcanos and lava fields to be seen in the western Andes of northern Chile are wonderful in a different way and easily accessible. There are many more extinct volcanos with perfectly preserved craters within a few miles of the Antofagasta Railroad than there are

¹George Huntington Williams Memorial Publication No. 20. The photographs, except where stated otherwise, were taken by the author's colleague, Prof. Joseph T. Singewald, Jr.



A TUNNEL ALONG THE LA PAZ VALLEY TRAIL, THROUGH DETRITAL MATERIAL WHICH ONCE FILLED THE VALLEY TO A GREAT DEPTH AND REPRESENTS THE WASTE FROM THE SLOWLY RISING MOUNTAINS



VIEW LOOKING DOWN THE DRY VALLEY OF THE LA PAZ RIVER



SANTA VELA CRUZ

The ages-old trail passing across the Tres Cruces pass to the eastern low country is seen in the lower left-hand corner of the picture

The ages-old trail passing across the Tres Cruces pass to the eastern low country is seen in the lower left-hand corner of the picture

SANTA VELA CRUZ



Photograph by E. M. Gierke

THE CHOQUETANGA VALLEY FROM HUANCHACA

Looking eastward from the Quimsa Cruz at the sea of clouds that daily drifts westward from the low Amazon country



LOOKING NORTHWEST AT ILLIMANI FROM HUERTA GRANDE



VIEW LOOKING EASTWARD AT CERRO JACHACUNOCOLLO, OR GREAT SNOW MOUNTAIN, FROM CHIOJACOTA OR GREEN LAKE

in all of the Auvergne, and they are ten times the size of the latter, and nowhere can one get a more vivid impression of nature's forges gone cold than in this region. None of the mountain groups mentioned, however, has more beauty compressed within a few square miles than has the Quimsa Cruz.

Finally, on a July morning in 1919, a start was made for the Quimsa Cruz. The trail follows the La Paz valley through Indian towns almost entirely hidden in prickly-pear thickets, and past wayside *chicharias*, that furnish refreshment to the great number of pack trains met with, for this is a much traversed highway leading down to the eastern low country, and the commercially inclined ever lie in wait near the centers of population to get the wayfarers' money, whether these wayfarers be Indians or of a more advanced race.

Chicha, which gives its name to the *chicharias*, is a varying alcoholic beverage, not to be confused with the light wine of that name which is so popular in Chile. It is made from corn and is often termed *cerveza de maíz*, or corn beer. It is a universal drink in the Peruvian and Bolivian Andes, and the vendors advertise their wares by displaying a small patch of cloth about the size of a handkerchief at the end of a bamboo pole.

The predilections of the aborigines are well illustrated by the apocryphal explanation of the red, yellow, and green of the Bolivian tricolor. It is said that the red represents the *aji* or native pepper—than which no other has a more distressing and vile flavor to the average Anglo-Saxon palate; that the green stands for the coca leaf, which is about the only article of commerce consumed by the Indian population; and that the yellow

symbolizes the *chicha*, or national beverage. The last is not quite so universal a drink among the Spaniards as among the natives although they do consume a large quantity. When the Bolivian Indian really wishes to celebrate, 40 per cent alcohol is favored in the beverage, and as there are at least one or two *fiestas* in every month, vast quantities of alcohol are consumed.

For the first eight leagues out of La Paz the trail clings to the valley sides and is kept in very good condition—a veritable *camino real*, and I have no doubt that an automobile could get over it although I never heard of one attempting to do so. As the trail approaches the gash which the La Paz River has cut between Illimani—the sentinel of the Yungas—and the Nevados de Araca, it descends to the flood plain of the river. This is in a cañon more than 15,000 feet below the crest of the range, and difficult to traverse. The Finca Millecota, where the first night was spent, is most picturesque with its mellow adobe buildings sprawling around and away from the dusty central patio. The warm red tiles of the roofs, the *Eucalyptus* trees—those ubiquitous aliens of South America,—and the inevitable chapel and belfry without which no *finca* or *hacienda* is complete add to the interest of the scene.

No material is more suited to an arid climate or more artistic than adobe until so-called progress crowns it with a corrugated iron roof, as has happened in many of the larger Andean towns. Millecota interested me because it was there that Sir Martin Conway had some unpleasant experiences in his ascent of Illimani, but our entertainment cost us nothing but much talk, and in the Andes the traveler must be prepared for argument with his pro-

spective host before he can expect entertainment of any kind.

To appreciate fully the magic effects of altitude and water the student must go to the Andes. There you may live at an elevation of 15,500 feet in a miner's shack built at the foot of a great glacier and yet obtain oranges and fresh vegetables from some deep valley only a few miles away. These contrasts exist especially on the southern flank of Illimani, where one may stand on a glacier and look down on fields of sugar cane. The La Paz River is only 5,900 feet above the sea level at that point, and the summit of Illimani, slightly less than fifteen miles away, towers to a height of more than 21,000 feet. We left Millecota before daybreak, at which hour the major domo was perhaps too lazy to crawl out and argue about payment for our supper and lodging. It was a most curious sight to see the familiar constellation of Orion standing on its head in the northern sky, a rather fitting emblem of this land of contrasts.

The rocks hereabouts are Palæozoic quartzites and shales, much folded, their strikes parallel with the general northwest-southeast structural lines of the region. Granite does not appear in the La Paz valley, which fact may explain how the river-cutting kept pace with the rising mountain chain in this region of easily eroded Devonian shales between the granitic mass of Illimani on the north and the considerable area of granite that reappears in the crest of the Nevados de Araca and continues along and to the east of the Quimsa Cruz Range as far at least as Jachacunocollo, or Great Snow Mountain.

It is this granite, of late Tertiary age, that is the source of the tin minerals for which the Quimsa Cruz is destined some day to win inter-

national renown, although many of the veins now being worked and, in fact, all of those known on the west side of the range, are in the Devonian shales and sandstones. These are considerably metamorphosed, but nevertheless fossiliferous at many points. Brachiopods are rare, as is usually the case in rocks that were originally muds, but beautiful trilobites are to be found at Araca and elsewhere near the crest.

The Quimsa Cruz is one of the few regions in the Peruvian or Bolivian Andes where mining was not carried on in colonial days. This neglect is not attributable to its relative remoteness and inaccessibility,—witness Huanavelica or Potosi, the latter still more inaccessible and yet for more than a hundred years the largest city in the Western Hemisphere. The real reason is that in the Quimsa Cruz the familiar association of tin with silver is lacking, and tin had no charms for the *Conquistadores*, or the adventurers who followed in their wake.

The Quimsa Cruz is the southward continuation of the Cordillera Real and is only slightly inferior to that range in altitude. The mountains extend for about thirty miles, from the cañon of the La Paz River southward to the pass of Quimsa Cruz, or Tres Cruces, the first designation being Quichua and the second the Spanish name for this celebrated pass, which somewhat arbitrarily separates the range from the Santa Vela Cruz, adjoining it on the south. There are no ice-free passes over this extent, consequently there are no trails on the flanks other than llama trails too difficult for mules, and the eastern side of the range was at the time of my visit in 1919 as remote and inaccessible as almost any part of Bolivia. Since then the Guggenheim interests have constructed, at enor-

mous expense, a road over the Tres Cruces pass.

The oldest mine in the district is Araca or Viloa, not far from the La Paz valley, and it is a scant twenty years old, which is youthful indeed when compared with the three hundred seventy-five years during which Potosi has been worked. At the junction of the Rio Caracota with the La Paz, in a region of pinkish and greenish slate-like shales, our route left the river bottom and zig-zagged upward over a painfully high divide to the southward, only to plunge down into an equally steep-sided valley and then in turn to ascend a still higher ridge before descending into the Araca valley. It might perhaps have been easier to continue down the valley of the La Paz and up that of the Rio Araca, which joins the former a few miles below the Caracota except for the tornado-like wind which blows up the La Paz valley at this point every afternoon.

Where we struck it, the Araca valley is about 10,000 feet in elevation, and consequently contains considerable vegetation. Higher up there is an abundance of cacti, bromeliads, and thorn bushes. One bromeliad in particular—a species of *Puya*—frets the slopes as with a black lace *mantilla*, the prostrate, blackened trunks as big as a man's thigh interlacing in every direction, and their bright, pinkish *Yucca*-like tips alive and vigorous notwithstanding the fact that the original root connection with the ground has long since disappeared. Lower down are *Cassia*, *pacay* (*Inga*), cherimoya, the fruits of which some depraved traveler has christened the ice cream of the tropics. Humming birds are particularly noticeable, and parrots and their smaller relatives are also in evidence. The *Eucalyptus* was in

bloom the latter part of July as were innumerable peach trees, and the tall straight gum trunks on the valley slopes suggested, in their slender grace, harp strings on which the gods might well play a pæan of praise to the beauty of Illimani as seen from the southeast. The Indians worshipped the great peaks and well might the discerning traveler.

Huerta Grande (beautiful garden), the home of our delightful host, was all its name indicates, and although at an altitude of more than 10,000 feet, the garden was gorgeous with roses, sweet peas, geraniums, hollyhocks, poppies, and forget-me-nots, along with native legumes, *Annonas*, *Agaves*, granadillas, small palms, and Chilean pines. There were trees of the so-called English walnut, and of the native South American walnut, the latter removed thousands of miles from its close relatives of the Northern Hemisphere—one of those curiosities of distribution explained only by a knowledge of the geological ancestors of the species involved. Higher up were numerous composites, holly, *Rubus*, *Ephedra*, and at 12,000 feet small *Polylepis* trees were still in evidence.

There is a lower trail southward from Araca which passes several Indian towns on its way to Yaco and Luribay, but we kept on the flanks of the range and, for the most part, not far below the glaciers. Until Araca is reached, the divide is of jagged Devonian shales and sandstones standing almost on end. At Araca the granite comes in and the scenery is indescribably beautiful. The vast snowfields along the crest contribute a glacier to each lateral valley and in each there are one or more lovely glacial lakes at different levels, each with its flocks of gulls. Glacial markings and deposits are very diagram-

matically displayed in each valley but nowhere, neither here nor elsewhere in the Andes, did I observe the terminal moraines of the more extensive glaciers of the past below about 13,000 feet.

Although the Quimsa Cruz, as a mining district, is still in its infancy, there are a number of small mines in operation and considerable development work is being done. All of the mine quarters and mills are above 15,000 feet, and the mines themselves are all still higher—that at Chojñacota being at 16,900 feet and that at Monte Blanco at 17,875 feet. Devonian fossils were abundant and nearly all of my collections in this district came from about 16,000 feet above sea level.

Looking westward from Monte Blanco down the valley of the Soracachi one beholds a sea of salmon and red peaks and ridges. It is a long half-day's ride down to Yaco, where these red beds by their contained fossils reveal themselves of Carboniferous age. It is one of the ironies of fate in this land of great mineral riches and intense cold that the rocks of the Coal Period instead of containing coal are almost entirely of marine origin and are either limestones or more or less gypsiferous red beds. Nowhere are red beds more baffling to the geologist than in Bolivia. Over on the Altaplanicie around Corocoro they are as young as the Pliocene; farther south around Potosi they contain Mid-Cretaceous marine fossils; and eastward in the vicinity of Santa Cruz de la Sierra they are Permian. Where there is not time to trace out their relationships, or search for their rare fossils, one can only guess at their age, which has been the method of most previous observers.

For two weeks we did not get below 15,000 feet and in this time we skirted the western and part of the eastern

crest of the range. Geologically the two sides are practically alike, but to the east the mists from the Yungas are constant even in the winter season, which is the season of almost continuous sunshine everywhere in the Andes west of the crest of the Eastern Range. On the eastern slopes of the Quimsa Cruz the only time you see the sun is intermittently during June and July and, because of the consequent much greater precipitation, the region is a wild country of snow and ice and crags, enhanced to the imagination by the fact that one rides along in snow squalls and mist, amid waterfalls that are heard but not seen, and with only fleeting glimpses of the great glaciers. The cloud effects are sometimes magnificent as the accompanying view demonstrates.

Traveling eastward down to the indescribably filthy Indian town of Quime, we found that place on the ragged edge of the usual and inevitable *fiesta* with resulting universal drunkenness. Here we encountered our first rain since leaving Panama months before. One must live in a desert for a while to appreciate the blessedness of rain for its purely psychic effect exclusive of its practical benefits. Rain at Quime gave way to heavy snow a few miles farther up and the higher trails were temporarily impassable. There is a good trail down the Quime valley and now that American interests are actively developing extensive mining properties on the eastern slopes of the range, it is to be hoped that American scientists will secure facilities for a biological station in this most interesting and important virgin field. Nowhere can the relations of organisms to altitude and climate be studied to better advantage than in the Yungas of Bolivia, and the height to which the

lowland tropical vegetation surges upward where the moisture is ample is a never-ending surprise.

A great many novelties, both animal and vegetable, are to be found here, not to mention plants of economic value, such as extra fine strains of the orange and coffee of a very superior flavor that never reach the world's markets. The great South American rain forest—the most extensive in the world—surges up the eastern Andean slopes favored by the moisture-bearing trade winds. This rain forest has occupied this area for several millions of years and one may venture to predict that it constituted an animal and plant refuge where yet may be discovered the direct descendants of Tertiary forms. Already we know of Tertiary plants in Chile the progeny of which occurs here. Although the known flora is more diversified than that of any other region of the globe (there are more than 22,000 described flowering plants in the Flora Brasiliensis, and Alfred Russell Wallace estimated that there are probably 80,000 species in tropical South America—a number about equal to that of all other tropical floras of the world combined) it may be conservatively stated that not more than 50 per cent of this flora is known. An apt illustration of this is furnished by the plants which I collected because of their resemblance to the fossil plants found in the Pliocene tuffs of Potosi, nearly all of which proved to be species unknown to science.

The trail to the Yungas passing by Quime to Inquisivi and Suri is not only excellent but fascinating; in the opposite direction it leads out over the Tres Cruces pass to Eucalyptus or Oruro on the railroad. It has been in existence for more than five hundred years. Going over the pass to Coluyo

after fourteen days in the saddle on the heights, we were gladdened by the sound of an automobile and quickly paying off our *arriero*, arranged with the newcomer to be taken to town. We made the sixty-six miles from Coluyo to Oruro in four hours, passing through a country that reminded me of that around Forsyth, Montana, even to a South American substitute for the sage brush of our own western country. Through this more expeditious mode of travel we saved two days.

Tres Cruces is a broad saddle of Devonian shales about 16,000 feet in altitude, but with no high peaks near at hand or even visible, and with a gradual descent to the westward. The country is more arid than is that a few miles to the northward, and the trinity of peaks that crown the Santa Vela Cruz to the east have no permanent ice cap.

Like all of the great mountain ranges that have figured in human history the Andes are very young—geologic, biologic, and physiographic evidence is at one in confirming this statement. I shall give but a single instance among the many of the sort of evidence that the geologist relies upon in making such an assertion. On a high pampa in the Sierra de Cochabamba I found sediments that had been deposited in a small Pliocene basin. Much of the material was volcanic ash the only known source of which was many miles away in the great volcanic field of the western Andes. This ash deposit, partly wind blown and partly water laid, had buried the fruits and leaves of trees the near relatives of which are to be found at the present time only in the Yungas—not far away to be sure, but at much lower levels, and not extending upward more than half way to the 11,800 feet where the fossils

were found. Hence it is inferred that these fossiliferous sediments have been uplifted more than a mile since the fossil trees lived in that region, and knowing that the latter are Pliocene in age, we get the minimum measure of the amount of uplift since Pliocene times.

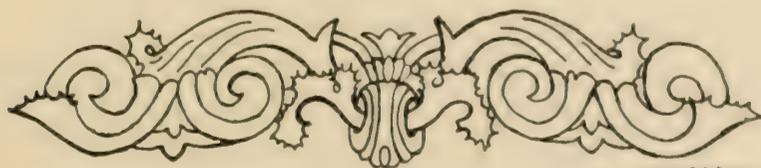
It had been supposed that this uplift was of a great segment of the earth's crust with bounding fractures or faults on the two sides. At any rate it was responsible for the anomalous climate that prevails in this region at the present time—the arid upland, the semi-desert of the Peruvian coastal region and the nitrate desert of northern Chile. This is shown in many ways, as for example at Potosi, where the terminal moraines of former glaciers are found at about 13,000 feet and where Potosi's silver mountain, although reaching upward to more than 15,000 feet, carries no permanent snow because of the dearth of precipitation.

Formerly a rain forest like that of the Amazon Basin extended across the site of the Andes to the Pacific coast, and probably beyond, for there is some geological evidence that the deeps found immediately west of the present coast were once land, which has since sunk on the seaward side of the great fault that runs along this part of the

present coast. Relics of this former rain forest have been found in the rocks of both Peru and Chile, and traces of it are preserved at a number of localities in the arid uplands of Bolivia.

The slow rising of these great mountain ranges across the equatorial zone in the path of the trade winds was a dramatic episode in the history of the earth—one that it would have been fine to have witnessed, although probably the rise took place with such slowness as not to have been perceptible within the proverbial threescore and ten years allotted to man. It occurred so recently, however, that not yet has the kinship been obliterated between the plants or the birds on the two sides of the Cordillera, in those regions like Colombia, where no strongly contrasted climatic change was set up on the two sides.

It is one of the fascinations of palæontological studies that such large and inspiring problems are pressing for solution. Although the results of such studies seldom admit of a mathematical demonstration, the main outlines emerge surely, as do those on a great canvas under the hand of a master painter. It is not surprising that the votaries of palæontology wonder why all men do not aspire to become palæontologists.



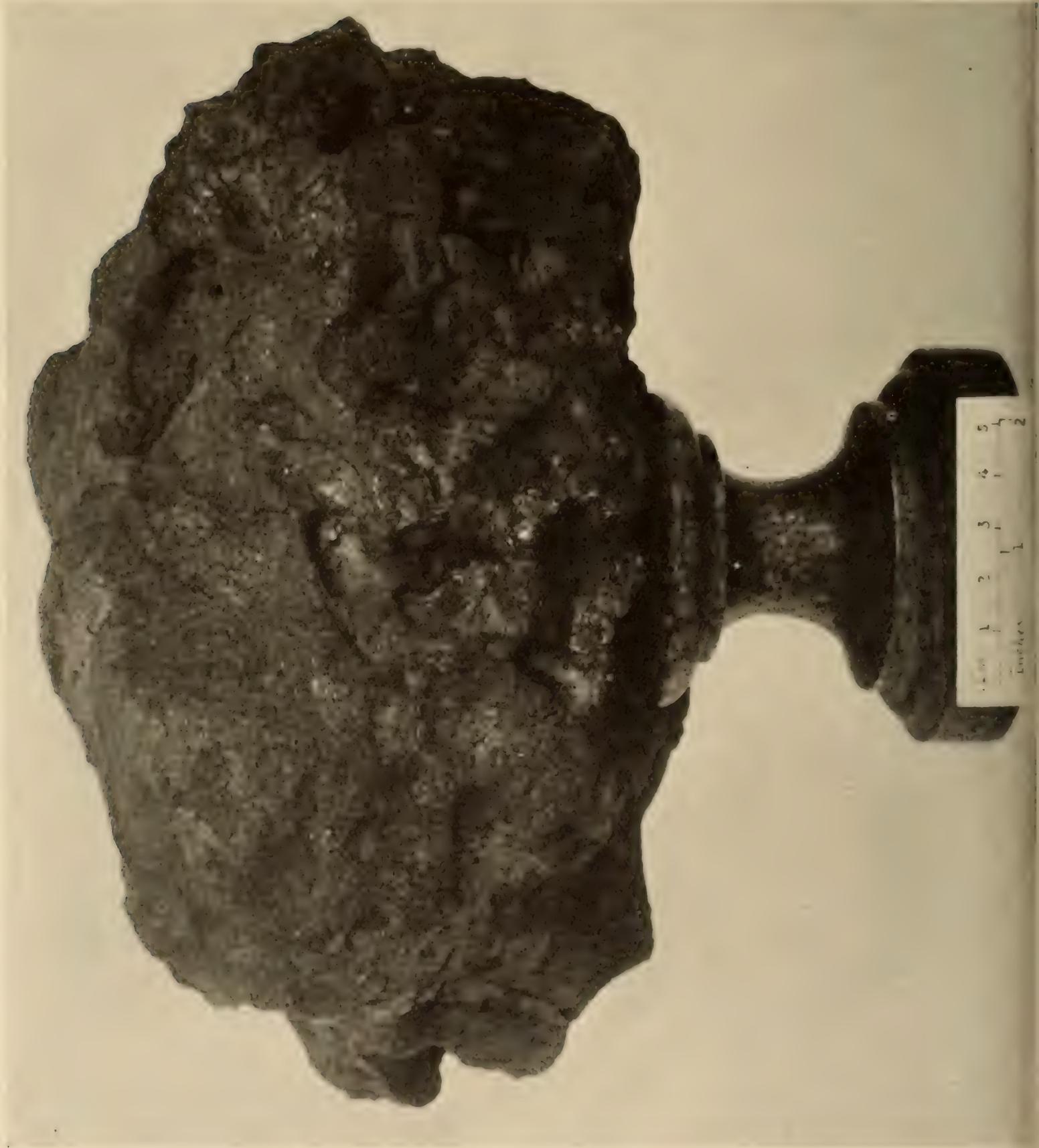
M. M. Glidden

"ROSE CITY"

Rose City—the locality of the fall—is the name that has been given to the new aërolite or stony meteorite from Michigan, the largest fragment of which, nine inches long, has been lent to the American Museum by Mr. P. W. A. Fitzsimmons and is here depicted in side view.

A dull skin covers much of the surface; the deep pits are due to superficial melting while in the air. The agglomeratic character of the mass is also recognizable.

The fragment is on exhibition on the first floor of the American Museum



A New Meteorite from Michigan

BY EDMUND OTIS HOVEY

Curator of Geology and Invertebrate Palaeontology, American Museum

METEORS, or shooting stars, are seen by the thousand in Michigan, as they are elsewhere in the world, but only three meteorites have been described from the state: one from near Reed City, another from Grand Rapids, and the third from Allegan. "Reed City" is an iron meteorite weighing about 43 pounds which was plowed up in a field near the town. "Grand Rapids" is a mass of iron weighing 114 pounds which was unearthed in making the excavation for a building. "Allegan" is the only one of the three which was seen to fall. It is a stony mass which weighed about 70 pounds when it struck the earth on Thomas Hill on the Saugatuck Road in Allegan, at about 8 A.M. on July 10, 1899.

Much interest, therefore, was aroused by newspaper accounts of a brilliant meteor that was seen to pass from north northwest to south southeast over the northeastern portion of the Lower Peninsula of Michigan, about eleven o'clock in the evening of October 17, 1921. The heavens were illuminated over an area thousands of square miles in extent. Near Rose City, Ogemaw County, the meteor exploded with the usual accompaniment of several loud reports, and three of the fragments into which it burst have been recovered on the premises of Mr. George Hall, about nine miles northeast of this little hamlet, which gives its name to the fall. These portions, it is stated, weighed about three and one-fourth pounds, seven pounds, and thirteen pounds respectively, when discovered. They are now the property

of Mr. P. W. A. Fitzsimmons of Detroit, who has very kindly lent the largest mass to the American Museum for exhibition.

The newspapers gave their customary vivid accounts of the occurrence, from which we may select the following:

The night the meteor fell buildings in Rose City shook and the effect was similar elsewhere in northwestern Michigan. At Caro, nearly 100 miles away, it was said the sky-traveler woke folks up, and Saginaw also reported a startling effect. The meteor attracted attention as far south as Detroit and Albion.

The flaming heavenly torch appeared to be eight feet in diameter, as it swished through space, apparently directly over the village of Rose City.

A tail of light streamed in the path of the falling body for a distance of at least 100 feet. There was a beautiful purple light encircling the outer mass of fire, and a shock followed by the rattling of windows and trembling of buildings was plainly felt for 30 seconds as the massive flaming mass struck the earth.

A man who was camping about fourteen miles from the George Hall farm gave Mr. Fitzsimmons an account of the meteor in nearly the following words:

I was sleeping in my tent that night and all at once I saw things very light outside. I quickly looked out and saw high in the sky, about five miles I should think, a large ball of fire and this looked to me as large as an ordinary barn. After the ball had traveled on its way, and the light had died out, I heard three loud explosions, one immediately following the other.

It seems that Mrs. George Hall was up rather later than usual, as her husband had been ill, and thus had an opportunity of witnessing the fall. Mr. Fitzsimmons reports her account of the event as follows:

I saw it very light out of doors and heard a roaring sound and then three loud explosions. I thought it was an airship and it was dropping some bombs or something of that character. I jumped up and ran to the door, and the big light was disappearing in the south. The roaring itself was not so very loud, but the explosions were very loud indeed, and while I stood in the doorway watching the disappearing light, I distinctly heard a sound like fine singing.

The largest fragment, which is about nine inches long, was found the next day forty feet south of the house, embedded about two feet below the surface in soft, sod-covered earth. By so narrow a margin did Mrs. Hall and her husband escape serious accident! The next piece in point of size was found later in the same day about 150 feet from the house, near a highway. It was not so deeply buried in the ground as was the first.

The meteorite is black in color, both on the surface and in the interior. It is deeply pitted and it presents a dull black skin over much of the outside, both features being due to surface melting caused by friction with the air during the last stage of its journey to the earth. One of the most peculiar features of the mass is that it looks somewhat like a conglomerate with rounded protruding knobs of relatively coarse material cemented together by duller fine material of the same nature.

Because of its origin and because there is no evidence of the action of water in connection with either the knobs or the cement, the material is called an "agglomerate" rather than a conglomerate. When the specimen was received at the American Museum, many of the surface pits contained grass, grass roots, and soil which were firmly wedged into them. The grass had not been burned or even charred and therefore the temperature of the meteorite when it struck the ground could not have been elevated.

Examination of the surface of this meteorite reveals the presence of minute specks of metallic iron in the midst of a stony matrix, which is a feature shown by almost all our stony visitors from space. A polished section shows not only innumerable particles of this character but also strings and irregular areas of metal. Chemical analysis discovered the presence of about 17 per cent of metal mixed with 83 per cent of mineral in the meteorite, while further tests showed that the metal was made up of about 91 per cent of iron and nearly 9 per cent of nickel and cobalt. The use of the microscope determined that the stony portion was composed principally of the two minerals, enstatite and olivine. The material furthermore is somewhat porous or spongy in texture. This is due to the presence of innumerable minute cavities which, under the magnifying glass and still better under the microscope, are seen to be angular in shape and to be lined with crystals of the minerals which make up the ground mass.

NOTES

MUSEUM OF THE AMERICAN INDIAN, HEYE FOUNDATION

Although the Indian is a member of a vanishing race, he lives and will live forever in the narratives of the Jesuit fathers, in the pictures and pages of Catlin, in Schoolcraft and Parkman, and a host of others. Place names throughout the length and breadth of the land perpetuate his memory in musical polysyllables, and his traditions have become part of the heritage of the later-day descendants of the alien conquerors of his lands. Yet, in spite of the widespread interest in the aboriginal inhabitants of the Americas, there was no institution devoted exclusively to the anthropology of the indigenous peoples until Mr. George Gustave Heye brought to fulfillment a splendid vision to which he had been steadfast for many years.

The Museum of the American Indian—Heye Foundation, which was opened on November 15, 1922, marks the culmination of twenty years of planning and collecting, in which Mr. Heye had the cooperation of many noted workers in the field of anthropology and the financial support, supplementing his own generous provisions, of the trustees of the museum and interested friends. Although almost two decades elapsed between the inception of the plan and its fulfillment—decades during which the two continents and the islands of the Western Hemisphere were scoured for exhibition and study material—the published results of studies made by members of the staff of the museum, numbering no less than ninety titles and including monumental contributions like *The Antiquities of Manabi, Ecuador*, by Professor M. H. Saville, have enabled the public to gauge the magnitude and diversity of the research work undertaken by the institution. No fewer than twenty-one names of anthropologists engaged in collecting and in study among different Indian tribes or in archæological work on the sites of former Indian occupation, are recorded in the pamphlet setting forth the aims and objects of the museum, and the work of several of these anthropologists in particular areas has stretched over many years, witness the exhaustive researches of Professor Saville on the west coast of South America and in Central America, the collecting of Mr. M. R. Harrington in the United States, and the excavation, by Mr. F. W. Hodge during the last five field seasons, of Hawikuh, one of the famed "Seven

Cities of Cibola," the reputed riches of which lured Coronado and his gold-hungry followers into the sun-scorched desert of the Southwest.

The excavation of the last-mentioned site was made possible through the generosity of Mr. Harmon W. Hendricks, a trustee of the museum, and one to whose benefactions it owes much. To list all of those who through gift and encouragement supported Mr. Heye in his undertaking, is not possible within the limits of this note, yet mention must be made of Mr. James B. Ford, one of the trustees, who has been the generous patron of much of the research in the countries to the south, in addition to enriching the collections of the museum; of Mr. Miner C. Keith, a trustee, who presented to the museum the largest collection extant of Costa Rican earthenware; of General T. Coleman du Pont, who financed the expedition to Kane County, Utah, for the exploration of an ancient site of the so-called Basket-makers; of Mrs. Marie Antoinette Heye, who for many years gave Mr. Heye's undertaking most generous support; of Mrs. Thea Heye, who has been the donor of hundreds of valuable objects; and of Mr. Archer M. Huntington, who presented the ground upon which the museum edifice has been erected and who in 1919 inaugurated the series of *Indian Notes and Monographs* in which have been published no less than sixty-five listed contributions.

Between a million and two million specimens representative of the culture of the Indians have been assembled through the activities of the museum, including many thousands that are unique. The three floors devoted to exhibitions naturally do not permit the presentation to the public of more than a fraction of this vast total, but even though it is only a fraction, it will go far toward satisfying the most exacting requirements of the lay visitor. Students will be afforded every facility for utilizing the study collection in their researches. ❧

THE CLEVELAND MUSEUM OF NATURAL HISTORY

The Cleveland Museum of Natural History, which began its existence only about two years ago, has already abundantly demonstrated its ability through exhibits, lectures, and library facilities to respond to the needs of the community which it serves. Late in October of 1922 it even opened its own printing plant, from which was issued under date of No-

vember 1 the initial number of the Cleveland Museum *Bulletin*. From that publication we learn of the work which the museum is doing and of the loyal support which it is receiving from the people of Cleveland. It is stated that through a recent gift from Mrs. Dudley S. Blossom of the Herbarium of the late Samuel Hart Wright of Penn Yan, New York, the museum has come into possession of approximately 10,000 specimens of plants, representing a number of the American and European genera. Mrs. Blossom's gift includes also a part of the Wright library of scientific books, many of which are out of print. Another acquisition deserving special emphasis is a collection of thirty-seven water color studies of the fur seals of the Pribilof Islands, painted by Henry Wood Elliott during his visits to the islands in the early seventies. For this donation the museum is indebted to Mr. John M. Henderson.

During the months of October and November nearly forty lectures were given by members of the museum staff, and certain additional lectures were delivered by invited speakers. The museum staff has been carrying the message of the institution beyond its walls by lecturing before clubs, schools, churches, and conventions, in addition to addressing audiences within the museum itself. Another evidence of the service the museum is rendering to education is the completion by its librarian, Miss Lindberg, of an annotated list of books on natural history suitable for children in their early 'teens or younger.

The museum is housed in Euclid Avenue in one of the Hanna mansions, which has been acquired for a period of years. Two rooms in the present edifice have been completely renovated and in them have been installed natural history exhibits of rare attractiveness. The collections of birds, mounted by Mr. Arthur B. Fuller, are particularly noteworthy for their excellent taxidermy. The Old-World birds, collected and presented by Mr. K. V. Painter, are one of the features of the museum.

THE FIELD MUSEUM

EXPEDITION TO SOUTH AMERICA.—Dr. Wilfred H. Osgood, curator of the department of zoölogy, Field Museum, and Messrs. C. C. Sanborn and H. B. Conover, of the division of birds in that institution, recently left Chicago for Chile, to penetrate some of the comparatively little-known regions of that country, including the area held by the Araucanian Indians.

After landing at Valparaiso, the members of the expedition plan to go to central Chile and thence to proceed southward as far as Chiloe Island. Doctor Osgood and Mr. Conover will then work across northern Argentina and into southern Brazil and Uruguay, returning probably about the middle of 1923. Mr. Sanborn, on the other hand, will remain in the field throughout the present year. He will move northward as the season advances, collecting in northern Chile and Argentina and in Bolivia.

The expedition will visit many of the localities of historic interest to zoölogists, including the type localities of animals collected by Charles Darwin during the voyage of the "Beagle." The expedition will devote itself to the general collecting of vertebrates. Among the animals of popular interest regarding which the party of scientists hopes to learn much is the chinchilla, now so rare because of its inordinate use as a fur. Another expectation which they will strive to realize is to bring back to this country the first specimens of the pudu, a very small deer, and one of the rarest in the Americas.

EXPEDITION TO HONDURAS.—Mr. Karl P. Schmidt, until recently assistant curator of herpetology in the American Museum and now assistant curator of reptiles and batrachians in the Field Museum, left New Orleans about the middle of January for Belize, British Honduras. Mr. Schmidt's primary purpose in undertaking this expedition, in which he is accompanied by a taxidermist, is to secure for the Field Museum material to be used for habitat groups of amphibians and reptiles as well as specimens for the systematic series of these animals. Mammals and fishes will also be collected. After a short stay in British Honduras, Mr. Schmidt and his companion will proceed to Puerto Cortes, Honduras, and thence to Lake Yojoa in the interior of the state. Honduras is perhaps the least-known, zoölogically, of the Central American countries and important results may, therefore, be anticipated from this expedition.

ASIA

WHAT THE GOBI DESERT HAS YIELDED.—In a cable sent by Mr. Roy Chapman Andrews to *Asia* and published in the December issue of that magazine, the leader of the Third Asiatic Expedition summarizes the remarkable results obtained from five months' work in the Gobi Desert. These include the discov-

ery of vast fields rich in Cretaceous and Tertiary fossils. The specimens obtained include not only the huge skull and portions of the skeleton of *Baluchitherium*, the largest known land mammal, which arrived at the American Museum toward the close of December, but also complete skeletons of small dinosaurs and parts of large dinosaurs; skulls of rhinoceroses; skulls, jaws, and fragments of mastodons, rodents, carnivores, horses, insectivores, and deer. Fossil insects and fish, in a fine state of preservation, were also found. Extensive deposits of Devonian, Carboniferous, and Permian age, hitherto unknown in Mongolia, were located, as well as a vast series of Pre-Cambrian and Palæozoic rocks. The expedition mapped a strip a thousand miles square in the type region of Mongolian geology and obtained 20,000 feet of film illustrating in full detail the work of the expedition, the life of the natives, and the behavior of the herds of antelopes and wild asses that were seen. A representative collection of the mammalian fauna of the region was obtained.

BIRDS

BIRD COLLECTING IN PERU.—Mr. Harry Watkins, who is conducting a biological survey on behalf of the department of birds, American Museum, to determine the relation between the avifauna of the coast of southwestern Ecuador and that of the Marañon Valley of Peru, reports the discovery of heretofore unsuspected areas of forest land on the western slopes and even on the summits of the Andes between Paita and Huanca-bamba. Through his capture in this region of motmots and trogons, the known range southward on the Pacific coast of these genera is considerably extended. The abundance of the bird life in the region is evidenced by the fact that already more than one hundred species are represented among the specimens taken by Mr. Watkins.

MAMMALS

A COLLECTION FROM ECUADOR.—Messrs. G. H. H. Tate and H. E. Wickenheiser are on their way to New York with a good-sized collection of mammals made in the Guayas Basin and in the central Andes of Ecuador. The collecting and field observation in the areas covered will prove a valuable supplement to the work already done by the American Museum in this South American state. Both Mr. Tate and Mr. Wickenheiser have

been suffering from malarial fever but according to reports recently received have recovered from their indisposition.

ANTHROPOLOGY

AZTEC RUIN.—Although interesting discoveries have been made from time to time in the course of excavating the pueblo known as the Aztec Ruin, New Mexico, the kind of ladders or steps whereby the ancient inhabitants of this settlement climbed from story to story remained undetermined. At first it was the impression of Mr. Earl H. Morris, who heads the Archer M. Huntington Archæological Survey of the Southwest, that the ladders must have been composed of pairs of heavy poles set side by side and alternately notched, but after two hundred chambers had been freed of their contents and not even a fragment of such a ladder unearthed, he abandoned this assumption and had no alternative suggestion to offer.

Recently, while he and his assistant were digging in one of the rooms of the ruin, the latter came upon an object unlike anything that had previously been excavated. By eleven o'clock at night their joint efforts had succeeded in bringing to the surface a number of pieces of worked wood and several poles, which, when assembled, revealed themselves as parts of a ladder of unique construction. The sidepieces of this ladder were straight, barked cedar poles, $6\frac{1}{2}$ feet long, that tapered from a diameter of $2\frac{1}{2}$ inches near the base to $1\frac{3}{4}$ inches at the upper extremity. Laid along each of these poles was a slender skunk-bush sapling that was lashed to its support by transverse withe bindings. The ends of the rungs were thrust between the cedar sidepieces and the parallel saplings, each rung above a pair of opposing lashings. The saplings were necessarily bent away from the timbers to which they were bound to permit the insertion of the rungs, and being of tough resilient wood, thereafter exerted a pressure which under ordinary circumstances held the crosspieces securely in place. The saplings extended beyond the ends of the sidepieces and their free extremities were bent inward toward each other and bound together, thus forming a curved top to the ladder. Thereby the ladder was prevented from spreading apart and a bail-like handle was provided by which this light yet strong and convenient device might be lifted and drawn up into the room above. The rungs of the ladder, five

in number, were round sticks of hard wood about $1\frac{1}{4}$ inches in diameter, each smoothly polished by the wear of bare as well as sandaled feet.

EUROPEAN ARCHEOLOGY.—As a result of President Henry Fairfield Osborn's visit to Europe in 1921, the department of anthropology of the American Museum this year renewed its effort to complete its Old-World archæological collections. Associate curator N. C. Nelson, who has charge of these collections, and who was in Europe for a similar purpose in 1913, returned early in December, 1922, after a six months' search, to report the acquisition of about 3000 new specimens and to explain that the way is open to acquire as many more. He brought back also about 100 photographs of archæological interest, as well as extensive notes on the principal prehistoric collections exhibited in the museums of western Europe.

Mr. Nelson's travels took him to England, Denmark, Germany, Switzerland, Holland, Belgium, and France. He visited more than 40 public museums, besides 20 important private collections; examined and photographed, for the first time, 19 more or less famous archæological stations; and called upon more than 100 people directly or indirectly interested in archæology. Exceptional opportunity for observation was afforded him in that he was invited to accompany a group of French and Belgian archæologists and geologists on a tour of inspection to several important archæological stations in England, Holland, and Belgium. In this way he was enabled not only to see for himself how the specimens occur, but he also learned of the various methods employed in their excavation. The kindness and hospitality enjoyed in this connection, with the insight afforded into real European home life, Mr. Nelson says, will long be remembered with gratitude.

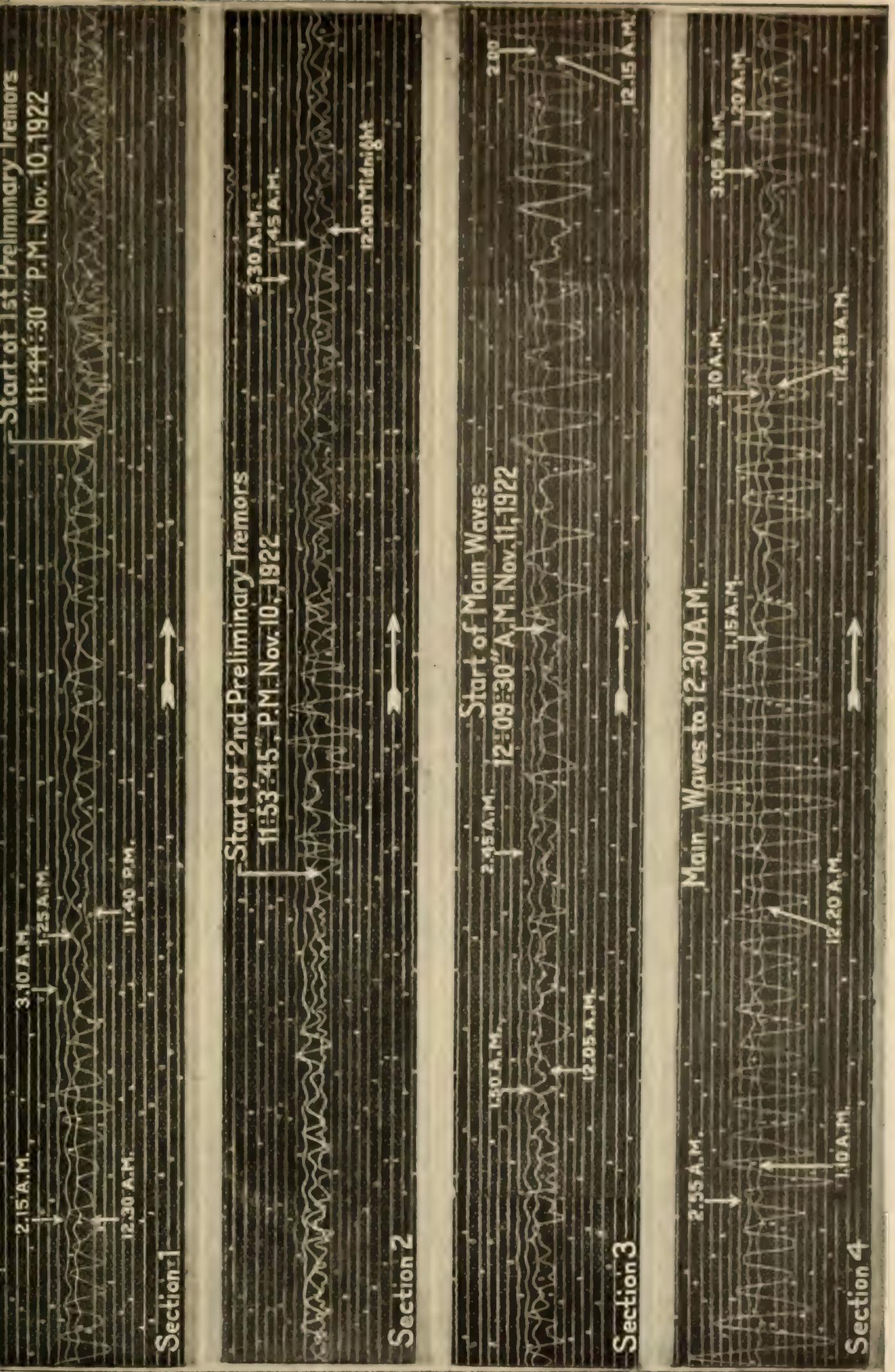
Regarding the general progress of archæological investigation in Europe, Mr. Nelson seems very hopeful. Many able workers were lost during the war and funds are everywhere limited or lacking. Nevertheless, those who remain are unbounded in their enthusiasm, and more or less work has been done everywhere, both during and since the war, that is of the highest importance. In certain quarters—as, for example, in England and Switzerland—discoveries have been made which promise to modify very considerably the present views of prehistoric development.

THE CHILEAN EARTHQUAKE

Though rivaled in destructiveness by the death-dealing instruments of war, the earthquake, manifesting its might without warning and defying control, will doubtless continue at intervals to topple down cities, even after an era of peace and good will has ushered out, as we trust it may, the troubled centuries of man-made strife.

There have been a number of earthquakes more cataclysmic than the Chilean earthquake of November 11, 1922. That of Lisbon in 1755 killed between 30,000 and 40,000 people; in the Kangra earthquake of India, in 1905, nearly 20,000 individuals perished; the total loss of life in the Messina earthquake of 1908 was, according to official returns, no less than 77,283. Yet the 800 or more men, women, and children who were killed by the Chilean earthquake do not measure the magnitude of this phenomenon, which, had it occurred in a more densely settled area of the globe, would doubtless have taken a greater toll of life. The earthquake and the resulting tidal waves affected the coast of Chile over an extent of 1200 miles, that is, from Antofagasta on the north to Valdivia on the south.

The record of this earthquake, as registered on the seismograph of the American Museum, is reproduced on the opposing page in four sections, each of a duration of about thirteen minutes, as indicated by the dots. The sections should be read consecutively from below upward, beginning with the section on the left, at the point marked "Start of 1st Preliminary Tremors." It should be explained that these four sections represent convenient subdivisions of a continuous band of smoked paper that revolves on a cylinder of the seismograph. In the course of a complete revolution the band moves to the right one space and the recording needle, which is one of the essential features of the seismograph, thereupon traces the waves of the second and subsequent circuits alongside the earlier part of the record. Three sets of such waves are shown on each of the sections depicted, those on the right of each section being earlier than any of the middle series, and those on the left representing the final stage. In reading the record, one should, therefore, after tracing the first line of waves through the successive sections, turn back to the first section and resume the story in the second line of waves, and so on through to the concluding phase.



THE RECORD, FROM THE SEISMOGRAPH IN THE AMERICAN MUSEUM, OF THE CHILEAN EARTHQUAKE OF NOVEMBER 11, 1922

The first preliminary tremors (see section 1) arrived at the seismograph in the American Museum about a quarter of an hour before midnight on November 11 and lasted for about 9 minutes and 15 seconds, when the second preliminary tremors (see section 2) set in and continued for 15 minutes and 45 seconds. The main waves (see sections 3 and 4) started 9½ minutes past midnight and remained prominent for about 21 minutes. At 1 A.M., however, the needle still registered waves of considerable intensity, which continued to 3 A.M. Although the quake lasted only the fraction of a minute at its point of origin, the record on the seismograph was spread over more than three hours of time. This spreading out of the three kinds of waves on the record is a measure which the observer uses in calculating the distance of the point of origin from the seismograph. The shorter the time of the first and second preliminary tremors, the less the distance to the point of origin.

In the bulletin posted on the morning of November 12 by Dr. Chester A. Reeds, the observer in charge, the distance was estimated to be 7900 km., or about 4937 miles. The correctness of this estimate is borne out by the fact that Coquimbo, near the center of the disturbed area, is 7900 km. due south of New York City.

This is the second time during a period of less than twelve months that the seismograph in the American Museum—the gift of the late Emerson McMillin—has been of service to science in recording data regarding an earthquake of major importance.

ARTHUR WESLEY DOW

Professor Arthur Wesley Dow, director of the department of fine arts, Columbia University, died on December 13, 1922. Not only an artist and author of recognized creative power, but a man of very fine personality, Professor Dow left an indelible impress on those with whom he came in contact and upon the art of the nation. He possessed preëminently the ability to awaken the creative impulse in others, his students responding to the magic of his influence in producing original designs of great beauty.

He was born at Ipswich, Massachusetts, in 1857, and was the son of David F. and Mary P. Dow. After completing his academic and classical education at Ipswich, he studied art in Boston, and in Paris under Boulanger and Lefebvre. His paintings were exhibited

in the Salon, Paris, in 1886–87, and again in 1889, receiving honorable mention. In the company of the artist Fenollosa, he made a thorough study of the art of Japan, and his work after his return to this country showed the Japanese influence. He was for years the curator of Japanese art, Museum of Fine Arts, Boston. He was instructor of art, Pratt Institute, Brooklyn, from 1895 to 1904, leaving it to become the director of the fine arts department, Columbia University. The inspiration he brought to Pratt Institute, having its center in the art department, was felt throughout the Institute, all departments responding to the art impulse which he had so deeply stirred. During this period he made a special study of the art of the North American Indian, visiting the American Museum frequently to study the Indian exhibits. In his lectures he frequently made reference to the wealth of material at the Museum, assigning to his students problems in art which necessitated their careful study of the dress, pottery, basketry, etc., of the Indians and the originating of designs with Indian motifs. He was a friend of Frank H. Cushing, who lived among the Zuñi Indians as an adopted member from 1879 until 1884, and who upon his return to the eastern states, visited Professor Dow at Ipswich and located there the site of an old Indian spring, all traces of which had been obliterated. Digging on the site revealed ancient Indian pottery.

At Columbia University his work broadened out and expanded, many thousands receiving his message and carrying it to different parts of the country. He was lecturer on art at the Art Student's League, 1897–1903, and for years director of a very interesting and live summer art school at Ipswich, Massachusetts. He was the author of a widely known book, *Composition*, richly illustrated; of *Ipswich Prints*; and *Along Ipswich River*.

INSECTS

THE GYPSY MOTH IN NEW JERSEY.—The citizens of New Jersey may congratulate themselves upon the vigor with which war has been made upon the gypsy moth (*Porthetria dispar*) that menaced certain areas of that state. Through appropriations made by the federal government, by the New Jersey legislature, and by individuals like Mr. Duke, on whose estate there was a heavy infestation, the work of extermination, which has now been in progress for two years, was made possible, and

the results attained should be a matter of pride to those who have given their energies to combating this insect pest. With what painstaking thoroughness the work of extermination has been pursued may be inferred from the fact that although during the first year of the campaign more than 3,000,000 egg masses were found, only 909 were discovered during the second year. This startling reduction in numbers acquires added significance through the fact that in the second year 1400 square miles of territory were scouted as against 894 in the first year. The actual number of trees examined in the second year was 2,025,403 as against 1,157,339 in the previous twelve-month, and when the fact is stated that some of these trees were in dense thickets, the difficulties confronting the careful scouting that is required may be visualized. Creosoting, spraying, and banding, were among the methods of attack again employed during the past year.

The reduction in number of discovered egg masses from more than three million to less than one thousand might seem to justify a relaxation of effort, but it is to be hoped that such false economy will not be practised. Only after unrelaxed vigilance over a period of years can one say with some degree of certainty that the danger is eliminated. Mr. Weiss, chief of the Bureau of Statistics and Inspection, New Jersey State Department of Agriculture, writing in the fall of 1920, at the very inception of the campaign against the gypsy moth,¹ estimated that it would probably require from three to five years before assurance could be given that the pest had been cleaned up. He added that in case it should be found in the Watchung Mountains—a region where spraying is carried on with great difficulty—the work of extermination would require more time and effort. During the past season a few egg masses were located in the Watchung, suggesting dangerous consequences if, as a result of the marvelous strides already made, the public permits itself to be lulled into a false sense of security. The work should go on with full financial support until all danger is removed.

LOWER INVERTEBRATES

WORK ON THE SHELL COLLECTION.—Mrs. Ida S. Oldroyd, of Stanford University, one of the foremost students of mollusks in this country, has been spending three months at the American Museum revising and bringing up to date the nomenclature of the shell

collection of the department of lower invertebrates. At least 200,000 shells, representing about 10,000 species, are in the possession of the department. Mrs. Oldroyd has been giving her attention to the marine gastropods (sea snails) of the collection as well as to the bivalves or two-shelled mollusks.

ADDRESSES BY DR. ROY W. MINER.—“Life’s Victors, or Why the Fittest Survive,” was the subject of an address delivered by Dr. Roy W. Miner before the Academy of Natural Sciences in Buffalo. Doctor Miner also spoke before the Rotary Club of North Adams, Massachusetts, on the American Museum of Natural History and its activities. Subsequently, on December 15, Doctor Miner lectured on evolutionary subjects before the University School of Cleveland and before the University Club of that city.

SPECIAL EXHIBITS

CAMERA CLUB EXHIBIT.—Photographic records of animal life are invaluable in natural history study, yet in our admiration of the exquisite results that such photographs present, we are too apt to overlook the technical processes whereby they have been made possible. The exhibit of mammal photographs in the American Museum last summer showed what nature photography has accomplished. Another exhibit of photographs, which was installed by the Camera Club of New York in the hall of woods and forestry early in December, remaining there throughout the month of January, illustrated the striking effects attained by different printing processes. The quality of the pictures may be gauged by the fact that of the 192 shown, about half had received recognition in different salons in this country and abroad.

Although the subjects depicted ranged over a field more extensive than natural history, two conspicuously placed portraits—that of Mr. Carl E. Akeley and that of Mr. Vilhjalmur Stefánsson—and certain other photographs, like that of the Museum itself, had a special interest for friends of the Museum in addition to that which they possessed as examples of different photographic methods.

Those not versed in the technique of photography had cause to wonder at the number and variety of the processes illustrated in the exhibit. There were examples of the bromide process, which is employed almost universally for enlarging; of a process resembling the bromide and known as the Artatone; of the carbon process; of the gum process, which

¹NATURAL HISTORY, Vol. XX, p. 500; see also NATURAL HISTORY, Vol. XXI, pp. 103-04, 647-48

involves the same kind of chemical action as the carbon process but in which gum arabic is used instead of gelatine to hold the pigments. Great skill is required in the use of the gum process, which gives broad, sketchy effects. A process which, like the one just mentioned, is a vehicle of expression for the artist photographer, is the oil process, in which unlimited scope is given for the production with brush and pigment of individual effects; a similar process is that known as the bromoil. By the platinum process a beautiful, clear, flat image is produced, that is devoid of luster. Due to the demands for platinum during the war, the manufacture of platinum paper almost ceased. Other processes represented in the collection of pictures were the gum platinum, the palladium, the gum palladium, the chloride, the Kerotype transfer, and—regarded by many as the most beautiful process of all—the bromoil transfer.

Different kinds of apparatus and instruments used in photography were also represented in the exhibit, including the camera known as the Naturalist Graflex, designed especially for photographing mammals and birds in the wild state where long focus or telephoto lenses are required.

BASKET WORK BY AN INSTITUTIONAL CLASS.—In the hall of woods and forestry, American Museum, there was shown during December an exhibit of baskets, dainty in workmanship and perfect in symmetry,—the product, one would have said, of skilled fingers directed by an attentive mind. Yet the baskets were made, not by professional workers in wickerware, but by the Institutional Class of Public School 9, the Bronx, at the Shelter of the Bronx County Society for the Prevention of Cruelty to Children. Here boys and girls that have some defect of character that they are unable to overcome unassisted, are given a new grip upon themselves, and a new vision, through the course in character-building conducted by Miss Lucy C. Simonson. To the baskets were attached bright and helpful little verbal hints how happiness may be gained through giving cheer to others,—an indication that the making of the baskets, however worthy in itself, was incidental to the larger task of giving these children a new ideal and inspiring them to achieve it.

MEETINGS OF SOCIETIES

NATIONAL ASSOCIATION OF AUDUBON SOCIETIES.—On October 30 a public meeting

under the auspices of the National Association of Audubon Societies was held in the American Museum, in the course of which illustrated addresses on "The New Era in Wild Life," "Bird Photography, Past and Present," and "Comments on Bird Protection in Europe and America," were delivered respectively by Mr. Ernest Thompson Seton, Dr. Frank M. Chapman, and Mr. T. Gilbert Pearson.

On the day following, the National Association held its eighteenth annual meeting. President Pearson announced that a gift of \$200,000 cash had been received during the year, to be known as the "Permanent Fund of 1922." He further stated that the donor, whose name he was not at liberty to divulge, stipulated that this gift should be preserved as an endowment fund, the interest from which was to be used for the following purposes:

"First, for the education of the general public in the knowledge and value of useful, beautiful, and interesting forms of wild life, especially birds.

"Second, for the actual protection and perpetuation of such forms of wild life on suitable breeding and other reservations.

"Third, for protecting and maintaining adequate protection for such forms of wild life in all parts of the Western Hemisphere.

"Fourth, or for any one of these purposes."

At the meeting Dr. Frank M. Chapman and William P. Wharton were reelected as members of the Board of Directors for a term of five years, and Mr. George Finlay Simmons of Austin, Texas, was chosen to fill the place on the Advisory Board of Directors left vacant by the death of Mr. Howard Eaton of Wyoming.

NATIONAL ACADEMY OF SCIENCES.—Among the papers presented at the autumn meeting of the National Academy of Sciences, November 14-16, were several contributed by members of the scientific staff of the American Museum, or by those closely associated with the undertakings of that institution. Professor Charles P. Berkey, who as geologist of the Third Asiatic Expedition participated in the interesting discoveries made in Mongolia, spoke on "A Tentative Geological Column for Central Mongolia." Dr. Clark Wissler, in unfolding his subject, "Dating Prehistoric Man in America by Methods of Distribution and Stratigraphy," gave a brief report upon studies carried on in the Museum from which has been developed a technique for estimating

the relative antiquities of prehistoric remains by comparing their geographical distributions. "The Restoration of Fossil Human Remains: Its Possibilities, Value, and Limitations," was the subject discussed by Dr. J. H. McGregor.

In a paper entitled "Probable Mutation in the Genus *Buarremon*," Dr. Frank M. Chapman expressed his belief that the presence or the absence of the black band across the breast, which distinguishes certain species of this genus of birds, is due to mutation. The theory was advanced that these pectoral bands, which, together with many other markings, like bars on the wings, stripes on the crown, or spots on the outer tail feathers, are present in many wholly unrelated species of birds, will be found to be unit characters which appear or disappear through the action of internal rather than external, or environmental, causes. Dr. Robert Cushman Murphy's paper "The Whitney South Sea Expedition of the American Museum of Natural History," was presented by title.

Dr. Frank E. Lutz presented, on behalf of himself and his co-investigator, Prof. F. K. Richtmyer, a paper entitled, "Ultra-violet Flowers and Their Possible Bearing on the Problems of Pollination by Insects." In it he pointed out that as certain experiments indicate that insects respond definitely to ultra-violet rays, it would seem that in considering flower colors in connection with pollination by insects, attention should be given not only to the visible spectrum but also to the ultra-violet, the reflection of ultra-violet rays by certain flowers having been established in the course of experiments conducted last summer at Boulder, Colorado, by Doctor Lutz and Doctor Richtmyer.

In his address regarding "Recent Discoveries of Fossil Vertebrates in China and Mongolia," Dr. W. D. Matthew dwelt on the significance of the finds made last summer by the Third Asiatic Expedition. Central Asia has been among the least-known regions of the world in respect to the history of its land fauna. The area is of peculiar interest because of the belief that land vertebrates of other regions were evolved in Asia and spread thence. The discoveries made by the Third Asiatic Expedition have indicated the existence of series of extinct faunas in Mongolia which will provide the necessary evidence to settle this problem.

AMERICAN GAME PROTECTIVE Association.
—The Ninth National Game Conference of

the American Game Protective Association took place in the roof garden of the Waldorf-Astoria Hotel on December 11 and 12. Scientists, game wardens, and others interested in the enforcement of conservation laws were in attendance from every part of the United States, as well as from Canada and Mexico. The American Museum was represented by Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, who presented a paper on "Some Aspects of the Close of the Age of Mammals," based on the article entitled "Can We Save the Mammals?" the joint contribution of Professor Henry Fairfield Osborn and Mr. H. E. Anthony to the September-October issue of NATURAL HISTORY.

Much attention was given at the gathering to the then pending New-Anthony Bill, for which support was solicited. The object of this Bill is two-fold: first, to provide chains of resting and breeding grounds where migratory game birds will be free from molestation on their fall and spring migrations; and secondly, to provide for people who do not have access to private preserves, places where they can shoot the ducks, geese, and other game birds in the proper seasons and under suitable regulations. Under the terms of the Bill a dollar license will be required of every one who hunts migratory game birds. The proceeds from the sale of these licenses will, according to the provisions of the Bill, be applied in part to the purchase of public game-bird refuges, in part to the enforcement of the Migratory Bird Law and the protection of the areas set aside for the birds. Due to the progressive draining of swamps, the feeding and resting grounds of the birds are already all too few in certain parts, and the acquisition and permanent maintenance of still undrained areas should assure the birds a chance for existence that will more than offset the toll taken from their number by the licensed hunter.

FOSSILS

FOSSILS FROM WYOMING.—Mr. George Olsen, of the department of vertebrate palæontology, American Museum, and Mr. Paul Miller, of Chicago University, temporarily attached to the staff of the Museum, spent a part of last summer collecting fossil vertebrates in the Eocene Bridger formation of Wyoming. A valuable collection, including skeletons of some of the rare and interesting primitive carnivores, rodents, etc., has been

sent to the Museum, and will be mentioned more fully in a later number of NATURAL HISTORY.

DINOSAUR REMAINS NEAR NEW YORK.—A fossil footprint of a dinosaur, recently presented to the American Museum by a member of the staff of that institution, Mr. E. D. Carter, reminds one that these reptiles once inhabited the country around New York. The footprint was found near Boonton, New Jersey, and as similar tracks have been found in the Connecticut valley, there is little doubt that these animals ranged over all the area between. Their bones have been found in the red shales and sandstones of Connecticut, but are very rare. Fossil skeletons seldom stand out from the weathered surface of the rock. They can be recognized, however, by their white or yellowish color and by the characteristic outlines of the vertebræ or limb bones.

CONSERVATION

PUEBLOS OF NEW MEXICO THREATENED.—The American Museum has coöperated with the Peabody Museum of American Archæology and Ethnology and with other public-spirited bodies and individuals in an effort to protect the Pueblo Indians of New Mexico, threatened by the Bursum Land Bill, which proposed by an *ex post facto* act of Congress to legalize the illegal invasion by settlers of lands which these Indians have irrigated for centuries and on the retention of which, in that region of little water, their very existence depends. At the instance of Dr. Herbert L. Spinden, until recently associate curator of Mexican and Central American Archæology, American Museum, President Henry Fairfield Osborn sent to a number of senators and congressmen the letter quoted below:

From very long experience and observation in all the states and territories of the West, since the year 1877, when I first went into Wyoming, and from subsequent journeys into Colorado, New Mexico, the Dakotas, Montana, Nebraska, and California, I am warmly in favor of preserving, both in letter and in spirit, our agreements with the Indians. I have especially observed in the Navajo Reservation the advantageous working of this principle.

Among all the Indians, none are so deserving of protection as the Pueblos—people who have never raised an arm against the United States and who have preserved their customs and culture as a wonderful and, in many respects, a beautiful monument of the past life of America.

Together with all my scientific colleagues and with the Trustees of the American Museum, I trust that Senate Bill 3855, known as the Bursum Land Bill, will not be passed by the House. It is the entering wedge which means not only the breaking of our national word but the breaking up of this most remarkable culture, which should be kept sacred by us, like our forests and great scenic wonders and beauties.

Trusting that you will not only oppose this Bill, but that you will use all reasonable influence against it, I am,

Respectfully yours,

HENRY FAIRFIELD OSBORN

President

It is gratifying to learn that this vicious Bill has been recalled by a resolution adopted by the Senate and that a preponderance of sentiment in Congress seems to be sternly arrayed against its passage.

PRESERVATION OF THE PRONGHORN ANTELOPE.—President Henry Fairfield Osborn of the American Museum has received a letter from Mr. Edward Seymour, president of the American Bison Society, which reports very favorable progress in the work to which that society is devoted, namely, the preservation of our fast-disappearing large game.

Mr. Seymour states that the Wichita preserve has recently received some additional specimens of the pronghorn antelope which were in fine condition. Part of a previous group of animals which had been brought to the preserve died from ticks, but the loss was made up through antelopes supplied under contract by Mr. C. J. Blazier of Alberta, Canada. Mr. Blazier, under the provisions of the license issued for the securing of antelope for preservation, has been quite successful in capturing these animals, and there are now available for distribution seventeen in addition to those which the Wichita preserve purchased.

There has been considerable difficulty in rearing antelope on preserves, because of the tick fever, but with experience it is hoped that some means of protection will be devised. It is possible that it will prove advisable to inoculate the antelope against fever.

The Society reports very generous responses to the campaign for stocking the Wichita preserve with pronghorn antelope.

The Society has been working hard on a census of the bison as well as on one of the pronghorn antelope, and has brought the task to completion. The United States Biological Survey has also been working on a census of the pronghorn antelope.

THE CENTENARY OF LOUIS PASTEUR

On the evening of December 27, 1922, the American Museum was the scene of an impressive gathering in honor of Louis Pasteur, the Father of Bacteriology, whose centenary those assembled had come to commemorate. The New York Mineralogical Club and the American Museum of Natural History, under whose joint auspices the meeting took place, had associated with them in making the occasion a success the following organizations, institutions, and departments of the government: Alliance française de New York, American Scenic and Historic Preservation Society, United States Department of Agriculture, Department of Health of the City of New York, Federation de l'Alliance française, New York Academy of Sciences, New York Academy of Medicine, Pasteur Laboratories of America, Department of Health of the State of New York, Rockefeller Institute for Medical Research.

Those entering Memorial Hall of the American Museum were at once reminded of the significance of the occasion by the wreath-encircled and flag-draped bust of Pasteur, presented through Mrs. Henry Fairfield Osborn,—a replica of the bust by P. Dubois in the Rockefeller Institute. The flags of France and the United States were conspicuous in the auditorium, where the meeting took place.

President Henry Fairfield Osborn briefly introduced Dr. George F. Kunz, president of the New York Mineralogical Club, who acted as chairman of the evening. Doctor Kunz in his address sketched the various activities of Pasteur with special reference to his work in mineralogy. President Henry Fairfield Osborn, who was the first speaker called upon by Doctor Kunz, dwelt on the spiritual side of the life of Pasteur, emphasizing that "Pasteur will stand as a symbol of the intimate relation that must develop between the study of nature and the religious life of man" . . . "that the two great historical movements of love of humanity and knowledge of nature, of the spiritual and intellectual and physical well-being of man, are harmonious parts of a single and eternal truth," a belief stressed also in Professor Osborn's volume on Pasteur entitled *The New Order of Sainthood*. The Hon. Gaston Liebert, consul general of France, then gave a vivid picture of Pasteur, based on his personal knowledge of him. A letter bearing on the celebration of the cen-

tenary, signed by President Harding, and a telegram of a similar nature sent by the Hon. Charles Hughes, Secretary of State, were then read. The Hon. Hermann M. Biggs, commissioner, State Department of Health, New York, spoke about the great accomplishment of Pasteur in discovering a cure for hydrophobia. Dr. George D. Stewart, president of the New York Academy of Medicine, gave an illuminating account of some of Pasteur's contributions to medicine, a science which his discoveries revolutionized, shaking the whole structure of disease treatment to its foundations. There followed addresses by Dr. Pierre Lecomte du Nouy, of the Rockefeller Institute for Medical Research, who brought out the fact that "it is due to Pasteur that we have surgery that doesn't frighten us any more"; by Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, who spoke of Pasteur's contributions to bacteriology; by Major Henry J. Nichols of the Medical Corps, U. S. Army, whose topic was "The Value of Pasteur to the Army"; and by Professor C.-E. A. Winslow, honorary curator of public health, American Museum, who paid tribute to Pasteur for his splendid spirit of scientific research. In closing the exercises of the evening Director F. A. Lucas, of the Museum, explained scenes from the life of Pasteur as they were thrown on the screen.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum, making the total membership, 6556:

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In 1922 no fewer than 1,309,856 individuals visited the Museum as against 1,174,397 in 1921, and 1,038,014 in 1920. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever. The **EXPEDITIONS** of the American Museum, working during the past year in several parts of Asia—where finds of extraordinary value were made—in South America, Africa, Australia, Europe, in the South Pacific Islands, in the West Indies, and in selected areas of our North American continent, have greatly enriched knowledge. Many habitat groups, embodying specimens secured by these expeditions, are planned for the new Museum buildings, the erection of which has been authorized by the city.

The **SCHOOL SERVICE** of the Museum reaches annually more than 4,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 475 schools, with a total attendance of 1,648,608 pupils. During the same period 330,298 lantern slides were loaned by the Museum for use in the schools as against 209,451 in 1921, the total number of children reached being 2,582,585.

LECTURES, some exclusively for members and their friends, others for the general public, are delivered both in the Museum and at outside educational institutions.

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The **SCIENTIFIC PUBLICATIONS** of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs* of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the scientific activities of the departments, aside from anthropology; the *Anthropological Papers*, recording the work of the staff of the department of anthropology; and *Novitates*, devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters.

A detailed list of the publications, with prices, may be had upon application to the Librarian, American Museum of Natural History, New York City

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NATURAL HISTORY

VOLUME XXIII

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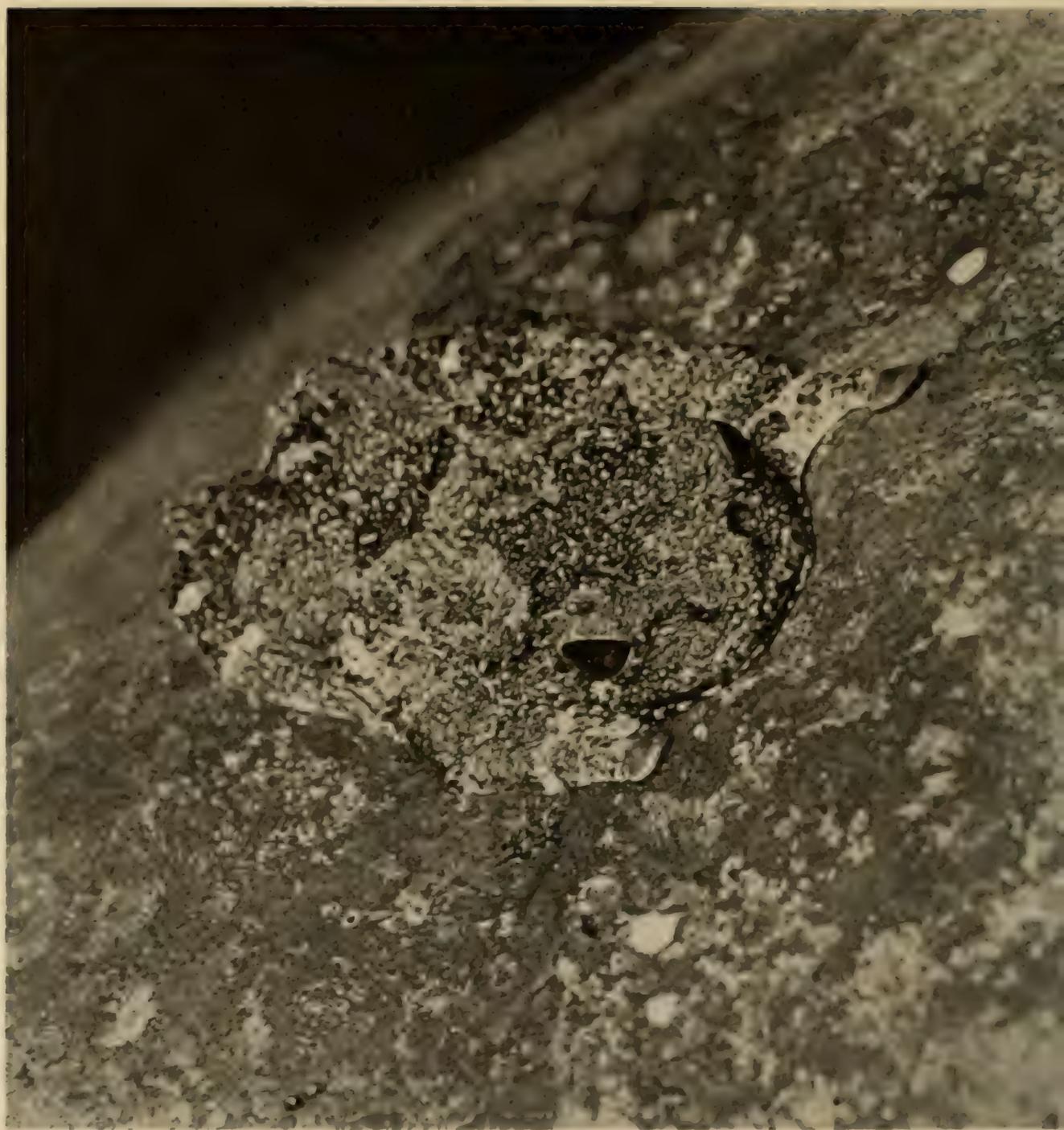
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THE GIANT FROG OF SANTO DOMINGO

After the sun has set, the giant tree frog, *Hyla vasta*, leaves his hiding place among the tree tops and descends to some rocky ravine. There, flattened out on a mossy boulder in midstream, he rests for hours, seemingly enjoying the cool mists which arise from the torrents. So closely does the frog resemble the moss and lichen of his surroundings that he would rarely be observed were it not for his big shiny eyes, which are conspicuous even when closed, the lower eyelid being translucent.

The frog must be hunted at night, for at the first glint of dawn he again seeks his arboreal retreat. Hunting at night is not an easy matter in these slippery, boulder-strewn chasms. It would be utterly hopeless were it not for the fact that sometimes the male calls loudly for his mate. It is more of a sob than a call, but it brings joy to the hunter, stimulating him to push on once more through the reeking darkness.

NATURAL HISTORY

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In Pursuit of the Giant Tree Frog

NIGHT HUNTING IN SANTO DOMINGO BY THE ANGELO
HEILPRIN EXPEDITION

By G. KINGSLEY NOBLE

Associate Curator of Herpetology (In Charge), American Museum

IT WAS some years ago that I first saw the giant tree frog of Santo Domingo. That specimen, the type, stood with its fellow *Hylidæ* on a shelf in the Academy of Natural Sciences of Philadelphia. Its head towered high over those of its relatives, for the Dominican giant frog is by far the largest tree frog in the world. For half a century many individuals have gazed at this specimen of *Hyla vasta*, the only one known, and have no doubt wondered, as I did, how the creature looked in life, what was the character of its voice, and what the length of the leap it could take with its tremendous legs. Still, through all these years the whereabouts and activities of this king of tree climbers remained unknown.

Last summer, through the interest of friends of the American Museum, an expedition was organized to search for this huge batrachian. The veteran naturalist, Dr. W. L. Abbott, had just returned from Santo Domingo with information as to where the creature might be found. Natives had brought him two small specimens. Stimulated by this announcement, we too hoped to secure for the Museum's new hall of reptile and amphibian life specimens of the giant tree frog. If in addition we should be fortunate enough to work out its life history, we would have a fit subject for a habitat group.

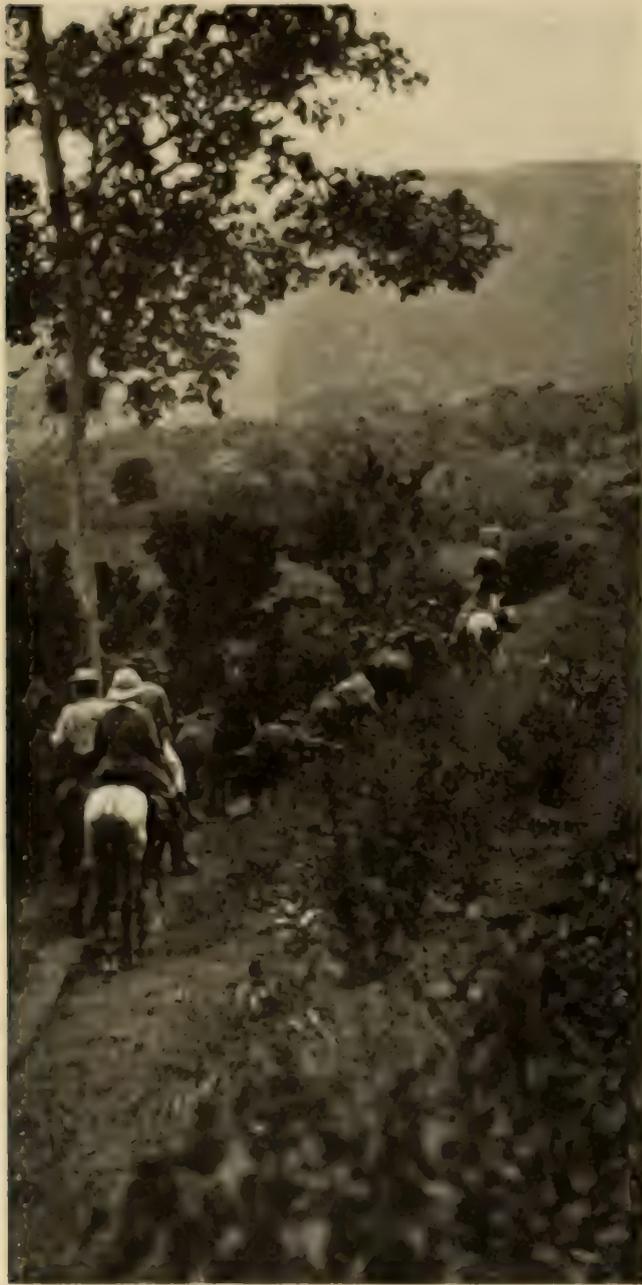
The expedition was to have the support of the U. S. Marines stationed

in Santo Domingo. The Guardia Nacional Dominicana would help us. With much advice, a few letters, and a full share of *impedimenta*, we left New York, not, however, without some misgivings. It is one thing to make general collections in a foreign land, and it is another to endeavor to secure information in regard to any particular creature. I thought of half a dozen Amphibia living within fifty miles of New York City, the life history of which was still unknown. How many times had I sought in vain for the eggs of those creatures!

Ten days later our party left San Francisco de Macoris, the last Dominican town, and started for an outlier of the northern mountain range known as the Quita Espuela. Our party must have seemed formidable to the natives we passed. There was Sergeant Schroff, who could not understand why he was "always given the hard details," a private who was glad to be in the hills, our guide and camp man, Juan, a pack train of six well-groomed mules, and finally my wife and I. This northern range parallels the coast and robs the trade winds of much of their moisture. It is on the slopes of these mountains that rain falls almost continually. Dense, reeking jungles struggle to choke the torrents that carve the mountain-sides. Here giant *Ceiba* trees grow to enormous proportions. Epiphytes climb every-

where, competing with each other for the little sunshine that filters down to them through chinks in the jungle roof.

It was late in the afternoon before we had reached the base of cloud-



The expedition, accompanied by marines, headed at once for the Quita Espuela

capped Quita Espuela. Our mules stumbled along a zigzag trail, over innumerable fallen logs, finally to give up entirely about a hundred yards from the place where we hoped to camp. The mist shroud drooped low over the mountains, turned from white to gray, and then to nearly black. A camp we had to have and that very quickly. There was a mountain stream some

yards away, that fell splashing in cascades and then babbled for a considerable distance over moss-covered bowlders. To the edge of this stream we carried our duffel. A clatter of machetes, a creaking of straps, and our little tent raised itself up, shook the odor of paraffin from its emerald sides and snuggled back among the wild plantain which lined the bank.

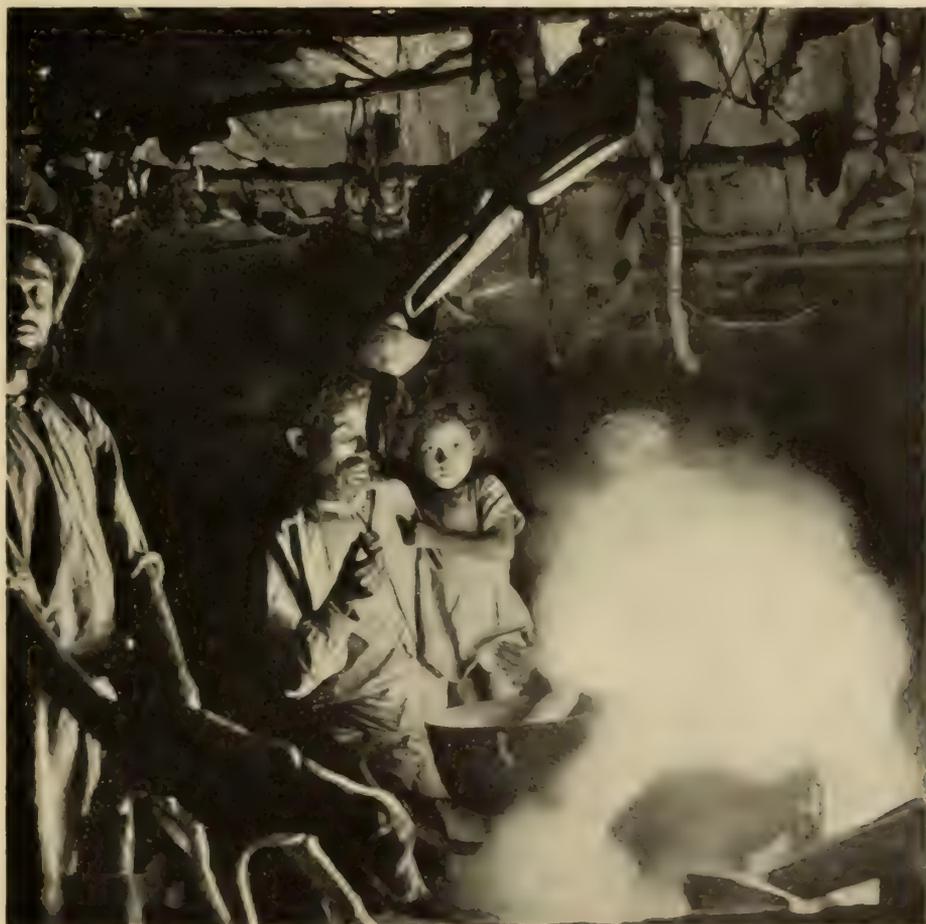
But the rain we expected did not come. With some hesitation we uncovered our duffel and prepared for the evening meal. Dusk had already fallen. A crab-bird screamed his evening complaint from high up on the mountain, innumerable bats appeared from nowhere and fluttered back and forth across our patches of heaven. I drew close to the water's edge to fill one of the buckets. Two gray bats had already taken up their ceaseless vigil, crossing and re-crossing the stream. At my feet was a small pool where the water smoothed out between two rapids. As I looked, a pair of luminous eyes appeared from a dark corner of the pool, only to vanish in turn as their possessor moved quickly across the current to another corner. Then another pair of these diminutive headlights appeared and disappeared. I realized that there were dozens of these shining eyes, moving shuttle-like now here, now there. I went back to camp, found a flash light, and returned. The eyes shone more brilliantly than ever. I drew nearer and made out the form of a huge shrimp, with stalklike eyes aflame in the light of the flash lamp. There were many of these shrimps and some carried masses of eggs attached to their swimmerets.

While I was thus absorbed, there arose from the tree tops high overhead a reverberating call, resonant and cavernous, *ook-ook-ook*. I thought of



At night as we wandered through the forests we sometimes chanced upon a native hut all aglow with the evening fire

Few of the back-country natives can boast of more than a single cooking vessel, but their warm hospitality more than makes up for their poor cuisine. Their bill-of-fare is limited. Besides beans and rice (the national dish), they have plantains and sometimes meat. Their favorite dish is an atrocious pork stew, highly seasoned, often not very digestible. Although these people have none of the conveniences or comforts of those living near the coast, they are always happy. Never did we see a Dominican treat his children badly. The boys and girls, like everyone else, had many chores to perform, but on no occasion were they punished even though they failed to do their work well



the geckos I had heard welcoming the night in Guadeloupe, but this call was more subdued, more guttural. Could it be a frog? I waited breathlessly. Nearer came the voice. Whether

our two big acetylene lights and dashed off into the night. We would work together until we ran down that voice. First we followed a trail skirting the edge of a half-made *conuco*, or clearing,



Individual frogs were studied throughout the night. Neither the glow of the acetylene lamp nor the sudden glare of the flashlight interrupted their activities. They continued their calling, love-making, and feeding as if our lamp was nothing but a giant firefly passing through their world. With the flash gun an accurate record may be made of these happenings. The flash gun, though often used for making portraits of big game, has never hitherto been used for recording the life stories of the small denizens of the tropical forest

gecko, frog, or elf, the creature was descending. I seized my field glasses, but could discern nothing. Once more, *ook-ook-ook—ook-ook-ook*, then silence!

Ten minutes and still no further sound! It was supper time so I returned to camp and swallowed a few mouthfuls. Then Juan and I seized

then crossed a stream bed into a dense jungle. The night was alive with tiny voices,—some metallic and bell-like, others soft, scarcely aspirated. To one side of us we heard a *click-click-click* that was very insect-like, but continued into a diminuendo of delicate bird notes. We turned and there, perched

in the very center of a leaf, was a tiny frog, less than an inch in length, with the lower part of its throat inflated into a glistening bubble. Never before had I seen a frog which inflated the lower part of its throat without distending the whole. We seized the little singer quickly and were about to proceed when we heard the bark of a "dog" sounding from a tangle of lianas forty feet above our heads. It was a very woeful call, such as only a lonely dog—or a frog—could make. Our lights were at once pointed skyward but we could see nothing save the festoons of mosses swinging in the night air.

In the glare of the headlight the jungle at night is transformed into a different world from that observed during the day. Everything within the magic circle of the light stands out in relief. Inky shadows thrust forth long arms. Fallen trees spring up and take on ominous proportions. Colors lose their values. Every stub and leaf turns to either black or gold. Drops of moisture reflecting back the rays of the light shine out like a thousand jewels. The forest becomes a land of mystic exaggerations.

It is not the strange sights, however, but the sounds which make the night forest awesome, even fearful. Voices, some soft and whispering, others harsh and grating, greet one on all sides. The monotonous chirping of the cricket we recognize at once, but what are those anvils ringing in the distance? A rustling in the near-by bushes and our imagination soars! Land crabs, large tarantulas, and whip scorpions seek their prey after the sun has set. One never loiters in the forest at night. Something always seems to be waiting there in the darkness.

With a last shot of our long acetylene rays toward the tree-top "dog," we

plunged on once more. Two hundred yards beyond we came to a third stream that was swifter and more torrential than the other two. There was something inviting about the white foam splashing in the light of our lamps. We turned and headed upstream toward the mountain. Hardly had we started when a shrill cry arose high above the swirl of the current. It sounded like a jet of escaping steam or a locomotive whistle stammering under excess pressure. We scrambled upward over slippery rocks, gained a bend in the torrent, and there beheld sitting on a rock in midstream and fairly bursting with exertion, a brilliant golden-green tree frog, flecked with white above and partly concealing with his legs four gaudy patches of brightest gold. I recognized at once that it was a species new to science, and whispered to Juan that we must capture it at any cost. Most frogs will show no concern toward the acetylene lamp, continuing their calling as tranquilly as if the lamp were only the moon staring down upon them. Not so our handsome new species. Hardly had the light settled squarely upon him when he ceased calling abruptly, edged off to the side of the rock, and jumped—whether intentionally or not I could not determine—into the heart of the swiftest current. The white waters threw up their arms a little higher. Our prize had disappeared.

We were now far from camp and low in spirit. We resolved to take the shortest way back through the jungle. A few yards and we were swallowed up in vines and lianas; but Juan had his machete and we progressed. Nothing is so black as a jungle at night. Our headlights pierced the saturated air with difficulty. We stopped to catch our breath. A "dog" barked high

overhead, another just ahead of us replied. Cautiously we moved forward. Again the "dog" gave forth a smothered bark. I pushed Juan aside, and, scarcely breathing, parted the lianas. There, two yards ahead, was a great brown tree frog, with sharp snout and a black stripe through the eye. No, it was not the giant frog we were seeking, but it was a species



Most frogs call with their mouth closed. Only a few have learned the trick of screaming with wide-open mouth. The male barking frog, *Eleutherodactylus inoptatus* would open his mouth on the slightest provocation and squeal like a pig

nearly as rare. Even as we looked, the frog puffed out his throat into a white balloon, the size of a golf ball, and gave a mournful *ba wo-ow!* Keeping my light shining in his eyes, I slipped my free hand along the frog's back and seized him quickly. Then a very strange thing happened. The frog opened his mouth and screamed like a frightened pig. When frogs call, they keep their mouth tightly closed. Very

few have learned the trick of opening their mouth to cry. The pond frog of eastern United States, when grabbed suddenly, screams like an injured child. Our spade-foot toad may give a series of loud clucks with open mouth. But never before was it known that an *Eleutherodactylus* had adopted a similar "terrifying behavior."

In my excitement I had noticed nothing but the frog. Before I had him safely bagged, Juan tugged at my arm and pointed out a tree snake asleep on a branch just above my head. The snake, nearly four feet long but not half an inch in diameter, so closely resembled the vines that I did not see it at first. As Juan lowered the limb, I recognized the species as a diurnal form that spends the sunlight hours stalking unfortunate lizards. Its mouth is equipped with two long fangs just behind the other teeth. Although these fangs are too small and too far back in the head to injure man, they are decidedly effective on smaller prey.

We moved on joyously to camp. If the giant tree frog did not live in these jungles, at least other interesting creatures did. We gained the ridge at the foot of which lay our camp. A light shone up from the tent door toward the tree tops. Mrs. Noble was signaling to us to approach cautiously. I caught the word *maco grande*—giant frog. I smiled; she, too, had been fooled by the barking frog, I mused, and stepped rather briskly forward. I saw she was holding a flash lamp on something up in the wild plantain in front of the tent door. As I stepped nearer, there took shape against the velvety blackness of the night a tree frog so large that it seemed unreal. Its four immense feet were flattened out against the plantain stalk but its head, with staring orbs,

slowly turned as if contemplating in which direction to leap. I thought of my lost species and a chill went down my back. I dropped everything, slipped out of my coat, and stealthily moved nearer. With both hands free I could not miss! Nearer I came. Why not the gun, I thought. Perhaps I could not hold the creature. But it was too late to go back. With both hands I clutched. Something squashy slipped in my fingers. Without daring to look, I dropped the frog into the bag which Juan stretched toward me. In another moment we were inside the tent, with mosquito bar closed, ready to examine our capture. It was then that I noted that my hands were red and swollen. I must have brushed up against a "poison ivy tree" in the jungle, I thought. We opened the bag cautiously; a penetrating odor like that of burning mustard, though more acrid and sickening, streamed forth. I looked more closely at my hands. To the red swellings was adhering some of the mucus from the frog's skin. In a moment it was clear to me—the skin of the giant frog had badly poisoned me.

The skin of all frogs and toads contains two kinds of glands: mucus and poison. But the poison of the latter gland was not known hitherto to be injurious to the unprotected hands. Toads do not produce warts, nor can they inflame one's skin in any way. Their glands secrete a poison which affects only mucus membranes, such as those in the nostrils and the eyes. The skin of the giant tree frog, we gradually realized, must be extremely poisonous to burn the hand. We concluded it would be well not to experiment further. The cutting odor alone warned us of the serious results which we might expect if we should brush

any of the secretion accidentally into our eyes.

We had captured the king of the tree climbers at our very doorstep. The mysterious voice from the tree tops had come nearer and nearer while Mrs.



The green tree snake, *Uromacer oxrhynchus* (lower picture), feeds primarily on lizards. It has fangs far back in the mouth. The poison it injects in its victim is not sufficiently virulent to harm man, but it is apparently very effective on lizards. *Anolis cybotes*, the lizard in the upper picture, quickly dies when struck by this serpent



Lizard eggs have the appearance of chicken eggs in miniature, but the larger eggs (those of *Anolis*) have a leathery shell. Some snails lay eggs identical in outer appearance with those of lizards. Some of the larger eggs shown here are not "chameleon" eggs, but the eggs of a helioid snail, *Pleurodonte*



A passing lizard, *Anolis cybotes*, was attracted by our metamorphosing tadpoles, *Hyla heilprini*, and attempted to seize these titbits through the glass walls of the aquarium

Noble waited below, and it was only our sudden return that robbed her of the glory of tackling his batrachian majesty single-handed. But our

work had just begun. Where did the female tree frog lay her eggs? Where did the young spend their larval life? Our attack upon the problem began earlier than we expected. The next morning, as Mrs. Noble was dipping up water for the coffee pot, she almost scooped up a tadpole. It was attached to one of the boulders in midstream. As no mountain-brook tadpoles had been recorded previously from the West Indian region, or in fact anywhere in the neotropics, we forgot our coffee for the moment and everyone joined in a tadpole hunt. We soon found that all the tadpoles in the stream near camp belonged to one species. They were all the same color—a mottled gray with yellow spots on the tail. Most remarkable were their mouth parts, arranged row after row and forming a great cup by which the tadpoles adhered to the rocks in spite of the current.

Directly across the brook from our camp Juan found an egg mass in a little basin of water among the rocks lining the shore. The eggs, many hundreds in number, were hatching and we hastened to build a cheesecloth cage completely around the mass to prevent the little tadpoles from wriggling away among the crannies between the rocks. To what species these tadpoles and these eggs belonged we could only surmise. Further observations alone could determine this.

That morning marked the beginning of three weeks of intensive hunting. The daylight hours were spent in seeking everywhere for eggs, tadpoles, and young. During the night we ran down the voices that called to us from the dark. We soon found that there were several kinds of tadpoles in our region, and that the different kinds were always confined to particular

habitats. In the mud puddles and ponds of stagnant water there were myriads of fat-bodied pollywogs, iridescent brown in color and with a few short rows of larval teeth. In the lower portions of the mountain streams, where the torrents broke into rapids interrupted by pools, we always found the gray tadpoles of our camp. They so closely resembled the rocks on which they rested that we rarely noticed them until they moved. High up on the mountain-sides, where the streams fell in cascades, throwing masses of spray toward the overhanging tree ferns, we found a third kind of tadpole. As if in adaptation to these swifter waters, the body of this tadpole was narrower, the tail more powerful, thicker at the base, thus affording better "stream lines" than in our gray tadpole of the camp pool. The mouth parts of this swift-torrent tadpole formed a broader cup with more rows of teeth than was the case in the camp tadpole. Its color was very much like that of the latter, but the yellow marks on the tail and rump formed a distinctive pattern.

We had many misgivings regarding our ability to rear these mountain-torrent tadpoles. Surely they must require highly aerated water. We placed a few, however, in one of the small glass aquaria and set it away in the shade. When we returned some hours later, the little tadpoles were not only alive but were so active that they had attracted a passing lizard, which, just as we arrived, was making desperate efforts to seize these dainty morsels through the glass sides of the vessel, against which he was bumping his snout ineffectually.

One night, as we were running down some of the diminutive yellow frogs that shrilly proclaimed their presence in the tangle of dodder and brush



Male "chameleon," *Anolis cybotes*, spreading throat fan and neck crest in amorous excitement. Only the male "chameleons" are equipped to give such emotional display

bordering the lower streams, we came suddenly upon one of these little frogs—a male—watching over a clutch of



Four days old! The young of the warbling frog *Eleutherodactylus*, new species, hatches fully formed from the egg

eggs, which in the aggregate appeared to be larger than their tiny guardian. These eggs, which were of considerable size and white, were laid on land on a dead leaf some yards from the water. Frog eggs laid in water swell rapidly immediately after being deposited. These eggs were so large they must have swollen considerably, but from just where they absorbed their mois-



The eggs of some of the Dominican frogs are of large size and are zealously guarded by the male. This little fellow, *Eleutherodactylus flavescens*, returned to his charge even after being frightened away

ture to bring about this condition we could not determine.

A few days later we discovered that the barking frog, too, laid great white eggs. These were deposited on land in a depression some distance from the trickling stream, and apparently guarded by the male. One discovery followed another, and soon we had our camp converted into a great frog nursery with hundreds of eggs in all stages of development. We found that more than half the species of the region laid eggs on land, and that these eggs were always large and unpigmented. They did not hatch out as tadpoles, as one would expect, but fully formed froglets. Most of the froglets cut their way through the egg capsules by means of a sharp egg-tooth on the snout, but the froglets of the barking frog seemed dependent on rains to initiate the hatching process. Some of the froglets on hatching were extremely small, the young of the little forest frog first discovered measuring only four millimeters in length. Often at night we would come across whole families of these little froglets making their way through the forest and as they moved from leaf to leaf they seemed, casually viewed, more like insects than frogs.

The large white eggs of the tadpoleless frogs were in striking contrast to the small pigmented eggs that we found in the pools and that hatched as tadpoles. Why, we might ask, should two frogs living on the same stream bank develop in two such different ways? The water embryos, provided with a minimum amount of yolk, we might liken to a boy with limited means. Frog and boy must get out early in life and hustle, each seeking his own upkeep. Not so with the embryo richly supplied with yolk; in its case the troublesome tadpole period



After a rain, the frogs call loudest. But this little yellow frog, *Eleutherodactylus flavescens*, rarely permitted us to watch him sing. At the slightest disturbance he ceased calling immediately and jumped quickly out of sight



The Dominican striped tree frog, *Hyla pulchrilineata*, does not blow out his throat like most frogs when calling. Nevertheless, his song, or wheeze, is very penetrating—sounding like the rhythmical creaking of an old harness

can be avoided. But what about the yolk? Was the frog family originally rich? Did frogs provide well for their children? If not, how did one group of frogs suddenly become rich? And why should rich and poor live side by side?

But to return to our giant tree frog,—as time went on and the evidence heaped up, our case against the giant tree frog became clearer. We now very often found pairs calmly seated on boulders along the lower reaches of the mountain streams. They seemed thoroughly to enjoy the mists that arose from the dashing waters. Often we would hear them calling from high up in the tree tops and some hours later would steal upon one of them as he left his arboreal retreat to begin his nocturnal mist bath among the boulders of the river bed.

Just as we were about to conclude our case, a wonderful thing happened. The tadpoles began to metamorphose. Those of the high torrent that were equipped with the great adhesive mouth parts assumed a beautiful green color, and changed within a day into the brilliant golden-green species we had lost the first night. The corpulent pollywog of the mud puddles changed into a tree frog that is widely known throughout Santo Domingo, and seems to get along equally well in arid and forest country. Possibly it is this preference of the tadpole for stagnant water that accounts for the wide distribution of the species. The gray tadpoles of our camp pool changed into little gray tree frogs which we

did not recognize at first. Soon, however, these assumed the characteristic features of the giant tree frog, the main object of our expedition.

But our story was not yet complete. We had assembled all the evidence for one locality. Under what conditions did the frogs live and breed in other parts of Santo Domingo? A week later we left the northern range and started across the great central cordillera of the island. Here we climbed to an elevation of 6000 feet, left the palm and tree fern behind, and wandered for days through pine woods in general appearance similar to the coniferous forests of the north. The nights were now very cold. The water temperatures of the streams ran 20° lower than those of the Quita Espuela. New voices called at night from the pine trees. We climbed to 8000 feet, to the torrents that pour from the very heart of the island. Here, where the water fell in cascades, the reverberant voice of the elusive green frog rose high above the roar of the torrent. Along the stretches of quieter water—now so cold that it chilled us to the marrow—our giant tree frog sobbed loudly, while in the rain water in the ruts of the trail we still found the fat little pollywogs of iridescent brown hue. At night, as we rode in silence through the whispering forests, barking frogs mournfully called to us to stop. These tropical frogs had invaded the highest peaks. New scenes, new temperatures did not affect them. They required only one thing of life—the mountain stream.



The smallest frog, *E. minutus*, in Santo Domingo; about $\frac{2}{3}$ life size

Field Studies of Dominican Tree Frogs and Their Haunts

BY G. KINGSLEY NOBLE



CAPTIVE GIANT FROGS

The giant frog of Santo Domingo, *Hyla vasta*, is the largest tree frog in the world. The great adhesive pads at the ends of its digits enable it to scale the tallest trees and to jump safely from limb to limb. Its skin, unlike that of all other frogs or toads, exudes a poison so virulent that it burns the unprotected hand. Some of this poison may be seen smeared over the glass face of the field terrarium. The frogs in the picture are about two-thirds natural size



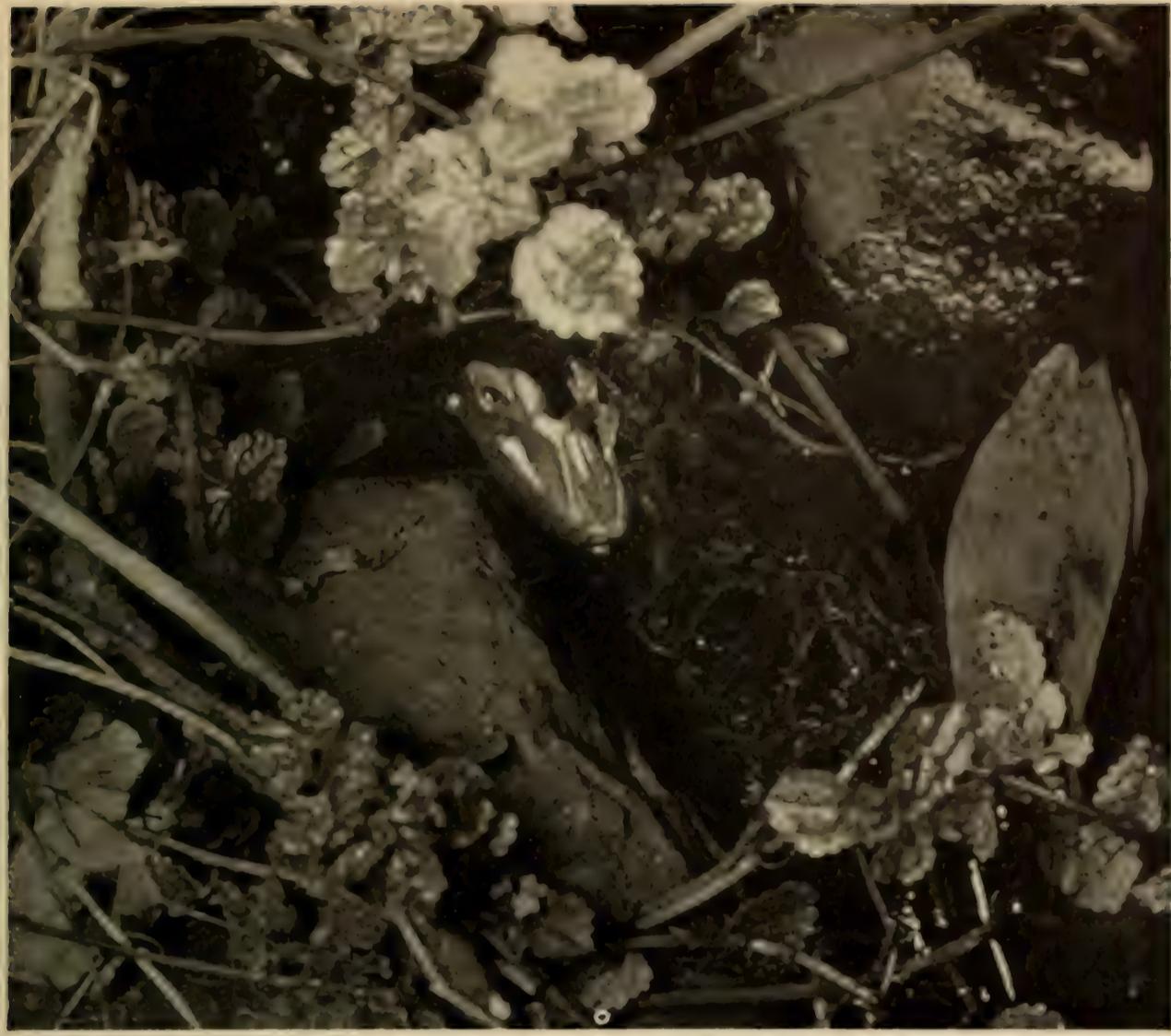
THE BARKING FROG OF SANTO DOMINGO

The most mournful sound of the Dominican jungle is the call of this frog, *Eleutherodactylus inoptatus*, which sounds like the wail of a lonely dog, as it echoes through the hills. The barking frog lives in tall forest trees, but it is not equipped with adhesive pads such as the giant frog has. Perhaps it is for this reason that the barking frog seeks only vine-grown trees in which to live. The frog in the picture is practically life size



THE WARBLING FROG

The plaintive call of this little frog, *Elcutherodactylus* sp. nov., is given with only the lower part of the throat inflated. The call is a series of clicks followed by three or more melodious warbler-like notes



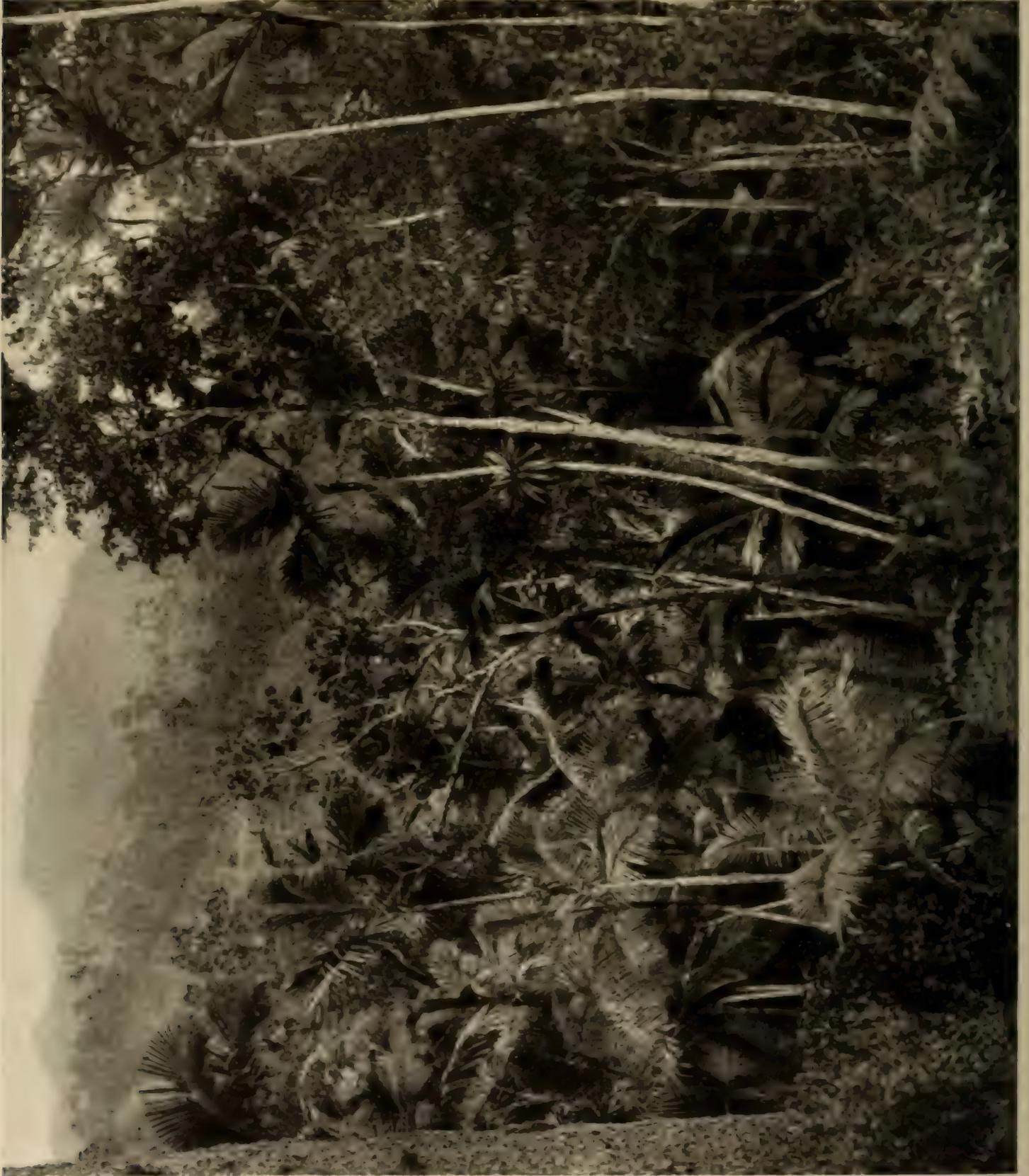
HEILPRIN'S TREE FROG

The shrill cry of Heilprin's tree frog, *Hyla heilprini*, is given with fully inflated throat. The frog calls chiefly from concealment, or from such out-of-the-way places that one experiences considerable difficulty in finding the singer

WHERE TREE FROGS DWELL

During the daytime tree frogs hide among the palms, among the leaves of the epiphytes, or in any cranny where they may secrete themselves. But at night they come out by hundreds and such a palm thicket as this, located near Paso Bajito, is alive with tiny voices, some musical or metallic, others harsh and grating.

Few have thoroughly investigated these Dominican jungles. Two new species of tree frogs were found in this thicket, while others were found in adjoining regions. Some of these tree frogs were found to lay eggs not as our northern frogs, in the water, but on land, and sometimes in the epiphytic growths high up in trees (center of picture). Many of these frogs brood their eggs (see illustration on p. 114). The body of a frog is cold and it is unknown why these tree frogs stay with their eggs. Perhaps it is to keep the eggs moist, perhaps some strong instinct attracts them to their treasures. This method of breeding and parental care seem to be a distinct advantage to the species, for the tree frogs which have adopted the habit form the dominant group in Santo Domingo





THE HOME OF THE GIANT TREE FICUS

In the moonlight the mountain ranges lose their perspective. Rising mist clouds choke the valleys, accentuating the strange effect. The landscape seemed like some Japanese painting and not like the hills we had crossed when the sun was shining. (Paso Bajito, Jarabacoa-Constanza Trail.)



The mermaids of our fancy combine human and fishlike characters, but the mermaids of commerce are pieced together out of elements even more diverse. Supported on arms that once enabled a monkey to swing from bough to bough, with childlike head and torso of papier-maché, and a tail fashioned from the body of a fish, the specimen here shown represents a not unsuccessful effort at welding together the incongruous. Photograph reproduced by courtesy of Mrs. Walter Taylor

Modern Mermaids

By FREDERIC A. LUCAS

Director of the American Museum

IN the "good old days" of our China Trade and long voyages, ship captains occasionally brought home with other curios a "genuine" mermaid. These mermaids—that is, the best of them—were cunningly and carefully made by grafting the torso of a small monkey upon the body of a fish, some scales being worked up into the body of the monkey and some hairs planted among the scales of the fish, so that the line of junction was invisible.

As mankind in general is fond of the marvelous and prefers an improbable to a simple explanation, these creatures were accepted by many as the "real thing."

It was one of these "fabricated mermaids" that was so profitably ex-

ploited by Barnum in the early days of his museum and that is noted by "Doesticks" in a lengthy parody on *Hiawatha*.¹

Barnum since has caught this Mermaid

• • • • •

She is now a scaly Mermaid;
And the children who behold her,
A'n't so green as was the Mermaid
But they wink at her in passing.

Barnum's mermaid was anticipated by one exhibited in London a few years before, which was said to have been "taken by a Dutch vessel from on board a native Malacca boat, and from the reverence shown it by the sailors, the conjecture of Mr. Donovan is probably correct—that it was intended to

¹Q. K. Philander Doesticks, P. B. (Mortimer M. Thompson).

be a representation of the incarnation of one of their idol-gods.

"So considerable were the profits that accrued from the exhibition, that the mermaid became the subject of a suit in Chancery; but the bubble soon burst, and it is now exhibited along with a learned pig in a penny show."

Love of money is the root of all evil—or is said to be—and in these degenerate days of machine-made products it requires too much time and labor to make a really good mermaid, so to supply the demand the canny Japanese have put on the market an inferior brand, made almost entirely of papier-maché, the fins and tail only being real, and the original species bids fair to become extinct.

And yet, so much does man long for the spectacular, so greatly does he prefer fiction to fact, that some of these papier-maché mermaids have been brought to the Museum for the purpose of ascertaining whether they were "genuine."

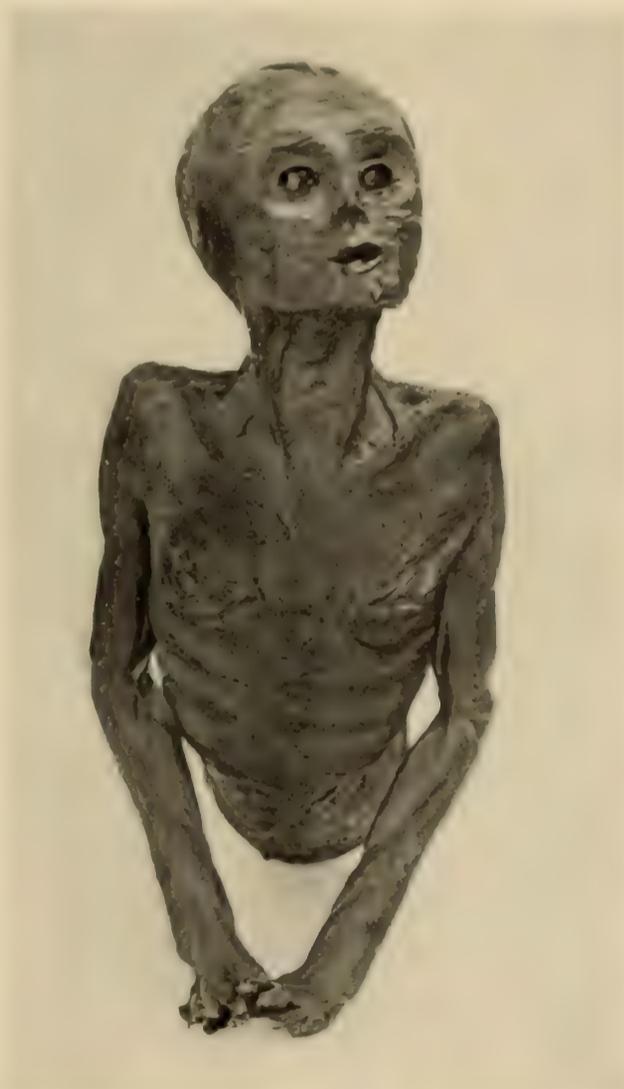
The mermaid seems to have been antedated by a species of pigmy which was described by Sir Marco Polo¹ as follows:

"I may tell you moreover that when people bring home pygmies which they allege to come from India, 'tis all a lie and a cheat. For those little men, as they call them, are manufactured on this Island, and I will tell you how. You see, there is on the Island a kind of monkey which is very small, and has a face just like a man's. They take these, and pluck out all the hair except the hair of the beard and on the breast, and then they dry them and stuff them and daub them with saffron and other things until they look like men. But

you see it is all a cheat; for nowhere in India nor anywhere else in the world were there ever men seen so small as these pretended pygmies."

It is just possible, however, that this really refers to the mermaid, or it may be that the pygmy gave way to the sea nymph when it was learned that she was the "better seller" of the two.

The mermaid here figured is one brought to the Museum a short time ago by Mrs. Walter Taylor. The ravages of time (a mermaid of fifty cannot be expected to look as fair as one of fifteen) and lack of care had impaired her good looks, and like the doll, she had apparently "died of a broken heart and a very bad crack on



A front view of the mermaid shown in profile on the previous page. The features are modeled from those of a child. Courtesy of Mrs. Walter Taylor

¹*The Book of Ser Marco Polo the Venetian Concerning the Kingdoms and Marvels of the East*. Translated and Edited by Colonel Sir Henry Yule. Vol. II, Book III, Chap. IX. p. 285.

the head,"—which was of papier-maché. This specimen represents an intermediate stage in the making of mermaids—perhaps we might call it a subspecies—the tail being that of a fish, the arms those of a monkey, while the head and torso are of papier-

maché, the features being modeled from those of a child and the jaws being those of a fish. Nevertheless she is a good representative of an ancient family, tracing her ancestry back nearly seven hundred years, and so her portrait is well worthy of preservation.



A very recent type, probably made in Japan. It is largely modeled in papier-maché, with little regard to the anatomy of the thorax. Courtesy of Mr. Max F. Clement



The plains east of Boulder, Colorado.—The road is bordered by a wealth of flowers with their insect visitors. On the left is Prof. T. D. A. Cockerell, who has been cooperating with the American Museum in connection with its study of Rocky Mountain bees. The automobile is the field car of the department of entomology

Flowers and Their Insect Visitors

SOME UNSOLVED PROBLEMS OF THEIR RELATIONSHIP

BY FRANK E. LUTZ

Curator of Entomology, American Museum

ONE of the interesting things about science is the way in which a problem that has been considered settled will not stay settled. Discoveries, often in a far-distant field, may force a reconsideration of the whole matter. Sometimes the former conclusion is confirmed; sometimes a new solution is reached, probably only to be upset at a future date. Far from being unfortunate, this is a sign of progress, for at each reinvestigation new facts are established, and facts, not generalizations, are the really important things.

One of the fascinating fields of research in natural history is that of the mutual relations existing between flowers and insects. Things have been fairly quiet, one might almost say dormant, in this field, because what seemed to be fairly satisfactory solu-

tions of most of the problems had been reached. Recently, however, investigations in other fields have had a stimulating influence in this, and not only have old problems been revived but new ones have sprung up. Let us consider a few of these.

Most of the higher plants perpetuate their race by means of seeds but, in order to develop fertile seeds, it is necessary that pollen should reach the egg cells hidden away in the plant's tissue. In some species only pollen is produced by certain individuals, males, and only egg cells by others, females; but the flowers we usually notice have both pollen-producing organs, stamens, and at least one pollen-receiving organ, the pistil, in each flower. Even in the latter sort of plants, however, there is often an interchange of pollen among individuals. If this interchange is

brought about chiefly through the haphazard and wasteful agency of wind, the plant must produce a large amount of pollen. There would seem to be an advantage in a more direct and less wasteful agent, and flower-visiting insects are such agents.

This being the case, it would seem natural that plants should not only develop inducements for such agents to work but should make their work easy and effective. This has been the explanation not only of the very existence of the flowers we usually think of when the word flower is mentioned but also of the various colors, odors, and structures of these flowers. What follows is not intended either to combat this idea or to tilt at windmills but to mention a few of the many interesting problems that have not yet been finally settled even so far as our present perspective is concerned.

A brightly colored flower, yellow let us say, set among green leaves, is very conspicuous to us, not only because of a difference in luminosity but because we can see color as color, and yellow gives a very different sensation from that given by green. Also we can readily distinguish yellow from red or blue. All of this, of course, is on the supposition that we are not color-blind. If a flower is benefited by insect visits, it would be well for it to be conspicuous so that insects could the more easily see it.

It is important, also, that, after an insect has visited one flower and has become dusted with the pollen of this flower, it should next visit another flower of the same species so that the pollen may be rubbed off by the pollen-receiving apparatus of a flower that can make use of that particular kind of pollen. Dandelion pollen carried to



An insect net seems out of place on such a mass of snow as is shown in this illustration, but, as a matter of fact, brilliant and beautiful flowers fringe the snow banks in the higher Rockies and insects fly about from flower to flower. The most common bees are the bumbles and members of the leaf-cutting family, but the most abundant flower visitors at this altitude are the flies



LONGS PEAK, COLORADO

The view was taken from above timber line and shows the mountain in all its majesty. The little notch near the summit is known as the "keyhole" and the approach to it is made through a desolate boulder field that gives no hint of the awe-inspiring beauty of the scene that bursts upon the gaze as one follows the trail through this opening and sees revealed for the first time the glory of the Snowy Range. The Longs Peak region was visited not primarily to study the flower-insect problem but to secure a cross-section of the fauna from plains to peaks

anything but a dandelion is a total loss to dandelions. Therefore, there would seem to be an advantage in having each kind of flower a different color so that an insect, having found things to its taste on, say, a yellow flower, would be likely to visit the next yellow flower it sees, the chances being that that flower would be one of the same species,—all on the supposition, of course, that insects are not color-blind.

We see, then, an apparent reason for the development of conspicuous and differently colored flowers. However, the physiologists have been investigating color-blindness and certain of them have concluded from their experiments that insects are totally color-blind; others deny this; while still others occupy a sort of middle ground and say that, although insects cannot distinguish the colors at the red end of the spectrum from black or some shade of gray, they can see blue as distinct from white, black, or any shade of gray. When one is in doubt, the middle ground is apt to be the safest. Furthermore, there is a good deal of evidence that the most important insect visitors of flowers, the bees, are largely given to visiting blue, purple, or violet flowers, although not totally ignoring yellow or red ones. This does not help us much, to say the least, in understanding why so many flowers are yellow and some are red.

What is more, we have been thinking only in terms of the colors which human beings see, and beyond each end of the visible spectrum there are vibrations (or whatever they may be) of the same general nature as those which give us the sensations of colors. Those beyond the red end we call heat waves because they give us the sensation of heat and those at the other extreme of the spectrum we call ultra-violet, or

chemical, waves because they are beyond the violet and actively bring about changes in certain chemicals such as those used in photographic plates. Now, if insects cannot distinguish red, we would not expect them to distinguish anything beyond red, but we have no right to say in advance of a trial that they cannot see ultra-violet.

Ants carry their pupæ out of light into dark places. Many years ago Sir John Lubbock found that ants moved their pupæ from ultra-violet (dark to us) into brilliant red light, but this has been considered as proving merely that ultra-violet is irritating to ants. The common red-eyed fruit flies go at once toward light, indeed so much so that they can be led from one end of a tube to another by simply shifting a light. They seem to like it. Professor F. K. Richtmyer and I tested their response to ultra-violet light in a dark room, and they flew straight for it. This could not have been a case of simple irritation; it looked as though they actually saw what was dark to us.

That experiment was interesting but it had nothing to do with flowers unless there are ultra-violet flowers. We knew of none. However, all the flowers in the world might be reflecting ultra-violet and we would never guess it by looking at them, for we are blind to it. As Professor Richtmyer is a physicist, he knew how to detect and even measure ultra-violet reflections, and as he and I were both members of the National Research Council's committee on the biological relations between flowers and insects, we worked on this problem last summer, or rather he did the working and I did the cheering. He found that not only are some flowers strongly ultra-violet all over their petals but some have an ultra-violet pattern and, what is also signifi-

cant, some are not at all ultra-violet. The last fact is important because, if every kind of flower reflected the same amount of ultra-violet as every other kind of flower, they might all be conspicuous to an insect that could see ultra-violet, but these uniform wavelengths of light would not help in distinguishing one flower from another.

Some of the flowers that were found to be weak in ultra-violet were brilliant white (the prickly poppy, for example); others were clear blue (a *Campanula*, for instance). This result surprised me as I had thought the prickly poppy would reflect all light waves and the *Campanula* would strongly reflect all the rays at the blue-violet end of the spectrum. It was rather curious that the most ultra-violet flowers we found—such as golden glow, wild sunflower, and evening primrose—were yellow ones. Perhaps the ultra-violet that insects may see compensated in these flowers for the yellow that may merely look gray to the insects. I do not know. In fact, this work did not solve any mystery; it added one more to be solved.

There are other points to be considered about color, but something should be said about odor. Perhaps it is the odor of flowers and not their color that attracts insects. Through the kindness of a friend I obtained samples of several dozen chemicals used in the manufacture of perfumes. For the most part these chemicals are all found in the secretions of flowers. Following his directions, I mixed them singly and in various combinations with lard and put the mixtures in little glass dishes. These dishes were set out on the grass, among bushes and in various other places while I sat in the sun ready to catch and record the insects that were attracted. My layout smelled like

a regular conservatory; bees, butterflies, and other insects were all about; but, although I watched day after day until my eyes ached, not a flower-visiting insect came to my dishes.

This was disappointing, not so much because it did not prove that the odors of flowers attract insects as that it did not prove anything. The chemicals were the best that could be had, but they may not have been good enough or they may not have been the right ones.

Then I tried another scheme. It is much more than probable that insects can smell odors that we cannot, but all odors are presumably borne by the wind and, therefore, if flowers attract insects by means of odors, we would expect most visitors of a flower to come up-wind. Accordingly, I suspended a small tuft of cotton by a silk thread now near this flower and now near that. The cotton enabled me to detect even the faintest breeze. Then I recorded the direction from which the insects came with respect to the direction of the wind. It was at once evident that most of the insects came up-wind and, what was more interesting, many insects coming down-wind flew past the flower, hovered as though something had just attracted their attention, turned, and came back up-wind to the flower.

Altogether, it seemed at first that the case was proved, but really the proof is not conclusive. When one is sailing a boat and wishes to make a dock or a buoy that is down-wind, the best way is to go past it, turn, and come up-wind to it. I am told that human aviators prefer to land up-wind, and insects were expert aviators geological ages before any other animal took up the game. Possibly the insects behaved that way in regard to the

TWO FLOWERS DEFICIENT
IN ULTRA-VIOLET

The prickly poppy (left) is a beautiful glistening white that one might expect, *a priori*, to reflect all of the sunlight falling upon it but, as a matter of fact, it gives back practically no ultra-violet. In other words, if a creature saw ultra-violet but no other color, this flower would be black to it.

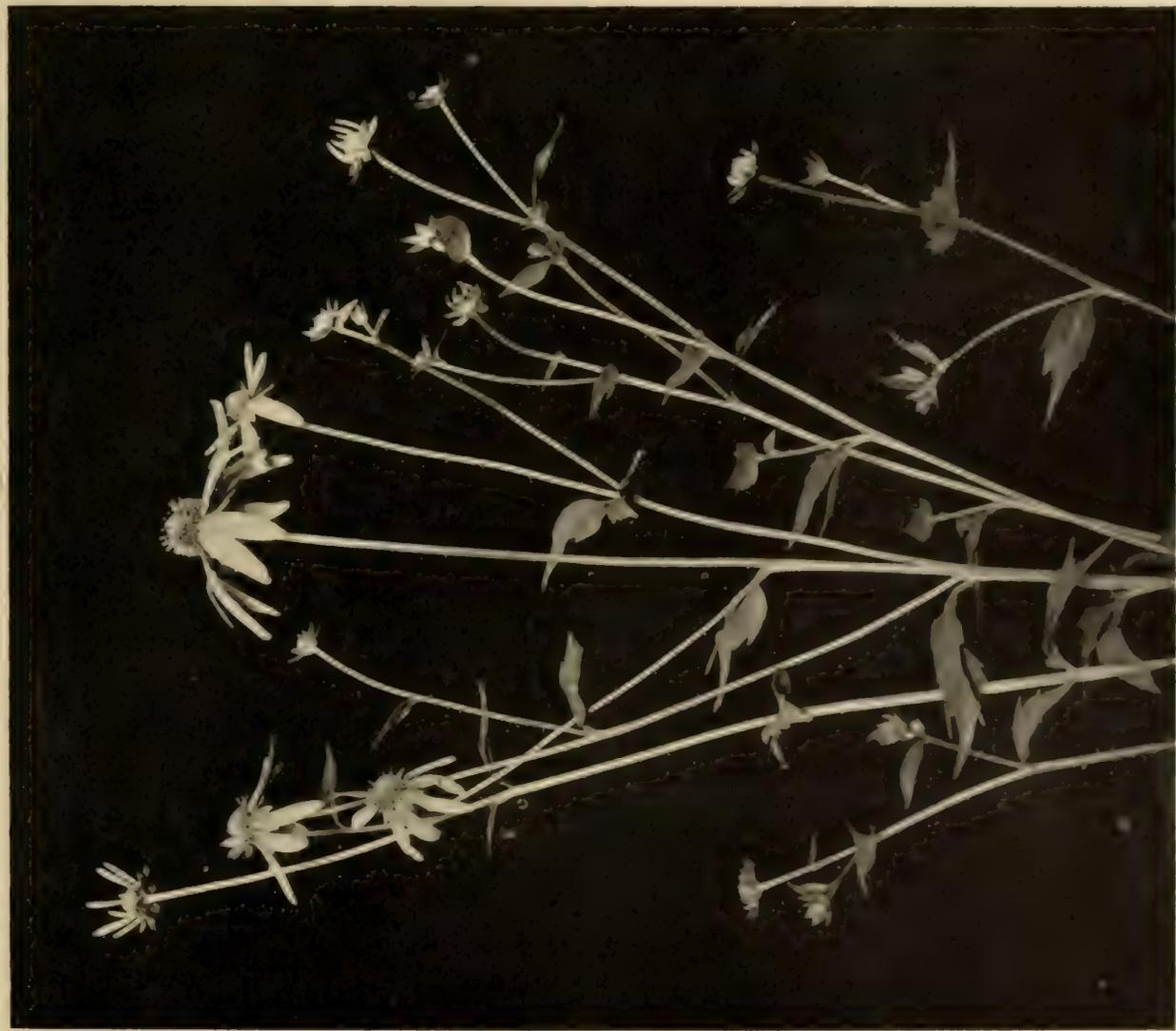
The *Campanula* or harebell (right) appears blue to us; that is, it reflects principally the rays of short wave length, the blue end of the spectrum. It is at this end of the spectrum that the still shorter ultra-violet rays occur but this flower reflects them only feebly.



TWO STRONGLY
ULTRA-VIOLET FLOWERS

The petals of each of these flowers, wild golden glow (left) and wild sunflower (right), appear to us to be an even yellow without any pattern. It will be noticed, however, that the camera found a pattern on the sunflower, the tips of the petals photographing lighter than the bases. Spectroscopic measurements made this summer by Doctors Richtmyer and Lutz showed that, all unseen by us, the entire petal of the golden glow reflects ultra-violet, as do also the tips of wild sunflower petals although the bases of the petals of the latter flower reflect relatively little of the ultra-violet. Since ultra-violet affects the photographic plate more strongly than does plain yellow, the photograph shows the pattern that would be apparent to a creature seeing shorter wave lengths than we can see.

(Photographed by Miss E. M. Kittridge)





The yucca, or spanish bayonet, is one of the most striking flowers of the western plains, so striking that it is frequently grown in eastern gardens without horticultural modification. It is apparently absolutely dependent on a small moth for the transfer of pollen that will enable it to set fertile seed. (See opposite page.)

flowers just to make a good landing. So the question of flower odors is still an open one.

It is evident that the investigation of the biological relations between flowers and insects demands coöperation not only between botanists and entomologists but also with physicists and chemists. The problems overlap each of these sciences and safe progress along the present lines cannot well be made by an individual specialist. Science has here reached the coöperative stage, a stage in which much of interest and importance is to be expected. In general, the ground between the separate fields of various sciences

has already proved to be very fertile, although its tillage is a relatively recent undertaking.

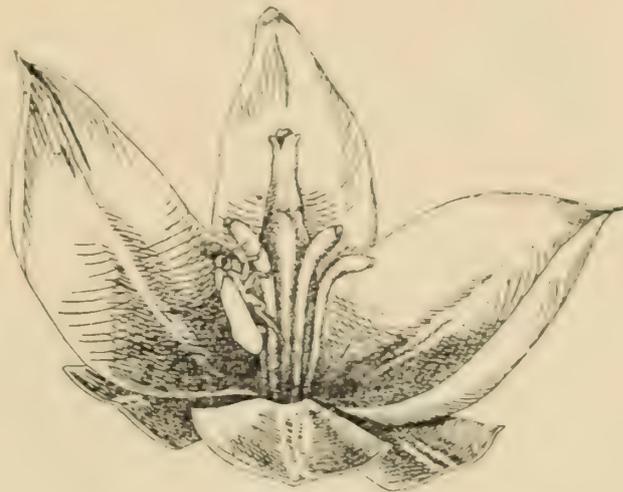
Trusting that it is permissible to speak in terms of human motives provided we remember that we are speaking figuratively, we may say that the flower and the bee are looking out for their respective selves. The insect goes from flower to flower in order to get nectar or pollen, or both, for its own uses. Some flowers seem to have become greatly modified in order to take advantage of their visitors, but there are few or no modifications of the insects to enable them the better to pollinate flowers. That is not what, as a rule, the insects are after. One exception to the rule is very interesting. The caterpillars of a little moth (*Pronuba*) feed on the seeds of yucca. The mother moth seems deliberately to gather yucca pollen in her modified mouth and to pat it down on the pollen-receiving organ of a yucca flower so that the seeds upon which her young will feed may develop. As the caterpillars do not usually eat all of the seeds, the yucca may benefit by this operation, but it pays a price in that at least some of its seeds are consumed.

As pointed out above, it is a distinct advantage to a plant to have a given insect visitor confine its visits to the same species of plant. Certain kinds of bees visit only certain kinds of flowers but other kinds of bees visit almost any sort of flower that is blooming in their neighborhood, just as certain caterpillars eat only one kind of leaf, whereas other caterpillars are general feeders. However, among the bees that visit all sorts of flowers, an individual on a given trip may be faithful to one particular species. It is generally believed that this is the rule but the belief is by no means estab-

A remarkable instance of the interdependence between a plant and particular insects is offered by the yucca and the little moths of the genus *Pronuba*. The pistil that bears the pollen-receiving organ of the yucca extends well beyond the pollen-producing organs of the plant, and hence without artificial aid fertilization would fail to take place. Yet fertilization must take place if the yucca is to develop seeds, and seeds must develop if the larvæ of the *Pronuba* are to secure the diet on which they are dependent. The act of pollination is performed by the moth. If it were not for this insect, the yucca would probably be doomed to extinction and with its passing out the little moth would lose the one source of its food supply.

The females of *Pronuba* have organs especially fitted for the performance of their task. They have a pair of maxillary tentacles with the spinous underside of which they hold the pollen ball that they gather. In the topmost illustration the numeral 1 indicates the pollen mass held in place by the organ mentioned, which is designated by the numeral 2. The illustration immediately below shows the moth assiduously gathering its ball of pollen. The illustration next in order shows the *Pronuba* in the act of laying her egg. Moths and butterflies in general lay their eggs on the surface of plants. *Pronuba* is one of the exceptions, piercing the tissue of the yucca with its egg-laying organ in order to deposit its eggs in the seed capsules, thus providing for the emerging larva an enclosed banquet hall. The larva when full-grown perforates the capsule and drops to the ground. The illustration at the bottom designated 1, represents a mature pod that has been artificially pollinated and protected from *Pronuba*. The illustration to the right of it, marked 2, shows a pod with constrictions due to the puncture made by the *Pronuba* mother. The emergence holes of the larvæ are also indicated. Illustration 3 is that of the interior of one of the lobes of a pod, with a larva present.

(Pictures reproduced from C. V. Riley's article in *Insect Life*, Vol. IV, pp. 358-78.)



lished as a fact. This statement is no disparagement of the patient observers who have worked on the problem. It is not easy, with a notebook in one hand and a pencil in the other, to chase about in the wake of bees through wet marshes and over rock- (or, still worse, cactus-) covered hills, keeping a bee's diary the while.

Now pollen grains, when viewed through a sufficiently strong microscope, are seen to have various shapes, sizes, and colors. Some of the shapes are very curious and quite characteristic and enable us to name the flowers from which the pollen came. If we knew enough to be able to identify any given flower by its pollen, we could catch a bee on its return from a pollen-gathering trip, rob it of its booty, and by a microscopic examination tell where it had been. This would not be so exciting as the method of pursuing a bee to determine its fidelity to a given kind of flower, but it would be

more productive of results. However, we do not at present know enough about the pollen of even our common flowers to put this method into execution. To meet this need, Miss Pope, working under a grant from the National Research Council and in coöperation with the University of Colorado, took up the matter of identifying pollen grains. Her work has not yet been published but some day we may be able, as a result of her labors, to sit in a comfortable chair and read on a long-dead museum specimen the record of its last activities among the bright flowers.

Even then we may not know certainly why the flowers were bright but we will have learned many interesting things of which we are now ignorant, and after all that is a large part of the joy of research. It is not so much the final goal as the overcoming of difficulties along the way that gives us pleasure.



Some of the various forms of pollen grains (highly magnified).—In the lower row, from left to right, are shown the pollen grains of the passion flower, the smaller enchanter's nightshade, the hedge bindweed, and hemp. In the upper row, from left to right, are those of *Cobaea*, *Morina*, and the common pumpkin. (After Kerner and Oliver)

The Extinction of Sea Mammals

BY ROBERT CUSHMAN MURPHY

Associate Curator of Marine Birds, American Museum

KNOWLEDGE of the extermination by man of a considerable proportion of the land mammals throughout at least the major part of their former ranges is common property. The examples of the bison of both hemispheres, of the wapiti, of the polar cattle or musk oxen, of elephants, of numerous African and Oriental antelopes and the North American pronghorn, of the beaver and the chinchilla, the Australian pouched animals, and many others, have been for years before a public which is slowly becoming conscious of the situation. But the plight of marine mammals, which is no less serious and even more difficult to ameliorate, has thus far not been appreciated sufficiently to awaken a widespread reaction.

The ultimate causes of the depletion of modern land mammals have been chiefly three: (1) the increase and extended distribution of human population, with the attendant clearing of forests and the claiming of wild land for grazing and tillage; (2) sport and the love of trophies; (3) the constantly growing demand for furs. The three factors have operated more or less selectively upon different aggregations of mammals. The first, concerned with the replacement of lower animals by man himself, is inevitable in its action and can be only partially corrected through the establishment of sanctuaries. The second and third can be controlled by popular sentiment, but the latter of these, namely, the increasing and non-essential use of fur apparel, is so intimately associated with static mental conditions, such as

habit and prejudice, that it is the most insidious of all. From a numerical point of view, the slaughter connotated by one of the great annual fur sales, involving millions of pelts, makes the worst ravages of sportsmen seem insignificant. It is doubtful whether educational propaganda can overcome the combined forces of fashion and commercial interest in time to prevent the absolute extermination of many terrestrial fur bearers.

The last consideration points directly at the outstanding difficulty in the attempted conservation of sea mammals—the fact that their pursuit is exclusively commercial. Few, if any, of them can be legitimately killed for sport; none can be classed as pests; probably not one species is being crowded out of existence by human occupation of its habitat, or through any other form of actual rivalry with man. Most of them, however, yield a marketable product, such as oil, hides, fur, or ivory, and in general the exploitation of the creatures has been more than ordinarily lucrative. Add to this the fact that the hunting is carried on largely in localities where no inhibition can be imposed by an outraged public conscience, and where no sympathetic eye notes that an entire unit of creation may sometimes be obliterated at one blow, and the stage is set for the disregard of every consideration except that of pecuniary profit. Finally, the field of action is in a large measure on the high seas or otherwise outside the domain of effective law.

For our purpose the marine mammals may be broadly grouped as fol-

lows: (1) whales, porpoises, and all other cetaceans; (2) seals and their kind, including the earless seals, fur seals, sea lions, walruses, etc.; (3) Sirenia or sea cows, comprising the manatees and dugongs, as well as an Arctic form long since wiped out of existence; (4) sea otters; (5) the polar bear.

The polar bear—to proceed in inverse order—is in no immediate danger. The sea otter, probably the most valuable of fur bearers, has been all but exterminated throughout its littoral range along the west coast of North America, although its numbers are said to be increasing at the Commander Islands, where twenty-seven individuals were captured in 1917 during eight working days.¹ The price upon the sea otter's head is high, for single skins have fetched as much as \$1000. Whether the animal can still be saved is doubtful, but at any rate its prospects, such as they are, rest mainly with a populace whose eyes have been opened.

The manatee, which occurs in estuarine waters of the southern United States, is protected by law, and it is doubtful whether this creature and the equally curious Indian dugong exist anywhere in numbers sufficient to support an organized fishery. The largest of the sirenians, Steller's sea cow of Bering Sea, may be pertinently mentioned, however, since it was the first marine mammal wholly exterminated by human wantonness. It was a beast twenty-five to thirty feet in length, and was destroyed for food by all visitors to Pacific Arctic waters from its discovery in 1741 until the last of the species perished less than thirty years later.

¹Information supplied by Dr. E. K. Suworoff, fisheries expert of the Department of Agriculture, Petrograd.

With one or two possible exceptions, the porpoises and other small cetaceans have not been hunted to the danger point in any part of the world. This leaves, therefore, the true whales and the seals, animals of the utmost importance which are now seriously threatened with extinction.

The history of sealing is a record of almost unalleviated carnage. For oil, or fur, or hide, these highly organized and valuable mammals have been clubbed and stabbed the world over, without regard to age, sex, or the presence of nursing young. The imperfect statistics of sealing in Newfoundland waters, in the Arctic, the Pacific, the Indian Ocean, the Falkland region, and elsewhere, are enough, at least when coupled with such personal experience as the writer has had, to make the blood curdle, for the figures run into scores of millions. Legal regulations ostensibly control shore sealing and, to a certain extent, pelagic sealing, but few laws have been more frequently or more brutally disregarded. One species, the West Indian seal, has apparently been exterminated, and at least six others are close to the brink of disappearance. Several of these are not adequately represented by bones or skins in any museum, and as a result we may never be able to determine even the elementary facts of their place in nature.

Whaling in the western world began as a national craft among the Basques, and passed successively into the hands of the Dutch, British, Americans, and Scandinavians. Today Norwegians either control or operate the bulk of whaling. A continuous improvement in technique has been correlated with a constantly augmented rate of destruction. The fleets of Yankee sailing ships that hunted the wide-ranging

sperm whale through all the warmer waters of the globe during most of last century, captured in the aggregate many thousands of victims; yet, because of the immensity of the grounds, and the time and labor involved in the utilization of a single carcass, the toll perhaps only slightly exceeded the natural increase of the whales. At any rate, it is certain that the sperm whale, until recently the most hunted of cetaceans, has held its own far better than other species, and is today the commonest of the large whales.

Hunting the bowhead for oil and whalebone in the restricted waters of the Arctic Ocean had, as might have been surmised, less fortunate results from the point of view of a conservationist. Both the bowhead and the right whale have at best but a dubious future. But the so-called shore or fin whales, such as the humpback, finback, and sulphur-bottom, which are the mainstay of modern whaling, are in imminent danger of disappearing from the seas forever. Pursued by steamers, slain with harpoon-cannon, towed ashore in pairs, sixes, or dozens, butchered and rendered with horrible dispatch by true efficiency experts, the fin whales have been cleaned out of the Northern Hemisphere, except in parts of the Pacific, and are now being harried to the impending end at their last stronghold in the Far South. For twenty years the hunt has been prosecuted, and in the Weddell Sea region 100,000 whales have been flensed at the "factories." At South Georgia Island alone the catch during several single seasons has exceeded 5500 whales.

The remedy for the evils described is an international understanding to which the assent of the British Empire,

Japan, Norway, the United States, and Russia would be fundamental. The remarkable results of the four-power agreement concerning the North Pacific fur seal are an example of what might be further accomplished by organized intelligence.¹ Scientific investigation should go hand in hand with legal restraint; our ignorance of the life histories of the creatures which we have been in such haste to destroy is a present stumbling block. But the emergency must not wait too long upon discovery. Protection of breeding localities, or of breeding periods, when either can be determined, is a clear and simple maxim: closure of certain regions pending further research would work no injustice to the industries.

Finally, the packers' system of waste elimination should be enforced, assuring the fullest possible utilization of every seal and whale carcass. Whaling has been in the past the most prodigal of occupations, in that half of the potential value of a prize was cut adrift. The thrift of the Japanese has led them to treat a whale as they would a hog, deriving oil, food, fertilizer, leather, glue, etc., and leaving no unused residue. The British have lately imposed substantially similar conditions upon the whalers who operate from the Subantarctic stations. Only by such steps can we hope either to bequeath the living wonders of the sea to our descendants, or to rescue fast-failing industries which, if wisely administered, are capable of a perpetual yield of products useful to mankind.

¹The reader is referred to the admirable resolutions regarding an international fisheries treaty and an international commission for the study of fishery problems of the North Pacific, adopted by the California Academy of Sciences, January 3, 1923. See p. 195 of this issue of NATURAL HISTORY.



The Chamois of the Pyrenees

By V. FORBIN

THE izard (*Rupicapra pyrenaica*) is a race of the chamois found today only on the high summits of the Pyrenees, although at one time it frequented also some of the other ranges of the Iberian Peninsula. It is unquestionably on the way to extinction and the bands, formerly numbering many individuals, today do not consist of more than ten head.

Hunting the izard is a dangerous sport, not because the animal is a redoubtable antagonist that attacks as soon as the hunter comes into view, but because it lives on inaccessible declivities, in the midst of frightful precipices, where one false step on the part of the pursuer means a terrible death. The mountaineers of both slopes of the Pyrenees sometimes pay with their lives for the excitement offered by the hunt of the izard. Even while Monsieur Jové, to whom the writer is indebted for the accompanying photographs, was arranging his expedition in the region, a fatality of this kind occurred. An experienced climber named Troc, who was far from making his maiden effort, shot down one of these animals. He made his way to it and had lifted it to his shoulders when a stone on which he was standing gave way and he rolled with his burden to the depths below.

What is hazardous for man proves no obstacle for the chamois. It has been asserted that it leaps over ravines sixteen or more feet in width and ascends or descends with ease formidable precipices. When a herd is feeding, one of the animals keeps watch and at

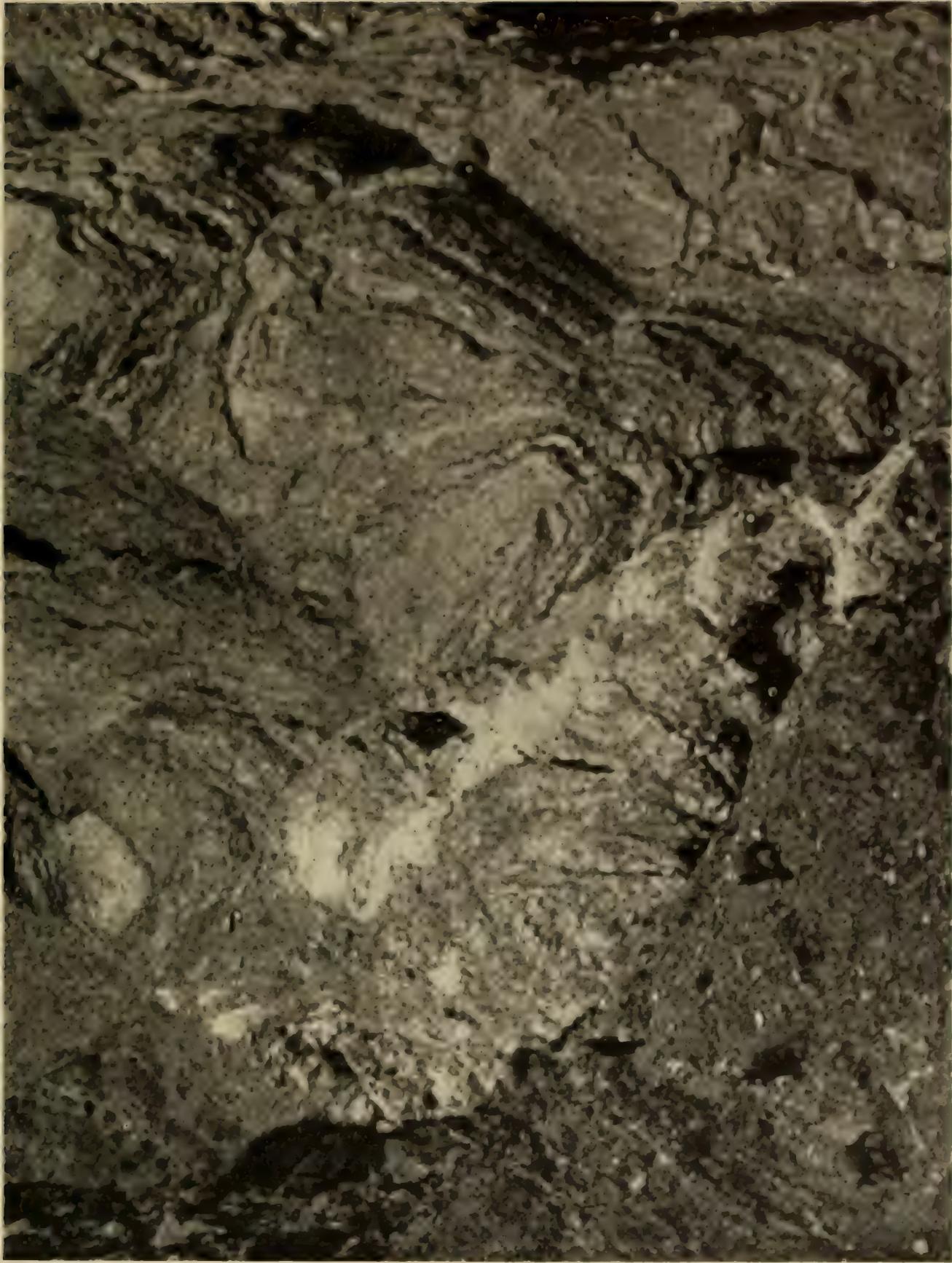
the first suggestion of danger gives forth a shrill note of warning. It is no easy task, therefore, for any one to make an approach. Yet, as Monsieur Jové points out, an essential preliminary to success in photographing the animal is "seeing it before it glimpses you, seeing it where it happens to be, whether at one hundred meters or at a thousand meters, and seeing it at all hazards." The izard, with its backward-hooked horns—a character of chamois in general noted even by Pliny—is an animal of striking appearance. It feeds, however, among growths that have a russet color similar to its own and among rocks and loose stones that have more or less the same hue. It is easy to understand that under such circumstances binoculars of the best type are an indispensable part of the photographer's equipment.

The field of action chosen by Monsieur Jové and his companions was the region of the Pic du Midi d'Ossau, a majestic mountain 2885 meters high which rises in the southern part of the department of Basses-Pyrénées, a short distance from the Spanish frontier. That they might be the more free in their movements, the hunters did not burden themselves either with picks or ropes. They even dispensed with professional guides. All of the members of the party knew the country thoroughly, however, and had had previous experience in hunting the izard,—all except Monsieur Jové; but the photographs reproduced herewith are evidence that he did not return from the hunt empty-handed.



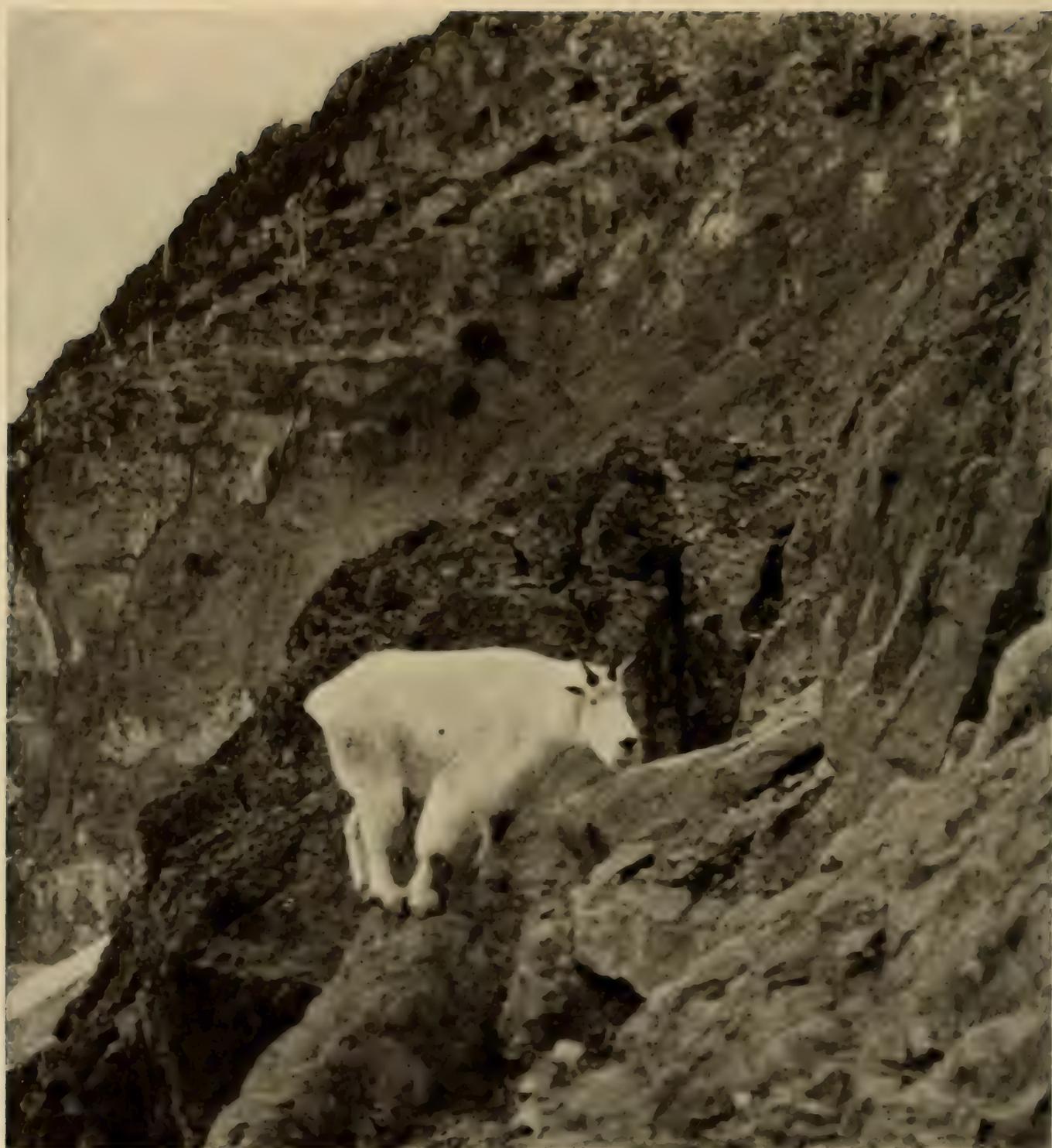
AN IZARD IN A ROCKY WASTE

Because of its vigilance and because of the obstacles imposed by the rough country in which it lives, the izard is an animal difficult to approach



IZARDS ON A ROCKY SHELF OF THE PYRENEES

Formerly the izard was found in bands numbering many individuals, but today the animal is on the way to extinction and the bands are small



A MOUNTAIN CLIMBER AT HOME

The Rocky Mountain goat is not a true goat but belongs to a group of ungulates more or less intermediate in relationship between the typical goats and the true antelopes. He rejoices in the scientific name of *Mazama*, is classed as an antelope, and his nearest relatives are the gorals and serows of Asia. He stands a little more than three feet high at the shoulder and as he is of stocky build, his body is as heavy as that of a medium-sized deer. The Westerners say that "he lives on rocks and mountain scenery" and all who have hunted him will agree that he has an abundance of both in his environment. Both sexes of the Rocky Mountain goat have short, black horns, sharp at the tip and slightly curved, which are never shed. The picture of the goat was secured by Mr. Tom Williams, a guide of Stanley, Idaho, and is reproduced by courtesy of Mr. M. S. Benedict, U. S. Forest Supervisor

White Goats of the Sawtooth Mountains

By H. E. ANTHONY

Associate Curator of Mammals of the Western Hemisphere, American Museum

ONE of the most beautiful camp sites I have ever had and, from the point of view of material secured, one of the most successful, was in the Sawtooth Mountains of Idaho. Here, near the shores of Stanley Lake, in the northern part of the range, I spent the early part of the autumn of 1915 doing general collecting of mammals, with an especial interest in the white or Rocky Mountain goat.

The weather was ideal,—cold, frosty nights with bright sunshiny days, and mornings when the grass was white with heavy frost and a crackling fire of dry boughs was the first focus of interest upon arising.

The afternoon of the day after camp was established I started out with the young man whom I had engaged to look after camp and cook the meals, to make half a day's reconnaissance back over the high country to the west. All of the region about Stanley Lake is very rugged and steep and the mountains well deserve their name, the Sawtooths. Viewed from a distance, the sky line of this range is a series of sharp, toothlike peaks, and a nearer approach does not dispel the impression but merely confirms it. Great rocky ridges run up into crests, some of them too sheer to climb, and everywhere is a succession of deep ravines and elevated ranges. Huge piles of frost-shattered rock lie along the base of every peak and ridge, and wherever there is enough soil for a root-hold, the Engelmann spruce, like trim sentinels, line the slopes. Every depression between the ridges holds one or

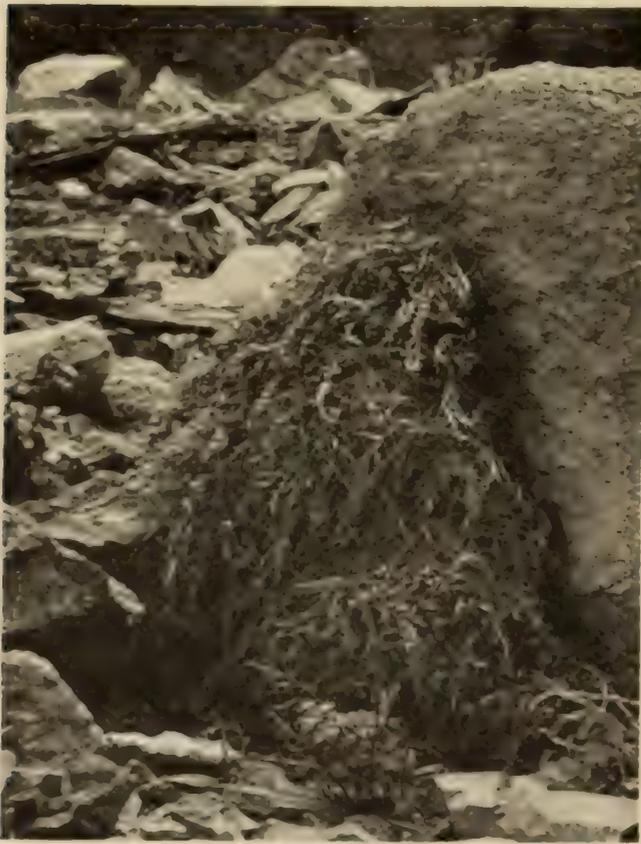
more mountain lakes, crystal clear and some of them so deep that their color rivals the blue of the sky above. The dust-free atmosphere allows the vision to discern distant objects as if they were near at hand, and far away in the distance one can pick out the mountain neighbors of the Sawtooths.

On the afternoon in question, we climbed back of camp until we were among the slide rock, dangerous for unwary feet, and were looking down into lake after lake as we topped the successive rises. At these higher elevations the cony, or pika, makes its home, and it is a common mammal in the Sawtooth Range. The cony looks like a diminutive rabbit, and is sometimes called "the little chief hare," but it is not a hare although somewhat related to it. It has no visible external tail, is about the size of a small guinea pig, and in color a light gray or brownish gray. It lives in the loosely piled rock which has fallen down from the disintegrating slopes and peaks, and finds secure refuge in the thousands of crevices that such a pile affords. The food of the cony is the vegetation it can find about the edges of the slides, which it cuts and piles out on the rocks to dry and cure in the sunshine, thus making hay of it. When this vegetation is properly cured, the cony drags it away under the rocks and stores it for winter or a rainy day. Industrious little creatures the conies are and their hay piles are often of good size.

The most peculiar feature about this strange little animal, found only at high elevations and in rough, rocky areas, is its call. It is impossible ade-



Chipmunks daily haunted camp, giving us their bright companionship in return for stray morsels from our larder

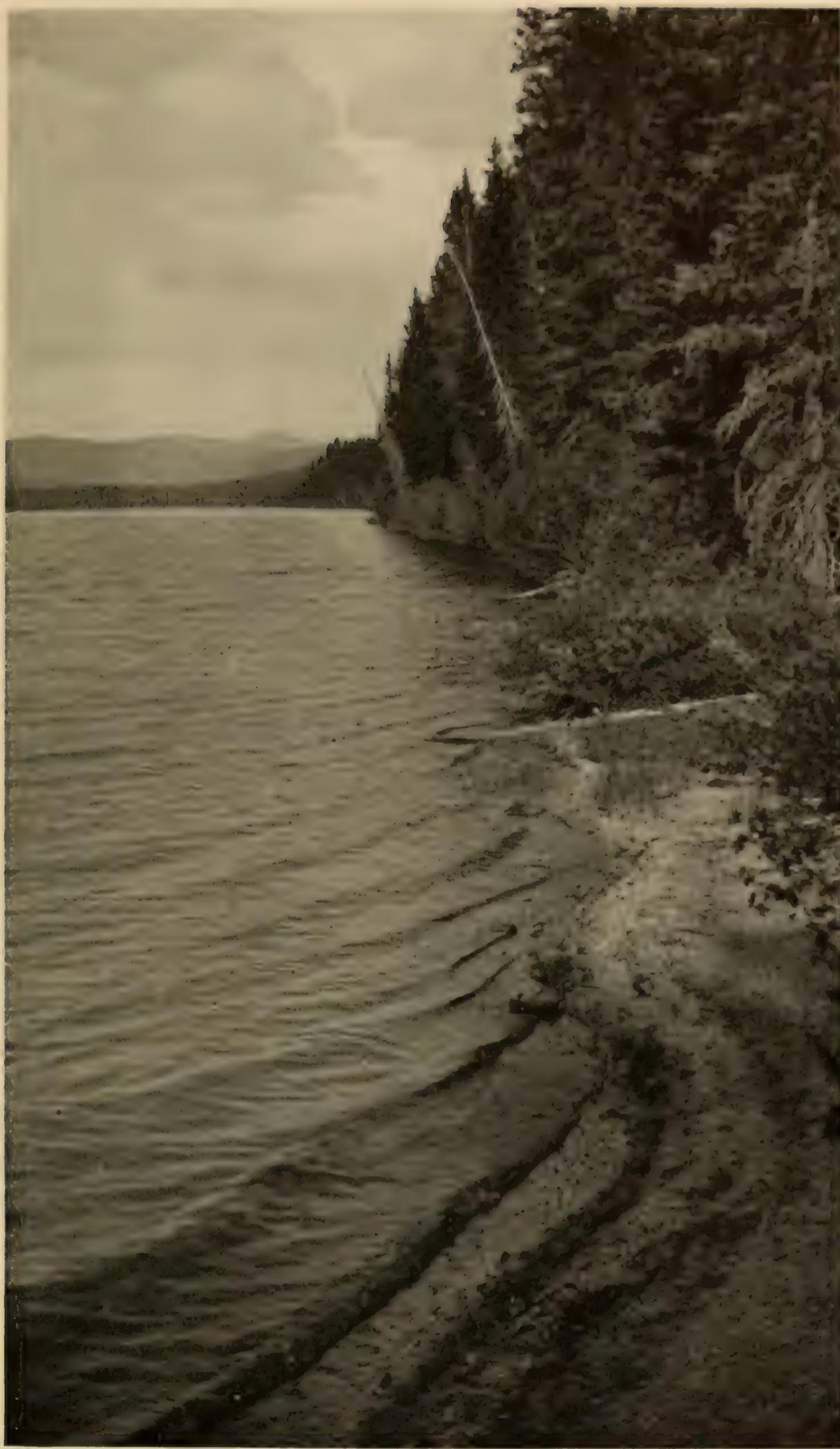


The hay pile of the cony is frequently stacked against the side of a large rock that has a sunny exposure

quately to describe the sound it makes, which has often been called a bleat but might better be likened to the noise produced by bending a piece of tin so that it "screams." So utterly unlike the cry of any other mammal is it that anyone who hears it for the first time is greatly puzzled, especially because of its ventriloquial quality.

We had reached a deep cuplike depression between the ridges, when a faint tinkle of falling rock came to my ear. After several seconds of such dislodgment of loose slide rock, I located the cause of the disturbance—two Rocky Mountain goats crossing a low divide, about a quarter of a mile away. Even as I glimpsed them, they filed away out of sight behind the row of spruce trees that topped the divide. Although they had apparently seen me, they did not appear to be much alarmed, moving off at a walk. It was my first sight of Rocky Mountain goats in their wild state and I was anxious to see more of them.

A short steep climb brought us to where the goats had been circling the brow of the ridge. It was necessary to walk carefully, for the rock was loose and slid down hill on the slightest pressure. Following through the spruces not more than fifteen minutes after the animals had passed, I reached the descent down the side of the divide and could see over to the next ridge, across a ravine too precipitous for human feet. There, on the other side, where huge blocks of rock and sheer cliffs formed the slope of the ridge, stood a goat, a huge "billy," on top of one of the most outstanding and conspicuous of the rocks, calmly watching his back-track from a spot where all the advantage of position was his. A step and he could disappear around the cliff, while to reach him an enemy



STANLEY LAKE

Set in a vast encircling wall of dense dark spruce of perennial green, the clear, cool depths of this lake mirror the blue of mountain skies or the whiteness of wind-banked clouds



A JAGGED SAWTOOTH PEAK

The culmination of a long knifelike ridge, this peak stands sentinel over the extreme northern end of the mountain range. This is the tall peak that is shown in the mid-background of the illustration on p. 154

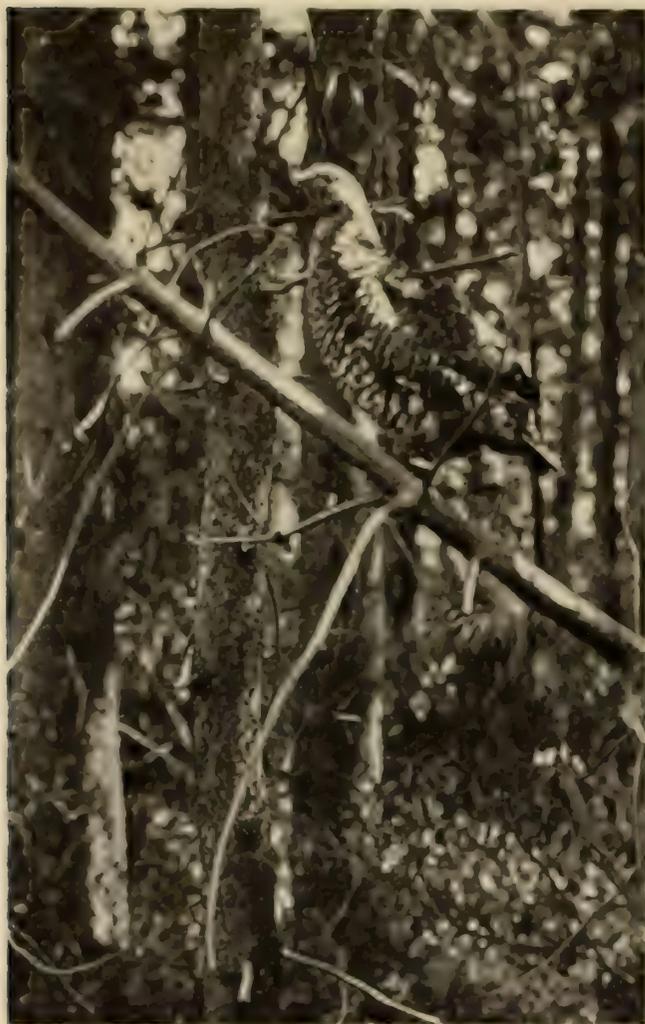


WHERE THE EYE RANGES ACROSS VAST SPACES

The clear atmosphere at this elevation permits wonderful vistas past rugged crags, bold in outline, deep into the distance, where the horizon loses itself in the vague blue outlines of remote ranges

must needs toil down into the ravine and be exposed to vision for most of the distance across.

What a fine animal he was and what a picture he made! Against the dark rocks his body stood out so clearly that it was difficult to conceive how he could be colored more conspicuously. The long tuft of hair that formed his beard moved slowly with the breeze but



By far the most interesting of the birds was Franklin's grouse or, as it is known locally, the "fool hen." This grouse is slightly smaller than the ruffed grouse and is dark, almost black, in plumage, the males having a bright orange mark over the eye. The "fool hens" were found in small flocks, in the heavy stands of pines and of Engelmann spruce. They showed very little fear of man and, when encountered, merely ran a short distance and stopped, or flew up to perch in a tree six or eight feet above the ground. It is this trust in its neighbors that has earned the bird its name, but the species is becoming rare because man has all too seldom deserved the trust

otherwise he was as rigid as the rock. Animal and setting made a picture that one could never forget. The majesty of the goat, the grandeur of the wild rocky cliffs about him, and the immensity of great heights and vast distances, were the dominant impressions of my introduction to the animal.

Knowing that I could not get across the cañon as the goats had done, I made a detour and approached the white sentinel from a different angle. Again I secured an excellent view of the big "billy" but could not detect the smaller of the two animals. I scrutinized the cliffs for some time and finally disclosed my presence. At once the goat on the rock whirled and clambered over the cliffside to the more open slopes at his back. The other goat appeared from behind a rock, where it had been hidden, and joined its companion. Progressing at a walk, or a stiff-legged run when the terrain allowed, the goats had soon disappeared where I could not follow. This was the beginning of a series of encounters that eventually brought me the specimens I needed and which took me over much of the northern end of the Sawtooths.

As the days went by, the weather became colder, and our tent seemed inadequate as a shelter, especially as the first snows were due. Still, the bright clear sunshine of Indian summer held out and I found much to interest me, whether climbing over the summits or staying down in the grassy meadow or along the creeks and lake. The bird life, while not conspicuously abundant, was made up of some of our finest species. Little flocks of Cassin's finch—the males with bright pink heads and breasts—small groups of pine grossbeaks fully as beautiful in their garb of softer, rose-pink and dull



The spruce struggles to maintain a foothold up to the very summit, and scattered clumps of these trees dot the little mountain parks and basins wherever the rock has been concealed by the soil



The mountain neighbors of the Sawtooth Range are not distant as the golden eagle might travel, but for man there intervenes a wide forested valley miles in extent



Stanley Lake is dominated by the huge rocky mass of the main Sawtooth Range

gray, added color to the dark green boughs of spruce or pine. Tanagers, bright yellow and red, showed distrust of their strong coloring by keeping well out of sight in the conifers. Woodpeckers and flickers drummed on dead stumps, and out in the bushy thickets on the meadow white-crowned sparrows lurked.

Soft, fluffy, gray Rocky Mountain jays flitted like shadows in the forest or visited the camp for scraps. At such times their quiet, subdued notes are in keeping with their harmonious color, and one could not ask for more well-behaved guests.

One day, as we were returning from the upper part of the valley, where we had been hunting, we heard a shot only a short distance behind us on the trail. Soon after we reached camp, a man on horseback appeared and told us that in an open meadow along the river he had come upon a huge old grizzly bear with her cub. It was his shot we had heard and he had killed the young bear.

Evidently luck had forsaken us that day and we had missed encountering the bear ourselves by the narrow margin of five or ten minutes. A few days later, one of a party of campers jumped a bear about a half mile from our tent.

One morning my assistant and I started for a full day of hunting, carrying our lunch in our pockets. It was our plan to make a great circle through the higher basins and then back to camp. About noon we separated, and I kept to a course that took me through some very rough country. An hour before sunset I was hurrying down a deep, wooded ravine, flanked by a high, rocky ridge to the north. I was anxious to get over the roughest of the traveling before the light failed, for I was still miles from the big meadows of Stanley Lake. Just to the left I discovered a small goat—I should judge a two-year-old—standing on a rock and watching my progress. It was the first time I had seen the animal at any distance

away from the bare, rocky crests, and it looked strangely out of place in the ravine. After I had fired a shot which set the echoes flying about the cliffs, I chanced to glance up along the high ridge which walled in the gulch to the north. There, outlined against the sky, where the last radiance of the declining sun contrasted strongly with the gloom of the dark ravine where I was, stood the very patriarch of goats. I lost my interest in the specimen I had just secured and longed to add this splendid fellow to the collection.

He was looking out over the depths below him, and whether he saw me or not I could not tell, but he had heard the shot and was on his post of observation. At the very edge of a sheer drop he stood as motionless as carved stone, and but for the perfect silhouette he made against the sky, I could not have been certain that the mass was not a light-colored piece of rock. To climb up to him from directly below was out of the question since he was at least three hundred or four hundred feet above, on a cliff that seemed straight up and down. To shoot from where I stood was to take one chance out of a thousand, either of hitting the goat or of securing it afterward if I did hit it. I gave up all hopes of reaching camp that night and made a wide detour to the west where a more gradual slope offered a chance for reaching the ridge.

Even then it took upward of half an hour of the stiffest climbing to reach the upper slopes, where I could see the summit just ahead. It scarcely seemed possible that I would find the sentinel at his post. A click of hoofs on the rocks warned me in time to see the goat running to the west in an attempt to pass me. He had become suspicious of being cut off at the top of

his crag and wanted to get back along the main ridge itself.

When, as the result of my shot, he fell in the midst of a stride, he lodged squarely across a large boulder that held him from tumbling a great distance down the slope, and I found it necessary to skin him without allowing his heavy body to roll off this support. It was just about dusk when the shaggy white hide was free from the body and it was imperative that I reach the gulch before total darkness set in. A night on the wind-swept rocks, without even a twig for fuel, meant more hardship than I cared for, and the shelter of the wooded gulch seemed a haven indeed. Straight down I clambered, slipping and plunging in the loose rock and earth. Now and then I came to eight- or ten-foot drops where the skin and head were thrown down first before I made my jump. Had I encountered a drop too great to negotiate in this fashion, I should have been held a prisoner indeed, for I could not have climbed back the way I had descended. Good fortune kept my course away from such places, however, and I arrived at the bottom just as the dusk increased to such a degree that it was difficult to see the dead wood lying about. A pile of dry limbs thrown down before the overhanging face of a huge rock, a long drink from the cold creek running down the little valley,—and the stars had ushered in the night.

The loose rock was scraped away and the big goatskin thrown down upon the ground, hair-side up. More than five feet in length, it made a soft, warm couch, the more inviting after a fire had been kindled near by. With the rock at my back I lay where no wind could enter, and with enough overhang above so that any rain, falling straight, would be deflected. The night was

clear, however, so that there was little fear of rain. The flesh of the old goat would have been tough and tasteless, so only the liver had been saved, and strips of this broiled on twigs held over the fire furnished a satisfying meal. By rolling about so as to warm my sides alternately, I was able to pass a fairly comfortable night and one immeasurably restful compared to what I should have had to endure on the bleak ridge above. The next morning I had a long and tedious hike before I had packed in the two skins and heads.

The last Rocky Mountain goat I saw. I met under circumstances that reversed the usual procedure. I had hunted along the crest of the high mountain directly back of our tent and had seen nothing there. As is so often the case in the home territory of the goats, there was a tall escarpment, perhaps a little more than two hundred feet high, along one face of the mountain. From the top of this cliff I leaned out as far as I dared and scanned the talus slope below. Apparently there was nothing to be seen. A shapeless patch of white at the foot of a small pine caught my eye and I tossed a fragment of rock out into the air to fall with a crash on the rocks below. The white object leaped into definite shape,—a young goat standing clear of the tree and looking for the source of the disturbance. For once he had been approached from the unexpected quarter. Old hunters have told me that Rocky Mountain goats never look to see if danger threatens from above, but always watch for it to come up from below, and for this reason are easy to approach if the hunter is able to get above them. In this instance, the animal's actions certainly bore out the truth of their statements, for it did not look upward to see if

an enemy had dislodged a rock from above.

That goats are sometimes killed by rocks that crash down on them would seem to be highly probable. They live in regions where rock is continually falling and occasionally their trails take them where it would be almost impossible to dodge such missiles. I had the truth of this demonstrated to me in a forcible manner.

I had climbed alone one day almost to the top of this same high mountain which overlooked our tent and all the expanse of the Stanley Lake meadows. The early morning had been bright but, near noon, heavy clouds rolled up and a storm was impending. When the clouds were blackest overhead, I was hurrying to reach the shelter of the pines along the summit, and chose as the most direct route a steep, rocky ravine, scarcely more than one hundred yards long, that ran down from a low pass in the crest of the ridge.

The floor of the ravine was choked with rocks of all sizes, fallen from the crags that formed the walls on either side. This mass of slide rock was lying at the angle of repose, that is to say, the steepest pitch at which the rock could maintain its position. Great care was necessary to avoid breaking a leg among these piled-up slabs and I was about midway to the top when a terrific thunderstorm burst. The storm would have been a severe one anywhere, but here in this walled-up cañon the ear-splitting crashes seemed to herald the end of the world. To make matters worse, rocks began to descend from the side walls and from the upper slopes of the talus and they were by no means to be classed as pebbles. Very luckily for me I was heading for a huge rock, the size of a house, which completely blocked the

ravine from side to side and served to dam back all the loose rock above it. Under the jutting lee side of this rock I was sheltered from missiles which came down the ravine, and in no danger unless one heavy enough to break off the edge of my rocky eaves was dislodged. Pandemonium broke loose and thunder echoed and reëchoed from the rocky crags, with one roll crowding close upon another. Rocks

hurtled down from the pass in abundance, starting slowly at first but gaining momentum until they struck the top of some big rock with shattering force, when the fragments sprayed the slope below like shrapnel. I could mark the progress of those that went overhead by the whistle of their passage although many went to pieces on the big rock that sheltered me. An animal caught upon the exposed slope



The feet of the Rocky Mountain goat are large and well adapted to hold on rocky surfaces. He has need to be sure-footed for much of his wandering is over loose rock and sloping rock faces. The photograph, secured by Mr. Tom Williams, is here reproduced by courtesy of Mr. M. S. Benedict

would have escaped only by a miracle. When the clouds passed by and the detonating crashes of thunder had ceased to jar the cliffs, I slipped from behind the protecting rock and scrambled for the pass with only one idea in my mind, to get to the top in the shortest possible time.

More might be written here of the days spent about Stanley Lake. It might be told how the first snows came and in a night changed the landscape into a beautiful world of frosted white,

how the rigorous nights drove us to forsake our tent and move into a deserted log cabin on the lake shore, and how we returned by wagon to the railroad using four days in making the journey. But since this was to be an account of the white goat, we shall leave him now, after the snowfall has transformed his domain into a background which suits his coat so well that our chances for seeing him, unless he moves, are slight indeed.



Snow lasts the year round in many of the deeper basins along the ridge crest, but early in the fall the entire country turns white and remains so until late spring



The Story of an Eskimo Dog¹

A GOOD story well told is always welcome, and here is one in the biography of Polaris by Ernest Harold Baynes. It is the true life story of an Eskimo dog, whose parents were among those selected by Peary to draw his loaded sledges, under the worst possible ice conditions, on the final stretch of the long trip to the North Pole.

The author needs no introduction to the members or to the scientific staff of the American Museum of Natural History. He played a very important part in saving the American bison from threatened extermination; he fired the first gun on the right side in the nature-faking controversy which swept the country a score of years ago; and he has done great service in the conservation of bird life by the organization of more bird clubs than any one in America.

Many who have heard Mr. Baynes tell in his lectures the stories of his animal friends, will be glad to learn that he has put this account in book form. We would not expect the author, who helped stem the tide of sham natural history, to humanize his animals or to be over-sentimental about them, and he does not err in this way; yet he has given us a most appealing account,—one that will rank in readableness with those two great dog stories of literature, *Rab and His Friends* by Dr. John Brown, and *Stickeen* by John Muir.

The style is not that of the ordinary narrative, but rather the colloquial style of the raconteur,—the energetic style used by Mr. Baynes in his inimitable lectures. The many humorous episodes add greatly to the attractiveness of the narrative.

The book is copiously illustrated with photographs by the author, and the introduction was written by Captain Bob Bartlett, who sailed the "Roosevelt" for Peary and the "Karluk" for Stefánsson, and who said that Polaris was the finest Eskimo dog in the world.—G. CLYDE FISHER

¹*Polaris: The Story of an Eskimo Dog*, by Ernest Harold Baynes. The Macmillan Company, New York. 1922.



The earliest representation of fishing with a rod appears on an Egyptian tomb that dates back to 2000 B.C. From *Beni Hasan*, by P. E. Newberry

Fishing from the Earliest Times: A Review¹

By E. W. GUDGER

Associate in Ichthyology, American Museum

MR. WILLIAM RADCLIFFE'S weighty tome is "so full of a number of things" of great interest—to borrow Stevenson's phrase—that it is no easy task to write a review of it, yet we may at least indicate the great diversity of the valuable data which the author has brought together through his painstaking researches.

In his introduction Mr. Radcliffe traces the evolution of fishing implements from the close of the Old Stone Age up to classical times. He draws the parallel between the fishing tools of the prehistoric fishermen and those of the Bushmen, Tasmanians, and Eskimos of a day just ending. He endeavors to settle the question as to what are the most primitive fishing implements and finds that the weight of evidence is in favor of the spear and the gorge.

The next section, by far the most important part of the book, consists of seventeen chapters of 233 pages devoted to fishing in classical times. The author begins with the accounts of fishing in Homer and ends with a discussion of pisciculture among the Romans toward the close of the Empire.

One can only indicate the wealth of material filling these chapters to bursting. Here are to be found accounts of the dolphin as man's friend and helper in fishing, of the Ichthyophagi, of the earliest records of tunny-fishing, of the use of fish as a sacrifice to the gods, of the first acclimatization of fish, of the use of the torpedo or electric ray in medical practice, of the extravagant prices paid by the Greek and Roman gourmands for their nine most highly prized fishes, of the sumptuary laws passed by the Roman emperors to keep down such prices, of fish in mythology and in symbolism (including the Christian fish symbol) and on coins and medals, of Roman vivaria, used first as mere storage places but later for the breeding and rearing of favorite fishes—the first known piscicultural efforts in the western world.

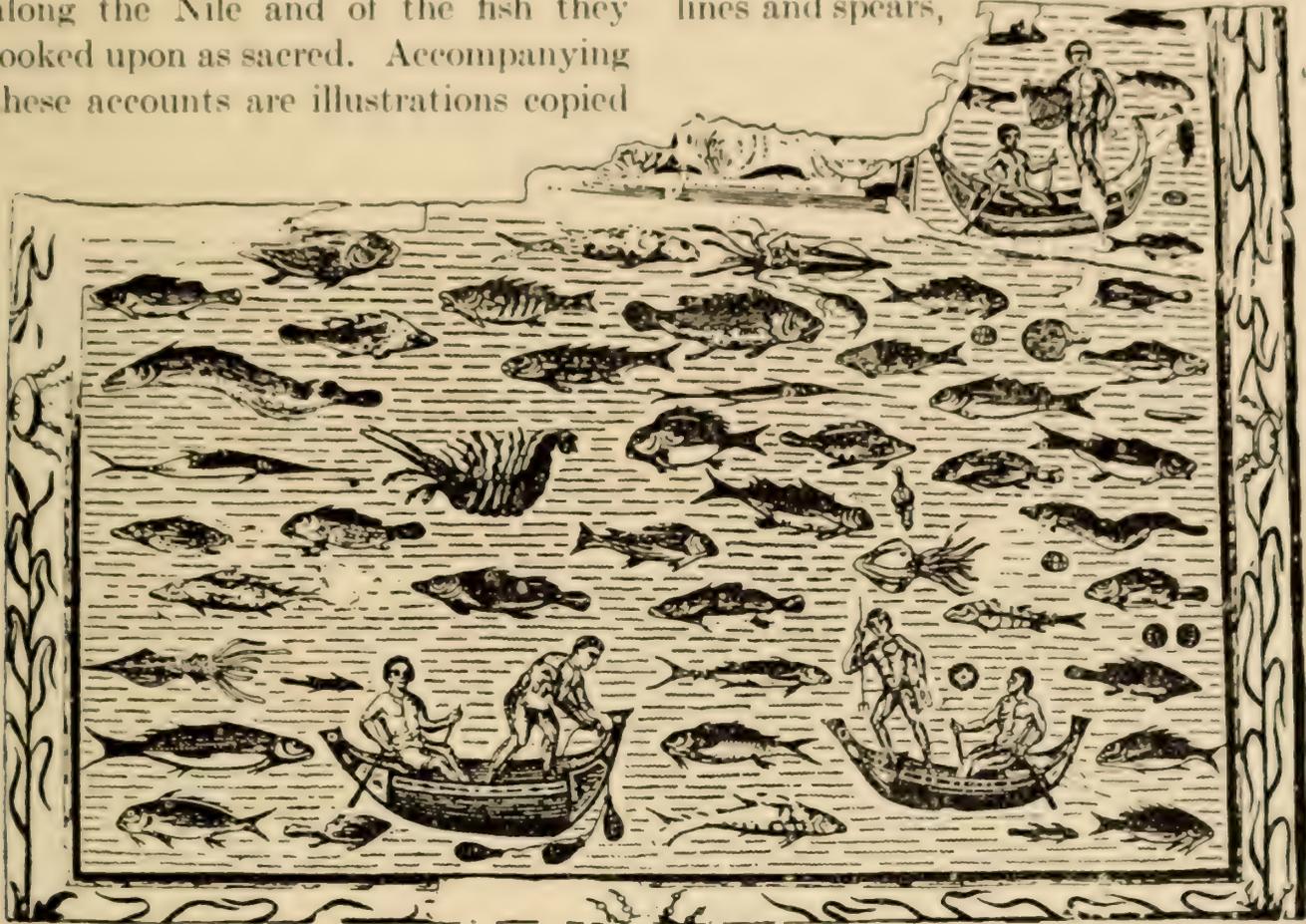
In addition, the ichthyologist will get exact references to the first descriptions of the salmon, trout, and pike and the first surmises regarding the method of reproduction of the eel; while the angler will find the earliest known accounts of the use of the jointed rod, the reel, and the artificial fly.

¹*Fishing from the Earliest Times*. By William Radcliffe. New York, 1921. E. P. Dutton & Co. 478 pp., 19 pls., many text figs.

The next section, consisting of seven chapters, deals with Egyptian fish and fishing, the latter being traced back to 2500 B.C. (according to Petrie to 3500 B.C.) Here we find interesting accounts of Egyptian fishing and fishing implements, of the fish that were taboo to the ancient dwellers along the Nile and of the fish they looked upon as sacred. Accompanying these accounts are illustrations copied

2000 B.C. and on these bricks we find listed also two hundred kinds of Assyrian fishes, a dozen of which can be positively identified today.

Fishing among the Jews is limited to five short chapters, for, if one excepts the account of the use of nets in Lake Galilee and to a less extent of hand lines and spears,



This picture, from a Roman mosaic at Sousse, illustrates different methods of catching fish, the net and the trident for spearing being indicated in two of the examples and what are believed to be bottle-shaped baskets in the third instance. The picture is derived from *Revue Archeologique*, 1897

from the tombs, including the earliest known pictorial records of fishing with the rod, the reel, and the net.

Next come eight fascinating chapters on piscatology in Assyria, among the topics treated, translated from the ancient bricks with cuneiform inscriptions, being the earliest fishing contract and the first record of poaching on fish preserves, divination and augury by the use of fish, Dagon and the fish gods, and the origin of fish in the calendar. Through these records in cuneiform, the use of vivaria is traced back to

there is little more to be said of it than can be related of the catching of snakes in Ireland. There was no fishing for sport, and no use of the rod, an implement which one might have expected the Jews to bring back from Egypt. No ichthyolatry was practiced in Judea, but there was a taboo on scaleless fish. Furthermore, the interested reader may learn much about the fishes of Tobias and of Moses, about Jonah and the fish (not a whale) which gave him refuge, and about the fish which restored Solomon's ring.

Shorter still is the account of Chinese fishing, for, since the author does not trace the history of fishing beyond 500 A.D., he has available as sources only translations of the Chinese manuscripts. However, the reader will learn with interest that the early Chinese were the first to engage in fish-breeding and that the first artificial incubation of fish ova was effected by filling the empty shells of hens' eggs with fish spawn, and then entrusting the hatching of the strange brood to a confiding hen.

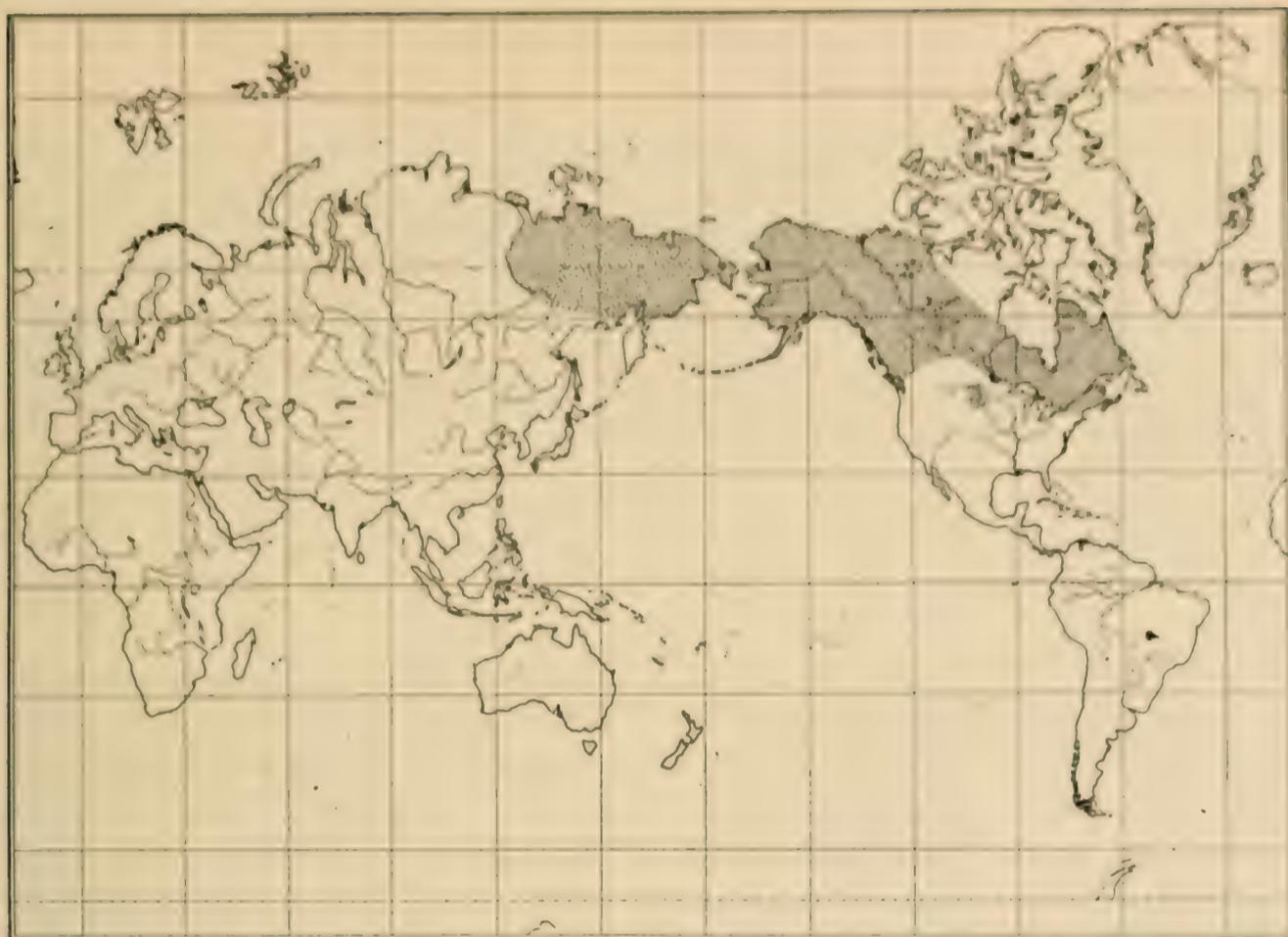
Mr. Radcliffe's book is alike entertaining and informing, touching as it does on a multitude of subjects relating to fish and fishing from the remotest times. The faults are few and, with one or two exceptions, of no particular detriment. In covering such a vast field of time and so great a range of subject, the book is somewhat discursive and diffuse, but I am not sure that this does not add to its charm. The typography is excellent, though one regrets to see Rondelet's name persistently spelled Rondolet.

The sales of the book should and undoubtedly will call for a second edition and when that appears, there should be associated with the title a subtitle indicating that the author's researches trace the subject up to the year 500 A.D. but not beyond. Then, the next edition should have a bibliography. Footnotes may be of value to the general reader, but, since this publication is a source book of great value, the titles of the works referred to should be collected and arranged alphabetically at the end.

Mr. Radcliffe's monograph is literally *sui generis*, a unique work. Other books on halieutics barely touch on the beginnings or at most give a few chapters to fishing among the Greeks and Romans, but here we have an octavo volume of 478 pages devoted to the ancients alone. *Fishing From the Earliest Times* is the most comprehensive treatment of the subject that has been attempted thus far and will probably hold an unchallenged position in its field for many years to come.



Two men engaged in fishing are shown on these coins from Carteia. The illustration is taken from *Descriptions générale des monnaies antiques de l'Espagne* by A. Heiss



The darkened portions on the map indicate the area of distribution of the crooked knife

The Story of the Crooked Knife

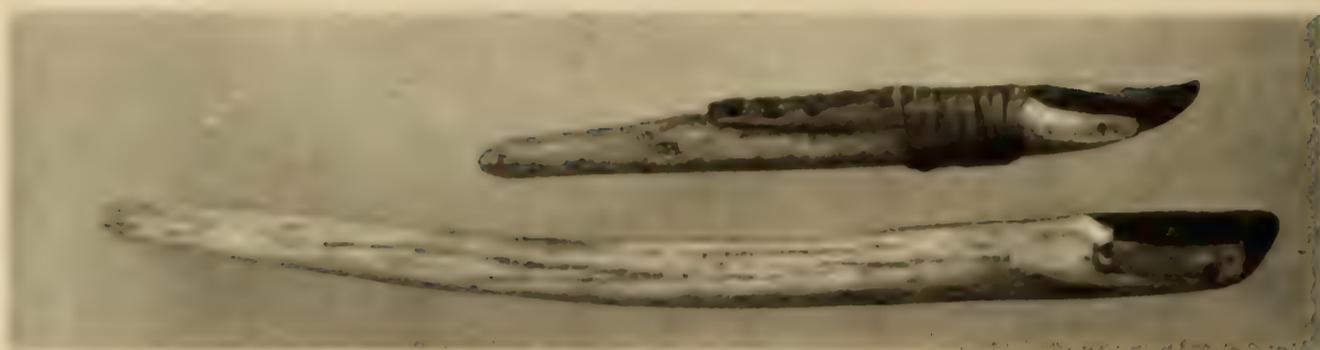
By CLARK WISSLER

Curator of Anthropology, American Museum

IN the American Museum collections from the Eskimo of Alaska are curious knives with short, crooked blades, suggesting the beak of a hawk. The blade may be of iron or steel, the handle of ivory, bone, or antler, curved as seen in the picture on p. 160. Knives of this character and similar knives are found among practically all the forest Indians of Canada, the area where it is used extending to but not including the Eskimo west of Hudson Bay and across the continent into Siberia. The Eskimo just west of Hudson Bay, among which are those visited by Stefánsson, do not have it, nor do those of Baffin Land and Greenland. On the other hand, it is reported from Labrador. This is a curious distribution reaching from Maine and Labrador on the east to the interior of

Siberia on the west, curious because only those Eskimo who live in the path of this crooked-knife zone use the implement. Furthermore, such a knife is not used in western Europe, and the Indians and Eskimo that know of it hold it in an unusual way; i.e., they draw the blade toward the body, guided over the surface by the thumb. It is interesting, therefore, to inquire how and where this knife originated, not merely for the history of this particular tool, but because the implement is typical of many elements of culture. An understanding of one such element may serve to explain what is happening in our own national life with its borrowings and adaptations.

Now, there are several ways by which the knife could have appeared in its area of distribution. For instance,



Specimens of the crooked knife of the Eskimo in the collections of the American Museum. The blades are of metal and the resemblance in shape to the beak of a hawk is well illustrated in the upper specimen

it could have been brought in by trade after the discovery of America, but since we do not find it in the countries from which these traders came, that supposition must be abandoned. Again, some native may have invented it. Yet, if so, this must have happened after the introduction of iron and steel by traders, because these metals were unknown in aboriginal times. This supposition is quite possible and so far agrees with the facts here presented.

However, people do not invent something from nothing, so we may expect that this crooked knife of iron is a modification of an older implement. Turning then to our Eskimo collections, we find a similar knife with a curved handle, but the tiny blade, instead of being of metal, is of stone, and in shape is straight instead of crooked. One might, therefore, conclude that the crooked blade of iron came in later as an improvement. Yet

Murdoch, who was the first to describe these stone-bladed knives in 1892, suspected the Eskimo of having made merely a few of them to sell to collectors, who seemed to favor stone tools. In fact, he made a strong case against the priority of these knives. But since the appearance of his contribution we have accumulated more data. Stefánsson excavated old villages around Point Barrow and among many thousands of specimens he thus obtained are a number of handles for the crooked knife, about sixty in all. Most of these lack blades, but a few have iron blades, badly rusted, one a copper blade, and five, blades of slate. There can be no doubt that these stone blades were put into these handles many years before Murdoch visited Alaska, yet iron, too, was, as indicated, in use even then, and careful study of the slots cut in the knife handles of the Stefánsson collection indicates that many were



These two Eskimo knives in the collection of the American Museum have a blade of slate, but their general shape and character entitle them to inclusion in the crooked-knife group

originally fitted with blades of this metal. There is one important point of difference, though: these blades were narrow strips of iron, ranging from one to two inches in length, whereas the crooked knives shown at the top of p. 160 carry a blade held on by rivets.

Strange to say, we get light upon this subject from an unsuspected quarter. In Dakota, along the Missouri River, lived the Mandan Indians, and from the house ruins of their forefathers have been gathered similar knives. The curved rib of a deer is used for the handle and in the Brower archæological collections in St. Paul, Minnesota, we find these knives with blades of chipped stone, bone, copper, and iron. Since archæological evidence shows that the Mandan lived continuously in this area, it is fair to conclude that the early prehistoric form of this knife bore a stone blade, that later copper was sometimes used, and that finally, with the coming of white traders, iron was substituted; but it was still the same kind of knife and employed in the same way.

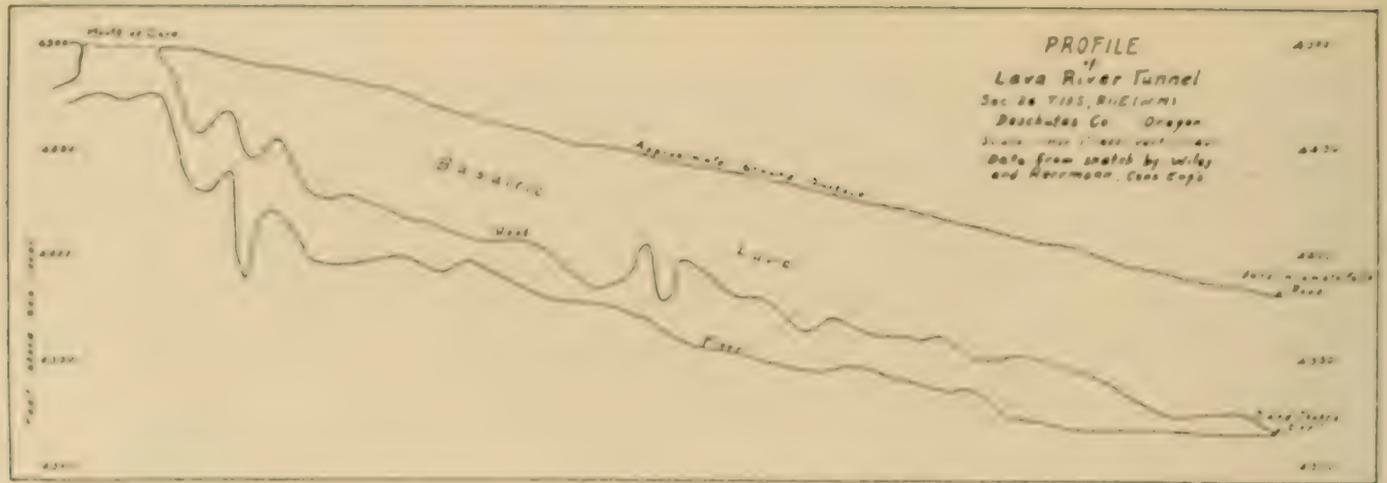
We have but glimpsed at an interesting story in the culture of man, and must close with a few comments. We see that the iron-bladed crooked knife is an improvement upon an older form, so far found only in Alaska and Dakota. Yet the chances are that this older form once covered all the intervening territory. That the Eskimo invented it is unlikely, because, seeing that it reached Dakota, it should also have found its way into Greenland, as did other Eskimo tools. Furthermore,

only the western Eskimo use it. We suspect, then, that it was invented by a Canadian tribe, many centuries ago, and had time to spread to Alaska on the one hand and to Dakota on the other before the coming of the fur



The way the Eskimo holds the crooked knife. The blade is drawn toward the person using it

trade. When iron became abundant, improved blades were made, and so the modern form of the knife came to prevail. Perhaps its distribution is somewhat greater than that of its humble stone ancestor, but of that we cannot be sure, for in all matters of culture, tradition and habit resist innovations. Europeans and the peoples of Central Asia do not draw the knife toward them when working down a piece of wood, as do the Indians and Eskimo who use the crooked knife; yet this was the way to use the old stone knife. Naturally, then, the American native found the trader's knife unsatisfactory in shape, but recognizing the superiority of its metal, improved his own knife rather than change his motor habit.



The Lava River Tunnel

A SUBTERRANEAN CONDUIT IN DESCHUTES COUNTY, OREGON, THROUGH WHICH AT ONE TIME FLOWED A WHITE-HOT STREAM OF MOLTEN LAVA

By IRA A. WILLIAMS

Geologist, Oregon Bureau of Mines and Geology

TOPOGRAPHICALLY the state of Oregon is separated by the Cascade Range into two parts, western Oregon and "central" or eastern Oregon. The summit line of this range is marked by a series of elevated mountain peaks the highest of which are snow-limned the year round and still carry upon their higher slopes the dwindled remains of once more-extensive glaciers.

Between and about these prominent peaks, at many places upon the crest and upper slopes of the range, there are new lava flows, and cinder and lava cones where eruption has occurred within geologically recent times. Indeed, it would appear that a good portion of the superstructure of the Cascades has been built up by successive and repeated outpourings of andesitic and basaltic lavas. Late volcanic action continued also as a dominating process over large areas at the east base of the Cascade Range, and hundreds of square miles of contiguous central Oregon country are dotted with craters which were the focal points during periods of recent violent volcanic eruption.

Large stretches of this interior Oregon region—Oregonians call it the Inland Empire—are still quite unsettled. Stage routes cross it in various directions. It has been livestock range for many years, and into the scattered yellow-pine areas that are not included in the national forests the logging companies are now vigorously pushing their operations. The juniper, a member of the cedar family, grows quite generally outside of the pine belts, and it, too, is being harvested in quantity for pencil wood. Settlement has been slow because of the semi-aridity of the climate, this limiting condition accounting also for the generally sparse covering of vegetation that characterizes much of the so-called sage-brush country.

On account of the low rainfall, soil formation has progressed slowly and rock surfaces are but little modified by alteration or obscured by the accumulation of the residues of rock decay. As a result, many of the primitive features of the later lava flows that overspread large areas in central Oregon are still in plain view today. The existence of open craters leaves no

doubt as to the points from which the liquid lavas have issued. Cinder cones are interspersed among the less conspicuous vents and represent the sites where the products of the eruptive forces, when they had acquired explosive violence, were flung out and piled up in heaps on the surface of the land.

A great variety of these recent volcanic phenomena is to be observed in Deschutes County, which includes the geographic center of the state of Oregon. The city of Bend, on the Deschutes River, 150 miles south of the Columbia, is the railroad outlet for this region. Branches reach Bend from both the Union Pacific and the North Bank railroads, the main lines of which thread the gorge of the Columbia for a hundred miles or more where it forms the northern boundary of Oregon. The novel attractions of this region are becoming known and accessible to an increasing extent each year as highway construction and settlement progress. The writer feels impelled to undertake the presentation of these varied attractions; for there are many reasons to believe that with a small amount of additional exploitation they will quickly become the Mecca of a tourist traffic comparable with that now enjoyed by Oregon's other wonder places,—the Columbia River Gorge, the Marble Caves of Josephine County,¹ established in 1909 as a national monument, and Crater Lake National Park.

For the present, however, attention is to be called to but a single thrilling spectacle, an outcome of only one of the many interesting events which must have accompanied the days of dwindling volcanic activity,—the Lava

River Tunnel. The applicability of the name will be appreciated when it is stated that this tunnel is but a distinctive form of lava cavern. Other types of caverns are found in the region but that to be described is the only one as yet explored sufficiently to leave no question that it formerly served as an underground conduit through which coursed a river of lava, a stream or succession of streams so seething hot as to flow for a long distance like water.

The entrance to this tunnel can be reached by automobile over a side-trip of a mile from one of the main arteries of the state highway system, the Dalles-California highway, at a point twelve miles south of the city of Bend. At the present time the region is forested by a beautiful open stand of yellow-pine timber. Logging operations are approaching the location of the tunnel and these, if unretarded, will greatly affect the attractiveness of its surroundings. It is hoped that before the day of complete deforestation has arrived measures may be taken through one agency or another to have the Lava River Tunnel and its environs permanently preserved as an outing and pleasure place as well as a natural curiosity.

So inconspicuous is the surface opening into this tunnel that on approach one is quite unaware of its proximity. Its position is indicated by a mere corrugation in the lava surface, away from the very brink of which the stately pines give no suggestion of its presence. The entrance consists of a shallow rocky trough at each end of the bottom of which there is a dungeon-dark opening. Careful examination of it shows without any question that the existence of the underground passageway, the Lava River Tunnel, has

¹See NATURAL HISTORY, September-October, 1920, pp. 396-405.

THE GATEWAY TO
THE TUNNEL

The entrance to the Lava River Tunnel is an inconspicuous opening at one end of a shallow rock-bound trough formed by the collapse of a part of its roof. The roughly circular black area that appears on the photograph at the person's right is the orifice which gives access to the tunnel depths. By consulting the profile map at the head of the article, the reader may get an impression of the relationship of the surface trough, designated "mouth of the cave," to the tunnel itself



been revealed to us because here a portion of its roof has collapsed. Each way, to the southeast and to the northwest from the entrance thus adventitiously produced, the tunnel has been traversed for a mile or more.

The tunnel entrance is near the southeast corner of section 26 in township 19 south, range 11 east from Willamette meridian. Only the part that extends northwestward has been at all carefully explored and it is in this part that the accompanying underground photographs were made.

The profile drawing shows a fairly regular gradient of the floor, approximating two per cent. It is interesting to notice also that the slope of the ground surface above it is a comparatively even one and of about the same angle from the horizontal. The roof of the tunnel, that is, the thickness of rock between its top and the surface of the ground, ranges from eighty to ninety feet. Measured from the entrance to the point where it is choked by a filling of volcanic sand, the northwestern part of the Lava River Tunnel has a length of 5462 feet if there be included in the calculation a number of moderate crooks in its course. The character and lay of the country are such as to suggest the likelihood that the Lava River Tunnel extends a considerable distance farther in a northwesterly direction.

To enter the tunnel, the coolness of whose darkening shadows is more often than not, at least momentarily, a welcome relief from outdoor temperatures, one clammers down over a steep, rather treacherous slope of large broken blocks of basaltic lava, the wreckage from the downfall of a portion of the roof of the structure. At the foot of this rocky slope it is apparent at once that we are entering a great bore which

runs through a body of solid lava. For its entire length it is surrounded by the basalt of this same flow, which is at least a hundred feet from top to bottom. Thinking of the tunnel as in general near if not at the base of the flow, we at once get the impression of its having existed here as a great open tube through which liquid lava moved as a subterranean surging white-hot stream, long after the enclosing rock, itself at one time liquid lava, had come to rest, cooled, and solidified. In other words, this opening, the traversing of whose winding course today excites so strong a thrill of interest, is the conduit through which, while the supply lasted, the molten stream continued to flow down the slope of the old land surface until it drained away just where we do not know, though more than likely through some outlet at a lower level in the ancient cañon of the Deschutes River.

As we explore the length of the tunnel, the evidence is profuse that the lowering of the stream was not an even and continuous process, but one, rather, of intermittent or fluctuating nature. There were doubtless stages of flood as well as intervals of sluggish flow, just as in streams of water, and the position of the lava surface rose and fell accordingly. Clinging to the tunnel walls today are remnants of the stony current, in some places appearing as mere projecting slaggy crusts and in others as rounded overhanging cornice-like shelves, that mark the varying levels of the liquid stream. Often the entire walls are so decorated, the protruding shelves at rare intervals extending across from one side to the other to form a false floor or "upper deck" for a little distance.

The depth of the tunnel, from the apex of its ceiling to its floor, ranges



That the lowering of the lava stream was not an even and continuous process but one of fluctuating tendency is abundantly evidenced by the slaggy remnants clinging to the walls of the tunnel that mark the varying levels of the molten stream



The walls and ceiling of the tunnel are coated almost throughout with a glaze of greater or less smoothness, and pendants, stalactite-like in form, decorate the roof in many places

from twenty to thirty-five feet. Its width from wall to wall is nearly as great. Almost throughout, the walls and ceilings are coated with a glaze of greater or less smoothness and pendants, stalactite-like in form, ornament the ceiling in many places. These are the lava-drip, clinging fragments from the plunging current which, while yet viscous, assumed by gravity a hanging position, and now delusively resemble the shapes of icicles or of stalactites formed by dripping water in limestone caves.

The deception is more striking still when either a single one or a cluster of these "lava-icles" is examined closely. It is found that they have a highly vesicular texture within and on the outside a dense and largely non-porous casing. Many of the vesicles are elongated up and down, and some of the more spikelike and more drawn-out of the forms are continuously hollow for inches of their length and have the lower end of the tube open. The last-mentioned feature is so notable that one is stirred to wonder if the shape and structure of these pendants may not have been modified to some extent in recent times through the deposition of mineral matter by trickling waters, evidence of the presence of which in certain seasons of the year we see in abundance. Neither chemical tests nor the petrographic microscope, however, lends any assurance whatever of the validity of this conjecture. Chemical tests indicate only a natural silicate slag in composition, while the microscope reveals the presence of a rudimentary set of minerals characteristic of the volcanic rock basalt, which are, of course, formed only through the igneous process of cooling from fusion.

We are thus left no alternative but

to conclude that not only the mineral composition but also the outer shape and internal make-up of these ornate features of our tunnel are normal results of this rather unique, still not so very unusual phase of volcanic action, — the period of activity, decadence, and final disappearance of a river of lava. The porous texture of the pendants is due to the inclusion of rock gases when cooling took place, while the open hanging tubes are most easily explained on the theory that they were formed by the solidification of a scum or outside crust of lava slag, from the inside of which the still



The form and character of the surface of a lava stalactite is well illustrated by this specimen. Approximately one-sixth actual size

liquid froth drained out to the last drop, leaving an empty shell and in some instances even failing to seal the tip end of the tube.

At a few places in the more than mile length of tunnel that extends from the



CAÑONS, PINNACLES, AND MESAS CARVED IN THE SAND BY DRIPPING WATER

The volcanic sand which partly fills the tunnel has been etched in places into a varied relief by the water that enters during the wetter parts of the year. The miniature Grand Cañon in the foreground is twenty-five feet in depth, eroded in sand. The curve of the tunnel arch is notably perfect here



LAVA DREGS FROZEN INTO SOLID ROCK

As movement of the molten stream finally ceased, stretches of the bed were covered with a scraggy veneer, the solidified dregs of the flow. The strains of flowage are indicated by the diagonal curving shadow lines that show on the roughened surface of the tunnel floor.

opening to the northwest, portions of the roof have broken down and one must clamber with extreme caution in the dungeon darkness over heaps of large lava blocks. This is the exception, however, and throughout most of its explored extent, the tunnel displays such a perfection of design as to resemble the best of man-made tunnels. Its dimensions and its shape were determined by the pressure of the moving stream of lava that was forcing its way down the long slope while the surrounding portions of the great flood were congealing into solid rock. After taking shape it accommodated for a long time a fluctuating but in general dwindling strength of current until, the supply exhausted, the stream went dry and its bed was deserted.

In the drying up or final draining of the channel, portions of the molten stream would settle into depressions in the floor, there to cool and solidify. As movement finally ceased, even stretches of the bed were at the last covered by a scraggy veneer of these lava dregs, frozen into solid rock as we now find them. The photograph on page 169 shows a very characteristic phase of this scoriaceous slaggy lava floor. It now displays the very features it possessed when first it hardened and forward motion of the ropy stream ended. In the view the diagonal and rather indistinctly parallel curving of the shadow lines on the floor mark the direction of the strains of flowage, the tendency being for the middle portions of the stream to forge ahead in relation to the more slowly moving side parts whose friction with and tendency to freeze to the tunnel walls became ever greater as the temperature lowered and motion became less.

Where the floor of the tunnel is not so paved with the hardened

final settlings from the lava stream, which, by the way, produce a surface that is rather more than usually destructive of shoe leather, it is quite generally covered by a filling of volcanic sand. In contrast, the sand affords a surface most delightful to walk over. While no evidence has as yet been found to suggest that the tunnel was ever occupied by a stream of water, or that the sand filling could have had that origin, its deposition in the tunnel is an event post-dating entirely vacation by the lava stream, though long before the present time. Where the sand really did come from is an interesting question. It has been suggested that earthquake tremors may have raised the sand through crevices from beds of it which are known to exist below the later basaltic lavas. It may, on the other hand, have filtered in through cracks from above. At any rate, in places in the tunnel the sand is many feet in depth, its surface here and there approaching the ceiling, and finally, as shown in the profile sketch, it chokes the bore completely blocking further penetration. In case an attempt is made to open up the tunnel further by excavation in the sand that now closes its northwest end, it will probably be found that at intervals its course is interrupted by falls of lava from its roof as well as by the sand.

The present surface of the sand varies from a quite smooth or slightly pitted condition to one of varied relief, produced by the sculpturing action of water dripping from the ceiling and side-walls during the wetter parts of the year. The accompanying photograph shows the extent to which the erosion of the sand has progressed in places. Apparently the quantity of water that finds its way into the tunnel is so considerable at times that by its

erosive action many of the common types of land forms are reproduced on a small scale. Here, molded in the sand which composes the walls of this diminutive Grand Cañon, are pinnacles and pillars, sharp gulches and intervening miniature mesas,—reproductions on a pygmy scale of many of the land features that often result from the rapid work of water in comparatively soft rock materials. The shelf beneath the tunnel arch in the rear is the top of the sand fill. From this level to the bottom of the "cañon" in the foreground is a vertical depth of about twenty-five feet.

Within approximately one mile of length, represented by the northwest part of our rock-bound tunnel—which, as we have seen, is but the deserted course of a once rapidly flowing river of liquid lava—are displayed, as might not be appreciated at first thought, very few of the characteristic features that would be presented by a similar underground channel formerly occupied by a river of water. In either case there would be, of course, first of all the bore itself. This tunnel came into being and was maintained to the end because of the heat and consequent liquid state of a portion of a lava flow. Once formed, its walls and ceilings were glazed and tastefully decorated by the splashings from the torrential white-hot stream, as to the turbulence of whose rapids and cataracts as well as the serenity of whose pools, we can only conjecture. When the supply failed, portions of the lava stream hardened, some clinging to the shore lines as it were, shelves of it

fastening against the walls of the tunnel, pools of it resting in the channel bed.

Similarly would a water stream seek out a subterranean passage or, more often than not, would find one ready-made; and upon desertion, water being a liquid ordinarily, would drain away completely, the wet of its splashings against the enclosing walls evaporating into the air and even the icy crusts of winter, if such there were, disappearing with the succeeding springtime. As a result there would be found in after years no such indelible details of the record of past events as are open to inspection in this tunnel of the lava river where not only main chapters are set forth, but a profusion of successive paragraphs of its story, and even poignant sentences and lines that throw light on its life history.

We revel in the reading of this story, partly perhaps because much of it must be done through the wavering shadows of a flickering torch or candle flame one hundred feet below ground, but mainly because thereby we are forging one more thrilling link between the present and a most stirring prehistoric past in central Oregon. There is, too, a possible economic application of our reading of the story, since the projection of the tunnel in a continued westerly direction beyond where it is now sealed with sand, would appear to take it within a short distance directly beneath the floor of a proposed reservoir site which is to be the nucleus of an irrigation project of considerable magnitude.



Cape Mountain terminates the range which extends along Seward Peninsula, Alaska, the westernmost extremity being known as Cape Prince of Wales. The mountain rises sheer from the water's edge, but slopes more gently from the tundra country. The higher benches were free of snow by June first, and migratory birds were abundant.

The Haunts of the Emperor Goose

BY ALFRED M. BAILEY

Of the Colorado Museum of Natural History

CAPE PRINCE OF WALES, the westernmost promontory in North America, has long been of interest to naturalists because of its nearness to Asia, the two continents being separated by a scant forty miles. Bering Strait acts as a barrier, but the Diomed Islands serve as stepping stones, so that Old-World forms of bird life might well be expected to take advantage of the short flight from the Old World to the New. The Cape is just south of the Arctic Circle—a precipitous, rugged mountain which seems to draw the winds from all points, making the territory immediately around a veritable blowhole and giving Wales, the little Eskimo settlement, the unenviable reputation of having the worst all-the-year-around climate in Alaska.

I had made the long trip down from Point Barrow by dog team over the winter trail, a distance of about 750 miles, purposely to study the birds of the Cape and to collect a group of walrus. A backward spring with much ice, southern gales, fog, snow, and rain, made the nesting season later than I was led to expect from my experience in other parts of Alaska, so that, although I was engaged in collecting my walrus group until nearly the latter part of June, there was still ample time to do a little field work among the nesting birds. Ornithologists are always interested in the ivory gull, the Mongolian plover, the emperor goose, and the spectacled, Steller's, and king eider, and as this region had never been worked by one interested in birds, it was my hope to

take specimens of some of these rare species. The spring work on the Arctic pack brought me a series of ivory gulls, and a Mongolian plover was secured along the sandy shores of Lopp Lagoon. The tundra at that time was still in its winter cloak of white, but as the higher benches of the Cape became bare, the migrants from the south arrived in numbers.

June found the tundra nearly free of snow but the northern slopes of the mountains were still white—only the prominent shoulders being exposed, and over the great expanse could be seen the various kinds of Arctic birds, carrying on their courtships and preparing to rear their young. The sandpipers of different species were the most common, but snow geese, cranes, and swans hurried northward, and a few red-spotted blue-throats drifted across the channel from Siberia.

Lopp Lagoon, a great shallow lake extending to the northward from Cape Prince of Wales, is separated from Bering Strait by only a narrow neck of land. It was along this lagoon that I hoped to spend some time. The latter part of June all arrangements were completed. The shore ice had gone out, making it possible for us to skirt the coast in the little skiff which I had secured for the purpose, but the adverse weather conditions and heavy surf made it impossible for us to leave. After a week's waiting I had the boat pulled across the tundra to the shore of the lagoon, and about midnight, July 3, got under way with two Eskimos, Nagozruk and Tavok.

To an ornithologist the tundra at midnight is a real delight, for the sun is just below the horizon, giving relief from the glare of the long Arctic day, but with light still strong enough for observations. The birds are resting,

often flushing from under foot, although the little sandpipers quickly return to the nest once the intruder has passed. On this particular evening we flushed flocks of old squaws lined upon the ice of the lagoon, for even at this late date the ice had melted only along the shore. A dozen or more red-throated and Pacific loons milled about overhead, darting by with arrow-like directness and often as not, after making a great detour, again passing above us.

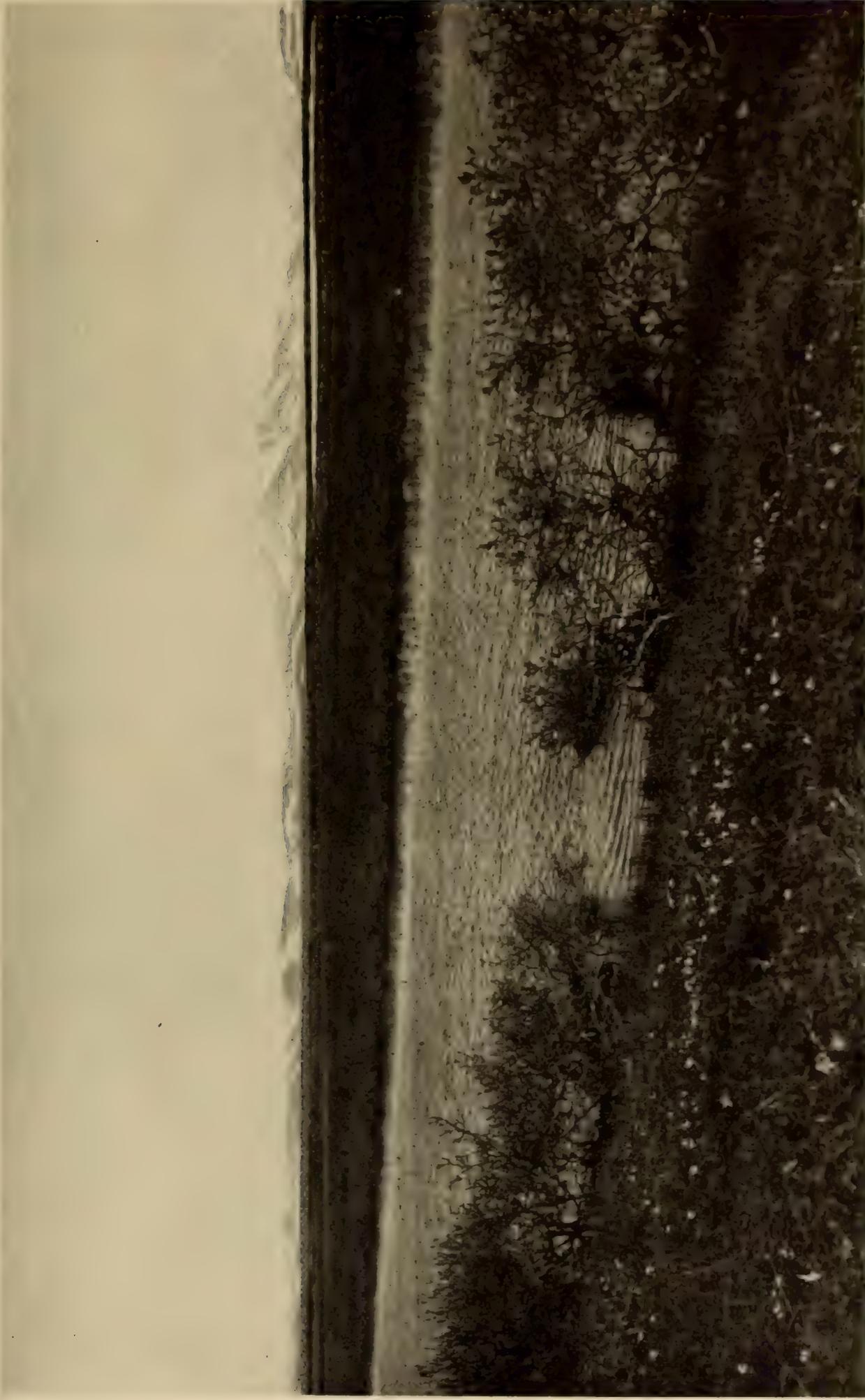
The first day's work on that trip was strenuous, for the ice reached the shore in many places, making it necessary for us to drag the boat across, and often the water was so shallow that we grounded. Then, even though the three of us tugged at the shoulder straps, we would advance only inch by inch—and sometimes we failed to make any perceptible progress.

It was very windy on the Fourth, but we made good headway notwithstanding and picked up a few specimens. The first emperor goose to fall to a collector's gun is apt to furnish a thrill. I had been studying the shore line with the binoculars as we worked along, and when I noted a pair of these birds standing on a tundra hummock, I motioned to my Eskimos to take me ashore. The ground was practically level, but by taking advantage of slight depressions I managed to get within shooting distance before the birds flushed, dropping the male upon the ice of a small pond. Two hundred yards beyond was another pair; the stalking was repeated and this time a female was taken. I had been in plain sight all the time, from which it may be inferred that the emperor goose is ordinarily rather unwary. As I was admiring the two birds I had secured, I saw a long string of geese far out over



LOPP LAGOON FROM CAPE MOUNTAIN

Lopp Lagoon extends northward from Cape Prince of Wales for thirty miles, a wide, shallow lake with tundra shores. Small islands at the mouths of several rivers which drain into Bering Strait are the favorite nesting grounds of old squaws and emperor geese



A HAUNT OF THE EMPEROR GOOSE

The valley of the Mint River is one of the most picturesque areas of the tundra country, with snow-scamed mountain ranges, placid lagoons, willows, Arctic flowering plants, and an abundant bird life. The emperor geese nest along the fresh-water ponds, in close proximity to Lopp Lagoon. Shore birds rear their families upon the barren tundra, and many little redpolls, Siberian yellow wagtails, and Alaskan longspurs are found among the Arctic willows



The first nest of an emperor goose that we found was on the small islet beyond the drift log. Water birds prefer islands for nesting sites because of the greater protection from predatory animals.

Lopp Lagoon, fairly high in the air. They suddenly dropped close to the ice and swerved directly ashore, the whole string passing at close range—and two more geese fell softly into the moss.

We camped that evening on a gravel bar, and as we felt a little "mukki" we turned in about six o'clock and slept until sun-up. The day was typical of the region—fog with drizzling rain—but we broke camp and started on our tour of investigation, visiting three small islands near by. Several flocks of emperor geese were seen, and in the course of the morning I added four more birds and my first set of eggs to the collection. The site from which the eggs were obtained was a little mound in a small pond on one of the mud-lump islands and its discovery was due to our flushing the nesting bird. She did not allow us to approach within thirty feet of her

before taking to wing, but she took the precaution of covering her two eggs with a mantle of down. I set my camera with a long string leading over a bank, thinking that unobserved we might be able later to photograph her, but upon our return after an absence of two hours I found her still resting on the sand bar on which she had first alighted.

Emperor geese are the only forms usually seen along Lopp Lagoon during the nesting season, although I observed a few snow geese and black brant during the week. It has been supposed that the center of abundance of the emperor geese is on St. Lawrence Island, but I believe they are equally numerous along the flat coast land bordering Kotzebue Sound on the south. The natives told me that Canada geese nested along the Serpentine River, but I did not see a single bird all spring that I could identify as

such. The emperor goose is not much larger in body than a male Pacific eider, and is as unsuspecting, so it is not difficult to bag. The geese fly low over the tundra, skirting along the edge of the lagoons, and flocks of

twenty or more often congregate on the gravel bars, where they loom up conspicuously. It seems that the nesting birds off duty band together with the immature and non-nesting birds to feed, for several specimens



Nest of the emperor goose.—Water birds of the Arctic usually conceal their eggs under a mantle of down, as indicated in the upper picture. Predatory birds, especially jaegers, are constantly working the tundra, searching for eggs, and destroy great numbers



At the mouth of the third river from Wales, which the natives call Mil-a-ka-tavik, is an abandoned Eskimo village. Its caches and igloos are gradually disintegrating, but there remains evidence of the prowess of the former inhabitants. When we visited the site, numerous skulls of polar bears and walrus lay about and the gigantic bones of whales helped support the igloos



Many of the Eskimos were "buried" near the abandoned village, the coffin being a rude box fashioned from drift wood, which was merely placed upon the tundra and left to decay. The Eskimos put the possessions of the "mukki-man" at the grave, old canoe frames, guns, and dishes being scattered in the near vicinity

which I took from flocks had their breasts partly picked. These geese are rarely seen far inland although they occasionally nest along the ponds quite far back from salt water. A roaring surf or grinding ice floes are ideal backgrounds for these beautiful birds, and we were continually seeing small groups of them while working along the coast.

We followed along the shore of the lagoon, headed for the third river from Wales. As the evening advanced, the water became glassy and reflected the snow-patched mountain ranges of the mainland in the violet sheen, and swimming ducks and loons were mirrored, their sizes grotesquely exaggerated. Several nests of glaucous gulls on near-by shell keys were advertised by the adult birds hovering overhead; long strings of old squaws scurried across the water as they took to wing, and an occasional small flock of geese curved away as we frightened them from their evening roosting place.

The details of an ornithologist's excursions afield are monotonous enough, and mine were no exception, for on rising each morning we had our usual breakfast of rice, eggs, and fried goose, followed by the tedious tramps across the tundra. It was my custom to send the Eskimos in the opposite direction from that which I chose to pursue, and when they found a nest, they would mark it in order that I might make positive identification later.

The next few days were spent in the vicinity of the third river, which the natives called Mil-a-ka-tavik. Our camp was located at its mouth, where the remains of an old-time Eskimo village still stand: a few ruined igloos gradually disintegrating and the skeletons of some of the former inhabitants

scattered here and there. The natives had "buried" their dead in crude boxes of drift wood, which soon decayed, allowing the moss-covered bones to be scattered over the tundra.

Redpolls, Siberian yellow wagtails, snow buntings, and longspurs congregated about the village site, and I found a nest containing four naked little wagtails under one of the foundations of a



Camp along the Mil-a-ka-tavik.—Our tent was always placed where it could be seen for a great distance, for there are few landmarks upon the tundra to aid the collector

decaying igloo. The semipalmated sandpiper replaced the western, which was the common form at Wales, only twenty miles away, and already the little chicks were beginning to appear. Red-backed sandpipers were numerous and an occasional Aleutian curved away at our approach. We found collecting profitable enough in that vicinity, taking a few eggs and specimens of the different jaegers, yellow-

billed loons, and Steller's eider. During the entire time the wind blew with such severity on shore that we could not venture into Bering Strait as was my desire. I had intended to run down the coast about thirty miles, but under the circumstances I finally had to give up the idea and instead headed for Mint River, on the mainland shore of Lopp Lagoon.

difference in scenery. The mountain ranges were clear cut, with their snow-patched valleys standing out in contrast with the blue ridges, and great snow banks lining the steep walls where the stream had cut its way through the high tundra. Several pairs of Pacific godwits, a flock of curlews, and numerous loons were seen, while willow ptarmigan were continually flushing, so

Habitat group of the emperor goose at the Colorado Museum of Natural History. These geese rarely occur far inland although they occasionally nest along ponds far back from salt water



Courtesy of the Colorado Museum of Natural History

It was a wonderful day, the finest of the trip, and Mint River proved an attraction to me because of its willows, some of them being five feet or more high—the first trees I had seen in more than a year! As we entered its shallow mouth, three geese dropped on a bar about one hundred yards away and Nagozruk showed his skill with the rifle by killing one of them.

The river was so swift we had to tow our boat along until we could find a suitable camping place above the muddy flats bordering the lagoon, but the work was enjoyable because of the

that I could hardly wait until camp was pitched and I was free to go afield.

I scarcely hoped to find nesting geese so far back from the lagoon, but worked the shore of Mint River carefully while the Eskimos went far back on the tundra. Cranes, loons, a pair of swans, and various shore birds were noted, and an occasional distant flock of emperor geese, but no nests of the last mentioned were found until my return toward camp when I nearly walked upon a brooding bird. The nest was about twenty feet back from a small pond, on a moss-covered mound.

The eggs were very conspicuous against their dark background, and a long-tailed jaeger circling near seemed quite interested.

The next day I covered a chain of ponds lying along the foothills of the mountain range, really on a search for the eggs of the yellow-billed loon, and there found my last set of goose eggs. Although it was July, the day was cold, disagreeable, and drizzly, with occasional flurries of snow. I had been out several hours with little success when I finally saw a goose feeding along a large pond, on which were also several yellow-billed loons. As I approached, the goose flew, and then as I neared the feeding grounds, I flushed the mate, which alighted in the water within twenty-five feet of me. The nest from which the bird had flown was made up of coarse grass, lined with down, and contained five eggs. They

were rather badly incubated as were the others which I took on the trip, including the set of two.

The following morning we started on our return trip to Wales, twenty-five miles away. A couple of yellow-billed loons were collected but for the most part we were too busy to hunt. We rowed and towed against a head wind, and at sundown had reached the first river, about eleven miles from the village; then we followed along the seaward shore of Bering Strait until we were forced to land because of the ice blocking the channel. We had no food but bird meat and not a dry piece of clothing among the three of us, so we cached our specimens and walked the rest of the way to Wales, getting in at seven o'clock in the morning, tired but satisfied with our little jaunt over the domain of the emperor goose.



The drifting pack

Natural Root Graft and the Overgrowth of Stumps of Conifers

By C. C. PEMBERTON

THE natural graftage which so frequently takes place between trees of the same species is a phase of plant life well worthy of the attention of the nature lover. When it occurs between roots of coniferous trees, it often produces a result which is of great biological interest and which has, in the past, provoked much discussion and comment.

As an art of the horticulturist, graftage has been known and practised from time immemorial and its uses and mode of accomplishment have, therefore, received abundant study and experimental research.

Natural graftage, on the other hand, has received comparatively scant attention. It has been looked upon largely as an accidental natural phenomenon. That it is in any way a tropism or a parasitic reaction does not seem to have been fully recognized. The frequency of its occurrence, the causes conducive to its attainment, and the results that follow, have not apparently received much attention.

Natural grafts between the stems and branches of a single tree, or between those of different individuals of the same species, have been noted very often. The union has generally been attributed to the different members coming in contact with each other and friction and pressure exposing the cambium and causing a graft.

Natural grafts between roots—either by the inarching of those of a single tree or the grafting together of the roots of several trees of the same species—is a well-known occurrence, though to what extent and under what circumstances these grafts will occur is

at present unknown and the causes conducive to the result are very difficult to determine. One reason for this is that in broadleaf trees (and a few conifers) root sprouts may develop to such an extent that there is every appearance of root graftage on an extensive scale.

The clearing from the land of the virgin forest growth with which this continent was originally provided must for several centuries have given plenty of opportunity to agriculturists to study the phenomenon and to observe whether root graft prevailed as a rule, or whether it was a rare occurrence, and also to determine what conditions were favorable to root graft. It does not seem, however, to have been deemed worth while to collect data.

In a number of species of conifers a very spectacular phenomenon has drawn attention to the prevalence of root graft. It consists of a peculiar condition of vitality which the stumps of coniferous trees sometimes retain after the stems have been felled and the stumps thereby deprived of foliage. These stumps heal over the cut and for years continue to form fresh, woody matter. The characteristic first attracted attention in Europe a good while ago and it has since, from time to time, raised considerable discussion. It is now generally conceded that the cause is the grafting of the roots of the stump with those of standing trees of the same species in the vicinity. Some people, however, still have doubts, especially where stumps are found very remote from standing trees.

These overgrown stumps have been found in various parts of the world.

They seem, however, to be absent from the eastern part of Canada and from the northern and eastern portions of the United States. If it is a fact that they are entirely absent from these regions, then the circumstance may be due, perhaps, to the long resting period during the winter in these localities, which may in some way prevent natural graftage of the roots. The outside bark may harden and lose vitality more quickly.

Irrespective of root graft being indicated by the presence of capped-over stumps, it is often observable directly in Douglas fir, the big roots of which spread along the surface of the ground. Sometimes this root graft between adjacent trees will develop into quite a bar, or wall, of wood connecting the two trees. Very extensive continuity of root systems has been noted in western hemlock (*Tsuga heterophylla*) on the west coast of Vancouver Island, where erosion has exposed the roots to view. It has not been determined, however, whether this is due to root grafting or sprouting.

Graftage is not due to contact and pressure alone, for there are plenty of instances where trees of the same species are found with their stems or roots tightly wedged together but without graftage ensuing. The point whether the bark remains vital or does not do so is, therefore, when the trees are of the same or closely allied species, probably the deciding factor. Many instances are to be found where stems or roots of trees of remote relationship are wedged tightly together, but nothing in the nature of graftage has taken place. In this connection it should not be overlooked that it is said that graft hybrids can be produced artificially and the finding of natural grafts actually existing between trees of

remote genera has also been reported.

The biological aspect of the phenomenon of natural graftage and of its attendant power in coniferous trees of maintaining the vitality in distant stumps, so that they cap over, is of absorbing interest. Evidently it is an indisputable fact that with some conifers a foliage-possessing tree can, by root graft, transmit life-giving sap to the stump of a felled tree of the same species. It also appears that this stump can in turn transmit the sap by further root graft to remote stumps which are too far away from the foliage tree to enable direct root graft to take place. A chain of indirect root grafts may, therefore, be the explanation why apparently isolated stumps show bulky overgrowth.

The practicability of the application of this wondrous creative power to economic use may be worth investigation. The root graftage should be capable of artificial accomplishment without much difficulty. Metal or concrete tops for use or ornament could be inserted on freshly cut stumps and would then become enveloped by the overgrowth. The stumps would thus serve as living pillars. Once root graft were established, the life of a stump could be made coextensive with that of the living tree from which it derived its vitality. On the other hand, if the standing tree utilizes the root systems of the stump, then trees in positions of drouth and paucity of soil might, by root graft, be made to obtain water and nutrition from stumps in damp, rich soil.¹ In fact, a wide field for experimental research and investigation of the phenomena of root graft and overgrowth of stumps seems to await exploration.

¹In California root systems of "gophered" orange trees are said to be successfully renewed by ingrafting saplings to the trunk of the "gophered" tree.

Natural Graftage

DIFFERENT PHASES OF THIS PHENOMENON ARE ILLUSTRATED BY THE FOLLOWING SERIES OF PHOTOGRAPHS TAKEN IN THE OPEN PARKLANDS OF THE SOUTHERN PART OF VANCOUVER ISLAND IN THE VICINITY OF VICTORIA

DESCRIBED BY C. C. PEMBERTON



NATURAL GRAFT OF STEMS

Natural graftage between stems and branches arises in a variety of ways. In the picture on the left are shown two stems of the Garry oak, *Quercus Garryana*, that are grafted together. When subsequently this compound tree was felled, the two stems broke apart and disclosed the mode in which the graft had occurred. In stems of trees the descending sap causes an increase of girth to take place by degrees downward. In this instance it could be seen that the graft had started at the top where the stems, due to their respective girth increases, had met. The impact had evidently induced the graftage, which had proceeded thence in a curved or horseshoe shape outward and downward. At the lower end there is a space in which the stems of both trees have retained their bark intact.

In the picture on the right the tip of a branch from the stem of a western red cedar, *Thuja plicata*, evidently became grafted to the stem of another cedar of this species. The branch thus linking the two trees seems to have formed a guide for the girth increases of both stems, which approached each other along the branch and culminated in a natural graft of the stems. Since the picture was taken, the trees have been destroyed by fire



In this instance it is apparent that the roots of two Douglas fir trees, *Pseudotsuga taxifolia*, crossed each other's path and that at the point of contact a complete natural graft took place. The Douglas fir on the right is flanked by two grand firs, *Abies grandis*, while other grand firs are to be seen in the background



As a result of pressure, due to their being crowded together in a pocket of soil, five saplings of the Douglas fir *Pseudotsuga taxifolia*, became firmly grafted together. They were subsequently overturned in a gale



WHERE CRAFTAGE HAS FAILED TO TAKE PLACE

This illustration not only tends to show that trees of distant relationship do not readily intergraft, even when pressed tightly together, but also incidentally emphasizes the great difference in mode of growth form between the coniferous trees of the fir type and broadleaf trees. One of the limbs of the Garry oak, *Quercus Garryana*, had crossed the path of a Douglas fir, *Pseudotsuga taxifolia*, that was pushing its way upward. The girth increase of each subsequently brought them into contact but no union or graftage followed and the fir gradually overcame the oak either by suppressing it through shade or by choking it through constriction



A seedling grand fir, *Abies grandis*, had lodged practically over the top of a large lateral root from a big Douglas fir, *Pseudotsuga taxifolia*. As these two trees of more or less distant relationship grew larger, the base of the stem of the grand fir, as well as its roots, came in contact with the underlying roots of the Douglas fir and there was evidently great pressure, for the roots of the grand fir indented those of the Douglas fir. No graftage, however, resulted from the pressure. After the felling of the trees and the consequent drying out of the roots, they rattled when shaken and, after they were sawed apart, the bark of each species proved to be intact.



When there is depth of soil, the grand fir, *Abies grandis*, has often a large tap root and also spreading lateral secondary roots. When the rich top soil is shallow and underlaid by stiff hard gravel or clay, the tap root is prevented from growing to a great depth. The lateral roots, however, are prone to send down a series of roots like tap roots. These come from the underside of the lateral roots like the prongs from a harrow and penetrate down to the hard soil or clay. The two grand firs shown in the illustration had been growing on a gravel mound and the downward direction of all of the roots was undoubtedly due to a quest for moisture and nutrition supplemental to the potent tendency of this tree to react to gravity. The lateral roots thus drawn downward had crossed each other's paths and the girth increase of each had induced graftage.



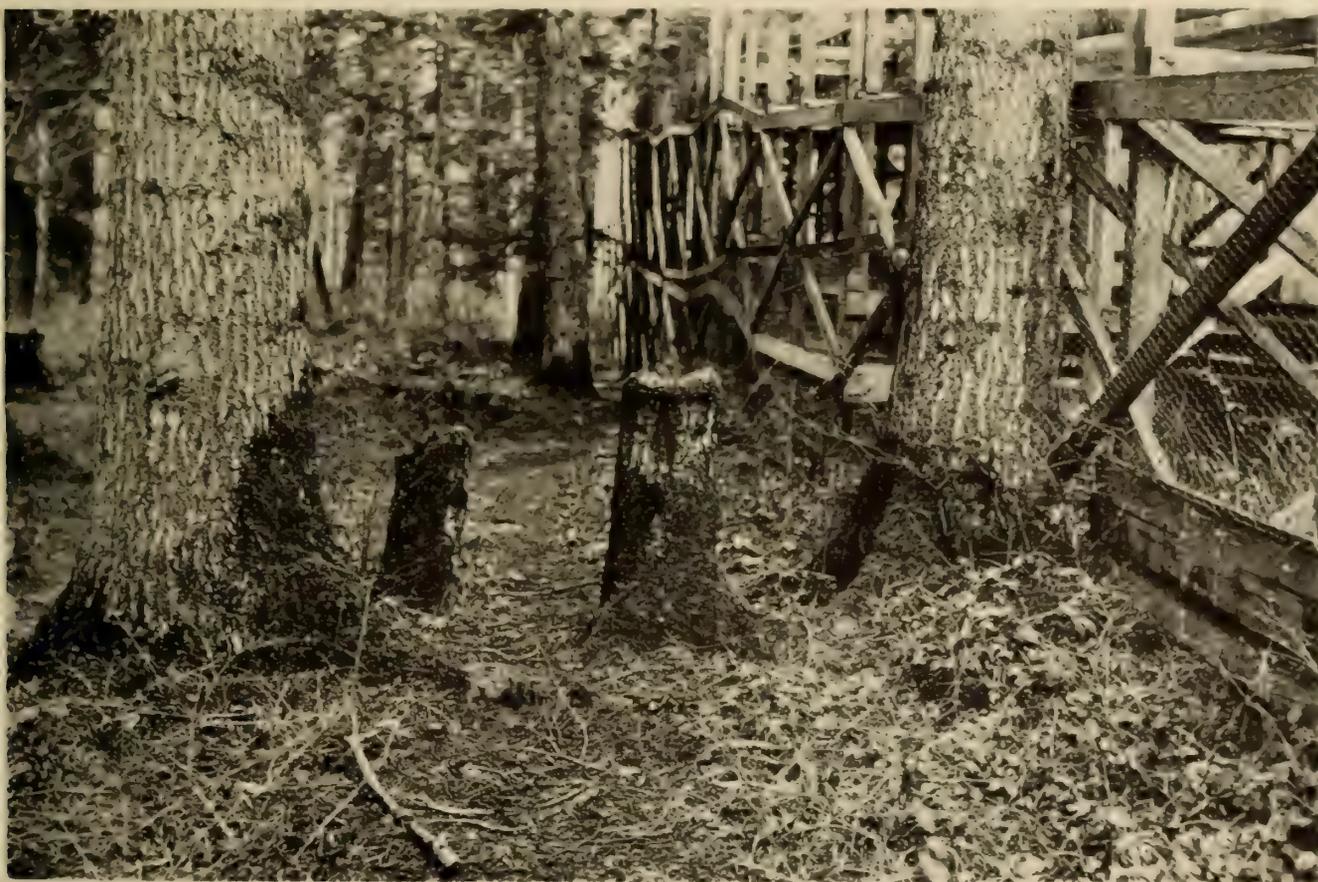
STUMP AND ROOT SPROUTS

In the center of the picture is a large stump of a Garry oak tree, *Quercus Garryana*. On the left is a sapling that has sprung from the rim of that stump. On the right is another sapling which is apparently a root sprout. As well as being examples of stump and root sprouts, both saplings show the healing-over of cuts made in the pruning off of limbs, and it is noteworthy that the healings in these cases are in the form of a ring from the outside, uniting in the center into a cap of wood. The cap will not form over a hollow; there must be wood or some other material to support it. In contrast to the broadleaf trees, few conifers can produce stump or root sprouts and consequently, unless united through root graft to a tree of the same species still possessing its crown, the stumps of most species of conifers die



The assertion that living stumps, such as those of the Douglas fir, *Pseudotsuga taxifolia*, in the illustration, could exist at all was at first received with derision. It was deemed impossible that stumps could remain alive after the loss of their foliage through the felling of the stem and without developing new foliage by stump sprouts. When, however, it was proved that stumps did actually remain alive in this miraculous manner, the cause became a subject of much controversy. That the living condition was a phase, or result, of natural graftage of roots was doubted, and many considered that the phenomenon might be due to the reserve material which enables stumps of broadleaf trees to sprout from the rim of a felled individual. It is now generally admitted, however, that the root-graft theory is the true explanation of the occurrence. The stumps in the illustration are good examples of the appearance commonly presented by the healing and overgrowth. In this instance the root graft has evidently been induced by the shallow soil, and the healing of the more remote stumps is as potent as that of the stump of the twin stem of the foster tree.

These stumps, as can be seen, are veritable living posts. Inasmuch as small saplings can cause the overgrowth of the stumps of trees of much greater size, it is conceivable that by artificial root graft the foster trees could be renewed from time to time and that, therefore, the posts could be made to last forever.

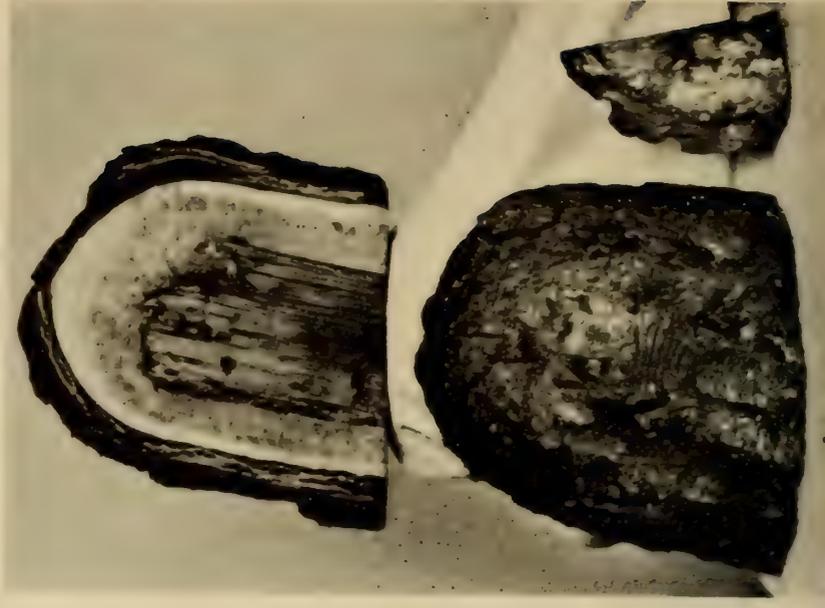
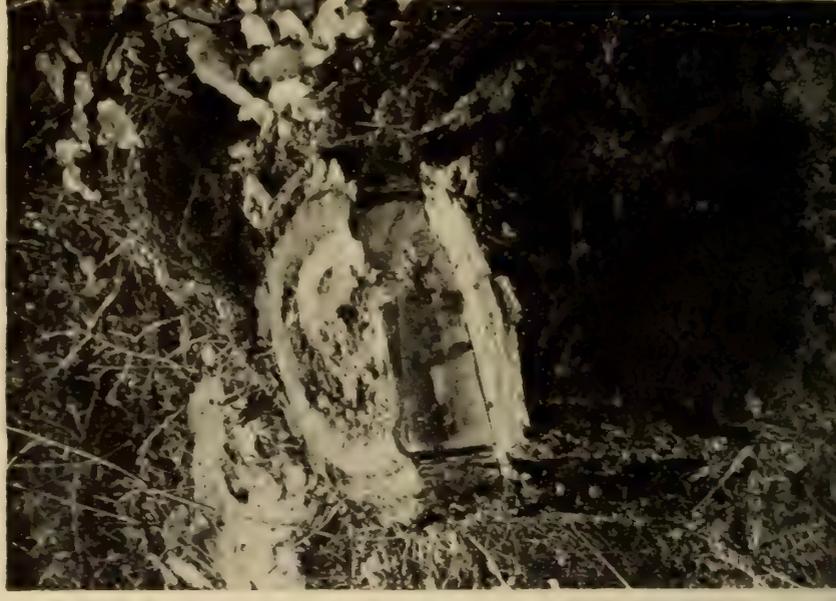


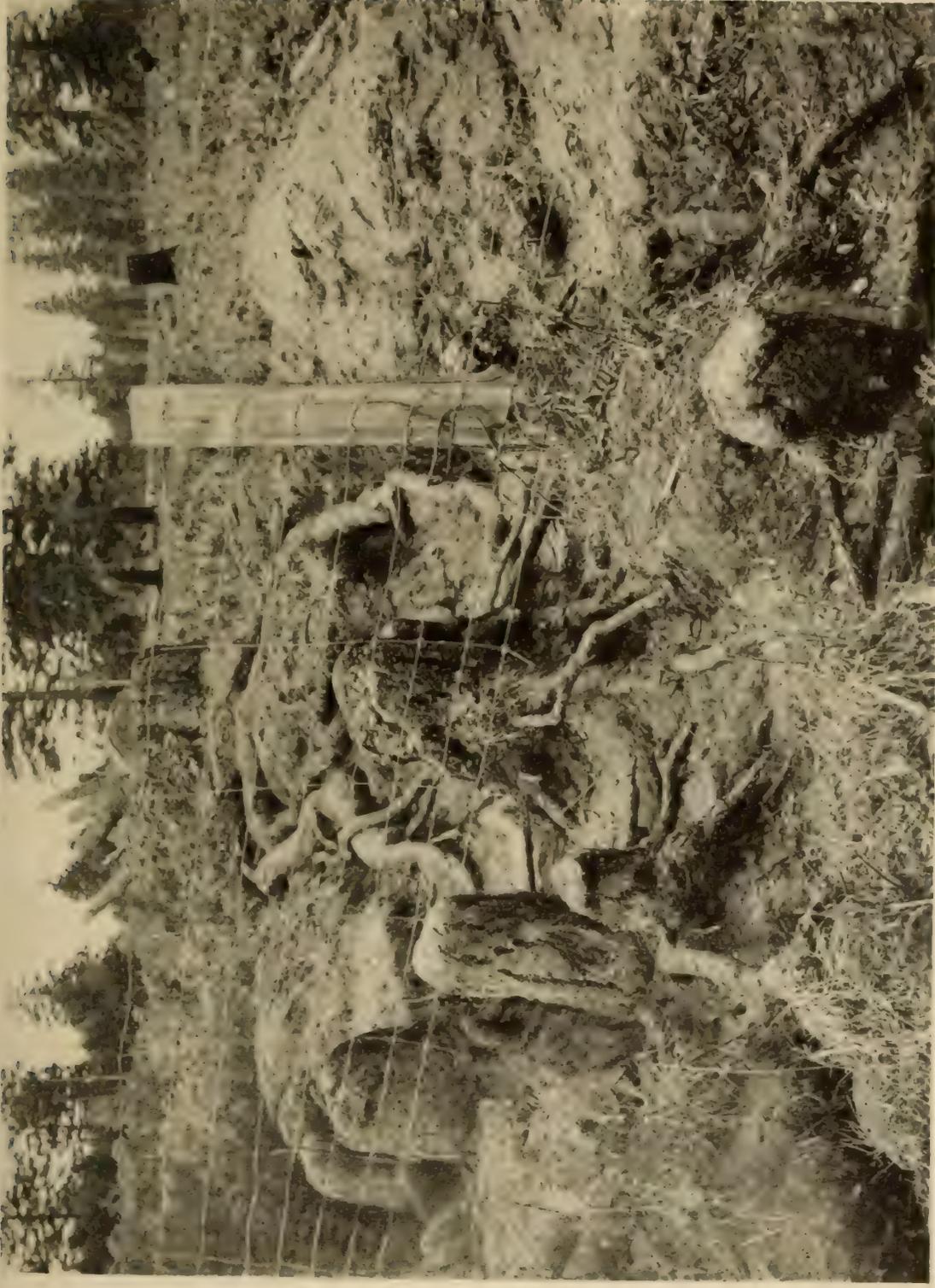
In this illustration the overgrowth of stumps of grand fir is shown. The stumps are situated between the two foster trees of the same species. The grafting together of the roots of the stumps and those of the foster trees is plainly visible on the ground, though not shown in the photograph. In this instance the capping-over of the stumps is not completed and the overgrowth has not materially increased for several years. Quite often the center of the stump decays and leaves merely a rim of live wood.



THE OVERGROWTH OF STUMPS OF CONIFERS

The large Douglas fir, *Pseudotsuga taxifolia*, in the background of the illustration on the left may, by reason of root graft, have become foster parent to its own offspring. The big tree evidently grew in virgin forest. About forty years ago a road was cut through this forest not far from the tree. Two seeds, probably dispersed from the big tree, germinated in the soil freshly disturbed by the making of the road. The vigorous growth of their roots quickly caused a natural graft with the root system of the big tree. When these saplings were about eighteen years old (the age was determined by a count of the rings of the right-hand stump) they were felled. However, the subtle reactions caused by the sun's rays in the distant leaf-laboratory, far up the massive trunk of the foster-parent tree, transmitted a life-giving stream of sap through the grafted roots to the stumps of the decapitated offspring and enabled them to heal over the wounds made by the ax. The capping-over of the stump in the left foreground had not been completed. That in the right foreground had been completely covered with a cap of wood and bark. This cap was cut off and is shown, in section, in the illustration on the right, and the resin-charged stem of the sapling prior to felling is seen enclosed by the subsequent cap of new wood, formed by the root graft. This section shows that the capping-over of the stump had taken place year by year, for about twenty-two years, coming in a ring from the outer rim, filling up the ax marks, and gradually grafting into one piece in the center, and continuing to add annual rings till cut off. After removal of the cap the sturdy foster tree lost no time in renewing the overgrowth. The new rings of the second overgrowth can be seen in the stump in the right foreground and also in greater detail in the illustration in the center





INDIRECT ROOT GRAFT CAUSES OVERGROWTH IN REMOTE STUMPS

The contention has often been made that certain overgrown stumps can be found too distant from foliage-possessing trees of the same species to admit of the possibility of root graft between the stumps and the trees. But the specimens of Douglas fir, *Pseudotsuga taxifolia*, in the picture on the left, prove that stumps with bulky overgrowth, even though apparently isolated and too far distant from other trees for root graft to exist, may be root grafted with such trees by a chain of indirect and concealed grafts. The stump of the foster tree and its large trunk, felled and lying on the ground, are shown in the background of the picture. In the foreground are eight capped-over stumps of young Douglas fir trees. Those seen on the left, the bulky one on the right, and one other are grafted to the spreading roots of the foster tree. Their roots, however, are grafted to those of the stump in the center of the picture, which, in turn, are grafted to the underlying roots of the foster tree. It is apparent, therefore, that indirect root graft will cause overgrowth to occur in remote stumps. The picture on the right also shows the stump of a very small Douglas fir sapling with its top root grafted to a lateral root from one of the two young trees. It had, therefore, only indirect root graft but healing-over was taking place notwithstanding.

It may be possible that a grove of sturdy fir trees in a rich valley with plenty of soil, moisture, and nutrition and adequate canopy of foliage could, by means of successive root grafts, maintain life and cause overgrowth over an immense area of root-grafted stumps in adjacent arid lands. This stream of life-giving material might never stop as long as there were living stumps, so long as they it forward. By natural or artificial renewal of the foster trees vitality might be continued for countless ages. Fancies, such as these, are apt to come to anyone contemplating daily the wonderful creative power of the root graft of conifers. When the foster tree in the picture on the left was felled, its stump, as well as those in the foreground, lost its vitality.

NOTES

VERTEBRATE FOSSILS

A FORERUNNER OF THE HORNED DINOSAURS.—The hope—one might almost say the conviction—has been entertained from the time the Third Asiatic Expedition began its work that it would discover in the fossil beds of Asia the prototypes of certain of the forms inhabiting western North America during the latter part of the Age of Reptiles and the early part of the Age of Mammals, thus tending to substantiate the view held by Professor Henry Fairfield Osborn, Dr. W. D. Matthew, and others, that these forms were immigrants from the Old World. An important piece of evidence of this character has recently come to light. A skull casually discovered by Mr. J. B. Shackelford, the photographer of the expedition, during a brief halt made in the course of the trip into Mongolia last summer, turns out upon examination to be of a type ancestral to the ceratopsians, which are known only from the Upper Cretaceous. These herbivorous dinosaurs, that carry on their disproportionately large head an armature of horns—two in the case of *Diceratops*, three in the case of *Monoclonius* and of *Triceratops*—are among the most grotesque and startling of the goblin-like animals of the past.

Standing in front of the huge skull of *Triceratops prorsus* in the American Museum and extending one's arms with fingers outstretched, one covers roughly the length of the head from the beaklike mouth to the bony crest at the back of the skull. Compared with this specimen, the skull, eight inches in length, of the recently discovered ancestral form of the ceratopsians is tiny indeed. Moreover, the latter lacks the horns that are so conspicuous on the ceratopsians of the Upper Cretaceous. Nevertheless, its relationship to these ceratopsians is evidenced by the fact that the jaws, teeth, and the portion of the crest below and behind the eyes are similar to the corresponding parts in these reptiles.

Could the newly discovered fossil be merely the young of a horned species? The assumption is negated by the fact that most of the sutures, or lines of contact of the skull bones, are well united and the teeth are much worn. The specimen is not an immature individual but an ancestral type, standing in much the same relation to the ceratopsians of the Upper Cretaceous as the primitive

hornless titanotheres of the early part of the Age of Mammals stood to their gigantic descendants.

Dr. W. K. Gregory and Mr. Walter Granger are jointly preparing a paper that will be published in the American Museum series, *Novitates*, and that will describe this remarkable skull and other parts of the skeleton that are little by little being worked out from the rock in which they were embedded.

NEW YORK ZOOLOGICAL SOCIETY

THE PYGMY ELEPHANT.—A great event in the annals of the New York Zoological Society was the recent arrival at this port of a second specimen of the pygmy elephant, known as *Loxodon pumilio*. The first specimen, which reached the Zoological Park in 1905, was the type of this pygmy species, for, while it was still in the possession of Carl Hagenbeck prior to shipment to this country, it was used by the Berlin naturalist, Doctor Noakes, for the scientific description of the species. This precious type animal, on its decease after a painful illness, was presented to the American Museum and in due time will be mounted and placed on exhibition.

The second young pygmy elephant, a female about two and one-half years old, reached the Zoological Park at half past six on the evening of December 6. The little creature is only thirty-six inches high; it is plump and hardy and seems fully resolved to live and to enjoy life. It is a little weak in its right hind leg, of which the fibula was once broken, but the injured part has been placed in a brace by Doctor Blair until the leg becomes strong.

The arrival of the pygmy caused a great sensation. Its advent was heralded abroad by all the newspapers and by radio. Several newspaper men, armed with cameras, went to the Park early on the morning of December 7 and photographed the pygmy under flashlight. These photographs were sent all over the United States.

Thus through the acquisition of the first and second specimens of the pygmy elephant from the type region of the Congo and West Africa, this animal, long regarded as mythical, has come into the light of science as an established fact. The new specimen was obtained through persistent efforts on the part of the New York Zoological Society and the discovery in

London of a man, Captain E. A. Cunningham, willing to share the risks involved in its pursuit and capture. We learn that the Zoological Society paid a very handsome price for the animal but the little elephant is certainly worth the sum expended, because it is one of the greatest of zoölogical rarities.

ASIA

MOTION PICTURES OF THE EXPEDITION TO MONGOLIA.—On January 17, Mr. J. B. Shackelford, the official photographer of the Third Asiatic Expedition, gave a preliminary demonstration in the American Museum of the motion pictures he secured during the trip which Mr. Roy Chapman Andrews and his associates made with auto trucks and laden camels into the heart of Mongolia. Of such a spectacular and valuable character have been the discoveries of the expedition in this neglected area of the Old World that unusual interest attaches to the motion picture record of the undertaking, indicating as that record does, through the swiftly changing scenes flashed upon the screen, the diversity of the work in which the expedition has been engaged and the bizarre attractiveness of the region traversed. President Henry Fairfield Osborn, in his remarks at the close, said the pictures were as valuable in presenting nomad life as those of "Nanook of the North" in making known the life of the Arctic. Mr. Louis D. Froelick, the publisher of *Asia*, who was also present, paid tribute to their quality and expressed pleasure that the American Asiatic Association and *Asia* on the one hand and the American Museum on the other were jointly associated in the expedition.

The pictures shown were devoted to that portion of the trip that lay beyond Urga. The opening scene showed the stately camels—seventy-five in number and each bearing a well-distributed burden of 600 pounds—as they struggled to their feet at the breaking-up of camp, to resume their trudging progress into the desert. The plodding caravan and the scouting automobiles passed many scenes of quaint interest. The religious edifices of the lamas, reminiscent in their architecture now of Thibet, now of China, and aflutter with prayer flags attached at close intervals along a rope; the hordes of curious priests hurrying out to view the Christian foreigners—gave place to scenes of practical life, such as the tending of flocks and the making of felt, or of festive gatherings of the nomads with

horse-racing and feasting. Natives clad in Chinese cloth, children naked except for the little bag, with prayer enclosed, that is hung about the neck of all Mongolians, were shown moving among their flocks or loitering about the encampments.

There were many pictures of the game of the region, including conies and hedgehogs, antelopes and wild asses, and birds of many species. Now and then an automobile would set out in pursuit of a small herd of antelopes or a group of wild asses, in order to test their speed and endurance. Beautiful was the action of the animals as they strained to the utmost to escape the fantastic thing on wheels that chased them over the sands. One wild ass was pursued for thirty-two miles before he permitted himself to be captured, only to find that after being petted, tended, and refreshed, he was again to be allowed his liberty.

A picture that combined unusual popular and scientific interest was that of the discovery site of *Baluchitherium*, the spectacular land mammal (related to the existing rhinoceroses but towering above them in size) that is one of the most valued finds of the expedition.

THE FAUNTHORPE INDIAN EXPEDITION.—Several letters reporting the progress of the Faunthorpe Indian Expedition have been received from Col. J. C. Faunthorpe by Prof. Henry Fairfield Osborn. Brief as has been the time since the expedition began its work, the specimens already obtained assure the American Museum a series of groups of unusual attractiveness, while the helpful interest manifested in the expedition by the British government officials and the native princes has in more than one instance opened the way to securing specimens that without their permission and coöperation would have been unobtainable. His Excellency the Viceroy of India is presenting to the American Museum a group of tigers; His Highness the Maharaja of Mysore, will permit the expedition to shoot an elephant within his territory and has kindly offered to give the expedition all necessary assistance; and the hope is entertained that His Excellency the Governor of Bombay will see his way to allowing the expedition to secure a specimen of the interesting Indian lion. The government of India, at the request of Colonel Faunthorpe and in deference to the interest in the expedition taken by Lord Reading, has

instructed all the local governments to assist the undertaking.

Colonel Faunthorpe has secured four specimens of the swamp deer, three of the specimens being stags and one a doe. The antlers of one of the stags are of record proportions, as they measure thirty-nine inches from tip to tip and have twelve points. On the same day that these animals were shot, three specimens were obtained of the swamp partridge, a rare bird of restricted range, as well as a number of birds of other species. An otter and a hyena were also secured.

A cablegram from Mr. A. S. Vernay, of later date than the letters from Colonel Faunthorpe, indicates that the expectations of the leaders of the expedition are being richly fulfilled. Materials for a nilgai group and for a chital group have been collected. A splendid sambur has been taken and mention is made of a rhinoceros hunt apparently in prospect in eastern Nepal.

Even before his departure from London Mr. Vernay evidenced his interest in the purposes of the expedition by purchasing twenty-one specimens of an Indian hornbill, *Ptilolæmus austeni*, originally a part of the Coltart Collection, and he has presented them to the American Museum.

THE MUSEUM PRESS

For twenty-two years NATURAL HISTORY and its predecessor, the AMERICAN MUSEUM JOURNAL, were printed outside of the Museum. With the January-February issue of the current year a new policy was inaugurated, the magazine being printed within the Museum itself. This is a momentous step for NATURAL HISTORY and at the same time evidences the impressive growth in the facilities and output of the Museum press, which now prints all of the publications of the Museum, in addition to the labels, cards, stationary, and other odds and ends that are required. Starting in the attic of the Museum on April 10, 1903, with but a single workman and a small hand press, the printing establishment has grown until now it occupies the greater part of one wing of the basement, employs a force of twelve individuals, and has available three job presses and two cylinder presses—one with a Dexter suction feeder and an automatic pile delivery—a double monotype keyboard, and two monotype casting machines. In addition to the printing establishment, the Museum has a

bindery that dates back to the fall of 1903 and that employs today five individuals. Mr. Stephen Klassen and Mr. E. P. Forshay, in immediate charge respectively of the printing establishment and of the bindery, have both been connected from the very start with their respective departments and have witnessed all the stages in the development of the Museum press.

One of the most important of these stages was reached in 1919, when the Museum first assumed the printing of its scientific publications. The magnitude of this undertaking is indicated by the fact that in the year 1922 alone there were printed of the *Bulletin* more than 1200 pages, of the *Anthropological Papers* more than 500 pages, of *Novitates* more than 200 pages, not to mention the issuance of guide leaflets and handbooks.

In 1922, for the better coördination of the work of related departments within the Museum, a division of education, books, publication, and printing was established under Mr. George H. Sherwood as curator-in-chief, with Dr. Ralph W. Tower in charge of the library and of publications.

With its demonstrated capacity for handling efficiently work that requires more than average accuracy and care, the printing plant of the Museum is extending its facilities to NATURAL HISTORY, and the January-February issue is evidence of the high standard of excellence with which it has begun its work.

CONSERVATION

THE ANIMALS OF THE YELLOWSTONE.—The need for protecting the mammals is demonstrated not only by their rapid disappearance in areas where they are hunted, but also by the heavy losses suffered by herds located in parks or sanctuaries, as the result of an unfavorable season or of some epidemic.

The antelopes of Yellowstone National Park began the spring of 1922 with their number reduced by twenty-five or more per cent. During the winter the snow had been softened by an interval of mild weather and had then been crusted over by the succeeding cold spell. The iced surface thus formed broke under the sharp hoofs of the antelopes, which, impeded and floundering, fell victims to the wolves and coyotes. Forage, too, was hard to obtain in the low valleys where the snow drifts are deep. In the *Sixth Annual Report of the Director of the National Park Service* it is stated that "The antelope herd of

the park is likely to be exterminated unless range north of the park can be provided."

The same *Report* states that the herd of tame buffalo in the Yellowstone has been the victim for the third time of an outbreak of hemorrhagic septicemia, which occurred during March and April, 1922. Fifty-two animals succumbed to this disease,—a loss that is more than offset, however, by the birth of 108 calves. Through this increase the herd numbered, at the time the *Report* was issued, 578 head. In view of the hardships experienced in former winters by the elk, it is gratifying to learn that during the winter covered by the *Report*, the forage was abundant, due to the fact that the heavy winds blew the high slopes bare of snow.

CONSERVATIONISTS TO GATHER IN PARIS.—

An international congress for the protection of nature and of natural monuments is being arranged by three French societies, la Société nationale d'Acclimatation de France, la Ligue française pour la Protection des Oiseaux, and la Société pour la Protection des Paysages de France. The congress is to be held in Paris in the beginning of June of this year and will be divided into five sections, dealing respectively with animals; plants; rocks, natural grottos, and minerals; waterfalls and water courses and other features of the landscape; and national parks, public gardens, and preserves. So many of the problems confronting the conservationist are international in character and for their solution require the coöperation of nature lovers everywhere, that a gathering of this character is certain to have far-reaching importance.

CONSERVATION OF MARINE MAMMALS AND FISH.—We are glad to be able to print, by way of supplement to Doctor Murphy's article (pp. 135-37 of this issue) the admirable resolutions unanimously adopted by the California Academy of Sciences, January 3, 1923, after a full and free discussion.

Whereas, It is known that many valuable species of marine mammals such as fur seals, sea otters, elephant seals and whales, and many species of important food fishes such as salmon and halibut, formerly occurred in the Pacific in such vast numbers as to constitute the objects of fisheries whose annual products were worth more than one hundred million dollars, and

Whereas, Nearly all of those great natural resources have been seriously depleted, many of them even to commercial extinction, through greed, short-sightedness and ill-considered fishery methods, and

Whereas, It is known that small remnants of fur-seal and sea-otter herds and small numbers of whales and of other commercially valuable species still remain in certain places, and

Whereas, The rapid recovery of the Alaska fur-seal herd in the short period of ten years from complete commercial ruin to an annual production of more than \$1,500,000, as a result of the international fur-seal treaty of 1911, demonstrates conclusively the wonderful recuperative power of such depleted natural resources of the sea under international co-operation, and justifies the belief that other depleted fisheries can be rehabilitated through similar coöperation among the nations concerned, and

Whereas, It is conservatively estimated that these resources when rehabilitated will yield to the world a regular annual product of more than one half-billion dollars in value, therefore be it

Resolved, That the California Academy of Sciences strongly recommends that the various countries bordering on, or interested in, the Pacific, take such steps as may be necessary to bring about an International Treaty for the restoration of the vanishing resources of the Pacific to their former abundance, that they may be maintained for all time as the objects of great commercial fisheries of which they are easily capable, and be it further

Resolved, That the California Academy of Sciences recommends that the governments of the countries bordering on the Pacific enter into correspondence for the purpose of establishing an International Commission for the scientific study of the biology, physics, and chemistry of the Pacific in the interest of the restoration, proper utilization, and conservation of its vanishing natural resources.

Similar resolutions were unanimously adopted at the Pan-Pacific Commercial Conference.

PASTEUR CENTENARY IN THE AMERICAN MUSEUM

A TRIBUTE BY PROF. H. F. OSBORN.—In the issue of *NATURAL HISTORY* for January-February a brief account was given (p. 99) of the ceremonies held at the American Museum on the evening of December 27 in commemoration of the Pasteur centennial. For the benefit of those who were unable to attend the gathering as well as of those who, having attended it, desire a printed record of the tribute delivered on the occasion by Prof. Henry Fairfield Osborn, we print below the passage that by invitation of the presiding officer, Dr. George F. Kunz, he read, with some slight alterations of the text, from his *New Order of Sainthood* (New York, 1913).

Among all the great scientific men whom the nineteenth century produced Pasteur ranks supreme as a benefactor of mankind. He played the original and creative part in the movement for the prevention and relief of human suffering. . . It is far under the truth to say that he has saved more lives than Napoleon destroyed. In Nature he found the causes of a very large part of human suffering; in Nature he also found the means of controlling or averting suffering. His attitude toward his fellow men was one of noble compassion. . . .

. . . It is interesting to imagine what tributes might have been rendered to Pasteur if he had lived in the period of the early saints of the Church, and had won the love of his generation and the reverence of succeeding generations by his mighty works. It is interesting to surmise what would have been the attitude of the early Church toward such a benefactor of mankind. Our belief today is that Pasteur will ever stand as a symbol of the profound and intimate relation which must develop between the study of Nature and the religious life of man, between our present and future knowledge of Nature and the development of our religious conceptions and beliefs.

. . . If Newton opened to us the new heavens, and Darwin showed us the new earth, Pasteur showed the way to the physical redemption of man. If we were to rewrite the Litany in the twentieth century, for the passage, "From plague, pestilence, and famine, good Lord, deliver us," we should read, "From ignorance of Thy Laws and disobedience of Thy Commands, good Lord, deliver us."

. . . The life-work of Louis Pasteur was more than humanitarian, it was more than scientific, it was religious. He regarded natural processes which in their superficial view appear relentless, cruel, wholly inexplicable, as part of a possibly beneficent order of things; he again revealed through his profound insight, through his unparalleled toil, and in spite of the discouragement, and even scorn on the part of his contemporaries, deeper laws, which are beneficent, protective, and restorative in action. . . .

We shall institute a new order of sainthood for Louis Pasteur. We find no one more eminent for consecration, piety, and service in life and character than this devout investigator. Entrance to this order shall be granted to those who through the study of Nature have extended the bounds of human knowledge, have bestowed incomparable blessings on the human race, have relieved human suffering, have saved or prolonged human life. A statue of Louis Pasteur placed in the Cathedral of St. John the Divine will proclaim our faith that the two great historic movements of Love and of Knowledge, of the spiritual and intellectual and the physical well-being of man, are harmonious parts of a single and eternal truth.

On the base of the statue will be inscribed the words written by Pasteur in the most perplexing period of his life:

GOD GRANT THAT BY MY PERSEVERING LABORS I MAY BRING A LITTLE STONE TO THE FRAIL AND ILL-ASSURED EDIFICE OF OUR KNOWLEDGE OF THOSE DEEP MYSTERIES OF LIFE AND DEATH WHERE ALL OUR INTELLECTS HAVE SO LAMENTABLY FAILED

PASTEUR EXHIBIT

In a later issue of NATURAL HISTORY will appear, it is hoped, an illustrated article dealing with the Pasteur exhibit that has been on view for several weeks in the hall of forestry, American Museum. Only brief allusion is here made, therefore, to this exhibit, which has been brought together through the enterprise of Dr. George F. Kunz, with the cooperation of several public bodies and of interested individuals. The exhibit presents graphically the personal side of the life of Pasteur and with especial emphasis the whole series of discoveries that are linked with his name, as well as data concerning a number of subsequent developments in the field of research in which he blazed the way.

A JAPANESE DELEGATION VISITS THE MUSEUM

On January 30 Director F. A. Lucas conducted through the American Museum a delegation of raw silk manufacturers from Japan, pointing out to the members of the party the significance of the different exhibits in the Museum, so many of which have been prepared under his supervision. Apart from the general interest that the Museum has for all visitors, it has a more or less special appeal for those engaged in the silk business. Not only is there among its exhibits of insects and their work an array of material relating to *Bombyx mori*, the industrious little moth that just before pupating spins the silk out of which the world's most beautiful raiment is made, but in the hall of birds are shown by courtesy of Messrs. Johnson, Crowdin and Company a series of ribbons designed by Mr. Emil Speck, the coloring and patterns of which were suggested by the plumage of different birds. The ancient Indian fabrics in the Museum have been repeatedly studied by designers of textiles, and their color schemes and figurations have been adapted and used in the fabrics produced by the mills.

RARE VOLUMES PRESENTED TO THE LIBRARY

The Library of the American Museum is indebted to Mr. Ogden Mills for his generous

gift of certain rare volumes, several of which were a part of the Ornithological Library of the late William Purdy Shannon. The gift embraces thirty-four works, one of which, Buffon's *Histoire naturelle des Oiseaux*, consists of ten volumes. The acquisition of this work meets a need of long standing. Published in the last quarter of the eighteenth century, it is valued not only for its text but for its beautiful *planches enluminees*, engraved by Martinet under the supervision of E. L. Daubenton. Another work embraced in the gift of Mr. Mills is the sumptuous *Monograph of the Pittidae or Family of Ant-Thrushes*, by Daniel G. Elliot.

PUBLIC EDUCATION

MR. G. H. SHERWOOD ADDRESSES THE MUNICIPAL ENGINEERS.—At the annual meeting on January 24 of the Municipal Engineers of the City of New York, held in the Engineering Building, 29 West 39 Street, Mr. George H. Sherwood, curator of public education, was the speaker of the evening, addressing the gathering on the topic, "The American Museum of Natural History and Its Activities." He traced the history of the Museum, its organization, and the sources of its financial support, rendering account of the stewardship of the Museum in the expenditure of funds with which it is entrusted, one-third of which are provided by the city. He dwelt on the different fields of science exemplified in the work of the Museum and made clear that the value of the habitat groups in the Museum is derived from the fact that they are restorations of actual scenes, in which care has been taken that not only the main features of the landscape, as represented by the painted backgrounds, but such details as soil and plant growth, shown in the foreground, shall be faithfully and minutely reproduced from data supplied by the collector.

Mr. Sherwood gave an account of the work of the Museum's department of education among the public schools of the greater city, through the distribution of lantern slides and traveling collections and through lectures delivered by the departmental staff both at the Museum and in the schools themselves.¹

Finally, with special cognizance of the fact that he was addressing an audience interested in engineering, he spoke of the exhibit of *Synura*, one of the minute dwellers in our

city water pipes that at times has spoiled the taste of our most popular beverage. A glass model of this protozoan animalcule, enlarged many diameters, was shown in the Museum during the height of its unpleasant activities last year and was viewed by throngs of visitors that were curious to know about this microscopic trouble-maker.¹

NEW YORK TRAINING SCHOOL FOR TEACHERS.—On January 22, the department of public education, American Museum, held its semi-annual reception for the faculty and graduating students of the New York Training School for Teachers. The guests assembled at two o'clock in the auditorium, where Curator George H. Sherwood explained to them the various ways in which the Museum renders aid to the schools, illustrating his address with stereopticon views pertinent thereto. Dr. G. Clyde Fisher, associate curator, illustrated the use of the motion picture as an educational medium by throwing on the screen and explaining a film entitled "Through Life's Windows," which shows the structure and function of the human eye. Mrs. G. K. Noble, assistant curator, followed Dr. Fisher, presenting a series of pictures illustrative of the work done in the department of preparation of the Museum, and including such operations as glass-blowing and modeling in wax, as well as taxidermy.

The visitors were then conducted by members of the Museum staff through the exhibition halls and the department of education, and at four o'clock tea was served in Morgan Memorial Hall.

THE AMERICAN NATURE-STUDY SOCIETY, of which Prof. William G. Vinal is president and Mrs. Anna B. Comstock is secretary, held its annual meeting in Boston, December 28-30, 1922, and discussed from many angles the aims, problems, and possibilities of nature study in our schools, in the home, in summer camps, among scouting organizations, and through other agencies. On December 28 a dinner was given in honor of Mrs. Comstock, on her retirement as professor of nature study at Cornell University. Dr. Clarence Weed acted as toastmaster on this occasion and among those who spoke were Dr. L. O. Howard, Prof. Vernon L. Kellogg, Mr. John L. Randall, Prof. E. Laurence Palmer, Miss

¹For a full account of the department of education, the reader is referred to Mr. G. H. Sherwood's article in *NATURAL HISTORY*, March-April, 1922, pp. 100-12.

¹See *NATURAL HISTORY*, January-February, 1922 p. 90.

Mabel Turner, Dr. George W. Field, and Dr. G. Clyde Fisher,—the last mentioned being the representative of the American Museum at the gathering. On the day following, Dr. Fisher delivered an illustrated address on a subject that has never failed to enthrall his audiences, namely, "John Burroughs." Other impressive addresses given in the course of the session—and only a few out of a number worthy of mention can here be indicated—were "Nature Study of the Various Scouting Organizations," by Prof. E. Laurence Palmer, "What Do I Expect That Nature Study Should Do for My Child?," a symposium presented by the Rev. G. Manley Townsend, Dr. Henry P. Lovewell, and Mr. F. Schuyler Mathews, and "Nature Study and Gardening," by Mrs. Comstock.

INSECTS

ENTOMOLOGICAL SOCIETY OF AMERICA.—

One of the interesting features of the seventeenth annual gathering of the Entomological Society of America, held December 26–9 in Boston and Cambridge, was the presentation of a symposium entitled "Adaptations of Insects to Special Environments." Dr. F. E. Lutz, curator of entomology at the American Museum, contributed to this symposium a paper on the "Adaptations of Insects to the Fertilization of Flowers." At the business session Doctor Lutz was elected second vice president of the society; Prof. T. D. A. Cockerell (honorary fellow of the Museum) and Dr. William S. Marshall were elected respectively president and first vice president.

MEETINGS OF SOCIETIES

THE GALTON SOCIETY, which was founded in 1918 for the study of the origin and evolution of man and of the physical and mental qualities of human races, holds its regular meetings in the Osborn Library, American Museum. In the first meeting of 1922 Professor Brigham, of Princeton University, gave a detailed analysis of the army intelligence tests, with reference to the comparative ratings made by representatives of the principal countries and races of Europe. In the December meeting Dr. Laughlin showed the results of an analysis of the social qualities of different groups of the population of the United States, according to the country of origin of the parents. The data were drawn from the records of prisons, state hos-

pitals, and institutions for the feeble-minded, insane, and other types of the socially inadequate. The analysis was worked out on the quota fulfillment basis—100 per cent, indicating that the particular racial or nativity population-group attaining this percentage had supplied its even share to the specific type of degenerates in institutions. The results indicated wide differences among the various racial and national groups of our immigrants. For example, in insanity, quota fulfillments by per cent run as follows: Japan, 42.85; American negro, 57.23; Switzerland, 69.23; native white, both parents native-born, 73.27; China, 78.33; United States, all native-born regardless of race or color, 83.98; Rumania, 100.00; native white, having one parent native, one foreign-born, 103.90; native white, both parents foreign born, 108.49; Canada, 124.42; all Asia, 130.00; Austria-Hungary, 134.26; Mexico, 137.50; Great Britain, 156.81; Italy, 157.53; France, 158.33; Netherlands, 171.66; Greece, 172.72; Germany, 174.53; West Indies, 180.00; Portugal, 181.66; Southern and Eastern Europe, 188.50; all foreign born, 192.85; Scandinavia, 193.33; Northwestern Europe, 198.36; Turkey in Europe, 200.00; Russia, Finland, and Poland, 265.95; Bulgaria, 300.00; Ireland, 305.44; Serbia, 400.00. These investigations have been conducted under the auspices of the Committee on Immigration and Naturalization of the U. S. House of Representatives and have proved of great use in the shaping of immigration laws designed to restrict the number of undesirable immigrants.

AMERICAN SOCIETY OF ZOÖLOGISTS.—At the twentieth annual meeting of the American Society of Zoölogists, held December 27–9 in connection with the gathering in Boston of the American Association for the Advancement of Science, a paper entitled "A New Liver Fluke from the Monkey" was read by Dr. Horace W. Stunkard, research associate in parasitology at the American Museum, and papers on "The Proper Wording of Titles of Scientific Articles" and on "The Bibliography of Fishes" were presented by Dr. E. W. Gudger, associate in ichthyology in the Museum. "The Pre-Linnæan Section of 'The Bibliography of Fishes'" Doctor Gudger discussed on December 27 before the section on historical and philological sciences of the American Association for the Advancement of Science.

GEOLOGY

A TRIBUTE TO DR. E. O. HOVEY.—To commemorate the completion of sixteen years of service that Dr. E. O. Hovey, curator of geology and invertebrate palaeontology, American Museum, has rendered as secretary of the Geological Society of America, his colleagues presented him, at the annual meeting of the Society in December, with a beautiful silver cup, on which is inscribed:

Geological Society of America
To
Edmund Otis Hovey
Secretary
1906-1922

The presentation was made by Professor James F. Kemp of Columbia University. The following tribute was entered upon the minutes:

At the present annual meeting Dr. Edmund Otis Hovey, Secretary of the Society since December 1906, is, at his own wish, retiring from office. The undersigned committee has been appointed by President Schuchert to prepare an appropriate resolution and present it for action by the Society.

Doctor Hovey has held for sixteen years the responsible and exacting office of Secretary. During all this time he has shown exceptional devotion and unsparing fidelity in the discharge of the duties of his office. Under his tenure the Society has maintained the high ideals with which it started on its career thirty-four years ago, and has done so in no small degree because of the influence and sound judgment of its Secretary. The publications have also held true to the exalted standards now long established.

Doctor Hovey has witnessed during his official life, and has shared in carrying through one important change in policy and organization,—that relating to the affiliated societies. The Paleontological Society became the first affiliate, the Mineralogical Society of America the second, and last year the Society of Economic Geologists joined the group. By this wise arrangement excessive and weakening subdivision is avoided, while a large degree of practicable unity is maintained.

The Geological Society desires to express and record upon its minutes a warm and cordial expression of appreciation of the unselfish service given by its retiring Secretary and to wish him the successful completion of the scientific labors to which he desires to give his entire efforts and attention.

(Signed) James F. Kemp, Chairman.
John M. Clarke
R. A. F. Penrose, Jr.

DR. C. A. MATLEY.—During his recent sojourn in America, Dr. C. A. Matley, geologist to the government of Jamaica, visited several of our scientific institutions,

including the United States National Museum, the United States Geological Survey, and the American Museum, and conferred with the several scientists working in his own, or closely allied, fields. In a letter, under date of January 11, 1923, addressed by the British Ambassador, Sir A. Geddes, to the Hon. Charles E. Hughes, Secretary of State, cordial thanks are expressed for the kindness shown Doctor Matley at all of the institutions visited. Of the American Museum's scientific staff, Dr. W. D. Matthew, Mr. H. E. Anthony, and Dr. Chester A. Reeds, received special mention in this connection.

Dr. Matley is an English geologist of distinction who had done important geological work in India previous to his Jamaican appointment. Among other things he discovered a Cretaceous dinosaur quarry near Jubulpore which has yielded specimens that are of great scientific interest, especially when considered in connection with recent discoveries made in Africa and in connection also with the American Museum's finds in Mongolia. On his present assignment he is absorbed chiefly in economic work, but he hopes that in pursuing his tasks he may chance upon fossil remains having a bearing on the geology and former land connections of Jamaica. The American Museum staff appreciated the privilege of discussing with him the evidence on these several problems of mutual interest, and profited greatly by his information and comments.

ARCHÆOLOGY

PREHISTORY OF MAN IN EUROPE.—Since 1912 the American Museum has renewed an interest in European archæology which began many years ago in the acquisition of valuable collections long unappreciated. The call of Mr. N. C. Nelson, of the University of California, as associate curator of North American archæology in the American Museum, has enabled the Museum to devote attention to the archæology of the Southwest and to the archæology of Europe through encouraging Mr. Nelson's activities in both lines. Studies in the Southwest have greatly profited by the application to this field of the far-advanced archæological methods of France. The methods of work in the two widely separated areas are similar—both converge in the writing of two separate chapters in the prehistory of man. In the Southwest Mr. Nelson has been aided by the generous provi-

sions of the Archer M. Huntington Fund; in western Europe by successive appropriations from the Jesup Fund. It was by aid of the latter fund that he made his third and longest archæological tour in Europe in the period between May 31 and December 4, 1922. Through his three successive journeys Mr. Nelson is now able to arrange the Museum's entire archæological collection from Europe in accordance with the results of the most recent researches, to note the main gaps, and to plan how these gaps may gradually be filled through exchange or purchase, until finally the American Museum shall be in a position to present a complete and representative *exhibition* collection of the whole prehistory of man in Europe. Emphasis is laid upon exhibition, because it is obvious that no attempt need be made to build up a research collection, as Europe is not the Museum's research field.

"LA PRÉHISTOIRE," BY DR. LOUIS CAPITAN.—This book,¹ a copy of which Doctor Capitan has recently sent to Professor Henry Fairfield Osborn, is a duodecimo of 157 pages and 26 plates, which presents in a most concise and attractive form the whole story of the Stone Age together with the Copper Age and the Bronze Age, concluding with the two earliest stages of the Iron Age.

It is especially welcome, as it brings the reader up to the date of the most recent discoveries, an undertaking for which the distinguished author is exceptionally qualified.

Born in 1854, from his youth up he evinced an active interest in prehistory, and as early as 1878 he contributed a prehistoric exhibit to the Exposition of that year. Since then he has made a very extensive collection of prehistoric, archæologic, and ethnographic specimens, which he has presented to the Musée de Saint-Germain.

In 1893 he commenced his researches and explorations in Dordogne in the valley of the Vézère, in collaboration with Peyrony, to whom he imparted his methods of stratigraphy—that is to say, the study of archæologic deposits excavated strictly layer by layer, a method which had never before been used in Dordogne.

In 1901, with Peyrony and Breuil (another of his pupils), both of whom are now recognized authorities, he discovered successively the two great caves of Combarelles and Font-de-Gaume near Les Eyzies, the walls of which

are covered with engravings and paintings made by men of the Glacial Epoch, at least ten thousand or twelve thousand years ago. The observations and reports of these three savants completely settled the question of the age and authenticity of these earliest works of art, and the results of their research are embodied in the magnificent illustrated work, *La Caverne de Font-de-Gaume aux Eyzies*, that appears under their joint names.

Lack of space renders it impossible to give even the titles of the hundred and more important works devoted to prehistory which have been published by Dr. Capitan, but an idea of the extensive scope of his work is obtained when we consider that he is professor at the Collège de France, in charge of the course on American antiquities; professor of prehistoric anthropology at the École d'Anthropologie; that he has been for thirty years past a member of the Commission des Monuments mégalithiques, and is at present vice president of the prehistoric section of the Commission des Monuments historiques—being especially occupied in securing the preservation of the caves and archæologic deposits of Dordogne, and of the huge megalithic monuments of Brittany; and—in the Commission municipale du Vieux Paris—chairman of the committee on excavations, which studies with painstaking detail all excavations made in the sub-soil of Paris.

It is on these various accounts even more than on his medical record that he was elected a member of the Académie de Médecine.

He is also an Officier of the Legion d'Honneur, for military service, having served as physician in charge of the department of contagious diseases in the military hospital of Bégin at Vincennes throughout the late war.

In *La Préhistoire*, his most recent book, the open-minded and progressive spirit of Doctor Capitan is especially exemplified by his acceptance of the human origin of the worked flint implements of Pliocene age recently discovered at Foxhall:

At Ipswich, Norfolk, England, Mr. Reid Moir has drawn attention for some years back to the existence of flints which he believed to be worked, at the base of the Crag, a marine deposit of Late Pliocene age, and consequently Tertiary. The study of these flints and of the strata where they were found *in situ* by Breuil and Burkitt, and later by myself, with several colleagues competent to pronounce judgment, makes it possible to assert that at least some of them—although not many—have unquestionably been worked

¹Published by Payot & Cie, Paris, 1922.

and retouched in order to produce tools for planing, scraping, and piercing. All the experts to whom we have shown them are of the same opinion. It is necessary, therefore, to assign a considerably earlier date to the appearance of the first implements fashioned and used by the first hominids, who must thus have been witnesses of the beginning of the great Glacial Epoch.

On the much more debatable evidence concerning the existence of worked flints signaling the presence of man in epochs earlier than the Pliocene, he writes:

Perhaps it may prove possible to assign an even earlier date. Our reference is to the flints noted by Rames in 1877 at Puy-Courny near Aurillac, Cantal, in sands belonging to the Late Miocene (Middle Tertiary), and lying beneath an eruption of basalt. Certain of these flints are identical with Mousterian implements. I myself have unearthed blades, scrapers, and piercers which seemed to me most probably worked. But the matter is by no means so certain as at Ipswich. Moreover, the fact would imply such sweeping consequences that one understands the hesitation of many savants in accepting it. Unfortunately, no human fossils have ever been found in these deposits, nor at the neighboring site of Puy de Boudiou, where Lacroix has found flints even more amazing. It is therefore wise to leave the matter in abeyance.

There is no need to refer to the cracked flints of Thenay, belonging to the Oligocene (Early Tertiary), noted by the Abbé Bourgeois in 1863. Their form is due to purely natural causes.

On the question which is most debated of all, namely, the value of eoliths, he expresses the following opinion:

Among the innumerable flint fragments and flakes from all the geologic levels, many series are found in which the marginal retouch, or the forms like lance-heads, points, tools with cutting edges, or even with dented sides, would seem to indicate that they were used for puncturing, piercing, scraping, and hammering. Rutot, an acknowledged savant, and curator of the museum of Brussels, considers them as the earliest stages of human handiwork, and has named them 'eoliths.' If Rutot's theory is correct, if such implements are innumerable and often authentic as they occur in all archæologic deposits, they are our tools of use or chance (see Plate II). They do not seem, however, to present such unmistakable evidences of being intentionally worked, that from them alone one could assert—as Rutot thinks—that they were fashioned with deliberate intent, and must therefore have been the work of men or hominids. It follows that we cannot admit, with Rutot, from this evidence alone, that the existence of eoliths at Boncelles, near Liège, at the very base of the Tertiary, or at a number of other very ancient sites, constitutes a certain proof of the existence at that time of man or even of pre-man.

ANTHROPOLOGY

THE AZTEC RUIN, one of the most interesting survivals from the past in our Southwest, has been created a national monument by proclamation of President Harding in recognition of its great antiquity and historical interest. This action has been made possible through the donation of the site to the government by the American Museum, in fulfillment of the wish of Mr. Archer M. Huntington, who supplied the funds through which the Museum originally acquired the site and who defrayed the expenses connected with its exploration as part of his contribution to the Survey of the Southwest. Mr. Huntington has always taken great interest in the history and prehistory of that part of the New World that was occupied by the Spaniards and this gift to the nation, which is virtually Mr. Huntington's gift, although presented in the name of the American Museum, is another instance of the generosity of this patron of early American history and art. The excavation of the ruin has been in progress since 1916, being in charge of Mr. Earl H. Morris, who has resided on the site. More than one-half of the ruin has been unearthed, including the famous "painted room," and a number of objects that have enriched our knowledge of the past have been brought to light. As a result of the transfer of ownership, Mr. Morris becomes the government custodian of the monument. It is fitting that a spot of such interest should be preserved, to quote the President's words, "for the enlightenment and culture of the Nation."

MR. JAMES A. TEIT, who died at Spence's Bridge, British Columbia, October 30, 1922, made very great contributions to the work of the American Museum without ever having held an official position in that institution. A Scotchman from the Shetland Islands, he came to Canada when a young man and later settled among the Thompson Indians of British Columbia, acquiring a thorough speaking knowledge of their language. His residence among them gave him an opportunity for securing ethnological information and his intelligent interest in them prompted him to make the best use of that opportunity. Under the inspiration and personal guidance of Professor Franz Boas, who directed the work of the Jesup North Pacific Expedition, Mr. Teit gathered and prepared for publication the material contained in the Memoir, "The

Thompson Indians of British Columbia" (*Publications of the Jesup North Pacific Expedition*, Vol. I, pt. 4, pp. 163-392, 1900). Later his work was extended to neighboring related tribes and similar studies appeared on "The Lillooet Indians" (Vol. II, pt. 5, pp. 193-300, 1906), and "The Shuswap" (Vol. II, pt. 7, pp. 443-789, 1909). As a continuation of Mr. Teit's work among the Thompson Indians, "Mythology of the Thompson Indians" (Vol. VIII, pt. 2, pp. 199-416) appeared in 1912. The extensive and carefully made ethnological collections of the Museum from these three tribes were gathered by Mr. Teit.

In addition to the work for the Jesup Expedition described above, Mr. Teit made a survey of the Salish dialects and the dialects of neighboring Athapascan tribes, a study of the Tahltan Indians, and, with the late Dr. H. K. Haeberlin, a thorough study of Salish basketry. Many of the results of his later work are still unpublished. It was mainly financed by Mr. Homer E. Sargent of Chicago, who became acquainted with Mr. Teit on a hunting trip in 1902 and remained his devoted friend until Mr. Teit's death. The more recent work, like the earlier work, was planned and directed by Professor Franz Boas from whom the facts contained in this note have been obtained.

RECEPTION FOR THE PUEBLO INDIANS.—On January 26 the American Museum accorded a reception to the delegation of Pueblo Indians that had crossed the continent to register a protest against the Bursum Bill, which through the invasion of their property rights would render still more precarious the existence they have been maintaining for centuries on their patches of irrigated desert in New Mexico. These visitors, bewildered by the sky-scrapers of New York and the thunder of subway and elevated trains, and chilled to the bone by our inclement winter, must more than once, in spite of the cordial reception extended to them everywhere in the city, have longed for the sunny quiet of their adobe villages. Accordingly, in preparing for their entertainment, Dr. P. E. Goddard, curator of ethnology, American Museum, arranged to show in the auditorium moving pictures of scenes that would be reminiscent of home. The life of the Hopi pueblos, with its daily domestic routine and its picturesque observances, including the snake dance, the flute ceremony, and the lalakonti, was accord-

ingly shown on the screen. Several of the Indian visitors from New Mexico had never been to Arizona, where the Hopi are located, and their first acquaintance with the ways of their neighbors was derived from these films.

Later the Indians were conducted to the Southwest Indian hall, where they were able to examine the ethnological collections illustrative of the civilization of their own and related pueblos and to speak to the gathering of white men sympathetic to the cause which they are pleading. Their legal representative, Mr. Wilson, outlined in detail the progress of the struggle which is being waged in Washington against the recalcitrant few in official life who persist in defending the Bursum Bill in spite of its obvious iniquities. Mrs. Atwood, to whose initiative it is due that defensive measures on behalf of the Indians were undertaken, was then introduced by Dr. Goddard and received an ovation of hand-clapping as she bowed acknowledgment. The representative from the pueblo of Isleta brought the exercises of the afternoon to a conclusion, addressing the audience in a dramatic speech that came straight from the heart, in which he pleaded for that justice to the Indian that has been so often denied him.

ADDRESSES BY ANTHROPOLOGISTS.—On December 27 Dr. Clark Wissler, curator of anthropology, American Museum, addressed the section of anthropology of the American Association for the Advancement of Science, on "Coöperative Research in Anthropometry." On the same occasion, Dr. Milo Hellman, research associate in physical anthropology, presented by title "Observations on the Eruption of Teeth in Relation to Growth and Development."

At the meeting of the American Anthropological Association on December 28, Mr. N. C. Nelson, associate curator of archæology, American Museum, presented some "Notes on the Progress of Archæology in Europe."

THE ART WORK OF MR. E. W. DEMING.—From December 10, 1922, to January 10, 1923, there was exhibited at the Brooklyn Museum a series of paintings, decorations, bronzes, and book illustrations of American Indians and of animals of the Western Hemisphere by Edwin Willard Deming. The artist, some of whose paintings figure as murals in the American Museum, has been interested in the red man from childhood, having played in the sixties with the Winnebago youngsters that accompanied their elders on the winter hunt-

ing and trapping trips to the district in Ohio where he then lived. As a young man most of his time was spent studying and sketching the Indian tribes from Hudson Bay to southern Mexico. He lived among the Indians of Oklahoma before that area was opened to settlers; he sojourned in the camp of Sitting Bull when the Sioux were dancing the big war dance just before the Wounded Knee fight; he has been adopted and named by the Black-foot Indians and by the Pueblo.

His art work gives evidence of the breadth of his studies and the extent of his travels. Included in the exhibition at the Brooklyn Museum were scenes ranging from Hudson Bay to the jungles of South America, and from the still-existing terraced-house communities of Arizona and New Mexico to the vanished Indian life of our eastern coast in the far-off days of the Dutch occupation. Animal subjects, represented both by paintings and by bronzes, gave further proof of Mr. Deming's breadth of interest and artistic skill.

BIRDS

MR. JAMES P. CHAPIN, assistant curator, African birds, in the American Museum, presented a paper entitled "Ecological Aspects of Bird Distribution in Tropical Africa" before the American Society of Naturalists at their gathering in Boston and Cambridge during the closing days of December.

At a meeting of the Executive Committee of the American Museum of Natural History, held on December 20, 1922, the following resolution was unanimously adopted:

Resolved, That the Trustees desire to express their deep appreciation of the valuable researches of DOCTOR WILLIAM MORTON WHEELER in biological science and especially in the field of entomology, who, through his indefatigable energy and keen perception, has advanced this science and brought fame to the American Museum of Natural History, the service of which he entered in the year 1903. In the light of these achievements, the Trustees are glad to comply with the recommendation of the Scientific Staff that the Board confer upon him the highest scientific honor within their power and hereby take pleasure in electing DOCTOR WHEELER an *Honorary Fellow*.

At a meeting of the Board of Trustees of the American Museum of Natural History, held on February 5, 1923, the following resolution was unanimously adopted:

Resolved, That the Trustees appreciate the keen interest of COLONEL J. C. FAUNTHORPE

and MR. ARTHUR S. VERNAY in the Museum as expressed in their organization and conduct of the Faunthorpe Indian Expedition, and in recognition of their contribution to the cause of science take pleasure in electing them *Honorary Life Members* of the American Museum.

At the same meeting the following resolution was passed by affirmative vote of all present:

Resolved, that in accordance with the recommendation of the Scientific Staff, as recorded in the minutes of its meeting of January 9, 1923, the Trustees hereby elect the following *Corresponding Members* of the Museum for five years ending 1928:

DR. J. G. ANDERSSON, Mining Adviser to the Chinese Republic, Peking, China; DR. F. A. BATHER, Deputy Keeper of Geology, British Museum (Natural History) London, England; DR. ROBERT BROOM, Douglas, South Africa; DR. LUCIUS C. BULKLEY, Medical Missionary, Presbyterian Board of Foreign Missions, Petchaburi, Siam; DR. L. CAPITAN, École d'Anthropologie, Paris, France; DR. CHARLES CHILTON, Professor of Biology, Canterbury College, Christchurch, New Zealand; DR. ROBERT DABBENE, Museo Nacional, Buenos Aires, Argentina; DR. CARLOS DE LA TORRE, Rector, University of Havana, Cuba; DR. EMMANUEL DE MARGERIE, University of Strasbourg, France; DR. VICTOR GOLDSCHMIDT, Professor of Mineralogy, University of Heidelberg, Germany; MR. F. H. HAINES, Brookside, Winfrith, Dorset, England; DR. ARCHIBALD G. HUNTSMAN, Professor of Biology, University of Toronto, Ontario, Canada; DR. ALFRED LA CROIX, Professor of Mineralogy, Muséum d'Histoire Naturelle, Paris, France; DR. ADOLPHO LUTZ, Instituto Oswaldo Cruz, Rio de Janeiro, Brazil; MISS BERTHA LUTZ, Secrétaire, Museo Nacional de Historia Natural, Rio de Janeiro, Brazil; HERMANO APOLINAR MARIA, Instituto de La Salle, Bogotá, Colombia; HERMANO NICEFORO MARIA, Instituto de La Salle, Bogotá, Colombia; DR. G. ELLIOT SMITH, Professor of Anatomy, University College, London, England; DR. BALDWIN SPENCER, Honorary Director, National Museum of Victoria, Melbourne, Australia; DR. SHIGEHO TANAKA, Professor of Zoölogy, Imperial University of Tokio, Japan; DR. FRIEDRICH VON HUENE, Professor of Geology, University of Tübingen, Germany; DR. KARL WEINGAND, Bad Mergentheim, Württemberg, Germany.

In addition to those mentioned above, the following persons have been elected members

of the American Museum since the last issue of NATURAL HISTORY made its appearance:

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A series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, is open only to members and to those holding tickets given them by members.

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The SCHOOL SERVICE of the Museum reaches annually more than 4,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or “traveling museums,” which during the past year circulated among 475 schools, with a total attendance of 1,648,608 pupils. During the same period 330,298 lantern slides were loaned by the Museum for use in the schools as against 209,451 in 1921, the total number of children reached being 2,582,585.

LECTURES, some exclusively for members and their friends, others for the general public, are delivered both in the Museum and at outside educational institutions.

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A detailed list of the publications, with prices, may be had upon application to the Librarian, American Museum of Natural History, New York City

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NATURAL HISTORY

VOLUME XXIII

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RESTORATION OF THE TREE-BROWSING BALUCHITHERES OF WESTERN AND CENTRAL ASIA

Drawn, under the direction of the writer, by E. Rungius Fulda, April, 1923

NATURAL HISTORY

VOLUME XXIII

MAY-JUNE

NUMBER 3

The Extinct Giant Rhinoceros *Baluchitherium* of Western and Central Asia

THE LARGEST RHINOCEROS OF ALL TIME—PROBABLY THE LARGEST OF
TERRESTRIAL MAMMALS—COMPARED WITH OTHER RHINOCEROSSES,
LIVING AND EXTINCT

BY HENRY FAIRFIELD OSBORN

President of the American Museum of Natural History

This remarkable animal was first found near Chur-lando, Baluchistan, by the Cambridge University explorer and palaeontologist, C. Forster Cooper, and described by him December, 1911; it was given the generic name *Baluchitherium*, to commemorate the region where it was discovered, and the specific name *osborni*, in honor of the writer of the present article. The second discovery was made near Turgai, a province of north Turkestan, by the Russian palaeontologist, A. Borissiak, and named *Indricotherium asiaticum* in 1916. Neither discovery included the skull, although parts of the teeth were found, indicating an affinity to the rhinoceroses. The third discovery, revealing for the first time the creature's skull, was made in central Mongolia, by the Third Asiatic Expedition, which the American Museum is conducting in coöperation with the American Asiatic Society and with *Asia* and of which Mr. Roy Chapman Andrews is the leader. This find was named *Baluchitherium grangeri*, in honor of Walter Granger, the chief palaeontologist of the expedition.

It is necessary to open this article with a brief outline of what we have previously known of the history of the horned and hornless rhinoceroses of the world, for without such an introduction we cannot give *Baluchitherium* its true setting among the great group of quadrupeds which originally derived its family name from the earliest rhinoceros known to the savants of western Europe, namely, the *Rhinoceros unicornis* of India.

The Greek word rhinoceros is derived from *rhino* (ῥινό), nose, and *keras* (κέρας), horn, to which was added the Latin specific name *unicornis*, signifying jointly the animal which bears a single horn on the nasal region of the skull. This unicorn-rhinoceros—famous in the history of zoölogy, in animal mythology, where it appears as the unicorn, as well as in the history of medicine throughout the Middle Ages because the horn was supposed to have peculiar medicinal virtues¹—was long

believed to be the only rhinoceros in the world. But when Africa was opened up to explorers, the 'black' rhinoceros was discovered with its two horns, namely, a nasal and a median, and naturally was described in 1758 as *Rhinoceros bicornis*, signifying the two-horned rhinoceros. This discovery was followed in 1817 by the description of the giant 'white' rhinoceros of Africa, distinguished by its lighter grayish color from the black rhinoceros. To this 'gray-white' rhinoceros the name *Rhinoceros simus* was given, the Latin-Greek specific name (Latin = *simus*, Greek = σιμός) signifying the flat-nosed or snub-nosed rhinoceros, in reference to the very broad snout adapted to grazing, quite different from the narrow and pointed snout of the black rhinoceros, which is adapted to browsing.

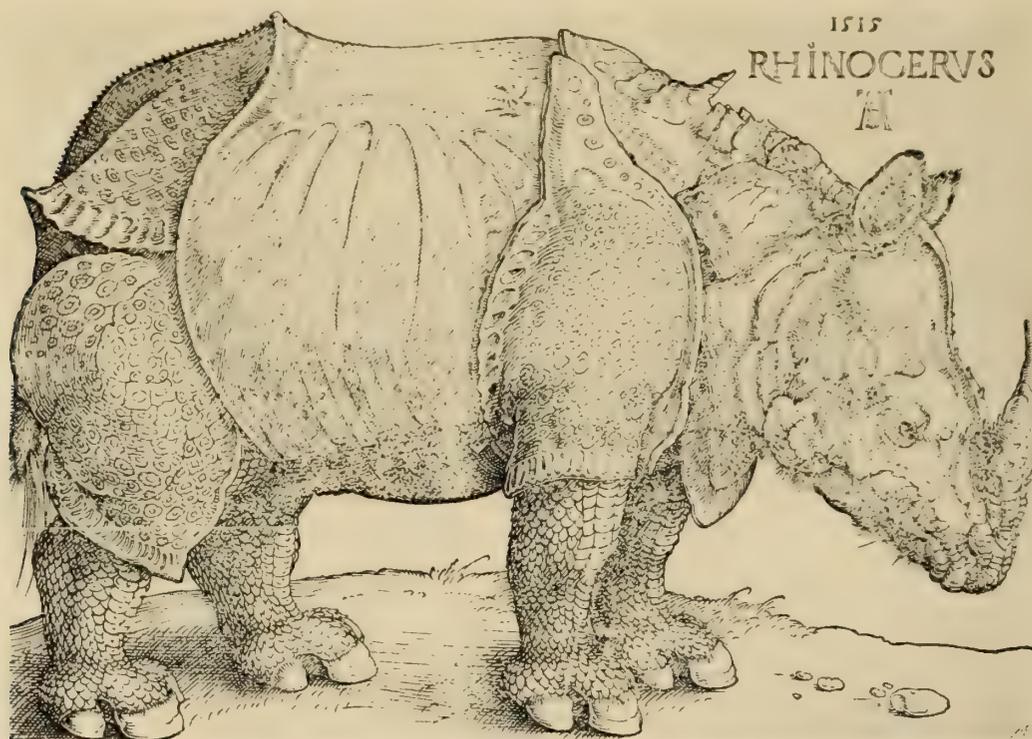
Long before this, however, fossil rhinoceroses began to be found. First came the discovery of the great *Rhinoceros antiquitatis*, so named by Blumenbach in 1799; this is the 'woolly' rhinoceros of the northern tundras of the

¹See the article entitled "The Unicorn and His Horn," by Frederic A. Lucas, *NATURAL HISTORY*, Vol. XX, November-December, 1922, pp. 532-35.

Ice Age, a companion to the 'woolly' mammoth (*Elephas primigenius*), also named by Blumenbach. All of these living and fossil rhinoceroses, discovered in Asia, Africa, Siberia, and various parts of western Europe, were distinguished by the presence of either one or two horns, varying in proportions and culminating in the gigantic single-horned *Elasmotherium sibiricum*

and the gray-white rhinoceros. Gray was the first (1867) to apply to the white rhinoceros the distinct generic name *Ceratotherium*.

Naturalists then began to be impressed with the differences in the cutting teeth of the rhinoceroses, which were composed not of *canine* tusks as in other quadrupeds, but of an enlarged pair of upper and lower incisor teeth,



After an etching of the "Rhinocerus" by Albrecht Dürer, dated 1515, presented to the American Museum by Dr. Bashford Dean. Comparing this remarkable etching with Philip Lutley Selater's drawing of the *Rhinoceros unicornis* reproduced on page 219, we observe that Dürer has interpreted the dermal armature of the Indian rhinoceros in terms of the ornamented steel armor of the age of chivalry

in which the horn was borne not on the nasals but on the middle of the top of the skull.

Thus a great variety of generic names was successively applied, referring to horns of different kinds, as follows: *Dicerorhinus* Gloger (1841) and *Ceratorhinus* Gray (1867) to the primitive two-horned rhinoceros discovered in Sumatra; *Diceros* Gray (1821) to the two-horned black rhinoceros of Africa; and *Opsiceros* Gloger (1841) to both the African black rhinoceros (type)

namely, the *second incisor* above and the *second incisor* below, corresponding with the tusks in the elephant family which are also second incisors above and below and not canines as would at first appear. Consequently naturalists began to distinguish the rhinoceroses by the presence or absence of their cutting teeth: for example, rhinoceroses without cutting teeth were all placed in the genus *Atelodus*, proposed by Pomel in 1853; the thick-jawed rhinoceros of Greece was named

Colodus, and the large-toothed rhinoceros of Archer, Florida, was named *Eusyodon* by Leidy.

All together between 1758, when Linnæus made the Indian rhinoceros the type of his genus *Rhinoceros*, and 1904, the year of the publication of Palmer's great *Index Generum Mammalium* (Index to the Genera of Mammals), not less than 42 generic names were proposed for the various kinds of rhinoceroses, many receiving several generic names which became synonyms of one another. Up to and including the years 1897-1905, when Trouessart's great *Catalogus Mammalium tam Viventium quam Fossilium* was written, upwards of 170 species of rhinoceroses, living and fossil, had been described.

HORNLESS RHINOCEROSES DISCOVERED, 1832-1911

Naturalists became so accustomed to the idea of one or two horns as a universal characteristic of the rhinoceros family, that in the year 1832 there came as a complete surprise the discovery of a skull near Eppelsheim in the vicinity of Darmstadt, Germany, of what was supposed to be a *hornless* rhinoceros. To this specimen the palæontologist Kaup gave the generic name of *Aceratherium*, signifying a rhinoceros without horns, the absence of horns being compensated for by a pair of strongly offensive upper and lower incisive tusks, to which the specific name *incisivum* refers; hence Kaup's animal was considered a hornless rhinoceros with incisive tusks. The writer's own observations, made during the year 1898 on this same specimen, are detailed below.

The timeliness of recalling Kaup's discovery at the present moment is that the great *Baluchitherium* also proves to be a hornless rhinoceros with very powerful incisive tusks, and at

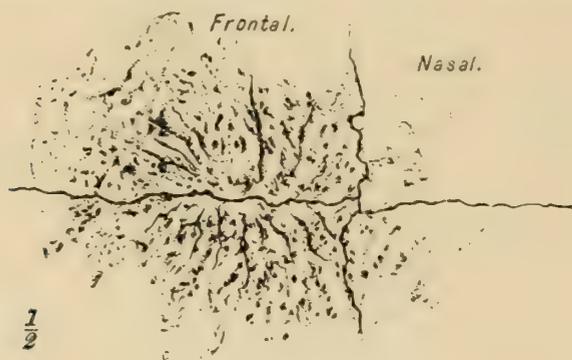
once the question arises as to its relationship to the *Aceratherium incisivum* of Kaup. In considering this question, we must first realize that *Baluchitherium grangeri* is of Oligocene or of Miocene age and is thus geologically more ancient than Kaup's *Aceratherium incisivum*, which is of Lower Pliocene age. Obviously *Baluchitherium* cannot be a descendant of *Aceratherium*, and with that possibility eliminated, another alternative suggests itself: whether it may not be a gigantic ancestor from which the Pliocene *Aceratherium* descended. We shall see that this conjecture must be answered with a decided negative, because *Baluchitherium* belongs to a distinct breed or line of hornless rhinoceroses, a line of evolution now made known for the first time by a series of discoveries beginning in 1911.

SEVEN DISTINCT LINES OF RHINOCEROSES, HORNED AND HORNLESS, RECOGNIZED BEFORE BALUCHITHERIUM WAS DISCOVERED

All the herbivorous quadrupeds tend to spread and migrate into different habitats and climates and into new feeding grounds of various kinds to which they become fitted through a principle of evolution which the writer has called *adaptive radiation*. The seven lines of rhinoceroses separated from each other at a very ancient period, and although externally similar in certain cases, they are really very far apart in their history and anatomy; even the two living African rhinoceroses probably separated from each other a million years ago. Thus the original genus *Rhinoceros* now includes numerous distinct branches of the great rhinoceros family.

During the years 1893-1905 the present writer was actively engaged in

the study of the living and extinct rhinoceroses of various parts of the world. At the time the multiplicity of 42 generic and upwards of 170 specific names was terrifying; it indicated an almost hopeless confusion in the minds of naturalists regarding the real relationships and affinities of these remarkable animals. There certainly could not be 42 different genera of rhinoceroses; the majority of these names must be synonyms. Nor was it likely that there could be 170 different species of rhinoceroses, highly varied as these animals were known to be in various stages of evolution. What key



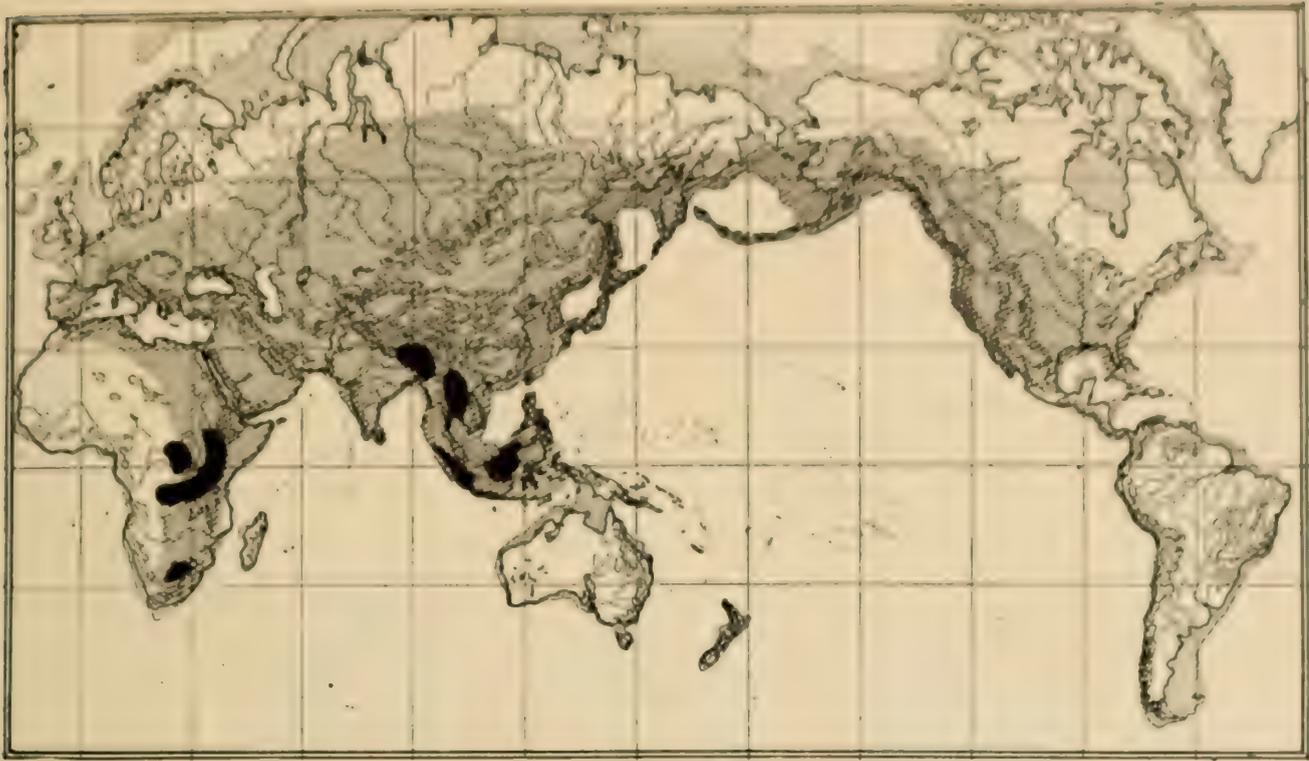
After the author's sketch of the horn rugosity at the union of the frontal and nasal bones of *Aceratherium incisivum*. Sketch made at Darmstadt Museum, August, 1900

could be found to this labyrinthine maze of names? The mode of search for such a key was indicated in the preface of the author's Memoir entitled *The Extinct Rhinoceroses*, published by the American Museum in 1898, namely, to arrive at a sound basis of classification for the anatomy and evolution of the rhinoceroses, derived from a comparison of their most primitive forms, according to the geologic period of their origin, and from a study of the characters in which various lines of rhinoceroses parallel or imitate each other, in contrast to those divergent characters in which they actually separate from each other in habits

and habitat; thus laying the foundation of a true interpretation of their ancestral history.

In order to carry out this purpose, which the writer formulated during his study of the very primitive rhinoceroses of North America discovered in the course of the American Museum expeditions that were conducted between the years 1890-98, the writer made a journey during the summers of 1898 and 1900 through all the great natural history museums of Europe,—London, Paris, Lyons, Munich, Darmstadt, Stuttgart, Augsburg, Vienna, St. Petersburg, and Moscow, where the principal types of fossil and living rhinoceroses described by the great palæontologists and zoölogists of Europe could be found, namely, the types of Blumenbach, of Cuvier, of Duvernoy, of Kaup, of Bronn, of Gaudry, and of other authors too numerous to mention.

In some instances these specimens were thickly covered with dust. In the ancient Museum of Darmstadt, for example, lay Kaup's classic type of *Aceratherium incisivum* on a shelf accumulating the dust of decades. The aged conservator was horror-stricken when a young American palæontologist appeared requesting the privilege of examining this venerable specimen more closely and only through a rather vigorous appeal to the distinguished geologist, Professor Richard Lepsius, did the writer succeed in having this ancient specimen brought out and placed on a table. By blowing upon it a few times and applying a duster the deposit of dust was removed, and, *presto*, the writer made a most interesting discovery which had completely escaped the learned eye of Professor Kaup in 1832, i.e., that this type skull bears indubitable proof of the presence



Rhinoceroses still survive only in the areas indicated in solid black on this map, namely, two species in Africa and three species in Asia. The oblique-line shading indicates the probable former range of these animals, including all the continents except Australia and South America. In North America the rhinoceros did not invade Mexico (in this respect the map is erroneous), but in Middle Miocene times it reached the eastern coast of Maryland, the Carolinas, and Florida

of a little horn right in the middle of its forehead, as shown in the accompanying sketch made by the writer before the eyes of the astonished curator, and that the name *Aceratherium*, or hornless, is therefore a misnomer. Thereupon, encouraged by this discovery, the dust was removed everywhere; rusty locks were opened; ancient trays filled with dust-covered specimens were taken down from the shelves. At times there were picturesque occurrences,—for instance in the Imperial Museum of Moscow, where the head curator appeared in an ornate uniform to welcome the writer. As a rule, however, the work was hard and prosaic, requiring rapidly executed pencil sketches and volumes of notes, drawings, and memoranda; but the sequel was highly satisfactory. It was expressed in the writer's rhinoceros article entitled "Phylogeny of the Rhinoceroses of Europe," published as

a *Bulletin* of the American Museum, December 11, 1900, in which the following conclusion was reached: that the true rhinoceroses of the Age of Mammals and of modern times belong in at least six great and distinct lines of descent and of evolution, which have been separated from each other since very early geologic times and from which lesser branches have been given off. The eight great lines now known are as follows:

I. Primitive hornless ACERATHERES of western Europe and North America, entirely hornless or with rudiments of horns on the forehead.

II. Primitive two-horned DICERATHERES, in which two little horns are placed side by side at the front of the nasals instead of tandemwise. These animals range from western Europe to North America.

III. Short-footed rhinoceroses, BRACHYPODINES, with a body shape like that of hippopotami, and a sharp, wedge-shaped horn at the very tip of the nasals. These migrated from western Europe to the southern United States.

IV. Tandem-horned rhinoceroses, CERATORHINES, chiefly of southern Asia and southern Europe, surviving in the Sumatran rhinoceros, now living in the forests of Sumatra; never finding their way to North America.

V. Typical rhinoceroses of India, RHINOCEROTINES, with a single anterior horn, *Rhinoceros indicus*, and its relative, *R. sondaicus*, and fossil ancestors.

VI. Rhinoceroses without cutting teeth, ATELODINES, of Africa, including the hook-lipped browsing *Diceros bicornis*, the broad-lipped grazing *Ceratotherium simum*, and fossil ancestors.

VII. ELASMOTHERES, or gigantic rhinoceroses of the tundras of northern Europe and Asia, with a single huge horn in the middle of the forehead.

VIII. BALUCHITHERES (Baluchitheriinae), gigantic hornless rhinoceroses of the early Tertiary or Oligocene age of Asia, resembling the ACERATHERES but with stilted limbs attaining colossal height.

I. THE PRIMITIVE HORNLESS RHINOCEROSSES, OR ACERATHERES

The Aceratheres are the simplest rhinoceroses known, appearing early in the Age of Mammals. They are found in southern Europe, southern Asia, and in our own western states, Colorado and South Dakota. At first they were no larger than tapirs, with perfectly smooth skull top devoid of a rudiment or sign of a horn either on the nasal or the frontal bones—thus typical Aceratheres. Undoubtedly the true Eocene ancestors of these animals still await discovery; we may come across them in Asia. Although there are animals very close to the ancestral rhinoceros stage among the varieties of the quadruped known as *Hyrachyus*, found near Fort Bridger in southwestern Wyoming, we are inclined to believe that North America was not the homeland of the rhinoceroses.

The first animal of this kind found in our western states was brought to Dr. Joseph Leidy of Philadelphia, the

founder of mammalian palæontology in America; he recognized at once its general resemblance to the *Aceratherium* of Kaup (1832) and described it as *Aceratherium occidentale*, or the Acerathere of the West. Quite recently there were found in Colorado the fossil remains of a little herd of Aceratheres characterized by even more primitive structure and known as *Trigonias* from an upper jaw that had been described by Lucas in 1900. The name had been given because of the presence of triangular cutting teeth at each angle of the jaw, for these little animals possessed small upper canine tusks or eyeteeth, also third upper incisors, as well as second upper incisors, which were beginning to be enlarged to press against the tusklike lower incisor teeth. Another distinction of these animals was the possession of four digits on the front foot, unlike the living rhinoceros, which has only three, hence their specific name *tetradactylum*, signifying four-toed.

These Aceratheres were not only very numerous but very hardy, well protected from their enemies and vigorous. In Lower Oligocene times they ranged widely over the whole Northern Hemisphere, both in North America and Eurasia, including India. They branched out into several varieties of descendants, which culminated in Europe in the *Aceratherium incisivum* of the Lower Pliocene of Germany. In North America they survived into Middle Pliocene times, being represented by the *Aphelops megalodus*, the hornless and big-toothed Acerathere of western Colorado described by Cope in 1873, and also by the very long-limbed *Aphelops malacorhinus* of Cope, the hornless, soft-nosed Acerathere, and finally by the long-footed one, discovered by Leidy

in Florida and described in 1890 under the specific name *longipes*.

These Miocene and Lower Pliocene Aceratheres were almost as large as the existing Indian rhinoceroses. As a rule they were everywhere distinguished by very powerful lower incisor tusks, splendid fighting weapons; also by long limbs whereby they were able to run swiftly and thus escape their enemies; the snout was either abso-

semble the Aceratheres in their long limbs, their relatively slender bodies, well raised off the ground, and their strongly offensive and defensive lower incisor tusks; they are of the size of tapirs and capable of rapid motion. They appear to differ, however, from the outset in two important characters: they have only three digits on the fore foot instead of the four found in the true Aceratheres; but still more im-



Typical Diceratheres of South Dakota, named *Diceratherium tridactylum*. The animals were drawn from a perfect skeleton discovered in 1892 and now in the American Museum. At this stage of evolution the horn rudiments were extremely slight; they appeared as paired rugosities on the nasal bones, and are observed only in old male specimens. These rugose areas are somewhat like the corresponding area shown in the sketch on page 212. Hence this animal was first regarded as an Acerathere by Osborn, but later proved to be an ancestor of the true pair-horned Diceratheres

lutely smooth or, yielding to the rhinocerotine tendency, had nasal horn rudiments. Yet the forehead or median horn rudiment, as observed in the *Aceratherium incisivum* of Kaup, is also present in some of the American Aceratheres.

II. THE PAIR-HORNED RHINOCEROSES, OR DICERATHERES, OF EUROPE AND OF WESTERN NORTH AMERICA

The Diceratheres, like the Aceratheres, are very primitive and ancient, namely, of the Oligocene of France and of South Dakota. They closely re-

portant and characteristic is the position of the horns, which appear side by side on the top of the nasals instead of in the tandem arrangement peculiar to all other horned rhinoceroses.

The Diceratheres, therefore, are readily remembered as the pair-horned rhinoceroses. They too are great travelers, being very abundant in central France and in the Rocky Mountain region of South Dakota; from the latter locality superb specimens were described by Osborn in 1893 under the specific name *tridactylum* in contradistinction to *tetradactylum*. These

animals were found by the American Museum expedition in beds of Upper Oligocene age, and the paired horns were so rudimentary that it was not at first recognized that they were true Diceratheres, directly ancestral to the species *Diceratherium annectens*, i.e., the annectent Diceratheres, which had been described by Marsh from the John Day valley of Oregon in 1873, or to *Diceratherium armatum*, the well-armed Diceratheres, so named by Marsh in 1875, from the same region of Oregon. Professor Marsh was thus the first to set apart the pair-horned Diceratheres from all other rhinoceroses. The French palæontologists, Aymard, Filhol, and Duvernoy, hesitated to separate these pair-horned rhinoceroses, which they found very abundant in Upper Oligocene strata in France and in Germany, although Duvernoy named one of his specimens *Rhinoceros pleuroceros*, signifying that the horns were borne side by side. These animals do not appear to have been quite so vigorous or successful in their migrations and combats as the Aceratheres, although they are traced into the Lower Miocene near Orléans, namely, the *sables de l'Orléanais* of central France; and are perhaps even present in Baluchistan, where they are reported from beds in the Bugti Hills although this discovery awaits confirmation.

So far as we know, the Diceratheres died out in Lower Miocene times, whereas the Aceratheres persisted into Middle Pliocene times both in America and Eurasia.

III. THE SHORT-FOOTED RHINOCEROSES, BRACHYPODINES

In wide contrast to the cursorial and swift-traveling Aceratheres and Diceratheres, there appeared in Lower Mio-

cene times in France, contemporary with one species of the Diceratheres, in the same river deposit now known as the *sables de l'Orléanais*, an animal first described by the French palæontologist Nouel as *Rhinoceros aurelianensis*, the rhinoceros of Orléans. This medium-sized rhino is the earliest known progenitor of one of the most extraordinary groups of rhinoceroses the world has known; extraordinary because, despite their excessively short limbs and feet to which the name *brachypodine* refers, and their low heavy bodies, probably adapted like that of the hippo to living along river borders, water courses, and in swampy lowlands, they traveled over the entire Northern Hemisphere in great herds, absolutely protected against their enemies by a very sharp pair of lower cutting tusks, which resemble those of the Aceratheres and of the Diceratheres, as well as by a very sharp, narrow, wedge-shaped horn placed on the very tip of the nasal bone. With this double protection and probably a very thick skin, they defied the Carnivora.

We find them in southern France in great numbers, in the quarries of the Island of Samos of the eastern Mediterranean, in the quarries of Maragha, Persia, in the Siwalik floodplain deposits of India, in the East Indies, and in Japan,—always migrating eastward. Finally they enter northern Asia, cross the Asiatic-American land bridge, reach North America, and, in Lower Pleistocene times, they not only spread over our western states as far south as Kansas, but penetrate even to Florida! Finally a great herd of these animals was discovered in 1883 in a quarry near Long Island, Phillips County, Kansas, by the veteran collector Charles Sternberg. This

wonderful quarry yielded rich collections to the University of Kansas, to the Museum of Comparative Zoölogy in Cambridge, to the United States National Museum, and to the American Museum.

These animals, as first discovered in the Upper Miocene of France, received the specific name of *brachypus*, signifying the short-footed rhinoceroses: as

partly aquatic in its habits, with a very large brain and no diploë or spongy lining to the skull. The limbs were far shorter than those of any living type of rhinoceros. In the females the nasals bore a very small horn; in the males, especially as found in the Lower Pliocene of the Republican River, Nebraska, the nasals became greatly thickened at the extremities into a



The short-footed or brachypodine rhinoceros, known as *Teleoceras fossiger*, as it appeared in Lower Pliocene times in the locality now known as Long Island, Kansas. After a painting by Charles R. Knight, made in 1898 under the direction of the author. This animal was almost certainly aquatic in its habits, and in a revised restoration it will be shown without the skin folds. It will then have more of the smooth, rounded appearance of the hippopotamus

found in the Lower Pliocene of Germany, they were given the specific name of *goldfussi*, after one of the German palæontologists. Later the American palæontologist Hatcher applied to them the generic name *Teleoceras*, signifying the end horn rhinoceros. From the collection, already referred to, that was obtained at Long Island, Kansas, Osborn in 1898 described *Teleoceras* as a broad-headed, extremely short-limbed rhinoceros,

vertically compressed plate which bore a tall, thin, wedge-shaped horn. The body proportions were 10 feet in length, with a height at the withers of only a little over 4 feet, and with a girth of the abdomen at the ribs of 9 feet 2 inches. It was on the mounted skeleton from this same Long Island quarry that Charles R. Knight in 1898 based the beautiful restoration of *Teleoceras* that he drew under the direction of the writer, as shown in the accompanying illustration.

IV. THE TANDEM-HORNED RHINOCEROSSES, CERATORHINES, NOW SURVIVING IN SUMATRA, EASTERN BENGAL AND ASSAM

Unlike the tandem-horned rhinoceroses of Africa, which have no cutting teeth, these animals retain small cutting incisor tusks, supplemented by a pair of relatively small but very effective horns.

In a little fossil-bearing hill near Sansan (Gers), France, Lartet in 1848 discovered the diminutive animal which he called the rhinoceros of San-

known as *Rhinoceros steinheimensis*, found in the Upper Miocene of Steinheim, Westphalia, Prussia, assume a little larger size; they appear somewhat larger still in the race known as Schleiermach's rhinoceros of the Lower Pliocene of Eppelsheim. Their first appearance in southern Asia is in the 'flat-nosed' rhinoceros, *Rhinoceros platyrhinus*, of the Lower Pleistocene deposits of India. Like all rhinoceroses these animals were first described as belonging to the genus *Rhinoceros*, but



This is the two-horned, hairy-eared rhinoceros of eastern Bengal, known as *Rhinoceros lasiotis*. Its tandem horns clearly distinguish it from the unicorn rhinoceros of Nepal and relate it to the rhinoceros of Sumatra. It is now very rare

san, the *Rhinoceros sansaniensis* of his "Notice sur la Colline de Sansan." Shortly afterwards, in the neighboring and somewhat more recent deposit of Simorre, he found the related rhinoceros of Simorre, i.e., *Rhinoceros simorreensis*, a diminutive tandem-horned rhinoceros of such slender proportions that Jourdan gave it the specific name of *elegans*. These tandem-horned animals were defended by a horn in the center of the nasals and a smaller horn in the center of the forehead. As first found in the Middle Miocene of France, they are small and of slender proportions, hardly larger than tapirs; those

they really were profoundly different from the Indian Rhinoceros, to which alone the generic name *Rhinoceros* properly applies. As observed in Sumatra, they are persistently primitive animals, and probably inhabited during the geologic past, as they still do at present, the deep recesses of forests. Such protected environment is never favorable to rapid evolution but rather to persistence of type: for example, the forest-living okapi of central Africa today is far more primitive than its remote relative, the plains-living giraffe, which is exposed to enemies on every side.

These forest-living Ceratorhines were nevertheless widely distributed in past time: they were quite abundant in central India, the present region of the Siwalik Hills, in late Pliocene or early Pleistocene times, and we trace them westward again along the north shores of the Mediterranean in the slender-nosed Ceratorhine (*Ceratorhinus leptorhinus*), which is represented by numerous remains from near Montpellier (Hérault), France. There is

article, namely, to the typical Asiatic rhinoceros, *R. unicornis*, a very powerful animal which is nearing extinction, but still survives in the forests of Nepal in northern India, where the Faunthorpe Expedition has recently secured a fine group for the American Museum. A related form occurs in the Islands of the East Indies in the species *R. sondaicus*. No representatives of these true Indian rhinoceroses have ever been found in Europe, or in



This beautiful drawing of the Asiatic rhinoceros, *Rhinoceros unicornis*, which appeared in Philip Lutley Selater's Memoir of 1875 on the rhinoceroses, exhibits the broadly overlapping dermal folds which completely protect this animal from its enemies, a defensive adaptation interpreted by Albrecht Dürer in 1515 as shown on page 210

also the long, slender-limbed Etruscan Ceratorhine (*C. etruscus*) from the Upper Pliocene, a geologic period when these animals, favored by a genial climate, occurred in the very broad forest belt extending from the east coast of England, where they are abundant in the Upper Pliocene Red and Norwich Crag, southward and eastward across southern France and northern Italy to distant India.

V. THE TYPICAL SINGLE-HORNED RHINOCEROSSES OF ASIA

The consideration of the fifth group brings us back to the beginning of this

Africa, or in the remote parts of the East Indies, or in fact anywhere except in southern Asia; none of them ever came over to North America; they appear to be exclusively Asiatic in their distribution.

The past geologic history of the true Indian rhinoceroses is rather obscure, for they are not found in any of the more ancient fossil beds of the Siwaliks, India, but appear with relative suddenness near the summit of the Siwaliks in the form of two species known as *R. sivalensis*, the rhinoceros of the Siwaliks, and *R. palæindicus*, the ancient rhinoceros of India. Of the two surviv-



(Left) Front view of the square-lipped 'white' grazing rhinoceros of the Lado district, Africa. After photograph by Herbert Lang



(Right) Side view of the pointed-lipped 'black' rhinoceros, a browser of the central African plateau. After photograph by Jenness Richardson

ing species the giant animal or typical *Rhinoceros unicornis*, with its longer crowned grinding teeth, is a *grazer*, preferring the grassy savannas of Nepal, whereas the smaller rhinoceros of India, known as *R. sondaicus*, is



White rhinoceros skull in the American Museum, brought to England by a missionary, the Rev. John Campbell, in the year 1815; preserved in the Museum of the London Missionary Society until 1867; in 1902 purchased from Cecil Graham by J. Pierpont Morgan and presented to the American Museum; described in a letter of 1821 as follows: "The head in the missionary museum supposed to be the head of the unicorn, appears to belong to a species of *Rhinoceros* previously unknown in this country."

chiefly a *browser*, its grinding teeth being shorter as in all browsers. Both fossil and living species exhibit a skull with a forwardly inclined occiput; the top of the skull is absolutely concave and hornless in the middle of the fore-

head, whereas the nasals are armed in the middle portion with a bony rugosity to support the great anterior horn, but beyond this the nasals are smooth and terminate in pointed extremities. Thus we readily distinguish the nasal horn region of the true rhinoceroses from the same part of the skull in either the Sumatran type or the next type to be considered, the African.

VI. THE RHINOCEROSES WITHOUT CUTTING TEETH, OR ATELODINES, OF AFRICA AND EUROPE

The two living African rhinoceroses, 'black' and 'white,' are the sole survivors of a group of African-European animals readily distinguished from the other groups by the fact that both the upper and lower cutting teeth are vestigial or wanting, evidently because these animals gave up the use of these teeth very early in geologic time and substituted very broad grazing lips like those of the white rhinoceros for the narrow pointed browsing lips that are characteristic of the black rhinoceros. They did not need the cutting teeth as offensive or defensive weapons because the top of the skull was provided with two large, strongly developed horns placed upon the nasals and frontals, the frontal horn

both in the white and the black rhinoceros being the most powerful fighting weapon of the kind developed in any quadruped.

The ancestors of these animals, known as *Ceratotherium pachygnathum*, suddenly appear in the famous Lower Pliocene quarries of Pikermi, Greece. It seems probable that these 'thick-jawed' rhinoceroses came to Greece from Africa accompanied by numerous antelopes and giraffes, which also

This thick-jawed rhinoceros of the Greek Pliocene resembles so closely the great woolly rhinoceros of the Ice Age of northern Eurasia, described by Blumenbach in 1799 as *R. antiquitatis*, the rhinoceros of antiquity, that Duvernoy believed that the Siberian and Grecian specimens belonged to the same species, and Albert Gaudry remarked in 1862 that this conclusion was very natural because the limb bones are so similar.



Mounted specimen of the superb example of the 'white' rhinoceros, *Ceratotherium simum*, collected by the American Museum Expedition of 1909-15 under Messrs. Lang and Chapin in the Lado district, central Africa, northeast of the Congo forests. Mounted by Mr. James L. Clark for the Roosevelt African Hall of the American Museum

appear to be of African origin. A fine skull and skeleton of the thick-jawed rhinoceros of Pikermi was described and figured in 1862 by the veteran French palæontologist, Albert Gaudry; even in the skull of the young of this animal there are indications of a very large frontal horn and the nasal bones are very broad and thick at their extremities, adapted to a large nasal horn; the jaws beneath are reduced and the front teeth, which are extremely small, soon disappear. This animal, like the black rhinoceros of Africa, was a browser or shrub eater.

The writer verified these observations by comparison of all the specimens of the black, of the white, of the thick-jawed, and of the woolly rhinoceros, and came to the conclusion that the woolly rhinoceros was intermediate in structure between the black and the white. The white rhinoceros of Africa (*C. simum*) is the largest living type. It has a square upper lip with very broad nasal bones, the horn rugosities being carried out to the very extremity of the nasals so that the horn pitches forward and its cranial resemblance to the thick-jawed rhinoceros is remark-

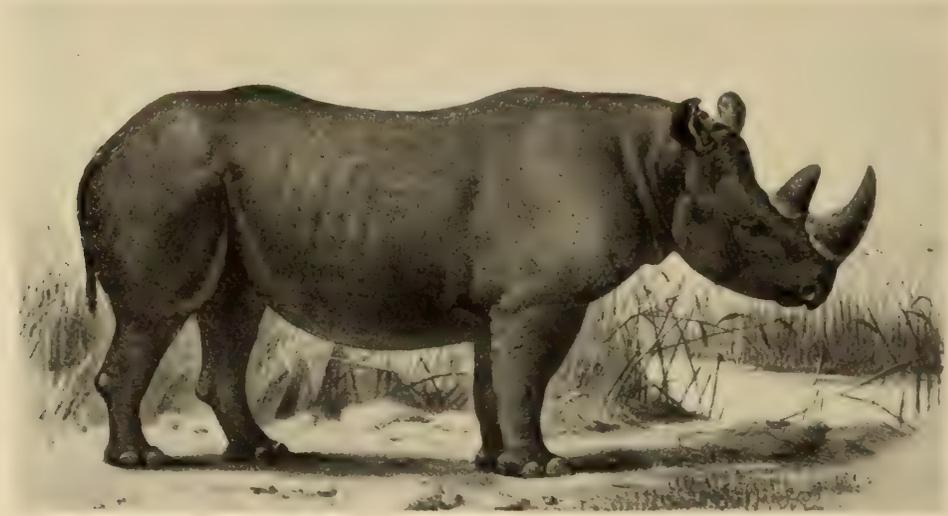
able. The black rhinoceros (*D. bicornis*), on the other hand, has a pointed prehensile upper lip with the somewhat more pointed nasals associated with this narrow snout, yet the horns are carried also to the very extremity. The writer's conception of the woolly rhinoceros, which is shown in Mr. Charles R. Knight's restoration (page 223), indicates an intermediate structure.

These animals were mainly African and European in their migrations but appear to have wandered as far east

able of the rhinoceroses, namely, the great single-horned Elasmotheres, which exceeded all other rhinoceroses in size with the exception of the recently discovered Baluchitheres.

VII. THE ELASMOTHERES OF THE TUNDRAS AND STEPPES OF PLEISTOCENE EUROPE

A peculiarity of these Elasmotheres which gives them their name is the wavy enamel of the teeth, which folds in and out in thin plates, the designation *Elasmotherium* (e.g., ἐλασμός, thin



The 'black' rhinoceros, known as *Diceros bicornis*, of the central African plateau; figured by Philip Lutley Selater in 1875. This animal is reproduced to the same scale as the rhinoceroses represented on pp. 215, 217, 218, 219, 221; it therefore represents a rather small individual of this powerful animal, which is none the less considerably inferior in size to the 'white' rhinoceros (page 221)

as Maragha; Persia. Their favorite habitat during the Ice Age was the cold steppes and tundras of the North to which they became perfectly adapted through the development of a thick undercoating of woolly fleece of a golden-brown color, a specimen of which is preserved in the St. Petersburg Museum.

The woolly rhinoceros has been found all over Europe, but to the east its geographical range may have been limited by the largest and most formid-

plate, and Θηρίον, wild beast) being applied by the Russian naturalist, Fischer, in 1808 to the first specimen discovered, namely, *E. sibiricum* from the Pleistocene in the vicinity of Miask, Siberia. During the Ice Age these animals were driven as far south and east as central Europe.

They differ from all other horned rhinoceroses in the entire absence of any trace of a horn upon the nasals and in the development in the middle of the forehead of a gigantic bony prominence

which may have borne a huge median horn, or may have supported merely a thickening of the epidermis. It is possible, as observed by the writer, that this median horn may have evolved out of the inconspicuous median rugosity found by him on the top of the *Aceratherium incisivum* skull in the Museum of Darmstadt. The ancestry of the Elasmotheres, however, remains an open question upon which some light will probably be thrown by

Cooper of Cambridge, England, formerly a student in the American Museum, made his expedition into the Bugti Hills of eastern Baluchistan on the borders of India. Here he discovered two kinds of aberrant rhinoceroses,—first, a small animal which he named *Paraceratherium*, that is “akin to *Aceratherium*,” represented by fairly complete skulls and lower jaws; second, evidence of an animal of enormous size the kinship of which he



The woolly rhinoceros, described by Blumenbach as *Rhinoceros antiquitatis*, now known as *Ceratotherium antiquitatis*. This scene is in the steppe period or climate of Postglacial time in northern France. During this period the woolly rhinoceros was portrayed by artists of the Crô-Magnon race in several drawings or etchings, from which this restoration was made. Drawn by Charles R. Knight under the direction of the author

the fossil-hunting parties now working in northern Asia. Suffice it to say that the Elasmothere skull surpasses in size that of the gray-white rhinoceros of Africa but is still far inferior in size to that of the Baluchitheres.

VIII. BALUCHITHERES, THE GIANT HORNLESS RHINOCEROSES OF WESTERN AND CENTRAL ASIA

Such was the general state of our knowledge of the great family of rhinoceroses and their migrations until the year 1911, when Clive Forster

was unable to determine with certainty although from the first he suspected its relationship to the rhinoceroses; this animal he named after the region of its discovery *Baluchitherium*, the wild beast of Baluchistan, and the specific name *osborni* he assigned to it in honor of the present writer.

In a series of papers Cooper described the perfectly gigantic neck bones of this animal and parts of the foot and limb bones exceeding those of the elephants in size. Finally, in February, 1923, he concluded that *Baluchitherium*

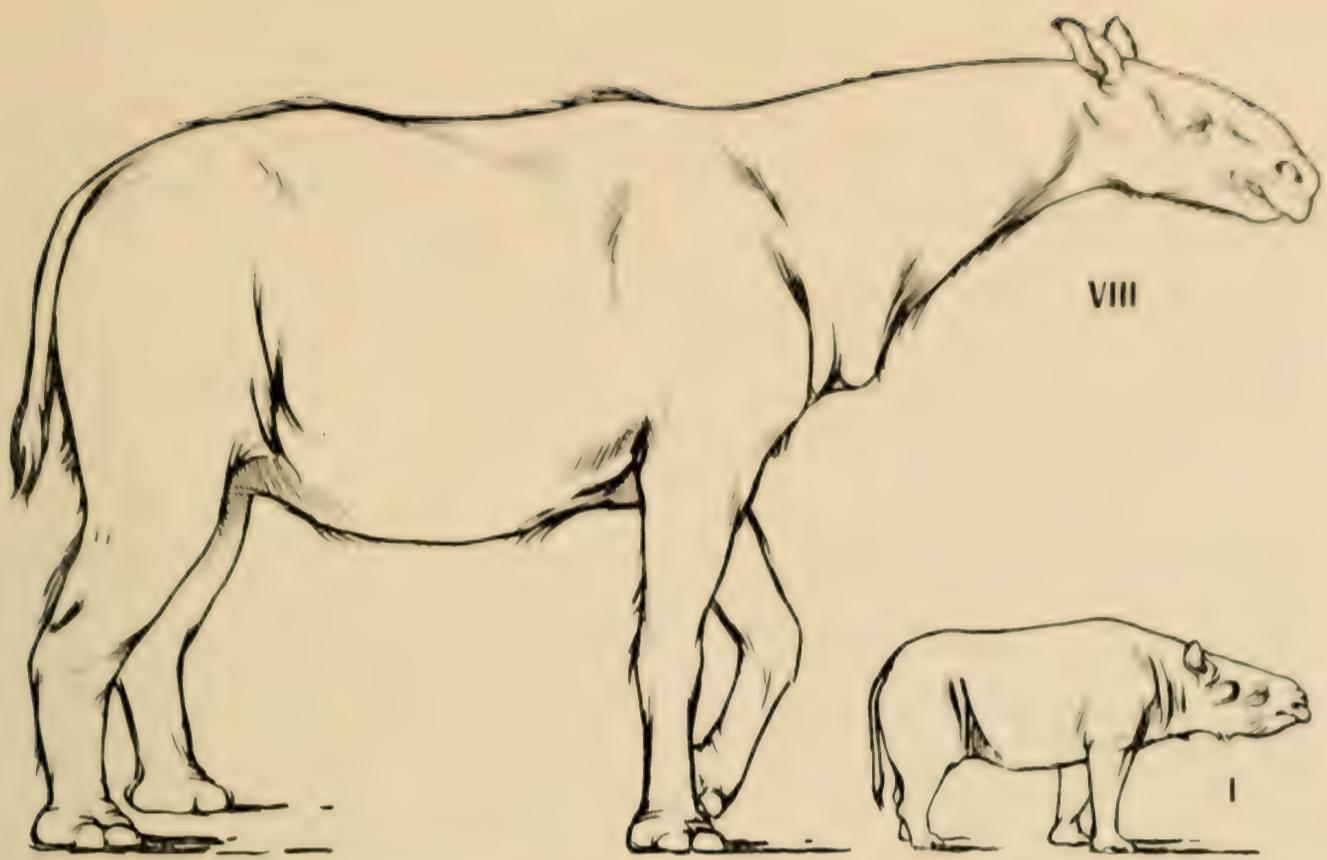
may be described as the only known member at the end of a series of odd-toed ungulates, extremely tall-footed, probably long-headed, of primitive kinship to the rhinoceroses, somewhat masked by adaptation to weight, the direct line of ancestry being as yet unknown. This excellent conjecture of 1923 was partly based on the discovery by the Russian palæontologist Boris-*siak* in Turgai, northern Turkestan, of a gigantic animal to which he gave the name *Indricotherium asiaticum*. Boris-*siak* was fortunate enough to discover not only parts of the skeleton but well-preserved grinding teeth, which he immediately observed were like those of some of the large Oligocene *Acera-theres* above described. It was found that the Turkestan animal is very closely similar in size to that from Baluchistan so that Forster Cooper and Borissiak together added to the rhinoceroses of the world a new animal of gigantic size without being able to determine precisely its affinities to the other rhinoceroses.

This was the condition of our knowledge when the Third Asiatic Expedition left Kalgan on April 21, 1922. The first giant bones were discovered on the journey north toward Urga near Iren Dabasu, consisting of an enormous heel bone (*os calcis*) and other bones of the foot and wrist which were recognized at once as comparable in size to those of *Baluchitherium*. The second and most important find was made on August 5, 1922, near Loh in the Tsagan Nor Basin: this was a skull with portions of the jaw, the lower end of the shoulder bone, and the humerus. The skull and jaw were about fifty feet apart but probably belonged to the same individual. About a quarter of a mile distant were found the remains of a third specimen.

Fortune favors the brave and the well prepared: about half the skull was found in large sections, the remainder was weathered into hundreds of fragments. From an examination of the larger pieces and the 360 fragments of bones and teeth which belonged to this remarkable specimen it was recognized at once that it might be possible to reconstruct the skull. These larger and smaller parts were excavated by Mr. Walter Granger with the skill and cunning which comes from twenty-five years' experience in the western badlands of the United States. The packing of this skull, its transportation across the desert of Mongolia, its preservation from bandits and from the unpaid Chinese soldiery, its journey to Peking, thence to the nearest port, and finally its safe carriage to the American Museum, where it arrived absolutely uninjured on December 19, 1922—these are among the great events of palæontologic history.

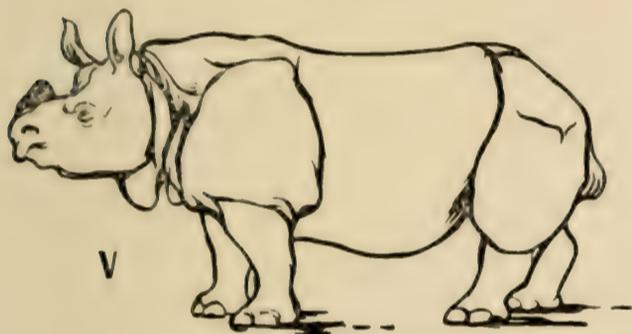
It required three months of the most skilful work in the Museum laboratories to prepare and restore the skull and jaws, as they are now shown in the photograph on page 227. From the first the animal seemed incredibly large; it was hard to believe that it was actually a reality; it immediately justified the estimate of its original discoverer, Forster Cooper, that it was probably the largest land animal known, taller than any of the existing elephants, dwarfing the existing or fossil rhinoceroses, equaling or exceeding in height the most lofty of the extinct elephants.

The two restorations which are reproduced on page 226, to be known as the first and second restorations, show the successive attempts to portray its size. The first restoration, which was hurried forward soon after the



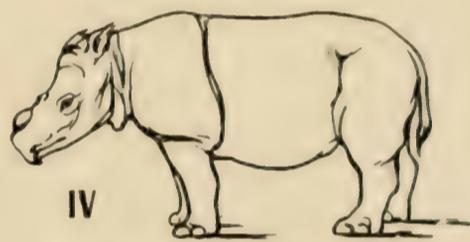
BALUCHITHERE

ACERATHERE



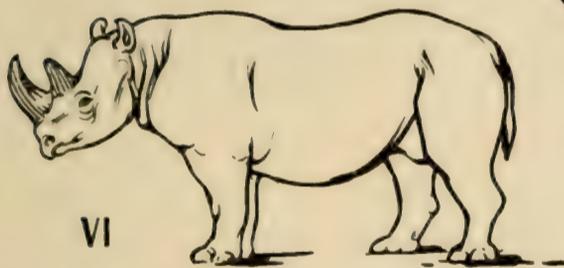
V

INDIAN RHINOCEROS



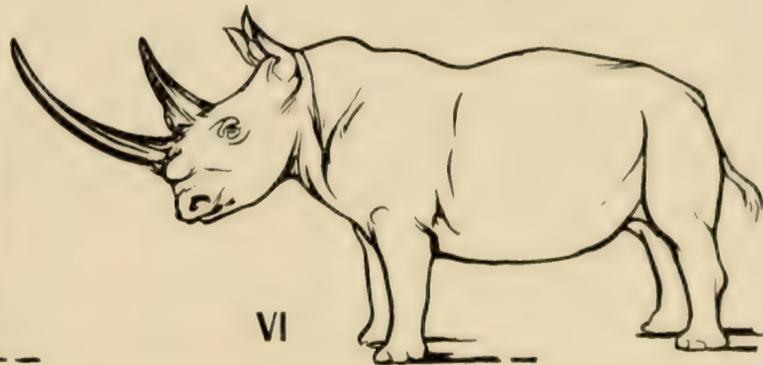
IV

SUMATRAN RHINOCEROS



VI

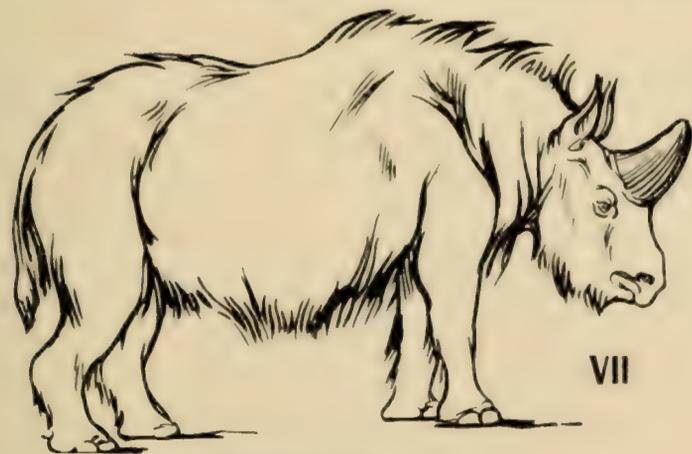
BLACK



VI

AFRICAN RHINOCEROS

WHITE



VII

ELASMOTHERE

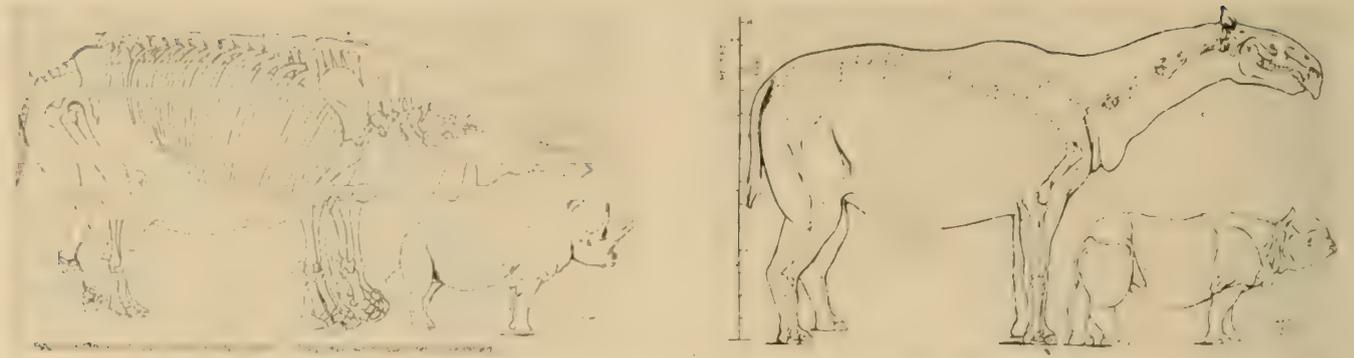


III

TELEOCERAS

RHINOCEROSSES, LIVING (FACING LEFT), EXTINCT (FACING RIGHT)

Baluchitherium grangeri (VIII) towers over all of its relatives (I-VII)



To the left is the first restoration of *Baluchitherium grangeri*, estimated as 12 feet in height at the withers, a massive animal towering above the existing 'white' rhinoceros placed beneath its head and neck.

To the right is the second restoration of *Baluchitherium grangeri*, estimated as 13 feet in height at the withers, towering above the Indian rhinoceros placed beneath its head and neck. In the second restoration the bones thus far discovered are represented in solid lines, the conjectural bones in dotted lines. The body outline in both restorations is highly conjectural

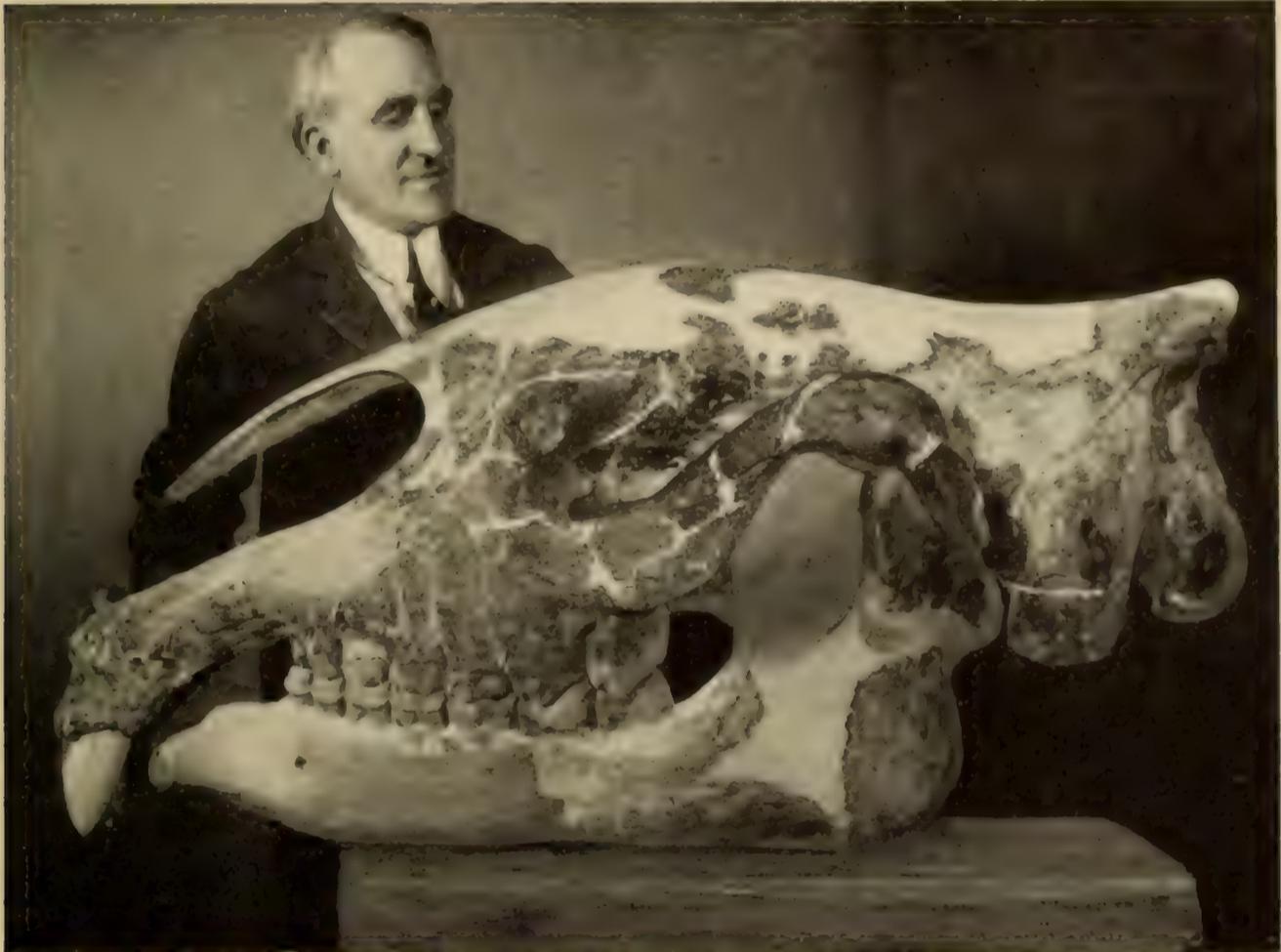
great skull arrived, represents a very massive animal proportioned somewhat like the rhinoceros, of a shoulder height of 12 feet, making the gray-white rhinoceros of Africa appear like an infant. The second restoration, dated March 24, 1923, prepared under the direction of the writer, changed the proportions considerably, giving the animal the greater height of 13 feet at the shoulders and a relatively longer neck. The head reached a normal height of 14 feet above the ground but readily attained a height of 16 feet when the creature stretched its neck. In this second restoration the body is relatively shortened, the limbs relatively lengthened. With the able assistance of Dr. William K. Gregory, the writer calculated with great care the body proportions of *Baluchitherium* as compared with those of the white rhinoceros, of the black rhinoceros, of the Oligocene *Aceratheres*, of the short-footed *Teleocerine* rhinoceroses, and finally of a gigantic horse bred in Kansas that attained a height of $18\frac{1}{4}$ hands, or 6 feet, 1 inch. It was proved that *Baluchitherium* surpassed both the living African and Indian elephants in height because while its limb bones are

equally long, its foot bones are relatively longer and more stilted, as observed by Forster Cooper; consequently it is a rhinoceros on stilted limbs with extremely long neck, proportioned as in the horse but of massive size.

With this elevated body form and massive neck, the head, gigantic as it at first appeared, diminishes in relative size, although far exceeding that of any existing mammal in absolute size. This very long narrow head placed at the end of an extremely long neck and provided with short grinding teeth, like those of the browsing rhinoceroses we have described, namely, the *Aceratheres*, the black rhinoceros, the Sumatran rhinoceros, and the Sondaican rhinoceros, compels us to believe that *Baluchitherium* was a gigantic browser, feeding upon leaves and twigs, buds and blossoms. It was certainly not a ground browser, like the black rhinoceros, whose head is carried very close to the ground, but more probably a tree browser, comparable to the giraffe and okapi among the even-toed animals and to certain other tree browsers among the odd-toed ungulates or hoofed animals.

In the third restoration (page 208), executed under the writer's direction by Mrs. E. Rungius Fulda, the *Baluchitherium* is represented as a gigantic tree browser stalking about among the fertile savannas of ancient Mongolia, in Upper Oligocene or Lower Miocene times, well protected from its enemies

evolution that the anterior part of the body of tree browsers is harmoniously elevated with the elongation of the neck. It is obvious that tree-browsing animals of increasing height of body and of shoulder, of a generally increasing length of neck, and of increasing stretch of prehensile lips



Skull of *Baluchitherium grangeri* as finally restored and ready for casting on May 1, 1923, in the laboratory of the department of vertebrate palæontology of the American Museum, by Otto Falkenbach of the department staff. This photograph gives an idea of the gigantic size of this skull, which is nevertheless relatively small as compared with the bones of the skeleton, as shown in the two restorations on page 226

by its very great height and by its power of locomotion, surpassing in speed that of the elephants and of the swiftest rhinoceroses, living or extinct.

The writer anticipates that when the complete fore limb and shoulder blade of this giant animal become known, it will be found that the shoulders were well elevated above the hips because it generally happens in the course of

adapted to feeding on the herbage of the higher branches of trees would up to a certain point become increasingly tall through the process of natural selection and survival of the fittest, which in our opinion is the best explanation of the long neck of the giraffe.

Finally, what is the relationship of the Baluchitheres to the other rhinoc-

crosses? Are they simply giant Aceratheres? This conjecture would at first appear to be probable from the close similarity in size and proportions of the skull and the absolute hornlessness of the skull, for both the frontal and nasal bones are perfectly smooth without any trace of a rugosity. But the very powerful superior tusks present a difficulty in the acceptance of this theory; there is nothing resem-

bling the *Baluchitherium* tusks in any other member of the rhinoceros family in which the remaining upper incisors are either short-crowned or vestigial but never tusklike or pointed. In *Baluchitherium* they are veritable tusks, shaped like canines or eyeteeth, terrible weapons of offense and defense, and wielded by a skull of surpassing size and weight and by a neck of gigantic proportions.



Map of central and southwestern Asia showing the type localities of (1) *Baluchitherium ostorni* type, eastern Baluchistan; (2) *Indricotherium asiaticum* type, near Turgai, northern Turkestan; (3) *Baluchitherium grangeri* ref., near Iren Dabasu, southeastern Mongolia; (4) *Baluchitherium grangeri* type, near Loh, central Mongolia

NOTES FOR THE READER AND THE STUDENT

The reader who desires to follow up this subject is referred to Dr. Philip Lutley Selater's Memoir of 1875 "On the Rhinoceroses Now or Lately Living in the Society's Menagerie," which appeared in the *Transactions of the Zoological Society of London*; also to the Memoir of Henry Fairfield Osborn (1898) entitled *The Extinct Rhinoceroses* or to his *Bulletin* (1900) on "The Phylogeny of the Rhinoceroses of Europe." Many recent papers of great interest have been published, especially on the woolly rhinoceros of Starunia by Dr. E. Niezabitowski. On the Baluchitheres the chief papers are by C. Forster Cooper and A. Borissiak, cited by the present writer in the first description of the skull of *Baluchitherium grangeri* in *American Museum Novitates* No. 78. In all 264 titles of papers and memoirs relating to extinct and living rhinoceroses are contained in the Osborn Library, a branch of the main Library of the American Museum.

The reader whose interest may have been

aroused by this article will find in the American Museum the finest collection of fossil rhinoceros remains that has ever been brought together, including a superb collection of fossil and recent skulls from all parts of the world, three beautifully mounted specimens of the gray-white rhinoceros collected in the Congo region by the Lang-Chapin Expedition, and especially a series of mounted fossil skeletons of Aceratheres, of Diceratheres, and of the *Teleoceras*, to which will shortly be added a diminutive *Trigonias* from Colorado. The *Elasmotherium* skull alone is represented by a cast; all the other skull types are originals including that of the recently finished skull of *Baluchitherium grangeri*. The interested visitor to the Museum should also see representatives of other main branches of rhinoceros affiliation known as the aquatic Amynodonts, which like the Aceratheres roamed through Europe and across Asia to North America; also the cursorial rhinoceroses or Hyraco-



A haunt of the American bittern near Arnprior, Ontario. This beaver meadow is flooded every spring with the high water from the Ottawa River, and here in the month of May, the American bittern can be heard chanting his extraordinary mating song. With a little maneuvering you may see him at such times engaged in the apparently very difficult task of producing the strange sounds he passes off as a love ditty

Some Bird Voices of the Northern Woods¹

By CHARLES MACNAMARA

ALTHOUGH members of the same bird family may differ much in size and appearance, there is often a remarkable resemblance in their voices. Alike in the "scream of freedom" of the great bald eagle and in the shrill piping of the little sparrow hawk is heard the same high-pitched note characteristic of the whole falcon family. All the ducks quack, and the same wild plaintiveness prevails throughout the voices of all the snipe and plover clans. The artless lilt of the song sparrow is typical of many of the sparrow tribe, and can be traced

even in the elaborated song of his cousin, the goldfinch. The wood warblers, who belie their name, being very poor warblers, are notorious generally for their thin wiry voices; while the thrushes all have the same rounded mellow notes—the wood wind of the orchestra—a quality to be detected even in the unassuming monotonous phrasing of the robin, and in the soft resigned notes of the bluebird, both of whom are, of course, members of the thrush family.

The hermit thrush gets his name from his shy retiring habit. He is

¹The birds considered in the article were visitors to Arnprior, Ontario, Canada.

truly a bird of the deep woods, and lives distant from human habitations, but the name is not quite appropriate. We always think of a hermit as an ascetic celibate, and the thrush takes a wife and rears his young, and no doubt enjoys life as much as any other bird. His song, a simple theme of grave flutelike notes in slow tempo, has all the dignified solemnity of a hymn. He is rightly accounted our finest singer, but his stage presence is poor, and his personal appearance is scarcely in keeping with his elevated music. He is a rather perky little bird, with an exasperating habit of nervously jerking his tail. He seems to know the limitations of his looks, and never shows himself much in public. Wisely, he is content to be a voice and nothing more.

The hermit thrush is the brother who went to Europe to study singing and became a grand opera star. The robin is the brother who stayed at home on the farm and whose public appearances as a singer are no more pretentious than the concert in the district school house. But the hermit's exalted song is far removed from everyday life, and is almost too pure for "human nature's daily food." We cannot long maintain so lofty a mood; while the homely ringing notes of the robin, sung perhaps from the peak of the back shed against a chilly sunset of early spring, give more pleasure to more people than the song of any other bird in North America. Consequently the robin is our most familiar and best-loved bird, and his spring coming is a marked event. Men who do not know an English sparrow from a junco, tell one another cheerfully that they saw a robin this morning, and his arrival is gazetted in the newspapers.

Another early and familiar singer is the song sparrow, whose naïve little

performance probably resembles the song of the canaries' primitive ancestor. I think this must be the most cheerful little bird in the world. Nothing seems to dishearten him. He pipes his simple lay in all kinds of weather, and even in the middle of the night; wherefore the French Canadians call him the *ros-signol*, or nightingale. Pouring rain cannot dampen his spirits, and once, when I was driven to take refuge under a pine tree from a driving sleet flurry that blotted out everything beyond twenty feet, in the midst of the storm a song sparrow close by burst into song. But his demonstration under such circumstances seemed out of place. Such absolute indifference to conditions is more like mere insensibility than real good humor.

The white-throated sparrow also comes early in the spring, although not so early as the song sparrow. He is silent for the first few days after his arrival but can sometimes be provoked into premature song by a human imitation of his whistle. There is a certain setting proper for each bird song. For the whitethroat you should be walking a mossy path in deep tangled woods, with a quiet rain tapping lightly on last year's leaves. Then from the thicket comes a song that to me, given to visualizing sounds, is a keen bright silver thread weaving into the gray day. A cool and tranquil song, expressive of the very spirit of the still, northern forest, it seems untouched by any hot emotion. But in reality it is doubtless a love lyric combined with a warning to claim-jumpers to keep off the singer's preëmpted area. It is answered in the same measured tones by another whitethroat a hundred yards away, and the challenge and counter-challenge continue as long as you are in hearing.

If the whitethroat's voice is silvern, the Baltimore oriole's is golden. Usually, just as the leaves are unfolding, he commences his singing. His prelude is like the notes of a clarinet beginning an Hungarian dance, but there is a plaintive sadness in his lovely liquid warbling which sounds like a regret that springtime is so brief. He is seldom heard after the middle of June. The thrushes, sparrows, finches, and many other birds are formal singers who perch ceremoniously on a bough to deliver their music. But the oriole sings at his work, and while he is busily searching for insects, his full-toned notes keep on without interrupting his intent examination of the branches.

Our goldfinch, like our robin, is called after an Old-World bird of a different species. Our robin is a thrush while the European robin is a warbler, but our goldfinch really is a finch, and shows his family connection in his song, which in a wild untaught way resembles that of the domestic canary, the master singer of the finch family. There is no regret in the goldfinch's song. He is another formal singer, and his crystal trills and runs, poured out from his perch on a branch, express nothing but high spirits and exuberant joy. His nuptial flight song is even more intense. One very hot day in July I noticed a goldfinch flying in circles above an old log fence and singing in ecstasy. He flew steadily and not in the usual undulations of his kind, and his rhapsody at no time ceased. I don't know how he managed to draw his breath. As I came nearer, I saw the female to whom this passionate homage was being paid. She sat on the fence, apparently giving little attention to the outpourings of her suitor's soul. She did not intend to let

him win her too quickly, and presently she flew away, followed by her lover, who now dropped into the wavy flight and gave forth the usual call note of *per-chic-o-pee*.

As I have said, this was on a breathlessly hot day in July, and the occurrence interested me as it recalled another nuptial song I had heard in the contrasting weather of a very cold day in January. It was perfectly calm that day, the sun was bright in a cloudless sky, but the temperature was considerably below zero. Snowshoeing through a wooded swamp, I was remarking the silence of the winter woods when a bird song burst forth from the top of a tall red maple. High up in the cold bright sunshine a white-winged crossbill was flying out in circles and returning to perch on the topmost twigs, warbling all the while as eagerly as if it were summer time. I could see no female, and in view of the earliness of the season and the severity of the weather I might have doubted that this was a nuptial song. But I had lately obtained proof of a crossbill actually nesting in January in this district, so I was sure that my bird, despite the extreme weather, was really out courting.

What some of our birds need is a good press agent. For ages innumerable poets of all countries have been "writing up" the nightingale, so that now everybody thinks of it as the finest singer in the world, although I have a suspicion that some of our native songsters are quite its equal. On this continent the mocking bird is celebrated in a famous song, and the thrushes, the bobolink, the oriole, the catbird, and others have gained great reputation with the general public from the applause of various writers, both in prose and verse. But who, except the

earnest bird student, knows even the name of the winter wren, and how many have heard his entrancing song? The answer is: very few. Therefore, I propose to advertise the winter wren a little.

Everywhere a favorite family, the wrens are the subject of numerous legends, and the hundreds of vernacular names that have been given them attest the affection of the people for them. But they have never been counted among the great singers. Our familiar house wren sings a defiant little jingle, and he means every scolding note of it, for he is one of the most quarrelsome of birds. The singing of the family in general, however, is undistinguished, except that of our friend, the winter wren, and he amply makes up for any musical shortcomings of his relatives.

I think my experience with this bird may resemble that of a good many other bird students. When walking in the woods in spring, I sometimes used to hear from low down in a brush heap or thicket tangle an explosion of bird music which for richness and finish surpassed any other song I knew. It was a rapid gushing melody, clear and loud, without a trace of the amateurish "home made" quality heard, for instance, in the song of the robin. This was the production of a highly cultured performer—a bird Tetrizzini,—and its motif seemed to be the joy of springtime living. Though the singing was usually near at hand, it was some time before I could find the bird. When I came closer, the song would cease, or would burst out again farther off, resembling in this respect those better days that are always a little ahead of us.

At last one April day I caught sight of the singer. It was a little bird of the

conventional wren-brown, with an absurdly short tail sticking pertly up over its back, a quaint and undignified little bird, astonishingly small to produce so powerful a voice. It was slipping expertly in and out of the forest cumber, searching minutely for insects and singing its wonderful song every minute or so with scarcely a pause in its work. As I watched it, it came quite close, so that I could see its tiny throat pulsing rapidly as it sang; and I noticed it could sing with its bill full of spiders. Only, as its mouth filled up, the music grew softer, and the gradual diminuendo produced a curious "Turkish Patrol" effect. At last the little bird worked out of my view, but for some time I continued to hear its rich treble with the distant drum roll of a ruffed grouse for a bass background.

The winter wren and most of our other good singers are birds of dull plumage. Apparently a fine voice alone is often enough to win a mate without any need for fine feathers. Of course, there are exceptions. That Chrysostom of birds, the Baltimore oriole, in his rich orange and black livery is one of our handsomest migrants; and the goldfinch is very gay in summer in his vivid yellow and black. The lovely rose-breasted grosbeak, too, sings a wild wandering aria remindful of an uneducated oriole. But the greater number of our bright-hued birds, such as the blue jay, the red-headed and pileated woodpeckers, the flicker, the ruby-throated hummingbird, the redstart, and other gemlike warblers are all non-singers. The purple finch—which is not purple at all, but gloriously flushed with crimson—is, I admit, well spoken of as a singer, but to my ear its song sounds rather flat and rattling. And the

scarlet tanager, of a brilliance so unexpected in these northern climes that he is sometimes mistaken for a tropical bird escaped from captivity, must also be regretfully denied a place in the choir. His call note of *chip chur-r-r* is loud and harsh and his attempt at a song is no better.

On hot days when I am out in the woods, I like to eat my lunch on a little rocky point that juts out into the Ottawa and catches any breeze that may be blowing over the river. There are a few stunted pines and cedars on the point and the bearberry vine manages to grow between the stones. This is where I sometimes hear the tanager singing from the trees of the mainland. It is an unmelodious song, not easy to describe, but is such as one might imagine a demented robin to make if he tried to imitate the grating notes of a crested flycatcher. But here it is often accompanied by the mighty bassoon of a bullfrog; and as I eat my meal and look out over the blue waters, I delight in a jazz duet such as no fashionable restaurant in the world can offer its diners.

Bird voices are sometimes represented by syllables or words as an aid in recalling the sounds. Though most of the inventions demand a lot of imagination, a few of them are very good. It is true that no bird can really pronounce a consonant, but I imagine that even if a perfect stranger were told that the chickadee called its name with a couple of extra syllables, *chick-a-dee-dee-dee*, he would at once recognize the bird by its voice. *Whip-poor-will* also expresses fairly well the cry of that nocturnal bird, which, not very common in the settled country, sometimes makes the backwoods ring with its whoops. Once upon a time awaking at dawn in a river-drivers' camp, I

estimated that, near and far, I was listening to one hundred of them calling together, but perhaps resentment at the untimely noise supplied a rather large factor to the number. Another bird that speaks its name plainly is the phoebe. It pronounces the syllables in a crisp business-like manner, very different from the way its melancholy brother, the wood peewee, drawls out its low-spirited *p-e-e-e-a-w-e-e-e-*. If you see a small yellow bird wearing a black domino mask, and calling *witchi-tee, witchi-tee, witchi-tee* with the accent on the first syllable, you will know that you have the pleasure of meeting the Maryland yellowthroat. One of the many cries of the blue jay is aptly rendered as *thief! thief!* This he screams as he flies away, adopting the old trick of the real thief joining in the hue and cry in order to draw attention from himself.

There are no absolutely dumb birds. All possess some means of vocal expression, but some have such weak voices, or use them so seldom, that if we wished to be technical, we might erect a division of birds called the "Aphonopteridæ." One that would belong here is our only humming bird, the ruby-throated, whose thin squeak is seldom heard. Perhaps like the bat's cry, it is pitched too high for most people's ears. Another silent bird is the exquisite smooth-feathered waxwing. Its ordinary note is a faint wheeze like the creak of an unoiled hinge, and its "beady" call on taking flight is not much louder. The ruffed grouse practises only a few chirps and clucks; it is blessedly free from the boisterous crowing and cackling of its close relative, the domestic fowl. The Canada jay, or whisky jack, when hopping around your camp fire looking for scraps, seldom utters a sound, although I have sometimes



The Canada jay or whisky jack is a familiar visitor at every camp in the northern woods. The tent is scarcely pitched before he arrives; looking for scraps. Usually a silent bird, he is capable of a large variety of notes, nearly all harsh

heard them give a low whistle. But when they like, they can raise as much disturbance as their disreputable brothers, the blue jays. One day last winter when I was visiting the beaver dam that is the pride of the little game sanctuary near where I live, a hawk flew overhead just above the tree tops. I began to imitate its whistle as well as I could, trying to induce it to answer me. I had whistled only three or four times when a sudden unexpected whisky jack came hurrying through the trees toward me, vociferating a series of quick raucous cries, the significance of which I have never quite determined. Was my hawk imitation so good that it had deceived the bird and he was shrieking in alarm? Or was it so bad that he was jeering at me in derision? I do not know; but anyway, after a while I got the hawk to answer me.

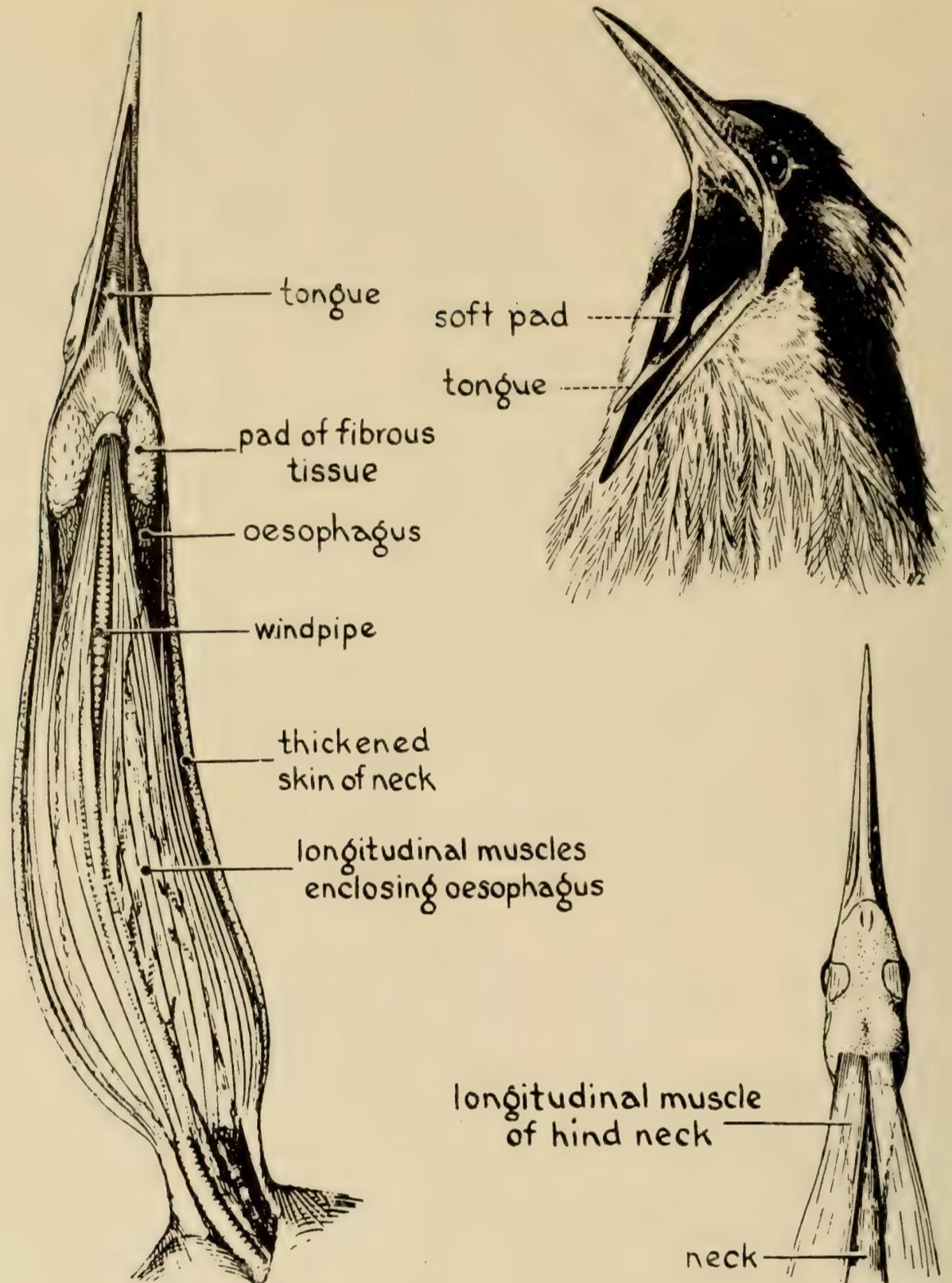
Another unofficial category might be formed of birds that think they can sing and can't. The leader of this class is undoubtedly the friendly little chipping sparrow. He is a most persistent singer, and a nightingale could not be more earnest in its endeavor. The result, alas! is only a tuneless trill, though it seems to give the neat little bird every satisfaction. Another serious and persevering singer of the same type is the slate-colored junco, who achieves little more than a vibrating chatter. Perhaps the black-and-white warbler is not really pretending to sing with his insect-like *zee-zee-zee*, nor the industrious red-eyed vireo prattling interminably on his daily round not merely of inspection but of scrutiny through the trees. But the redstart certainly thinks he can sing. Watching him, one thinks he must have taken lessons in voice production, for he throws back his head and opens his tiny bill widely. But if he has, his teacher should return the fee, for the voice that issues is only a meager sizzle.

Traversing all accepted classification, another division might be formed of birds whose voices do not sound like those of birds at all. The voices of most of the perching birds are in the upper registers, so that when we hear the low-toned *quank* of the nuthatch, or the soft deep notes of the cuckoo, we can hardly believe that the sounds come from a bird. The great horned owl's horrifying shriek is another inconceivable bird voice, and is usually attributed to a lynx or some other bloodthirsty animal. The voice of the saw-whet owl is generally described as sounding like a file being dragged across the teeth of a large saw. This little owl is rare in my district, and it is many years since I have heard it, but my recollection is that the cry was astonish-



WHERE THE VIREO IS HEARD

One of the most typical bird voices of summer time is that of the red-eyed vireo. And it is by his voice alone that most people have knowledge of him, for this "gleaner among the leaves" is seldom seen. Essentially a bird of the woodlands, he frequents the tops of the highest trees, scrutinizing every leaf and twig for insects, all the time uttering a slow unending succession of notes; and as the phrases each end on a rising inflection with a slight pause between, he seems to be asking a series of earnest but never-answered questions. This peculiar delivery has earned him the popular name of the "preacher." He keeps up his unceasing prattle all day long, and is often the only bird to be heard in the noontide heat



These drawings show the mechanism connected with the bittern's unusual voice. The whole neck (left) is seen from below, the hind neck (lower right) from above, and the open gape (upper right) from in front.

During the breeding season the skin of the male bittern's neck is distinctly thickened. Beneath it lies a thin layer of muscle which supports this heavy skin. Perhaps the soft pads along the inside of the lower jaw, as well as the lumps of fibrous connective tissue at the sides of the throat, aid the bittern in retaining the air in the oesophagus when it is blown up during the "stake driving." After James P. Chapin, (*Auk*, Vol. XXXIX, pp. 196-202)

ingly like the clink of a hammer on an anvil. Another "mechanical" bird cry is the hunger call of young chimney swifts, who make a noise far more like the rattle of a badly constructed

machine than the voice of any living creature. But perhaps the most extraordinary of all bird voices is that of the American bittern, and the popular idea still is that the mud and water of

the bogs in which the bird lives must have something to do with his incredible *chunk-er-lunk*. All ornithologists know that the sound is produced solely in the bird's throat, but the method of production is nevertheless very remarkable.

For two days I had been looking for a miserable difference of 25 cents in a trial balance. At last, when my delighted eye caught sight of the elusive "quarter," which had not been brought down from the last month's balance, I shut the books and went out for a walk of thanksgiving. Such good fortune would have satisfied me for one day, but I was in for more. I headed for a flooded beaver meadow, and there, like the Lady of Shalott, I "found a boat beneath a willow left afloat." It was flat-bottomed with square ends, it leaked a little, and its equipment was a single rude paddle chopped out of a slab; but it was enough. The meadow was busy with insects, fish, frogs, turtles, birds, and musk-rats all industriously making their living. As I was paddling slowly across the water, watching their vital interactions, I saw an American bittern standing about 150 feet away in the shallow water beside a partially submerged bush. He was stock-still with his bill pointing skyward in the traditional bittern attitude. Presently, as a bubble swelled out in his throat, he developed a slight hiccup, which rapidly became worse until it culminated in a frantic retching with racking contortions of his neck. The accompaniment to this was the well-known "stake-driving" sound. The attack lasted ten to fifteen seconds, and when it subsided he stood motionless, once more pointing the way to the stars. But he enjoyed the respite only a minute or two. Then he had another

of the alarming seizures, and the attacks followed one another with short intervals during the half hour I watched him, at the end of which increasing rain drove me home. Such is the bittern's love song. Love seems to be a painful and violent passion with bitterns.

The northern raven is an untamed dweller in the wilds who never ventures into civilization, but he is well and unfavorably known to log makers. The French Canadian shanty men say that he calls *poche, poche*, referring to the bag in which they carry their mid-day meal. If the "poche" is not hidden under a stump or buried deep in the snow while the log-makers are at work, the raven is very likely to tear it open with his powerful bill and eat the men's lunch of bread and pork. I set out one winter day from a lumber depot to walk to a camp a few miles distant. The road through the forest forked several times, and after a while it dawned on me that I had taken a wrong turning, for there was no sign of the camp, and I had already walked more than its distance from the depot. Just then I heard a small, hoarse dog barking a little way ahead. There, I thought, is a gang of log-makers who have a dog with them. I shall get my directions from them. But "the small hoarse dog" was a stately raven who made no more obeisance to me than his famous ancestor did to Edgar Allan Poe. With a few more gruff barks he flew away over the trees, and I had to return to the depot without reaching the camp that day.

There are many other birds whose voices I like to call to mind, but only a few can be noticed here, and they must be passed with a mere mention: the bobolink gurgling and klinking on fluttering wings over new meadows; the comedian catbird giving his clever

but ill-natured burlesque of all his acquaintances; the brown thrasher singing his fine, if somewhat artificial, song in a wayside bush; the rich mellifluous warbling of the purple martins from the veranda of their community house; the trumpet clangor of the wild goose squadron against a seamless gray sky; the shout of the loon answering you back across the water of a pine-rimmed lake; the quavering wail of the little screech owl on moonlight nights, sometimes heard even in towns where he comes to search the cornices of buildings for sleeping English sparrows;

the spring laugh resounding through the open woods of that bird eccentric, the flicker; and the "rusty gate" creak of the iridescent blackbird just arrived, as impudent as ever, from the lost cities of Yucatan.

Of these voices and the others we have considered, some are musical and some could scarcely be harsher, but the true lover of birds finds none of them disagreeable. My affection for birds is without prejudice. I like them all equally and cannot tell which of their voices I like the best.



THE SIGN MANUAL OF THE GREAT HORNED OWL

The common cry of this fierce bird marauder is a hoarse, long-drawn variety of the "hoot" practiced by all the owl family. But on occasion he gives vent to a horrifying scream, more like the voice of some ferocious wild beast than that of a bird. This photograph shows where a great horned owl struck at a squirrel on a branch above, but missed, and came down in the snow with outspread wings and tail

Nature and Human Nature in a Probationary Classroom

BY LUCY CLARKE SIMONSON

Teacher, Public School 120, Bronx Children's Court Annex, New York City

“**O**NE up, Mrs. Forster!”
“All right,” calls the cheery voice of the matron from the third floor, and Mrs. Forster steps forward, unlocks the wire gate at the head of the stairs and stands waiting to receive the latest member of our family.

He proves to be a boy brought in from the street after hiding several days in an empty freight car at the railroad yards. As he ascends the stairs, his mind is distracted between the dread of being sent home and meeting an angry father, and his apprehension regarding the unknown dangers of his new situation. Coming within sight of the open gate at the top of the stairs, he sees a motherly woman who notes his neglected appearance, evidence of his having shifted for himself, as well as his expression of chagrin and resentment at having finally been “locked up.” Putting her hand kindly on his shoulder, she looks into his face with the understanding which has come from meeting thousands of boys and girls in trouble, and says, “Well, son, what’s the matter?”

Such is the reception given to each child who climbs the stairs of the Shelter maintained in connection with the Children’s Court by the Bronx County Society for the Prevention of Cruelty to Children.

The necessary preliminaries over, the new boy takes his place in the schoolroom among other boys who like himself are finding temporary shelter and motherly care while their cases are being disposed of. It is my privilege

to be the teacher assigned to this class of children.

In this one small schoolroom, which at night is used as a dormitory, there are children who have come from homes disrupted through sickness, death, or crime; boys who have found crowded home conditions unbearable and have broken loose from parental restraint; boys who have yielded to the temptation to satisfy their craving for pleasure by thieving; truants either through mental incapacity for the work of the schoolroom or through natural restlessness which takes them to the street bent on mischief; psychopathic cases that have been brought in because of uncontrolled acts; as well as subnormal and feeble-minded children, the “misfits” in home and school; boys who have run away from their homes in neighboring cities; all ages from six to sixteen; all races; all conditions of mind and spirit. They are all transients, their stay in the Shelter averaging only six days.

With this diversity in age and condition and with the shortness of the children’s stay—although of course I teach the regular school subjects—it is impossible to follow a complete course of study with any continuity. Every day I must adjust myself to the class as I find it, and the work of necessity is fragmentary and unsatisfactory.

To prepare the schoolroom for the boys, whom I meet first in the morning, everything is made as cheery and home-like as possible. Chairs are placed around the teacher’s desk in a semicircle with a small table near by on which

are the current magazines appropriate for all ages. We usually start with talks about what is going on in the outside world, and the pictures which I bring illustrating the news of the day are much appreciated. These talks include anecdotes of interest about living heroes, discoveries in science, new inventions, and live, interesting stories. Most of our children come from narrow and contracted homes, where parents are too much absorbed in the struggle for existence to talk over interesting subjects with them. I try to lead their minds away from their narrow street life, into bigger places, where imagination is quickened and vision enlarged.

One never knows just what question a boy may ask; so I was not surprised one morning when a lad anxiously inquired, "Teacher, is the world coming to an end? The papers say something's going to smash into us, and the world's coming to an end."

Not answering his question at once, I began to explain the marvelous movements of the heavenly bodies, each one in its appointed place at its appointed time, our own earth spinning through space at the rate of a thousand miles a minute. At about this place in the story, as I was leading the boys' minds to the thought of a Higher Power, who guides the universe without friction and without accident, I saw that I had made my point clear, when one boy, expressing the idea in his own crude way but with all reverence and wonder, burst out with "Gee! *Some Traffic Cop!*"

Sometimes a simple experiment by the boy himself seems to be the most effective way to convince him of a natural force. I recall an overgrown fellow expressing his contempt for any statements regarding the movements of the earth, even the cause of day and

night. With his air of superiority he said, "How can you prove anything?" Noting at that moment the early morning sunshine streaming through the window, I handed him a piece of chalk, suggesting that he trace a mark along the slanting line made by the sun across the floor. Then I told him to watch and see if there was any change. As the morning advanced and his chalk line was left in the shade, his astonishment was profound, and I saw that no comments of mine were needed to impress the lesson.

Probably not one of the regular callers at our building is looked for with happier anticipations than Mr. Herman Sievers, the messenger from the American Museum of Natural History, who regularly and cheerfully brings the natural history specimens and the valuable lantern slides. His appearance usually brings out the eager question, "Movies, teacher?" the younger children calling anything in the line of pictures "movies."

Many of the truants come to us with a distaste for school, from which "playing the hook" seems to be their only escape. Their inability to read without great effort causes them to look upon books as a bore. As they have never formed the habit of reading for pleasure, their leisure has been occupied in making mischief on the street or going to motion-picture shows. Nine out of ten boys who come in for stealing tell me quite frankly that they "crooked" to get money to go to the "movies." The right or wrong of a dishonest act seldom enters into their minds. It is astonishing how little they are guided by the old principles of honor and integrity and how lightly the disgrace of thieving touches them. In discussing this many have said to me in all seriousness, "Why should I be

honest? Why should I work to earn money when I can get it so much easier by crooking?"

To supplant the wrong ideal of the "slick guy who steals and gets away with it," I endeavor to create a different hero for the boy to imitate. Too many have the notion that success in life depends on luck or on some distinction of class or fortune. The invaluable aid of the slides from the Museum cannot be overstated in this connection. Such sets as "Through the Brazilian Wilderness with Colonel Roosevelt," "The Search for Crocker Land," and "Climbing Mont Blanc," thrill the boy with real admiration for the right kind of heroism—courage, fortitude, and self-control—and help him to appreciate the truth of the following lines, which I often write on the blackboard:

You will find that luck
Is only pluck
To try things over and over;
Patience and skill,
Courage and will,
Are the four leaves of luck's clover.

The sets of slides which show the life of men and boys engaged in great industries, such as agriculture and lumbering, seem especially attractive to some of our boys, who remark on the unlimited spaces of the prairie and the forest. I often make the point that too many people crowd into the congested city instead of choosing a vocation which takes them into the country.

The faithfulness of the Eskimo dog makes a strong appeal to spoiled children, who are especially impressed with the fact that these dogs rarely cry or whine for food, knowing if their master has it, they will get it.

Our girls present problems of their own, and it is in the afternoon talks, when I meet them by themselves, that we discover where the emphasis

needs to be placed. My first task is to divert their burdened minds and bring their emotions under control. One afternoon a large girl, whom we shall call Olga, came in weeping violently. Her home and her mother had failed her in her hour of need. What did she care about *school* when she was learning the hardest lessons in the school of life? Bitterness, revenge, despair had taken possession of her soul, and she refused to be calmed. Just then a wee child whose home had been disrupted by the violent death of her mother was brought into the schoolroom in the hope that there she would find something to comfort her lonely little heart. As the big tears were rolling down the little one's cheeks, I led her to Olga saying, "Look at this heartbroken baby! Couldn't you take her into your nice big lap and cuddle her a bit?" Without hesitation Olga folded the little one in her arms, and smiling down at her through her own tears, she "mothered" the child until she had her fast asleep. Sunshine had dispelled the dark, angry clouds that fitful April afternoon and the rain had ceased to fall. Olga had learned to "look out, not in," and "lend a hand."

One of the most difficult lessons for our girls to learn is to live together without quarrelling, differences in race or in religion forming a never-ending source of dissension. Many are brought up in an atmosphere of perpetual conflict. To "agree to disagree" and be pleasant about it, seems to be a new doctrine to many. I have many stories from real life to impress the point, which I tell in detail. The following is the gist of one of these:

A farmer and his wife who had separated received little sympathy from their friends when it developed that the whole trouble arose from a

difference of opinion regarding which of two holes in the kitchen floor a mouse had run into. A reconciliation was effected, the couple lived happily—not ever after—but until months later while laughing together over their previous foolishness, one of them started the whole quarrel over again by remarking, “But, my dear, you must admit that I was right.” The separation was permanent this time, and the deserted house became a laughingstock to all passers-by.

“Agree to differ, resolve to love,” has a new meaning when the girls see the point of this story, and often when a quarrel begins among themselves some peacemaker is sure to remark with a smile, “Forget it. Who cares which hole the mouse went down?”

I find that the girls returning to their homes carry this story with them and report to me later that it has had its part in smoothing out family quarrels.

The Museum slides prove valuable in helping our girls to get out of their warped, little lives and to obtain a proper perspective on their problems. The lure of the cheap show is very great, and from the false, shallow standards depicted there our girls often form their ideals in life. The following was composed by a girl of fourteen in answer to my suggestion that she write out her ambition in life:

“I should like most of all to be a millionaire’s daughter and belong to society and have anything I wish for. And then when I get big, I want to be a toe-dancer and one of the Broadway stars and have everybody love me. I wish to marry a clown, a millionaire’s son, so he could dance with me.”

The study of natural history is a means of deepening character and of giving our girls a truer value of life. Contact with the marvelous handiwork

of nature refines and softens the coarse influences of a brutal environment. By means of the slides, in imagination at least, we can “creep reverently” through the November woods with Helen Hunt Jackson “watching all things lie down to sleep.” We can thrill with the wonderful scenery of mountain and stream, clouds and sunsets, which thereafter forms a background for the appreciation of choice gems of literature. As one sweet girl, who has had her young life burdened in an unusual way, recently remarked, “We all love the slides because they help us to forget our troubles and teach us about so many things we never knew before. I just love that quotation now, ‘The soul would have no rainbow if the eyes had no tears.’”

Mrs. Margaret Forster, our wonderful matron, is an ardent lover of nature, reflecting in the strength of her character and the beauty of her daily life the grandeur and charm of the New Hampshire mountains, where she spends her brief vacation period. As often as possible during the showing of the lantern slides, she slips into the schoolroom and frequently adds interesting stories of plant and animal life out of her own experience on her New England farm.

Sets of slides showing our insect enemies have proved a revelation to both boys and girls, strikingly teaching them the necessity for cleanliness and for waging eternal warfare against the fly and other household pests. After observing these slides with open-mouthed wonder, one large colored boy remarked with great emphasis: “They—learn—you—sense.”

This article has dealt more with the intellectual influences, including nature study, utilized for the general cheer and uplift of the children. Handwork also

has a considerable part in our program. For lack of both space and equipment, however, this is limited in variety, and the making of reed baskets has proved most satisfactory in its results with the children.¹ It must be remembered that each pupil is usually detained in our Shelter only a few days, but this is long enough for him to learn something about the art of basket-making—at least enough to complete one well-made basket, which always causes him delight.

One of the most effective means I have found for helping the children to discover their individual defects of character and to strengthen them, is a system of so-called "squeak-cards." The idea grew out of a story I heard when I was a young teacher in a country school on the prairie. A farmer set a "green hand" to grease a squeaking wagon wheel. The fellow worked long and hard, rubbing grease over every visible part of the wheel. When the wagon was next used, the wheel squeaked worse than before, and it was only after the farmer had removed the wheel and shown him the axle that the man discovered that a little grease applied to the right spot made the wheel run smoothly.

"Find the squeak and grease it," became a maxim in my school work, and the "squeak box" naturally has become a favorite device in this class.

After I have told the story of the squeaks to the children, I give each of them an opportunity to take a card and write out his own weak points as he sees them. I tell the children that if they succeed in conquering any of their faults and will report to me later, I shall be pleased to hear from them and shall draw a red line on the card through the squeak. Of course,

the confidence of the children is never violated, but a few squeaks taken at random from the "squeak box" will illustrate in their own words what things the children have to overcome.

From boys:

"My squeaks are cursing at my mother and fighting with my sister at home."

"Going with bad company. I can't say no."

"I pick up cigarettes and smoke them and then throw them away."

"I would like to stop crooking. I take anything I see."

"I got the habit of shooting craps and hitching behind the freights."

"Always demanding money off my mother."

"Bum."

From girls:

"My squeaks are I think I know more than my father and mother. That is why I am here today. I hope I soon recover."

"I am crazy over every good-looking fellow I see."

"I will not cuss, spit on, or kick my sister any more."

"My squeaks are bad temper. I lack patience. In anger I say nasty words."

"Often I can't control myself from lying."

"Tattle tail."

I continue the use of the "squeak box" because I find that young people whom I have taught often come back to me or write testifying to its value in their lives.

"One down!"

This time it is the matron who calls. We are bidding good-bye to the lad whose arrival a few days before was described at the beginning of this article. A warm handshake, a few words of advice, an invitation to come back to let us know how he is getting on, and the boy, neat, clean, and with his eye alight with hope and the determination to "make good," descends to the street. His case has been considered by the judge, who has brought to bear on the problem his many years of invaluable experience with juvenile delinquency, and the boy has been released on probation. An efficient probation officer has been assigned to see that he maintains a good record, and a Big Brother has volunteered to be his "guide, counselor, and friend."

¹Specimens of the children's handicraft were recently on exhibit at the American Museum. The reader is referred to *NATURAL HISTORY*, January-February, 1923, p. 96.



A SECTION OF THE HALL OF MEXICAN AND CENTRAL AMERICAN ARCHÆOLOGY,
AMERICAN MUSEUM

In the foreground is a reproduction of a sculptured column from the Temple of the Jaguars, Chichen Itza, Yucatan. The column represents a rattlesnake and is one of two that stood on either side of the doorway of the temple. The general coloration of the serpent is light green, the scales being outlined in red. Of a deeper red is the forked tongue and the mouth, in which the white teeth are conspicuous.

The original molds for this column were made in the field under the direction of Mr. Edward H. Thompson; the cast, including the restoration of the damaged parts, was made in the Museum by Mr. J. C. Bell

Man as a Museum Subject

By CLARK WISSLER

Curator-in-Chief, Division of Anthropology, American Museum

FROM the very beginning the founders of the American Museum assumed that it was self-evident that a great natural history museum, to be complete, must include in its scope the natural history of man. Accordingly, even in the first years of the Museum's existence collections were acquired, by gift or otherwise, containing relics of the Stone Age and other primitive forms of culture. The gradual accumulation of museum materials in these ways ultimately led to the establishment of a distinct department under the name of anthropology. The curatorial responsibilities for this new department were delegated to Professor A. S. Bickmore, who was the originator of the movement that resulted in the erection of the Museum.

Professor Bickmore served as curator for eighteen years, and it was during this period that a number of the most distinctive collections were acquired. Among these were the Andrew Ellicott Douglass archæological collection, which, with the Terry, Squire, and Jones collections, presents a representative series for the United States, the collections of Stuart, Robinson, and Feuardent, illustrative of palæolithic and neolithic Europe, the Sturgis and Finch collections from the islands of the Pacific, the Emmons and Bishop collections made among the Indians of Alaska, and the collection of Squier, representing the ancient civilizations of Central America. Thus, when Professor Bickmore resigned as curator in 1891 that he might give his whole time to the educational work of the Museum, the foundation had been laid

for a comprehensive presentation of man's natural history.

A few years later Professor Frederic Ward Putnam, the new curator, organized the work of the department as we see it today, in which according to the problems presented and the method pursued, the activities of the staff fall under three heads, ethnology, archæology, and racial anatomy. The responsibility for these subjects was divided among the personnel of the department, according to the special interests of the men involved.

As in the case of other departments of the Museum, the greatest progress came with field work and exploration, for it is by this means that new concrete facts are brought into the Museum's halls. Systematic work of this kind was inaugurated by Professor Putnam. Among the first of these enterprises was the Jesup North Pacific Expedition, which endeavored to determine the connection between man in the Old World and the New.

THE JESUP NORTH PACIFIC EXPEDITION

The Jesup Expedition, or rather series of expeditions, begun in 1897 through the munificence of the late Morris K. Jesup, constitutes one of the greatest of anthropological projects. The questions attacked were of cardinal significance, the scheme for their solution was carefully elaborated and was executed on a vast scale with all the resources of modern technique. Professor Franz Boas was in charge of the expedition and himself took part in the field work. Among his collaborators

were Doctor Bogoras and Doctor Jochelson, Doctor Laufer, and Doctor Sternberg in Siberia, Professor Farrand, Doctor Swanton, and Mr. Harlan I. Smith in America. The results thus far published in a series of sumptuous Museum *Memoirs* embody a wealth of important material, descriptive and interpretative.

The primary problem of the expedition was to determine whether there was any connection between the peoples of Asia and northwest America. This question was answered affirmatively as to race, language, and culture; that is to say, the so-called Palæo-Siberians of northeasternmost Asia proved to form a unit with the aborigines of northwest America. Physically the latter display a stronger development of the Mongoloid eye and other Asiatic traits than do other New World natives, while they lack the pronounced nose that is so marked a feature of the American Indian physiognomy farther east. The tongues spoken by the ancient Siberians cannot indeed be regarded as belonging definitely to any one of the several linguistic stocks of aboriginal America, but morphologically they are distinctly nearer to the languages of the New World than to those of other Asiatics.

Culturally a variety of relations have been established between the peoples of the East and the West. The coastal Chukchi and Koryak closely resemble the Eskimo in their economic life, while their mythology betrays an old contact with the Indians of British Columbia that possibly antedates the arrival of the Eskimo in Alaska. The occurrence on both sides of the Pacific of a semi-subterranean house likewise constitutes a remarkable parallel.

While thus contributing materially to our knowledge of the history of the

American race, the work of the expedition also shed light on the general problem whether cultural likeness shall be interpreted as the result of independent development due to the similarity of human psychology throughout the world, or whether resemblances may be explained as the effects of contact and borrowing. It was shown conclusively that many of the parallels are intelligible only as products of diffusion from a common source. This general inference has certain significant theoretical implications. For example, it was commonly assumed by writers on primitive society that all peoples necessarily passed through a stage antecedent to that of the family organization, the place of the family being taken by the clan. But the researches of the Jesup Expedition showed that in not a few cases this order is reversed, inland tribes of British Columbia, formerly organized into families, having encountered the clan system of the coastal peoples and adopted it secondarily. Finally, the Jesup Expedition not only paved the way for highly important scientific conclusions but contributed enormously to the Museum's collection of ethnographic material, which as regards northeast Siberia is doubtless superior to any other in the country.

EXPLORATIONS IN PREHISTORIC AMERICA

Likewise under the curatorship of Professor Putnam and almost simultaneously with the organization of the Jesup Expedition, there was projected the B. T. B. Hyde Expedition to explore the cliff houses of Utah and uncover the ruins of Pueblo Bonito in Chaco Cañon, New Mexico. In 1897 work was begun upon the Bonito ruin, a magnificent communal house, a



TRANSPORTING ETHNOLOGICAL COLLECTIONS THROUGH SIBERIA

A reindeer train of twenty-five sledges was required to convey to the coast the collections made among the natives of Siberia by Dr. Waldemar Jochelson in the course of the Jesup North Pacific Expedition of 1902. This photograph shows a portion of the sledge train crossing the southern forested slope of the Verkhoyansk Ridge in the province of Yakutsk, Siberia

portion of which was still standing. Parts of this ruin proved a veritable storehouse of turquoise ornaments. Thousands of beads were found, some so small that one can scarcely conceive how they could have been fashioned and drilled with the tools at the command of the ancient inhabitants. There were other rooms containing vast stores of pottery, some of unusual form. These collections were brought to the Museum, where the finest were placed on exhibition. At about the same time startling discoveries were made in the cañons of Utah, where cliff houses were found belonging to a period when no pottery was made. These are evidently remains of a much earlier age than the large pottery-bearing ruins of the Bonito type.

The early work of the American Museum in the rich archæological field of Mexico and Central America, where the highest ancient civilizations of the New World were developed, was made possible through the generous support of the Duc de Loubat. In 1896 a concession was obtained from the Mexican Government under which excavations were carried on at Mitla, Monte Alban, Xoco, Guiaroo, Xochicalco, and other sites, resulting in fine archæological collections. This general work was continued until 1903 under the direction of Dr. M. H. Saville.

Invaluable archæological and ethnological collections were secured by the successive expeditions of Dr. Carl Lumholtz during 1892-1900. The most intensive work of these expeditions was among the Tarahumare, Huichol, and Tarascan Indians of the Sierra Madre Mountains.¹ The textile art of the Huichol is of the greatest value to modern students of design.

¹The reader is referred to the article by Doctor Lumholtz entitled "My Life of Exploration," *NATURAL HISTORY*, May-June, 1921, pp. 224-43.

In the expedition of 1894 to Copan, a great Mayan city in western Honduras, and in the field work in Guatemala under Dr. Eduard Seler of Berlin, the American Museum coöperated with the Peabody Museum of Harvard University.

Since 1909 the anthropological work in Mexico and Central America has been limited to exploring expeditions made by Dr. Herbert J. Spinden and Mr. Clarence L. Hay. These expeditions have resulted in the gathering of much data on the ancient civilizations as well as in important archæological and ethnological collections. In 1909 and 1910 many of the ancient sites in central and southern Mexico were visited and important stratigraphic studies were made at Atzacapotzalco where the remains of Archaic, Toltec, and Aztec cultures were found in superimposed layers. In 1912-13 and in 1914 exploration was carried on among the ruined cities of the Mayas in Guatemala and Honduras, including Copan, Quirigua, Tikal, Ixkun, Seibal, Yaxchilan, and Piedras Negras.

During these years the horizon of the Archaic culture was greatly extended to the south, first to Salvador and Costa Rica and then across northern South America and down the western coast to Peru. It was correlated with the establishment and spread of agriculture from a center on the highlands of Mexico or Central America. Studies made at the ancient ruined cities of the Mayas, in coöperation with Mr. S. G. Morley of the Carnegie Institution, resulted in the discovery of new monuments and in the dating of many old ones. Both the sculpture and the architecture of the Mayas were shown to pass through historical developments. More recently, in 1917 and 1918, ethnological collections were

made in Guatemala, Salvador, Honduras, Nicaragua, and Panama. Especially noteworthy was the material obtained in Guatemala, consisting of textiles and costumes, the designs and construction of which are rich in valuable suggestions for students of industrial art. The Sumu and Moskito Indians of Nicaragua were visited as well as the Valiente Indians of Panama.

As the combined results of these several explorations in the deserts and jungles of ancient America, the Museum possesses rich collections and from them has installed an entire hall, the Loubat Hall. Conspicuous in this exhibit are the casts of great monuments and sacrificial stones bearing hieroglyphic inscriptions and dates. The Museum has also been fortunate in securing the deposit of the collection of Mr. Minor C. Keith that represents the pottery, stone work, and gold work of Costa Rica.

TEXTILES AND POTTERY FROM PERU

Turning now to South America, we note that the Museum's prehistoric Peruvian collection was begun as far back as 1874 when the Edwin H. Davis collection was purchased. During the next year (1875) the rare collection formed by E. George Squier during his several years of sojourn and travel in Peru was acquired. This was a most important addition, as many of the specimens are figured and described in his well-known work *Incidents of Travel and Exploration in the Land of the Incas*. Following this no very important additions were made until 1892 when Adolph Francis Bandelier went to Peru, in which country and in Bolivia he continued collecting for the next ten years. The expenses for the first two years were defrayed by the late Henry Villard, who presented the large

collections made during this time to the Museum. The services of Mr. Bandelier were then taken over by the Museum and his work continued under its auspices for the next eight years. Mr. Bandelier's ten years' work so increased the Peruvian and Bolivian collection of the Museum that it is now one of the largest and most representative in the world.

Among other important accessions are the famous Garces collection from the Island of Titicaca, the Gaffron collection from Nazca, and the Montero collection from Ica. Notable objects in the collections are sixty trephined skulls, including the "Squier skull," from the Yucay valley, which was the one that first revealed to the scientific world the fact that this difficult surgical operation was successfully performed in Peru in prehistoric times. The "Squier skull" has probably appeared, as an illustration, in more books and papers than any other object in the Museum.

The beautiful shawl-like garments from Ica and the unique polychrome pottery from Nazca attract general attention and furnish an endless number of suggestive motives for the designer and art student. The collection of textiles is a very large one. Almost every technique known was employed by the ancient Peruvians, and many of the pieces are very beautiful even when judged by modern standards of art; while the textile expert is astonished at the quality of the yarns and the evidences of skill on the part of the weaver. A number of such experts who from time to time have examined some of the finer pieces in this collection declare that from a technical point of view they have never been equaled. This collection constitutes the specific source from which come the inspiration



A SIOUX INDIAN

The standards of excellence and accuracy in the modeling of museum figures to present the distinctive races of men have risen to a high level. The photograph shows a Sioux man in the costume of a war leader. The figure of the man was first modeled in clay by Mr. F. F. Horter according to anatomical measurements for the tribe, but to give it individuality, portrait studies of a single Indian were used for the face and the pose. When complete, the modeled figure was cast in plaster. Mr. Frederick H. Stoll then gave it a dressing of wax and color to resemble skin. He was able to impart to it a lifelike appearance by using color studies of this particular tribe and of the individual represented. Lastly, a costume and equipment were selected from the Museum's Sioux collection and the figure was dressed

and the suggestion that underlie the recent tendency to develop a national type of art. This movement is in a large measure due to Mr. Charles W. Mead, aided by his former student, Mr. M. D. C. Crawford. Many professional designers spend days in the Museum studying the remarkable textiles in the collection. The variety of form and elegance of technique found in these textiles make them an almost inexhaustible source of inspiration.

In addition to the regions mentioned, other parts of the South American continent have been visited by collectors on behalf of the Museum so that there are housed within its walls extensive collections from Guiana, from the Amazon basin, from Chile, and from Tierra del Fuego.

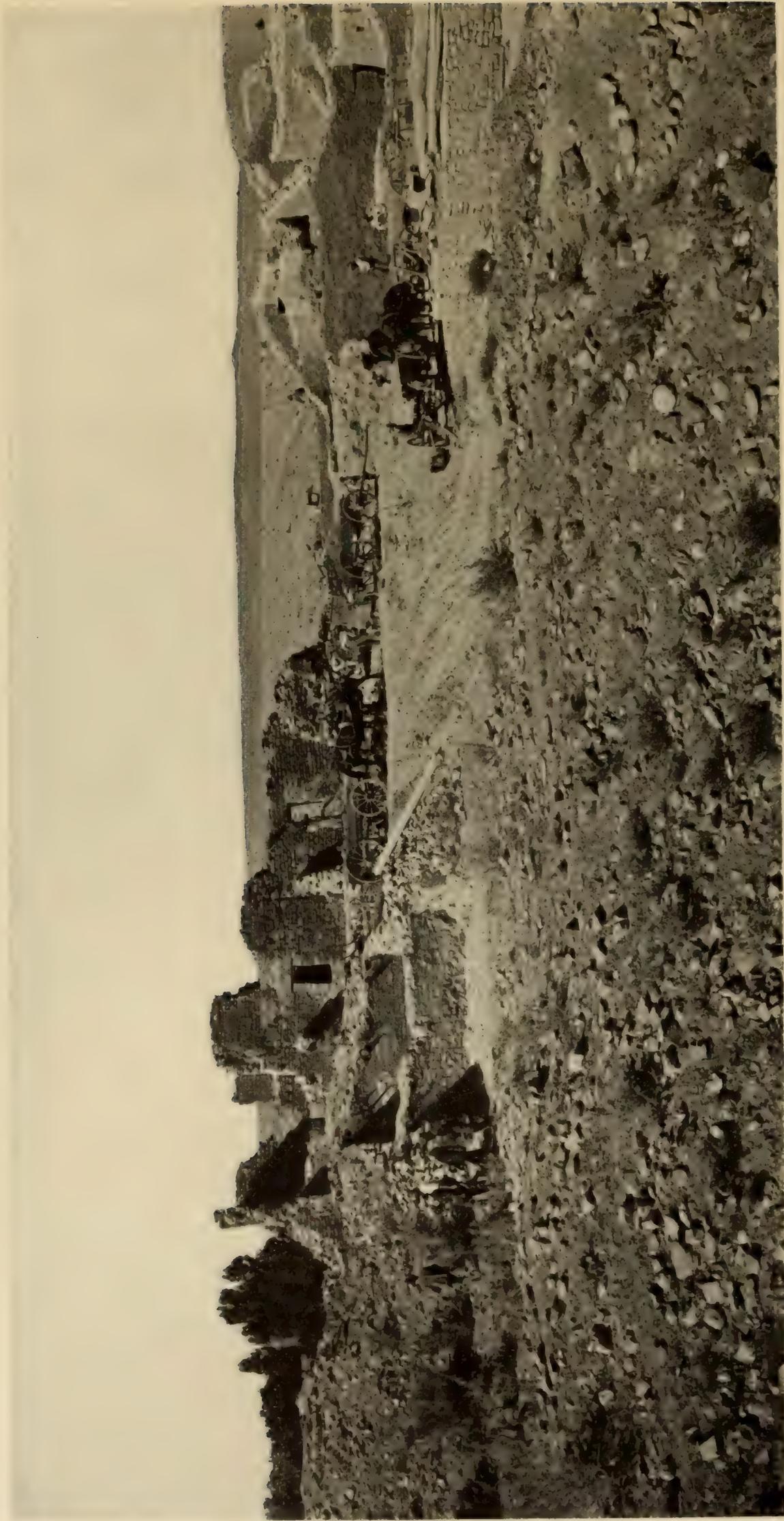
INDIAN TRIBES OF THE UNITED STATES

Work among the western Indians of the United States did not begin until about the year 1900. Previous to that date there were no collections in this Museum representing the culture of even a single tribe of the buffalo-hunting Indians, such as the Sioux, Comanche, Cheyenne, Blackfoot, Crow, etc. The first systematic collections were made by Dr. A. L. Kroeber among the Arapaho. Intensive collecting was begun about 1905 and carried on vigorously for six years. During this time practically every Plains tribe was visited, to the end that the Museum might have a comprehensive collection, presenting the most important phases of Indian life. Particularly rich is the series of beaded and otherwise decorated objects, offering great variety of design and of color combination. Students of art and design have been making new discoveries in the course of their examination of this material. In fact, no collection of equal size seems

to offer such boundless opportunities for investigation and exploitation. Great discoveries in the evolution of art and in the prehistory of our continent still await the assiduous explorer within the Museum itself.

With this wealth of material is a full collection of notes. Many important objects in the cases have their intimate personal histories carefully recorded by a museum man and placed on file. Here will be found data as to how beadwork was done, how moccasins were made, how feather bonnets were fashioned, and similar accounts, together with much valuable information as to the beliefs and fancies of the Indian. To secure all this intimate information the members of the staff lived for brief intervals with the Indians, making notes and observations and often receiving intensive instructions from old sages as to the Indian's philosophy of life and the homely ways of his fathers. Sometimes life friendships have sprung up in this way. Many Indians have taken a deep interest in the work and have shown much enthusiasm over the perpetuation of their past in a great scientific institution. An old Indian once said to the writer, "Now I pass in peace. You have written down our history; you have put away in a safe place the things of the old people. Our grandchildren can read and see what their ancestors did. Otherwise all would be lost. It is good that you came before it was too late."

Collecting among the Indians of the Plains is practically ended. In a few years the subject will be a closed book, to be read only in libraries or in the collections of museums. This work on the part of the Museum covered a period of less than fifteen years, occupied but a small part of the time of its anthropological staff, and the cost was



A SCENE AT THE FAMOUS PUEBLO RUIN NEAR AZTEC, NEW MEXICO

This large prehistoric ruin was excavated by the American Museum, the undertaking covering a period of six years. The study of the archaeological objects unearthed will require several years for its completion. This exhaustive research was undertaken at the suggestion of Mr. Archer M. Huntington, the site being purchased by him and recently donated to the United States as a national monument and park

insignificant. In addition to obtaining collections the department of anthropology prepared a comprehensive series of publications regarding these Indians, all of which will stand as substantial contributions to the subject.

THE ARCHER M. HUNTINGTON SURVEY
OF THE SOUTHWEST

In 1909 Mr. Archer M. Huntington offered to finance a survey of the living and of the prehistoric peoples of the Southwest. Accordingly, the curator of the department organized a series of investigations that were in continuous operation until 1922. Field studies were made among the Rio Grande Pueblo peoples, the Hopi, the Zuñi, the Apache, and the Navajo. At the same time work was begun upon the prehistoric ruins in three areas: (1) the valley of the San Juan River in northern New Mexico, and parts of Colorado, Utah, and Arizona; (2) the valley of the Rio Grande in New Mexico; and (3) in the basin of the Little Colorado in Arizona. The most prolonged and intensive work was in the area first named where efforts were concentrated upon the very large and hitherto unexplored ruin near the town of Aztec, New Mexico. Under the immediate direction of Mr. Earl H. Morris this large ruin was uncovered and partially restored. The return in collections has been rich. During the current year the Museum, with Mr. Huntington's generous assistance, purchased this ruin from the owner of the land upon which it stood and tendered it to the United States. The gift was accepted and by proclamation of President Harding the area was declared a national monument.

Some idea of the magnitude of the archaeological part of the Huntington

Survey may be gathered from the fact that 1530 sites and ruins were studied, covering an area of more than 50,000 square miles. This survey certainly ranks as one of the great archaeological undertakings of our time.

SEEKING THE TIME CLOCK OF PRE-
HISTORIC AMERICA

About ten years ago the department of anthropology set out to find clues to the time sequence of cultures in ancient America. The question in its simplest form is: what is old and what is recent? Though at first thought this question may seem easy to answer, it is, as a matter of fact, one of the most baffling known to science. So far as the problem applies to the Southwest, it was made one of the objectives of the Archer M. Huntington Survey. Associate Curator Nelson found superimposed deposits of refuse about the ruins in New Mexico, from the pottery in which a time scale could be devised for that area. We can now say whether a given type of pottery is older or more recent than another. This method was applied to other districts by Messrs. Spier and Morris. Combining the results thus obtained with those of other investigators, we can now draw up the general outline of history in the Southwest from a remote simple culture without pottery or agriculture down to the higher cultures of the Hopi and Zuñi Indians of the present.

A number of years ago, under the curatorship of Prof. Frederic W. Putnam, search was made for traces of glacial man in the vicinity of Trenton. At that time it was established that there were at least two periods of occupation on the famous Abbott Farm, the earlier of which is frequently spoken of as argillite culture, a simple Stone Age civilization. The collections

made under the direction of Professor Putnam were brought to the American Museum. Later, under the present curator of the department, further investigation of the site was undertaken, with the result that it was shown that the argillite culture was contemporaneous with the sand deposit in which it occurs. While it is still impossible to assign an exact date to this deposit, it seems to fall not later than the period of receding glaciers.

Supplementary to these investigations, Mr. Nelson examined shell heaps on the south Atlantic coast and also deposits in the Mammoth Cave region of Kentucky, finding in each case evidences of successive occupation, pointing to an early period represented by non-agricultural tribes without pottery. Doctor Spinden found stratified deposits in Mexico which revealed an old underlying culture, traces of which are found in the adjacent parts of both North and South America.

These accomplishments, taken in connection with the important additions to knowledge made by investigators representing other institutions, mark the opening of a new era in the study of man in the New World. We are now about to date the achievements of the aborigines and so bring the history of the New World in line with that of the Old.

THE ROLL OF EXPLORERS

The exploration projects briefly reviewed in the preceding pages could have been greatly expanded by the inclusion of minor and special undertakings, such as collecting trips in the Arctic, in the heart of Africa, Polynesia, and Asia. Although more detailed reference to these is omitted for considerations of space, no presentation of the expeditions of the department

would be adequate without mention of the many men who have shown so unreservedly their zeal and enthusiasm for exploration and research. In addition to the present staff of the department, there is a long list, among which appear the names of many distinguished anthropologists, including:

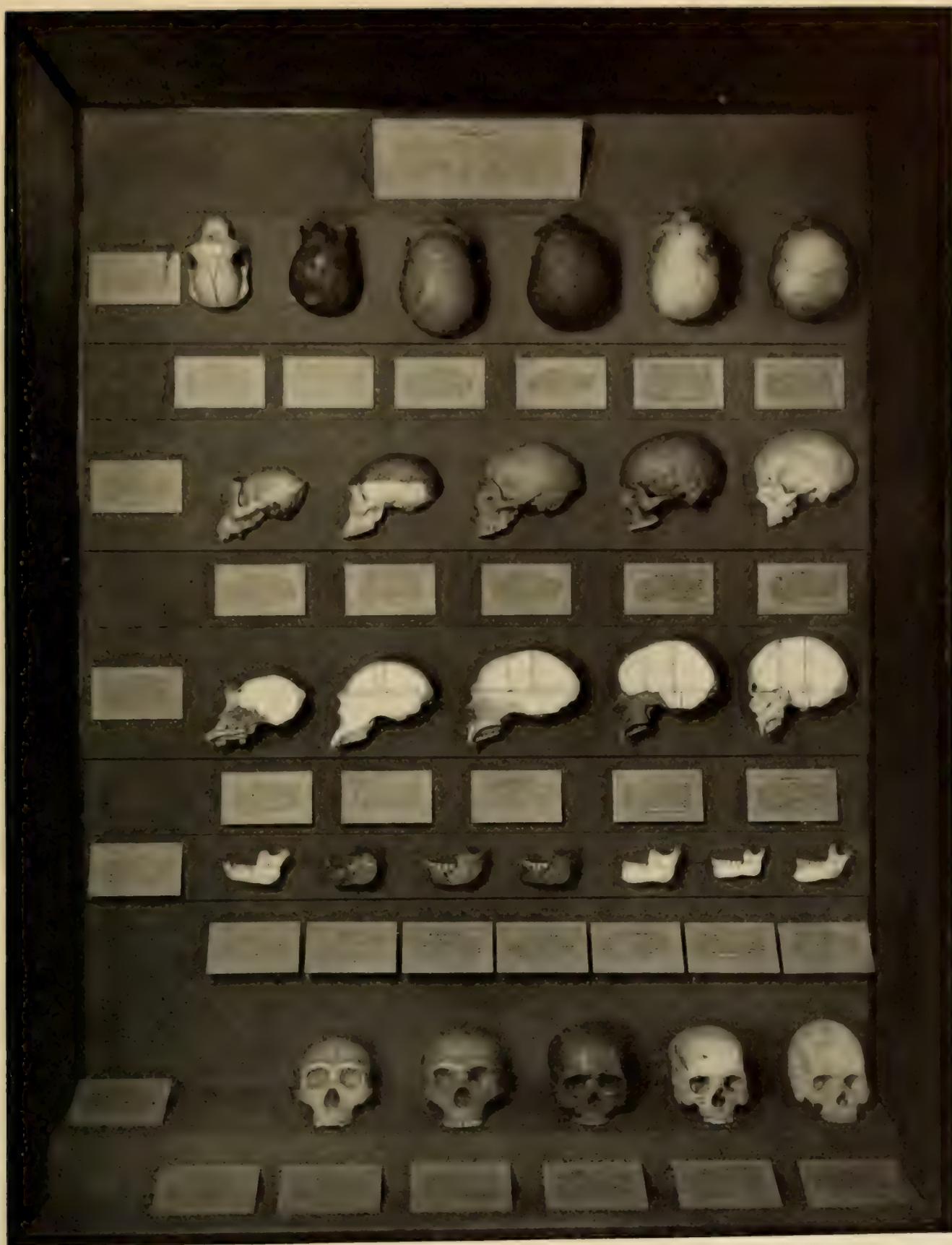
A. F. Bandelier	Robert H. Lowie
Franz Boas	Earl H. Morris
Waldemar Bogoras	Frederic Ward Putnam
George Comer	George H. Pepper
Roland B. Dixon	Edward Sapir
G. T. Emmons	Marshall H. Saville
Livingston Farrand	Alanson Skinner
Gerard Fowke	Harlan I. Smith
Waldemar Jochelson	Frank G. Speck
William Jones	Leslie Spier
M. R. Harrington	Herbert J. Spinden
A. Hrdlička	V. Stefansson
M. L. Kissell	J. R. Swanton
A. L. Kroeber	Ernest Volk
Berthold Laufer	J. R. Walker
Carl Lumholtz	Gilbert L. Wilson

To these could be added the names of many others who have made special collections for us in lands all over the world.

THE EXHIBITS

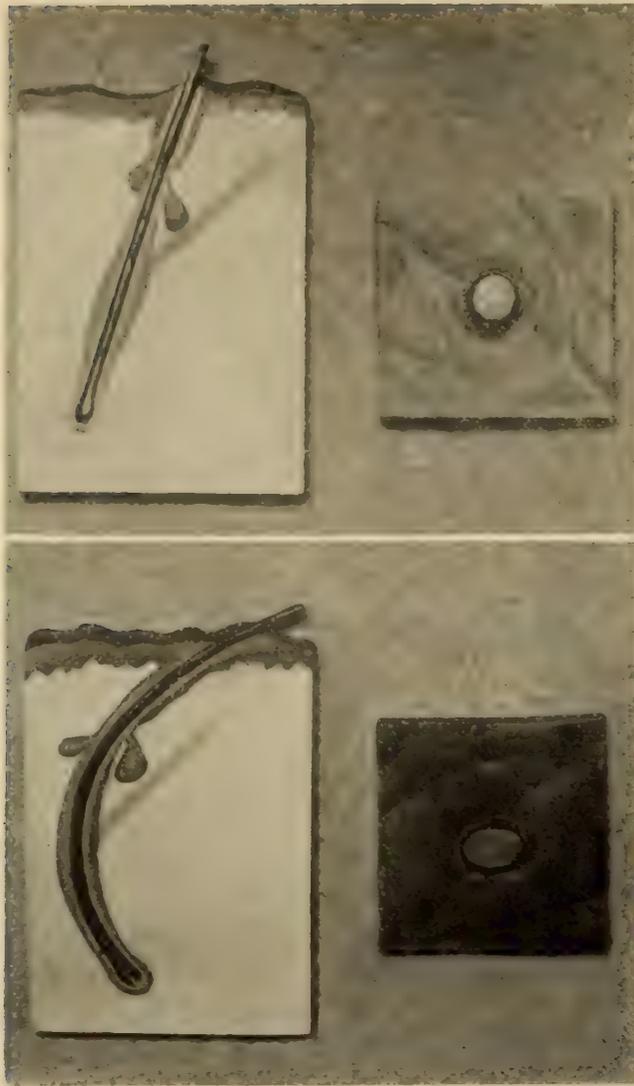
The expeditions of the department are undertaken with the object of obtaining materials and data to be used in the preparation of exhibits. To make these exhibits effective and authentic it is essential that duly qualified men visit the out-of-the-way places of the earth and lay in a store of scientific material. As the department grew it became clear that its policy should be to prepare special exhibits from carefully selected material in its reserve stock. In consequence, about the year 1907, the collections were reorganized under two heads, exhibition material and the study series.

Of the twelve exhibition halls occupied by the department eight are



FOSSIL MAN EXHIBIT

In this exhibit replicas of the skulls and jaws of early types of man are so arranged as to be readily compared with the corresponding parts of an anthropoid ape on the one hand and with those of modern man on the other. In the top row from left to right, the skulls are those of an anthropoid ape, of *Pithecanthropus*, of Neanderthal man, of Crô-Magnon man, and of the modern long-headed and short-headed types. This order of arrangement applies also to the next two rows, except that modern man, instead of being represented by two types of skull, is indicated by only a single example. In the fourth row from the top material is offered for a comparative study of the human jaw at different stages of evolution. The reduction in size of the bony framework of the face becomes apparent as the eye traverses the bottom row from left to right, viewing successively *Pithecanthropus*, Neanderthal man, Crô-Magnon man, the Negroid type of modern man, and the European type of modern man



Racial differences manifest themselves even in the form and structure of the hair. The straight hair characteristic of Indians and Mongolians is straight in the hair-sac (upper left) and circular in cross section (upper right); the woolly hair of Negroid peoples is sharply curved in the hair-sac (lower left) and oval in cross section (lower right). European hair, usually wavy, is of intermediate type. These wax models of hair, highly magnified, were prepared by Mr. Shoichi Ichikawa.

devoted entirely, and two mainly, to living peoples. Four of these eight halls are concerned with North America, one with Africa, one with Asia, one with Malaysia and the Philippines, and one with the Pacific Islands. The general arrangement of these halls is geographical; that is, primarily by large culture areas and secondarily by tribes or islands. The objects from any one tribe are grouped in the cases according to subject; those illustrating art, for instance, are separated from

those illustrating household utensils and ceremonial objects. By means of indexed labels, maps, and diagrams the student visitor is quickly able to locate any particular type of specimen from any desired region or tribe. For the benefit of visitors whose interest is more general, each hall as a unit is arranged to produce a lasting and definite impression. The spacious canoe, the totem poles, and the material in the cases of the North Pacific hall, for example, give unescapable evidence of skillful work in wood and bark and of a grotesque conventionalized art. Mural decorations and groups representing the industrial and ceremonial life of the people are being provided to supplement the displayed collections.

Two of the remaining halls, or exhibition units, are devoted to the ancient civilizations of Mexico and of Peru. A third hall presents a synoptic series of man's handiwork from the earliest Stone Age in Europe to the dawn of history. Supplementary to this story of man's upward trend in industry and art is a section showing his racial characteristics and his biological history.

The material in the second division of the collections, the study series, greatly exceeding in bulk the total number of objects displayed in the halls, is preserved with great care in storerooms. The specimens are so arranged and classified on metal shelving, or in trays, that any specimen desired can be found quickly. This wealth of permanently preserved material is being constantly used by our own staff, by graduate students from the universities, and by visitors interested especially in ethnology, design, art, etc.

During the past few years the chief concern of the department has been to emphasize the salient features of the

exhibits and to improve the technique for habitat groups, as evidenced in the Apache, Hopi, and Navajo sections. The groups mentioned are constructed to natural scale, with painted backgrounds, and are based on careful field studies by Messrs. Young and McCormick. In technique and boldness of execution they set a new standard in museum groups embodying human figures.

Finally mention may be made of a series of small booklets introducing the visitor to the important problems presented by these groups and special exhibits. It is the hope of the present staff that ere long the halls of the Mu-

seum given over to anthropology may present in their arrangement a comprehensive view of man's origin and of the slow and laborious development of his culture throughout the vista of prehistoric time, that these halls may also be rich in detail, presenting geographical and racial types of human life, so that the visitor may, if so inclined, realize by repeated visits to the Museum, the relation of man to the earth and the intimate relation that exists between him and the environment in which he chooses to live. It is thus that the exhibits in anthropology reveal the natural history of man.



The ethnological laboratory.—Specimens illustrating the arts and mode of life among the tribes investigated by the Museum staff or visited by explorers are stored in specially constructed vaults on the attic floor of the anthropological wing and adjoining these vaults is a small laboratory into which collections can be taken for study. The photograph shows Dr. Waldemar Jochelson, a distinguished Russian ethnologist, on the right and Mr. C. M. Barbeau, of the Anthropological Division, Canadian Geological Survey, specialist in Indian languages and folklore, on the left, both making detailed studies of collections in their special fields



THE MARKET PLACE AT CHALCHIHUITES

The Buried Past of Mexico

OPPORTUNITIES FOR ARCHÆOLOGICAL WORK IN THE CENTRAL AND
NORTHERN PARTS OF THE REPUBLIC

By CLARENCE L. HAY

Research Associate in Mexican and Central American Archaeology, American Museum

MEXICO is a very dangerous country for the American traveler. It leads him into the perilous habit of prophecy. If he has been in that land two weeks, he writes an article; if his sojourn has been prolonged to a month, he writes a book. I confess upon the occasion of one visit to have written a political forecast, but it was never published, for before I reached home the entire situation had changed. Now, whenever I return, and am asked the invariable question: "What is going to happen down there; how is the situation going to work out?" I fall back upon an answer once given me by an erudite observer, "You can dope the situation out thirteen ways, and the fourteenth will happen!"

There is, however, a field which is unaffected by the kaleidoscopic changes of conditions in that unhappy country. The revolutions which sweep down from the north lay waste the surface of the land and flood the mines, but leave unharmed the scarcely hidden wealth which awaits the pick and shovel of the archæologist. In the midst of all the political unrest since the fall of Diaz, the archæological branch of the government has blossomed and has borne fruit.

The stores are so widespread that it is difficult to decide which regions to emphasize. I shall not consider the wonderful Mayan or Zapotecan country of the south, but will confine this article to the highlands of Mexico and to the less explored fields in the east, west, and north.

The Valley of Mexico alone, with the great age of its deposits, and the evident cross-currents of cultures, offers many problems which may not be solved in the present generation. Possibly the most fascinating remains, though the least spectacular of all, are those of a primitive culture which, for want of a better name, has been called the "Archaic," and of which the richest finds have been made in the outskirts of Mexico City. For several years past, the Mexican government has been conducting a most interesting exploration of an Archaic site at San Angel, a southern suburb of the city. Excavations have been made at a quarry, on the edge of an ancient lava flow, which occurred, geologists variously estimate, from two thousand to ten thousand years ago. The volcanic stone is from fifteen to thirty feet in thickness, and on top are found articles belonging to the Aztec civilization. Beneath the great cap of lava tunnels were made, and objects of the Archaic type were found therein. These consist of stone utensils, pottery vessels, figurines of baked clay, quantities of potsherds, and several skeletons, the latter apparently from burials. This discovery is a most valuable contribution to science, as it establishes beyond question the relative age of the Archaic type, which is found here unmixed and undisturbed. The deposit of lava is very extensive, and the Mexican government would welcome scientific excavations made at other points on the edges of the flow.



A lava-quarry site at San Angel, near Mexico City. The earth stratum in which Archaic remains are found is clearly seen at the bottom of this picture. Aztec remains are found on top of the lava. Courtesy of Dr. Manuel Gamio



A skeleton belonging to the Archaic period, obtained from a stratum of earth that had been covered by a lava flow at some time subsequent to the burial. Courtesy of Dr. Manuel Gamio

There is another volcanic deposit on the other side of Ajusco Mountain, running toward Cuernavaca, in the state of Morelos, and it would be interesting to discover if the culture to be found beneath this flow is identical with that found at San Angel. It is noteworthy that pottery resembling the Mexican Valley Archaic has been found in many parts of Morelos, as well as in the adjoining state of Puebla.

The land about Atzeapotzalco, a little to the northwest of Mexico City, is especially abundant in archaeological remains. There the excavator is rewarded by finding three distinct cultures, superimposed and varying in relative depth according to the site chosen. At one place the writer found near the surface of the ground objects of the Aztec type, and at a depth of from three to eight feet, specimens of the Teotihuacan or Toltec type, while it was necessary to continue to the depth of from ten to twelve feet to find Archaic specimens, which were similar in every particular to the objects found under the quarries at San Angel.

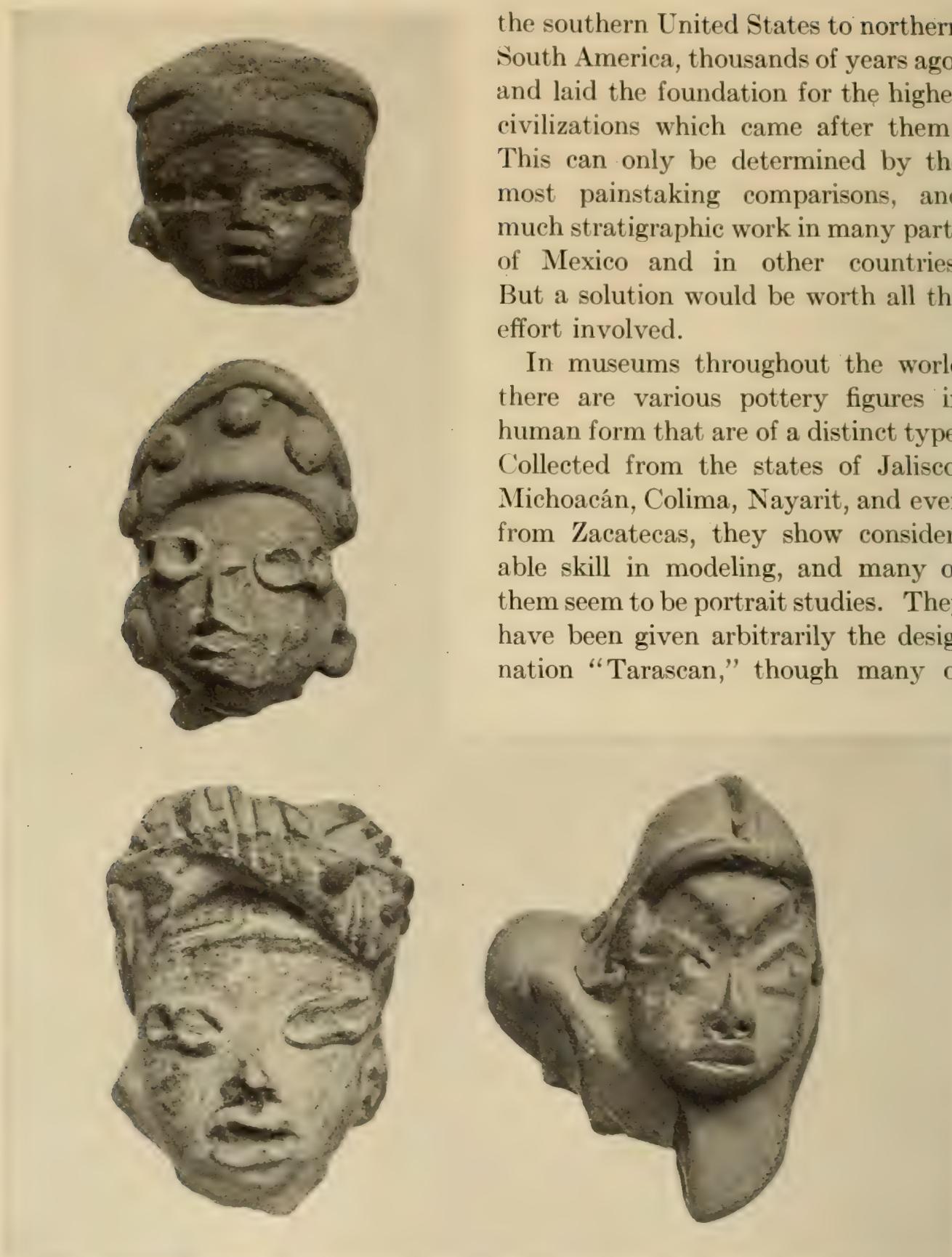
On many of the hills surrounding the Valley of Mexico, this same Archaic type is found at, or near, the surface of the ground. It has not yet been established whether these surface finds represent a survival of the Archaic culture, or whether they were deposited at the same time as those in the valley, and escaped being deeply covered, as the valley objects were, by erosion from the hills.

A classification of the Archaic is difficult, owing to the wide variety of types of the anthropomorphic figurines. No two are exactly alike. They are the work of the savage, groping for self-expression in art, and though many of the images are grotesquely crude, some of them—particularly in respect to the

heads—are surprisingly well executed, and indicate a long process of development. It would not be surprising, therefore, to discover in some lower strata a "pre-Archaic" of still cruder form, antedating anything hitherto found. In short, this fundamental culture presents the most important, and the most puzzling, of all the archaeological problems of Mexico; and it is with the object of eventually working out a solution that intensive studies should be made in all parts of the republic.



These figurines of Archaic type were obtained from water-bearing gravels at Atzeapotzalco, near Mexico City. The one on the left is a specimen of unusual character that finds place in the collection of the American Museum. That on the right is reproduced from the collection of the author



These Archaic types from the Valley of Mexico indicate an interesting range in portraiture; facial proportions, features, and headdress differing from individual to individual. They are part of the collection in the Museum of the American Indian—Heye Foundation

There is much primitive pottery in Central America, and some even in the United States, which suggests a common origin with the ancient type of the Valley of Mexico. Was it a primitive people that overran this continent from

the southern United States to northern South America, thousands of years ago, and laid the foundation for the higher civilizations which came after them? This can only be determined by the most painstaking comparisons, and much stratigraphic work in many parts of Mexico and in other countries. But a solution would be worth all the effort involved.

In museums throughout the world there are various pottery figures in human form that are of a distinct type. Collected from the states of Jalisco, Michoacán, Colima, Nayarit, and even from Zacatecas, they show considerable skill in modeling, and many of them seem to be portrait studies. They have been given arbitrarily the designation "Tarascan," though many of

them come from points outside of the historic Tarascan area. This is another alluring field for the archæologist, not only on account of the artistic value of the objects found, but also because its investigation will help to clear up the



Statuettes from the "Tarascan" area, now in the American Museum. They differ so much in facial type and expression that they appear to be individual portraits

riddle of the Archaic. No scientific stratigraphic work has been done in this entire region, and as the figures are apparently a later development of the primitive Valley of Mexico type, excavations may reveal the true Valley culture underlying the "Tarascan."

A similar, though even more complex, situation exists on the east coast, in the Panuco region of the oil fields. From this part of the country comes a diverse assortment of clay figures of three general types: figurines in semi-relief, apparently made from a mold, and resembling certain small idols found in the Maya area in the south; well-made idols of pastillage technique; and a few distinctly resembling the Archaic of the Mexican highlands. As this region was populated by the Huastecas, an outlying Maya tribe, the Maya-like types are to be expected, but it is hard to determine the chronological position of the free-hand figures of the second type, which appear to



This figure, of late Archaic type, from the Peabody Museum in Cambridge, was collected by Mrs. Zelia Nuttall in the Panuco region. Figures are frequently found on the surface of the ground after a heavy rain



The plaza of San Juan de Teotihuacán is surmounted by small truncated pyramids with stairways giving access to them. The Pyramid of the Moon is seen as a dark mound against the hill in the background on the left of the center of the panorama; the Pyramid of the Sun is on the right of the center

be of a later date, and the Valley of Mexico Archaic, which may or may not be the earliest. Farther down the coast, the Totonacan area in the central part of Vera Cruz shows characteristics of both the Maya and the Archaic, and a careful study will be necessary to determine the relation of the two cultures.

To those who believe that Mexico is a land now inhabited chiefly by "grafting" generals on the one hand and bandits on the other, nothing is more instructive than a glance at the work recently accomplished by the government under the able direction of Dr. Manuel Gamio, of the Departamento de Agricultura y Fomento, at San Juan de Teotihuacán. This ancient Toltec city, which can be reached within an hour by train or automobile from the capital, has for long been one of the well-known attractions of Mexico. The Pyramid of the Sun, about 180 feet in height, is

the largest of its monuments,¹ and was restored under Porfirio Diaz. The Pyramid of the Moon, which is somewhat smaller, has not as yet been restored. These pyramids were built of adobe bricks, faced with stone and cement, and apparently were enlarged from time to time. Unlike those of Egypt, they contain no burial chambers. Originally there probably existed an altar on the flat summit of each, dedicated to its respective deity. In addition to a quantity of smaller mounds and buildings, there is another structure, third in point of size, but now first in point of interest, which has been known popularly as the "Citadel." To this group Mexican archæologists have been devoting their time for the past three years, with the most astonishing results.

The temple enclosure consists of a

¹There is a still larger pyramid at Cholula, in the state of Puebla. It is built of adobe, and was originally about two hundred feet in height. It is much greater in volume, though not as high as the pyramid of Cheops in Egypt.



The double structure on the right half of the panorama represents two periods in the history of San Juan de Teotihuacán,—the addition on the right, only partly freed of its covering of soil, being of later date than the exposed pyramid. This group is known as the “Citadel” and was probably erected to the god, Quetzalcoatl. Courtesy of Dr. A. V. Kidder

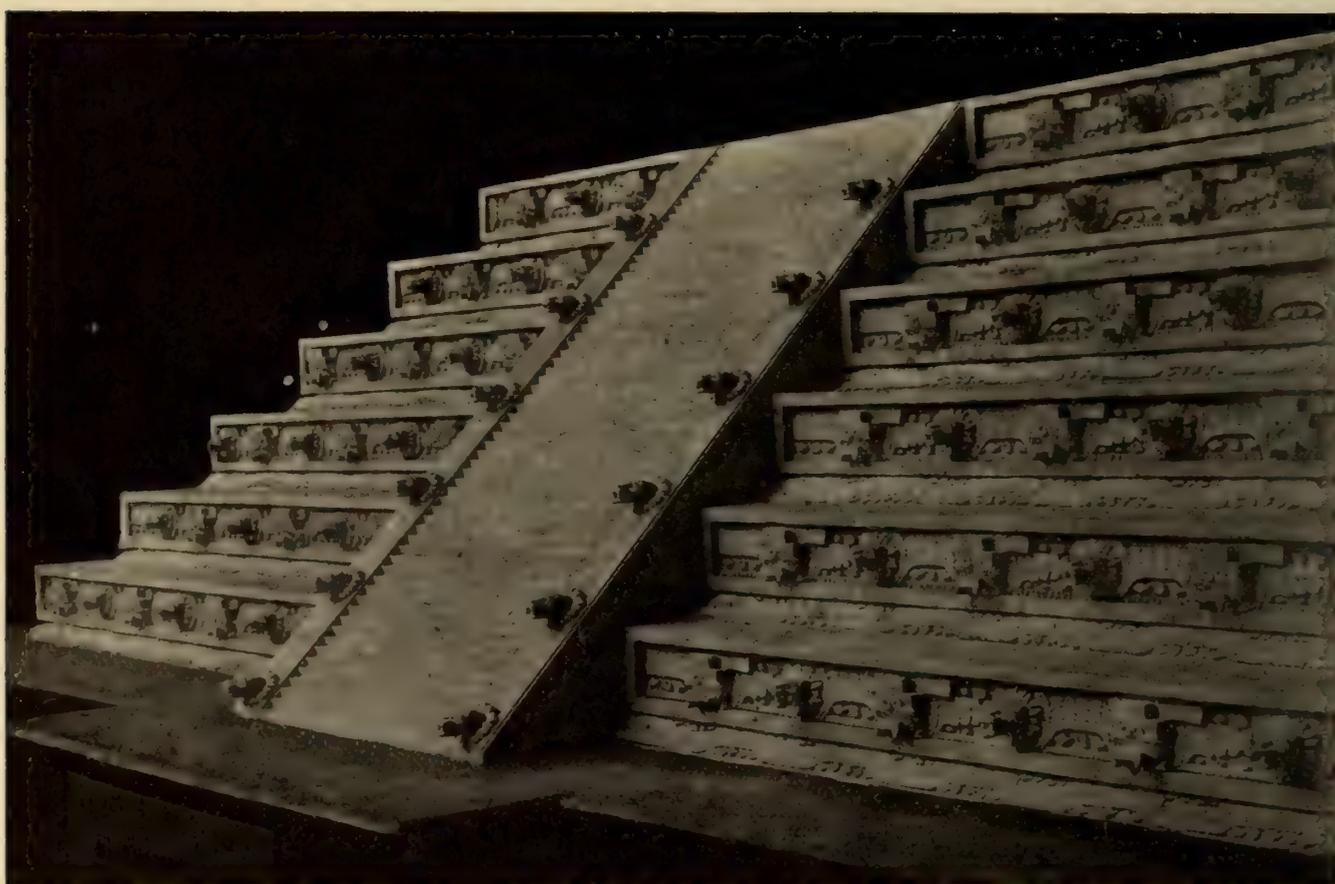
quadrangular plaza 160,000 square meters in area, its two principal axes oriented in the direction of the four cardinal points. It adjoins the “Pathway of the Dead, which leads to the two great pyramids. Each side surrounding the plaza is composed of a platform 400 meters long, 7 meters high, and 80 meters broad, surmounted by small truncated pyramids, which are connected with the platform and the plaza by stairways. There are four small pyramids on each side, except on the east, where there are but three. A stairway on the west side leads from the Pathway of the Dead to the top of the platform, and another takes one down into the plaza.

In the center of the quadrangle stands a double temple, which represents two epochs in the history of the city. It appears to have been erected to Quetzalcoatl, god of the winds. Excavations were begun on the western elevation, which proved to be a

later addition, representing the “period of decadence.” It is higher than, but similar in construction to, the smaller structures on the platforms, and like them bears no decorative art. It had been attached to the older temple on top of the existing façade.¹ In this manner the builders of the second epoch buried, and unwittingly preserved for discovery a thousand years or more later, some of the finest sculptures ever unearthed on the American Continent. On the other sides of the older temple, which had been exposed to the elements and to the depredations of Christian builders of the Colonial Period, hardly a trace of the original facing remains.

On the older temple serpent heads in stone adorn either side of the stairway, and the entire side of the terraced pyramid is covered by rows of plumed

¹There is abundant evidence in other parts of the city of two epochs: floors, walls, and stairways of houses are frequently found beneath the ruins of other buildings.



In the upper picture is shown that portion of the "Citadel" that fronts the later and only partly excavated pyramid. Richness of ornamentation characterizes this well preserved side of the original temple. The character of the sculpture appears in full detail in the restoration (lower picture) where the head of the plumed serpent is seen alternating with that of another god, probably Tlaloc. Both of these pictures are reproduced by courtesy of Dr. Manuel Gamio

serpent heads, with representations of the head of another god (probably Tlaloc) alternating, while associated with them are the bodies of serpents in bas-relief, sculptured sea shells, and

other figures. Not only have most of the stone carvings on the façade been preserved, but many of the delicate shells, carved in stucco, remain intact. There are also many vestiges of the



The steps in the upper picture illustrate two periods of culture, evidences of which are found in various parts of the city of Teotihuacán. Inferiority in art and workmanship is apparent in the structures of the later period.

The frescoes on the masonry shown in the lower picture have been preserved to a remarkable degree. Some of the paints on excavation were still bright and the individual colors stand out with considerable sharpness. Courtesy of Dr. Manuel Gamio

polychromatic covering, and in several examples incrustated obsidian eyes are to be seen in the serpent heads.

Restoration was necessary in this group in order to preserve the exposed monuments from complete disintegra-

tion, and a certain amount of reconstruction was resorted to. This seems to have been conducted faithfully and scientifically, with the minimum amount of guesswork.

That part of the temple of Quetzal-



One of the largest Aztec mounds in the vicinity of Mexico City is shown in the upper picture; it awaits exploration by the archæologist.

The lower picture is that of an Aztec pyramid located at Cuernavaca. Mexico abounds in monuments of this kind, which before their excavation seem to the casual observer to be merely small hills. Courtesy of Dr. Manuel Gamio

coatl which is standing today may have been the substructure of a temple, or may simply have been crowned by an altar. The same is true of the smaller buildings of this group. In any case, nothing remains to show what was on

the top, and no attempt has been made to erect a hypothetical superstructure. In every instance where reconstruction was practiced, there was a sufficient amount of the original façade remaining to indicate clearly the lines to follow.



From the top of the ancient fortress known as El Chapin in the vicinity of Chalchihuites one looks upon the scene depicted in the photograph. This fortress was built on a prominent hill, isolated and admirably adapted for defense. Some of the walls are still standing



The columns of one of the buildings—probably a temple structure—at Chalchihuites. Originally these columns evidently supported a roof, but this roof has long since disappeared. The Chalchihuites region offers exceptional opportunities to the archæologist. Doctor Gamio has been excavating one of the sites but much still remains to be done in the area

There appears to be a wing attached to the Pyramid of the Moon, and recently test tunnels were being dug, to discover whether a façade similar to that on the Temple of the Winds exists on the Moon Pyramid.

The Government at one time employed as many as four hundred workmen on the Quetzalcoatl group, but in spite of what has already been accomplished, there are a vast number of mounds in other parts of the city which

have not been touched, and the department of anthropology in Mexico would gladly offer facilities to the foreign archæologist to excavate at Teotihuacán. There was obviously at one time a great population at that place, but as yet no burying ground has been discovered. Fortunate will be the man who finds this cemetery and the precious objects that lie buried with the countless dead!

Though the discoveries at Teotihuacán have overshadowed all other recent archæological accomplishments, the Mexican government has not confined itself to this site alone. Some work has been done at various sites in the south of Mexico; work is being completed on a most interesting Aztec ruin at Cuernavaca in Morelos; Aztec temples have been brought to light in the City of Mexico itself, and in the environs, at San Bartolo Naucalpan and Mixcoac. Mexico has undertaken an important work in the restoration of the great ruins of Monte Alban in Oaxaca, and an Archaic pyramid, situated near Tlalpam in the Federal District, is being brought to light by Professor Byron Cummings of the University of Arizona, under the auspices of Doctor Gamio. Lava had flowed around the pyramid, partly covering the base of it. The pyramid is impressive in size, is of good, though crude, workmanship, and gives the Archaic people who undoubtedly built it, a position of great importance in Mexican archæology. Plans are also being made for the restoration of Tajin, a temple of the Totonacan culture in the state of Vera Cruz, and of a group of ruins known as "La Quemada" in Zacatecas.

It would seem that I had exhausted the potential archæological regions in Mexico, but this is by no means the case. There is much work to be done in

the central part of the republic, and to the north, in Durango and Chihuahua. La Quemada, in Zacatecas, which the government proposes to restore, is an important group of ruins of an undetermined culture, resembling the Toltec in architecture. Pottery has been found here which connects it also with the "Tarascan" civilization.

Associated with La Quemada, are the ruins of the Chalchihuites region in Zacatecas. This is a most important area and except for a site which was excavated by Doctor Gamio in 1908, the work being resumed by him in February of 1922, nothing has been done in all this territory. There is a ruin of the Chalchihuites type not far from Canutillo, Zacatecas, which must have been an impregnable fortress, standing as it does on an isolated rock, commanding an extensive stretch of country. It appears to be of greater consequence than the Chalchihuites ruin already excavated, and the work of clearing it would be far easier. Loose earth and other débris could simply be dumped over the edge of the rock to the plain below.

This is but one of legion. So far we know almost nothing of the nature of the many ruins farther north in Durango. In the neighborhood of Zape, for instance, there are remains which, when investigated, may prove to be the link between the cultures of Mexico and our own Southwest.

In northwestern Chihuahua is a great group of adobe ruins, now almost leveled to the ground by erosion. This group, known as "Casas Grandes," has lent its name to a type of pottery widely distributed in Chihuahua, which is affiliated with the Pueblo ware of the southwestern United States. These ceramics are justly celebrated for the beautiful and varied forms of the

vessels, and for the wealth of designs upon them, the colors of which have remained bright through the ages in which they have lain under ground.

The many mounds, which are known locally as "Montezumas," were formed by the fallen roofs and walls of the structures. The objects, which were buried with the dead, are found beneath the original floors.

No knowledge of archæology is required to discover the pottery, a fact which was confirmed by the amateur excavators of the Pershing expeditionary forces. As far as I am aware, however, there is available to science no record of a single complete exploration of a Montezuma. And there is no more delightful country to work in than northern Mexico.

I had occasion recently to make a trip in Mexico with Dr. A. V. Kidder, of Andover. We were everywhere treated with the utmost courtesy, at the hands of officials and people alike.

We were particularly grateful to Dr. Manuel Gamio, director of anthropology, for the efforts which he made on our behalf. He personally took us to many of the most important monuments in the republic and was largely instrumental in making our journey a success. I must also mention the un-failing hospitality extended to us by our fellow Americans resident south of the Rio Grande.

The "secretaría" of anthropology has available a quantity of data to assist the archæologist in his pursuits. These include charts of the various regions, with the geographic situation of the remains; itineraries and means of access; and a list of the accommodations which may be obtained at, or near, the respective sites.

The foregoing outline may serve as a meager indication of the crying need for new men in this field. It is necessary to go to Mexico to gain any true understanding of the endless opportunities for research.

"Something hidden. Go and find it. Go and look behind the Ranges—
Something lost behind the Ranges. Lost and waiting for you. Go!"



Archaic vase of the gourd type found by the author in the valley of Mexico



Photograph by Dr. P. J. S. Cramer

MONKEY GATHERING COCONUTS IN JAVA

These agile animals are trained to climb the coconut trees and detach the fruit. From below the owner of the monkey guides its actions by means of a long cord (not visible in the picture) that is attached to the creature before it is sent on its errand

Monkeys Trained as Harvesters

INSTANCES OF A PRACTICE EXTENDING FROM REMOTE TIMES
TO THE PRESENT

By E. W. GUDGER

Associate in Ichthyology, American Museum

IN the issue of *Science* for February 7, 1919, I published a note entitled "On Monkeys Trained to Pick Coconuts," the opening paragraph of which read as follows: "Readers of the Sunday editions of some of our metropolitan papers may recall that in the fall, the season of cotton-picking in the South, waggish space writers sometimes make the suggestion that monkeys be trained to do this work and that thereby the shortage of labor be relieved." This statement was followed by quotations from the books of Miss Isabella Bird and of Mr. R. W. C. Shelford to show that in the East Indies monkeys are employed to pick coconuts for their masters.

Some quiet fun was made of me for having been "taken in" by these accounts, but the laugh passed to my side when Mr. Carl D. La Rue, writing from Kisaran, Asahan, Sumatra, published in the issue of *Science* for August 22, 1919, a note entitled "Monkeys as Coconut Pickers." In this he said:

"E. W. Gudger has recently called attention in *Science* to the use of monkeys as coconut pickers. The Malays and Bataks of Sumatra very commonly use monkeys in this way. The current English name for the monkey, *Macacus nemestrinus*, is 'coconut-monkey.' The work of picking the nuts is performed in a way essentially the same as that described by Shelford and quoted by Gudger.

"These monkeys not only work, but have a considerable commercial value as laborers. The price of a trained coconut monkey ranges from about

\$8.00 to \$20.00; a price far above that put upon other common sorts of monkeys which are kept only as pets.

"Coconut monkeys grow to a considerable size, and are very strong."

My friend, the late Dr. A. G. Mayor, became interested in my note in *Science* and told me that on one of his trips to the Pacific, he had met Dr. P. J. S. Cramer, director of the experiment station at Buitenzorg, Java, who had shown him photographs of the monkeys at work. A letter to Doctor Cramer brought the following courteous reply:

"I have the pleasure to enclose three photographs of a monkey picking coconuts. On the first you see him climbing up the stem, on the second sitting on a leaf, on the third stretching his hand out over a coconut. What you cannot see on the photographs is that the animal is attached to a thin cord, by means of which the owner governs his movements."

Since I wrote my note in *Science*, there has come to my attention, as the result of considerable reading, a number of similar accounts reaching back into remotest antiquity, and it has seemed worth while to bring all of these together, arranged in reverse chronological order, so that readers of NATURAL HISTORY may have available the record of this ancient but little-known example of coöperation between man and his fellow Primates.

First comes Shelford's account,¹ dated 1916 and worded as follows:

"*Macacus nemestrinus*, the pig-tailed Macaque, or Brok of the Malays, is a

¹Shelford, Robert W. C. *A Naturalist in Borneo*, London, 1916, p. 8.

highly intelligent animal, and Malays train them to pick coconuts. The modus operandi is as follows:—A cord is fastened round the monkey's waist, and it is led to a coconut palm which it rapidly climbs, it then lays hold of a nut, and if the owner judges the nut to be ripe for plucking he shouts to the monkey, which then twists the nut round and round till the stalk is broken and lets it fall to the ground; if the monkey catches hold of an unripe nut, the owner tugs the cord and the monkey tries another. I have seen a Brok act as a very efficient fruit-picker, although the use of the cord was dispensed with altogether, the monkey being guided by the tones and inflections of his master's voice."

One of the most important of scientific voyages of recent times is that of the "Siboga," sent out by the Dutch government to explore the waters of the East Indies in the years 1899-1900. Its leader was the distinguished naturalist, Dr. Max Weber. His wife accompanied him, and in her book¹ descriptive of the voyage we find this paragraph relative to our subject.

"In 1888, we lived there [at Manindjau in Sumatra] for a month in a Kampong house. Opposite us was a Malayan family which owned two Lampong, or Lapond, apes (*Macacus nemestrinus*), big, impudent beasts, which had been taught to pick coconuts. For this purpose, a band, to which a long rope was attached, was tied around the body of the ape, and then the animal was chased up into the tree. Arrived there, the ape seated himself on a branch and began to twist with his hands and feet one of the coconuts that hung under the branch, until the stem broke and the fruit fell down. If he dallied too long

over his work, the strap around his body was jerked unsympathetically. How the ape knew which nuts he was to pick remained a puzzle to me, but a fruit never dropped that was not fully ripened."

In 1904, Odoardo Beccari, the Italian explorer of Borneo, published the story of his journeyings in that great island during the years 1865-68.² Of *Macacus nemestrinus* he writes that it is trained by the natives and taught to gather coconuts.

Miss Isabella Bird, the well-known woman traveler, writes as follow:³

"A follower had brought a 'baboon,' an ape or monkey trained to gather coconuts, a hideous beast on very long legs when on all fours, but capable of walking erect. They called him a 'dog-faced baboon,' but I think they were wrong. He has a short, curved tail, sable-colored fur darkening down his back, and a most repulsive, treacherous, and ferocious countenance. He is fierce, but likes or at all events obeys his owner, who held him with a rope fifty feet long. At present he is only half tame, and would go back to the jungle if he were liberated. He was sent up a coconut tree which was heavily loaded with nuts in various stages of ripeness and unripeness, going up in surly fashion, looking round at intervals and shaking his chain angrily. When he got to the top he shook the fronds and stalks, but no nuts fell, and he chose a ripe one, and twisted it round and round till its tenacious fibers gave way, and then threw it down and began to descend, thinking he had done enough, but on being spoken to he went to work again with great vigor, picked out all the

²Beccari, Odoardo. *Wanderings in the Great Forest of Borneo: Travels and Researches of a Naturalist in Sarawak* [1865-68]. London, 1904, p. 30.

³Bird, Isabella. *The Golden Chersonese and the Way Thither*, New York, 1883, p. 425.

¹Weber-Van Bosse, Mrs. A. *Ein Jahr an Bord I. M. S. Siboga, 1899-1900*. Leipzig, 2nd edition, 1905, p. 229.

ripe nuts on the tree, twisted them all off, and then came down in a thoroughly bad, sulky temper. He was walking erect, and it seemed discourteous not to go and thank him for all his hard toil."

About eighty years ago Robert Fortune began his career as a botanical collector in China. From 1843-48 he collected for the Horticultural Society of London, while from 1848-56 he was a collector in the service of the Honorable East India Company. During the latter engagement, his collections of tea plants and tea-making tools played a large part in establishing the tea industry in northern India. The testimony of such a man regarding the general subject under consideration cannot be disregarded. In books published in 1852 and in 1853 he writes thus:¹

"I have even heard it asserted (I forget whether by the Chinese or by others) that monkeys are employed for the same purpose [i.e. gathering tea leaves] and in the following manner:—These animals, it seems, do not like to work, and would not gather the leaves willingly; but when they are seen up amongst the rocks where the tea bushes are growing, the Chinese throw stones at them; the monkeys get very angry, and commence breaking off the branches of the tea-shrubs, which they throw down at their assailants! . . . I should not like to assert that no tea is gathered in these hills [of Woo-e-shan in the neighborhood of Tsong-gan-hien] by the agency of monkeys, . . . but I think it may be safely affirmed that the quantity procured in such ways is exceedingly small."

For our next reference we must go back nearly one hundred years, in fact

¹Fortune, Robert. *A Journey to the Tea Districts of China, etc.* London, 1852, p. 237, and *Two Visits to the Tea Countries of China, etc.* 2 vols. London, 1853, Vol. II, pp. 199-200.

to 1757, when Pehr Osbeck's *Voyage to China*² was published.

Among the curious and interesting things that he notes was the keeping of monkeys as pets by the Javanese, and in this connection he introduces the following statement apparently as an afterthought: "It is said that the monkeys in China gather rhubarb and pound rice."

Edward Tyson closes his *Philosophical Essay concerning the Pygmies of the Ancients*,² published in 1694, with a reference to the activities of certain trained monkeys as recounted by three authors antedating him. Instead of giving this citation, the authors concerned will be quoted directly. It is perhaps needless to caution the reader that they wrote at a time when nature-faking was not condemned as it is today.

In 1670, Olfert Dapper⁴ published his book on Africa, and in his description of "Sierra-Liona" is found the statement appended below. There is no evidence that Dapper ever visited Sierra Leone, nor is there any to show from whom he got his information though he may have known of the citation immediately following this one. His words are:

"Three kinds of monkeys are found here; and there is one, of a certain species they call Baris, which they catch when little; raise, and train so well, that these monkeys can give almost as much service as slaves. Ordinarily they walk quite erect like men. They can grind millet in the mortar, and go to draw water in a pitcher. When they fall down, they

²Osbeck, Pehr. *Ostindisk Resa til Surat, etc.* Stockholm, 1757. English translation by John Reinhold Forster, *A Voyage to China and the East Indies.* London, 1771, Vol. I, p. 152.

³Tyson, Edward. *Philosophical Essay concerning the Pygmies of the Ancients.* London, 1694, pp. 101-02.

⁴Dapper, Olfert. *Umständliche und eigentliche Beschreibung von Africa, etc.* Amsterdam, 1670. A French version is entitled *Description de l'Afrique, etc.* Amsterdam, 1686, p. 249.



In Egypt monkeys apparently at times shared with men the tasks of harvesting. In the picture—the original of which appears as a painting on the tomb of Hui—one man and four monkeys are engaged in the common labor of picking the fruit of the dôm palm. From Vol. IV, p. 341, of *A History of Egypt, Chaldea, Syria, Babylonia and Assyria*, by G. Maspero

show their pain by cries. They know how to turn the spit, and to do a thousand clever little tricks which greatly amuse their masters.”

Going back still farther, in Petri Gassendi's life of the French scholar, Peiresc, published in 1641, is found the following interesting statement which agrees with the foregoing, in so far as the author's very unclassical Latin can be made out.

Peiresc was informed by a certain physician named Natalis, that in Guinea a particular kind of monkey

called Baris was of so gentle a disposition that it could be readily trained, taught to wear clothes, play on a pipe, husk grain in a mortar, assist in keeping the house swept and in order and in performing various other menial services.¹

Nearly seventy years earlier than Gassendi, José de Acosta, a Jesuit monk, one of the early explorers of the natural history realm of the new world, published in the natural history section

¹Gassendi, Petri. *Viri illustri Nicolai Claudii Fabricii de Peiresc Vita*. Parisii, 1641.

of his work¹ the following account. It will be noted that he claims to have been an eyewitness of the incident mentioned. Perhaps, however, it is just as well that he did not print the account in that part of the work dealing with morals, for there greater sobriety of statement would seem to be required. He writes thus:

"I sawe one [monkey] in *Carthagene* [Cartagena] in the Governour's house, so taught, as the things he did seemed incredible: they sent him to the Taverne for wine, putting the pot in one hand, and the money in the other; and they could not possibly gette the money out of his hand, before he had his pot full of wine. If any children mette him in the streete, and threw any stones at him, he would set his pot downe on the one side and cast stones against the children till he had assured his way, then would he returne to carry home his pot. And which is more, although hee were a good bibber of wine (as I have oftentimes seene him drinke, when his maister has given it him) yet would he never touch it vntill leave was given him."

For our next citation we must delve into the past about 1400 years to Philostratus called "the Athenian" to distinguish him from others of the name. Philostratus, who was born circa 170 A.D. and died in 245, was a disciple of the Greek Pythagorean philosopher, Apollonius of Tyana, who was born a few years before the Christian era. Apollonius traveled extensively and among the countries he visited was India. He died at the age of about one hundred years at Ephesus where he had established a school.

The narratives of the travels of

Apollonius were collected and written out in full by Philostratus. In the English version² of these we read that near the river Hyphasis, which traverses India, the parts of the mountains which stretch down to the Red Sea are overgrown with aromatic shrubs, as well as many other species of plants, including pepper trees, which he states "are cultivated by the apes."

"It [the pepper tree] grows in steep ravines where it cannot be got at by men, and where a community of apes is said to live in the recesses of the mountain, and in any of its glens; and these apes are held in great esteem by the Indians, because they harvest the pepper for them. . . For this is the way they [the apes] go to work in collecting the pepper; the Indians go up to the lower trees and pluck off the fruit, and they make little round shallow pits around the trees, into which they collect the pepper, carelessly tossing it in, as if it had no value and was of no serious use to mankind. The monkeys mark their actions from above out of their fastnesses, and when the night comes on they imitate the actions of the Indians, and twisting off the twigs of the trees, they bring and throw them into the pits in question; then the Indians at daybreak carry away the heaps of spice which they have thus got without any trouble, and indeed during the repose of slumber."

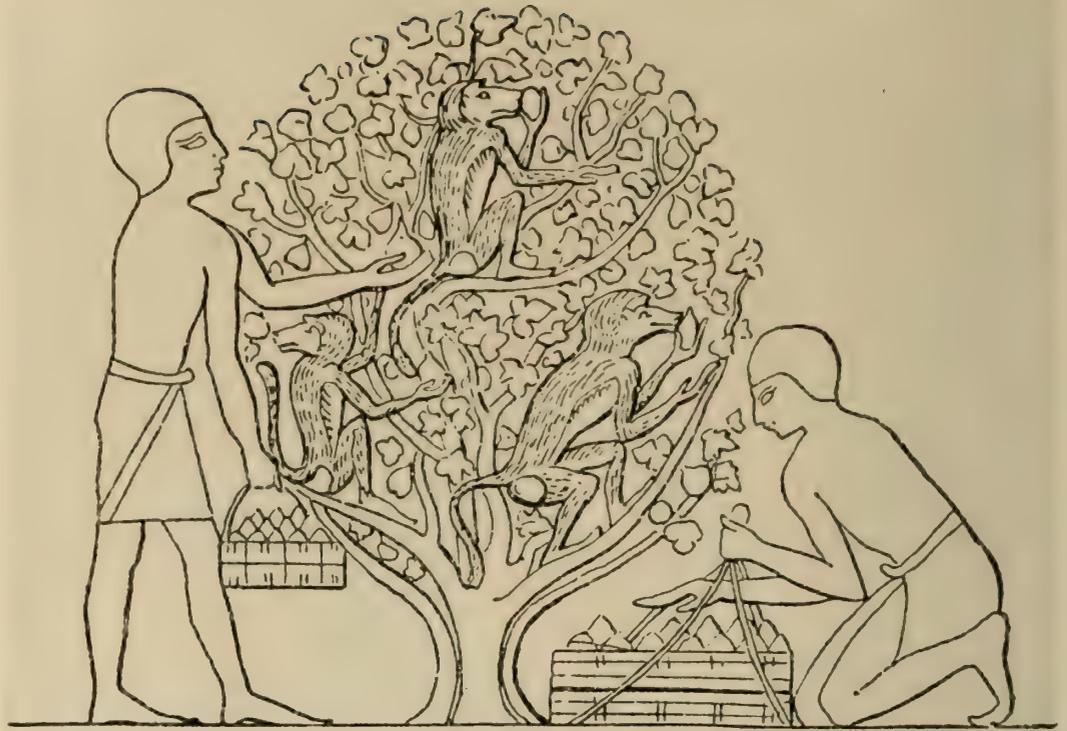
Our next excursions in ancient history take us to the valley of the Nile and here we find in paintings on the tombs three illustrations of monkeys serving man. To one of these I am unable to assign any date whatever, but for the other two fairly definite times can be set.

¹Acosta, José de. *Historia natural y moral de las Indias*, etc. Sevilla, 1590. English version by Edward Grimston, *Natural and morall historie of the East and West Indies*. London, 1604, p. 315. (Reprinted 1880 by the Hakluyt Society, as its Volume LXI.)

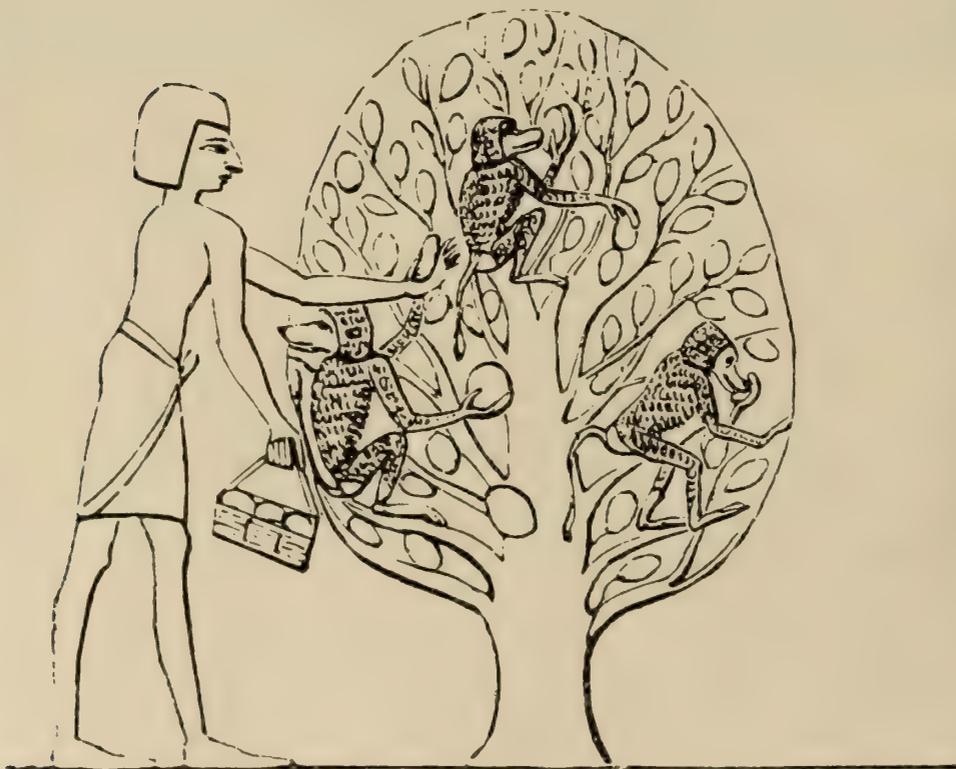
²Philostratus ["the Athenian"]. *The Life of Apollonius of Tyana*. English translation by F. C. Conybeare. 2 vols. London and New York. (Reprinted, 1917.) Vol. I, p. 239.

FRUIT GATHER-
ING IN EGYPT

The upper picture, reproduced from a tomb at Beni Hassan belonging to the Twelfth Dynasty of the Old Kingdom, bears witness to the fact that monkeys were used by the Egyptians as fig-gatherers. Judging from the propinquity of fruit and mouth in the case of two of the apes, it is permissible to infer that in addition to assisting their masters, these animals occasionally helped themselves.



The lower picture is similar in character to the upper one but differs somewhat in details. It, too, is taken from a tomb at Beni Hassen and dates from the same dynasty. Both of these records are,



therefore, several thousands of years old,—by the lowest estimate about forty-four centuries; yet the practice therein depicted persists in certain parts of the world even today.

The upper picture is a reproduction from the cut on p. 199 of *Life in Ancient Egypt*, described by Adolph Erman, and translated by H. M. Tirard; the lower picture is from Vol. I., page 382, of *The Manners and Customs of the Ancient Egyptians* by Sir Gardner Wilkinson, revised and corrected by Samuel Birch

In Maspero's *History of Egypt*,¹ there is a reproduction of a picture from the tomb of Hui which this distinguished Egyptologist says "represents men and monkeys gathering the fruit of a group of dôm palms."

Another representation of this use of the monkey is found in the accompanying figure from Adolf Erman's *Aegypten*.² With reference to this figure Erman notes that fig trees have gnarled trunks, that they rarely attain more than sixteen feet in height, and that they have limbs too weak to sustain the weight of the gardeners. Hence people "send tame monkeys into the branches to gather the fruit for them."

This figure is credited to Lepsius' great work,³ from which we learn that it is reproduced from a tomb at Beni Hassan belonging to the Twelfth Dynasty of the Old Kingdom. According to accepted Egyptian chronology the Twelfth Dynasty dates from 2800-2500 B.C. or according to Petrie (1906) its time was 3450 years before the Christian era. And in this remote antiquity monkeys had been trained to perform menial services for man.

Yet another figure and reference remain. Sir Gardner Wilkinson in his great work on the ancient Egyptians,⁴ has this to say on the subject. "Monkeys appear to have been trained to assist in gathering the fruit, and the Egyptians represent them in the sculptures handing down figs from the sycamore-trees to the gardeners below; but, as might be expected, these animals amply repaid themselves

for the trouble imposed upon them, and the artist has not failed to show how much more they consulted their own wishes than those of their employers.

"Many animals were tamed in Egypt for various purposes . . . and in the Jimma country, which lies to the south of Abyssinia, monkeys are still taught several useful accomplishments. Among them is that of officiating as torch-bearers at a supper party; and seated in a row, on a raised bench, they hold the lights until the departure of the guests, and patiently await their own repast as a reward for their services. Sometimes a refractory subject fails in his accustomed duty, and the harmony of the party is for a moment disturbed, particularly if an unruly monkey throws his lighted torch into the midst of the unsuspecting guests; but the stick and privation of food is the punishment of the offender; and it is by these persuasive arguments alone that they are prevailed upon to perform their duty in so delicate an office."

From Wilkinson is reproduced the accompanying picture showing monkeys gathering fruit. This figure, also from the tombs of Beni Hassan, is very similar to that reproduced from Erman but is different in details. It likewise dates from the Twelfth Dynasty.

Here then we have accounts and illustrations showing monkeys gathering coconuts in Java in the present year of grace, and at the other end of the time scale we have Egyptian rock paintings and carvings showing how monkeys assisted in gathering figs and dôm palm fruits not later than 2500 B.C. and possibly as early as 3450 years before the birth of Christ—at the lowest figure a range of more than 4400 years, at the largest a range of 5370 years.

Verily there is nothing new under the sun.

¹Maspero, G. *A History of Egypt, Chaldea, Syria, Babylonia and Assyria*. Edited by A. H. Sayce. Translated by M. L. McClure. London, n. d. Grolier Society edition, Vol. IV, p. 341.

²Erman, Adolf. *Aegypten und aegyptisches Leben im Altertum*. Tübingen, 1885, p. 279. English version by H. M. Tirard, *Life in Ancient Egypt*. London, 1894, p. 199.

³Lepsius, R. *Denkmäler aus Aegypten und Aethiopien*, Vol. IV, Section 2, p. 127.

⁴Wilkinson, Sir Gardner. *Manners and Customs of the Ancient Egyptians*. 3 vols. New edition, revised and corrected by Samuel Birch. New York, 1879, Vol. I, pp. 381-82.

The Buffalo Drive and an Old-World Hunting Practice

A CULTURAL PARALLEL BETWEEN THE LAPPS AND THE NORTH AMERICAN INDIANS

By ROBERT H. LOWIE

Associate Professor of Anthropology, University of California

ONE of the perennial questions debated by anthropologists relates to the independence of aboriginal American culture. The point at issue is really not so much the existence as the extent of alien features in the customs, beliefs, and arts of the natives. Probably everyone admits that the sinew-backed bow of the Far West must be conceived as an Asiatic intrusion; but American ethnologists have not been convinced that the essential features and higher developments of the New World cultures imply importation from the Eastern Hemisphere.

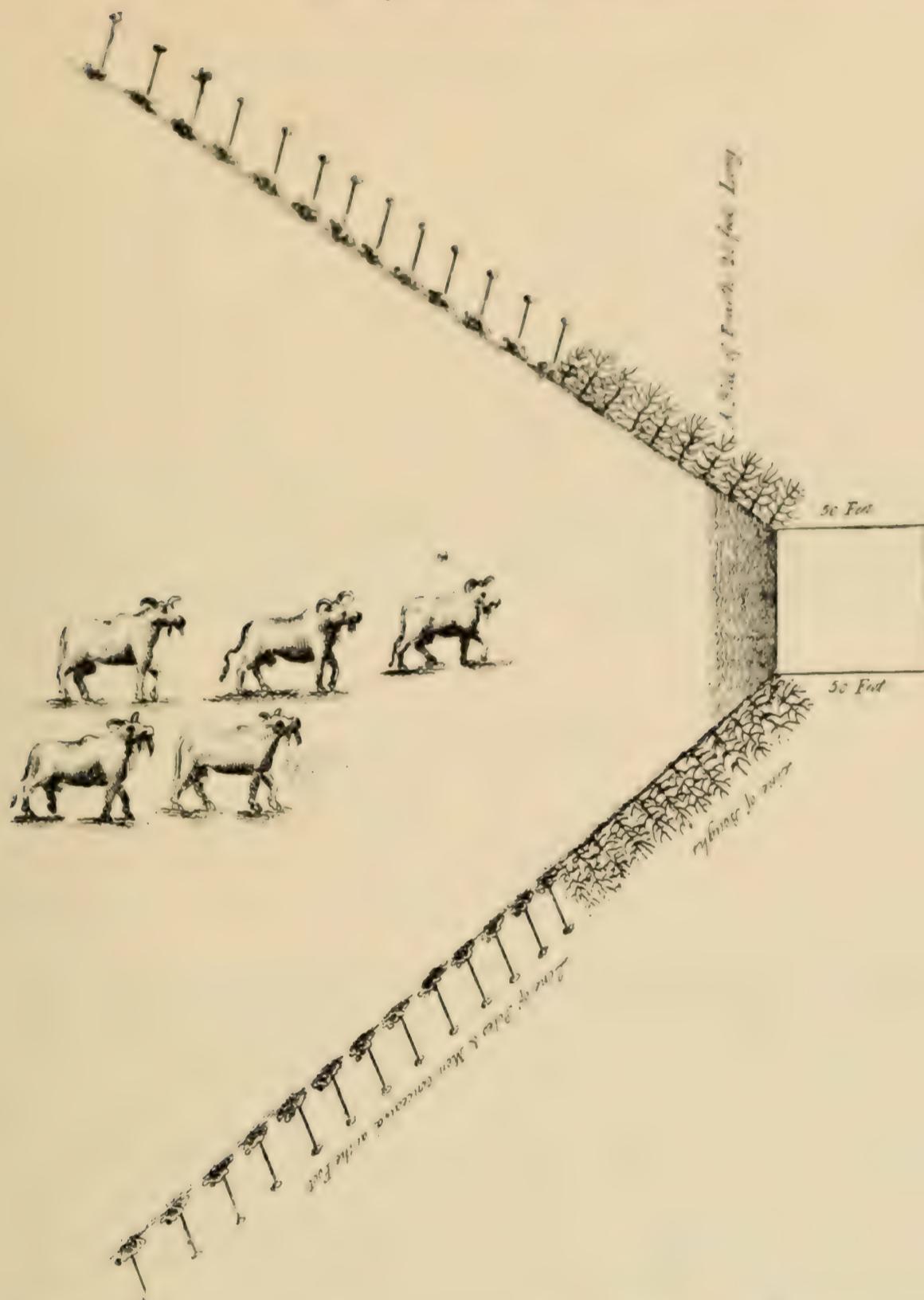
In the following paragraphs I wish to call attention to an old Lapp custom that strikingly resembles a North American practice. The similarity has been noted by Hatt, but without direct reference to its historical significance; according to this writer the usage also extends to the Samoyed of western Siberia.¹ My subject is the impounding of game in a communal hunt. The source of information for the Lapps is an old narrative by Tornæus, whose report, dating back to 1672, is partly reproduced by the noted Finnish linguist and ethnographer, Castrén.² The English rendering is my own.

¹"Notes on Reindeer Nomadism" by Gudmund Hatt (*Memoirs*, American Anthropological Association, Vol. VI, p. 94).

²*Reiseerinnerungen aus den Jahren 1838-1844* by M. Alexander Castrén. Published by A. Schiefner, St. Petersburg, 1853. Page 44 f.

The *wuomen* is made as follows. For a distance of one or two miles lengthwise, the width being one or more miles, the hunter sets up high posts on level or bald, woodless rocks, *quasi duo cornua* (like two horns). First he sets the posts at some distance from one another, but as he proceeds (for the length of the distance is one or two miles) he sets them closer together and puts on each pole some black and horrible object, from which the reindeer recoil. When he gets to the *angustiora* (narrower parts), he constructs field hedges after the fashion of those customary in Sweden, and high fences over which the reindeer cannot jump. As soon as he arrives *in angustissimo* (in the narrowest section), he makes a five-stepped slope, at the foot of which there is a lofty and strong enclosure, well protected like a stockade or blind alley, so that no creature could escape from it. Then the Lapp travels about in all the mountains; wherever he finds reindeer herds, he drives them carefully and gradually in the direction of his *wuomen*. When the reindeer get between the posts, they dare not pass through either side because they are afraid of the black objects on the posts. The Lapp and his followers are in the rear and take care lest the reindeer turn back, letting them step slowly forward and occasionally eat white moss (their diet), lie down and rest as though no danger at all were impending. But when they get *ad angustiora* and *angustissima* (to the narrower and narrowest parts), where there is a strong fence on both sides, he proceeds after them with might and main, driving the reindeer *in præcipitium* (headlong) down the

Plan of a Buffalo Pound.



This illustration, derived from a quaint volume published in 1790 and entitled *The Present State of Hudson's Bay*, is of particular interest because in it are shown not only the two converging rows of crouching Indians but, towering above them, poles that in some respects recall those used by the Lapps in impounding reindeer. Edward Umfreville, the author of the volume, states that—after the erection of the walls of the pound, which in some cases is circular, in others square, and the construction in front of it of the hill of earth and the converging lines of boughs, shown in the picture—“a number of poles, nearly fifteen feet long each, are placed at about twelve feet distance from each other, with a piece of Buffalo dung on the top, and in a straight line from the boughs above mentioned. At the foot of each pole a man lies concealed in a Buffalo skin, to keep the animals in a straight direction to the pound. These poles are placed alike on each side, always increasing in breadth from one side to the other, and decreasing in the same proportion as the animals approach the pound.”

The sedate movements of the bison in this illustration are in striking contrast to the frenzied confusion of the animals in the picture of the communal hunt of the Cree

five steps he has made. From there they are not able to jump up again but are compelled to remain *in suo carcere* (in their prison). Then the Lapp comes whenever he so chooses and kills them all, large and small, thus destroying the breeding of reindeer in the country, for which reason such men are hated by the other Lapps.

To every reader of North American ethnographic literature this account must at once recall the method employed by some Plains Indian peoples in impounding buffalo and by tribes farther north in impounding caribou. Hind's picture of a Cree buffalo stampede has been rendered accessible by Dr. Clark Wissler.¹ There we see the lines converging, the circular enclosure toward which they lead, the hunters driving the game through the passage created by them. Only two significant differences appear: the absence of a slope before the pound

¹*The American Indian* by Clark Wissler. Opposite p. 11.

and the substitution of men for posts in the formation of the two lines. Other North American reports, however, make it clear that elsewhere, in part at least, some of the converging walls were made of sticks and that an inclined plane was used in one of the most characteristic forms of this method of hunting.

Altogether, I cannot escape the impression that we are here face to face with a cultural parallel which implies a single center of origin, that the impounding of game in the manner described evolved possibly in some Siberian tribe and thence spread to the east and the west. It is indeed a far cry from the Samoyed to the nearest North American aborigines, but the resemblance is too great and the feature too complex to permit the assumption of independent invention. Perhaps further inquiry will serve to discover traces of the custom in western Siberia.



This picture, reproduced from Hind's *Narrative of the Canadian Red River Exploring Expedition of 1857*, shows a communal hunt of the Cree. Two converging lines of Indians, some gesticulating, others aiming arrows, tend to prevent the escape² of the affrighted animals either to the right or to the left, while other Indians armed with weapons are driving them to their doom in the circular pound seen in the distance



Bushmen hunting with bows and arrows

The Natives of South Africa¹

BY ROBERT BROOM

Corresponding Member of the American Museum

POPULARLY and even semi-scientifically it is the belief that the natives of South Africa present to us a very simple and easily solvable problem. The races are generally held to be (1) the famous Bushmen—light-skinned, stunted, untameable savages, almost verging on the semi-human, who are believed to be the aborigines; (2) the Bantu or Kafir tribes—a dark-skinned, powerfully-built race, somewhat resembling the Negro and who within comparatively recent times have come down from the north; and (3) the Hottentots—a second light-skinned race who resemble the Bushmen in some characters and, it is thought, are a cross between the Bushmen and the Bantus.

Recent discoveries of skulls of very great antiquity, belonging to races which are not Bushmen, and the published statement by the director of the

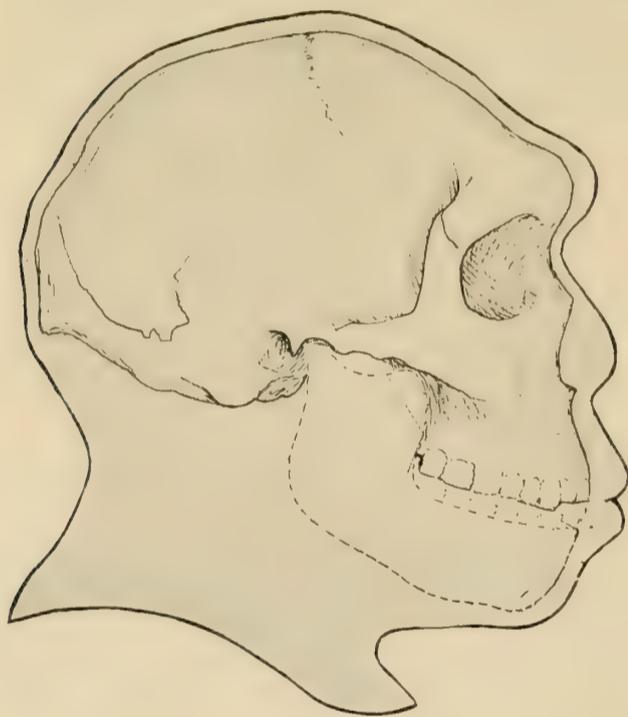
South African Museum that he is unable to tell a recent Bushman from a recent Hottentot have thrown much of our supposed knowledge into confusion.

About ten years ago there was discovered at Boskop in the Transvaal a completely fossilized human skull. Unfortunately the skull is imperfect, practically all the face and much of the jaw being lost; and we are quite unable to give even its approximate age. Still we can quite confidently state that it must be very ancient. The skull is of enormous size—in fact, one of the largest human skulls on record. Most Europeans have a brain capacity of from 1400 to 1600 c.c., and only in very exceptional cases do we find a brain capacity of 1800 c.c. Bismarck, Sir Walter Scott, and a few such geniuses had enormous brains, but the Boskop man had a brain possibly larger than that of any of them. I estimate that

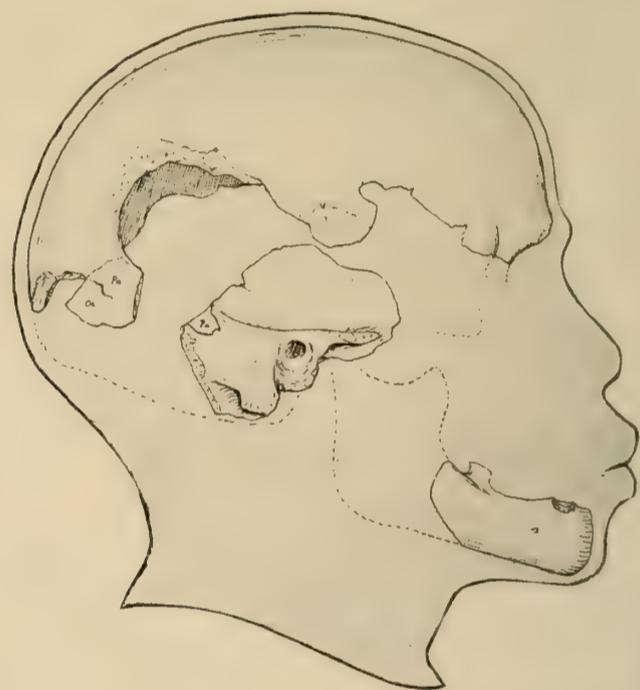
¹The photographs accompanying this article were taken by Mr. A. M. Cronin and are here reproduced by courtesy of Miss M. Wilman, curator of the McGregor Museum, Kimberly, into the possession of which they have passed

his brain capacity was at least 1950 c.c. The skull is also extremely thick—in parts nearly three times as thick as that of the average European. Concerning the affinities of this Boskop man we know but little. Notwithstanding the enormous size of the skull, its breadth and height indices and general shape agree so closely with those of the unde-generate Bushmen as to suggest that the stunted Bushmen of today are probably the direct descendants of

differs considerably, and the shape of the face differs very greatly. When this Broken Hill man lived we cannot at present say but like the Boskop man his antiquity must be very great. This primitive human type has been named *Homo Rhodesiensis* by Smith Woodward, and Elliot Smith from the examination of the brain cast considers him more primitive than any other known type of extinct man except the ape-man of Java and the Piltdown



Outline drawing of the Broken Hill skull, after a photograph by Smith Woodward (reversed), with outline of the soft parts restored



Restoration of the Boskop skull, with outline of the soft parts,—the representative of the great-brained prehistoric race of South Africa

the large-brained race represented by the Boskop man.

About two years ago a far more remarkable ancient human skull was found at Broken Hill in Rhodesia. Fortunately this skull is nearly perfect, only the lower jaw being missing. The top of the head is comparatively flat as in the ape-man, *Pithecanthropus erectus*, of Java, and over the eyes there are enormous gorilla-like bony ridges. In appearance the skull bears some resemblance to the Neanderthal skulls of Europe, but the shape of the brain case

man of Sussex. Though there is no race at present surviving, the members of which might be regarded as the little-modified descendants of *Homo Rhodesiensis*, we nevertheless find clear evidences of an Australoid strain in some still-surviving races, and it is not improbable that this is due to an admixture in other races of the blood of the descendants of the race represented by the Broken Hill man. Occasionally we meet with a Korana with supra-orbital ridges not much inferior in size to those of *Homo Rhodesiensis*,

and I have seen a Korana with a sloping brow almost as flat.

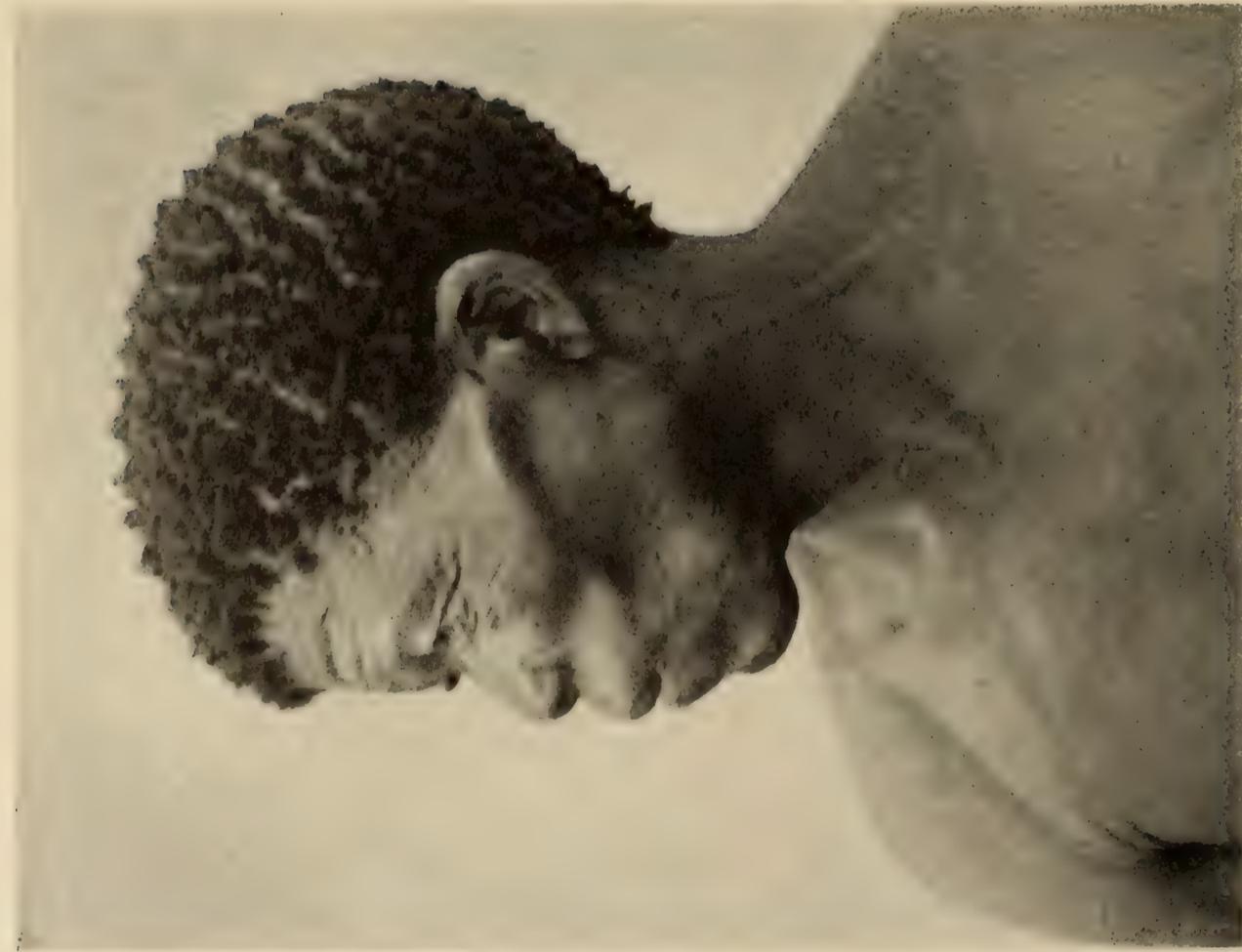
Of surviving races the Bushmen are among the most interesting. The Bushmen, as seen today in the Kalahari and Southwest Africa, are a somewhat dwarfish race with small faces, hands, and feet and usually with short curly hair on the head and comparatively little hair on other parts of the body. Occasionally, however, there is fairly long hair on the scalp, and this suggests that the very short hair often seen is a secondary character. Though the Bushmen are usually regarded as dwarfs, it is well known that many of the early Cape Colony Bushmen, who could obtain good supplies of game, were men and women of quite ordinary size, and even today if the very young children of dwarfish parents are taken to farms and well fed, they grow to a fair stature.

In Cape Colony pure Bushmen are now rather rare, though they must still number many hundreds. In early days they were looked upon by the white farmers who had invaded their hunting grounds as untameable, semi-human savages, and were shot at sight. As the Bushman might be lurking anywhere, with the cunning of an American Indian, ready to discharge his poisoned arrows, and as he gave and asked no quarter, and furthermore refused to make any distinction between the sheep and cattle of the farmer and the wild buck of the veld, it is not to be wondered at that hunts were organized and the Bushmen nearly exterminated. There was no League of Nations in those days to whom the weak could appeal and so, like the Tasmanians, the Australians of Victoria and New South Wales, and many American Indian tribes, the Bushmen were killed off or driven away.

Fortunately there are still a fairly large number left in the Kalahari and Southwest Africa, where their language, folklore, and habits can be studied.

The Hottentots were a more civilized race, who kept cattle and sheep, worked in metals, and were ready to trade with the whites. In appearance they resemble a little the Bushmen, having somewhat similar flat noses, but they are usually hairier. The shape of the head differs entirely, being long and narrow, and by this alone a pure Hottentot can always be distinguished from a pure Bushman. In fact, the Hottentot is one of the narrowest-headed human races known. The ratio of the breadth of the skull to the length in the Hottentot is almost invariably under 70 to 100 and is frequently as low as 64. In the pure Bushman the cephalic index is usually between 76 and 80.

There is one tribe which is usually grouped with the Hottentots, but which differs appreciably. I refer to the Koranas. This is the race which the early travelers found inhabiting the Orange and Vaal river valleys near the middle of South Africa. The members of this race differ from the Hottentots of the west in being of a darker complexion, in having broader noses and frequently in having well-developed supra-orbital ridges. They are a stupid, indolent race and the examples given by Campbell of their mentality are very characteristic. "No nation in Africa," he says, "has been found by the Missionaries more indifferent to all kinds of information than the Corannas. If a Missionary visits a Kraal they will attend to his address; if he chooses he may remain; if he goes away they manifest no wish to detain him. They are equally in-



A PRACTICALLY PURE BUSHMAN AND BUSHWOMAN OF THE KALAHARI

The Bushmen of this area of South Africa are somewhat undersized in appearance, with small faces, hands, and feet. Although the head is usually covered with short, curly hair, individuals having fairly long hair are occasionally seen. In his letter transmitting these two portraits the author speaks of them as "the finest Bush studies ever published"



A BUSHGIRL AND TWO BUSHMEN
The girl and the man on the right are from the Kalahari

different to his coming, remaining, or departing; they feel indisposed to any effort of mind or body. Mr. Sass, who knew the Corannas well, from a residence amongst them, gave me a striking illustration of the contracted state of their mental powers. 'Suppose,' said he, 'that you ask a Coranna man how



This young Korana resides at Douglas, South Africa. The Korana are frequently grouped with the Hottentots but they differ from them in certain of their features as well as in their darker complexion

many children he has. He muses for a while, looking toward the ground; then raising his head he appears to be engaged in calculating with his fingers. Yet after all this he requests others to assist him in solving the difficulty. After further calculation again upon his fingers, he will look you in the face, and tell you he has three!"

Physically the Korana seems to be a Hottentot with a quite appreciable Bantu or Negro strain, and also some blood of the Australoid race, but whether these admixtures were acquired

in the north or in South Africa is at present unknown.

The Bantus or Kafir tribes are by far the most numerous peoples of South Africa. Under the term Bantu are included a large number of different tribes of Negro-like natives who are scattered over the greater part of Africa south of the equator. Physically the Bantus include some of the most handsomely built specimens of mankind, and some of the women are as graceful as the Venus of Melos, and while intellectually the average is below that of the European, the race has produced some leaders of the very greatest ability.

The Bantu tribes differ often very greatly from each other in appearance. This is due evidently to the admixture with different races. Some of the southern tribes give clear evidences of a Bushman strain; others of a Hottentot infusion. Many of the northern tribes seem to have Semitic blood in their veins.

In north Damaraland there is a Bantu tribe which has lost its own language and now speaks the Hottentot language. These are the Berg Damaras, of one of whom I am able to show a photograph. It has been held that the Hottentots were always a feeble folk, never numbering more than a few thousands. But this seems very unlikely when we consider that the Hottentot language is spoken by this Bantu tribe in the north of Southeast Africa, that Hottentots speak or spoke it along the west and south coasts of Cape Colony, and that the Koranas of the Orange and Vaal river valleys also spoke a dialect of it. The very wide extent of this remarkably distinct language would also make us hesitate in accepting the view of certain scientists that the Hottentot is only a Bush

and Bantu cross. Certainly the language is not a Bush and Bantu cross, nor does the skull appear to be, being narrower than even the Bantu.

The future of the various races of South African natives can be foretold with much probability. The Bushmen and Koranas are rapidly passing away as distinct races, the remaining individuals being steadily absorbed by the other races, mainly by the mixed Hottentots, and in one hundred years it will be difficult to find a pure Bushman or Korana. The Hottentots will survive longer as a distinct race. In Namaqualand, where there will never be any very extensive white settlement, they may survive in a state of relative purity for some hundreds of years, and so also in Southwest Africa, but in other parts of South Africa they are bound to become absorbed into the mixed Cape Race or the Bantus.

But the future of the Bantus is very different and provides those of us who dwell in South Africa with our most alarming political problem. Almost all colored races of man go down before the onslaught of the white man's diseases and alcoholic drinks. The South Sea Islander, the Australian, the Bushman are all passing away; but the Bantus thrive, and today are multiplying twice as fast as the whites. Every Kafir wishes to have a family and generally marries young. Polygamy has been recognized from time immemorial and even Christian missions have to compound with it. Since devastating native wars have ceased under the *Pax Britannica*, the sexes have become more equalized, and polygamy is now the exception, but it is still largely practised in the native territories. Every woman becomes the mother of children and many have large families. At present the Kafirs or

Bantus outnumber the whites by about five to one, and every year the proportion of black to white is becoming larger. Before very many years it must be ten to one, and before the present century draws to a close it seems very certain that the Kafir will rule the whole of South Africa, and white civilization be replaced by black.



The Berg Damara, of which this individual is a representative, is one of the Bantu tribes that speaks the Hottentot language

There will be no need for the Kafirs to rise in rebellion in order to gain commanding power; they have only to breed and to study. The Kafir chiefs are often men of great intellect, and they are certainly better statesmen than many of the whites. They look far into the future. In the first half of the nineteenth century there was a continuous succession of Kafir wars, and the blacks showed that they must be classed as formidable warriors. But since the Zulu war of 1879 there has been no serious native war. There has, however, been far more serious



XOSA MAN (LEFT) FROM EAST CAPE COLONY AND MASUTO WOMAN (RIGHT) FROM BASUTOLAND



ZULU TYPES



BANTU TYPES

On the left is a Matabele from Rhodesia; in the center is a Mutchopi from Delagoa Bay; on the right is a Swazi



BANTUS FROM BECHUANALAND

On the left is a Motlharo; in the center is a Morolong; on the right is a Mokgatla

native peace. When there was a little rising in Zululand about a dozen years ago and hundreds of Zulus were shot down by machine guns, the Zulu mothers quietly said, "We can breed sons quicker than you can shoot them down."

In olden times the Hottentots were the more or less docile slaves of the Dutch and French immigrants. They were intellectually and physically too inferior to the whites ever to be any source of direct danger. But unfortunately the very inferiority of the Hottentots has given rise to the idea in the minds of many of the white colonists that all colored races are inferior, and that there is really no danger from the Kafirs, and as a result the Kafirs have been encouraged to come into Cape Colony, most of which was really originally the country of the Hottentots and the Bushmen.

Already the Kafir has displaced the Hottentot as the laborer in most of the towns, on the railways, and on most of the farms of the middle of Cape Colony. He is also displacing the poorer class of whites and the less intellectual. In most countries the unskilled labor is performed by this class of whites, but here in South Africa the Kafirs can do it more cheaply than the whites, and can do it just as satisfactorily. Hence there is nothing for the poor white man to do. Already we have in South Africa tens of thousands of a class that has no counterpart in any other country in the world—the "poor whites"—not well enough equipped through intellect and education for the performance of

skilled labor and with no unskilled labor for them to do. Every year sees the problem getting worse. The government tries to help by creating labor colonies, land settlements, and through other schemes, but for every thousand relieved, two thousand more seem to arise.

This class of "poor whites" with no steady work to do, and too often on the border of starvation, is a constant source of danger, being a ready tool in the hands of unscrupulous politicians. In 1914 there was quite a serious rebellion and this year again there was an attempted revolution in the Transvaal. Both these uprisings have been put down by the government, but the disease continues. Until recently the Kafir competed only in unskilled labor; now he is entering the fields of skilled labor, and very steadily but surely displacing more and more whites.

Many years ago Balfour said that South Africa had a terrible problem in the native question, and he added, "I do not envy the man who has to tackle it." Whether for good or for ill to the world the Bantu and Negro tribes are going to play a big part in the future. It is well we should study them.

All the photographs illustrating this paper have been taken by Mr. A. M. Cronin, and are selected from what is probably the finest collection of studies of South African natives that has ever been made. The collection belongs to the McGregor Museum, Kimberley, and those here presented are published by the kind consent of the curator of that museum, Miss M. Wilman.



A group of white oak trees, *Quercus lobata*, at Diablo, Contra Costa County, California. On the ground under one of these the jumping "seed" was found

Jumping "Seeds"

PLANT GROWTHS THAT HOP ABOUT LIKE FLEAS

BY FRANK A. LEACH

IN THE fall of 1920, my attention was called to some diminutive globular objects that were lying on the ground under a large white oak tree (*Quercus lobata*) and that appeared to be possessed with life. They were about the size of and looked like mustard seed. Upon gathering a few in the palm of my hand and examining them, I was led to the conclusion that they were indeed some kind of seed, notwithstanding the fact that the locality possessed no plants that produced seeds similar to them, either in size or character. Still more mystifying was the circumstance that upon the slightest disturbance they jumped or hopped about in a surprising manner. They had, of course, no legs or other appendages, yet they could jump to the height of half an inch and twice as far horizontally in a way very suggestive of the actions of that disagreeable little pest, the flea.

"What are they?"

This was the inquiry of all who saw them, but there was no answer, for no one present knew, or had ever seen them before. Their vegetal appearance and jumping proclivities, it was generally admitted, suggested that they must be somewhat akin to the Mexican jumping "beans," so for some time afterward they were generally referred to as "jumping seeds." Though conceding that appearances afforded some justification for it, I was not entirely satisfied with the conclusion. If these curious little things were seeds, where was the mother plant? If they were not seeds, what could they be? The problem must be solved, but to whom should we go for help,—the botanist or the entomologist?

We addressed individuals, far and near, but no one had ever heard of the seedlike objects. At the end of about a week or ten days, my specimens be-

came inactive. Therefore, very soon after I began my campaign of investigation, I could only describe their capacity for jumping, being unable to produce ocular evidence of the fact. From the incredulous stares I received, I was not sure whether people thought I was just mistaken in my observations, or was musing up Mark Twain's well-known story of the "Jumping Frog of Calaveras."

Days and weeks passed and no headway was made in solving the mystery. Months before, when I first obtained the strange objects, I had opened several but the contents then appeared nothing more than shapeless plant tissue. I resolved, however, again to examine the interior of one. On opening a "seed" I was surprised to find within it a small winged insect. It proved to be one of the Cynipidæ, belonging to the Hymenoptera, an order that includes the bees, ants, wasps and saw flies.

With the statement that the Cynipidæ are among the "makers" of the oak tree galls, the significance of this identification will be more clearly understood. These insects to the uninitiated look more like little flies than wasps, hence they are sometimes referred to as "gall flies" but, correctly speaking, they are "gall wasps."

My son Ed, who had also been interested in the effort to identify the little stranger, said, "If the structure that housed the insect is an oak gall, the material composing it should contain tannic acid." Acting on the suggestion, the pieces were submitted to a chemical test, and a strong reaction was obtained, showing the presence of the well-known acid. As a result it seemed almost beyond question that the queer little globular things were minute oak galls, although,

of course, the chemical test was not conclusive.

It was now in the spring of the year when the oaks were just beginning to put forth their new leaves and therefore too early to find any galls. The winter storms and winds had destroyed or swept away all the leaves of the preceding year, so there was nothing to do but wait until the new leaves were developed and the gall wasps of the season had pierced the tissue of the foliage in the egg-laying act. It is this operation that causes the growth of the gall.

While considering these circumstances another question arose: how did the galls found on the ground in the previous fall become detached from the leaves of which they were apparently a part? A little thought afforded an answer. The fallen leaves were raked up daily and carted away; the galls were found in greatest number where piles of leaves had been. Apparently the operation of raking detached many of the galls from the leaves. In this connection it should be noted, however, that this gall is probably not dependent on artificial means for a separation from its leaf. Mr. Charles V. Riley states of either this or a closely related gall:¹ "It falls from a cavity on the under side of the leaves, very much as an acorn falls from its cup, and is sometimes so abundant that the ground beneath an infested tree is literally covered."

It occurred to me that there was another test to which I ought to subject the little jumpers before finally abandoning the theory that they were "seeds." Therefore a number were placed in moist earth and another lot between moistened blotters, and such

¹*Proceedings of United States National Museum*, Vol. V, p. 634.

careful attention was given them that had they been seeds, some of them at least would have exhibited evidence of the fact by sprouting. Not a sign of germination appeared. On the contrary, in about two weeks the little spheres were wholly enclosed in a covering of fuzzy mildew.

About the time I subjected some of the supposed "seeds" to a germinating test, I gave others to my son, to breed out the insects they presumably contained. In the last part of June, upon making an examination of the condition of these "seeds," we were pleased to find that one of them was ruptured and had given egress to a diminutive four-winged insect, in all respects exactly like the one I had found some weeks previously. Upon opening another "seed" and finding that it contained a pupa, we returned the remainder of the "seeds" to their cage, but no more insects made their appearance.

The jumping phenomenon¹ is not the only feature of interest in relation to the gall and its occupant. Some of the later things discovered regarding it were nearly as surprising. I found that the little wasp, when it had reached the stage of maturity and was ready to be released from the confines of the gall, completely filled the interior, much as a young chicken when about to hatch fills the egg. The walls of the gall are thinner than the shells of eggs, a condition that enables the wasp to escape by bursting them apart. This circumstance is remarkable, in view of the fact that so many of the inmates of the larger galls bore holes through their vegetal prisons and thus gain egress to the outer world. In a

number of such instances, the galls are many times the size of their respective insect occupants, whereas the wasp of the jumping gall looks larger than the gall whence it came.

In addition to the detached galls, specimens still fastened to the leaf were necessary to the investigation. Soon after the oak trees commenced to send forth their leaves, I began to examine them for the coming of the little curiosities, but it was well along in the month of May before I found any promise of success for my efforts; then I began to find here and there, as I had expected, on the underside of the new leaves, little spherical excrescences, that in the course of a few weeks assumed the exact shape and exterior peculiarities of the "jumpers."

Gratifying as this was, I had yet to find galls in the active or jumping stage to show that the diminutive growths on the leaves and the jumping "seeds" of the previous season were one and the same thing. When this should be accomplished, my discovery, if discovery it was, would be ready for announcement. However, encouraged though I was to believe that something new in nature's work was about to be given publicity, I could not altogether avoid the thought how strange it was that such an unusual occurrence in nature should have heretofore escaped all notice.

As it must be the life within the gall that supplies the force for its peculiar activities, I reasoned that the larva upon emerging from the egg would have to grow and gain the necessary strength before it could make its habitation hop about in response to its sudden movements. Of course I did not know at what time that stage would be reached. I could only watch and wait for it. It was in the

¹In *The American Naturalist*, Vol. X, p. 218, Mr. C. V. Riley is quoted as saying that "The insect within can make it [the gall] bound twenty times its own length."—EDITOR

early part of October of the previous year when the galls were discovered jumping about on the ground, but how long prior to that time they had possessed the power of such activity was not known to me.

Beginning with May, the oaks were visited periodically, and on each occasion, a number of the galls were detached from the leaves and given every opportunity and encouragement to exhibit their active powers. These visits continued into November, without my finding a single jumping specimen. The leaves were falling freely from the trees and it was no trouble to collect a quantity of the galls, but it was impossible to find one that I could take into the court of science as a witness to the truth of my claims.

I was beginning to doubt the accuracy of my observations of their jumping capacity made in the previous fall when it occurred to me that the workman who raked up the leaves from under the oak trees on the golf course would have seen the galls in their active stage, if such a thing were observable. Therefore I asked him.

"Do you mean them little seed things that hop like fleas?" was the comforting response.

When told that was what I was looking for, he said he had not seen any this year but he had seen "lots of 'em before."

That settled it. I had not been dreaming, and I was still on the highway to fame, though it will be seen soon that I was to be unceremoniously ditched by a large immovable obstruction labeled: "Known for Fifty Years."

From the date of the conversation above related to the coming of the winter storms that destroyed or carried away the foliage of the trees, I gave much time to trying to solve the

mystery, why the little galls that were so active the year before were immobile this season.

The life cycle of the Cynipidæ, like that of other Hymenoptera, embraces four periods,—those of the egg, larva, pupa, and imago or adult. As the egg and possibly the pupal periods represent inactive stages, it seemed to me probable that it is during its existence as a larva that our little cynipid imparts the jumping feature to the gall that encloses it;¹ the presumption that the insect abandons the home of its youth as soon as it reaches maturity would exclude the adult stage from consideration.

After I had arrived at this conclusion, the only question remaining was, why do not the insects cause the galls to hop this year as in the past? With the hope of discovering an answer, I collected and opened dozens of the little galls from day to day until the close of the year, when no more were to be found. The result of this investigation, I think, solved the mystery, for of all of the galls examined, only in one specimen did I find a larva that was alive. In this exceptional case, the larva was emaciated and feeble. If the insect in the gall is dead or moribund, obviously the movements that make the gall such an interesting object cannot take place. But what was the cause of such a remarkable fatality? That I could only conjecture. Possibly some

¹In the *American Naturalist*, Vol. X, p. 218, Mr. C. V. Riley states: "The motion [of the gall] is imparted by the insect in the pupa and not in the larva state." Later, however, he abandoned this view, for in the *Proceedings of the United States National Museum*, Vol. V., p. 634, he writes: "The bounding motion is doubtless caused by the larva, which lies curved within the gall, and very much on the same principle that the common cheese-skipper (*Piophila casei*) is known to spring or skip. Dr. W. H. Mussey, of Cincinnati, in a communication to the Natural History Society of that city, December, 1875, states, in fact, that such is the case; though members of the California Academy who have written on the subject assert that the motion is made by the pupa, which I think very improbable." Reprinted also in *Annals and Magazine of Natural History*, Vol. XII, Fifth Series, p. 142.—EDITOR.

parasitic enemy prevailing in overwhelming numbers, or the occurrence of weather conditions fatal to their existence, or a combination of both may have been responsible for the seemingly unusual circumstance. It is not uncommon in the insect world for certain species to appear at times in unusual numbers, then to become so scarce as to be difficult or impossible to find.

When the winter storms closed the opportunity for further investigation, as well as ending the possibility for that year of procuring any jumping galls to show persons whom I had interested in the matter, I was somewhat disappointed and a trifle chagrined, feeling that the accuracy of my statement as to the remarkable actions of the galls would not be accepted until the animated galls could be produced to prove it. However, I was soon relieved of further anxiety regarding the matter in an unexpected manner.

Through my friend, Mr. G. S. Radford of New York, who enlisted the kind services of Dr. Frank E. Lutz of the American Museum, I was brought into touch with Prof. A. C. Kinsey of the University of Indiana, who was at the time engaged in making a detailed study of the gall wasps of the Pacific Coast, working on collections that he had made two years previously. Consequently he was not only familiar with the jumping gall, but was in a position to refer to the literature bearing on the subject of this particular gall. His kind and prompt communication informed me that the gall had been brought to the attention of scientists nearly half a century ago. An account of it appeared in the *Rural Press* of San Francisco in 1874 with the description by Henry Edwards

attached, and it was written up in certain scientific publications two years later by Prof. C. V. Riley. Its name, Professor Kinsey stated, is *Neuroterus saltatorius*.

In his letter he added: "Your gall has been recorded in literature from only Stockton and Marysville, California, though I have species from a number of other localities. It is confined to the Pacific Coast." He also said that related species occur elsewhere in the United States, particularly in Florida, where similar behavior is found in the cynipid gall, *Andricus saltitans*.

In closing his letter he said: "Your observation of this insect has indicated an unusual degree of interest and perseverance in the rather difficult task. I hope that you will not let the fact that the species is already known to science deter you from making further observations."

After some search in the public libraries, the account of the discovery of the jumping galls, referred to as having been published in the San Francisco *Rural Press*, was found. As it is not only the original but the most comprehensive description of the gall and the insect that has appeared in print, so far as I can ascertain, it is reproduced in full herewith:

"FLEA SEED," CYNIPS SALTATORIUS

We present this week the engraving of an insect and shell from which it emerged, for the purpose of showing our readers an object which has attracted considerable attention for the past year or two in the state.

They were first brought to notice by the curious jumping qualities possessed by what was supposed by some persons to be mustard seed, and many theories were advanced as to how the thing was done, some of which were quite amusing.

The "seed" from which the insect was obtained was gathered with a number of others, under an oak tree on the ranch of

Mrs. H. Wilder about eight miles from Marysville, by Mr. F. W. H. Aaron of that city and by him sent to Mr. Hanks, President of the San Francisco Microscopic Society. The matter was referred to Mr. Kinne for examination, who has followed their development



A reproduction of a woodcut originally published in the *San Francisco Rural Press*, showing the jumping gall and the insect that emerged from it

through to the perfect insect, and from his report we collect the following:

The gall or cocoon is found lightly attached to the leaf of the oak and in time falls to the ground, where the noise occasioned by the thousands that are leaping about without any apparent cause or organ of motion, sounds much like the falling of fine rain on the leaves. An examination shows that the extraordinary activity displayed is caused by the spasmodic contraction and concussion of the abdominal parts of the occupant against the side of the shell (enclosing it), which movement does not cease even after the covering is nearly split in halves, if the tender structure of the crysalis be not injured. That it is the crysalis and not the larva has been shown by the microscope, and its change to the perfect insect has been noted at weekly stages.

The average length of the insect is five hundredths of an inch, and in each have been found from sixty to eighty pear-shaped ova. The engraving gives its general appearance

with wings raised somewhat unnaturally, for the purpose of showing their size and shape. It was drawn by Mr. Kinne and enlarged twenty diameters. Its ovipositor is a tiny, though perfect, piece of nature's mechanism and lies encased in a sheath at the lower part of the abdomen. At a recent meeting of the "Microscopic Society," Mr. Henry Edwards furnished a report giving the following technical description of the curiosity:

GENUS CYNIPS—L CYNIPS SALTATORIUS
(nov. sp.)

Black, shining. Head broad between the eyes, which are very prominent. Antennæ 14 jointed, the 1st and 2nd joints being much swollen, and the 3rd joint longer than the other two, the remaining joints are long, simple and nearly equal. Thorax densely but finely punctured, very globose in front, projecting so far as to almost hide the head. Abdomen globose, shining. Ovipositor cases short, spatulate received into marginal groove in the body. Ovipositor itself flesh color, curved inwardly toward its middle. The abdomen is six-jointed. Terminal joint of palpi, hatchet shaped. Tarsi very hairy throughout, the anterior pair with six and the remainder with seven joints. Coxæ very globose. Tibiæ long, with large and powerful spines at the base. *San Francisco Rural Press*, February 2, 1874.

The writer has been asked a number of times if the jumping galls are not analogous to the Mexican jumping "beans." There is not only a great difference in size, but there is an altogether different origin and character of growth. The former is an excrescent of the epidermis of an oak leaf, and the latter is a seed, but the peculiar activities of both arise from a similar cause, both being inhabited by insect larvæ, one the larva of a member of the wasp family, the other the larva of a moth. The activity of the gall is apparently confined to a short period, thought not to be longer than a fortnight, but the movements of the "beans," it is said, last for several months.

NOTES

AFRICA

MARTIN JOHNSON'S PICTURES OF AFRICAN GAME.—Although many remarkable pictures of the animal life of Africa have been brought back by those who have visited that continent, those recently obtained by Mr. Martin Johnson are entitled to special praise. The excellence of his results is due in part to technical skill and the power of the long-focus lens in producing close-up views of remarkable clearness, but at least in equal measure the quality of these pictures is attributable to the purposes and spirit of the leaders of the expedition,—we say leaders because Mrs. Johnson's pluck, marksmanship, and dependable aid in the moment of danger made it possible for her husband time and again to venture into positions that otherwise would have exposed him to great danger.

Mr. Johnson went to Africa not with the sportsman's purpose of bringing back heads to hang on the wall or furs to stretch on the floor. He went there to get the best possible records of animal behavior. It was with the camera rather than the gun that he bagged his game. His pictures give every evidence that he killed animals only when they were needed for food or when he was imperiled by their furious charge and there was no other way of stopping them. With the interest focused on the animals themselves, there is in his pictures a commendable absence of the extraneous and the preposterous. Mr. Johnson spared no pains to obtain pictures that should be natural and enlightening. As an example of his care and patience, he built within a radius of forty miles no less than fifty blinds of thorn and stone to hide his cameras for close-up work, and then waited many weeks for the animals to get used to them. He was finally well rewarded, as those who have seen the results of his photography will testify.

The descriptions that accompany the pictures are informing. Through them we learn that no two zebras are marked exactly alike, that the oryx is capable of impaling a lion on its rapier-like horns, that the giraffe can deliver a death-dealing stroke with its powerful fore feet, that the ostrich never hides its head in the sand, that the rhino cannot see clearly for more than thirty-five yards. So much misinformation still exists regarding

animal behavior that it is a pleasure to witness a series of films that far from perpetuating error, or more damaging still, swelling the total of untruths, succeeds in presenting unchallengeable facts about animals.

Both the captions and the pictures have been censored by Mr. Carl E. Akeley, who has placed at the disposal of Mr. Johnson his extensive knowledge of African wild life, and by Mr. George H. Sherwood, curator of public education in the American Museum. The films are endorsed by the American Museum as a scientific record of the free wild animals in Africa in their native haunts. When the pictures were shown at the American Museum on March 9 the total attendance was 4098,—representing more than twice the seating capacity of the auditorium. Mr. Johnson kindly consented to show the film a second time and a number of those who could not gain admission at first waited till ten o'clock for the privilege of seeing the films.

Mr. and Mrs. Johnson spent two years in securing the pictures. Their route extended from the Thika River, near Nairobi, where they organized their safari (African for expedition,—across the equator, past snow-capped Mount Kenia, through waterless stretches of the Gusoot Desert, on to the goal of their exploration), a lake near the Abyssinian border, which, because of its soul-satisfying beauty, they rechristened Lake Paradise.

Mr. Johnson has traveled in the outlying parts of the world for more than twenty years. Originally a member of the expedition of the "Snark" in company with Jack London, he has since voyaged in the South Pacific, believing it the region of the greatest appeal. Today Africa has supplanted the South Pacific in his affections and he is contemplating a return to that continent for a sojourn of five years, to be devoted to the working-out in pictorial records of the life histories of many of its native animals.

ANIMAL LIFE OF THE HIGHLANDS OF THE GREAT CRATERS.—Although the so-called "craters" of the moon reach a size that makes even the largest craters of our earth seem insignificant in comparison, a crater that has a diameter of twelve miles and the circumference of which, measured along the unbroken

ring of cliffs that rampart it, is believed to be about thirty-five miles, may well fill one with awe. Ngorongoro in Tanganyika Territory (formerly German East Africa) is spoken of as such a crater and, though it is the largest formation of its kind in the area and rivals if it does not surpass in size the crater of Asosan in Japan, it is but one of several similar mountain-girt enclosures that have earned for the region the name, Highlands of the Great Craters.

In the days when, it is thought, the lava boiled in Ngorongoro and an incandescent glow rose at night from the fiery molten matter, the spectacle must have been magnificent. Today, however, there stretches over the surface of Ngorongoro a rich grassy carpet, and on its floor is revealed a scene very different in kind, it is true, but not less impressive than that which would be presented by volcanic activity. Ngorongoro is today the pasture ground of vast numbers of the great browsing animals, as well as a stalking place for many of the clawed beasts of prey that in this remote area, safeguarded by the forbidding character of the surrounding country, still enjoy a degree of immunity from attack by man.

Mr. T. Alexander Barns, who was apparently the first to present an account of the region in English¹ and who has been lecturing regarding it before American audiences, speaks of the extraordinary abundance of animal life in Ngorongoro and in other parts of the general area. His descriptions conjure up a picture as replete with moving herds as our own western plains before the railroads laid an iron grip upon the romping grounds of the bison and the antelope. Mr. Barns saw "thousands of blue wildebeeste and thousands of zebra"; in fact, so great were the herds that notwithstanding the ample expanse of Ngorongoro, there was in many places what he describes as a "crush of game." Although "not filling the landscape to the extent that the gnu and zebra did," there were many other animals. Kongoni hartebeeste and Thompson's gazelle were present in abundance, as well as the rhino, Grant's gazelle, Chandler's reedbuck, oribi, lion, cheetah, hyena, jackal, baboons in bands of a hundred or more, ostrich and many smaller birds.

It is to be hoped that, with the example furnished by other parts of Africa of rapid

¹"The Highlands of the Great Craters" by T. Alexander Barns, *The Geographical Journal*, Vol. LVIII, No. 6.

and ruthless extinction of game, this area, apparently one of rarely surpassed richness in respect to its fauna, may be properly conserved.

ASIA

THE FAUNTHORPE INDIAN EXPEDITION.—The reports by letter and by cable that are reaching the American Museum from Mr. A. S. Vernay, joint leader of the Faunthorpe Indian Expedition, indicate that the purposes of the expedition are being progressively realized, complete material for several of the groups planned, such as the nilgai, swamp deer, and chital, having already been collected.¹

Early in February the expedition reached Bhopal State, where Mr. Vernay had the good fortune to secure specimens of the exquisite little chinkara gazelle (*Gazella bennetti*). This graceful animal is only about two feet high measured to the shoulder and weighs in the case of the male about fifty pounds. Notwithstanding its small size it carries a fine pair of ringed horns; those of one of the specimens shot by Mr. Vernay measured eleven inches. All that is now needed to complete the chinkara group is a fawn, and this has been graciously promised by the Crown Prince.

A group of sambur (*Cervus unicolor*) is also assured. Just after dawn one morning Mr. Vernay obtained a male specimen of this the largest of Indian deer, which with its erectile mane and fine antlers presents a striking appearance. Blanford in his *Fauna of British India* says that any sambur antlers "over 35 inches in length are of good size." The antlers of the specimen shot by Mr. Vernay measure 42 inches. A doe and a fawn of the sambur will be readily obtainable, thanks to the helpful interest of the Crown Prince, and will round out the group.

In Bhopal State Mr. Vernay collected also a fine langur. He had occasion subsequently to watch a band of these long-tailed monkeys munching their meal while one of their number, a sentry, searched the jungle to detect the possible presence of their enemies, the tiger and the leopard. Impressed by the inoffensive behavior of this contented band, Mr. Vernay refrained from shooting.

Among the birds obtained by the expedition are "two very good floricans, spoonbills, gray hornbills, a rare ibis, and others."

¹See NATURAL HISTORY, March-April, 1922, pp. 193-94.

On March 19, Mr. Vernay cabled from Lucknow that by the gracious permission of the Maharajah of Nepal he had secured three exceptionally fine rhinoceroses,—two bulls and a cow. The Maharajah rendered invaluable service to the expedition, providing elephants and coolies for transport as well as the supplies required. In addition to the three rhinoceroses, which are particularly valued because of the fact that this animal is rapidly disappearing, a tiger, a tigress, and a bear were also secured.

AMPHIBIANS

At the Thirty-ninth Session of the American Association of Anatomists, held at the University of Chicago, March 28–30, Dr. G. Kingsley Noble read a paper on "The Carpus of Eryops and the Structure of the Primitive Chiropterygium." The paper was a summary of the embryological, myological, and palæontological investigations being carried on by Dr. W. K. Gregory, Mr. R. W. Miner, and the speaker. Although it is usually stated that the hand and foot were primitively five-rayed—that is, had five digits,—this synthesis of embryological and palæontological work showed conclusively that the earliest land vertebrates must have had a seven-rayed hand and a seven-rayed foot. The first, or inner ray, was a short, supporting prop, while the last, or outer digit, was also reduced in even the most primitive tetrapods. On the basis of these investigations, a comparison was made between the hand of the amphibian and the pectoral fin of certain fish—the probable ancestors of the land vertebrates. The gap between fish and land animals is not so great as usually believed.

Doctor Noble also spoke before the Biological Seminary of Princeton University, April 27, on "Some Observations on the Habits and Development of Local and Exotic Batrachians," presenting a summary of the field work and studies on amphibian embryology he made in Guadeloupe in 1914, in Peru in 1916, and in Santo Domingo as well as in the state of New Jersey during 1922.

EARLY MAN

THE NEW FOSSIL MAN OF JERSEY.—The reported discoveries of prehistoric human skulls in the Island of Jersey, England, and in Patagonia, have aroused widespread interest in the public press. Naturally until more definite information is received, nothing very satisfactory can be said about these finds.

Previous discoveries of prehistoric remains in the Island of Jersey include a number of molar teeth described by Mr. R. Marett and by Prof. Arthur Keith in 1911. These show in an extreme condition the lengthening of the tooth and the deepening of the pulp cavity that have also been seen in some of the Krapina (Croatia) Neanderthals. The teeth discovered in Jersey were associated with flint implements of Mousterian type. The new find is compared in the preliminary dispatches with *Pithecanthropus*; it is more probable that it represents a Neanderthal man. Sir Arthur Keith's report on this specimen will be eagerly awaited.

ALLEGED TERTIARY MAN OF PATAGONIA.—With regard to the Patagonian discovery, the outstanding feature is the statement that the skull was found in a sandstone of Tertiary age. The first matter of importance to palæontologists, however, is to ascertain the meaning of the term "Tertiary" as used in this connection. Many South American geologists and palæontologists, accepting the determinations of the late Prof. Florentino Ameghino, have referred to the Tertiary Age certain formations which, all northern palæontologists are agreed, were deposited in the Quaternary or even later times. Professor Ameghino reported the occurrence of several fossil human skulls in formations of relatively great antiquity in South America, but these specimens have been examined by Doctor Hrdlička, of the United States National Museum and other authorities, and they regard them as belonging to Indians. Northern geologists, also, who have examined the geological formations adjudged them to be much later than Tertiary.

If, however, the Tertiary age of this Patagonian skull should eventually be established, this discovery will not be so entirely revolutionary as might appear. The evidence for the Tertiary age of man in Europe is now being accepted by leading archæologists of Europe, and in this country Professor Osborn was one of the first to come to the support of Mr. W. Reid Moir, who has long held that the flints in the Red Crag and related formations of Pliocene age in southeastern England were of human make and not merely the accidental results of stream action and other natural forces upon broken fragments of flint. It was thought by some authorities, too, that the Vero man of Florida dated back to the Pliocene, although the weight of the testimony seems to indicate a later age.

COMPARATIVE ANATOMY

TWO IMPORTANT CONTRIBUTIONS.—“The Evolution of the Human Foot” is the title of an important paper by Dr. Dudley J. Morton in a recent number of the *American Journal of Physical Anthropology*.¹ Doctor Morton, whose studies have been conducted in the department of comparative anatomy, American Museum, presents strong evidence for the view that the structure of the human foot still bears the traces of its remote derivation from an apelike foot, with the ability to grasp the branches of trees. He shows that the feet of infant gorillas are more adapted for grasping and climbing, while the feet of the heavy-bodied adult gorillas, which spend most of their time on the ground, show significant advance towards a subhuman type.

Another article of interest to students of evolution is that on “The Piltdown Jaw,” by Dr. Aleš Hrdlička, in the same journal. The author has recently studied this famous specimen in the British Museum in great detail. He concludes “that it is no longer possible to regard the jaw as that of a chimpanzee or of any other ape, but that it is the jaw of a human precursor or of very early man. Dr. Smith Woodward’s designation of this form as being from the dawn of the human period seems very appropriate.”

ERWIN S. CHRISTMAN

The late Erwin S. Christman’s bronze group of two running horses, called “The Rivals,” a copy of which is on exhibition in the new hall of horses, American Museum, continues to receive deserved recognition in the art world. Several prominent sculptors have recently given high praise to this spirited group, and the two leading bronze dealers of the city have put it in a position of honor in their collections.

MAMMALS

FIELD WORK IN ECUADOR.—Mr. G. H. H. Tate, who for two years has been collecting mammals in Ecuador for the American Museum, is on his way to that country, after a brief sojourn in New York, to resume his field work. His plan, subject to modification as circumstances may dictate, calls for an extended period of hunting and trapping as well as the gathering of scientific data in selected areas of Ecuador. As much of this

¹*American Journal of Physical Anthropology*, Vol. V, No. 4, October-December, 1922.

program as possible will be undertaken during the coming twelve months. He expects to work on the coast, traversing first the arid Manta region, where are located Monte Cristi and Jipijapa, famous as the producing centers of the best Panama hats, and then the moist coastal region that lies beyond and that becomes increasingly humid as one moves north. Possibly he may work as far north as Pata de Pajero, a mountain of undetermined altitude near Pedernales and the probable high point in the coastal range that backs the shore line of Ecuador. This whole area has been explored zoologically to only a trifling extent and though it may be predicted with reasonable certainty that animals like the ocelot, raccoon, coatimundi, agouti, and paca will be found there, the real character of the fauna in its completeness is a thing still to be revealed.

Another region to which Mr. Tate will devote attention is that of the mountainous country about Quito, with special reference to some of the principal type localities like Santo Domingo, Rio Pita, and Cayambe, the purpose being to complete the collections from this area and to round out and verify the classical data of earlier workers.

Papallacta, representing the high paramo zone, will also be visited. It is here that is found the Ecuadorian *Pudu*, a little deer of great rarity. Mr. Tate will likewise work over the region that lies between Quito and Esmeraldas, which is almost unknown zoologically and is probably difficult to traverse, being for the most part a very humid area covered with heavy vegetation. Finally, the plan provides for a visit to the densely forested Amazonian country in the neighborhood of the isolated mountain, Sumaco, which rises to a height of 13,000 feet. Here it is hoped that material new in character may be secured.

BIRDS

A BOATLOAD OF PEALE’S PETREL.—The capture of the fourth known specimen of Peale’s petrel (*Pealea lineata*) by the leader of the Whitney South Sea Expedition fills the last generic gap in the American Museum’s collection of Tubinares, the fascinating order of sea birds which includes the albatrosses, shearwaters, and Mother Carey’s chickens.

Nearly a year ago a member of the committee in charge of the Whitney Expedition closed a letter to Mr. Rollo H. Beck with the facetious comment, “Be sure to send us a



A boatload of Peale's petrel

boatload of Peale's petrel." On Christmas day, 1922, after the Museum's schooner, the "France," had returned to Tahiti from a long cruise among the Marquesas Islands, Mr. Beck replied, "Due to your kindness in not mentioning the size of the boat, I am able to comply with your request."

The meaning of this somewhat cryptic message was not clear until the consignment of Polynesian material was opened in the Museum in March. Then, in the middle of a large case of bird skins, a single Peale's petrel was found resting in a miniature outrigger canoe. Its appearance was hailed by the ornithological staff with such enthusiasm as ardent Egyptologists might show over the unwrapping of a new Pharaoh.

The first specimen of this rare petrel was obtained by Titian R. Peale at Upolu, of the Samoan group, during the celebrated United States Exploring Expedition of 1838-42, and was described and figured by Peale in his excessively rare volume on the birds and mammals collected by that expedition, which was published in 1848. The type skin is still in the National Museum at Washington. Since the original discovery of the species, three additional examples have been taken. Two of these are from New Zealand waters, and are preserved in the Paris Museum and the British Museum respectively. The fourth

specimen, which has been removed from its canoe to one of the dust-proof steel cabinets of the American Museum, is a female which Mr. Beck collected off Huapu or Adams Island of the Marquesas group, in September 1922. Like Peale's example from Upolu, it seems to have been a nesting bird.

—R. C. M.

COLLECTING FOR MUSEUMS VERSUS DESTRUCTION FOR SPORT OR GAIN.—An inventory of the bird collections of all the museums in the world is now being made by Dr. T. S. Palmer of the United States Biological Survey in the National Museum. While the figures are still far from complete, Doctor Palmer says that in all the museums of the world there are preserved about three million birds, of which a million, perhaps, are found in the museums of the United States. These figures are only approximate, but they enable us to contrast the use of birds for scientific purposes during the entire past century with the *destruction* of birds in a single year for purposes of the sportsman and market hunter. For example, in the state of Minnesota alone, from a million to two million ducks and geese are killed in a single year. Probably many times this number are killed in the United States and in the world at large each year for the market, a total vastly exceeding that of the specimens collected for scientific study in a whole

century. This is certainly sufficient answer to those who criticize collecting for museum purposes.

FISHES

FLYING FISHES AND AËRONAUTICS.—A three-page note on "flying fishes and soaring flight" by Dr. E. H. Hankin in the *Proceedings of the Cambridge Philosophical Society* (February 8, 1923) mentions facts which, the author concludes, "indicate that the flying fish is likely to be a useful guide in attempts to achieve artificial soaring flight." He also expresses the opinion that "the flying fish is by far the most efficient of existing soaring animals in respect of power of carrying weight in a horizontal direction."

It may be appropriately mentioned that this heavy loading per unit area of wing surface possessed by flying fishes is also stressed in a paper of similar tenor and somewhat wider scope by R. E. Dowd, entitled "The Aëronautics of the Flying Fish," which was based on an examination of material in the American Museum, read before the Aëro Club of Ithaca, New York, December 16, 1920, and published in the *Aërial Age Weekly*, January 10, 1921. Both authors note the under surface projection of the ribbing of the flying fish pectoral as a detail of soaring efficiency.

It cannot but be gratifying to ichthyologists to see the study of fishes playing a part in the coming of man's mastery of the air, and to see the flying fish accorded due honors.—J. T. N.

"THE ELASMOBRANCH FISHES," BY J. F. DANIEL.—The University of California is to be congratulated on a recently published book entitled *The Elasmobranch Fishes*, by J. Frank Daniel, professor of zoology in the university. Elasmobranch fishes comprise sharks, skates, and rays. Skates and rays are essentially sharks with a specialized flattened body form.

Professor Daniel's book is a monographic review of the anatomy of sharks, which are the most primitive true fishes, those which have inhabited the earth since the earliest times and which are unquestionably ancestral to all more highly specialized forms, that is to say, the entire vertebrate phylum from mud-fish to man. To know of them is, therefore, of the greatest interest, and this authoritative, comprehensive work on their structure is correspondingly important. Along with an essentially primitive character, certain members of the group show structures which are of

interest because of their high degree of specialization, for instance, in the reproductive system. In an advanced embryo of the butterfly ray, a viviparous species, villi from the uterine wall of the mother enter the spiracle and supply nutriment direct to the digestive tract, as can be demonstrated by opening up the digestive tract of the embryo. In certain rays there is present an electric organ by means of which electric shocks can be generated. This is one of the most highly specialized organs found in the animal kingdom.

The seven-gilled shark of the Pacific Coast, one of the most primitive living species, is used as a standard for comparison, in each of the eleven chapters of the book treating of the structures and anatomical systems of sharks. At the close of each chapter there is a carefully prepared bibliography, making of the whole a useful key to unlock the considerable and important literature bearing upon the group. The work is thus simply and well arranged for reference. It is profusely and most attractively illustrated. In its appearance as well as in its substance the book is one in which all concerned may well take pride.

LOWER INVERTEBRATES

LOWER INVERTEBRATES FROM BRITISH GUIANA.—Through the kindness of Mr. Herbert Lang and Mr. William J. La Varre the department of lower invertebrates, American Museum, has come into possession of a total of 1078 specimens collected during Mr. Lang's recent trip to British Guiana. Most of these specimens were taken from 150 to 180 miles inland, at such localities as Kama-kusa, Kurupung, and Meamu in or near the area of the Diamond Workings, but some were obtained at Georgetown and Bartica. Included in the collection are 458 mollusks (of which the greater number are land snails), 268 crustaceans (among which the isopods are of especial interest), 292 myriapods, and 41 annulate worms. Particularly valued, because of their rarity, are 16 specimens of *Peripatus*, a group of invertebrates occupying, it is believed, an intermediate position between the segmented worms and the true arthropods. This collection supplements in an effective way that recently donated by Mr. William Beebe from the region of Kartabo, in which a number of estuarine forms find place. The isopods of both collections are being studied by Dr. Willard G. Van Name, who is

preparing a *Bulletin* regarding the isopods of the West Indies and of South America as represented in the collections of the American Museum.

INVERTEBRATES COLLECTED BY THE CANADIAN ARCTIC EXPEDITION.—A notable addition to our knowledge of the invertebrate animals of the arctic regions has been made in the Report of the Canadian Arctic Expedition of 1913-18, led by Vilhjalmur Stefánsson and Rudolph M. Anderson, that is now being published by the Canadian Government. Volumes VII, VIII, and IX of the Report (in which most of the invertebrates—exclusive of the Insects, covered in Volume III—collected by the expedition are dealt with) have been appearing in parts, but the completion of the volumes may be expected soon.

The fauna of the arctic regions had already been too extensively studied to allow of the discovery of new species in large numbers, but much was learned regarding the distribution of forms already known, especially in the region lying north of western Canada and Alaska, the fauna of which had been little investigated. The articles dealing with the various groups have been prepared by more than thirty zoölogists, mostly of the United States and Canada, a number of whom have gone much beyond a mere description and discussion of the material collected by the expedition and have prepared reports that are of much wider interest. Among these may be mentioned that of A. E. Verrill on the Aleyonaria and Actinaria, which is profusely illustrated and deals with many species that range south along the New England coasts; those on the marine and parasitic copepods by Arthur Willey and Charles B. Wilson respectively, the former for its numerous descriptions and illustrations, and the latter for its lists of all the known parasitic copepods of the Polar regions; that on the Gephyrea by Ralph V. Chamberlin for its complete bibliography of the group; and that on the Euphyllopoda by Frits Johansen for its descriptions and for its information on the habits and ecology of the species considered.

ANTHROPOLOGY

FRANCISCO GONZALES GAMARRA AND HIS ART.—For some time there was on exhibition in the Southwest Indian hall of the American Museum a collection of water colors, pen and ink drawings, and etchings by the Peruvian

artist, Francisco Gonzales Gamarra. Señor Gamarra is a master of color effects, using his pigments daringly but without overstepping the bounds of good taste or producing a color combination that is other than harmonious. Doubtless his art has been influenced by his study of the decorative work of the Incas, a subject which was the thesis of his doctorate, for in the ancient textiles and pottery of Peru there is a similar employment of brilliant yellows and reds. Indeed, several of his pictures are copies of designs derived from fabrics, pottery plates and water jars, wooden vases, and other ornamented objects in the museums or private collections of Peru.

It is in the portraying of Quichua Indian types that his art is perhaps at its best. In these Indians of nonchalant and graceful carriage, with their bright shawls and hats of unusual shape—the manner of dress and the ornaments worn being suggestive in this respect and in that of the Inca days—Señor Gamarra has found subjects that lend themselves to vivid portraiture.

Other pictures in the collection are the Cathedral of Cuzco, the best example of architecture left by the Spaniards; the Church of Santo Domingo, built on the walls of the Temple of the Sun; an unfinished sketch entitled "The Coronation of the Inca"; and a fine picture of a cowled monk deeply absorbed in reading a book, the somber simplicity of his brown garb in contrast to the rich inlay of blue mosaic that studs the walls of the room and the soft red of the brick flooring.

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THROUGH THE MUSEUM



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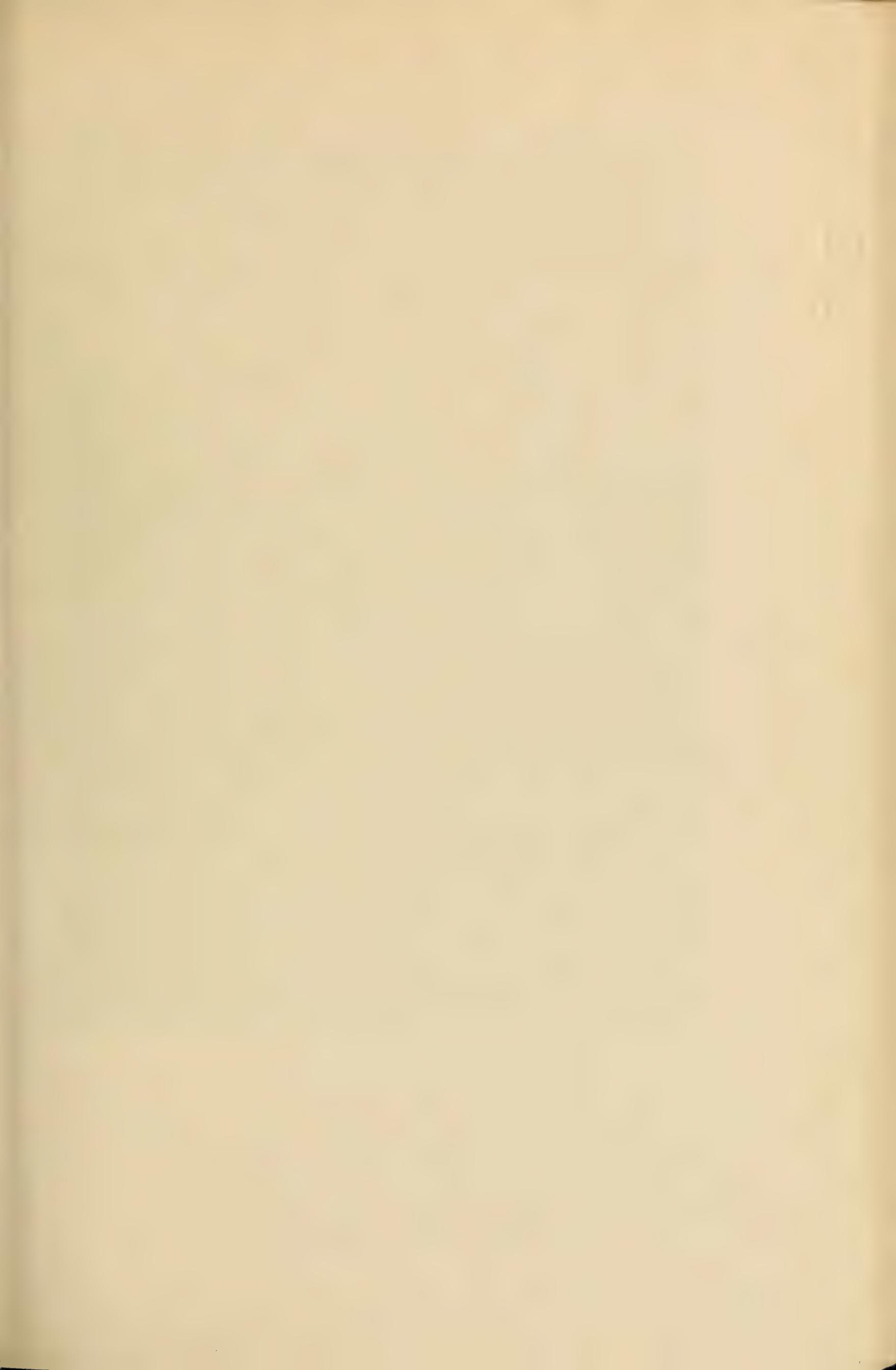
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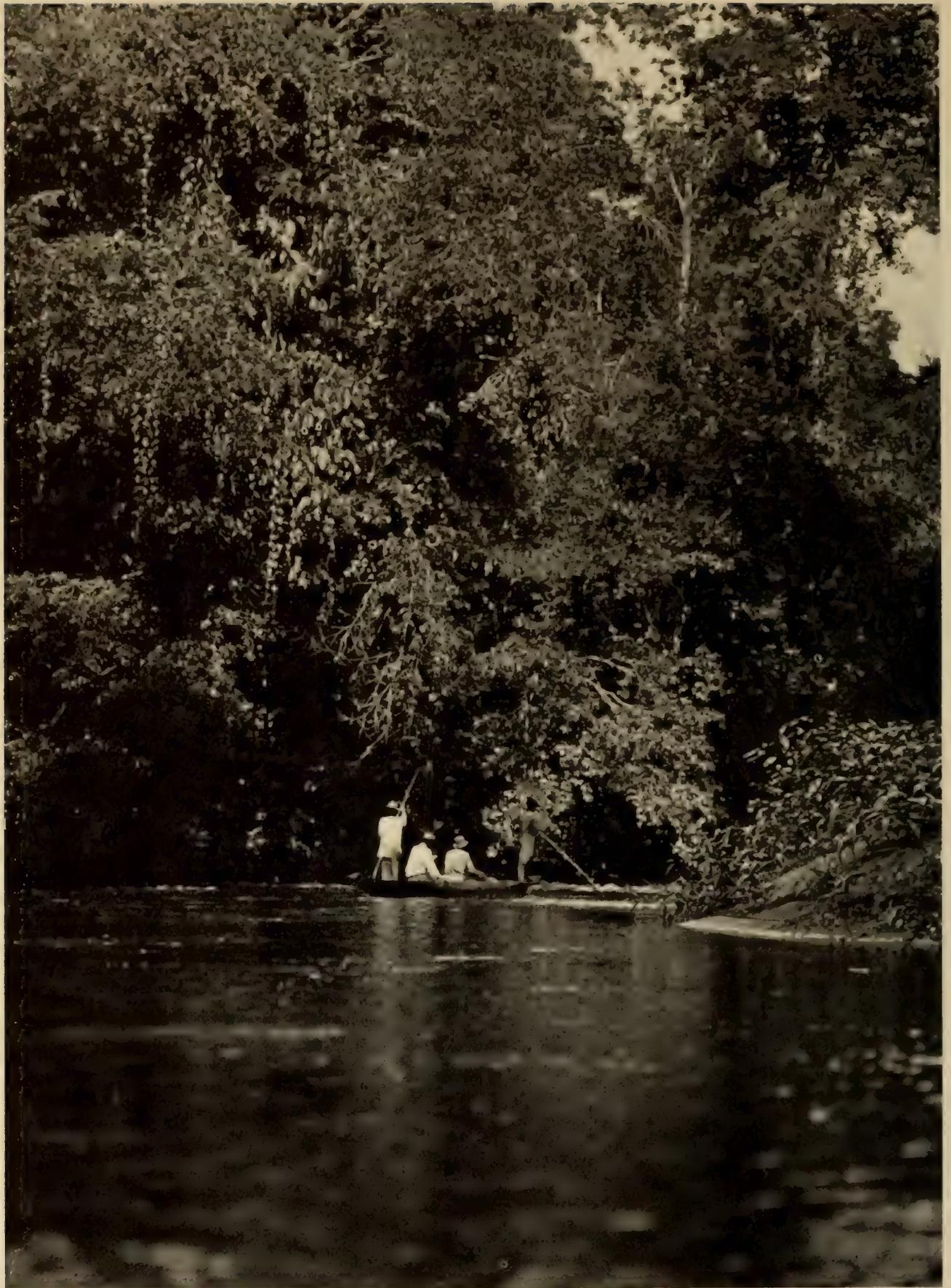
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THE RIO TUYRA, NOT FAR FROM BOCA DE CUPE

The Rio Tuyra flows across almost the entire width of the Isthmus of Darien. Its headwaters spring from the steep slopes of the Cordillera, which rests upon the Atlantic shore, and the combined tributaries discharge into a broad tidal estuary of the Gulf of San Miguel. It is the largest river in the Darien, and Balboa must have been in more or less constant touch with it or its affluents for most of his passage from Atlantic to Pacific. Our party ascended the Tuyra to the height of canoe navigation, leaving the waterway at Tapalisa. For all of this distance the river flowed through magnificent tropical jungle, the overhanging walls of which not infrequently converted our course into a shadowy corridor, with bats occasionally flitting ahead alarmed by our approach

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JULY-AUGUST

NUMBER 4

In the Footsteps of Balboa

BY H. E. ANTHONY

Associate Curator of Mammals of the Western Hemisphere, American Museum

ON September 25, 1513, Vasco Nuñez de Balboa, climbing to the top of a mountain on the Isthmus of Darien, discovered the Pacific Ocean. Keats, with a fine poetic disregard for the actual facts, credits Cortez with the discovery but draws a thrilling picture of the event in the sonnet wherein he writes:

Then felt I like some watcher of the skies
When some new planet swims into his ken,
Or like stout Cortez when with eagle eyes
He stared at the Pacific—and all his men
Looked at each other with a wild surmise—
Silent, upon a peak in Darien.

In the spring of 1915, I was sent by the American Museum to take charge of an expedition into the Isthmus of Darien and had an excellent opportunity to appreciate through personal contact the problems that confronted the intrepid Spanish explorer, since the itinerary of our expedition, throughout part of its extent at least, was in the footsteps of Balboa. However, while he crossed from the Atlantic to the Pacific, we entered from the Pacific and proceeded in the reverse order. Even today the passage of the Isthmus of Darien is not to be lightly attempted and one who has an understanding of these conditions can feel only the greatest respect and admiration for the hardy band of explorers who pushed their way into an unknown region, overcame every obstacle, and won through to their goal. In the story of Balboa the reader encounters the best of early Spanish exploration and few are the pages marred

by the blood-thirsty greed characterizing the epics of Cortez and Pizarro.

Our expedition took launch from the harbor of Old Panama for the Tuyra River to the southeast. I was accompanied by William B. Richardson, a veteran collector who had spent over thirty years in Central and South America, and by David S. Ball from the department of birds of the American Museum. At the outset we discovered that we had embarked upon a journey of surpassing interest.

The launch was a small one loaded to the gunwale with passengers and their baggage, so I found it expedient to stretch myself out on some of our collecting trunks on the deck where I was but a foot or two above the lukewarm waters of the tropic Pacific, which met the launch in a long rounded swell. A gentle languorous breeze brought off-shore the subtle odors of the dense green jungle, only three or four miles to the westward, and when night came on, the darkness seemed of velvet softness. From the forefoot of the launch, twin crests of softly hissing flame, bluish white in color, spread out in an ever widening V to mark our progress through the phosphorescent waters, while every moving organism left a similar luminous path. Small fish, alarmed at our approach, darted to safety at the head of cool lambent streaks which seemed to be ever pursuing. Tiny bits of marine life flashed in the depths and disappeared astern, while occasionally long, sinister shapes that streaked



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El Real de Santa Maria, old as age is reckoned in the New World and now living in its romantic past, is situated upon the high mud banks of the lower Rio Tuyra. The hot tropical sun beats upon the yellowed thatched roofs as the listless life of the community goes on; when the tide turns and the brackish current sets toward the sea, crocodiles crawl upon the brown shores

diagonally away from our path with the speed of torpedoes told us that the launch had surprised sharks on their patrol. The most beautiful effects were produced when a flying fish would break water and take to the air. From the black depths would arise a swiftly enlarging trail of bright bubbles which broke at the surface in frothing fire as the fish emerged, and then out over the waves his progress could still be followed by the falling drops of water, magically converted, when they met the ocean, into glowing pearls of light.

Sunrise revealed to us the fact that we were entering the Gulf of San Miguel, the mouth of the Rio Tuyra, at this point about five miles from headland to headland. It was on the lower reaches of this river and in this gulf that Balboa encountered much hardship when, after descending the

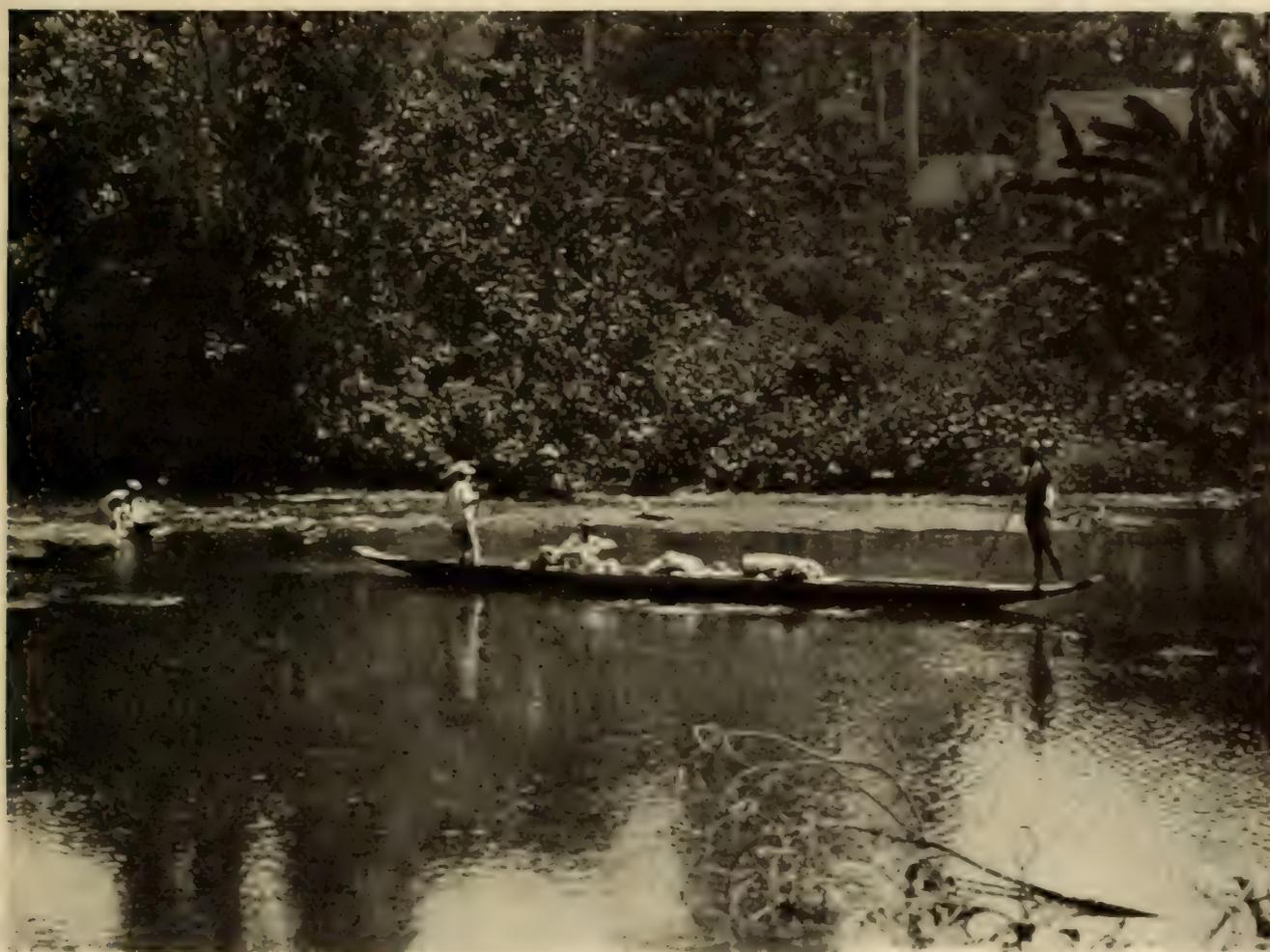
mountains, he drew near to the ocean he had discovered. The Spaniards in exploring the gulf, which Balboa called the Gulf of San Miguel because he had discovered it on September 29, the day of Saint Michael, were overwhelmed by a sudden storm and forced to seek refuge on a tiny island. Eventually they reached the mainland but only after trying adventures.

Up the Tuyra our launch ran for some hours, stopping to land passengers or cargo at little native villages of thatched huts. In the afternoon of the second day, after ascending the Tuyra almost to the head of tidewater and seeing it narrow from a stream several miles in width to one about one hundred yards across, we tied up at El Real de Santa Maria, situated at the junction of the Rio Pirre with the Rio Tuyra. If space permitted, the history

of El Real would be well worth relating in detail, for it was the principal stronghold of the Spaniards in the Darien for many years, serving as a base for the operation of the rich mines at Mount Pirre. It was attacked by the English on several occasions, once by a fleet of English vessels which sailed up the Tuyra from the Pacific. Two days by canoe up the rapidly narrowing river brought us to Boca de Cupe, a smaller settlement than El Real and now used as a base for present-day operations at the Pirre mines. Here our equipment was divided and part of it stored for future use, while the remainder was taken to the head of canoe navigation at Tapalisa.

On the night of our arrival at Boca de Cupe we were the guests at dinner of the principal Chinese merchant. He

gave us a very appetizing meal and one that was greatly relished after the snatches of food eaten in the canoes. I had seen many chickens running about his yard and so was prepared for the chicken stew which was the *pièce de resistance* of the meal. Near the close of the repast, during which I had been so preoccupied in listening to what our host had to say that I had paid little detailed attention to my plate, eating what was before me, I turned over a chicken leg for the meat remaining on it and discovered that the foot which was still attached had five claws; then I realized that I had eaten my first iguana. The iguana, a huge lizard, sometimes called the "chicken of the tropics," reaches in this region a length of six or seven feet. The Spaniards of Balboa's day had

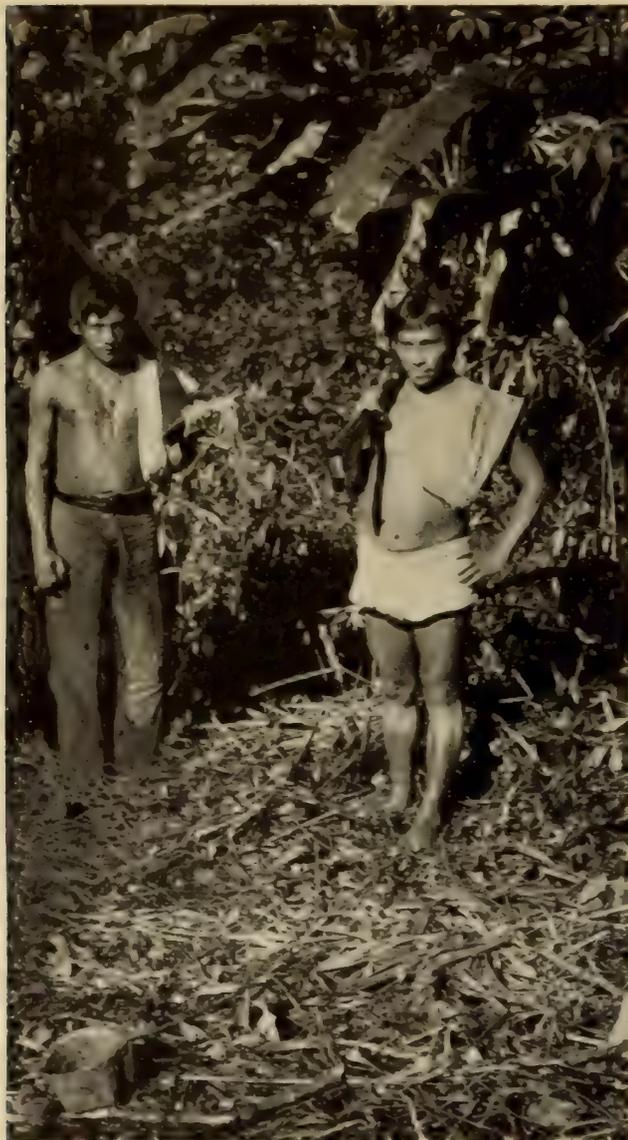


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The native dugout, or *cayuca*, is an admirable craft for the streams of the Darien. It would, perhaps, be exaggeration to say that the natives can run them over grass wet with a heavy dew, but they can work them upstream against a current seemingly navigable only to flat-bottomed ducks or shallow-draft eels.

also learned to eat iguanas and even crocodiles, which finally they came to esteem as a delicacy, although at first they felt repugnance toward them.

Another two days of paddling and poling from the Boca de Cupe, and we reached our final base of operations, Tapalisa, at the western foot of the



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Our guide to the deserted village of Tacarcuna was a sturdy Indian. He was accompanied by his son, who hid part of his pack the last day when he was tired of carrying it

Cordillera. This last bit of canoe travel was up streams which had become so shallow and swift that only expert river men such as our natives could have navigated them at all. The canoe of this region is dug out of a single tree trunk and has a long flat platform at bow and stern upon which the canoe men stand to use their poles

when working upstream against swift water. Thrusting their stout poles into the stream bed, the men walk toward the stern, forcing the canoe upstream under their feet. Then one or two of their number hold the dugout stationary while the other polers move forward for a new hold. A large dugout may be thirty feet or more in length and may be poled by three or four men, who can drive it against swift water over an incredibly shallow channel.

Mr. Ball and I left Richardson at the base camp, Tapalisa, and struck eastward for the crest of the Cordillera and the highest mount of the Isthmus of Darien, Mt. Tacarcuna.¹ We had been made most welcome by the Indians at Tapalisa, who gave us a large hut. After a consultation with the head man we had arranged for a guide and packers to carry our outfit. These Indians have many interesting customs and, because they frequently come into contact with the Spaniards from down river, have adopted many of the conveniences of civilization. I had no sooner arrived at Tapalisa and been received as a guest in the hut of the largest land owner there than he brought me a clock with the request that I make it run. Considering what might have happened to it, I feared that this might be a pretty tall order, but was relieved to find that a liberal dose of kerosene was the only tonic needed, for no sooner was this applied than the clock began ticking steadily and, since it was a German-made affair with fancy trimmings, thenceforth played a music-box tune regularly

¹Dr. Thomas Barbour, in a recent article in the *Geographical Review* of the American Geographical Society, calls attention to the spelling of the name of this mountain, which he gives as Tatarcuna, without citing his authority. As this spelling has not been seen on any map consulted by me, and following the pronunciation of the name given by the natives themselves, I have adhered to the spelling Tacarcuna as published in papers of the American Museum and of the National Museum



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At the last house on the river our packers assembled for the climb over the Cordillera. Spaniards, Indians, Negroes, and a dog or two made up the party, which required three days to cut a trail to Tacarcuna



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The huts of the Indians are constructed upon simple lines. The fastenings are all made with lianas or strips of bark and the walls are far from tight. The thatching, of plantain or palm leaves, keeps the rain out and the interior is dark and cool. The floor is of earth and the kitchen is where the fire is built; all about are piled wooden dishes, gourd receptacles, crude seats or benches, and baskets made of palm leaves. Dogs slink about underfoot, while above, tame parrots keep to a post of vantage, or demure parroquets nod at one another as they tread sideways along the paling of the walls



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One of the very characteristic birds of the Darien is the hang-nest or cacique, also called *oropendula*, a large, dark brown bird with bright yellow feathers in the wing and tail. The *oropendula* builds long, hanging nests and is sociable in its nature, many individuals living in the same tree

at twelve o'clock midday and midnight. I also saw a sewing machine in the corner of the hut.

What a contrast these conveniences represented to the condition found by Balboa when he passed from tribe to tribe! He, too, made some friends among the Indians, but had he shown them a music-box clock, the whole village would probably have rushed to the jungle for safety when the thing struck. However, at Tapalisa we left the last vestige of civilization behind and advanced into the primitive jungle.

We had a party of ten Indians, Negroes, and Spaniards, and the packs, made up to weigh from fifty to sixty pounds, were carried high up on

the neck and shoulders of the porters. At first the traveling was easy and over a good trail, which crossed the last level approach to the mountains. Finally we began to climb the slopes, the trail disappeared, and two men were detailed to go in advance with long brush knives, or machetes, and clear a path. We were in a splendid tropical jungle where luxuriant vegetation ran riot and where trails are overgrown a week after they are cut. Tall trees towered upward, overhung by vines and lianas draped in coils and festoons, while nearer to the ground the vagrant rays of sunlight which filtered through the mosaic of leaves above were trapped by an end-

less variety of shrub, palm, or fern. Orchids, bromeliads, mosses, and ferns grew along the limbs in crowded array, and moisture dripped unceasingly. Several times daily, short, violent, rain squalls swept the wooded slopes, pelting the foliage with a roar like a cataract.

Grotesque toucans with ungainly, painted bills, leaned forward from moss-enveloped boughs to yelp a discordant welcome; macaws flew by in pairs, shattering the quiet of the green forest below them by raucous, strident cries; parrots and parrakeets furnished the lighter motif in the jungle chorus when the diapason of the black howling monkeys heralded the onrushing storms; while solemn-faced marmosets peered cautiously through the protecting foliage, their wrinkled visages startlingly like those of diminutive old men. We shot parrots and guans as opportunity presented and ate them at nightfall. The reputation of the parrot for longevity was well substantiated by some of those we tried to eat, for prodigious boiling made no impression upon them. Once we surprised a small herd of peccaries, the little wild pig of the Americas, the animal which occasioned so much wonder among the Spaniards, who thought that its dorsal gland was its navel and consequently the beast was in part bottom-side-up.

Three days were required to reach the old deserted Indian village of Tacarcuna, three long, hard days of climbing and trail-making, days during which because of the dense vegetation we could seldom see more than thirty or forty yards from the spot where we stood. Only two or three times were we able to see through the forest fringing a ridge and to obtain a glimpse of the distant terrain. Long ascents were made, only to be lost when a valley had to be crossed; and the close, humid

atmosphere made us feel as if we were in a Turkish bath.

How well I could appreciate what such travel must have meant to Balboa and his companions! Forced by the hostility of the natives to wear some sort of armor, the Spaniards were compelled to travel at a great disadvantage. They early abandoned their armor of steel, replacing it by a protection of quilted cotton, which, although effective against New World weapons, must, nevertheless, have been very hampering on a march. The ticks, which infest the jungle and nearly drove us frantic, must have been a terrible scourge to Balboa's party, especially when they crawled beneath the armor. These miserable creatures hung upon the foliage in such numbers that one brushed off dozens of them in passing, and once upon the favorable background of our Negro cook's arm I saw a cluster of hundreds, which had dropped from a thicket of cane. Later on, one of our party was so seriously infected on the leg by tick bites that grave consequences were only narrowly avoided, and this notwithstanding the fact that we had a well stocked kit of modern antiseptics. The Spaniards knew of only one or two ways to combat infection; their chief reliance was a probe of the spot with a red-hot iron.

At the village of Tacarcuna we lived in a deserted Indian hut on the headwaters of the Rio Tapalisa, about 2500 feet elevation. Here we were in a region as wild as it was the day Balboa crossed the isthmus and through just such country as this he must have passed, although probably a little to the north of where we were. We had a variety of interesting experiences at this spot, not the least being the unexpected arrival of an Indian family who claimed to be the owners of the

hut and of the deserted garden area we had been ravaging. A state of mutual distrust and armed neutrality prevailed for several days until a party of our packers from Tapalisa arrived and among them one who could speak the tongue of the old Indian who was the

though the leaves dripped moisture with dismal regularity, it was very difficult to locate a spring or running water where a camp could be made. The historians note that this scarcity of water worked great hardship upon Balboa and is all the more surprising



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The interior of our hut at Tacarcuna. The natives sleep in hammocks, which are slung up out of the way during the day. A balcony, extending over about one quarter of the floor space was reached by a ladder made of a notched pole (the leaning pole just to the left of the hammock)

owner of the hut. This old Indian had never seen a white man, spoke no Spanish, and was so distrustful that he was in constant fear lest we poison him.

Our last camp to the eastward was made on the Atlantic slope of the Cordillera. All of the higher mountain country was uninhabited and was almost untraversed by trails. Al-

because the Darien is a region of excessive rainfall. The cause of this scarcity is the fact that the rain sinks into the earth very rapidly and is drained off from the steep mountains, resulting in a lack of surface water.

I climbed Mt. Tacarcuna, which reaches an elevation of about 5600 feet, and secured a superb view of the

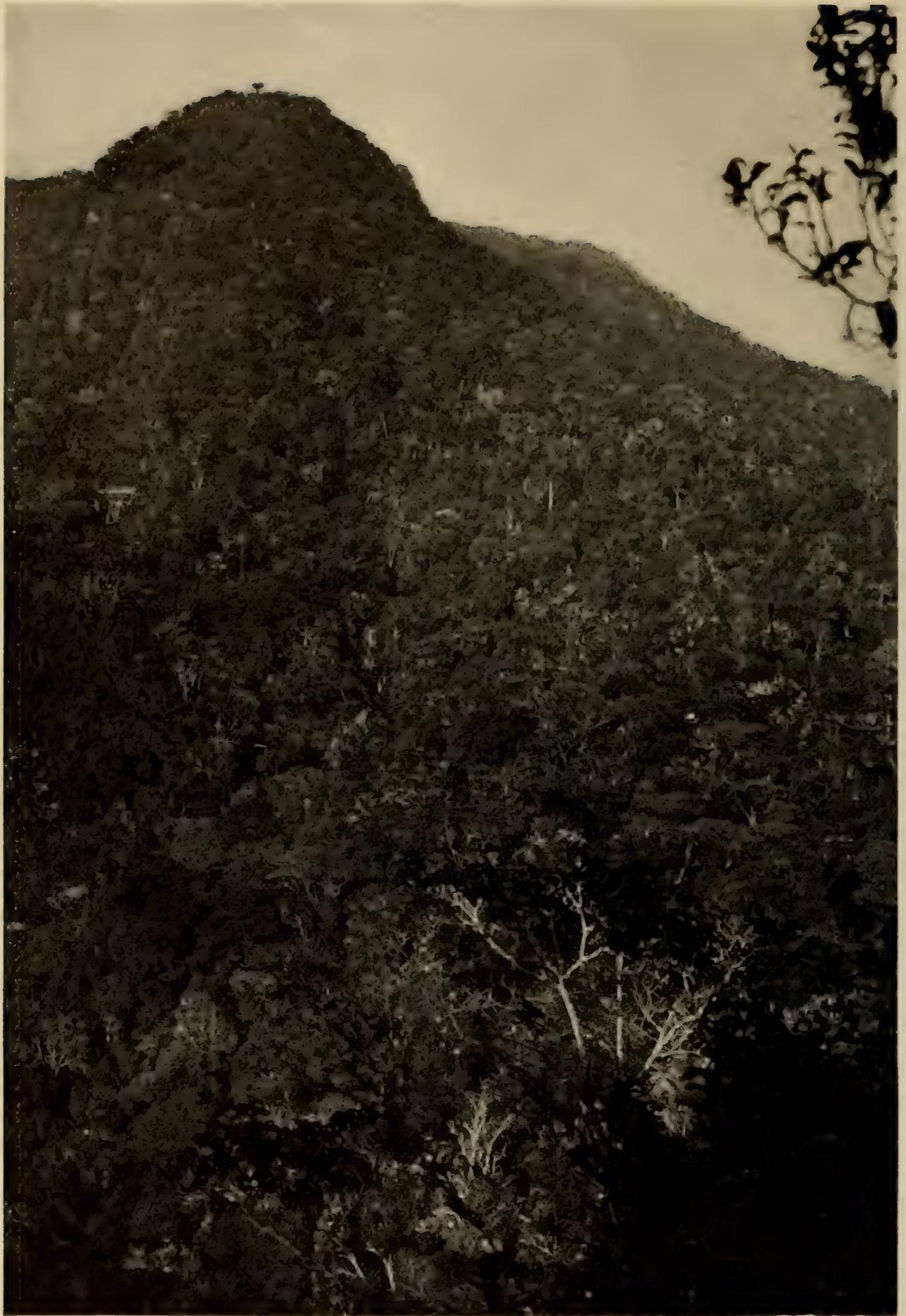
Cordillera about me before the ever-present clouds swirled up from below and obscured the landscape. From Mt. Tacarcuna I was unable to see either ocean, although the Atlantic and possibly the Pacific would have lain within the range of vision had the atmospheric conditions not been those of the humid tropics. Mile upon mile of jungle stretched out in every direction, a veritable sea of green foliage that flowed over each ridge and down into the valleys with nowhere a spot of earth showing through. It was quiet on the peak itself, which is conical in shape and stands detached by its elevation from the surrounding slopes. From the forests far below occasional cries of birds or mammals were well nigh muted by the distance, but the sonorous roaring of the black howling monkeys nevertheless rolled up to me from some remote band like the far-off mutter of sullen surf. It was a picture to fire the imagination of any one, and to the Spanish explorers the sight of such an extent of new and unexplored leagues must have played no small part in strengthening their resolve.

From some similar peak Balboa must have glimpsed the Pacific, but as to just which peak it was, history is not clear. While in Panama I heard it said that the famous peak is Mt. Pirre, but Pirre lies in the wrong quarter of the compass and Balboa must have approached the Rio Tuyra and the Gulf of San Miguel along the north bank of the river. At any event, Bancroft tells us of the clear morning when Balboa and his men fought their way to the summit of an eminence which dominated the terrain. The soldiers hacked a path with their sabers through a tough growth of shrubbery, and it is interesting to note that the hardest

wood I encountered on the entire isthmus was the gnarled shrubbery that clothed the upper limits of Mt. Tacarcuna. To the Spaniards, Bancroft goes on to say, in these "terraces of living green, sportive with iridescent light and shade . . . visions of the mighty future appeared pictured on the cerulean heights, visions of populous cities, of fleets and armies, of lands teeming with wealth and industry."

During our stay in camp on the crest of the Cordillera we experienced one of the phenomena of the region which may well have caused misgivings to the first explorers of the isthmus. About noon one day a severe earthquake passed through the heart of the mountain range. The ground moved and trembled, there was a deep subterranean rumbling like distant thunder, the trees quivered, and dead twigs broke off and fell to the ground, while throughout the forests the howling monkeys voiced audible protest.

One day Mr. Ball had gone farther than usual to the eastward and from a favored spot, whence he could command a view toward the Atlantic, he believed he had seen in the uncertain distance a large body of water. Several days later I, too, visited this spot, hoping to have a clear afternoon and to secure a picture if possible. Climbing a tree and looking out over the intervening forest I saw a series of steeply descending terraces, jungle-clothed, a wide expanse of apparently level, densely forested plain, and then a silver sheet of water that met the sky at the horizon. The atmosphere was saturated with moisture, however, and distance made the view hazy, but there could be little doubt that I was looking upon Atlantic waters. As I was returning toward camp, I found that I had misjudged time and distance



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Above all the other ridges and peaks Mt. Tacarcuna stands as a rounded cone, and up to its very summit and flowing over it stretches the green jungle. From such an eminence Balboa beheld the inspiring spectacle of the far-extending Pacific

and faced the prospect of spending the night in the jungle. In my haste I took the wrong ridge at a place where

there was no trail, and very soon was completely off my course. It was some consolation to my sense of woodcraft to



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On rare occasions it was possible to glimpse a distant scene through the foliage that screened the higher ridges. Once, when a tree was climbed, a view was had of the Atlantic, far off and five thousand feet below, dim and hazy on the horizon

reflect that it was not I but the trail that was lost, but the final result was the same. Sundown found me on a ridge miles from camp and I hoped that the night would not see any of the torrential downpours so prevalent in these mountains. Wood in abundance was to be had but all so damp that fire-making promised little success. With scraps of paper from my hunting jacket, using the driest of the dead wood I could find and blowing carefully upon the tiny flame that sprang up, I made three unsuccessful attempts that left me half-stifled by acrid wood smoke. I tried to sleep on the damp ground in my sweat-drenched clothes, but finally in desperation made one more attempt to kindle a fire. This time the blaze caught, wood piled about the margins of the flame dried

out, and I kept a warm fire going until dawn. Far off, toward camp, I could hear the old muzzle-loader of Pedro, my cook and camp tender, booming at intervals, as the faithful fellow explored the trail near the tent; but I made no attempt to cross the pathless jungle to him or to attract him to me by firing my gun, since such travel would be hopeless at night. A tinamou I had shot during the afternoon made a very acceptable meal when boiled before the fire; no rain marred the night; nor did the wind rise to make falling trees and boughs a menace. Soon after sunrise I met Pedro near the trail and came into camp for breakfast.

Many incidents occurred during the period of our stay in the Darien that threw a side light on the accounts of the early explorers: storms that lasted

for days, when the water fell in torrents; high winds, when trees went down right and left throughout the jungle, and among them several that stood about the tent; days when the fine mists drove through the trees and transformed noonday into gloomy twilight and we had to work by candle light; times when provisions ran low, when the jungle yielded practically nothing to eat; strange calls at night in the forest, which the natives could not identify; frogs that barked like shaggy mastiffs; vampire bats that bit exposed ears or toes; and other things that might seem commonplace today but must have been marvelous to behold for the early Spaniards.

The hardships that were experienced by Balboa and his men, the courage they required to face the terrors of a new and unknown land, the fortitude they displayed in meeting fever, insects, and countless discomforts, the initiative they showed in solving new problems as they arose, and finally the efforts of Balboa to make friends of the Indians wherever they would accept friendship—all have united to make Balboa my favorite among the New World Spanish explorers, and the glimpses I have had into present-day conditions in the Darien have convinced me that this explorer is well worthy of all the credit that can be given him.



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Gatun Lake at Sunrise.—What a contrast exists between the man-made lake at Gatun, where palatial steamers pass over the ancient jungle submerged beneath eighty feet of water, and the Isthmus of Balboa's time when the weary soldiers dragged their feet through tangled wilderness and at night often had little assurance that they would see the next day's sun arise!





"THE GLORY OF THE SEA"
(*Conus gloria-maris*)
Natural size

The "Glory of the Sea"

By ROY WALDO MINER

Curator of Lower Invertebrates, American Museum

DURING the year 1838, Hugh Cuming, the great British conchologist of that time, while collecting on a Philippine coral reef, chanced upon three specimens of the rare and beautiful mollusk known as the *Conus gloria-maris*, or the "Glory of the Sea." A few weeks later, so the story runs, the reef was destroyed by an earthquake and tidal wave, and though the region was systematically searched, no more specimens were located. In fact, since that time, no one has seen, so far as our information goes, a living example of this species. The shell was found at various times before that date, and was known to collectors as early as 1758, but even then was considered to be the rarest and most desirable of acquisitions and was consequently much sought after. Only twelve to fourteen specimens are represented today in collections, and not more than half of this number are perfect.

Hence the American Museum considers itself fortunate to have secured a fine and richly colored specimen of this shell, which has recently been placed on public exhibition. It is illustrated by the accompanying colored plate, which gives a faint idea of the delicate tracery of its pattern and the rich beauty of its coloration.

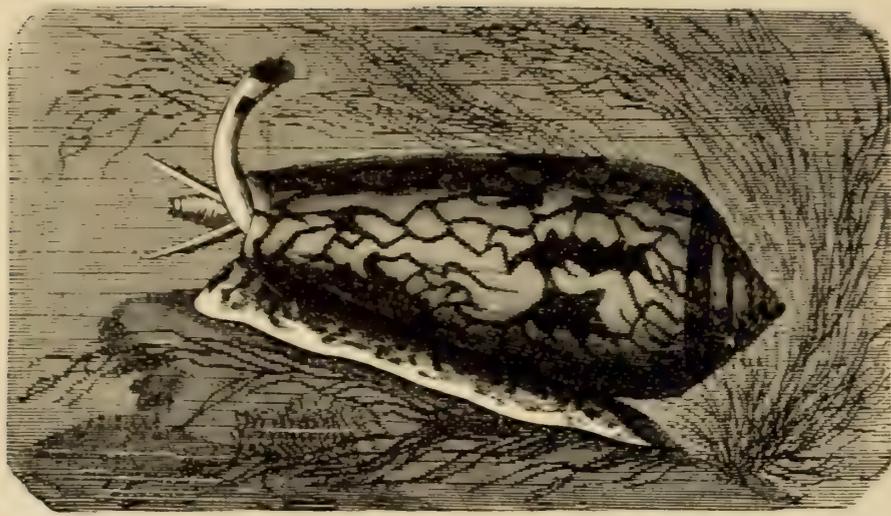
The shell itself is practically five inches in length, and like its immediate relatives is conical, but in this species the unusually slender and graceful proportions and tapering spire suggest an unfolding rosebud. The ground color is pale ivory, overlaid with a mosaic of thousands of triangular figures ranging from an eighth of an

inch to an almost microscopic size, practically defying reproduction by the lithographer. These triangles are outlined in chrome yellow or deep chestnut brown. Three broad spiral bands of orange encircle the body whorl beneath this fretted pattern, adding richness to the color scheme. One must see the shell itself to appreciate this and sense the porcelain luster that in certain lights suffuses it with a faint rosy sheen.

As mentioned above, Cuming's specimens came from the Philippines. The reef where he found them was located off Jacna on the island of Bohol. Other examples collected earlier are recorded from the island of Ceram in the Moluccas, and the label accompanying the specimen in the American Museum ascribes it to the latter group. The range is therefore very limited and the species is doubtless practically extinct.

The *gloria-maris* was famous among the Dutch collectors of the eighteenth century, and a number of traditions have grown up around it. The great collector Hwass owned a fine example, and when another was put up at auction, he bid it in for a large sum and then crushed it under his heel, exclaiming, "Now I possess the only specimen in the world!"

The shells of the family Conidæ, to which the *gloria-maris* belongs, are readily recognized by their characteristic conical shape. They are noted for their striking and variable coloration and hence are much sought after by collectors. Many species are of widespread occurrence throughout the tropical seas of the world, but the shells of



The textile cone is one of the commonest and handsomest of the cone shells. The breathing siphon, which is brightly colored, extends upward from the shell opening. The proboscis is conical and extends forward between the sensory tentacles, which also bear the eyes. The proboscis contains two bundles of poison teeth. (Natural size; after Lydekker)

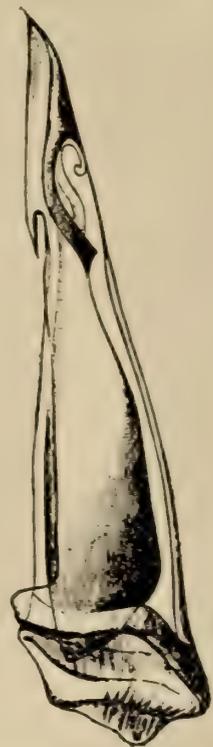
this family are especially abundant and diversified in the Pacific and Indian oceans. One species occurs in the Mediterranean.

The cones are often found in the neighborhood of coral reefs, where their rich hues rival the brilliancy of reef-fishes, corals, and sea-fans. Here they lurk in hidden crevices whence they emerge to attack their prey, which consists largely of other mollusks. For this purpose they possess a most effective weapon concealed in a proboscis, which projects forward and resembles a conical snout. The mouth is located at the end of this organ, and in the cones is furnished with a bundle of about sixty extremely sharp barbed teeth, set in pairs in a fleshy tube. These are used for biting the prey or as a drill to penetrate its shell. Other carnivorous mollusks differ from the cones in having their numerous small teeth set in rows on a "lingual ribbon," which is pulled back and forth like a belt over a pulley to permit a rasplike action.

At least three species among the cones, namely, the cloth-of-gold cone (*Conus textile*), the brunette cone (*Conus aulicus*), and the tulip cone (*Conus tulipa*), are notorious for their poisonous bite, and probably all the members of the family are more or less venomous, as the teeth have a hollow

tube or duct which leads from a gland that apparently secretes poison. There are a number of instances on record showing that the above-mentioned species are dangerous to handle. Mr. Arthur Adams, in the *Narrative of the Voyage of the Samarang*, relates as follows:

"The animal of *Conus aulicus* has the proboscis beautifully varied with red and white, and there is a square and very minute operculum on the dorsal



One of the sixty or more poison teeth from *Conus imperialis*. There is a poison gland in the base of each tooth from which a duct leads to the tip. The tip is furnished also with one or two barbs. The figure is enlarged about fifty-five diameters. (After A. H. Cooke)

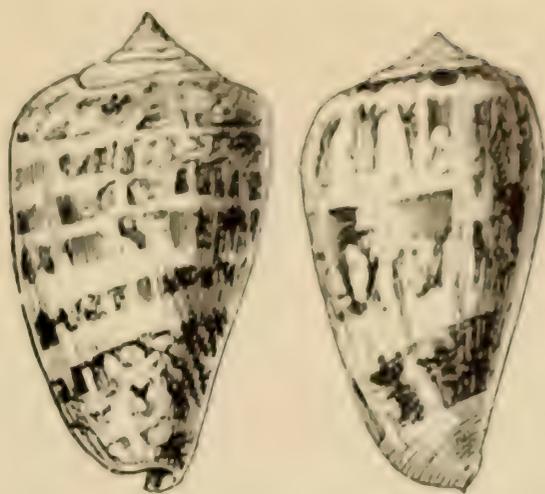
surface of the hinder part of the foot. Its bite produces a venomous wound, accompanied by acute pain, and making a small, deep, triangular mark, which is succeeded by a watery vesicle. At the little island of Mevo, one of the Moluccas, near Ternate, Sir Edward Belcher was bitten by one of these Cones, which suddenly exerted its proboscis as he took it out of the water with his hand, and he compared the sensation he experienced to that produced by the burning of phosphorus under the skin. The instrument which inflicted the wound, in this instance, I conceive, must have been the tongue, which in these mollusks is long, and armed with two ranges of sharp-pointed teeth."

It is said by the natives of certain Pacific Islands, that *Conus textile* throws its poison from a distance of several inches.

Certain harmless, herbivorous mollusks of quite a different family, the Strombidæ, apparently mimic the poisonous cones and are thus literally protected by sailing, or rather crawling, under false colors. At least *Strombus mauritianus* closely resembles *Conus janus* in shape and color pattern.

The American Museum possesses an unusually fine collection of cone shells, many of which were originally in the Jay and Steward collections. Among them are many beautiful and interesting, as well as rare, specimens. For example, there is the record specimen of the largest known cone (*Conus prometheus*), which measures nine inches in length. One of the most beautiful species is the rhododendron cone (*Conus rhododendron*).

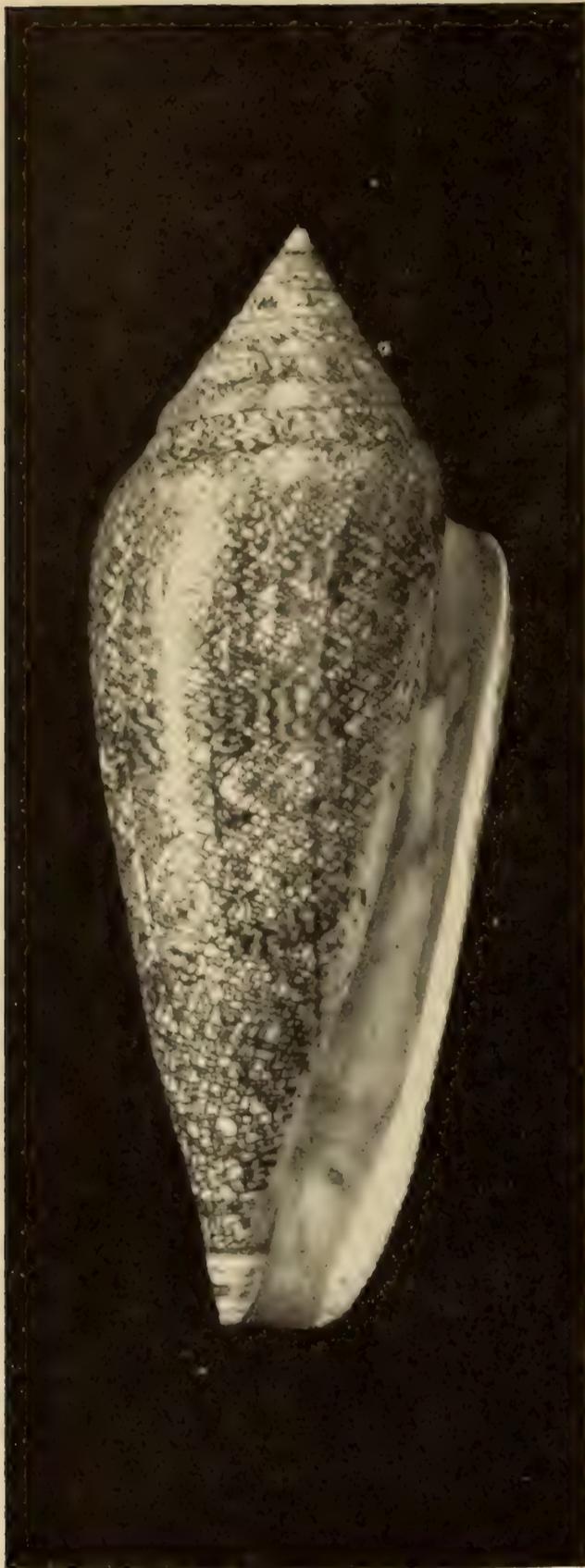
The *Conus gloria-maris*, however, is now the most highly prized of all the cones in the Museum. It is planned to exhibit this shell in such a manner as to give it special prominence.



These two shells from the island of Mauritius illustrate the theory of mimicry in animals. The specimen to the right is *Conus janus*, a species known to be poisonous. To the left is *Strombus mauritianus*, belonging to quite a different family, the members of which are never poisonous. The shape of the shell in most species of this family differs considerably from that of *Conus*. The species illustrated, however, is closely similar in shape to the *Conus*, so that from a superficial examination it could easily be mistaken for one. As the two species are found in the same locality, it is supposed that the harmless species is protected from enemies by its resemblance to its poisonous neighbor.

Through the courtesy of Mrs. F. A. Constable of this city we are able to present in this article a photograph of another specimen of *Conus gloria-maris*, which was acquired by her late husband while building up the important private collection associated with his name. This specimen, while not so large or so brightly colored as that in the American Museum, is nevertheless beautifully proportioned, with an unusually perfect spire.

The Museum specimen, the Constable specimen, and another belonging to Mr. A. L. Ward of Shelbyville, Illinois, are the only examples of this species in the United States known to the writer. The Museum specimen was obtained from Mr. Walter F. Webb of Rochester, and formerly belonged to the noted collection gathered by the



This beautiful specimen of *Conus gloriamaris* is in the collection of Mrs. F. A. Constable. The unworn spire is practically perfect. This specimen, the one in the American Museum, and a specimen owned by Mr. A. L. Ward of Shelbyville, Illinois, are the only three specimens that, so far as is known, exist in American collections. The illustration is natural size

late Mrs. S. L. Williams of Chicago. She obtained it from Mr. Hugh C. Fulton of London, England, who secured it from the collection of the late Dr. James Cox of Australia. Its previous history is unknown, but as the latest recorded find was that of Hugh Cuming, in 1838, as mentioned above, it must antedate that year, and may easily have been collected by some Dutch trader in the eighteenth century. Three of the specimens in European collections are in the British Museum, one is in the Amsterdam Museum, and one, it is said, is in the collection formerly belonging to the King of Portugal. Still another specimen is accredited to the Melbourne (Australia) Museum. Perhaps four or five others are in the hands of private collectors.

Rarity in living forms is often the result of the practical extinction of a group. Hence this species doubtless represents the surviving remnant of a vanished life, standing in somewhat the same relation to shells as the great auk and Labrador duck stand to birds and the okapi to mammals. Such records are often lost to science by being retained in private collections, while if placed in a large museum they are permanently preserved. To the popular mind the rare and the beautiful always make their appeal, and in the case of the "Glory of the Sea," the eagerness with which it has been sought for the greater part of two centuries among the Spice Islands of the Far East has imbued the shell with a legendary charm such as now and then brings romance and color into the dry atmosphere of scientific records.



Prof. O. C. Marsh and members of his expedition in the field near Fort Bridger, Wyoming. Standing (left to right): Dr. Thomas Carter, J. W. Griswold, H. B. Sargent, G. B. Grinnell, C. W. Betts, O. C. Marsh, C. T. Ballard, J. R. Nicholson, J. M. Russell. Sitting: Eli Whitney, A. H. Ewing, H. Ziegler, and Bill, the cook

An Old-Time Bone Hunt

AN ACCOUNT OF THE EXPEDITION UNDERTAKEN BY
PROF. O. C. MARSH IN 1870 TO THE THEN WILD WEST

BY GEORGE BIRD GRINNELL

IN the spring of the year 1870 it became known to members of the senior class at Yale that Prof. O. C. Marsh contemplated making a geological expedition to the Far West, for the purpose of collecting vertebrate fossils. Marsh, although then professor of palæontology at Yale, did not conduct courses and was personally known to few undergraduates. The students knew little about palæontology and were not greatly interested in geology.

From boyhood I had read the books of Capt. Mayne Reid, which told of the western country in the forties, and that country and its wildness had taken strong hold on my imagination.

When I heard of the proposed expedition by Professor Marsh, I determined that, if possible, I would accompany it, but I felt that I had no qualification for a position on such an expedition.

However, after much pondering I mustered up courage, called on Professor Marsh, and asked if I could in any way attach myself to his party. I found him far less formidable than I had feared. He said that he would consider my application, and later told me that he would be glad to have me go. He discussed with me the composition of the party, and after a little it developed that I was the only member as yet chosen. His consultations with me enabled me to suggest

to him names of men I knew well and whom I wished to be of the party.

Marsh was possessed of considerable means and had a wide acquaintance. He had interested General P. H. Sheridan in his project and from him had obtained orders directed to military posts in the West to provide the party with transportation and escorts needed in passing through dangerous Indian country. Besides that, some well-to-do business men had contributed funds to defray the expenses of the trip, and I have always suspected that some of these, being railroad men, had given Marsh either free transportation for his party or at least rates much lower than those usually in force.

In the light of later events the personnel of the expedition is more or less interesting. Among its members were James W. Wadsworth (the father of the present senator from New York) who left Yale in 1864 to join the Union forces and who subsequently for twenty years represented one of the districts of northern New York in Congress; C. McC. Reeve, who later did good service in many directions for his fellow men, was a general in the Spanish War, and served effectively in the Philippines; Eli Whitney and Henry B. Sargent, who in later years were members of the corporation of Yale University; J. R. Nicholson, who subsequently served as chancellor of the State of Delaware; and a number of others, who became successful business men. All these finally left New Haven, June 30, on their start for a west that was then actually wild. Probably none of them except the leader had any motive for going other than the hope of adventure with wild game or wild Indians.

Except through what they had read Professor Marsh and his party knew

nothing about the West. It was an entirely innocent party of "pilgrims," starting out to face dangers of which they were wholly ignorant. At this time the Sioux and Cheyenne Indians occupied the country of western Nebraska and that to the north and northwest, and they objected strongly to the passage of people through their territory, and when they could do so—that is, when they believed they had the advantage,—attacked such parties.

We crossed the Missouri River in one of the old-fashioned stern-wheel ferry boats and spent a day or two in Omaha, where some of us tried our rifles, which up to then we had not fired, at targets in what is now the fashionable residential section of the town, but which was then bare—and, of course, uncultivated—prairie. Professor Marsh and Jim Wadsworth went on ahead to Fort McPherson on the Platte River, then the headquarters of the Fifth Cavalry, where General Emory was in command. The rest of us followed a day or two later.

The day we reached the post a party of two or three antelope hunters out from the fort had been attacked by a dozen Indians who had swooped down upon them. One of the Indians, bearing in mind the injunction often given him by his elders that it is no disgrace to be killed in battle, rode up close to one of the antelope hunters and sent an arrow through his arm. The hunter responded with a well-directed rifle ball and the Indian rode away, falling from his horse before he got out of sight, whereupon the antelope hunters returned to the post.

A troop of cavalry sent out to overtake the Indians, of course failed in their purpose but found the dead Indian boy, wrapped in his buffalo robe, on top of a hill near where he had



YALE SCIENTIFIC EXPEDITION OF 1870

Standing (left to right): J. R. Nicholson, Geo. Bird Grinnell, James W. Wadsworth, O. C. Marsh, C. Wyllis Betts, Henry Ziegler, H. B. Sargent. Sitting: John Wool Griswold, A. H. Ewing, Eli Whitney, C. McC. Reeve, James M. Russell

fallen. William F. Cody—Buffalo Bill,—who was then post guide at Fort McPherson, brought in the boy's moc-casins and some trinkets taken from the body, at which the newcomers from New Haven stared in wonder.

Professor Marsh had arranged that we should go first from Fort McPherson to the Loup Fork River to the north, where, it was understood, there were late Tertiary fossil beds of considerable interest. A troop of cavalry was to accompany us as escort, with six army wagons to carry the provisions and supplies, including tents, blankets, and ammunition.

The young men from the East, some of whom had never mounted a horse, were taken out to the corral near the post stables and there were introduced to a lot of Indian ponies captured from the Cheyennes the previous autumn at the Battle of Summit Springs. Major Frank North with two of his Pawnee Indian scouts had taken part in that fight and they chose for us the gentlest mounts.

We crossed the Platte River and, led by Major North and his Pawnees, started north through the desolate sand hills toward the hoped-for river. No one in the outfit, excepting the Pawnee Indians, had ever before been through the country, but by keeping north we could not fail to strike the Loup River. The sand hills were not high but they were very steep, and the sand was deep, making the pulling hard for the teams. Major North, riding ahead, selected the easiest way for the wagons, while still ahead of him the Indian scouts went forward and from the tops of the highest hills peered through the grass to see whether enemies could be discerned.

The country to be passed over was dangerous, for at any time one might

meet parties of Sioux Indians, who would certainly attack us if they felt that they could safely do so. We were blissfully ignorant of all this and supposed that because we saw no Indians, there were none about and that there was no danger.

Perhaps none of the eastern members of the party had ever before been very far out of sight of a house, and none could understand the possible danger of the situation, because all the surroundings were something entirely outside of their experience. The first day's march was long, monotonous, and hot, and there was no water to drink. Some of the young men imagined that they were perishing from thirst and that they must have a drink of cold water.

At the end of the long day's march one of the soldiers, hot, thirsty, and utterly weary, was heard to exclaim, "What did God Almighty make such a country for?" To which one of his companions made the reply that "God Almighty made the country good enough, but it's this infernal geology that the professor talks about that has spoiled it all!"

Just before dark, water was found and we camped for our first night out of doors. That night at the camp fire Professor Marsh talked to us and to an audience of soldiers about the geological changes that had taken place here in past ages and about the discoveries of unknown animals that he hoped to make. Buffalo Bill, who had ridden out with us for the first day's march, was an interested auditor and was disposed to think that the professor was trying to see how much he could make his hearers believe of the stories he told them.

The hot, waterless marches continued, and two or three days satisfied the

young men that they had seen quite enough of Nebraska. However, as the journey went on, they became more accustomed to the situation—to the heat, to the lack of shade, and to the absence of water—and began to take an interest in the country. Every day Major North took ahead with him one of the young men, whom he permitted to shoot at the antelope. No member of the party killed anything, which is not surprising in view of the fact that none of us knew anything of hunting or rifle shooting, or of the arms we were using.

At last we reached the Loup Fork, not without some alarms of Indians, for from time to time columns of smoke were seen,—signals indicating that the Sioux were communicating with one another. It was even said that an Indian had been seen watching the outfit from a distant hill.

The Loup River flows through a valley far below the general level of the prairie, and into this valley open many cañons, narrow and wide, in the sides of which were seen the strata of an ancient lake bottom through which the water had cut. There were many exposures of the so-called *mauvaises terres*, and in these bare clay surfaces fossil bones were found. The escort made short marches up the river, and the easterners, with a small guard of soldiers to act as lookouts, devoted themselves to bone hunting. After a little while the soldiers became as interested in collecting fossils as the members of the party, and brought in many specimens. As they gained experience, some of them became quite skillful collectors.

The region then examined was of late Tertiary age and gave us many Pliocene mammals—horses, camels, and other vertebrates—which tended

to throw light on various problems more fully elucidated by recent investigations.

The country was full of game, antelope being by all odds the most abundant. This was long prior to any settlement on the plains and the antelope were still nearly in their primitive numbers. On the Loup Fork River elk were found and killed, and fresh meat for the party was never lacking. More than once we came upon Indian burial places, the wrapped-up bodies resting on platforms, each supported by four poles standing in the ground. With the bodies had been placed the usual accompaniments of arms and implements, and beneath each platform were the bones of two or three horses, killed to provide the owner with mounts in his future life. The dried skulls of the Indians on these platforms were added to the party's collections.

One night a prairie fire, which, it was thought, had been kindled by the Sioux, crept down toward our camp from both sides of the river, but as we were in a bend, it was not difficult by back-firing to protect ourselves from the flames. The advance of the fire along the hills on either side of the river was interesting and—when our anxiety with regard to the camp had subsided—very beautiful. For the next day or two, however, the question of grass for the animals was one of difficulty.

We worked up the river quite a long way, but I have never known which of the branches we followed. At last, turning southward, we set out again for the railroad, and once more entered an area where water was hard to get. What little we did find, was bitterly alkaline. This was a region of dry lakes, and water could be had only by digging. Some years later, when as a

humble cow-puncher I worked cattle through this country, I often had excellent deer-hunting among these dry lakes.

Journeying south through this country we followed down the Birdwood River and one evening crossed the Platte, and at North Platte City had a real meal, sitting in chairs at a table and eating from china plates. There we learned of the Franco-German War, declared in our absence, and that night on our return to camp, Lieutenant Reilly ordered his men to fall in and with something of a flourish of oratory announced to them that war had been declared between France and Germany. The men, who were more or less surprised at the unusual order to get in the ranks while they were in camp, manifested slight interest, and when they were dismissed, I heard one of the soldiers declare with forcible profanity how little he cared about the news.

From Fort McPherson we proceeded west by rail to Cheyenne, and a few days later left Fort D. A. Russell, Wyoming Territory, to explore a region lying between the north and south forks of the Platte River. Before long we came upon some bad lands not previously known, the southwestern boundary of a Tertiary lake basin, in the margin of which were entombed and waiting to be excavated turtles, rhinoceroses, *Oreodon*, and the huge *Titanotherium*. These beds we followed for a long distance westward. At Antelope Station on the railroad, a locality from which Professor Marsh had secured some fossils the year before, we found several species of horse, one of them a little fellow only two feet high and having three toes.

Crossing the North Platte River we came upon and followed the old California and Oregon trail, along whose

ruts so many searchers for wealth had traveled less than twenty years before. The grass was growing all along the road and where the wagons had passed was a continuous bed of sunflowers. Shortly before we reached Scotts Bluff we came upon another outcrop of fossil bones.

From the Platte we went to Horse Creek searching for other fossil grounds, and here two of the young men left our party, after being informed by the commanding officer that camp would be made about twenty miles farther along the creek, and followed up the stream to shoot the ducks that then were migrating in great numbers. The commanding officer did not know, nor did anyone else, that near here the creek made a great bend and that to follow it around to the place where the camp was to be pitched meant a journey of fifty or sixty miles.

The duck shooters killed some ducks, but as the sun drew toward the west, they began to be doubtful about reaching camp. They started back, intending to cut across country and strike the trail of the command, but before they had gone far, they were threatened by a prairie fire. One man dismounted and began to back-fire, but with the fire came a tremendous wind which swept on the flames at an inconceivably rapid rate. Finally he who was watching on his horse shouted to his companion to mount. He did so just as the flames swept toward them singeing the hair of men and horses; but two or three jumps took them to a burned space and the fire passed by on either side. The young men believed that the fire had obliterated the trail and rode back to the stream, feeling that this was a guide that would not fail them. They only now realized that to be far away from camp unarmed, except with shot

guns, on the border of the Cheyenne Reservation was not a pleasant situation. They rode down the stream, stopped just as the sun set, built a fire, and made preparations for spending the night there. As soon as it grew dark, however, they remounted, rode into the stream, followed that down for a mile, so that no trail should be left, and then riding out on the bank spent the night there without fire.

Meantime Professor Marsh and all at the camp were much concerned about the absentees. Searching parties were sent out next day but found no trail they could follow. They came upon a couple of crippled horses abandoned by Indians, and this lowered the spirits of the searchers, who supposed that their companions had been killed, their horses taken, and these cripples left in their place. Meanwhile the lost ones, following the stream down to the camp of the day before, took the wagon trail there and that night appeared in camp.

After some weeks in this general region the party traveled west by rail to old Fort Bridger in Wyoming, a trading post established long before by the famous Jim Bridger. At and near Fort Bridger a long stay was made. South of the fort were great washed deposits of greenish sand and clay of Eocene age, and here we found great numbers of the extraordinary six-horned beasts later described by Marsh as *Dinocerata*. It was from this locality too that came *Eohippus*, the earliest horselike animal of which we know.

South of this great bone field, which was explored during early September, was Henry's Fork of Green River, on which was camped a little company of old-time trappers living with their Indian families in buffalo skin lodges. They still trapped the beaver and

several times during our stay in this neighborhood I spent the night in their camp and in the morning went out with them to look at their catch. It was a glimpse of the old-time trapper's life in the Rocky Mountains of thirty years before, and a most interesting one. All the members of this little group wore buckskin clothing, and the men hunted and trapped, drawing their support from the country. One or two of them had come out to the Rocky Mountains in the year 1834. Another survivor of early days seen at Fort Bridger was "Uncle" Jack Robinson, who was of the famous band of trappers who had found the Arapaho Indian baby later known as Friday.

Professor Marsh wished to go still farther south to reach the junction of the Green and the White rivers in Utah. The way was unknown to anyone, but finally a Mexican, who knew a part of the route, went along as supposed guide. He did not know the mountains, however, and we were obliged to follow down the Green River, passing through Brown's Hole, finally to reach White River not very far above its junction with the Green. There were no roads and travel with wagons was impossible. With some difficulty the journey was made by pack train. On the way we saw many wonderful things which now can hardly be told of. Here is a paragraph written by one of the men which suggests a view seen from the eastern ends of the Uinta Mountains.

"After crossing an extensive table land a grand scene burst upon us. Fifteen hundred feet below us lay the bed of another great Tertiary lake. We stood at the brink of a vast basin, so desolate, wild and broken, so lifeless and silent that it seemed like the ruins of a world. A few solitary peaks

rose to our level and showed that ages ago the plain behind us had extended unbroken to where a line of silver showed the Green River twenty miles away. The intermediate space was ragged with ridges and bluffs of every conceivable form, and rivulets that flowed from yawning cañons in the mountain sides stretched threads of green across the waste between their falling battlements. Yet, through the confusion could be seen an order that was eternal, for as age after age the ancient lake was filled and choked with layers of mud and sand, so on each crumbling bluff recurred strata of chocolate and greenish clays in unvaried succession, and a bright red ridge that stretched across the foreground, could be traced far off with beds of gray and yellow heaped above it."

At White River, not far from where it joins the Green, many Pliocene fossils were found, and before long, with pack animals heavily loaded, we crossed the Green River near the ancient trading post known as Fort Roubidoux and made our way to Fort Uinta, the agency of a section of the Ute Indians. From here a Shoshoni Indian guide led us through the Uinta Mountains, over a beautiful forested country with frequent open parks through which flowed clear sparkling trout streams. The region, known only to the Indians, had much game, and the journey in early autumn was full of joy. Going down one of the rough narrow mountain trails toward the valley of Henry's Fork we lost the pack mule which carried our mess outfit, and at the foot of the cliff were able to recover from its load only a few battered tin plates and broken knives

and forks; even the saddle that the animal wore was smashed to match-wood.

It was here that a curious free Cretaceous crinoid *Uintacrinus* was discovered. This was described much later.

At Salt Lake City some of us met Brigham Young. From there we went on to California, visiting the Yosemite, the Mariposa Grove of "big trees" and the geysers. Returning eastward we stopped at some of the famous old-time placer mining districts in California, and thence went on to a point not far from Green River, Wyoming, where in an early Tertiary deposit many petrified fish and some fossil insects were found.

The plains of Kansas were the next collecting ground and here great numbers of Cretaceous reptiles were unearthed, among them giant mosasaurs and many fishes. From these beds came, a little later, the extraordinary birds with teeth—*Hesperornis* and *Ichthyornis*—and later still many pterodactyls. These bone fields are in a region that is now a great wheat-and-corn-growing district. In Kansas some members of the party killed buffalo, which were abundant there.

The expedition now began to break up. Some of its members returned in late November, and before Christmas time the last of them had reached New York and New Haven.

In subsequent years Professor Marsh conducted other expeditions to the western country and all of them yielded rich results. Later his collections were made by hired collectors. The sum total of the material brought together is now preserved in the Washington and New Haven museums, and not all of it has yet been worked up.



Maximilian, Prince of Wied-Neuwied, explorer,
naturalist, and student of primitive races

Maximilian's Travels in the Interior of North America, 1832 to 1834

By VERNON BAILEY

Chief Field Naturalist, Biological Survey, U. S. Department of Agriculture

NINETY-ONE years ago Maximilian Alexander Philipp, Prince of Wied-Neuwied, came to North America as an explorer, ethnologist, and naturalist. Born on September 23, 1782, the eighth child of Friedrich Karl, ruler of a small principality in Rhenish Prussia, he had of necessity given some years to military training and service. He had taken active part in several wars, had been captured at the battle of Jena, had won the iron cross at Châlons, had been promoted to major-general, and was with the victorious army that entered

Paris in 1813. Soon after the peace of Paris he was allowed to retire from military service and to devote his time to study and research, which had ever been his great desire.

Encouraged from childhood in his love of nature by his mother, and later a pupil of the famous Blumenbach, he had become an enthusiastic naturalist and in his younger days had gathered a creditable collection for his private museum. At the close of his military career he at once set about fulfilling his cherished hopes for travel and in 1815 made a trip to South America,

where he spent a couple of years in collecting specimens representing the native fauna and flora of Brazil, and in studying the ethnology of the various indigenous tribes.

As a result of this trip he published in 1820 his *Reise nach Brasilien* in two large quarto volumes, accompanied by an atlas containing plates and maps, and by a collection of ninety colored plates of mammals, birds, reptiles, and batrachians. Later (1825-33) he published his *Beiträge zur Naturgeschichte von Brasilien*, containing descriptions of great numbers of new genera and species. Thus even before his trip to North America in 1832 he had taken high rank among men of science.

His object in visiting North America was to reach the little-known interior of the continent, study the native tribes, and make collections of natural history specimens. Accompanied by his hunter, Dreidopple, and his artist, Bodmer, he arrived in Boston on the Fourth of July. He subsequently visited New York and Philadelphia and spent some time with friends at Bethlehem, Pennsylvania. Thence he made his way across the mountains to Pittsburgh and by various boat trips to New Harmony, Indiana. There he arrived in October and, tempted by its excellent library and such congenial spirits as Thomas Say, Charles Alexander Lesueur, and William and Robert Dale Owen, he remained throughout the winter, collecting specimens, studying the reports of previous expeditions in the West, familiarizing himself with their results, and planning his own trip with great care and forethought.

In the spring of 1833, being then at St. Louis, he embarked with his party and outfit on the steamer "Yellow-

stone," and made his way slowly up the Missouri River to Fort Buford, near the mouth of the Yellowstone River, where he transferred to a river keel-boat, propelled by man power and sails, and in it continued up the river to Fort McKenzie, just below the Great Falls of the Missouri and in the country of the Blackfeet. Here he remained long enough to obtain vocabularies of several tribes of Indians, to do considerable collecting of mammals, birds, reptiles, and plants, and to experience an Indian battle between the Blackfeet and Assiniboines. He then returned to Fort Buford and below to Fort Clark, where Lewis and Clark on their memorable journey across the continent had spent the winter twenty-nine years before. In this area were located the Mandans and other neighboring tribes of Indians with whom he sojourned. Here he made his most important ethnological observations, for the long winter gave him time for a close study of Indian languages and habits, and enabled his artist to make numerous drawings of the natives, the animals, and the country. Valuable collections of specimens of animal and plant life were also made, and a considerable number of genera and species previously unknown to science were obtained.

In the spring of 1834, before the steamers were running, he embarked with his party in a large Mackinaw boat and rowed down the river to St. Louis, thence returning to his native land with a part of his collections, including a couple of live grizzly bears.

The greater part of his collections, entrusted to the care of the American Fur Company's steamer "Assiniboine," was later destroyed by fire on the way down the river, and the net results of his trip thus seriously curtailed. For-

tunately, however, his notes and drawings and many specimens escaped the fire.

Besides descriptions of new species and the more technical results of his expedition published in scientific journals, Maximilian has left us two large quarto volumes of narrative, mostly in journal form, entitled *Reise in das Innere Nord-America in den Jahren 1832 bis 1834*, published at Coblenz in 1841. These volumes contain a vast fund of interesting and valuable information on the physical features, geology, natural history, and native peoples of the region visited. In numerous appendices the mammals, birds, and plants are listed and vocabularies of many tribes of Indians are given. His ethnological notes are especially full and valuable, but to the naturalist his descriptions of the animal life in the days of abundant buffalo, elk, deer, antelope, mountain sheep, and grizzly bears are equally fascinating.

An excellent map of the eastern states and Great Lakes region and the little-known plains country west to the Rocky Mountains accompanies the volumes and furnishes a valuable record of names and places no longer found on our maps, besides giving the outlines, as far as then known, of the areas occupied by the various tribes of Indians of the Missouri Valley.

The numerous illustrations throughout the text and in the accompanying folio of plates contributes not a little to the value of the work, for Maximilian was accompanied by Carl Bodmer, a young Swiss artist of unusual ability and later of considerable fame. A great number of the plates are of Indian types in full regalia or with war equipment, so carefully done that the markings on the skin, the feathers, and other ornaments are as readily recogniz-

able as from the best of photographs. As a painter of men and animals in action, however, the artist especially excelled, and his pictures of primitive life in America are worthy of more general recognition.

The original German text was translated into English and published in London in 1843, and retranslated in this country in 1906, as Volumes XXII, XXIII, and XXIV of Reuben G. Thwaites' *Early Western Travels*. Even in this more recent and excellent translation some of the natural history notes have been omitted and some of the charm of both original text and illustrations is necessarily lost.

Three years after the death of Maximilian in 1867 his zoölogical collections were purchased by the American Museum of Natural History and brought to New York, where they became a valuable addition to the Museum collections. The specimens consisted of about 4000 mounted birds, 600 mounted mammals, and 2000 fishes and reptiles.

The specimens were from many parts of the world, but by far the greater part were from North and South America, and include the types of a large number of species described by Maximilian. In commenting on the South American birds in this collection in the *Bulletin* of the American Museum for 1889, Dr. J. A. Allen says: "Maximilian for the time in which he lived and worked was an excellent ornithologist, combining ample field experience with a good technical knowledge of his subject. He not only took careful measurements and notes of the color of eyes, bills, feet, etc., from freshly killed specimens, but his published descriptions in respect to detail and the careful discrimination of nice points are not

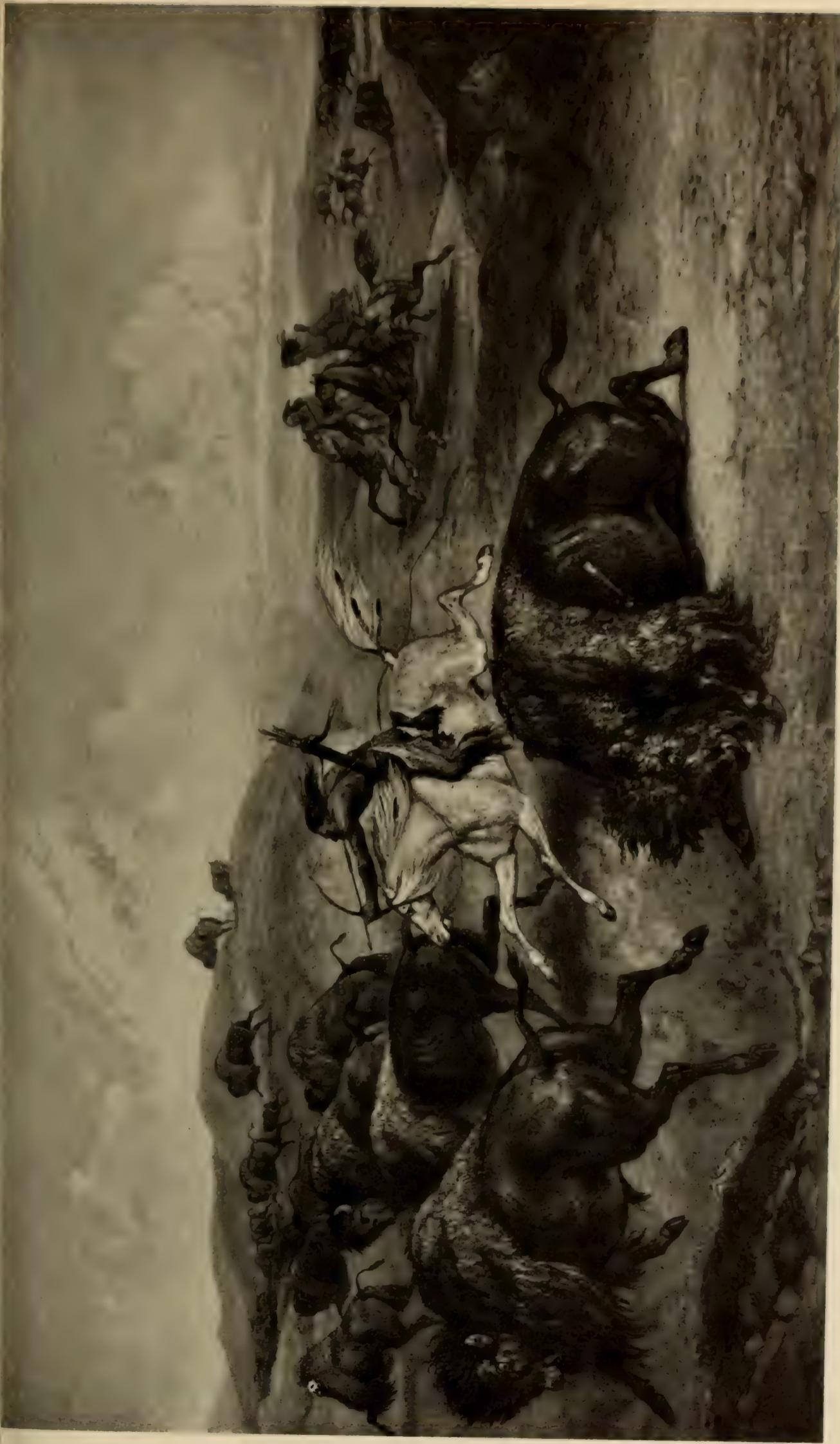


BIGHORNS IN THE BADLANDS OF THE UPPER MISSOURI

By Carl Bodmer, the Swiss artist who accompanied Maximilian on his travels

The picture indicates that mountain sheep were abundant in the region when Maximilian and his followers penetrated it in 1833. Sixty-eight years later Merriam named this sheep *Ovis canadensis auduboni*, in honor of Audubon, who, ten years after Maximilian, made observations upon it. Today this sheep, probably extinct, is represented by only a few old skulls from the region

BIGHORNS IN THE BADLANDS OF THE UPPER MISSOURI
By Carl Bodmer, the Swiss artist who accompanied Maximilian on his expedition in the region which Maximilian and his followers penetrated in 1833. Sixty-eight years later Merriam named this sheep *Ovis montanus carolinensis*, and ten years after Maximilian, made observations upon it. *Today*, this



THE BISON HUNT

By Carl Bodmer, the artist of the Maximilian Expedition

On the Upper Missouri in 1833 the bison still ranged in countless herds. Firearms were few, but the Indians, supplied with good horses and arms, with bows and arrows, were able to obtain abundance of meat to go with their corn, beans, and squashes, as well as a plentiful supply of skins for clothing and tepees. Although the Indians were being rapidly debauched by the firewater of the traders, there were still fine old types among them



MANDAN INDIANS

One of these gorgeously arrayed Indians is wearing a necklace made of the claws of the grizzly. This illustration is another example of the work of Carl Bodmer

excelled and rarely equaled in our best modern work."

As much could be said for his descriptions of new genera and species of mammals, while his notes on the habits of his little tame kit fox, his grizzly bears, and many other vanishing species can never be duplicated.

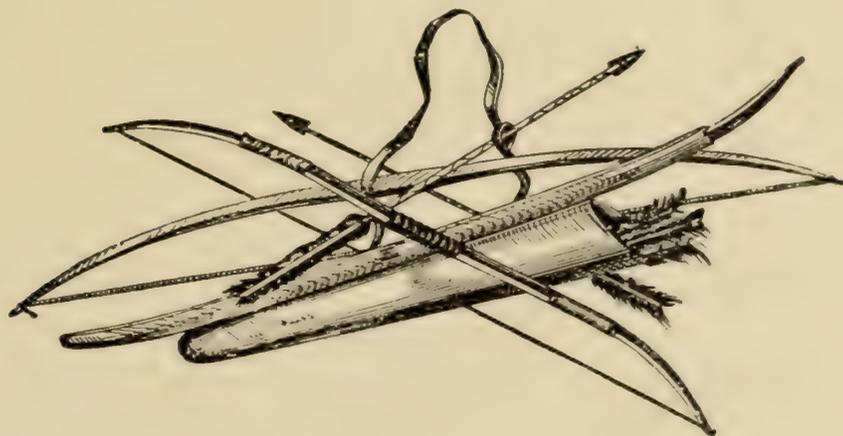
In the period when his journey was made grizzly bears were still common along the Upper Missouri River and, as they had not learned to respect the white man and his weapons, which at that time were not very deadly, the prince and members of his party were several times attacked and narrowly escaped with their lives. The long front claws of these bears were worn as much prized necklaces by the Indian hunters, as shown in the pictures of some of the chiefs and leading warriors who had won the right to wear them, while the canine teeth of the elk were used as dress ornaments by the Indian women only.

Buffaloes, still in untold numbers, were the main source not only of meat supply, but of the skins used for tepees, robes, and bedding by these tribes of hunting Indians. Maximilian

and his party also found in the buffalo their chief sustenance, although elk, deer, antelope, mountain sheep, beaver, and game birds all contributed to the support of the expedition. The buffalo hunt is well shown in the picture by Bodmer, who accompanied the hunters and depicted the details from a knowledge that few artists have ever attained.

The little kit fox, or swift, an animal then common but now almost unknown in the region that Maximilian visited, was easily domesticated. The kit fox that the prince kept all winter as a pet was gentle, affectionate, and full of quaint interesting little ways and dog-like tricks. It also proved useful as well as interesting, for the common house rats had found their way up the river on the steamers and become a great pest among the food stores of the Indians. At night the little fox was placed in rooms where the Indian corn was stored and where he took great delight in killing the rats.

As our wild life and primitive conditions disappear, such records of the New World before the newness was gone have an ever increasing value and should be more generally known.





THE CROSSING OF THE FATHERS

The picture was taken looking downstream from the right bank of the Colorado. At low water the bar extending from the opposite shore may be reached by fording from near the base of the cliff in the middle distance

El Vado de los Padres¹

THE STORY OF THE OLD UTE FORD OF THE COLORADO RIVER, CROSSED IN 1776 BY THE SPANISH FATHERS, ESCALANTE AND DOMINGUEZ, AND NEARLY A CENTURY LATER BY THE MORMON PIONEER, HAMBLIN; LONG A ROUTE OF MARAUDING INDIANS

BY GEORGE C. FRASER

THE upper waters of the Colorado River are augmented by confluence with Green River in southeastern Utah. Thence for five hundred miles the river flows through a series of cañons trenching the plateau country and emerges into the open beyond the Grand Wash escarpment near the Arizona-Nevada boundary. Throughout this long stretch nature has provided but a single crossing, and that available only in autumn and winter when the river is low—the Old Ute Ford, best known as the Crossing of the Fathers (El Vado de los Padres) five miles north of the Utah-Arizona line. There are other places where the cañon walls break down and the river can be crossed with craft or by swimming; but swimming is always dangerous because of the ferocity of the stream, its swiftness, turbulence, and overload of silt. Under primitive conditions, therefore, this waterway was an effectual barrier, and its only ford was a factor of economic and ethnological influence.

The name, "Crossing of the Fathers," commemorates a most daring piece of exploration. On July 29, 1776, Fathers Francisco Silvestre Velez de Escalante and Francisco Atanasio Dominguez with seven Spaniards and some Indian servants left Santa Fé, New Mexico, in search of a new route to the Mission of Monterey, California. For about three hundred miles they followed substantially the line of

what later became known as the Old Spanish Trail, and then, abandoning this easier course, veered easterly and northerly through a portion of what is now Colorado. North of White River they turned to the west and in late September reached Utah Lake. The eighth of October found the party at the westerly margin of the snow-covered High Plateaus of southwestern Utah, suffering from cold, and with provisions nearly exhausted. The dangers ahead and the certainty, if Monterey were reached, that they would see Santa Fé again only after long delay, "prejudicial to the souls of the Indians to whom we promised to return and who sought their eternal welfare by means of holy baptism," led them to abandon their aim and seek the shortest way home. They headed south and by the fifteenth of the month appear to have reached the Virgin River near the site of St. George, Utah, in such condition that Escalante notes, "tonight all of our provisions are entirely gone, leaving us only two tablets of chocolate for tomorrow morning."

Had Escalante been fully informed, ten days' riding easterly on a fairly easy trail would have brought him and his party to the ford. Instead, under advice of frightened Indians, who perhaps were misunderstood, they wandered southerly into rough dry country, as if directed to the Colorado within the Grand Cañon or below Grand

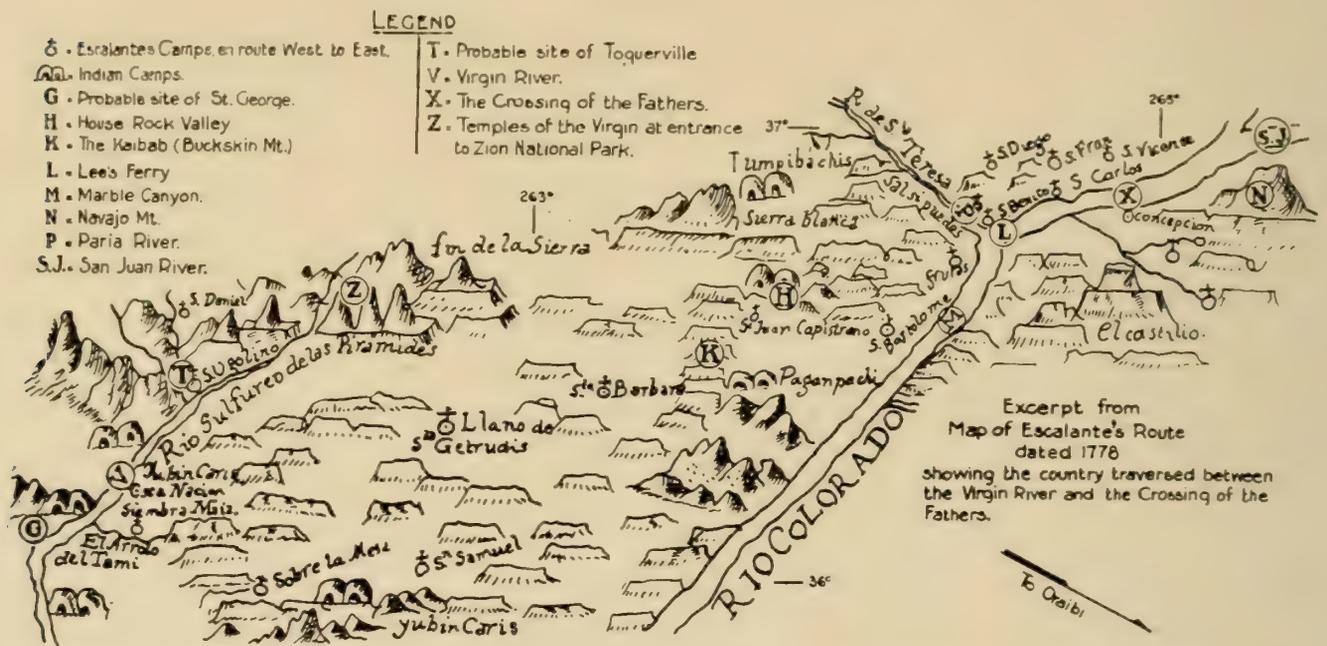
¹Photographs by the author, with the one exception noted

Wash. After becoming quite lost they turned to a proper easterly and northerly course, ultimately approaching the rim of Marble Cañon and coming to the river at the mouth of the Paria, the present Lee's Ferry.

Subsisting on seeds, cactus, herbs, piñon nuts, and the meat of such horses as could be spared, they threaded Paria Cañon a little way, scaled its northerly

ing it necessary to cut steps with their hatchets in the rock of the mountain. This cañon led in brief space to the Colorado River.

"We continued downstream for a distance of about two gun shots . . . until we reached what seemed the widest part of the current where there might be a ford. One of our people entered, and found a foothold, without



The map from which the above has been traced was lately found in Mexico, and a photograph thereof sent to Mr. F. W. Hodge, of the Museum of the American Indian, Heye Foundation, by whose kind permission this portion is reproduced

wall and with difficulty progressed over the broken bare rock surface in which the Colorado is here entrenched. Seven days later they "arrived for the second time at the river, that is to say, on the edge of the cañon, with its great bank and sides, from which the descent to the river is very long, very high, very precipitous and rocky," again to be disappointed in their search for the ford.

On proceeding upstream near the rim, "a trail not much traveled" was encountered leading to the river where it was "very wide" and "did not seem to be very deep, judging from the current." Finally, on November 7, a dangerous descent was made into a side cañon, the members of the party find-

being obliged to swim at any point. . . . At about five o'clock in the afternoon we all accomplished the passage of the river, praising the Lord our God, and firing off a number of musket shots to show the joy we felt at having triumphed over so great an obstacle, that had cost us so much labor and long delay."

Eight days more of strenuous though less trying travel brought the Padres to Oraibi, a village of the friendly Hopi, whence they proceeded by leisurely stages, via Zuñi and Acoma, to Santa Fé, ending, on January 2, 1777, a five months' journey of 1600 miles, for the most part unguided and through an unknown wilderness.

It has long been my desire to follow Escalante's trail. Portions of it I have covered in New Mexico, western Utah, and near the Utah-Arizona line, where I have wandered during many seasons with my friend, D. D. Rust of Kanab, Utah. Besides possessing the extra sense or two of the accomplished plainsman, Mr. Rust is versed in the history of his people and state and has supplemented college courses in natural science with acute and interested observation. To him I am indebted for seeing (and for the capacity to see) much that in other company would have escaped me, and for reference to many of the facts here noted.

The accuracy of description characteristic of Escalante's journal as a whole is wanting in the portion covering his journey from the Virgin River valley to Oraibi. The privations and anxiety endured during the weeks spent in this wilderness doubtless account for the fragmentary and inconclusive diary entries of that period. The salient physical features of the region will be fairly clear, however, to any one who has traversed it with attention and viewed it from high vantage points. Grateful indebtedness is acknowledged to Mr. F. W. Hodge of the Museum of the American Indian, Heye Foundation, for his courtesy in allowing the use here of part of a hitherto unpublished map of Escalante's route recently found in the Mexican archives. Reference to it discloses the course of Escalante's wanderings in the rough country between the Colorado and the established trail.

In the period intervening between Escalante's journey and the advent of the Mormons, other white men—trappers, prospectors, or Canadian voyageurs,—may have used or passed the Crossing, but the next reference to it

that I find is in connection with Jacob Hamblin, locally famous as an explorer and revered for his services as a missionary of the Mormon Church among the Indians.

In 1847, when Brigham Young led his followers to their promised land, the Latter-day Saints were as effectually cut off from the world and as dependent on the resources of their vicinage as was Robinson Crusoe. Almost everything requisite to existence had to be found in their new country. Primarily a colonizer, a Cecil Rhodes in our Southwest, President Young began the exploration of his territory immediately after the emigrants were assured of food by raising a crop near Salt Lake. As early as 1854, it was conceived that cotton and other warm-weather plants might be raised in the low-lying Virgin River valley, appropriately known in Utah as "Dixie." In 1855, a settlement was established near the site of St. George, where good soil and abundant water for irrigation combined with a mild climate to promise productivity. Among the first colonists was Jacob Hamblin, and to him fell the duty of establishing and maintaining friendly relations with the neighboring Indians, who then, as in Escalante's time, were engaged in primitive farming.

Hamblin's success as a diplomat, founded on rare tact, indomitable courage and strict observance of the truth in his dealings, marked him for further service as plenipotentiary of the Church. Accordingly, in 1858, he was commissioned to visit the Hopi on the far side of the Colorado, whither he set out with a party of twelve in late October.

"A Spanish interpreter was thought advisable from the fact that the Spanish language was spoken and

understood by many of the Indians in that region of country. A Welsh interpreter was taken along, thinking it possible that there might be some truth in a report which had been circulated that there were evidences of Welsh descent among these Indians. An Indian guide was requisite, from the fact that none of the brethren had traveled the route."

Going by Pipe Spring and across the northerly portion of the Kaibab "after climbing dangerous cliffs and crossing extensive fissures in the rocks, the tenth day out from home we crossed the Colorado River, at the Ute Ford, known in Spanish history as the 'Crossing of the Fathers,'" eighty-two years to the day, after Escalante's crossing.

Four of the brethren were left among the Hopi to "study their language, get acquainted with them, and, as they are of the blood of Israel, offer them the gospel"; the remainder returned by the same route, anticipating that "sixteen days of hard travel would be necessary to accomplish the journey." Intense cold, deep snow, loss of provisions by a runaway, and failure to encounter Indians from whom they might get meat, caused delay and privation, necessitating the killing of a horse for food. "The journey home was very laborious and disagreeable"—a volume in a sentence, for Hamblin was neither soft nor fastidious.

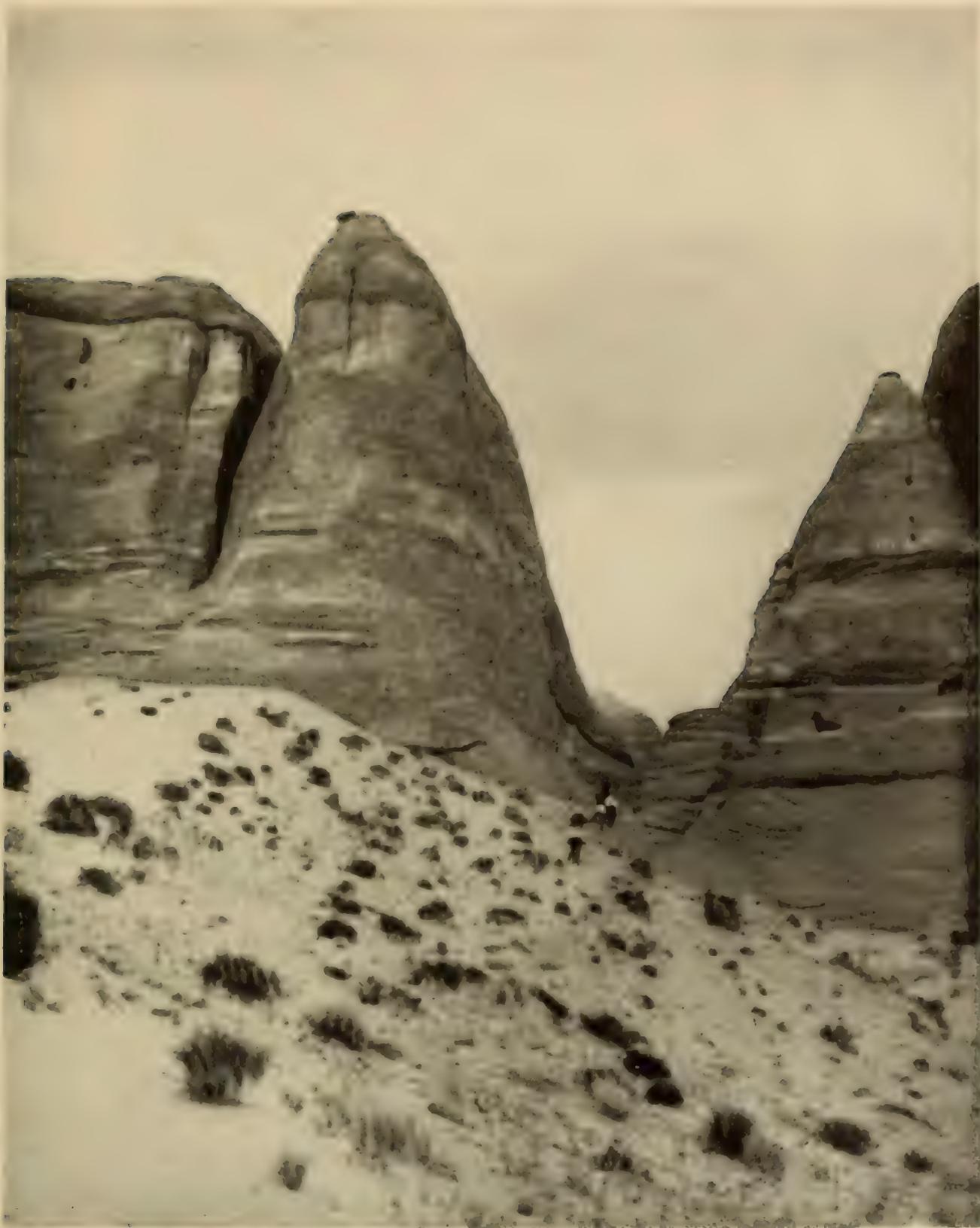
Hamblin again traversed the trail to the Hopi villages and back in the autumns of 1859 and 1860, maintaining a schedule of fifteen to seventeen days en route. In the course of the latter journey one of his companions was killed by Navajo and the rest were in jeopardy. Thanks to Hamblin's shrewdness, however, the party safely returned to the ford and thence arrived

at the settlement in nine days, "jaded and worn with hard travel and anxiety of mind."

Two years later Hamblin broke a new trail to the Hopi country across the river at the Grand Wash, over the Coconino Plateau, around the base of the San Francisco Mountains, and through the Painted Desert. Three Hopi returned with him and, although "they objected on account of a tradition forbidding them to cross the great river," he induced them to wade the ford on New Year's Day, 1863. Failure of the Welsh interpreter to be of service on the previous expedition had not stilled the rumor of the Hopi's Welsh extraction. These Indians were consequently promptly taken "to a Welshman who understood the ancient Welsh language. He said he could not detect anything in their language that would warrant a belief that they were of Welsh descent." Thereupon, "As Lehi promised his son Joseph that all his seed should not be destroyed, it was in the minds of the brethren who reflected upon this subject, that in the Moquis [Hopi] people this promise was fulfilled."

Hamblin had many of the qualities of the Spanish fathers. Convinced that Indians were the Lamanites of the Book of Mormon, and regarding them as errant brothers, he earnestly sought to minister to their spiritual welfare and ignored every risk and sacrifice involved in the service which his convictions demanded. Hamblin's early journeys over the ford paved the way for Mormon colonization in Arizona. His descendants now living on either side of the river recall his work as pioneer and leader in bringing about the settlement of the country.

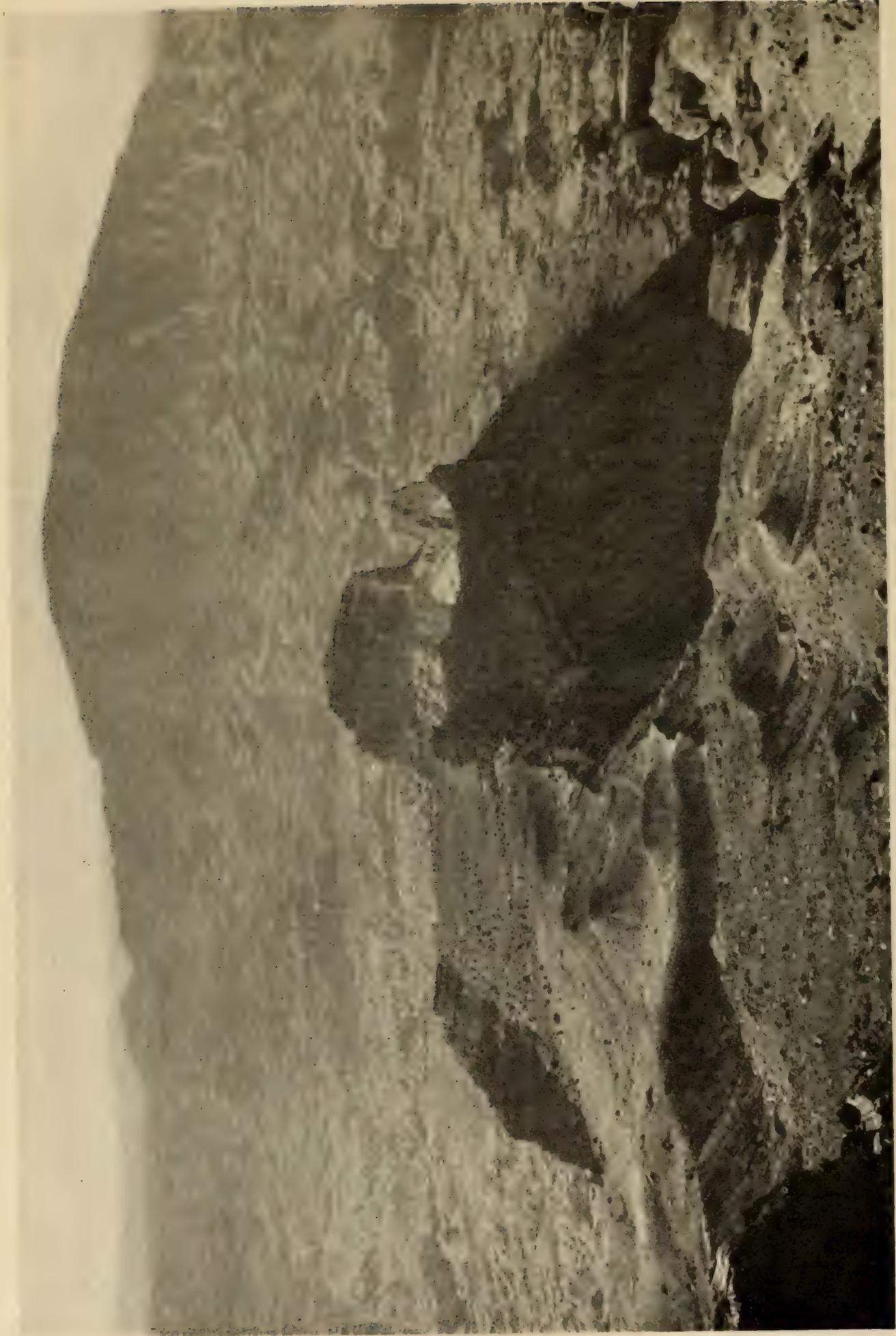
With the influx of settlers stock on the ranges multiplied, and much "of



"The Gunsight."—The trail to the Crossing from the west is blocked by a rocky spur jutting to the cañon rim from the heights bounding the river plain. The notch in the center of the picture, however, affords a pass, steep of approach and barely wide enough to accommodate packs. It is shaped like the rear sight of a rifle and when looked through, as here, reveals a distant knob analogous to the front sight of a gun; hence the name

the vegetation that had produced nutritious seeds, on which the Indians had been accustomed to subsist," was devoured. "Lank hunger," which resulted, led to many depredations; the settlers retaliated, often to the injury of the unoffending when the

culprits had escaped, so that those who were well-disposed also became desperate. A striking feature of travel in this country is the recurring evidence of the effect settlement and overstocking the ranges has had upon plant life and even the face of the land.



NAVAJO MOUNTAIN

This view is from the southerly point of Kaiparowits Plateau, a narrow strip, fifty miles long, of high land between low-lying deserts. At the foot of the straight sheer walls defining its summit are unresistant shales underlain by cliff-making sandstones forming a bench which terminates in the serpent's tongue in the foreground. Beyond, the Colorado River's cañon cuts from left to right across the bare floor of the Rainbow Plateau; the great Natural Bridge spans a tributary draining from the right base of the mountain. The difference in altitude between the cañon's rim and the mountain's summit is a mile and a quarter; from camera to peak in an air line is nearly fifteen miles

Pioneers say that in the earliest days the Utes were to be feared and the Navajo were not troublesome until the sixties. This accords with the inference to be drawn from the Crossing's original name—the Old Ute Ford. Navajo raided at Kanab and Pipe Spring in 1865 and 1866, and two men were killed near the latter place. This led to Hamblin's organizing a body of Piutes to coöperate with the brethren in watching the eastern frontier. He spent the next four seasons cultivating peace with the Indians on the west side of the river and guarding the passes, occasionally having a skirmish with the Navajo.

The era of scientific exploration commenced at this time. Major Powell on his cañon voyage in 1869, recognized the Crossing from Escalante's description, and noted there a well beaten trail and the ashes of many camp fires.

A detachment of the Wheeler Survey visited the ford in 1872, and reported, "The scene is of remarkable grandeur and almost unique in its loneliness."

The early seventies saw the beginnings of Mormon settlement east of the Colorado. As the trail via the Crossing was impracticable for wagons, the colonists used either a route into the San Juan country, striking the river to the north, at Hole in the Rock, near the mouth of the Escalante River, where a stretch of still water made it possible to float rafts and wagon boxes across, or Lee's Ferry, forty miles to the south, where a boat was kept after 1871, and through which a road was laid out in 1873, giving access to northern Arizona. The ford consequently fell into disuse save by marauding Navajo. To stop their raids the sufferers finally blasted away the rock

trail leading to the river on the west side and thus effectually relegated the Crossing of the Fathers to history.

The country about the Crossing is barren, rocky, cut by deep cañons, dominated by high buttes, and lined with precipitous walls. Here color, in delicacy of shade and sharpness of contrast, combines with the natural sculpture, light, and atmosphere to create effects beautiful and appealing. An earlier generation of geologists—Newberry, Powell, Gilbert, Dutton, Marvine, Howell, Thompson, to mention only a few—in this vicinity learned their science at first-hand from the book of Mother Earth, wide-open and illustrated in color. Such scenery, moreover, carries interest in the tale it unfolds of geologic processes obscured in more favored regions. Here nature, stripped of her accustomed mantle of vegetation, unreservedly reveals her curves of beauty and her faults—the structures and fractures influencing the plateau province's major topography—and through the distinct and varied tinting, texture, and form of the features displayed, lays herself open to appreciative observation.

Little traveled nowadays, the trail to the Crossing still bears evidence of long usage, and occasional artefacts strewn along it speak loudly of the past. The abandonment of the ford in favor of more accessible ferries leaves this section deserted save by cowmen and shepherders, who find sparse winter range for their stock in the low lands near the river. A journey thither now, as in all previous time, calls for good trail horses and pack animals, the same equipment Escalante and Hamblin had, for it is—and until the Colorado shall be dammed and harnessed, will remain—remote and difficult of access.

PARIA SETTLEMENT

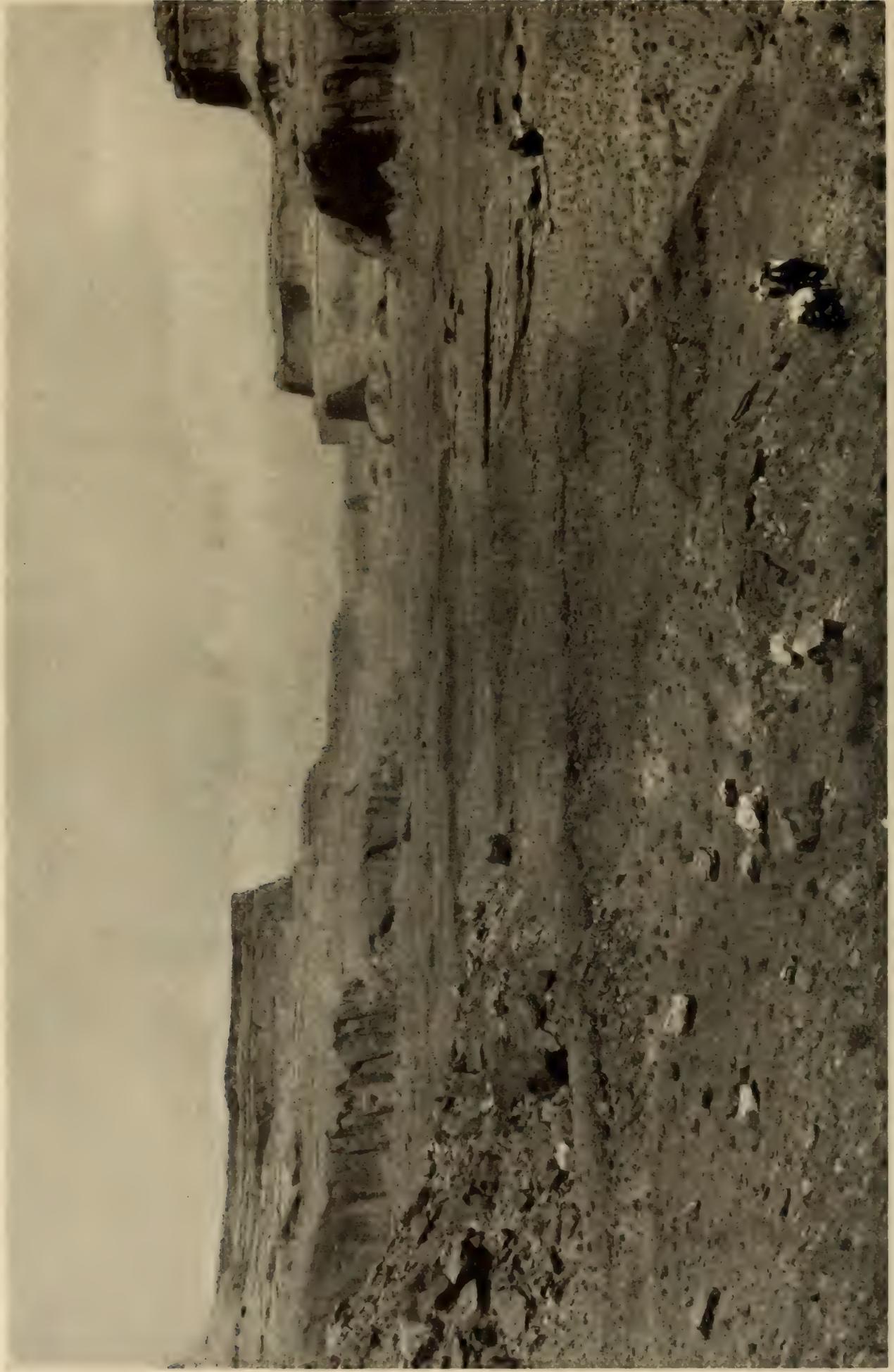
On the river of the same name, forty-five miles from the Crossing, is Paria Settlement. In the nineties this was a community of more than twenty families; now only one house remains, and in it the owner of the ranch that is shown in the picture and his four boys "batch" during the summer months. It is said that thirty years ago the wash was thirty-five feet wide, as against a furlong or more today. In the interval most of the arable land, with its improvements, has been washed away by the floods whose vehemence is attributable to the destruction of vegetation wrought by stock on the ranges tributary to the stream. The cliffs across the river are the same variegated shales that have aroused enthusiasm for the coloring of the Painted Desert



SAND ROCK SPRING

The only good water on the trail from Paria to the Crossing is obtainable at Sand Rock Spring, a seep so feeble that it took nearly two hours to water this outfit. On the far horizon in the left center are the Vermilion Cliffs at the end of the Paria Plateau and the Echo Peaks above Lee's Ferry, seventeen miles southwest of the spring. Escalante wandered over the intervening country in the last days of his search for the ford. At Lee's Ferry the Colorado emerges from Glen Cañon and immediately entrenches itself in the floor of the Painted Desert, threading Marble Cañon to the amphitheater about its junction with the Little Colorado at the head of the Grand Cañon.

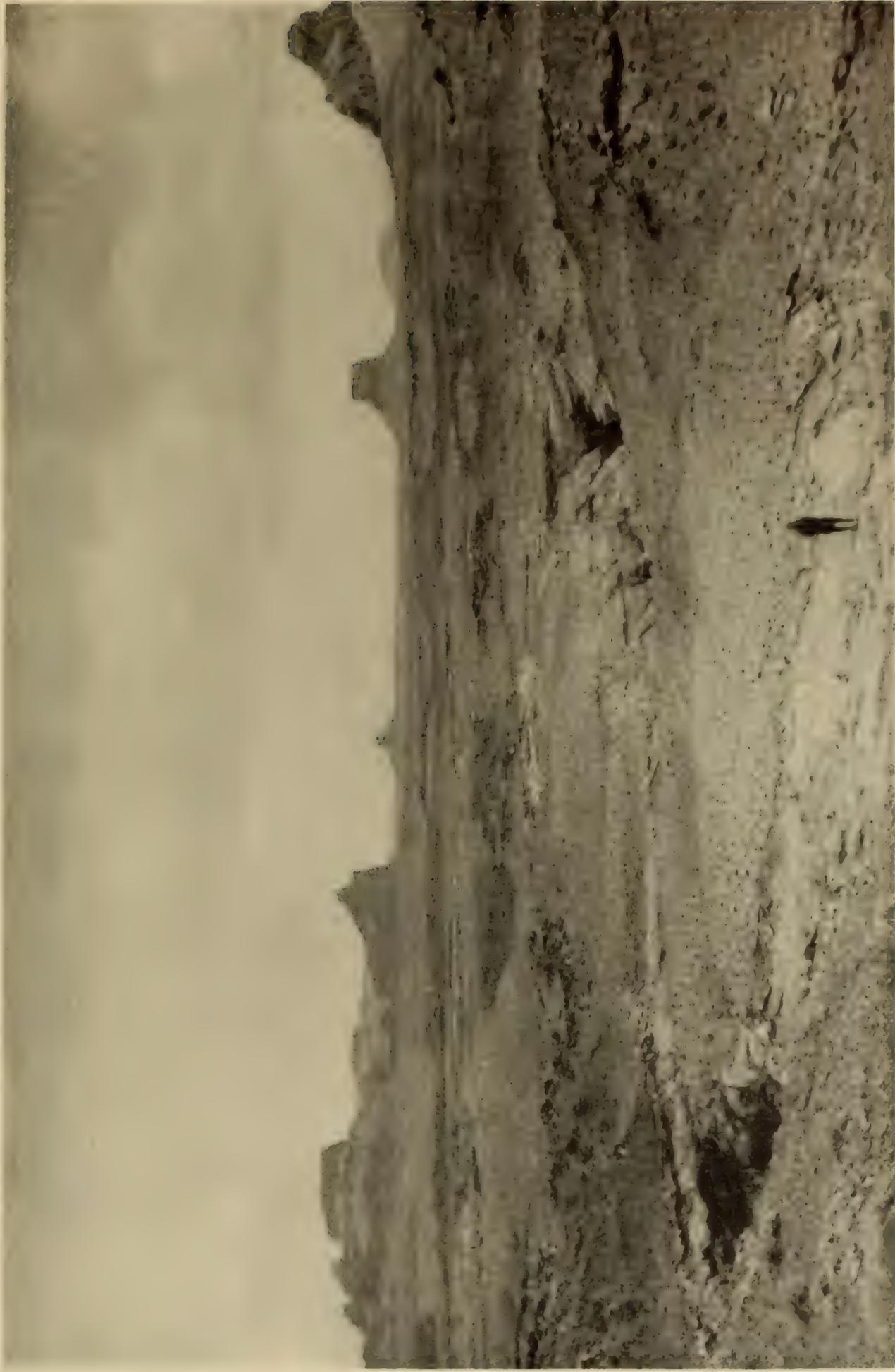




LAST CHANCE

This scene is typical of the side cañons tributary to the Colorado near the Crossing. The name Last Chance was given to this creek because the water in its upper reaches is the last to be had for a long while as one follows the trail to the settlements

This scene is typical of the side cañons tributary to the Colorado near the Crossing. The name *Last Chance* was given to this creek because the water in its upper reaches is the last to be had for a long while as one follows the trail to the settlements.



TOWER BUTTE AND OTHER MONUMENTS NEAR THE CROSSING

The Colorado flows from left to right between the camera and the buttes; the easterly wall of its cañon shows at the left. In the center is one of Hamblin's "fissures"; such cañons are frequent obstacles to travel, necessitating long detours and preventing the skirting of the rim for any distance



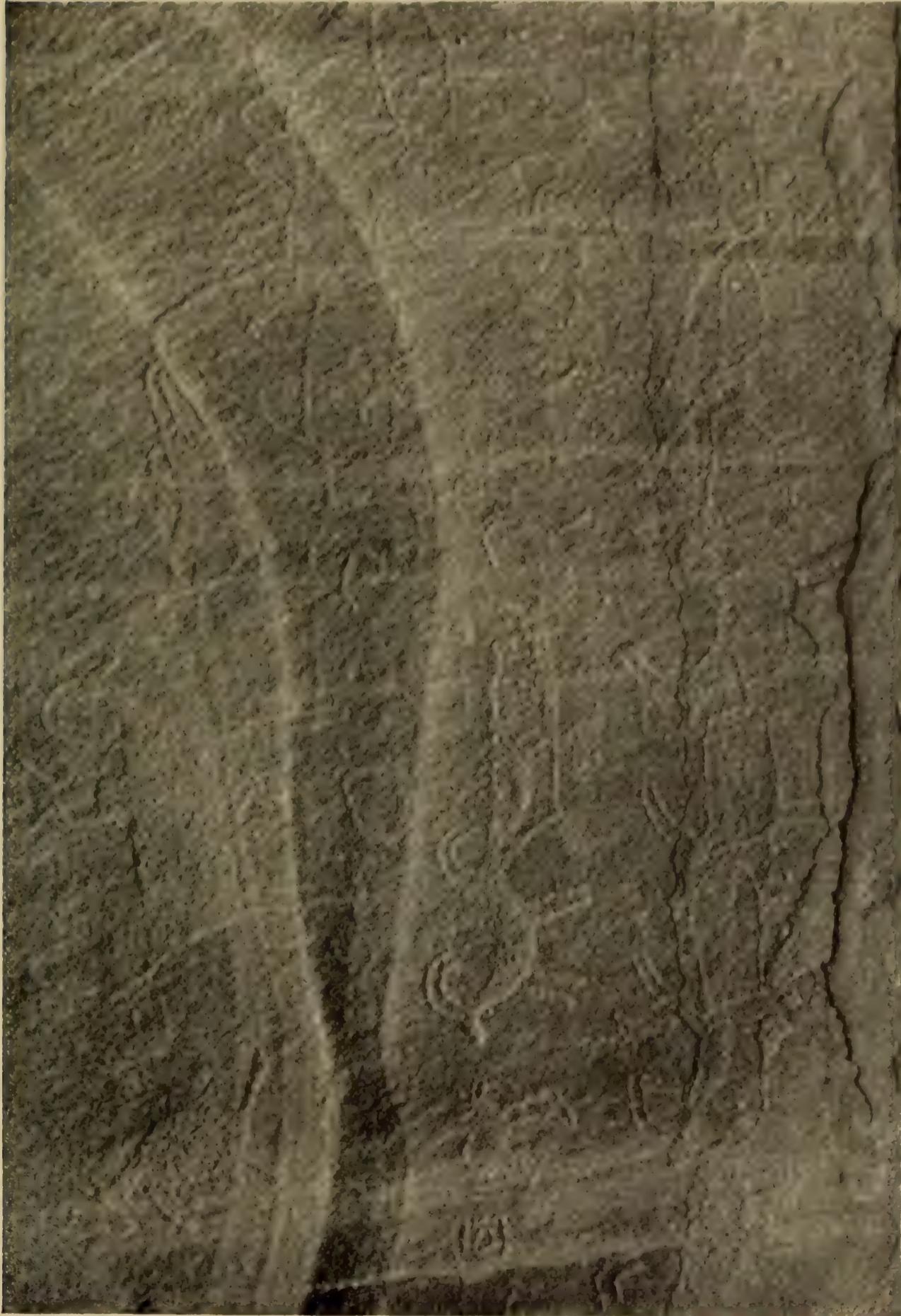
Photographed by N. W. Bass, of the United States Geological Survey

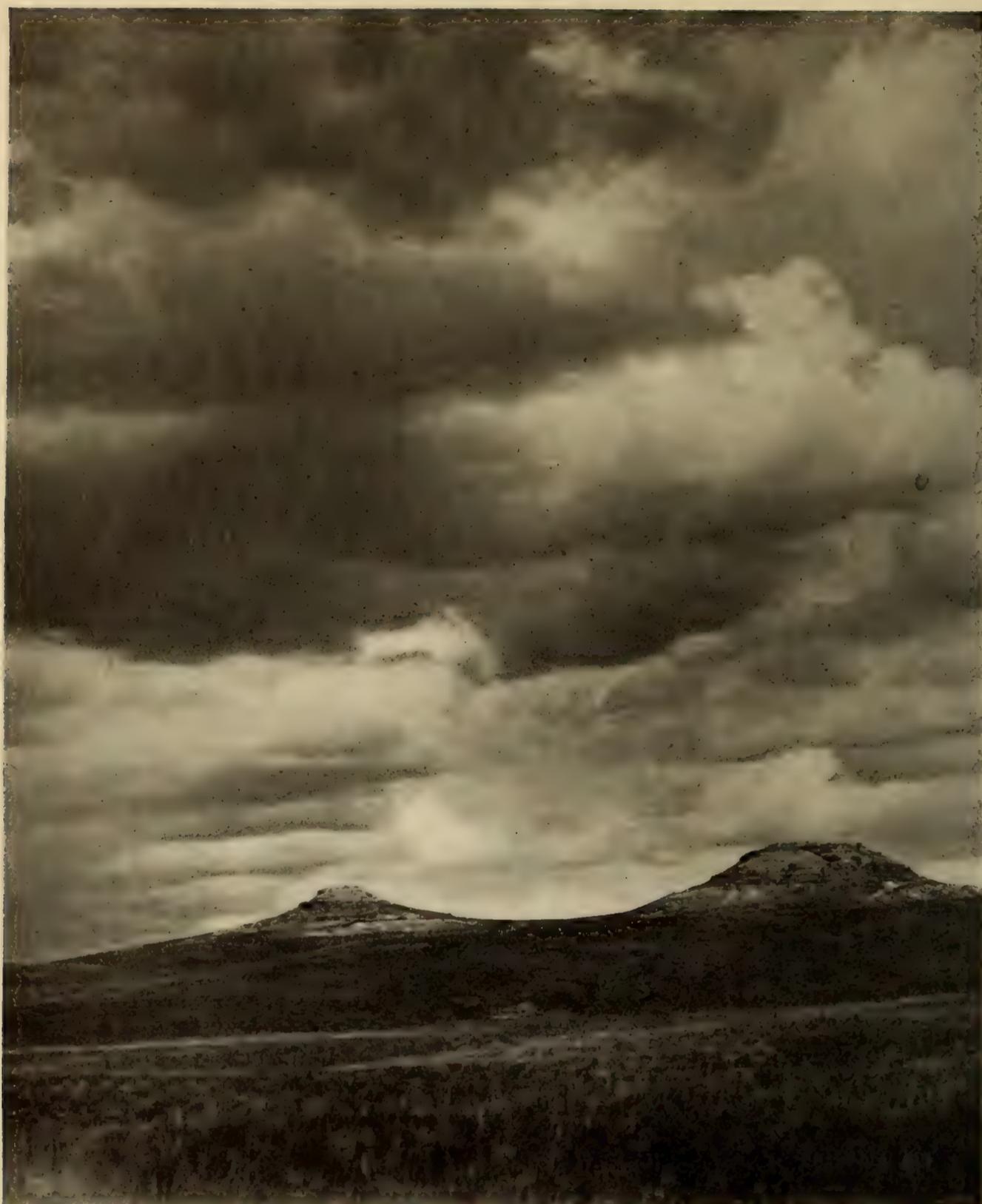
MOUNTAIN SHEEP

This bunch was encountered in Rock Creek Cañon, northwest of the Crossing, by a United States Geological Survey party in August, 1922

A RECORD IN THE
ROCKS

This petroglyph in Temple Creek Cañon, near the Water Pocket Fold, depicts a number of mountain sheep and warrants the inference that those animals were plentiful in this region before the white men came. The picture on the opposite page is evidence that some remain. Sculpture in relief like this is frequently found on smooth sandstone surfaces, pecked by hammer stones or cut with pointed instruments. There are also other vestiges of a vanished race: pottery, stone implements, crude paintings, and occasional cliff dwellings.





THE AGATE FOSSIL QUARRY IN WESTERN NEBRASKA

The two isolated hills are outliers of the high plain through which the Niobrara River has cut a broad valley. The bone layer is a little above the level of the saddle between the two hills and outcrops all around the slopes of both peaks but is especially rich on the south (right hand) face of Carnegie Hill, the larger hill to the right. Here are situated the principal quarries of the Carnegie Museum and of the American Museum, the dump showing as a level terrace in front of the quarries. The University of Nebraska opened a quarry on the smaller hill, hence called University Hill, and secured from it a fine collection.

It is estimated that the total accumulation of bones in Carnegie Hill represents about 17,000 skeletons, chiefly of the little pair-horned rhinoceros, or *Diceratherium*

Fossil Bones in the Rock

THE FOSSIL QUARRY NEAR AGATE, SIOUX COUNTY, NEBRASKA

BY W. D. MATTHEW

Curator-in-Chief, Division of Mineralogy and Geology, American Museum

THE Agate Fossil Quarry, discovered by James H. Cook in 1877, is one of the greatest fossil quarries ever found in America. The bones are in a layer from six to twenty inches thick, packed closely together. They are seldom articulated, but most of the bones of a single skeleton lie near together, although some parts may be found at a little distance.

The quarry is near the Niobrara River, although seventy-five feet above its present level. It is in the Lower Harrison beds of the Arickaree formation, belonging to the beginning of the Miocene epoch of the Age of Mammals, or Tertiary Period. The formation is a rather soft sandstone of light gray color, made by the accumulated flood-plain sediments of a river that flowed eastward across the plains, for then as now the region was one of open country and grassy savannas. It is believed that the accumulation of bones was formed in an eddy in the old river channel at a time when the valley was not so deeply cut out as it is now and when the river flowed at the higher level. A pool would be formed at this eddy, with quicksands at its bottom, and many of the animals that came to drink at the pool in dry seasons would be trapped and buried by the quicksand. The covering of sand would serve to protect the bones from decay and prevent them from being rolled or waterworn by the current, or from being crushed and broken up by the trampling of animals that came there to drink. But sand of this kind is always moving and shifting (whence

its name of *quick*) and with it the buried bones would be shifted around, disarticulated, and displaced, so that when finally buried deeper by later sediments of the river valley, they would be preserved as they are found here, complete and almost undamaged, yet all separate and dissociated.

The bones taken from this quarry belong almost wholly to three species:

(1) The dwarf pair-horned rhinoceros *Diceratherium cooki*.

(2) The chalicothere, or clawed ungulate, *Moropus elatus*.

(3) The entelodont, or giant pig, *Dinohyus hollandi*.

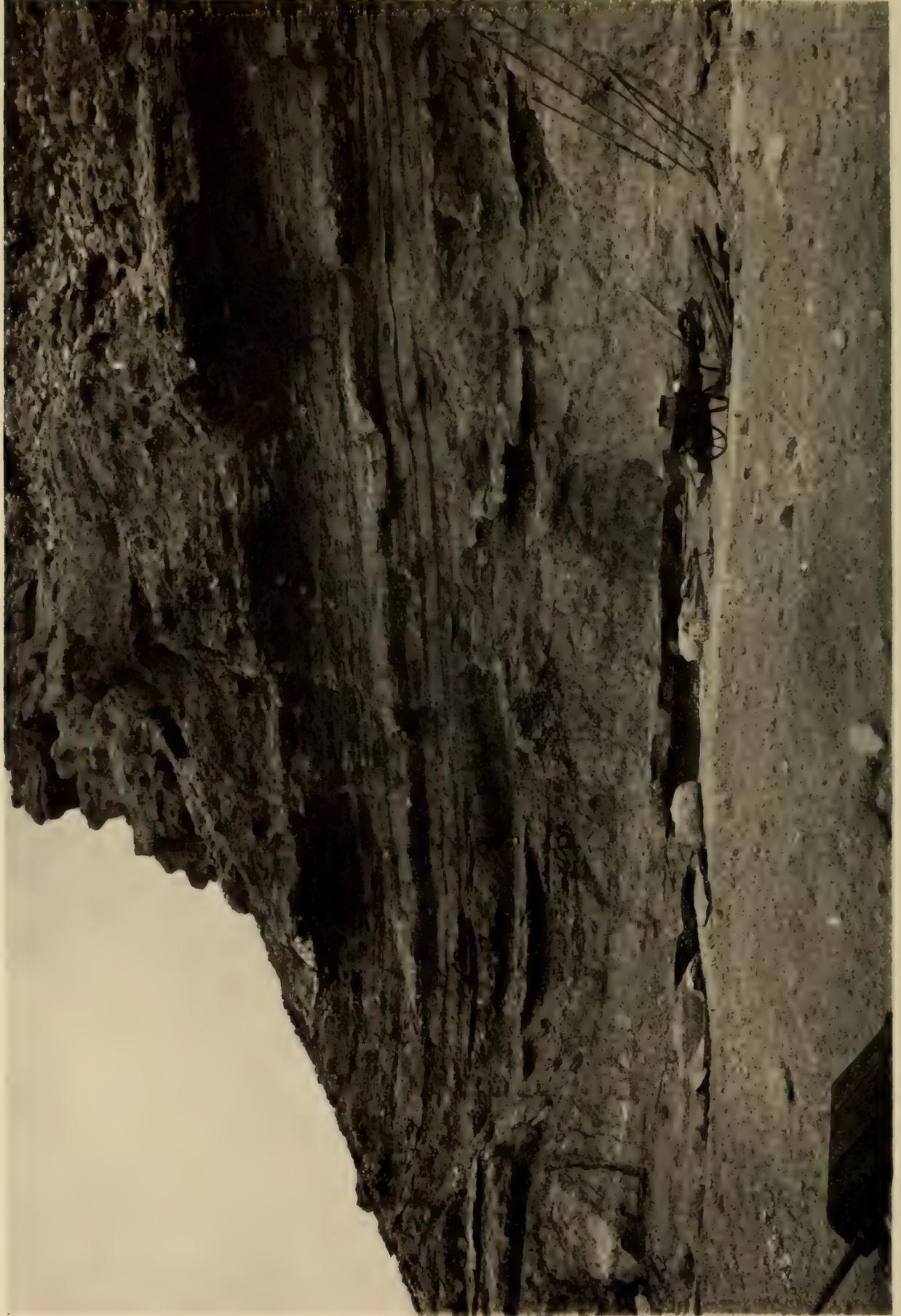
The little rhinoceros is by far the most abundant and has been found everywhere in the bone layer. The *Moropus* is found chiefly in the northern end of the quarry, and the *Dinohyus* is the least abundant.

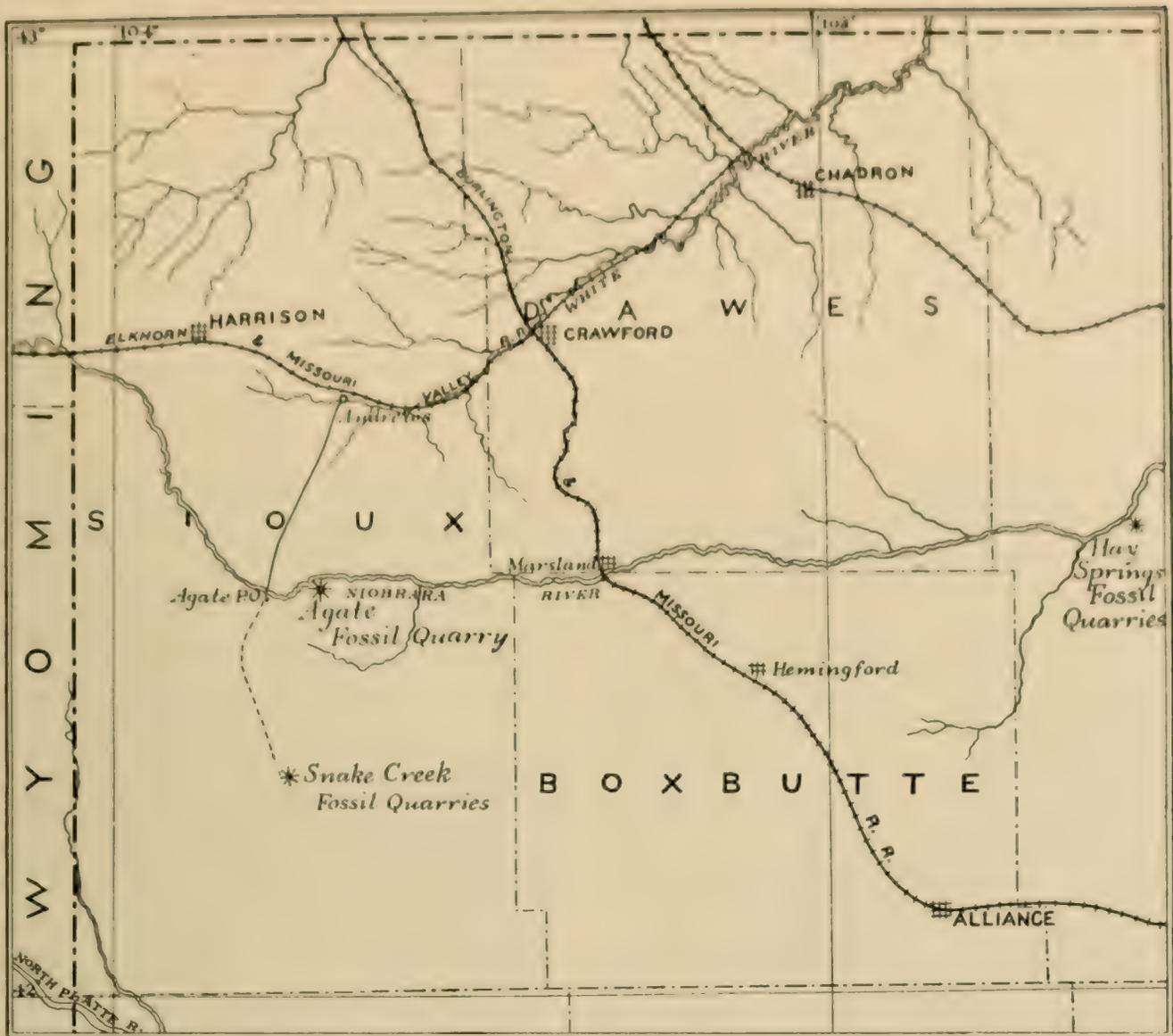
A block, $5\frac{1}{2} \times 8$ feet, taken from this quarry in 1920 and now on exhibition in the hall of fossil mammals, American Museum, contains twenty-two skulls and an uncounted number of skeleton bones, all of the little rhinoceros. If the various bones of the body and limbs correspond in numbers to the skulls, we may estimate the total number of bones as follows:

Each skeleton of a dicerathere consists of	
skull and lower jaw.....	2 bones
7 cervical, 19 dorsal, 5 lumbar, 26 caudal vertebræ, and the sacrum.....	58 ..
19 pairs of ribs.....	38 ..
5 sternal segments.....	5 ..
2 scapulæ, humeri, radii, and ulnæ.....	8 ..
8 carpals on each fore foot....	16 ..

NEAR VIEW OF PART OF
THE AGATE FOSSIL
QUARRY

Here the American Museum obtained a series of skeletons of the great clawed ungulate *Moropus*. The vertical face of the quarry is composed of alternating layers of harder and softer sandstone and was cut down by blasting to a floor about two feet above the bone layer. Careful prospecting with hand picks and digging awls exposed enough of the layer to enable the collector to recognize the bones, which were treated by the bandaging method and removed. In following out the fossil layer the rock wall has been undercut at the base as far as it was safe to do so without timbering





Northwestern Nebraska, showing location of Agate Fossil Quarry

4 metacarpals (one vestigial) on each fore foot.....	8	bones
9 phalanges on each fore foot.	18	"
Pelvis, 2 femora, 2 tibiae, 2 fibulae.....	7	"
7 tarsals on each hind foot....	14	"
3 metatarsals on each hind foot	6	"
9 phalanges on each hind foot.	18	"
	198	"

Twenty-two skeletons, each of 198 bones, give a total of 4356 bones in this block of 44 square feet, or on the average 99 bones to the square foot. It is doubtless true that many of the bones belonging to these twenty-two skulls are not in this block; but by the laws of chance their numbers should be offset by a corresponding number of skeleton bones which are in this block but belong to skulls that are not here.

The total area of quarry opened up by the American Museum amounts to about 2750 square feet. The bones in a large part of this area were as abundant, apparently, as in this block. In other parts the bone layer is much thinner. An average of a little less than one-half the numbers shown in this block, or forty bones to the square foot, would perhaps constitute a fair estimate. In addition to the area uncovered by the American Museum, about 1350 square feet have been excavated by the Carnegie Museum. On the basis of forty bones to the square foot there are in this excavated area 164,000 rhinoceros bones, belonging to 820 skeletons. Mr. Peterson estimated that more than two hundred individuals of *Diceratherium* were represented in the Carnegie collection alone.

According to the estimate of Mr. Albert Thomson, field representative of the American Museum, not more than five per cent (one-twentieth) of the total area of the bone deposit has been uncovered if, as appears probable, it extends through the entire isolated hill. On this basis the total



James H. Cook, the discoverer of the fossil quarry, well known as an army scout in his early days, settled on the Niobrara in the seventies. His ranch, covering many thousands of acres in and along the fertile little valley, has become a place of pilgrimage for visitors from far and near

number of skeletons in the hill may be roughly estimated at:

<i>Diceratherium</i>	820×20.....	16,400
<i>Moropus</i>	25×20.....	500
<i>Dinohyus</i>	5×20.....	100

The number is probably too high for the *Moropus* and *Dinohyus*, but too low for the *Diceratherium*.

It is to be observed that the five per cent excavated has cost more than \$20,000, not including the expenditure for preparation work, which would amount to a much larger sum than the

collecting. If one had a million dollars to spend!—but then if one had, there are a good many other problems that would be more important to investigate. I think it unlikely that the great quarry will ever be entirely cleaned up—at any rate not in our day, it is to be feared.

The Agate Fossil Quarry was discovered by James H. Cook. It is situated on the eastern border of his ranch, which extends for some miles westward on the Upper Niobrara River, or Running Water, to the Nebraska-Wyoming line. It was upon Mr. Cook's invitation that various museum expeditions have undertaken collecting work in and around the fossil quarries,



Harold Cook, son of James H. Cook, is the owner of the quarry. He is a palæontologist of high standing, devoting such time as he can spare from the care of the ranch to fossil hunting and the study of the very considerable collection that he has brought together. Many valuable fossils in the museums in New York, Lincoln (Nebraska), and Pittsburgh were found by him

and all are indebted to him for many and various kindnesses. The quarry is owned by his son, Harold J. Cook, who, himself an expert palæontologist, has maintained the family tradition of

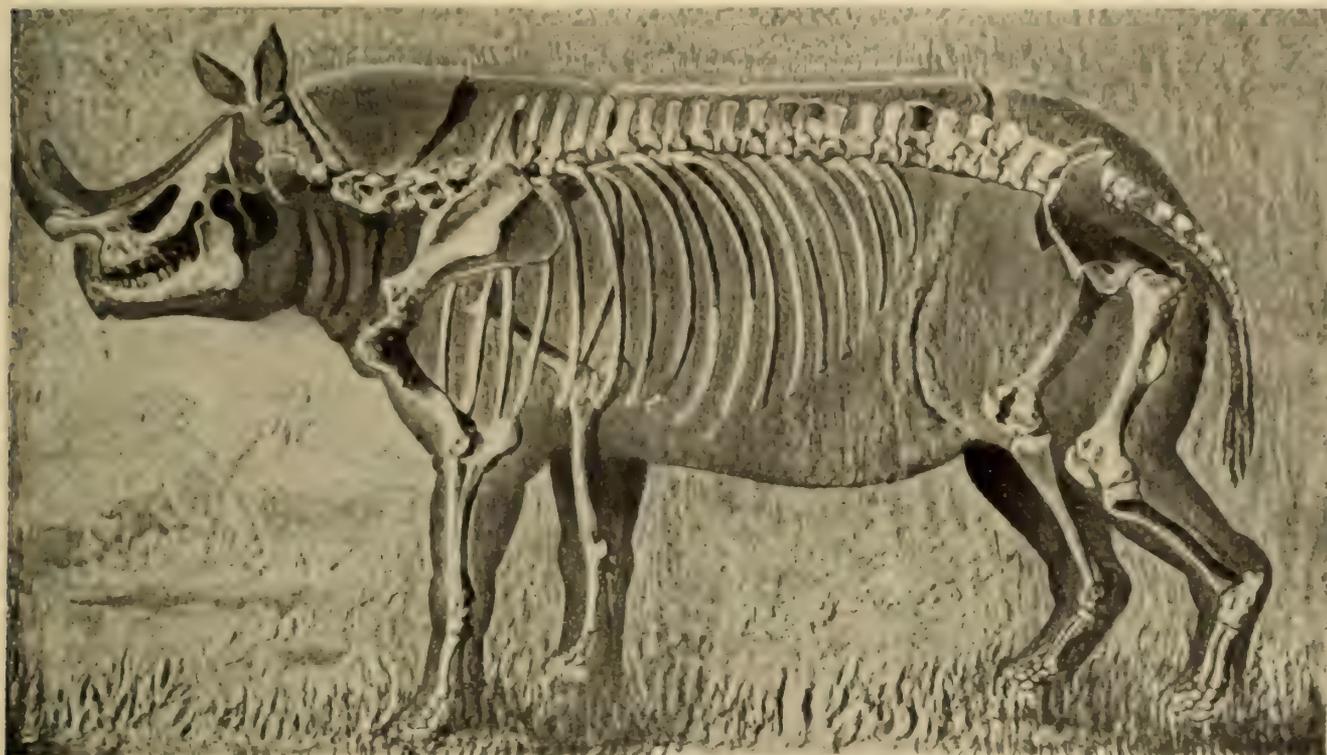
open-minded generosity, and to his courtesy and aid the many scientific museums in this country and in Europe are directly or indirectly under obligations for their representation of fossils from this remarkable quarry.

The *Diceratherium*, by far the most abundant fossil in the quarry, is a rhinoceros with a pair of horns placed side by side on the nose instead of with

blunt nubs like the back horn of a white rhinoceros.

Skeletons of the *Diceratherium* from this quarry have been mounted in various scientific museums. It is the intention to mount a group of them for exhibit in the American Museum. *v*4

The *Moropus* belongs to the chalicotheriids, an extinct family of mammals of the order Perissodactyla and



Courtesy of the University of Nebraska

The *Diceratherium*, or pair-horned rhinoceros, was about the size of a year-old calf and had a pair of small horns, or bony nubs, at the front of the muzzle instead of the single or the tandem horns of the modern rhinoceroses. The mounting of the skeleton on a panel, with the restored form of the animal and an appropriate scenic background faintly suggested, represents an unusual and very artistic method devised by Professor E. H. Barbour

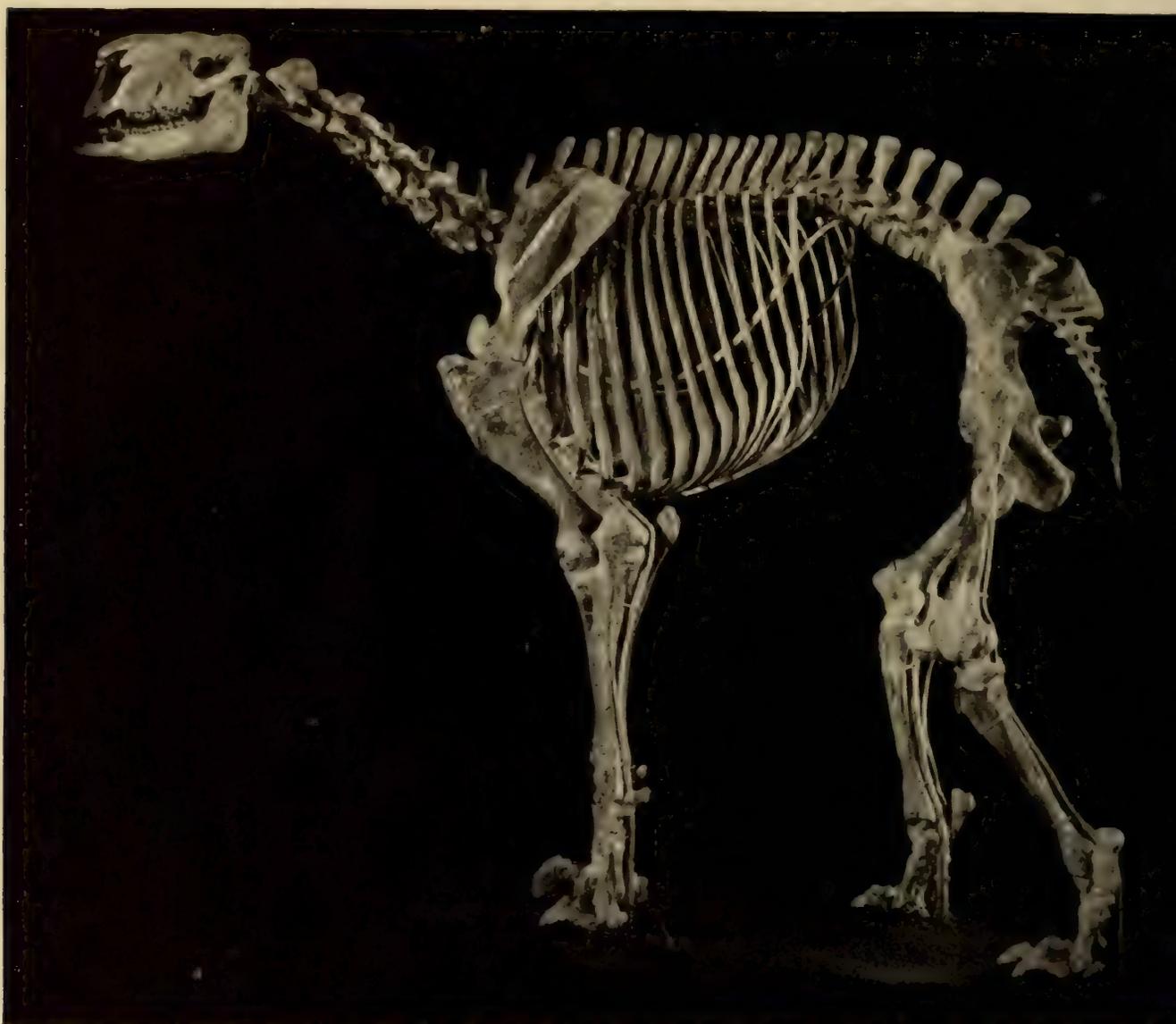
the single horn of the Indian rhinoceros or the "tandem" arrangement of the horns seen in the two African rhinoceroses. These pair-horned rhinoceroses lived about the middle of the Age of Mammals, and various species have been found all over western Europe and in North America from New Jersey to Oregon. The species of the quarry was a small one, a little larger than a pig, with somewhat the same proportions of body, but a very different head. The horns were probably not long and pointed, but stout

about equally related to the horse, the rhinoceros, the tapir, and the titanothere (also extinct). It combines characters of all four of these animals with some peculiarities of its own. The neck and the general shape of the head remind one of the horse. The short arched back, sloping hips, and rudimentary tail, suggest the tapir. The limbs and feet resemble the proportions and construction of the great modern rhinoceroses, except that the fore limbs are longer. The grinding teeth are most like those of the extinct

titanotheres, while the front teeth are those of a ruminant. But the toes are the most remarkable feature of this odd beast, for they are tipped with claws instead of hoofs as in horses, tapirs, rhinoceroses, etc. This feature, in an animal that certainly is one of the

the pangolin. Only when they were found together as parts of the same skeleton was the proof afforded that they belonged to the same animal.

The chalicotheres are rather scarce among the fossils of Europe and Asia and exceedingly rare in America, except



Skeleton of the *Moropus*, or clawed ungulate, in the American Museum.—The name “clawed ungulate” sounds like a contradiction in terms, for the distinguishing feature of the ungulates is that they have hoofs instead of claws. The *Moropus*, however, belongs unmistakably to the ungulate division. It is related, although distantly, to the horses, tapirs, and rhinoceroses, but in its case the hoofs have been changed into large compressed claws on the forefeet and into smaller claws on the hind foot. The animal is as large as a modern camel

ungulates, as shown by every other character of its skeleton, is unique and very difficult to explain. When the bones of chalicotheres were first discovered in western Europe, the skull and teeth were recognized as being akin to those of the titanotheres, etc., but the toe bones were supposed to be those of a gigantic edentate related to

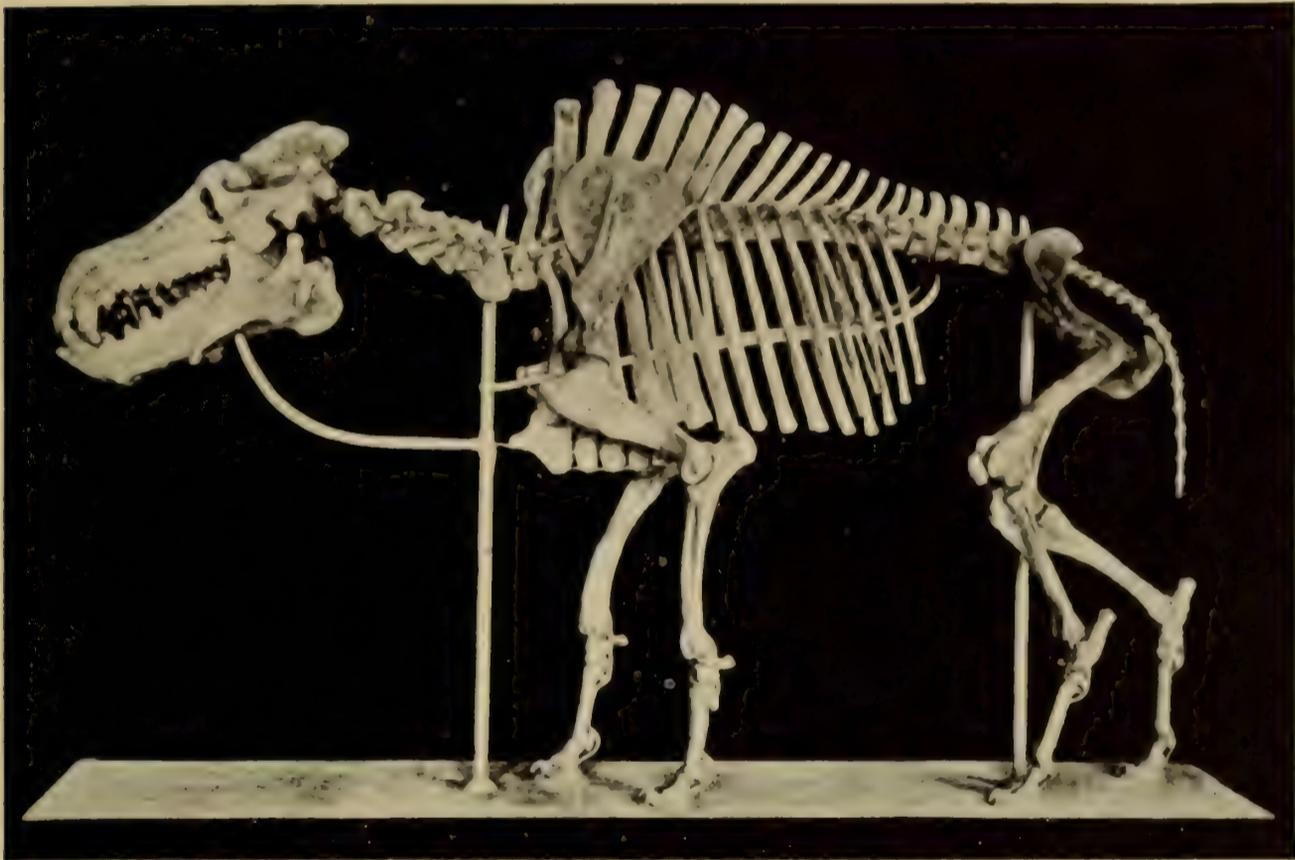
in this quarry. They are by no means so common in the quarry as the rhinoceroses, but a number of incomplete skeletons were obtained by the Carnegie Museum, and seventeen complete skeletons by the American Museum.

The *Dinohyus* is the largest of the entelodonts. These extinct animals are commonly called giant pigs, al

though they were not very piglike in appearance, and were not related to the pigs any more closely than to the ruminants. These entelodonts are fairly common in some of the American formations, and are also found, although more rarely, in Europe and Asia. They were rather tall, but compactly proportioned, with two-toed feet like a bison's, very large, heads with long muzzles and large, powerful tusks. The tusks and indeed all the front teeth are much more like those of

tions is to cut down the overlying rock to about two feet above the bone layer. This is done by the usual methods of rock-cutting with drills, dynamite, and blasting powder, heavy picks to trim the rough surface to a floor, and team and scraper to remove the débris.

Next comes the far more careful work of removing the cover down to the bone layer itself. This must be done with light hand picks, awls, and whisks, the débris being shoveled away as it accumulates. As soon as bone is



Courtesy of the Carnegie Museum.

Skeleton of the *Dinohyus*, or giant pig, in the Carnegie Museum at Pittsburgh. This animal was somewhat larger than a modern bison, but the huge head, with its long jaws and powerful, wolflike teeth, suggests a fierce, aggressive beast, as active as a bison and more savage than a wild boar

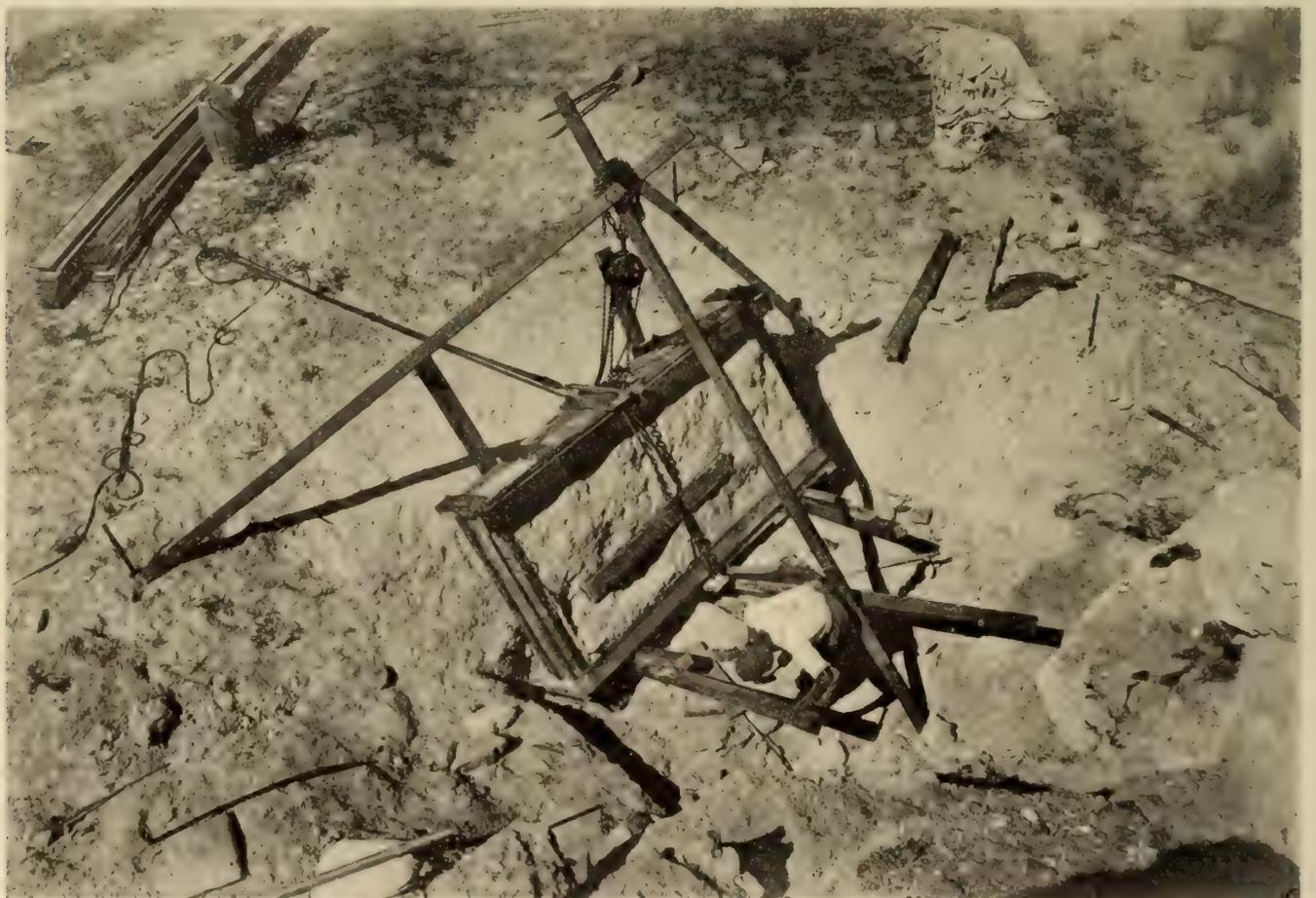
wolves or other large carnivores than like those of any living herbivora, while the back teeth are of omnivorous type. These formidable beasts were probably omnivorous like the pigs and bears, but better equipped than either to pursue and attack animal prey.

It may be of interest to the reader to know how these fossils are taken out of the quarry. The first stage of opera-

reached, its surface is carefully followed and exposed. It is cleaned with small soft brushes whereby the risk is avoided of breaking through the delicate brittle outer skin of the bone surface, and it is soaked with thinned shellac varnish, especially at parts found to be cracked or shattered. When a considerable strip of the bone surface has been thus exposed, the lay



When this large block was taken from the bone layer at the Agate Fossil Quarry, it was channeled all around, the edges were undercut, and the top and sides were bandaged with strips of burlap dipped in cement. A box was then built around it, tightened with long rods bolted from side to side and end to end, as well as through the middle beneath the bone layer, and a crisscross of wooden braces was fitted over the surface before the cover was nailed down on it



When completely boxed in, this block, weighing more than two tons, was jarred loose from the rock floor, lifted, and turned over with tripod and tackle. The under side was then trimmed off, flooded with cement, and the bottom nailed on. The block was then turned right side up, loaded on a wagon, and hauled twenty miles to the railroad

of the bones can be studied and a decision made as to how the problem of taking them out can best be handled. If some of the bones belonging to the rarer *Moropus* or *Dinohyus* are lying closely packed in with a mass of *Diceratherium* bones, it may be necessary to sacrifice some of the latter in order to channel around the more valuable bones, and secure all of these without damage. If large blocks of the dicerathere bones are desired, it will be necessary to channel all around them, at the sacrifice of some other parts. In any event the bone layer must be reduced to blocks of a size that can be handled and transported, which means usually not over four or five feet square and one or two feet thick.

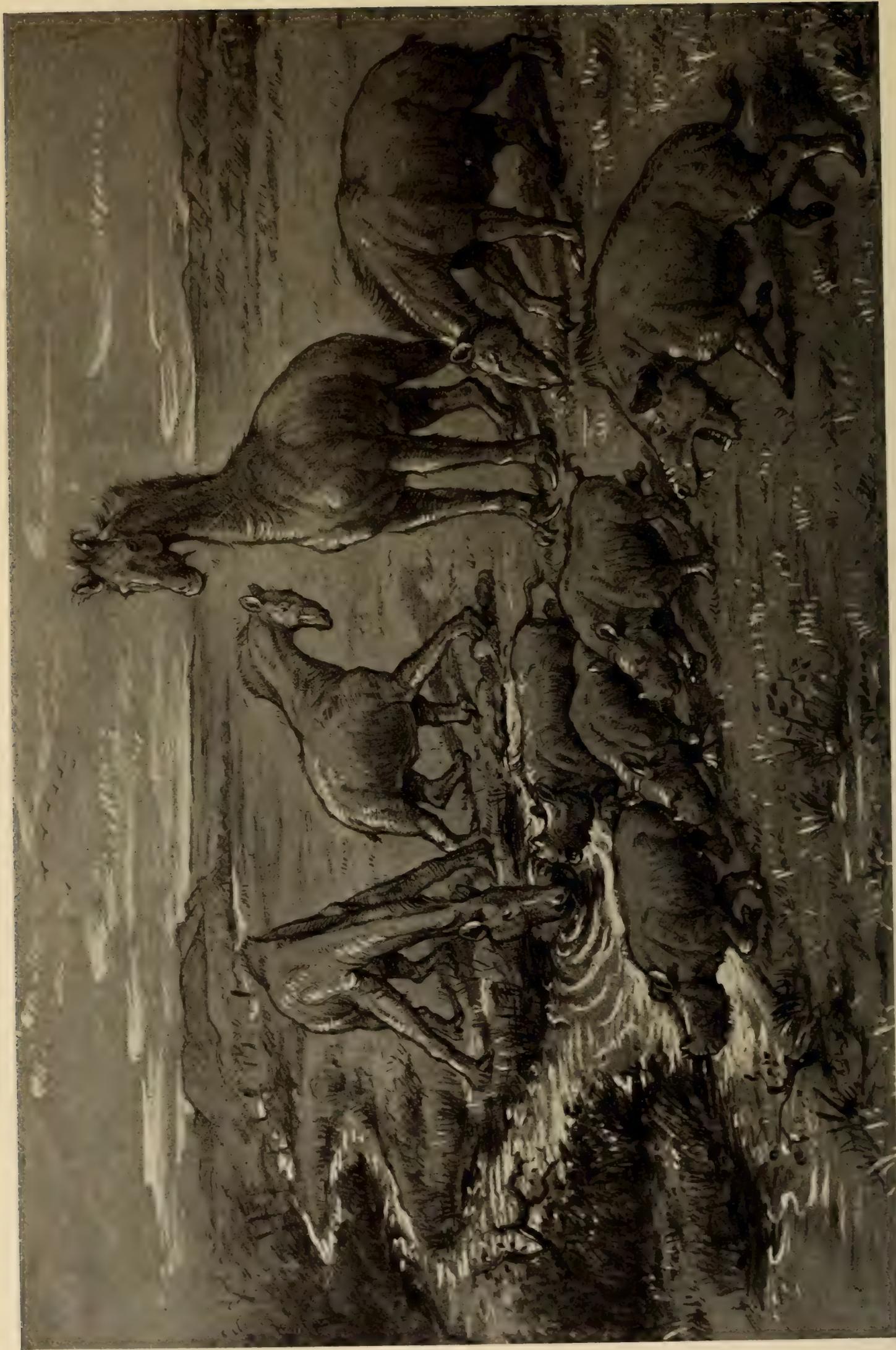
After a narrow channel has been cut all around the block through the bone layer, it must be undercut a little, that is, as far as is safe, and then bandaged. Before being bandaged it is very thoroughly soaked with the shellac, as much being used as it will take in on repeated applications, and then given a few days to dry in the hot western sun. Strips of burlap are thereupon dipped in plaster of Paris, applied to the surface, and kneaded down upon it so as to stick as closely as possible. The strips are laid parallel until the entire surface is covered. A second set of strips is then laid on at right angles, and finally cinching strips are placed around the undercut margin. One or more additional series of strips are sometimes required for large and heavy blocks. When the plaster sets and dries, a rigid and tough casing is formed over the block and around its edges.

The next stage is to undercut the block farther until it is nearly free from the quarry floor below, when it can be loosened and carefully turned over. The under side is then trimmed smooth,

soaked with shellac, and similarly bandaged, and when thoroughly dried, the block is boxed or crated and by skids and levers is lifted on board a wagon and hauled to the railway station. For handling large heavy blocks a tripod with differential pulley and ropes or chains is necessary.

Arrived at the Museum, the block casing is cut away from the top of the block and the work of preparation begins. This is much more delicate and careful than the rough cleaning out in the field. Most of it is done with saddlers' awls, curved and knife-edged. The matrix is scraped away bit by bit, chiselled away with fine chisels where necessary, the surface being kept clean, the rock scrapings removed with a vacuum cleaner, and the bone surfaces continually soaked, as they are exposed, with shellac solution. In this way as much of the rock is removed as is thought desirable or practicable, and the bones are taken out or (in the case of the big block) left in place. Record has been kept at all stages of the position and orientation of each block or of each separated bone, and upon being thoroughly cleaned, the bones can be fitted together. When the fit is precise or for other reasons they are considered to belong to one individual, they are associated under one record number.

The huge block 44 square feet in area, already referred to, is the largest single section yet taken out of the fossil quarry. The larger the blocks are, the more difficult are they to handle and transport without breakage. The surface of the bone layer was exposed and the block channeled around, bandaged and undercut and turned as explained above. On the under side was then laid a permanent base of cement, framed and covered with wood, through



A MIOCENE WATER HOLE
Restoration, by the late Erwin Christman, of the animals found in the Agate Fossil Quarry

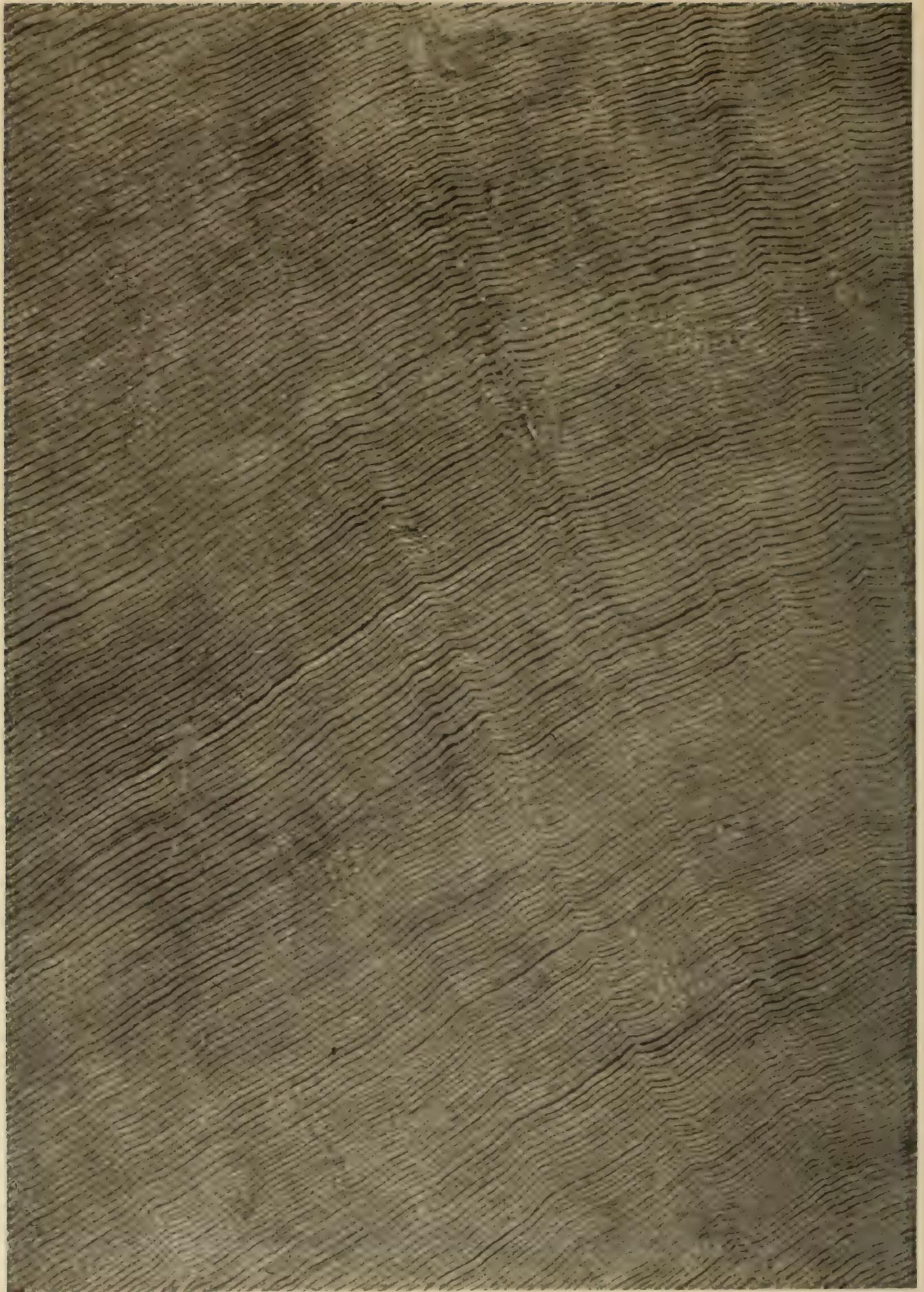
which iron bolts were passed from side to side and from end to end. The block was then turned right side up and the sides and top boxed in. The block, when boxed, weighed 4800 pounds, and was of course turned and moved with chains and tackle. When it reached the Museum, it was brought up to the exhibition hall, cleaned there, the base set upon a frame with castors, and the glass case built around it.

It is remarkable that the great multitude of bones in the quarry belong to but three species. The formation in which the quarry lies has been quite thoroughly prospected for fossils, and a large number of specimens have been found representing many species of animals. Several kinds of oreodonts, or "ruminating hogs," several kinds of three-toed horses, of primitive camels, primitive deer, wolves and foxes and other Carnivora, primitive beavers and pocket gophers—all of the same geologic age—have been found in the same region and formation. All of these animals undoubtedly were living in the vicinity at the time that the bone layer was made. Occasionally one finds fragments of their bones or teeth in the quarry; but never complete skulls or skeletons, and the bones or teeth are always more or less rolled and waterworn. These waterworn fragments were evidently brought down by the current of the stream from some distance above and deposited at this quiet eddy. They were in no case trapped and buried at the place where they are found.

The explanation no doubt lies in some differences in drinking habits. One might think it a question of size, the smaller animals escaping because

they were too light and active to be caught in the quicksand, or because the large, powerful beasts drove them away. But this would hardly explain why the larger oreodonts—as large as the little rhinoceros and quite as well able to take care of themselves in a fight—are never found in the bone deposit, although they are one of the most abundant of the animals in the strata round about. It might be supposed that the animals not represented in the quarry left the plains and went up into the wooded hills during the dry season, when we may assume the river dried up and the pool became a water hole and drinking place at which certain animals would congregate. But this explanation of their absence from the quarry deposit would scarcely apply to the rodents, or to various other members of the fauna that are more adapted to open dry plains than are the three that we find in the quarry.

Whatever be the explanation, the fact remains as a curious limitation, though one not uncommonly found in these fossil quarries. Another quarry two or three miles from the Agate Quarry has yielded great numbers of skeletons of the gazelle-camel *Stenomylus*, a small slender creature of the size and proportions of the vicuña, but practically nothing else. There are reasons to believe that this *Stenomylus* quarry was the bedding ground of this extinct animal; at all events the conditions of deposition there were very different from those in the Agate Quarry, as many complete articulated skeletons have been found there. At the American Museum five of them may be seen in the camel alcove near the Agate Quarry exhibit, in a large block, lying just as they were found in the rock.



TREE RINGS USED IN MEASURING TIME

Two hundred three years of seasonal records, as shown by the annual rings (natural size) on the section of the big *Sequoia* tree in the American Museum of Natural History. Time represented 1150 A.D. to 1353 A.D.

Seasonal Records of Geologic Time

AS NOTED IN ANNUAL RINGS OF TREES, BANDED GLACIAL CLAYS, AND CERTAIN DEPOSITS MADE DURING PERIODS OF ARID CLIMATE

By CHESTER A. REEDS

Associate Curator of Invertebrate Paleontology, American Museum

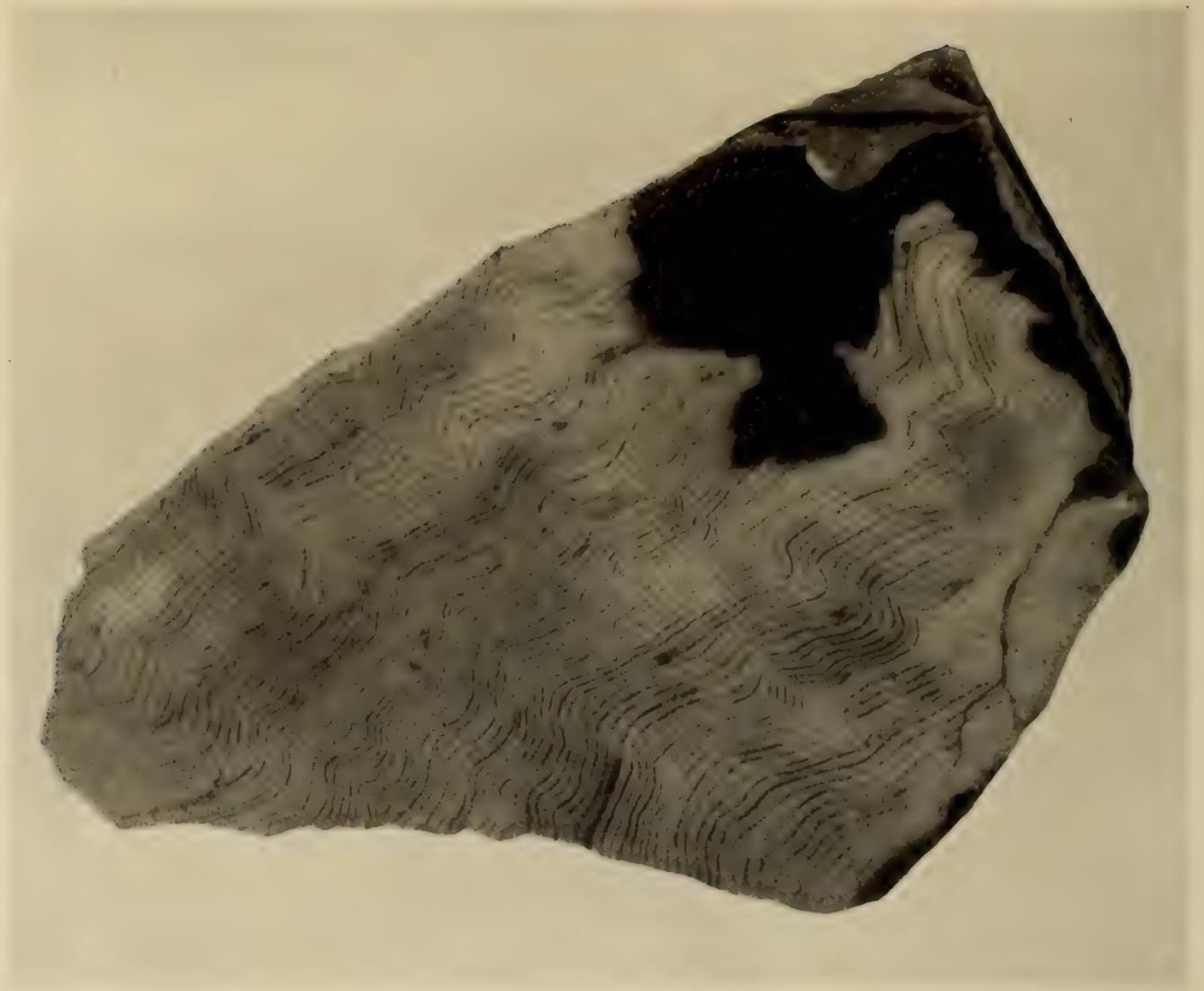
WE are all impressed with the variable daily amount of light and heat received from the sun and with the recurrence of day and night caused by the revolution of the earth on its axis every twenty-four hours. We are not unmindful, too, of the gradual passing of the seasons, spring, summer, autumn, and winter, and the accompanying variations in temperature and moisture, as the earth completes its annual circuit about the sun. The questions naturally arise: what is the net result of these seasonal fluctuations, for how many years have they been going on, and what will be their tendency tomorrow? We turn to the past records for an indication as to the future. We know that there have been seasonal variations for the thousands of years that man has been keeping his calendars and writing history. We also have good reason to assume that they were true for prehistoric man, who kept no tangible records, as well as for the great eons of time that preceded the advent of man upon the earth.

Those of us who have observed nature in one or more of her varied phases are greatly impressed with the effect of the seasonal changes upon the plants, which have adapted their growing periods to spring and summer, and their resting or maturing stages to autumn and winter. The researches of Dr. Ellsworth Huntington and Prof. A. E. Douglass on trees and climate are especially interesting in this connection.

In the trees the seasonal changes are recorded in the annual rings. Soft white cells grow at a rapid rate in the spring. This growth is dependent upon the relative amounts of snowfall and rainfall of the preceding winter as well as upon the porous or compact nature and depth of the soil. In the autumn, due to lowered temperature or diminished water supply, there is a gradual cessation of the activity of the tree. This change is recorded by the deposition of denser and darker material in the cell walls. During the winter, growth practically stops.

Occasionally, due to two stages of growth in one year, superfluous rings may arise, or, due to the lack of a spring development, two or more autumn rings may merge together and an apparent omission of rings will occur. To detect a possible error in counting these abnormal rings, groups of rings in different trees are compared and "cross-identifications" are thus established. Years deficient in rainfall or lowered temperature are more noticeable and more widespread than favorable years, for a deficient year is characterized by an individual ring that is small compared to those beside it. Large rings are more apt to come in groups and are not so extensive geographically as small rings.

Variations in climate can thus be detected in the growth rings of trees. Successive years are not all alike, for a factor like rainfall may be variable; besides, more than one factor may



A portion of a fossil *Sequoia* tree of Middle Tertiary (Miocene) age from the Yellowstone National Park, showing annual rings

affect the tree rings, such as rainfall, temperature, and length of growing season. In regions where trees have an abundance of moisture there is often noticed a beautiful rhythm of annual rings which matches with the sun-spot cycle of 11.4 years. Other cycles of 6 years, 22 years, 35 years, and 100 years have been noted. In fact, different centuries may have different combinations of climatic cycles. When they are better known, they may give us a basis for long-range weather forecasting. Some of them have been used by Professor Douglass in determining the relative dates of prehistoric ruins in northern New Mexico.¹

¹See the article entitled "Dating Our Prehistoric Ruins," by A. E. Douglass, *NATURAL HISTORY*, January-February, 1921, pp. 27-30.

The longest record of tree growth is that found in the "big trees" of California, the *Sequoia washingtoniana*. Some of these trees have lived for more than 3000 years. In the Jesup collection of North American woods in the American Museum, there is a cross section of a large *Sequoia* tree which was cut in 1894. According to the count of the annual rings this tree started to grow in A.D. 550. Recently Doctor Huntington has added to this exhibit a climatic curve based on the variable growth in the *Sequoia* and has indicated the rise and decline in response to climatic variations of the great governments of the countries bordering the Mediterranean from 1300 B.C. to the present. This comparison is

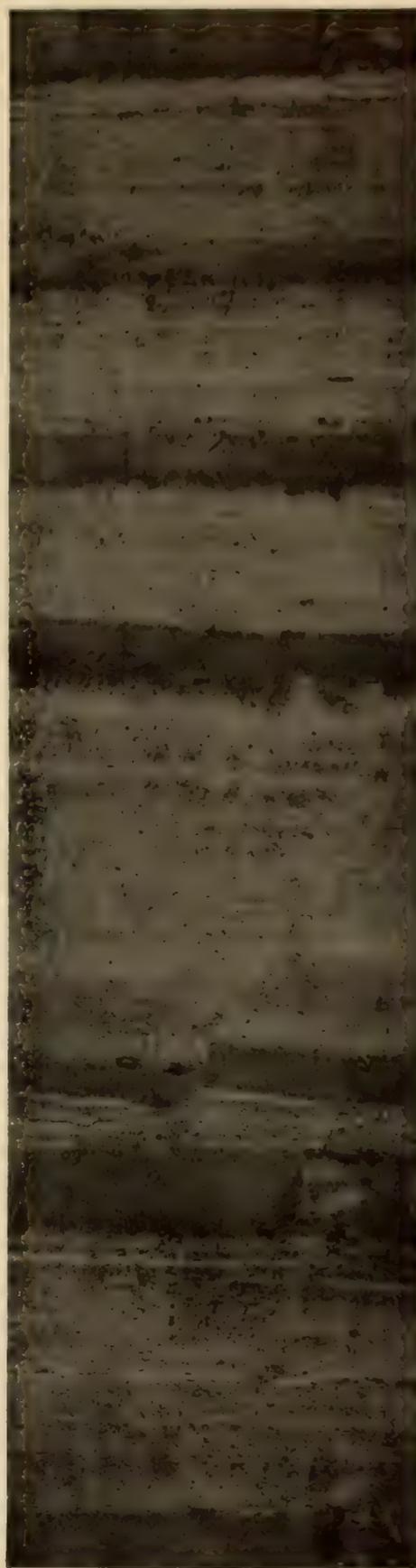
possible since a study of the countries bordering the Mediterranean shows that the climatic pulsations felt there were similar to those indicated by the "big trees" of California, and indeed the climate of the two regions is still of the same type.

From the trunks of fossil trees it is probable that a very much longer record will be obtained. Trunks of fossil *Sequoia* trees occur in the Yellowstone National Park, in the eastern foothills of the Rocky Mountains, and elsewhere, in places where the trees do not now grow. The cross section of the silicified wood sample, p. 372, shows ninety-two well marked rings with a thickness of about one millimeter each. Fossil woods exhibiting annual rings have been found in rocks of various ages from the Upper Devonian Period to the present, that is, as far back as 18,000,000 years ago, but only comparatively few have been collected and are accessible.

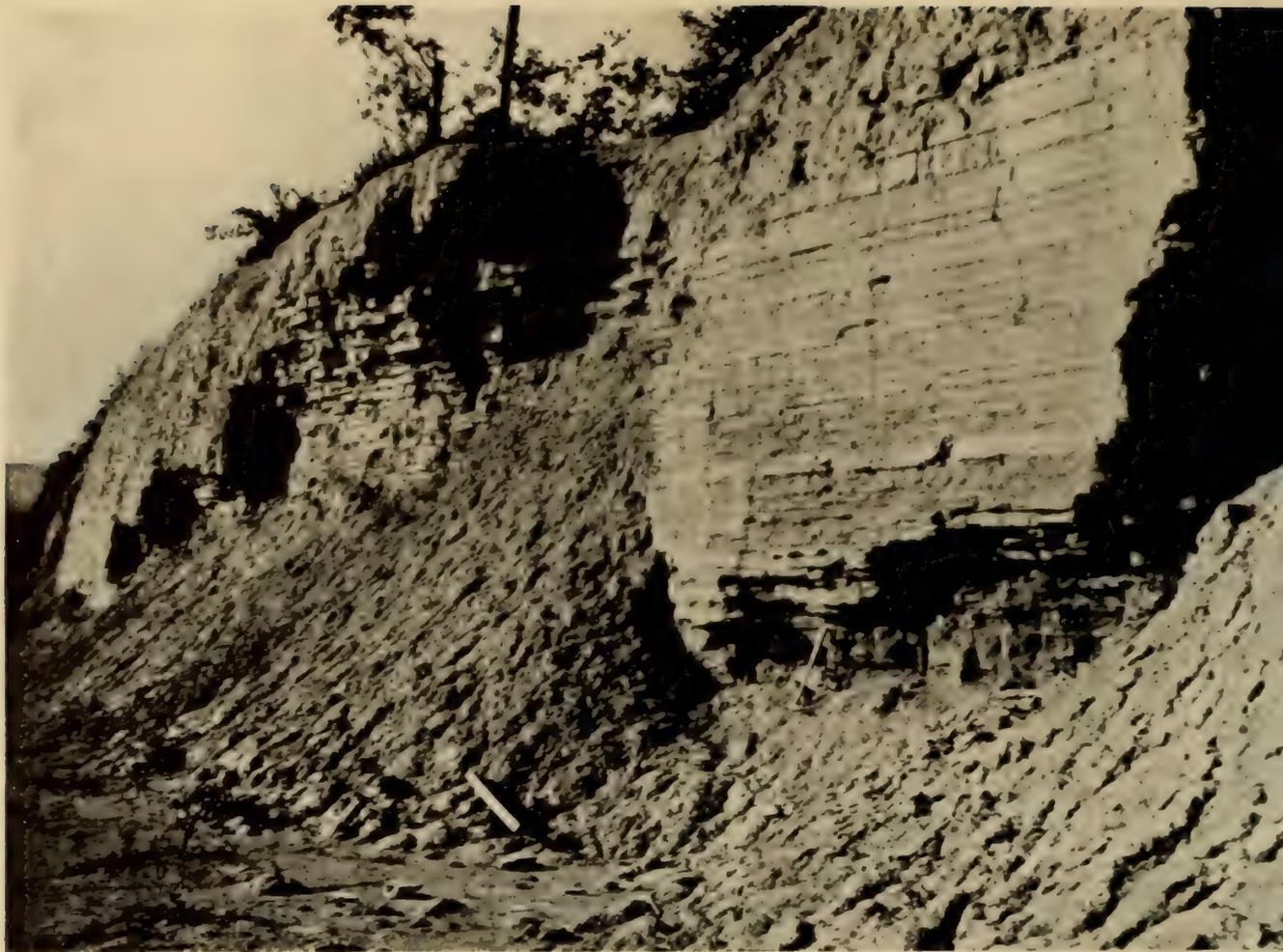
A longer annual record than that afforded by the living *Sequoia* trees has been obtained in Sweden from the glacial clays deposited in fresh-water lakes which laved the retreating ice front of the last continental glacier. The stratified clays of the Hudson, Hackensack, and Connecticut river valleys and of many other points in America were likewise deposited in fresh-water lakes which followed the retreating ice border of the last great North American ice field.

On close inspection these glacial clay deposits show distinct seasonal layers or bands: a summer layer, which is the thicker, of more sandy material, and of lighter color, usually gray; a winter layer, which is the thinner, of very fine clay, and of darker or reddish color, depending upon the color of the rock from which the fine

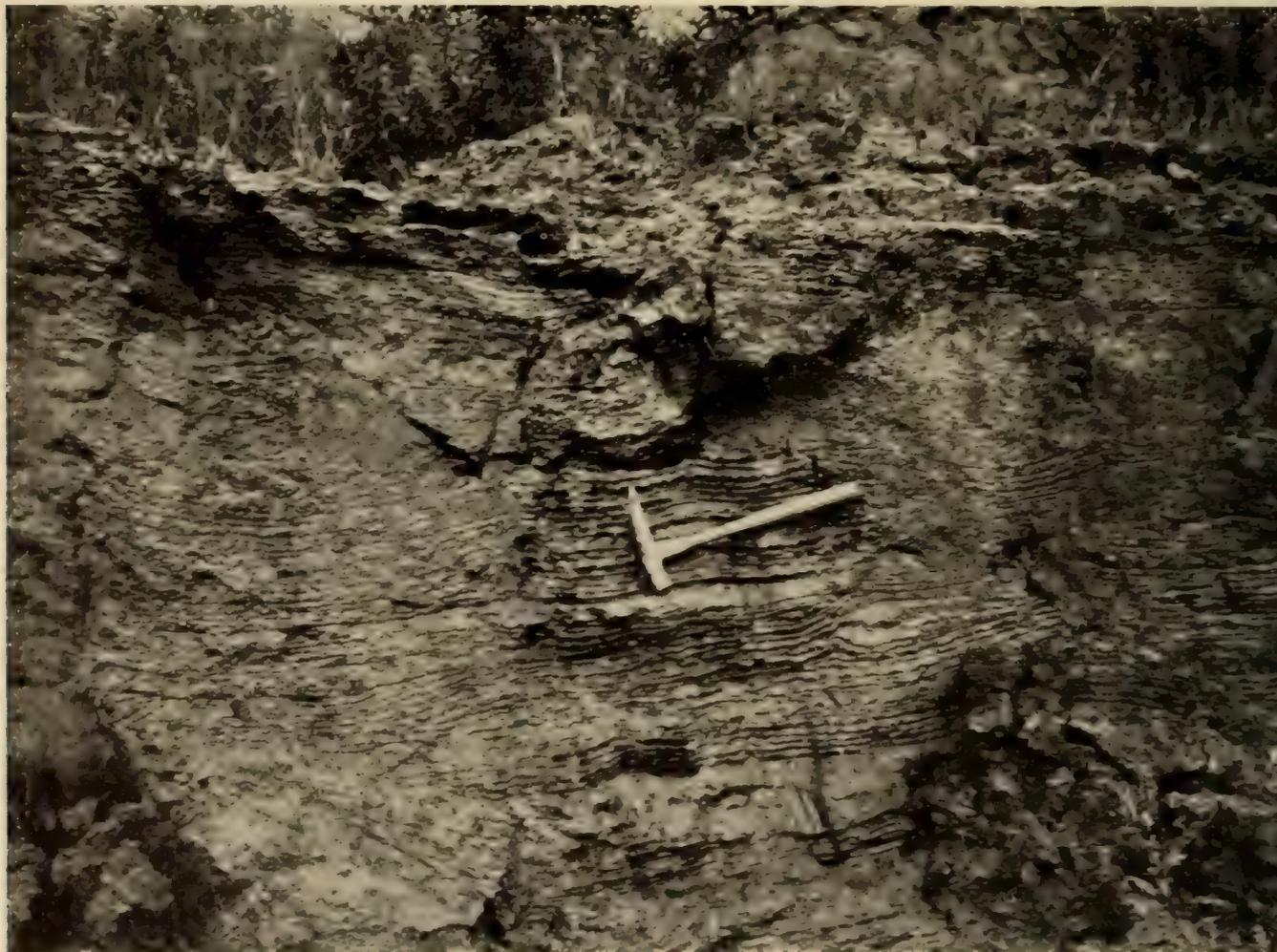
clay particles were derived. In passing upward from a dark winter layer to the



Banded glacial clay (varve clay) from New Haven, Connecticut, showing seven dark winter layers and six lighter summer layers (natural size). An annual deposit consisting of a summer layer and the succeeding winter layer is called a varve. Collected by Dr. E. Antevs, 1922



Postglacial banded clay exposure at Dunnings Point on the Hudson River near Beacon, New York. Photograph by the author, September, 1922



Varve clay from clay pit one-quarter mile north of Mountain View, New Jersey. The deposit was made on the bottom of the former glacial lake, Passaic. Photograph by the author, September, 1922

coarse gray summer layer, the change is abrupt; from the summer layer to the winter layer, however, the change is gradual in all cases. The coarse summer layers have very fine wavy lines of bedding while the fine winter layers are homogenous and uniform in appearance. These seasonal layers alternate in position without exception throughout the deposits. A pair of such layers is called a varve, or annual deposit.

In different years different quantities of sediments were carried to the glacial lakes and consequently there arose variations in the thickness of the varves. Over the several areas of sedimentation, however, the varve for a particular year is approximately of the same relative thickness. Another circumstance of considerable note is that the varves overlap each other very much like the shingles on a roof. This was brought about by the amount of summer melting and the annual retreat of the ice northward. The location of the northern limit of each varve, that is where it touches the bed rock, thus enables one to determine the position of the ice for a particular year as well as the rate of retreat.

In Sweden the rate of glacial retreat was irregular; in Scania and Belecking about 75 meters a year. Before reaching the two great Fennoscandian moraines near Stockholm, which represent distinctly adverse climatic conditions, it increased to 100 meters or a little more. North of the great moraines the retreat fluctuated from 100 to 300 meters or more a year and only occasionally was it interrupted by a stoppage or small advance.

This retreat of the last glaciation in Sweden, (see map) may be subdivided and summarized as follows:

(1) DANIGLACIAL—Part of Denmark, part of Scania, and north central Germany south of the Baltic Moraine. Time undetermined.

(2) GOTIGLACIAL—Retreat from the terminal moraines in middle Scania to the southern border of the great Fennoscandian moraines south of Stockholm, 11,600 B.C. to 8600 B.C., or 3000 years.



Retreat stages of the last glaciation in northwestern Europe. After Osborn and Reeds, 1922

(3) FINIGLACIAL—The retreat from the southernmost of the Fennoscandian moraines to the parting of the land ice into two parts in the Ragunda district, 8600 B.C. to 6600 B.C., or 2000 years.

(4) POSTGLACIAL of Swedish geologists, based on the work of Lidén in the valley of the river Angermanälven, 6600 B.C. to 1900 A.D., or 8500 years. The above figures give a total of 13,500 years for the retreat of the last ice sheet from central Scania to the present small ice caps in north central Sweden.

The glacial clay studies in Sweden have been made chiefly by Baron Gerard de Geer¹ and a number of younger men trained by him, particularly Dr. R. Lidén and Dr. E. Antevs. It was in 1878 that De Geer arrived at the conclusion that a pair of these seasonal layers constituted an annual deposit, or varve. De Geer also developed a method of correlating these

¹See the article entitled "Baron Gerard de Geer and His Work" by James F. Kemp. *NATURAL HISTORY*, Vol. XXI, pp. 31-3.

deposits not only in the same region but also in different regions.

Studies of glacial clay, deposited during the retreat of the last ice sheet in North America, have been made by a few investigators, particularly Antevs, 1921-22, who has determined a sequence of varve clays representing 4100 years for the retreat of the ice front from Hartford, Connecticut, to Saint Johnsbury, Vermont, a distance of 185 miles. The average rate of retreat was a little more than one mile in 22 years, but it was not regular. Between Springfield and Amherst, Massachusetts, a distance of twenty miles, it was much slower, about a mile in 47.5 years. Then for 350 years the ice front remained in the vicinity of Amherst, but at the termination of that span of years retreated more rapidly, about a mile in 15 to 16 years. The results of Doctor Antevs' investigations have been published in book form, under the title of *The Recession of the Last Ice Sheet in New England*, by the American Geographical Society, New York, 1922.

Banded clays of an earlier glaciation were described by Prof. R. W. Sayles in 1916 from the Squantum peninsula near Boston, Massachusetts. It is estimated that they are 13,000,000 years older than the clays deposited during the retreat of the last or Quaternary (Pleistocene) glaciation of northwestern Europe and eastern North America. They are 800 feet thick and have been referred to the Permian Age, a period nearly one-fourth the way down the geological scale (see p. 378). Since deposition these ancient banded clays have been converted by diastrophic movements into slate or argillite, but they still retain their original relations and characteristics.

The most ancient glacial clays with varves so far noted appear near the base of the geological column and are estimated to be 37,000,000 years old or older. They exist as argillites associated with the Huronian glacial drift deposits at Cobalt, Ontario, Canada. According to the late Prof. Joseph Barrell, they occur at the south end of Cobalt Lake; they are delicately banded and indicate rhythmic deposition. The bands are grouped in series that show larger rhythms representing climatic fluctuations covering periods of years.

Deposits made under arid climates sometimes show seasonal developments. According to R. Gorgey (1911) seasonal bands appear in certain salt deposits of northern Germany. Varves representing 5653 years have been noted in these deposits. The salt beds which exhibit this banding are associated with red formations and gypsum of Upper Permian age. Unlike the varve clays, which formed under a moist glacial climate, these salt deposits were developed from brines under a period of continued arid climate characterized by excessive evaporation during the summer.

Another example of seasonal bands formed under an arid climate is furnished by the specimen of Triassic red sandstone shown on p. 377, which the author found in September, 1922, as a sporadic boulder in the five feet of "yellow drift" overlying the late glacial clays of the Quaternary (Pleistocene) Period in the vicinity of Little Ferry, New Jersey. The normal position of the Triassic rocks in this region is beneath and on the margins of the Pleistocene clays. In cross section this specimen shows more than nineteen annual bands of red sand. The summer layers are the lighter in color and are

relatively thick with moderately coarse sand; the winter layers are the darker and are thin, being composed of a finer grained sand than the summer bands. The varves are quite regular and show marked seasonal differences.

From the instances cited it is apparent that seasonal records of one kind or another occur at widely separated

that is, the two extremes of climate. Furthermore, their presence is restricted to the fresh-water lakes which laved the retreating ice front or to the vanishing lakes of arid regions. The marine formations, which constitute the greater portion of the stratified rocks of the earth's crust, show no varves or seasonal banding; hence

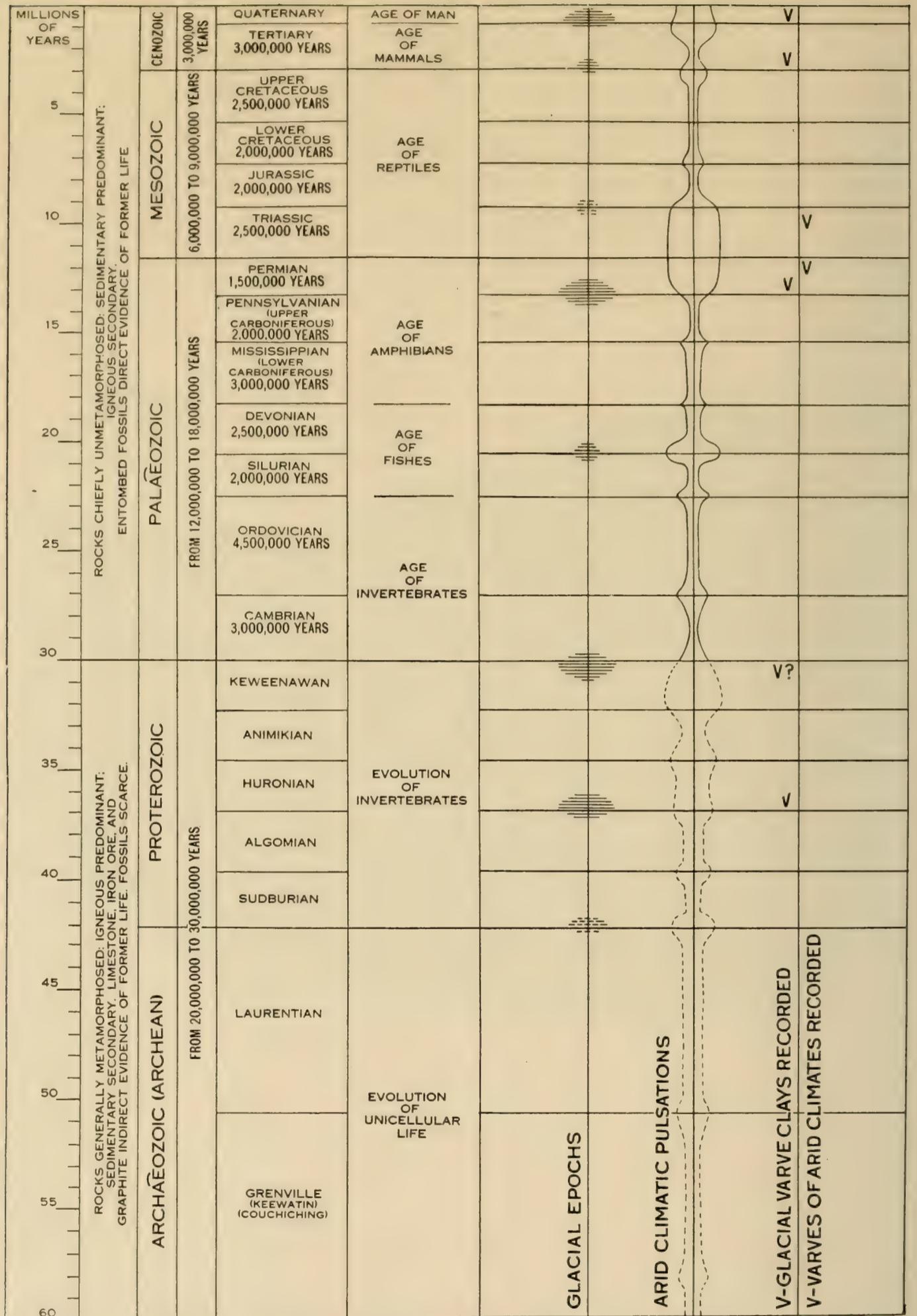


Cross section of varves in a Triassic red sandstone boulder from Little Ferry, New Jersey

intervals in geologic time, in fact so early and so late and with sufficient frequency to justify one in assuming that seasonal changes took place regularly from year to year throughout all geologic history. Seasonal records, however, have not been preserved for every year, as a certain combination of circumstances must exist to bring about deposition. Sharply marked seasonal deposits were formed either under glacial or under arid conditions,

deposits exhibiting varves form only a small part of the geologic record. Such deposits are of the greatest importance, however, in the study of geochronology, climates past and present, and the evolution of life.

Where varves exist, they can be counted and the actual length of time involved in their deposition ascertained. In the many instances, however, where they do not exist, the duration of time is uncertain; nevertheless, the thou-



A CHART OF GEOLOGIC TIME

The glacial epochs are shown by the shaded areas (dotted where the data are indirect); the arid climatic pulsations by a curved line (dotted where the data are indefinite); and the varve deposits by a V, placed on the left of the ruled line where glacial action is responsible and on the right of the line where the varves were produced by arid climates

sands of sedimentary beds represent millions of years for their deposition. Competent observers using different criteria have made various estimates as to the age of the earth. Some say that it may be 60, 100, 200, or even 750 million years old. Whatever the true estimate may be, there are actual beds of rock which represent a tremendous length of time for their deposition.

In recent years many geologists have concluded that the earth's climate has pulsated back and forth and that a stable climate has not prevailed for any great length of geologic time. There have been periods when extensive land areas, now comparatively free of ice, were covered with great ice sheets. At other times arid to semi-arid or desert conditions often-times prevailed in the same or even higher latitudes. To account for changes in civilization at various places in historic times, Prof. A. Penck and Dr. E. Huntington point to the shifting of climatic zones back and forth and cite examples along the northern and southern margins of the Sahara and Sonoran deserts.

Now it may be observed that due to repeated oscillations of the climate during geologic time from one extreme to the other, life has passed through successive crises and that each crisis was a step forward toward the estate of man. The various groups of life which have been successively dominant on the earth have been listed in the life column on p. 000. That these various classes of life are genetically connected is known (1) from the recapitulation, in the embryological stages of the higher animals, of the types of life that have preceded them; (2) from the finding in the geological record of large numbers of fossil specimens which

bear witness of this connection and development.

Variations in climate should not be regarded as the sole cause of evolution but one of four or more contributing factors which Prof. Henry Fairfield Osborn has considered in his book, *The Origin and Evolution of Life*. It may be noted, however, that geologic and secular changes of environment have preceded many of the most profound changes in life.

In the Archæozoic Era, which embraces the oldest rocks, there is indirect evidence that unicellular forms of life were present, also that nothing higher existed.

The Lower Huronian Period, with an extensive glaciation in southern Canada and other parts of the world, was among the first of the critical life periods. The Archæocyathinæ, coral-like animals, appear in great numbers before the close of the period. They represent the oldest invertebrates known and an early step forward in the evolution of life from the unicellular forms.

Toward the close of the Proterozoic Era another pronounced glacial climate prevailed in various parts of the world, the net result of which was the sudden appearance in the Cambrian rocks of numerous examples of all classes of marine invertebrates. It is also probable that the tendency toward vertebrate life was initiated at this time, for primitive fossil fishes have been found in the Upper Ordovician rocks of Colorado and Wyoming.

The next important crisis occurred in the late Devonian when, due to the rather extensive arid conditions in many parts of the world, there was an emergence of the earliest vertebrates from the water. Huntington says it was drought which apparently drove our

fishlike ancestors out of the water upon the land. He considers this a most momentous step, for only in the highly varied environment of the land does brain power develop rapidly.

Glacial conditions which were to have a far-reaching effect upon life returned in the late Pennsylvanian and again in the Permian periods. The Permian glaciation was prominent in both the southern and northern hemispheres to within 30° of the equator. It was during these trying times that the warm-blooded mammals probably arose. Their bones, however, have not been found earlier than the Upper Triassic. According to Huntington, the transition from cold-blooded to warm-blooded animals represents one of the most profound developments in the history of evolution.

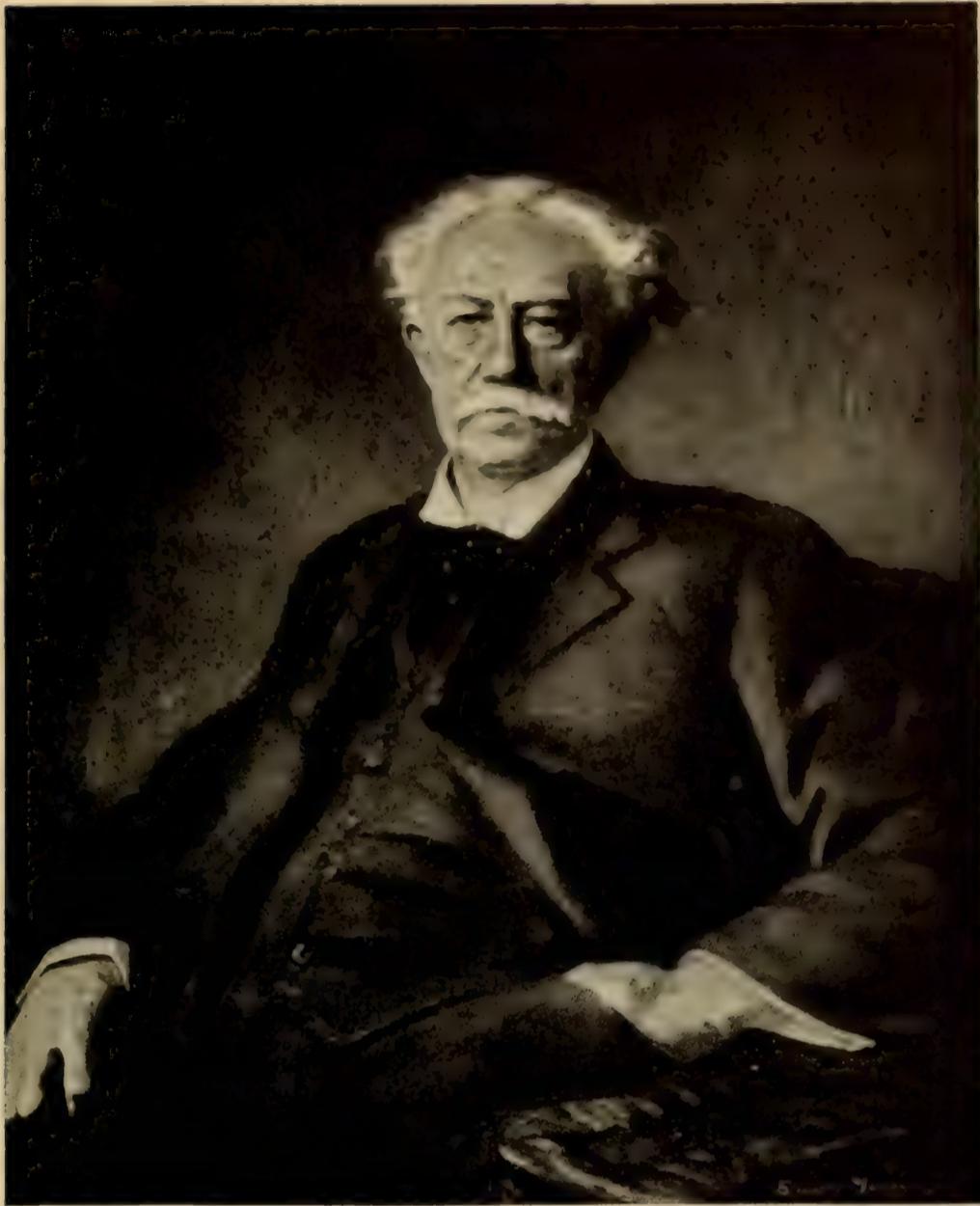
Throughout the Mesozoic Era the reptiles were the grand masters of the realms of land, air, and sea. During this time they waxed strong, deployed widely, and became adjusted to their environment. Then there came a great change over the landscape in the early Tertiary: the Rocky Mountains were uplifted, seas and marshy lowlands were drained, glaciation returned, the reptile horde was diminished, and the mammals became the dominant class.

The mammals in turn took on many diverse forms and, like the reptiles, occupied all the media of land, water, and air during the millions of years of the Tertiary Period. When they had reached a condition of complete domi-

nance and adaptation, they too were suddenly wiped out in wholesale lots. This may be attributed directly or indirectly to the severe climatic vicissitudes of the Pleistocene or early Quaternary glaciations.

The Quaternary Period is called the Age of Man. In Europe south of the fifty-third parallel evidences of Pleistocene man and even of a late Tertiary (Pliocene) man have been found. Successive types of men lived, struggled, and endured the privations of the glacial and interglacial epochs. During these times the cultural development of man centered about the perfection of stone implements of chipped flint, the palæolithic stage; then during the short Postglacial stage, with its minor climatic oscillations, he passed rapidly through the neolithic into the historic and modern culture stages. According to Huntington, it was apparently this Glacial Period which chiefly stimulated man's mental development and caused his intelligence to dominate the earth.

We pause on the threshold of the future; we dare not enter, for we have a profound respect for the past. We know that this is the Age of Man but we do not know what the next age will be. We feel assured that seasonal and climatic variations will continue in a pulsatory way as before, but as to man he will in all probability succumb in time, as did his ancestors, to the natural forces that caused him to rise and conquer.



DAVID STARR JORDAN, 1921

From a portrait by E. Spencer Macky, presented to Stanford University by Mrs. Jordan

David Starr Jordan—Naturalist and Leader of Men

AS PORTRAYED THROUGH HIS WORK "THE DAYS OF A MAN"

By J. T. NICHOLS

Associate Curator of Recent Fishes, American Museum

THE scientific value of autobiographical documents varies with the point of view, training, ability in expression, originality, and "apperceptive mass" of the author. Autobiographies of men of eminence reflecting a wide and intimate contact with life have a peculiar interest. As was to have been expected, notes covering more than half a century of an

active life, brought together in two volumes by Chancellor David Starr Jordan, of Stanford University, under the title *The Days of a Man* is a publication of more than ordinary importance.

It is not too much to say that no American naturalist can afford to be without access to this work, for reference if for no other purpose. Jordan's interest in the natural sciences has been

a very wide one. With great talent for leadership and for coöperation he has crowded into this narrow span of years an astonishing wealth of personal contact with individuals representing many different fields of thought, and with events of importance to our present knowledge of natural history subjects. Trivial sidelights some of these contacts may have been, but chronologically recorded as they are, elaborated where pertinent, and made accessible for reference by an index, they form a preëminently useful historical document.

It would seem that with the pleasure of recalling and making permanent record of incidents and friendships of a lifetime, Jordan also had in mind the preparation of just such a useful historical document rather than a purely personal or literary work. It will be criticised as rambling in character, and much of it as being beside the point, but how else could it fulfill its reference function?

Further light on the scope of this autobiography may be had by quoting two paragraphs from the Foreword:

"For half a century the writer of these pages has been a very busy man, living meanwhile three more or less independent lives: first, and for the love of it, that of naturalist and explorer; second, also for the love of it, that of teacher; and third, from a sense of duty, that of minor prophet of Democracy. If he had his days to live over, he would again choose all of the three."

* * * * *

As stated in the text, this work is essentially a record of friendships; but even as thus considered it is far from complete. For in the author's varied experience as teacher and as executive, he depended on the willing coöperation of his associates—aid granted in an unusual degree. To every one who has shown him sympathy and tolerance he is very grateful.

Bits of interesting natural history lore blossom from page to page of the

two volumes. These items have for the most part been published elsewhere in something like their present form, but are essential here for the proper background. A naturalist cannot fail to enjoy them, and should find some with which he was previously unfamiliar.

The work is a narrative of travel. Jordan's keenest interest in natural phenomena from the outset appears to have been in their relation to one another in the formation of some larger whole rather than in an analysis of their minutiae—a scenic rather than a microscopic viewpoint. A very early interest in botany manifested itself in a comparison of his home woods with others farther afield, where different trees kept company with different flowers. Indeed, he tells us that inability to travel extensively at that time and to make wider comparison of other floras, the vegetation of foreign lands, probably prevented him from becoming a botanist. As the years went by, he seized upon and made opportunity to visit all parts of our United States and many foreign lands, and throughout there is interesting comment on his impressions thereof.

He says of an early sojourn among the mountains of the Southern States (1877):—

This wild, rough mass locally known as Black Mountain, beset with dark balsam firs, soft moss, and many subalpine plants, rises 6711 feet above tidewater—that is, about 500 feet higher than Mount Washington. It does not, however, give the same impression of altitude because of the richness of its vegetation under a warmer sky. On its towering summit, under an overhanging rock, we passed a night.

Of Switzerland (1881) he writes:—

The Matterhorn burns itself into the memory as nothing else in all Europe does. Three of its neighbors, Monte Rosa, the Weisshorn, and the Michabelhorn or Dom,



The steep-sided peak of the Matterhorn,—the “huge pyramid of the grandest of the Alps,” climbed by Doctor Jordan in 1881

as well as Mont Blanc, are indeed a little higher, but no other peak in the world makes such good use of its height. Most great mountains have white rounded heads, their harsher angles worn away by the long action of glaciers. The Matterhorn, however, is too steep for snow to cling to and no glacier has ever rounded its angles. It is therefore a creature of sun and frost, the wreck or relic of some ancient giant from which the strong gods of heat and cold have hurled down their avalanches of loosened rocks.

With this introduction we read of an adventurous ascent of the Matterhorn wherein one of the party, Doctor Gilbert, nearly lost his life. Jordan tells us elsewhere that the motto “there is plenty of room at the top” impressed itself upon his memory in early life. The reader may, if he likes, connect this fact with Jordan’s evident reluctance to leave any eminent mountain peak unconquered.

On a trip to Japan (1900) he visited one of the few remaining villages of the Ainus, which people occupied a large part of Japan prior to its conquest by the present-day Japanese:—

For myself the only thing apparently worth while was to visit the little Ainu village of Edomo, four miles away. But it was too damp to walk and the only available horses were wild, unbroken brutes. A boat was then suggested if I didn’t mind getting wet. Meanwhile, an Ainu woman with bushy, curly hair and tattooed mustache trotted gayly into town, her tight blue trousers covered with mud—altogether an amazing freak that made me wish to see more where that one came from. So, buying an oiled-paper blanket and borrowing coat and umbrella, I hired a little sailboat with two fishermen and started out.

This is his pithy description of the South Seas (1902):—

Four thousand miles from the Golden Gate the little archipelago of Samoa lies in the

heart of the "South Seas," a stretch of warm ocean dotted with the asteroids of our earthly Cosmos, tiny verdant worlds—thousands of them between Java and the Marquesas—filled with joyous people as innocent of curiosity as to what happens in London or New York as the folks of Vesta and Ceres are careless of the politics of their planetary neighbors, Mars and Jupiter.

The narrow home may be an atoll, a ring of broken corals fringed with tall coco palms which skirt a serene blue lagoon; or it may be a tangible island, the sharp verdure-clothed crest of an uplifted volcano, its wide-leaved evergreens mingled with royal palms and tree ferns, the whole inextricably tied together with a meshwork of climbing vines. Lava, however, constitutes the solid framework of all the islands; two hundred inches of rain a year and an ardent tropic sun urge their wonderful "bush" and guarding palms; the coral polyp builds up the white shore-lines and the cruel reefs; copra (dried meat of the coconut) creates their economic value.

Down through the dense greenery leap clear, dancing streams with deep pools where lurks the agile *sesele* or mountain bass, while under the white waterfalls laughing girls disport themselves. Along the shores sway bending palms; from every vantage point one sees blue water meet blue sky, and ever to the ear comes the low growl of surges along the barrier reef. And all about (at least in olden days) swarms a joyous people with shining skins of yellow-bronze—straight and strong as Greeks; simple as children also, happy, affectionate, irresponsible, and human.

In the author's words this narrative is a record of friendships; as such it is a record of personalities. Therein perhaps lies its greatest human interest. There also may be found a real value, for a very large and representative number of the world's citizens, men and women, has gravitated within range of his keen sympathy.

There is space here to quote, as an illustration of his talent for portraiture, only the description of the elder Agassiz:—

None of us will ever forget his first sight of Agassiz as we arrived on a little steamer from New Bedford in the early morning, and

he met us at the landing, his face beaming with pleasure. For this experiment might prove to be his crowning work as a teacher. His tall, robust figure, his broad shoulders bending a little under the weight of years, his large, round face lit up by kindly, dark-brown eyes, his cheery smile, the enthusiastic tones of his voice, his rolling gait—all these entered into our abiding impression of the great naturalist. . . .

To the Darwinian theory as it looked to him he was most earnestly opposed. Essentially an idealist, he regarded all his own investigations not as studies of animals and plants as such, but as glimpses into the divine plans of which their structures are the expression. "That earthly form is the cover of the spirit was to him a truth at once fundamental and self-evident." To his mind, also, divine ideas were especially embodied in animal life, the species being the "thought unit." The marvel of structural affinity—unity of plan—in creatures of widely diverse habits and outward appearance he took to be simply a result of the association of ideas in the divine mind. To Darwin, on the other hand, those relations illustrated the tie of a common heredity acting under diverse conditions of environment.

Yet Agassiz had no sympathy with the prejudices exploited by weak and foolish men in opposition to Darwin's views. He believed in the absolute freedom of science, and that no authority whatever can answer beforehand the questions we endeavor to solve—an attitude strikingly evidenced by the fact that every one especially trained by him afterward joined the ranks of the evolutionists. For he taught us to think for ourselves, not merely to follow him. Thus, though I accepted his philosophy regarding the origin and permanence of species when I began serious studies in Zoölogy, as my work went on their impermanence impressed me more and more strongly. Gradually I found it impossible to believe that the different kinds of animals and plants had been separately created in their present forms. Nevertheless, while I paid tribute to Darwin's marvelous insight, I was finally converted to the theory of divergence through Natural Selection and other factors not by his arguments, but rather by the special facts unrolling themselves before my own eyes, the rational meaning of which he had plainly indicated. I sometimes said that I went over to the

evolutionists with the grace of a cat the boy "leads" by its tail across the carpet!

All of Agassiz's students passed through a similar experience, and most of them came to recognize that in the production of every species at least four elements were involved—these being the resident or internal factors of heredity and variation, and the external or environmental ones of selection and segregation.

To the writer the chief charm, the main value of *The Days of a Man* is that it gives us a tangible expression of Doctor Jordan's personality. Therefore he hopes to be pardoned for devoting some space to this aspect.

In spite of the fact that a not inconsiderable percentage of our American population aspires to leadership, a young man instinctively turning to his elders for that intangible commodity may sometimes look around in vain for just the kind he can use. By reference to the index we find in Volume II the following incident relating to a collecting trip made by Jordan and others in the Hawaiian Islands in 1901 in the interest of the U. S. Bureau of Fisheries. "[A] lad, John T. Nichols, since ichthyologist of the American Museum of Natural History, joined us as volunteer assistant." That, my first meeting with Jordan, was the occasion on which this peculiar quality of leadership which he possessed came to my attention. Many others have noticed that quality in him, before and since.

In this as in other cases leadership is doubtless due not to a single trait of character but to a balance wherein several such traits have their part. Any attempt to trace the nature of leadership will not be a complete success but some probably contributory causes in Jordan's case may be touched on to advantage. Jordan has been preëminently fearless, preëminently simple, democratic; he is a man with wide sympathies and a true dramatic sense.

He says that to the best of his recollection he only once experienced an overpowering sense of fear, apparently a common one among mankind in general. Speaking of his early childhood he cites a single childish panic as an incident to be valued in after years as giving an insight into such feelings in others.

To be sure, this one incident is sufficient to show that he was not incapable of fear, but the writer's surmise as to why his sense of fear never developed—a surmise which may be readily verified from incidents in the narrative of the autobiography—is worth emphasizing, for it introduces another marked trait of character. After one taste of that disagreeable emotion Jordan probably concluded that it had nothing to recommend it and was unnecessary, therefore shut it out from future consideration.

To those who know him Jordan always seems to have mental leisure. It is axiomatic that an active person, in order to have any leisure, must eliminate the unnecessary. This was pointed out some centuries ago by Marcus Aurelius, and likely earlier. Many of us follow it as a precept but not with this complete success, from which it may be further surmised that Jordan has combined with great mental and moral sensitiveness an emotional and nervous insensitiveness rather in keeping with his large frame and his rugged physical strength in early years. That an explanation in line with the above is more or less correct is attested by various personal matters recorded in the autobiography, for instance his attitude toward the use of tobacco, to which he has always been opposed.

Those who find solace in the fragrant weed are able through its means to shut out more or less successfully

assaults on their nerve centers by the complications of a civilization that has grown almost too rapidly for human adjustment.

It's nice to feel
When planets reel
Like drunken ships at sea
That there's only the scratch
Of a lighting match
Between my pipe and me.

To the invulnerable such a smoke screen will appear merely useless waste of a man's better energies, its essential friendliness not being apparent.

Democracy is a subtle art and seldom found without impurities in great universities, city governments, or elsewhere. The democracy of Jordan seems always to have been of a very high degree of concentration, which has tended to give him the support of free men and increase his influence among free men.

As to the part played by the dramatic in leadership, we may point to a parallel in nature. A swallow-tailed kite, one of the most inspiring of our native birds of prey with magnificent aërial control, seen resting motionless on the air currents, whether favorable or adverse, makes one feel instinctively that here is a bird that can soar to any height.

The connection which doubtless exists between leadership and the dramatic has been noticeable in Jordan's career. Native fearlessness quite above any petty embarrassment in the company of truth unadorned, simplicity fostered by years of training in the rigid elimination of the unessential in word and deed, a democracy founded on Puritan ideals and conscience, were combined at any given point of contact with his fellow men, whom he loved, by a rare dramatic intuition.

An interest in verse furnishes a side light on his personality, quite a number

of contributions from his own pen being scattered through the two volumes of this autobiography. The appeal for him in this mode of expression seems to have lain in its economy of words and its dramatic possibilities. We quote two choice bits, first a jingle illustrative of the "pidgin," or trade English, of the west-coast Chinaman; the second, a stanza of a longer poem, partaking of the nature of propaganda.

Mellican man go China side
Catchee China dishee;
China man go Mellican side
Catchee Mellican fishee.

Lorenzo's city, can it be
Thou livest but in history?
Are all the glories of thy race
Dissolved in sordid commonplace?
Seek'st thou on an unfriendly shore
The petty pillage of the Moor?
O Florence! thou shalt rise again,
Thy deeds once more be deeds of men!
Such real men the ages know
Crowded thy Ponte Vecchio—
Not stage-struck singers of the day
With "endless dirges to decay."
Even thy Ghibelline and Guelph
Lusted for power and not for pelf.

The history of one of the most successful teaching careers that America can show, about which these biographical notes are grouped, has not been touched upon in the present review. I have also left unnoticed Jordan's activities as "prophet of Democracy." It is well known that he devoted himself whole-heartedly to world peace for years, to have his labors in that direction interrupted by the most universal and destructive of wars. Whereas they may bear fruit in the years beyond our knowing, it is also true that scholars were often unlucky in politics, even in Cicero's day. Comment upon these things has been omitted because, as a naturalist, I like to feel that Jordan is and has been primarily a naturalist, a leader, carrying the torch of knowledge forward in that field.

The Ainus

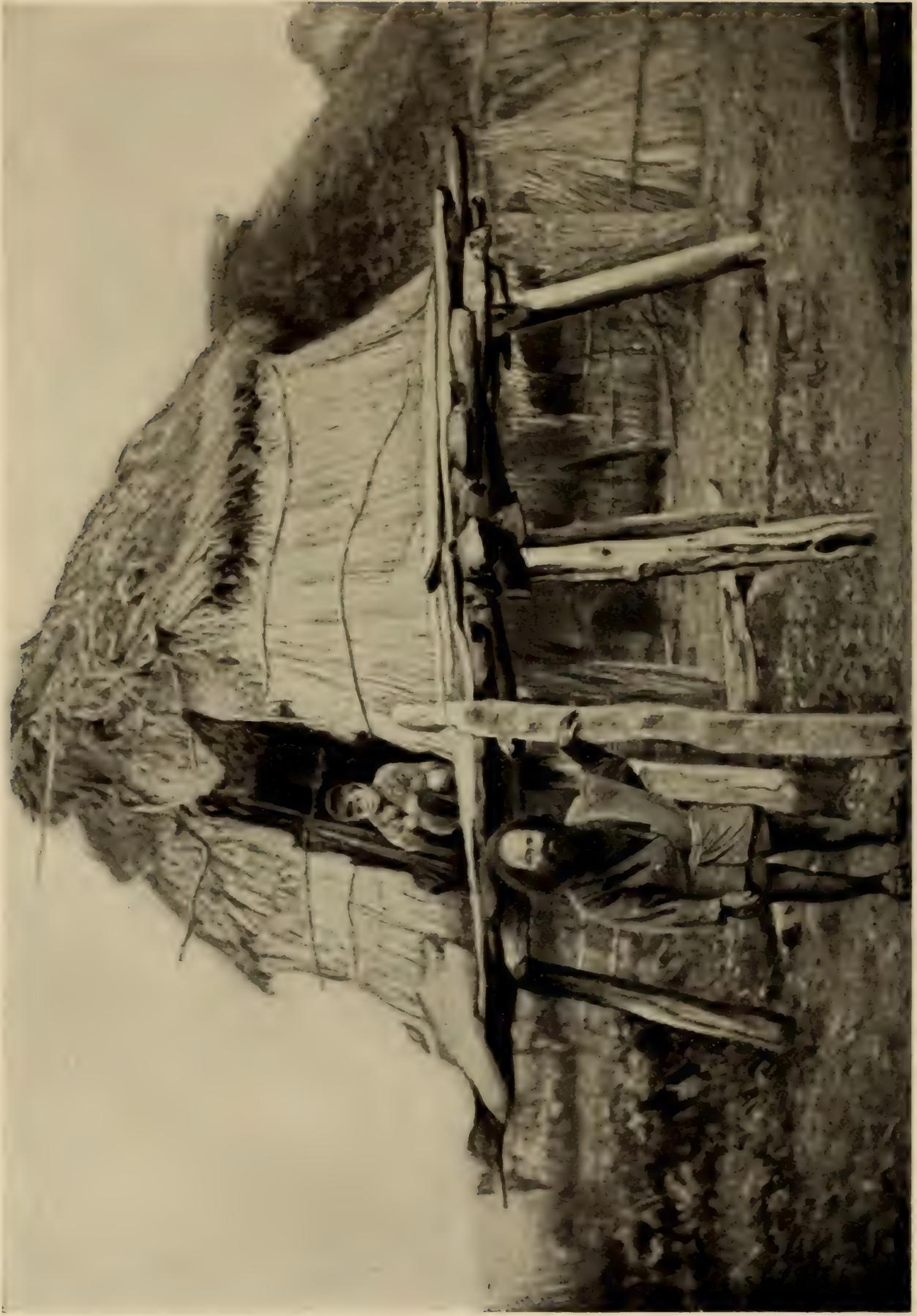
THE ABORIGINAL RACE OF JAPAN

In the course of his travels in Japan Dr. David Starr Jordan visited the little Ainu village of Edomo, referred to on page 383 of the preceding article. Meanwhile his traveling companion, Dr. John O. Snyder, visited Sapporo and there obtained the pictures of Ainus which through his courtesy we are privileged to reproduce herewith



AN AINU WOMAN IN JAPANESE DRESS

The Ainus are a dwindling race, today numbering about 20,000 individuals; yet of old they occupied large sections of Japan and apparently offered stubborn resistance to the invading Yamato tribe. The woman in the picture is married, a fact indicated by the black mustache tattooed on the lip



AN AINU HUT AT SAPPORO

The interesting dwelling in the foreground is built on a raised platform but other huts in the background rise from a level with the earth. In *The Days of a Man* Doctor Jordan states that "The huts of the Ainus are made of rye-straw, walls and roof alike, and consist each of one large room." He adds in a footnote that "According to students of architecture these one-roomed structures seem to have been the prototype of the modern Japanese house, divided not by permanent partitions but at will by sliding screens"



A GROUP OF AINU'S

It is frequently assumed that the Ainu are a divergent branch of the white race. Their lighter skin and the heavily bearded faces of the men, not to mention their more European cast of countenance, readily differentiate them from the Japanese



AINU WOMEN GRINDING MAIZE

Doctor Jordan tells us that in the north grain is never ground into meal, "for the usual Japanese stove is a mere box or pan burning only a few twigs at a time, and thus no food which takes long to cook can be utilized." Before the introduction of maize into Asia, a mortar and pestle of the type here shown were used solely for the pounding of rice, and that is still their main function. Among our eastern woodland Indians strikingly similar implements were also used for grinding maize

Louis Pasteur and His Benefactions to Mankind

EXEMPLIFIED IN THE CENTENARY EXHIBITION RECENTLY
HELD AT THE AMERICAN MUSEUM

BY GEORGE F. KUNZ

Research Associate of Gems, American Museum

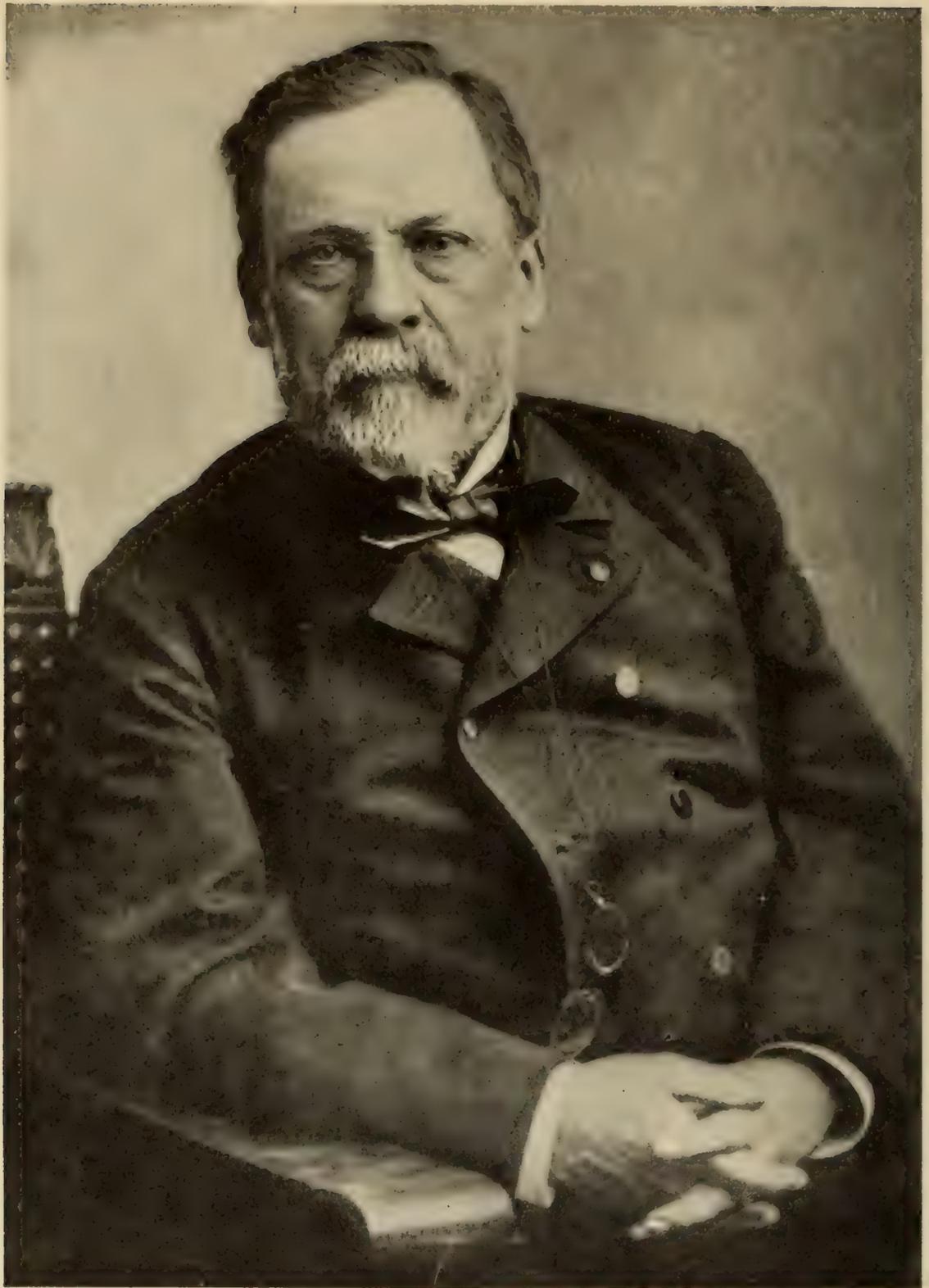
The Pasteur exhibition at the American Museum was initiated by the New York Mineralogical Club with the coöperation of the Museum and with contributions of exhibition material and assistance from the United States Department of Agriculture, the New York Academy of Medicine, the New York State Board of Health, the New York City Board of Health, and other institutions, and individuals. To enumerate all of those to whom credit is due is not possible within the available space, yet special mention should be made of the Secretary of Agriculture and of the following members of the scientific staff of the United States Department of Agriculture for their efforts in behalf of the exhibition: Dr. E. D. Ball, director of scientific work; Dr. E. T. Wherry, for the exhibit having reference to the development of isomerism in crystals; Dr. Charles Thom, of the Bureau of Chemistry, for the series showing experiments in lactic and alcoholic fermentation, processes carried out by Pasteur controverting the theory of spontaneous generation, aerobic and anaerobic life, and proof of germs in the atmosphere; Dr. John S. Buckley and Dr. W. S. Gochenour, of the Bureau of Animal Industry, who have shown as closely as possible the work carried out by Pasteur on anthrax, chicken cholera, and rabies; Mr. B. A. Linden, of the Bureau of Chemistry, for drawings, photo-micrographs, culture media, and glassware similar to that used by Pasteur, and also for the coördination and installation of the exhibit at the American Museum. For their special helpfulness grateful acknowledgement is due also to Mrs. Henry Fairfield Osborn, Dr. Robert Abbé, and Monsieur Vallery Radot, the son-in-law of Pasteur.

THE centenary of Louis Pasteur was observed at the American Museum not only in the form of a memorial meeting held on the evening of December 27, 1922, but through the installation, in the early weeks of 1923, of an exhibition illustrating the great contributions to science and to human welfare made by Pasteur. The results of the impetus which Pasteur's discoveries gave to later medical research were also graphically set forth, and finally the personal side of this great scientist and his relationship to the world in which he lived were indicated by hundreds of photographs, paintings, statues, letters, autographs, and memorabilia.

It is by his epoch-making discoveries that Pasteur opened up a new field for scientific exploration and it was fitting that the material illustrating these should have had the place of greatest

importance in the exhibition. Through certain carefully planned experiments Pasteur was able to demonstrate the true nature of fermentation, thereby overthrowing the popular doctrine of Liebig and others, that fermentation is a spontaneous chemical or semi-chemical process. According to the belief held in Pasteur's day all fermentations, alcoholic and putrefactive, were the result of the chemical changes taking place in dead matter. This idea was repugnant to Pasteur, and his preliminary experiments led him quite naturally to think of fermentation and putrefaction as vital acts.

A number of flasks (exact reproductions of those used by Pasteur) were introduced in the exhibit to show the phenomena of lactic fermentation. One of these contained some bouillon, which had been heated to sterilize its contents. Under such circumstances



Louis Pasteur, the father of bacteriology, through whose discoveries a new field of medical research was opened up

the contents remain clear. Another flask showed bouillon that had been inoculated with some cabbage, thereby causing the lactic organisms to develop in great numbers and the bouillon to become turbid. Still by way of illustrating the experiments of Pasteur, a tiny speck of liquid was transferred from one flask to another, the contents of which were perfectly clear. Within

twenty-four hours bouillon thus inoculated will display a tremendous growth of lactic organisms. The sugar present in solution is converted to lactic acid after several days' growth of this lactic ferment.

Passing now to alcoholic fermentation,—Liebig had regarded yeast, and in general all ferments, as a nitrogenous albuminous substance, which had the

power to cause certain chemical decompositions, but he failed to insist that in its quality as a living organism it had anything to do with the fermentation. He considered as far back as 1843 the organic nitrogenous matter as absolutely essential for fermentation. Berzelius, for his part, asserted that the ferment only exerted an action by its presence and caused decomposition of the organic matter without changing it quantitatively or in quality.

For Pasteur, however, the ferment was not a dead substance in process of destruction, but a living thing in process of organization. To refute the old theories he grew yeast in liquids from which all organic nitrogenous matter had been removed; for instance, in one containing only pure cane sugar, certain mineral salts, and an ammonium salt to provide nitrogen. Pasteur triumphed over Liebig and Berzelius by producing a fermentation under these conditions. The yeast multiplied, the added weight coming from the sugar, and Pasteur declared that increase of weight was a proof of life, of a profound chemical work of nutrition and assimilation.

These various experimental tests of the true cause of alcoholic fermentation were illustrated just as thoroughly and consecutively as in the case of lactic fermentation.

The clarification of the long-disputed question regarding spontaneous generation was another of the great contributions made by Pasteur. To say nothing of the rather childish beliefs of ancient physicists, and indeed those of much later periods, it was still the general conviction in Pasteur's time that the organisms accompanying putrefaction and fermentation were spontaneously produced by the elements of the putrefying substance or

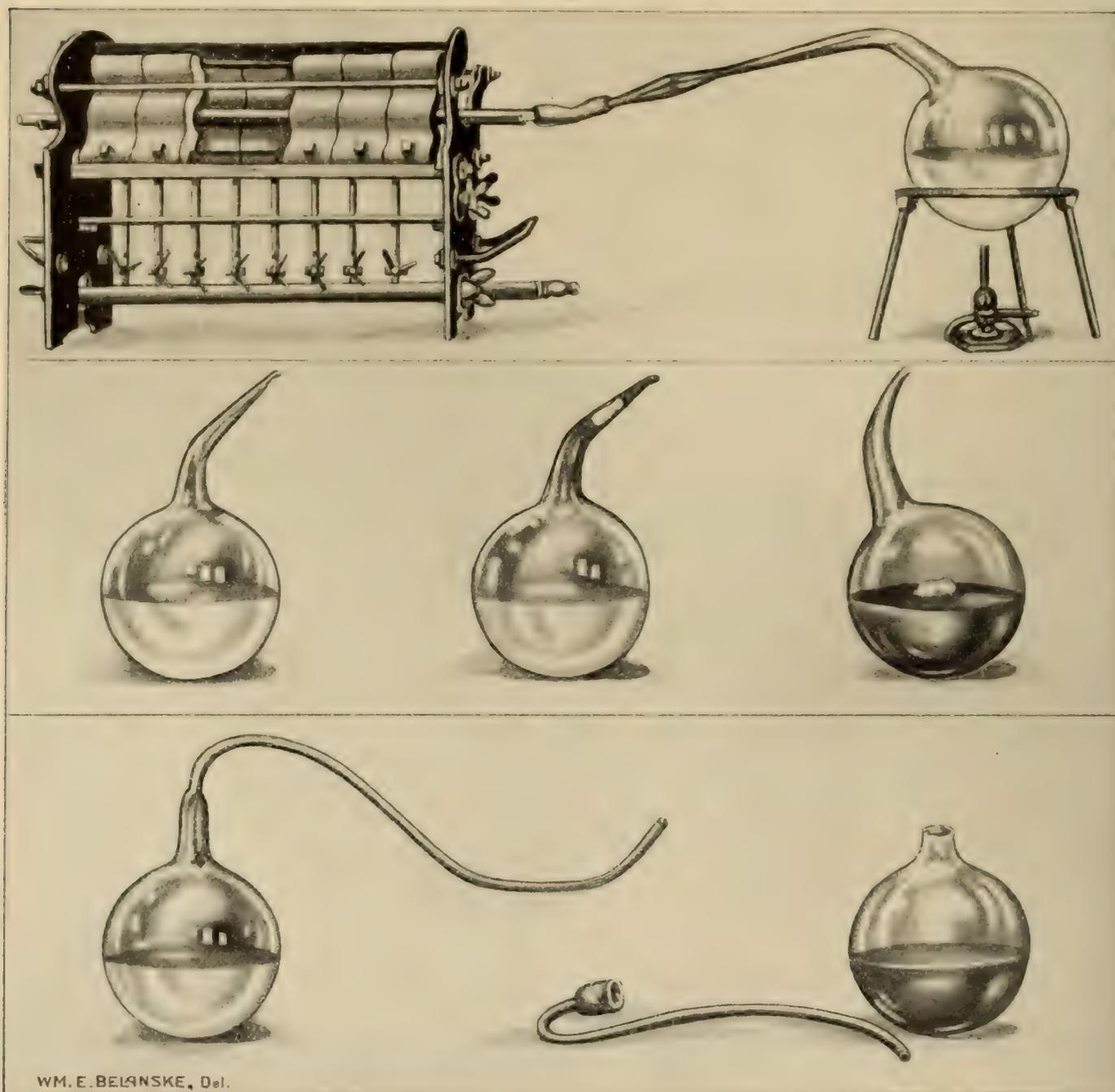
of the fermenting liquids. But Pasteur's experiments in fermentation had taught him differently and led him to the discovery that there are constantly floating in the air vital germs which will multiply as soon as they find a favorable environment.

The course of the experiments whereby he refuted the theory of spontaneous generation was shown in a series of flasks. Pasteur drew out in a flame the neck of a flask containing a vegetable or animal infusion, and then boiled the liquid so as to destroy by heat anything living it contained. The vapor produced by boiling drove out the air and at the same time the interior of the flask was sterilized. The vapor escaped into the outside air after traversing a platinum tube, heated to redness in a gas furnace. (The apparatus, as well as the flask with lengthened neck, is shown in the topmost drawing on page 394.) After some time the flame was extinguished, the liquid was cooled, the vapor was condensed and was replaced by air which had traversed the red-hot platinum tube, wherein everything living had been burned. The tapering neck was then sealed in a flame and the infusion remained clear, for nothing living was able to enter it. (This condition is represented by the flask on the left of the middle series of drawings.) Taking one of these sterilized flasks, Pasteur passed into the neck a little piece of cotton soiled by dust from the air, the living quality of which his critics had denied (center of middle series). As long as this cotton remained fixed in the neck, the liquid retained its clearness. However, when at the end of fifteen days he caused the cotton to fall into the infusion by simply inclining the flask, the liquid became clouded in twenty-four hours, and at the end

of forty-eight hours it contained millions of living organisms (right of middle series).

To prove to his critics that the piece of cotton used in the previous experi-

remained clear and sterile indefinitely. Pasteur then cut off the neck of the flask, so as to leave the fluid exposed to the fall of atmospheric dust (right of lowest series). In two or three days



Through a series of experiments, indicated in the above diagram and described in the text of this article, Pasteur decisively refuted the theory of spontaneous generation

ment did not influence the result, he introduced into a swan-neck flask (left of lowest series) an infusion capable of fermentation. He thereupon boiled the fluid until all the air had been driven out of the flask and the fluid was sterilized. Ordinary air was permitted to enter the flask through the curved neck. The flask

the fluid was swarming with microorganisms.

The tests of putrefying matter were then taken up, and a drop of liquid from some decaying organic matter undergoing butyric fermentation was added to liquid in a sterilized flask. A gas was liberated, but it differed from alcoholic fermentation, consisting of

carbonic acid gas and hydrogen. Examining a drop of the liquid under the microscope, Pasteur saw to his surprise a great number of motile rods, so disposed as to prove that reproduction took place by fission. Thus was revealed the new world of bacteria, more active and more densely populated than the world of yeasts.

In 1877 the French Government requested Pasteur to undertake the study of splenic fever (anthrax) because of losses mounting up to 20,000,000 francs annually from this disease. Pasteur was able in a very short time to confirm the findings of Davaine, who had previously seen rod-shaped bodies in the blood of animals dead of anthrax, and claimed these rods to be the cause of the disease.

Pasteur prepared a vaccine No. 1 and later a second culture of the anthrax organism, a somewhat stronger vaccine No. 2, yet one not wholly virulent. This is administered ten days after vaccine No. 1.

In 1880 Pasteur started his studies on chicken cholera, and in the course of these he developed as a culture medium for the growth of the micro-organism a bouillon of chicken gristle, neutralized by potash and rendered sterile by subjection to a temperature of from 110 degrees to 115 degrees Centigrade. Cholera could be produced in healthy chickens by means of the organism grown in this medium.

Pasteur's work on chicken cholera was interrupted for several months. When he again took it up, he found that the old cultures were no longer capable of producing the disease in healthy fowls. On the contrary, inoculation with these old cultures brought about a marked immunity in the fowls, so that they were able, when subsequently inoculated with virulent

cultures of the chicken cholera organisms, to withstand the disease. Thus was established a fundamental principle in the attenuation of micro-organisms and this principle has been made use of since then in preparing vaccine for immunizing animals against certain diseases.

Pasteur's first experiments on immunization against rabies were conducted on dogs. He proved conclusively that by repeated injections of rabies virus which had been attenuated or weakened, dogs could be rendered immune to rabies, no matter how severe the exposure.

Pasteur first immunized dogs with repeated injections of a virus which had passed through monkeys a number of times. He found this virus to be not only harmless when injected into the dog, but that repeated injections made the animals refractory to the disease. Later, by a number of passages through rabbits he was able to increase the virulence of the virus, so that rabbits were brought down with the disease regularly in seven days. He found that this virus, which was present in the spinal cords of rabbits that had died of the disease, could be attenuated or its virulence reduced by drying, so that after fourteen days the virulence of the virus was destroyed. He evolved from this a system of vaccination, starting with a cord which had been dried fifteen days, and successively injecting emulsions of cords dried fourteen days, thirteen days, and so on until the last injection was that of the emulsion of a cord dried only one day. Experiments on dogs revealed the fact that this method of immunization was highly efficient.

So great was Pasteur's confidence in the efficiency of this method of vaccination, that he requested of the

Minister of Public Instruction that a committee be appointed to determine whether or not the dogs vaccinated were refractory to rabies infection. This request was granted and a commission appointed. Pasteur furnished the commission with nineteen dogs which he himself had vaccinated, and these nineteen dogs together with nineteen control dogs, were exposed by the commission to rabies infection.

The results were as Pasteur had predicted. Of the nineteen vaccinated dogs not one developed rabies, while of the nineteen control dogs, thirteen died of rabies infection. Later his methods were utilized for the cure of rabies in humans. Pasteur's method of vaccination has also had considerable

use in veterinary medicine, and has been of economic value in the protection of livestock exposed to rabies infection by bites of rabid dogs, wolves, coyotes, etc.

In conclusion, we must repeat that the Department of Agriculture faithfully reproduced all of Pasteur's experiments with apparatus exactly like that made for and used by him in these investigations. The apparatus was so systematically disposed that one was able to study the great discoveries just as Pasteur saw them. So impressive is the restaging of these world-famous experiments that the Department of Agriculture will make a permanent exhibit of them, now that the apparatus has been returned to Washington.



There is no single discovery of Pasteur more dramatic or more far-reaching in its beneficence than that of the cure for hydrophobia. The picture shows Pasteur surrounded by a group of children whom he saved from the fatal results of this disease



Courtesy of Dr. Frank E. Lutz

Royal Palm State Park (formerly known as Paradise Key) is in the southern portion of the Everglades and is a spot of great natural beauty as well as of exceptional biological interest. Conspicuous are the majestic royal palms that rise to a height of more than one hundred feet, proudly aloof from the lesser plant world. There are 4000 acres in the park—960 acres ceded by the state of Florida in 1915, an additional 960 acres presented by Mrs. Henry M. Flagler, and 2080 acres ceded by the state of Florida in 1921. The park is owned and administered in the public interest by the Florida Federation of Women's Clubs

Swinging the Net in Southern Florida

By HERBERT F. SCHWARZ

Research Associate in Hymenoptera, American Museum

WHEN we left New York, the feel of winter was in the air. By the time we reached Miami, Florida, less than forty-eight hours later, we had passed through more than half of the cycle of the seasons. Spring greeted us in North Carolina, the white bloom of dogwood spangling the green of the open forest. As the train moved southward, flowers appeared in increasing variety and we regretted that we could not jump off for just a moment to peep into the funnel-like leaves of the flaring-yellow pitcher plant (*Sarracenia flava*) and note its insect captives. South Carolina, with its darkey cabins and its mules, gave way to Georgia. It was not the rising temperature alone

but the character of the landscape—the abundance of fan-leaved palmettos, of stately royal palms, and of blooming red *Hibiscus*—and especially the trucks laden with freshly picked oranges that told us we were rapidly reaching our destination.

We had come to Florida to make a collection of the spring and early summer insects and to pick up in spare moments what information we could regarding their habits. Dr. Frank E. Lutz, curator of entomology in the American Museum, who planned and headed the field trip, believed that in the area from Miami southward specimens might be obtained that would link up in an interesting way with the

insects collected in previous years in the West Indies.

Over this southern portion of the map of Florida is written in large letters the term Everglades, a term that may to some still conjure up a picture of inaccessible swamp land, infested by the deadly moccasin,—the lurking place of scattered bands of Seminoles who found refuge in its fastnesses after the bulk of their nation had fallen in battle or had been deported westward. This region is, however, being rapidly opened up. Already a road extends from Miami, via Homestead, through the Royal Palm State Park, to Flamingo on the Bay of Florida, and beyond toward Cape Sable at the southwestern tip of the peninsula. Another highway is now in course of construction, and canals for drainage and as channels of communication are among the actualities. With this penetration of what was once looked upon as practically impenetrable, it is probable that before long the plant and animal life of the region will be changed and there is, therefore, no time to be lost if a record is to be made of the interesting species that dwell there.

The very first day of our sojourn brought us evidence of the doom that awaits some of the spots of greatest biologic interest. On the outskirts of Miami lies the famous "Brickell hammock," a bit of West Indian jungle on the mainland of the United States that has been the collecting ground for the representatives of several scientific institutions. The growing city of Miami has spread like a prairie fire toward this spot. In places it has already reached it and in a little while will have completely engulfed it. The dense growth of tropical trees is falling before the ax to make way for ornamental gardens, and in time the true character

of the land will be a memory only, if indeed it is not completely forgotten. That we might contribute our small share toward perpetuating the record of this hammock, we collected for two days along the jungle paths, in the jungle itself, and in the open pine land that flanks it.

Glad as we should have been to continue our work in the environs of Miami, other localities of the region awaited our examination. At Miami we had enjoyed many courtesies through Dr. J. Arthur Harris, who at the time was engaged in research work at the Plant Introduction Gardens of the United States Department of Agriculture, and through his assistant, Mr. Crane, and it was in their company that we were privileged to journey by automobile to the Royal Palm State Park. The road wound by many a fine estate, past orange groves, some of the trees of which bore both blossoms and fruit, on to Homestead. It was while stopping near Homestead for a few moments that Doctor Lutz noticed a bee of unusual appearance. A swing of the net yielded the first *Centris*, a tropical genus of bees the females of which have on their third pair of legs a heavy development of pollen-collecting hairs that suggest the chaps of the western plainsman. Although in our later collecting we obtained additional specimens of *Centris*, we were glad indeed to feel that at least one of these bees was represented in our catch.

We jumped into the auto again and headed toward the Royal Palm State Park. This park is owned and administered in the public interest by the Florida Federation of Women's Clubs, as a site deserving of perpetuation in its pristine state. Hunting, fishing, and mutilation of foliage are forbidden on the premises and if the danger of fire,



Courtesy of Dr. Frank E. Lutz

The Royal Palm Lodge affords every comfort for those visiting the Royal Palm State Park. Provided with a screened porch, a comfortable living room and bedrooms, with running water, bathing facilities, electric lights, and other conveniences, it is a place where one may sojourn with ease although surrounded by the primeval jungle

which has already devastated some portions of the reserve, can be guarded against in the future, a hammock of unusual interest—perhaps the finest hammock in the Everglades—will be available for the study and enjoyment of nature lovers. Dusk overtook us before we reached the park but even in the half light its dense verdure, above which rose toweringly the tall stems and graceful fronds of the royal palms that give the park its name, was in sharp contrast to the level grass land through which the approach is made.

In a few more moments we were in front of the rustic gateway of the Royal Palm Lodge. An electric light surmounted this entrance, attracting a host of minute fliers; below on the pathway were gathered a number of tiny tree toads, waiting expectantly and not vainly for the insects that dropped exhausted after their spiral dance. Occasionally a carabid beetle would scurry

across the path, clumsily pursued by a hopping toad, but even when overtaken would leave the aggressor staggering and repentant and perhaps just a little thankful too at having escaped swallowing an insect that on closer acquaintance proved so unsavory. We had met with some of our competitors in collecting; but in a bush, fully illumined by the lamp, yet so intent in her attitude, so statuesque in her absorption that it was necessary to glance at this motionless thing twice to be sure that the eye had not been deceived, was another collector of insects, the mantis, with her traplike front legs bent to seize the hapless moth that might thoughtlessly stray her way. We put an end to her projects by capturing her. There is sometimes a little satisfaction in feeling that collecting includes the predatory insects as well as the gatherers of pollen and the sunshine-loving sippers of nectar.

Next morning we were off for the tip of Florida through the southern portion of the Everglades. As the rainy season advances, the grassy plains that stretch on each side of the road become submerged, creating a vast swampy area. At the time of our visit, however, the rainy season had only begun and the plains were merely spongy to the tread. Evidence of the true character of the region was afforded, however, by the canal of sluggishly flowing water that ran parallel with the road. This road was constructed by dredging in the desired direction, a canal forming *pari passu* in the ribbon-like excavation that yielded the material out of which the road was built. The canal was water-filled even at the close of the dry season and yet it was shallow enough so that one could see from the moving automobile the fish that swam just a little below its surface or that rose and splashed only to scurry below again. An eagle flapped in low leisurely flight

ahead of our auto, keeping to the road almost without deviation. Buzzards were seen circling in intent examination of the flat expanse below. As we passed marshy places, herons and ducks winged away from us.

Even more interesting than the signs of life about us was the country itself. Here was a great sea of prairie out of which rose at irregular intervals islands of tropical verdure, the so-called hammocks. Rarely was there a stray tree that overstepped the dead-line of the island bounds. To penetrate these compact jungles you would have to step with care, so as to avoid the dense network of ensnaring growths, and yet just beyond the wall of green there was a treeless stretch of coarse grass and sedges. Though much of the country was of this character, it was not all treeless. We passed by areas on which grew dwarf cypress, resembling the artificially stunted trees of the Japanese, and dwarf mangroves,



Courtesy of Dr. Frank E. Lutz

The southern coast of Florida is a low-lying flat area, menaced in the hurricane season by the intruding sea, which often pours far inland and in its retreat leaves sandy patches like those shown in the picture

stranded specimens of a tree that thrives on the shores of warm seas. As we approached the salt water, the mangroves became larger, until finally they stood well above us in height.

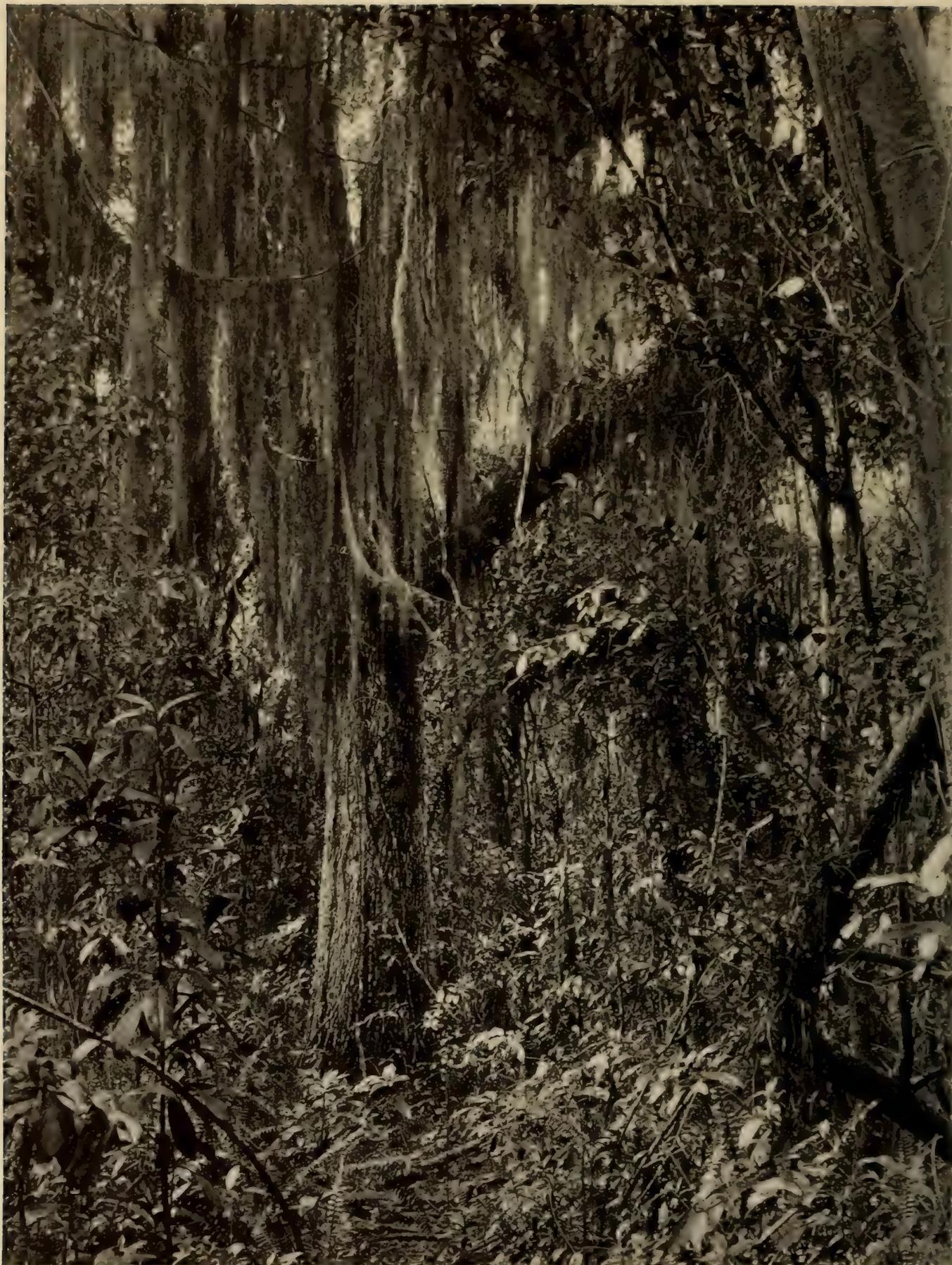
At last we reached the tiny settlement of Flamingo on the Bay of Florida. In former days, it is said, a colony of flamingos existed on this site. These beautiful birds have disappeared but a faint suggestion of their structure still survives in the stiltlike supports on which the houses of the region are lifted high above the ground, thereby escaping the inrush of the sea when a West Indian hurricane lashes the coastal waters to fury.

We collected a few miles west of Flamingo as well as on some of the hammocks and along the flower-strewn areas that we passed in returning to the park. Bees—the particular object of our search—were scarce, but occasionally one was found visiting the wild cotton, or busying itself in the cuplike yellow flower of the cactus, or gathering its provisions from some other plant equally favored.

As the days went on we collected in and about the park, choosing now the flower-bordered roadside of the open country, now the jungle paths that lead into the green interior of the hammock, now the pineland, where the graceful *Pinus caribæa*—the same species that grows on the Isle of Pines—shares the terrain with the palmetto and the cycad, the latter a true blue blood among plants, tracing its ancestry back to the Carboniferous. To one entering the region for the first time nothing is probably more impressive than a walk into the jungle. One does not have to penetrate far to get the feeling that one is entombed in green and to observe the remorselessness of the struggle for life in these congested

centers of plant population. It is not only the weak that are crowded out; the strong, too, are the object of more or less successful attack. Here, for instance, is a great live oak, the very embodiment of strength. Yet about it coils a ropelike growth (*Hippocratea volubilis*) that fetters its limbs, while up the trunk of the manacled giant climb resurrection ferns, and pineapple-like tillandsias take strategic positions in the branches and on the stem, thus simulating an attack even though, unlike the *Hippocratea volubilis*, they do not endanger the tree by their presence. Great curtains of Spanish moss, ashlike in color, drape the oak like a garment of repentance. The gumbo limbo tree, with its cocoa-colored bark, grows tortuously with sinuous trunk and writhing branch. Indeed, many are the twists and turns taken by not a few of the trees of the park jungle in their upward growth. In contrast, the royal palms rise erect and majestic, lifting their frond-crowned heads above the lesser plant world.

We frequently noticed the web of a large, conspicuously marked spider (*Nephila clavipes*) stretched across the jungle paths. One night, provided with an acetylene light that cast a circle of radiance ahead of us as we made our way through the soft darkness, we came upon the web of one of these spiders that presented points of special interest. Along the supporting strands of this web, far away from the center of the orb, where the true proprietress had her station, spiders of different species (they were not the males of *Nephila*) had constructed little gossamer barriers of their own, attaching them to the main web. It is commonly thought that spiders are cannibalistic. Yet these squatters



Courtesy of Dr. Frank E. Lutz

“BEARDED WITH MOSS”

Even more applicable than to “the murmuring pines and the hemlocks” of Arcadia is Longfellow’s description to the patriarchal live oaks of the Royal Palm State Park, bearded as they are with a heavy gray growth of Spanish moss. Yet the botanist will interpose an objection, denying such poetic license and calling attention to the fact that Spanish “moss” is not a moss at all but related to the pineapple. Other epiphytic “pineapples” are abundant on the trees of southern Florida. A beautiful example of one, a *Tillandsia*, is shown in the picture on the opposing page. Spanish moss, in addition to being ornamental, has an interest for the ethnologist, for it was used by the aborigines in making aprons and skirts



Courtesy of Dr. Frank E. Lutz

THE JUNGLE OF THE ROYAL PALM STATE PARK

upon another's property—nay, more than squatters, possible poachers upon the insects that, but for their snares, might have found their way into the larger web—were enjoying immunity.

It is interesting to note in passing that the attempt has been made more than once to use commercially the silk of certain species of *Nephila*, including that of *clavipes*. Though this silk is stronger and finer than that of the silk worm, it is an easier task to grow mulberry leaves and other food plants for the larvæ of *Bombyx mori* than to supply live insects to *Nephila*, and it is not likely, therefore, that the former will ever be supplanted as man's chief dependence for his supplies of raw silk.

Our net swings yielded many insects—one of the advantages of entomological collecting is that one is always assured of a bag—but the catch of bees was not as ample nor as diversified as we had hoped might be the case. Moreover, we were at first surprised at the paucity of andrenids and other ground-nesting bees and at the relatively large number of Megachilidæ. A plausible reason for this disparity seemed to be the character of the country. Where vast areas are submerged annually for a period of months, the risks of ground-nesting must be great indeed, many of the larvæ imprisoned in their cells succumbing as the water seeps in and turns the earthen walls to mud, spoiling the provisions that have been gathered by the mother. Under conditions such as these, the Megachilidæ would have a better chance of survival. One afternoon the watchful eye of Doctor Lutz detected one of the bees of this family as it entered a hole drilled in a sign board. It proved to be an *Anthidium*. Of *Dianthidium*, a related genus, we collected many specimens. In the Old World, species of Magachilidæ have

been found nesting in empty snail shells. There was an abundance of such shells in the hammock of the park but, though we examined not a few of those that lay in our path, we did not discover a nest.

One of our hopes was to learn something of the nesting habits of *Centris*. One day Doctor Lutz observed a swarm of bees flying in and out of a hole high up in a tree. Their behavior suggested that they were honey bees but we had taken no *Apis* in spite of industrious collecting and it seemed just possible, therefore, that we were on the verge of an interesting discovery. Tying his net to the end of a long pole and climbing into the branches of a neighboring tree, Doctor Lutz was able to reach the point, about forty feet from the ground, where the insects were emerging. A dexterous swing of the net while he balanced on a support none too secure, yielded a bee, but it was only an *Apis*, and thus defeated our hopes that it might be a species the nesting habits of which are less well known. A little later we caught an *Apis* on a flower and this fact and the behavior of the swarm suggested that these bees had arrived only just before Doctor Lutz detected their presence.

Doctor Lutz's triumph came, however, next day. While collecting in the pine land at Homestead he observed a *Centris* entering the earth that filled a little irregular concavity in the rock. He proceeded to excavate the nest which lay more or less perpendicular to a horizontal passageway about three inches long that formed the entrance hall. Two earthen cells were taken out of it, one incompletely stocked with food, the other containing not only provisions but a small white larva. In the course of the excavation the bee was caught.

At Homestead, which is beyond the Everglades, the proportion of andrenid bees was very much greater than in the immediate vicinity of the park, thus strengthening our impression that their paucity in our earlier collecting ground was due to the seasonal submergence of that area. Confirmation came also in a visit to Long Key, one of the islands in the chain east and south of Florida that have been made accessible by the seaward projection of the Florida East Coast Railway. Here we found andrenids in abundance but only a single specimen of *Megachile* was represented in our catch! As the train moved over concrete bridges built in the shallow sea and crossed narrow islands, we saw, glancing oceanward, the brown pelican as it swam leisurely over the emerald

waters or dropped beak-first from the air upon some hapless fish. Near one of these birds was a laughing gull, and as the pelican emerged from the water, the gull would alight on its head, presumably in the hope of sharing in the catch.

The time had come when one of the members of the party had to start for the north. Little by little the land of oranges and palms faded in the distance. As the train sped northward, the seasons again succeeded one another, only now they were running counter-clockwise, the full tide of summer ebbing into spring, and spring in turn giving place to that in-between period when things seem to be in a state of equilibrium and only a little is needed to advance the year or to throw it back for a brief moment into winter.



Courtesy of Dr. Frank E. Lutz

A bit of palm-fringed shore on Long Key, one of the islands in the chain that includes Key West and the Dry Tortugas

NOTES

MARY CYNTHIA DICKERSON

On April 8, 1923, Miss Mary Cynthia Dickerson died after an illness of nearly three years. Even before becoming associated with the American Museum, she was known, wherever nature is revered, for the breadth of her understanding of the world of living things and her ability to convey to others through her rich and many-sided personality their interest, beauty, and significance. To her the fields, the woods, the streams were places of intimate sojourn, wherein she claimed as familiar friends the trees, the flowers, the birds, the moths and butterflies, and the shy creatures that slip silently in and out among the cool shadows of the water grasses or sport unafraid in the sunny open shallows in the sheer joy of living.

Many of Miss Dickerson's beautiful and remarkable photographic studies depicting phases of the life histories of these creatures in their natural environment have found place from time to time in the pages of *NATURAL HISTORY* while the pictures in her *Frog Book* and *Moths and Butterflies* attest the skill of the trained observer in producing records of unusual value and interest.

During her years of association with the Museum she was curator of woods and forestry, curator of herpetology, and editor of *NATURAL HISTORY*, and she carried these responsibilities not successively but simultaneously. Her achievement in each of these departments considered independently was such that it might well have constituted a claim to enduring recognition. In a later issue it is our hope to publish several articles dealing with the different phases of her work in the Museum, but a special word of tribute to Miss Dickerson for her untiring devotion to *NATURAL HISTORY* may fittingly find place, by way of anticipation, in this issue.

Miss Dickerson assumed the editorship of the magazine in the course of 1910, having previously been for some time associate editor. In the ten or more years during which she directed its destinies, the magazine assumed a commanding position among publications devoted to nature study. While the undertakings of the Museum continued to receive deserved emphasis, space was given also to contributors other than those associated with that institution, and a perusal of the list of those who have enriched

the magazine with their articles will be found to include many of the ranking scientists of this and other countries.

Miss Dickerson's vision of what the magazine should be led her unfalteringly. Although technically trained, she never lost the point of view of the lay reader and she had the almost magic ability of giving sparkle and interest to whatever she touched with her pen. With sturdiness of ideal, scientific grounding, and rare literary aptitude, she combined artistic intuition. The elements in a photograph that lent themselves to effective, independent treatment at once flashed upon her, and many a picture published in *NATURAL HISTORY* that has been admired for its beauty and significance owed its effectiveness to her perception of its possibilities when detached from a larger composition.

It is a matter of great regret that her versatile personality has been withdrawn from the fields of activity in which she found so much genuine pleasure and satisfaction.

ASIA

THE THIRD ASIATIC EXPEDITION RESUMES WORK IN MONGOLIA.—When the Third Asiatic Expedition set forth about the middle of April last year for the Gobi Desert, few would have ventured to predict that finds of such momentous importance to the understanding of the animal life of the past would be brought to light during the weeks that the expedition devoted to the region. The discoveries of 1922 made imperative a second trip this year, so that this promising area might receive the proper measure of attention. Indeed so great a field as has been opened up in Mongolia can be exploited only through a campaign extending over several years, with well organized field and transport arrangements, such as are assured under Mr. Roy Chapman Andrews' leadership. It has taken seventy-five years to uncover the faunal record of our Great Plains and the work is still going on. Mongolia offers possibilities comparable to those of the Great Plains.

The date of departure of the expedition this year was set for April 17. On April 12, President Henry Fairfield Osborn cabled Mr. Roy Chapman Andrews as follows:

Last season's discoveries splendid. May continued good fortune attend third season! Look for Lower and Basal Eocene fossil

mammal beds; also for Lower Cretaceous land fauna unknown elsewhere. Round up collections discovered last season. Expect me end of September. Godspeed from all your Museum friends!

The solution of many important questions hinges upon the further discoveries of the expedition. The real outstanding proof of the Asiatic dispersal theory would be the finding in the Cretaceous of placental mammals (five-toed ancestors of the horse, etc.) It is the prediction that these will prove to be small and primitive and will require for their discovery eyes specially trained in the detection of Eocene mammals. Messrs. Granger, Olsen, Kaisen, and Johnson are particularly fitted for a successful scrutiny of the terrain. The Tertiary faunas should yield strong evidence as to the source of various later immigrations—those of the cats, various ruminant phyla, most of the later rodents, the rhinoceroses, and, especially the ancestral series of man.

The first destination of the expedition was Kalgan; thence it proceeded to Iren Dabasu. The very first month's work yielded a find of great importance, a perfect skull of a titanotherium,—a member of a group of animals that had their origin in the New World. In addition to this Asiatic titanotherium, the expedition unearthed a choice collection of fossils of large and small dinosaurs.

The American public will have the opportunity in the fall of hearing from the leader of the expedition in person the account of its adventures and accomplishments. Mr. Roy Chapman Andrews, accompanied by Mr. Clifford Pope, will sail from Shanghai on October 13 to begin on November 26 a lecture tour that will take him to different centers throughout the United States.

A BRUSH WITH BANDITS.—Heroism and devotion are required of the collector in China under the present turbulent conditions. In a recent letter Mr. Roy Chapman Andrews wrote, "I am a bit worried about Granger—a big row has started in his vicinity." Mr. Andrews' anxiety was not wholly ill-grounded, as is indicated by the following citation from a letter of Mr. Walter Granger regarding the trip which Mrs. Granger and he took along the Yangtze:

Had a fine trip down through the Gorges, five and a half days from Wauhsien to Ichang. Warm sunny days and favorable winds. Ran into a small band of robbers in Wushan Gorge and opened up on them with everything we had; this broke up the party in short order. Nobody hurt on our side.

Mr. Granger's brief report of his experiences is supplemented by a more detailed account written by Mrs. Granger:

The pirate gang found us in the middle of the Wushan Gorge, and a more isolated spot could not be imagined. Recent depredations by the band had driven all the inhabitants from the neighborhood, and the river itself was devoid of life because no coolies were left (after the army passed through) to make the boats go. In one place the soldiers even stopped our boat and wanted to confiscate our coolies to pull a boatload of ammunition. However, nothing short of a foreign gunboat would have been of any help to us. As it was, we were able to defend ourselves and we think the robbers must have had the surprise of their careers when they found their rifle fire returned with interest. The prompt action was partly due to two American sailors whom we brought down with us from the United States Gunboat "Palos" stationed at Wauhsien. Their terms of service had expired and the captain in command thought it would be wise for them and for us to be together. Each sailor had on an automatic pistol which, when discharged, sounded like a machine gun. Later one of these men used Mr. Wong's rifle to good effect. [Mr. Wong is the official interpreter of the Third Asiatic Expedition.] Three shots were aimed at us, none of which hit anything but the water. By the time forty-three rounds of ammunition had left our boat, the five assailants were getting out of sight as fast as they could. We are the only people we have heard of who didn't have to let the bandits have it all their own way. A big American flag flew bravely over our boat, but that of itself was no protection whatever. Plenty of natives do not know one flag from another. This call to arms came about 1:30, just as we had finished our luncheon. The rest of that day was an anxious one. Not until 7:45 that night did we get out of this gorge and into more open country where it was safe to tie up until morning.

Mr. Clifford H. Pope, who has been collecting reptiles and fish on behalf of the Third Asiatic Expedition, writes from bandit-infested Hainan:

Hainan is just now overrun with robbers and one never knows when one will be robbed or kidnapped although as yet these robbers have not attempted to kidnap a foreigner. It may be because they have had few chances, foreigners, other than missionaries, rarely coming this way. They rob us at will. Only a few days ago they took a \$250 microscope on its way to the mission hospital. Chinese citizens always travel with a military guard. On this occasion the band of one hundred well-armed robbers easily put to flight the ten guarding soldiers after blowing off the sergeant's head. This robbery took place only four or five miles from Nodoo. There have been several since my arrival. The robbers enter the market when they wish, as

no one dares molest them. We expect at any time to be served a notice of a general attack and looting. In that case one can only hide one's money and wait. But one is so utterly at the mercy of these outlaws that one never fears. If they come, they come, and if they stay away, one thanks one's stars for one's good fortune in not being attacked. They call themselves—"The People's Army." Today half the missionaries leave for Kachek, which is over on the east coast. Day after tomorrow the last crowd leaves and then for three weeks I shall be completely alone in charge of the compound—four days from the nearest foreigners.

A TRIUMVIRATE OF TALENT.—The Third Asiatic Expedition was remarkably fortunate in securing the services of three such experts as Walter Granger in vertebrate palæontology, Frederick K. Morris in physiography, and Charles P. Berkey in geology. This was a triumvirate of unusual talent, inspired by a single purpose, each doing what he was best qualified by training and experience to do, all working together to produce and perfect a harmonious whole. In referring to the united work of these three men in recent addresses before the American Philosophical Society, the National Academy of Sciences, the New York Academy of Sciences, and the Explorers Club, President Henry Fairfield Osborn compared them with the pioneer field workers in western North America, Joseph Leidy as vertebrate palæontologist, William H. Holmes as topographer, F. A. Hayden as geologist. The reconnaissance work done in Mongolia in a single season is comparable with that done in our western territory in several seasons, partly through the accumulated experience of the men, partly because of the present rapidity of transportation. Hayden and Holmes traveled by wagon at the rate of fifteen miles a day; this was the rate of the camel caravan of the Third Asiatic Expedition, while the automobile caravan can make from thirty to forty miles a day. Already two very important geologic papers have been published by Messrs. Berkey and Granger in *Noritates*, copies of which may be purchased by applying to the librarian of the Museum.

The Trustees of the American Museum, in recognition of the splendid field work of Professor Berkey and of his devotion to subsequent research and publication, have taken great pleasure in appointing him Research Associate in Geology, the first appointment of the kind in this department of the Museum.

THE FAUNTHORPE INDIAN EXPEDITION.—The joint expedition of Col. J. C. Faunthorpe and Mr. Arthur S. Vernay is fulfilling in a remarkable way the purposes which it set out to accomplish, and the record of its achievements is all the more notable in view of the scarcity of several of the species obtained. The expedition has enjoyed rare privileges, meeting with the most generous coöperation on the part of the native rulers and the government officials. In Nepal, for instance, where tigers and rhinoceroses are "royal game" and may be hunted only on exceptional occasions—such as visits of royalty or of the British Envoy,—Mr. Vernay was privileged to engage in several tiger shoots, thanks to an invitation extended to him by the British Envoy.

The tiger after killing its prey drags it some distance into thick jungle, there to feed on it all night. By daybreak the beast is gorged and abandoning its prey for the time being, looks for a pool of water somewhere comparatively near, where it rests during the day, only to come forth again after dark and resume feeding. Consequently, when a kill has been located by the trackers, it is almost certain that the tiger is within a quarter of a mile of it. In Nepal—according to the graphic account contained in one of Mr. Vernay's letters—the method is to approach such a lair silently with a herd of trained elephants and then surround it, one line of elephants executing an encircling movement to the left, and the other a similar movement to the right, until the two lines meet and complete the ring. At intervals in the chain are the howdah elephants bearing the gunners with their rifles primed for action and confident that it will not be long before the tiger attempts a break for freedom. When the chain is completed, the elephants are about twenty yards apart.

Now the *sabedar* (the equivalent of captain) blows his whistle and at the signal the silence that has previously been observed is broken. Everybody deliberately begins talking. Simultaneously the elephants are turned inward, and as they move forward, the circle gradually grows smaller and smaller. Meanwhile the tiger, hearing noises all around, retreats bewildered toward the center. The narrowing circle has shrunken to a diameter of from 100 to 150 yards. The tiger by this time is hidden in the thickest grass he has been able to find or in thorn scrub.

The important moment has arrived. The in-moving elephants come to a halt. Two of the largest tusked are then sent into the ring to beat the tiger out. Huge and powerful as are these beasts, they are obviously nervous, trumpeting and tapping their trunks on the ground, swaying their enormous heads in order to break through the seemingly impenetrable cover. Suddenly there is a shrill trumpet from an elephant, a roar from the tiger, and the baffled and alarmed animal charges. It is a tense moment. If the aim of the gunner is not true, the elaborate preparations have been in vain, for the elephants in most cases will not stand and the tiger may break through a convenient gap in the circle.

The hunts in which Mr. Vernay participated were exceptionally successful. In the course of seven days, five tigers were secured, two of them falling to Mr. Vernay. The number of participants in these hunts is an indication of the princely scale on which the operations were conducted, there being no less than 58 elephants, 177 mahouts and elephant men, as well as coolies, camp men, etc., totaling in all 533 people.

At the conclusion of the tiger hunts Mr. Vernay joined Colonel Faunthorpe at Bagaha in west Nepal. Thence they moved into rough, difficult country to hunt the one-horned Indian rhinoceros (*unicornis*) and obtained three specimens (two males and a female) that are well above the average in size. (A cable announcing this valued acquisition was referred to in the May-June issue of *NATURAL HISTORY*, p. 303.) "We stalked the first one on elephants," writes Mr. Vernay in his letter, "but when I saw a rhino and shot it, my elephant tried to bolt, and had the rhino charged, it would have been rather uncomfortable as the howdah is apt to be swept off by the trees. So we stalked the others on foot with satisfactory results."

To the Prime Minister of Nepal, Maharaja Sir Chandra Shamshere Jung Bahadur, the expedition and through it the American Museum are much indebted for generous aid, and his gracious consent has been secured to the proposal that the rhinos be placed in his name in the Museum.

Colonel Faunthorpe and Mr. Vernay next turned their attention to Mysore, the Maharaja of Mysore having generously given his consent to the securing not only of an elephant but also of bison. Two bull elephants, one of which is 9 feet 5 inches in height and

has beautifully matched tusks, and a cow, the hunting of which was attended by a good deal of excitement, were obtained, one of the elephants being shot in Mysore, the other two in British Government Forest. The bison secured will make a superb group. They include two bulls (measuring respectively 5 feet 10 inches and 5 feet 9 inches at the withers), a cow, and a calf.

Leaving Mr. Vernay in this region, Colonel Faunthorpe went with the photographer to north Oudh and the Nepal border to obtain the tigers, leopards, and sloth bears necessary to complete these groups for the Museum, and to secure motion pictures and photographs of various animals in their living state.

According to information received by mail two cases containing material secured by the Faunthorpe Indian Expedition are on the way to the American Museum. They include a number of skins and skeletal material of such mammals as the sambar, nilgai, gazelle, swamp deer, chital, hyena, etc.

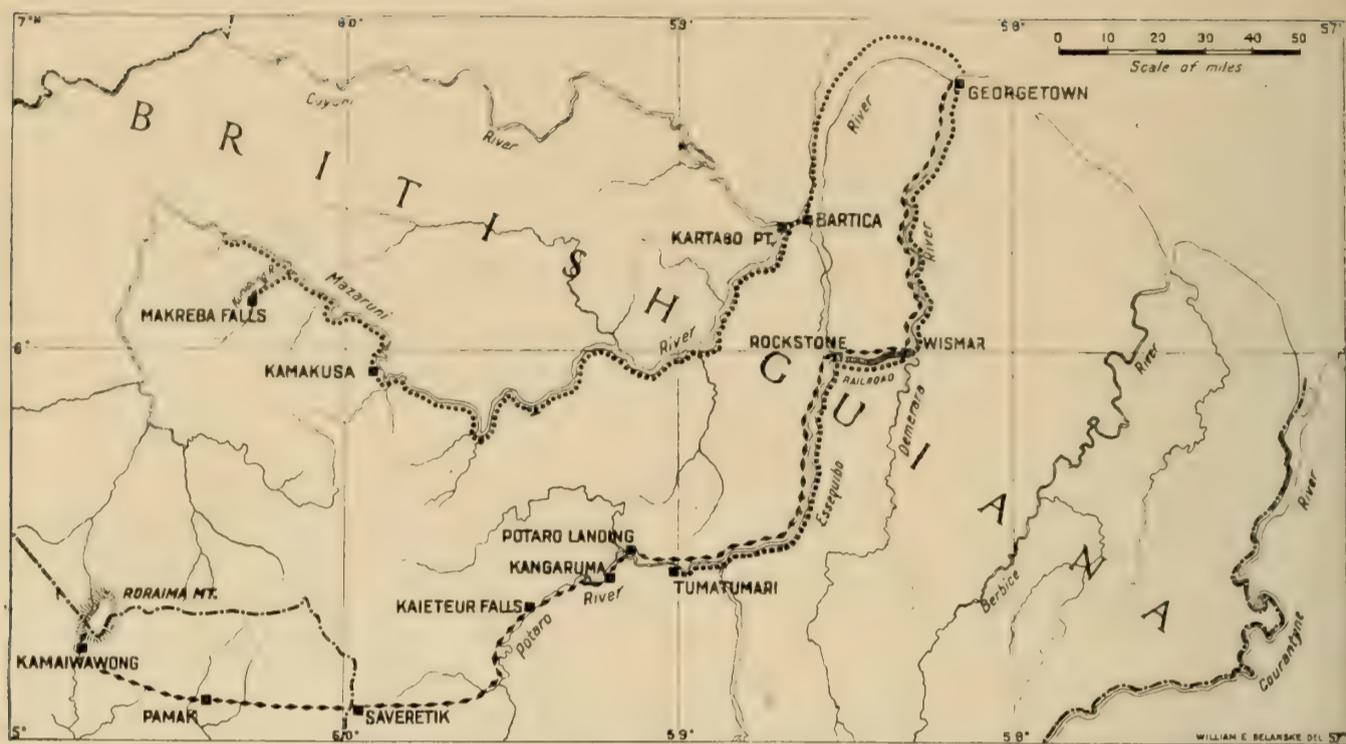
MR. DOUGLAS BURDEN, who throughout February and March hunted for the benefit of the American Museum in the jungle of Indo-China, writes from Delhi, India, under date of April 3, 1923, that he has secured several interesting specimens of the game of the region, notwithstanding the fact that hunting was difficult due to the long grass. The specimens include a bull and a cow of the water buffalo; a bull, a cow, and a calf of the gaur and of the banteng; and a buck and doe of the sambar, barking deer, and hog deer; in addition, there is a wild boar and sow and three kinds of civet cats.

SOUTH AMERICA

FROM THE INTERIOR OF BRITISH GUIANA.—A note announcing Mr. Herbert Lang's proposed trip to the interior of British Guiana appeared in the issue of *NATURAL HISTORY* for July-August, 1922, pp. 375-76. We give now his resumé of the expedition, to be followed later by two articles dealing respectively with the forests of British Guiana and the life along the rivers of that country.

I left New York on September 15, 1922, and returned to the Museum on March 10, 1923. Through the kindness of Mr. W. J. La Varre, to whom I am indebted for much assistance, everything was ready on my arrival at Georgetown to start on the boat journey up the Mazaruni River to the interior.

His Excellency the Governor, Sir W. Collet, through the Colonial Secretary, the



Hon. Hampton King, extended every possible privilege, whereby my progress was rendered easy beyond expectation. At the Department of Science and Agriculture, Messrs. W. Francis and L. D. Cleare, in the absence of Professor J. B. Harrison, extended a hearty welcome. Soon we were engaged in discussing questions which brought forth much helpful advice as both wished to make my trip successful and pleasant. Georgetown has among its men of distinction also Mr. James Rodway, whose delightful volumes have carried his fame far beyond the Americas. Several visits to his home and subsequent visits to the Museum under his charge enabled me to benefit from his ripe experience. Ever kind and helpful, he had brought together for me a number of separates of *Timehri* articles in which various travelers had published their accounts.

But I had not come to Georgetown as a stranger. I was warmly welcomed and made to feel at home by Director William Beebe and the enthusiastic circle of collaborators whom he has gathered about him at Kartabo, the home of the Tropical Research Station of the New York Zoological Society. Situated at the very portals of the Essequibo, Mazaruni, and Cuyuni Rivers, the Station offers unique advantages for the observation of the inexhaustible wealth of tropical life. Far too rapidly passed the hours in such fascinating company. Mr. Beebe and his associates were just setting out for new adventures in Venezuela. With his customary generosity Mr. Beebe insisted on my carrying away some of the volumes from his own library, which proved of great assistance later in the field.

In going up river we were favored by the season. The volume of water was still ample enough to allow us the use of the power boat at our disposal. In less than half the usual time, six and a half days, we reached Kamakusa base, 180 miles in the interior. The

many treacherous rapids and terrific currents added sufficient zest to an otherwise monotonous river journey.

Hardly had I made my first personal acquaintance with the surrounding forest country when good luck piloted my way Mr. George K. Cherrie, well-known for his long and distinguished services in exploration. The wealth of his experience gathered in nearly every region of South America, as he imparted it to me, opened up many vistas in my own undertaking.

When after months in the interior among the glories of untouched nature I had to turn homeward, I was naturally sorry; yet, on the other hand, I was glad that so many happy incidents had helped make my first South American journey successful far beyond my original expectation.

The collections proved to be interesting as they were made in a region from which all material is practically new and therefore a desirable acquisition for the American Museum. Among the mammals is an undescribed form of marsupial, together with a fine series of peccaries, primates, and rodents, not to mention a tapir and a rare puma. The birds are represented by 75 genera and 85 species and are especially valuable as topotypes of the Whitely collection of the British Museum. The reptiles and batrachians number several hundred. Among them are a series of giant tree-frogs and the first breeding specimen ever brought to America of *Hyla evansi*, discovered in 1904, carrying twenty-four well developed eggs on its back. Fortunately photographs from life were made of it [one of these will appear later in *NATURAL HISTORY*]. Fishes were rather difficult to secure but among the 135 specimens are some fine examples and a good variety. To anthropology the most interesting contributions are a series of photographs of the dwarfed Akawoi Indians, especially as the measurements I took

show that some of these forest people are smaller even than the Congo Pygmies.

In all, the expedition was able to present material to the departments of geology, mammalogy, ornithology, herpetology, ichthyology, invertebrate zoölogy, and entomology, not to mention more than six hundred photographs and several thousand feet of moving-picture film presented to the department of public education.

A collection of 503 folders of plants was presented to the New York Botanic Garden and, it is said, supplements their own series in a most fortunate manner.

Mr. Lang's expedition to British Guiana recalls the interest of the American Museum in this area of South America, as evidenced by the three expeditions the routes of which are traced on the accompanying map.

A. HYATT VERRILL, EXPLORER AND ARTIST.—A series of paintings by A. Hyatt Verrill of Indian types encountered during his extensive travels and explorations in British Guiana and in Panama has recently been on view in the Southwest Indian hall of the American Museum. Mr. Verrill, who has undertaken expeditions to these regions in the interest of the Museum of the American Indian-Heye Foundation, has made valuable pictorial records, not only of the better-known tribes but of some that had not apparently been visited by white men before Mr. Verrill penetrated their country. In his pictures he has brought out with full emphasis the different physical characteristics of the several tribes (as exemplified, for instance, in the pale yellow or olive skin of the Caribs in contrast to that of the other natives), their distinguishing ornaments (ranging from the tuft of white down of the king vulture invariably worn on the forehead by the Caribs, and the beautiful, brightly tinted feather decorations of such Indians as the Akuria and Waiwos of British Guiana, to the remarkable crowns of painted wood or bamboo worn by the Chokoi of Panama), and the tattoo markings of some of the tribes,—for instance, the Chokoi, just mentioned, and the Patamona and Atoradi of British Guiana. Although a number of the pictures are portraits, others show the Indians engaged in their wonted activities. An Akawoia is depicted with drawn bow, aiming his arrow at a fish, and a girl of this tribe is shown squeezing sugar cane from a typical Indian mill; an Arekuna is seen using a blowgun, the dart of which has been dipped in the deadly wurali poison, and on another picture is a woman of this tribe sifting cassava through a basket-work sieve.

PALÆONTOLOGY

OSBORN LIBRARY AND RESEARCH ROOMS

Research and publication in vertebrate palæontology in the American Museum have produced a long series of valuable memoirs and bulletins which in collected form are now brought together in seven volumes under the title *Fossil Vertebrates in the American Museum of Natural History*. On May 18, 1923, the Trustees unanimously adopted the following resolution: that the Trustees, in grateful recognition of Curator Osborn's contributions to vertebrate palæontology, amounting altogether to \$60,000, to the presentation of his palæontological library, the most complete of its kind, and to the presentation of his biological library and collection of historic portraits and memorabilia, desire to provide for the continuation in perpetuity of this branch of research. To this end they set aside the present Osborn Library and southeast tower room and anteroom as the Osborn Library and Research Rooms in Vertebrate Palæontology for the purpose of research and discovery, in such manner as they may from time to time direct.

The Osborn Library is already equipped with about 6500 bound volumes and papers relating to vertebrate palæontology, but includes also comparative anatomy and zoölogy, evolution of man, and mammalogy in all its branches. The library communicates by a passageway with the tower room, which will be equipped especially and permanently for research in vertebrate palæontology, and with the anteroom, which is provided with materials and files to facilitate the work of publication. On the list of investigators who have taken advantage of the hospitality of the American Museum are many of the most distinguished palæontologists, not only of America, but of Europe, of Japan, and of South Africa. The policy of the department of vertebrate palæontology has been to make the study collections immediately accessible and to encourage the division of the collections among investigators competent to reveal the wonderful stores of information the fossils offer.

CHARLES R. KNIGHT AND HIS ACHIEVEMENTS.—There is probably no task confronting the conscientious painter of animals more difficult than that of giving life and character to his restorations of extinct animals and yet keeping within the bounds of ascertained fact or legitimate inference. A master in this field

is Mr. Charles R. Knight, whose paintings and drawings, made in large part under the supervision of Professor Henry Fairfield Osborn and other members of the department of vertebrate palæontology, American Museum, are praiseworthy not only as works of art but as scientific records.

Although Mr. Knight has devoted himself to this field of painting for thirty years, the magnitude of his output and the variety of the animal life depicted must have surprised even him as he viewed his canvases ranged in close array on the walls of the hall of horses in the American Museum, where he has recently had an exhibit. To pass from picture to picture in this exhibit was to review the history of millions of years, from the reptilian monsters of the Mesozoic to man of the Glacial Age. Even some of the present-day animals have been recorded in lifelike attitude by Mr. Knight though for the most part he has devoted himself to resurrecting the past.

Many of the paintings were arranged by groups—such as those of the horse, living and extinct, of the rhinos, and of the elephants—enabling the visitor to compare the changes manifested in these animals throughout the ages or in different regions. In a collection of such vast range and of such a high standard of excellence, unanimity of choice is not to be expected. Some will prefer one picture, some another. Of wonderful impressiveness are Mr. Knight's pictures of the felines, perhaps the most outstanding of this group being the picture of the saber-tooth tiger on the rim of a cliff, his jaws wide apart showing the rapier-like upper teeth, and the head and attitude expressive of defiance, rage, and supreme realization of mastery.

WESTERN FIELD EXPLORATION OF 1923 FOR FOSSILS.—This is the thirty-second season of continuous Western field exploration of the department of vertebrate palæontology, American Museum, inasmuch as the first expedition, made to the Wasatch formation of Wyoming, was fitted out by Prof. Henry Fairfield Osborn in the year 1891, in the hope of showing the Trustees of the Museum what might be done among the fossil mammals. Dr. J. L. Wortman, trained for many seasons under Professor Cope of Philadelphia, was in charge of this party, and he returned in the autumn with a small and interesting collection of Lower Eocene age. The work of preparing these fossils was carried on in the attic room on the sixth floor of the Museum, at the

top of the little elevator shaft of the old wing. As the fossils were cleaned, they were exhibited in one end of a case in the hall of geology and met with President Jesup's immediate approval. This undertaking marked the beginning of expeditions that have since extended to all parts of the world and that are now being carried on more actively than ever.

In spite of the more extensive area today under investigation the Western field work has not diminished. Recently, under the generous encouragement of Mr. Childs Frick, a special Western field fund has been donated in addition to the field fund donated annually by Honorary Curator Osborn. Mr. Albert Thomson, who joined the Museum forces in South Dakota twenty-nine years ago and who came to the preparation laboratory of the department of palæontology twenty-four years ago, has been promoted to the senior post in the laboratory. For many years he has also been chief of field work in the western Nebraska section, where the Museum has enjoyed the hospitality of Mr. Harold Cook and his father at the famous Agate Springs Quarry. In the trip to the West this summer Mr. Thomson will be accompanied by a party of three young men, including a son of Professor Loomis of Amherst. In the party will be also one of the Museum preparators, Mr. K. Lorenson. The owner of the land where *Hesperopithecus* was found will not allow work in the locality he controls without the payment of an exorbitant sum for the privilege; consequently the Museum party will work chiefly in various quarries of Upper Oligocene, Miocene, and Lower Pliocene age.

The great collection of seventeen *Moropus* skeletons secured in previous years in the Agate Quarry is being described in the *Bulletin* by Honorary Curator Osborn. The remarkable collections of Miocene and Pliocene mammals secured by the expeditions in this region are being described by Curator Matthew, who has also contributed to the present issue of NATURAL HISTORY (pp. 358-69) a popular article on the quarry. The Museum now has an absolutely complete picture of the Eocene life of North America and is beginning to fill out its picture of the Miocene and Pliocene life with equal fullness.

FOSSIL FAUNA OF MEXICO.—Mr. Childs Frick, research associate in palæontology, American Museum, has returned from a two-months' visit to Mexico, where he devoted himself to the study of the Pleistocene fossil

mammals of the Valley of Mexico. This classic locality has been well known as the source of the splendid collections secured chiefly during the opening of the great drainage canal and preserved in the two museums of Mexico City. Mammoths and mastodons, great glyptodonts (tortoise-armadillos) and ground sloths, horses and camels, various Carnivora, and other remarkable types of extinct animals are well represented in these collections. Some of the earlier finds were described by the English paleontologists, Falconer and Owen; later on, Cope and other Americans studied the collections and described some of their novelties, and the German, Freudenberg, has published two considerable memoirs upon the collections. The lack of specialists in fossil vertebrates in Mexico has prevented their being fully and adequately described or becoming as generally known as they should be.

Mr. Frick, following his usual policy of promoting coöperation in research work, has arranged for two months of active field work by two members of the staff of the Geologic Institute in Mexico, Señor Vivar and Miss Reyes, and for comparative study at the American Museum of the collections made by them. The collections are then to be returned to Mexico. He has also taken steps in other ways to stimulate interest in the search for more material in connection with excavations that are in prospect.

THE PLUMAGE OF AN EOCENE BIRD.—Among recently installed exhibits in the American Museum few have attracted as much attention as the huge extinct flightless bird *Diatryma* that confronts the visitor as he steps out of the elevator at the fourth floor to roam among the animals of the past. Although the skeleton of *Diatryma* is very fully known, the question of its plumage was until recently at least open to conjecture. Prof. T. D. A. Cockerell of the University of Colorado, who has contributed so much to our knowledge of the animal and plant life, past and present, of that state, believes that a specimen of the plumage of the *Diatryma* has at last been discovered. During a recent visit to the fossil beds in the vicinity of Roan Creek, in western Colorado, Mrs. Cockerell, who accompanies her husband on many of his trips, found long strands of plumage, of a soft and wavy character, even more filiform, more delicate, and less bristly than the plumage of the cassowary.

Professor Cockerell concludes that "Among the known Eocene birds, this could only have come from *Diatryma*." He has tentatively named the specimen *Diatryma (?) filifera*, a new specific name at least being justified in Professor Cockerell's estimation because of the fact that the specimen was found at a horizon considerably higher than any previously known for the genus. During the same trip Professor Cockerell found "a typical contour feather of a bird, perhaps the oldest ordinary feather known."

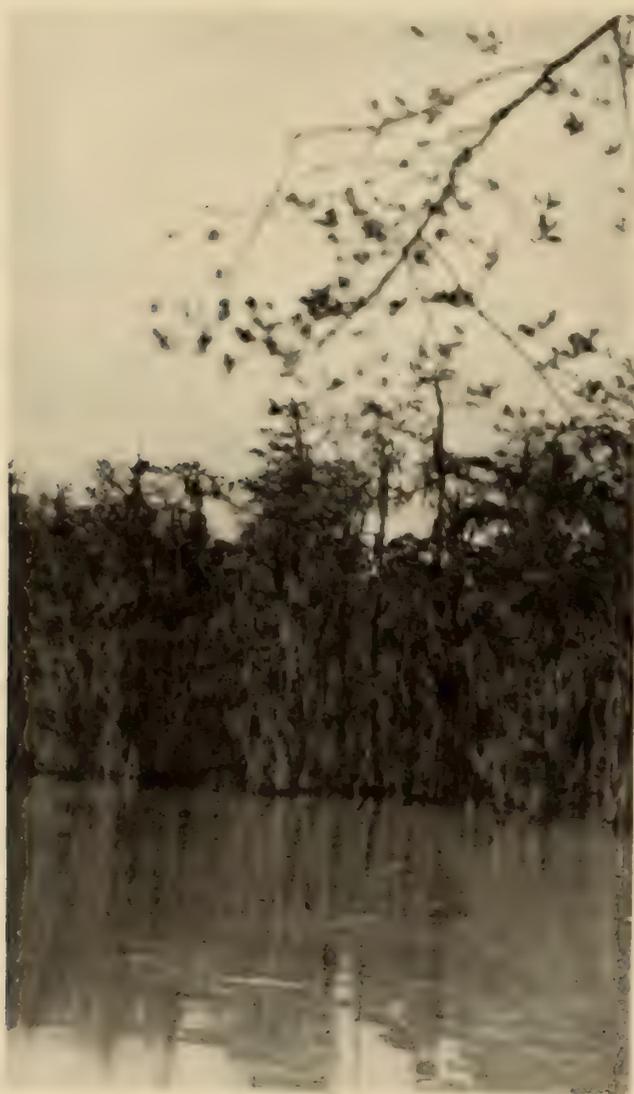
THE AMERICAN ASSOCIATION OF MUSEUMS

THE EIGHTEENTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF MUSEUMS was held at Charleston, South Carolina, April 4-8, 1923. No more appropriate gathering place could have been selected, for it was in Charleston one hundred fifty years ago that the museum idea first took root in America. It was on January 12, 1773, that at a meeting of the Charles Town Library Society "His Honour the President [of the Society] proposed that a special Committee should be appointed for collecting materials for promoting a Natural History of this Province which was agreed to." In this manner the institution that was incorporated in 1915 under the name of The Charleston Museum began its career of educational service.

The gathering at Charleston in April, 1923, of the representatives of a great number of museums scattered over the country—the repositories of collections representing many different fields of interest—evidences the stage of growth that the museum idea has already attained. That growth, however, is merely to be the preliminary of still greater progress. National headquarters are to be established by the Association in Washington. A grant of \$30,000 covering three years, has been made by the Laura Spelman Rockefeller Foundation, conditional upon the raising of an additional \$55,000 from museums and their supporters. To broaden the field of usefulness of the Association, the following projects as stated by its secretary, Mr. Laurence Vail Coleman, are to be undertaken: "Through the printed and the spoken word and through the screen, the museum idea is to be placed before the public so that museums wherever they may be, will find the tilling of their soil more simple. A field secretary will make continuous studies and will go in person

to communities where suggestions and assistance will be welcomed. Headquarters will be a clearing house and a service center for museums. Publications will broadcast and give permanency to new findings and new thoughts and finally steps will be taken in coöperation with universities to promote research in museum administration and technique and to bring about the training of new museumists to carry on the work which will open before the movement."

A program of unusual interest was provided for the Association gathering, and those who attended were rarely impressed with the warm hospitality accorded them in the old historic homes of Charleston, around many of which cluster memories of Colonial and Revolutionary days. A boat trip was made up the Santee River and a visit paid to the heron reserve, where the great blue heron and the night heron, and above all the egret, were seen in numbers. This is one of the few places in the United States where the egret is still to be



A detail of the heron reserve on the Santee River, to which an excursion was made by those attending the eighteenth annual meeting of the American Association of Museums

found and is the locality from which was secured the group in the American Museum. On the evening of April 7 at one of the large plantations there was singing of spirituals by negroes around the fire out of doors. Representatives of the American Museum who attended the gathering of the Association were Director F. A. Lucas, Dr. E. O. Hovey, and Dr. F. E. Lutz. Doctor Lucas also represented the Museums Association of Great Britain and on its behalf extended greetings to the American Association of Museums and to the Charleston Museum.

FOREIGN MUSEUMS

THE PORT ELIZABETH MUSEUM of South Africa reports an attendance of 136,984 visitors during the year 1922, probably the largest attendance of any museum in the world when measured with relation to the population of the place in which the museum is located. In certain parts of the ample grounds surrounding the museum interesting species of South African flora have been planted, while other special features offered by this scientific institution are its so-called snake park, where live reptiles are exhibited, its aquarium, aviaries, and cages containing monkeys and other animals. A number of museum specimens have been acquired during the past year through donation, exchange, and purchase. Research work has been conducted in several different fields of science with gratifying results and the publication of these results is in progress. Among the lectures given at the museum were several on astronomy, in which the museum telescope proved of aid. It is a pleasure to be able to refer in *NATURAL HISTORY* to an institution which, while separated by so many miles from the American Museum, is, like the latter, widening scientific knowledge in the community which it serves.

JOHN THOMAS GULICK

John Thomas Gulick died in April of this year, in the Hawaiian Islands, which were the scene of his birth and of certain of his scientific studies. Well-known as a missionary in China and Japan, where he labored devotedly for thirty-five years, his claim to recognition is not less on the score of his contributions to science. To a fuller conception of the ways in which evolution works Doctor Gulick made notable contributions, including his "Divergent Evolution through Cumulative Segrega-



The Charleston Museum, although incorporated under that name only in 1915, had its inception 150 years ago and is therefore a patriarch among the museums of the country. Old in years, it is progressive in spirit,—an institution of which Charleston is justly proud

tion," "Isolation and Selection in the Evolution of Species," and *Evolution, Racial and Habitudinal*. In the preface to the last-mentioned work Doctor Gulick states: "I believe Prof. H. F. Osborn makes no mistake when he suggests that the ruling method of the next important advance in the interpretation of evolution must be one recognizing the complex action of diverse principles, and at the same time grasping the underlying unity of the process." The underlying principle sought, Doctor Gulick professed to find in geographical segregation, with its controlling influence in the spheres of both racial and habitudinal evolution. In addition to his more general studies in evolution, Doctor Gulick devoted himself to the special study of snails and more than one of his contributions has dealt with members of the sub-family Achatinellinae.

Doctor Gulick was graduated from Williams College in 1859, having been in still earlier years a miner in California. Subsequently he studied in the Union Theological Seminary. He received an honorary A.M. from Williams in 1889, was awarded a Ph.D. by Adelbert in the same year, and obtained his Sc.D. from Oberlin in 1905.

INSECTS

QUARTERS FOR BOY SCOUTS.—The department of entomology of the American Museum has recently set apart an enclosed area on the

third floor of the Museum to serve as a work place for Boy Scouts interested in studying insects. Provided with a large table and chairs as well as working equipment, these quarters offer Scouts the opportunity to mount insects they have collected, to work out life histories, to start formicaries, and, not the least, to come into intimate touch with the Museum's exhibition collection of insects. It is the intention of the department of entomology to give recognition to individual work of excellence by displaying such work on a table reserved for the purpose. Work so exhibited may later be displaced by other work showing still greater merit. There will thus always be an incentive for the Scouts to put forth their best efforts.

GEOLOGY

GEOLOGIC RELIEF MODELS.—The series of fifteen geological relief models planned for installation in the hall of geology and invertebrate palæontology is nearing completion. These models give the existing surface of the areas chosen in its varied topographic development, with the hard-rock or underlying geologic formations represented by their natural colors and textural characters. There are two exceptions, however: the Watkins Glen-Seneca Lake model, where the superficial Glacial deposits are shown, and the Porto Rico model, where the scale of the map is too small to permit

such treatment. The painted background of each model represents the present-day scenery of the country surrounding its area, and the sky depicts different meteorological conditions as far as practicable.

The models selected for the west side of the hall have been chosen with reference to the exhibits of stratigraphical or historical geology in the neighboring cases. They comprise the "Grand Cañon of the Colorado River," showing rocks of Pre-Cambrian, Cambrian, and Carboniferous ages; "Niagara River and Falls," illustrating Ordovician and Silurian strata, with important phenomena of Glacial age; "Pawpaw," West Virginia, showing beds of Devonian age and important mountain-building upturns, folds, and erosion; "Van Horn," Texas, exhibiting rocks of Mississippian, Pennsylvanian, and Permian times, igneous intrusions, and the phenomena of a desert region; "Yellowstone Park," representing Jurassic and Comanchian strata with associated igneous rocks, hot springs, and geysers; "Pikes Peak," illustrating Ordovician, Pennsylvanian, and Cretaceous rocks lying against a great massif of Pre-Cambrian granite; "Crater Lake" (the most recent to be completed and now on exhibition) showing the crater of a vast extinct volcano which has been erupted through rocks of Tertiary age; "Standingstone," Tennessee, representing sink-hole topography in an unglaciated region of Carboniferous rocks.

The models which have been chosen for the east side of the hall illustrate varied geological features. That of "Porto Rico and the Virgin Islands" shows well the great Brownson Deep of the Atlantic Ocean and the Virgin Deep and the Caribbean Sea in relation to the islands. The "New York City" model illustrates the drowned valley of the Hudson River, barrier beaches, and other shore-line phenomena, the intrusive trap ridge of the Palisades of New Jersey, Triassic sedimentaries and Pre-Cambrian crystalline rocks. In contrast, the "San Francisco Bay and the Golden Gate" model presents the great harbor of the Pacific Coast, with its elevated sea beaches and Tertiary beds, showing its recent geologic age as compared with New York, the great harbor of the Atlantic coast. The "Yosemite Valley" model illustrates the extreme development of recent atmospheric, stream, and glacier erosion in a complex of massive granites and other igneous rocks of the Sierra Nevada, Cali-

fornia. The results of early glacier action on a complex of ancient granites and other igneous rocks and mica schists are shown by the "Mt. Washington-White Mountains" model. The model of "Watkins Glen-Seneca Lake," New York, indicates a stage in the retreat of the continental glacier of the latest great Ice age, with its accompanying mantle of till, moraines, and glacial lakes, and shows some effects of subsequent stream erosion. The model of "Mount Tom-Mount Holyoke," Massachusetts, brings out the development of a great river, the Connecticut, in a region of soft Triassic sandstones lying in a *graben* between hard crystalline rocks and affected by the Mount. Tom-Mount. Holyoke range of intrusive diabase or trap rock.

With the exception of the "Yosemite Valley" and the "Mount Washington" models the subjects of these models and their locations in the hall were chosen by Associate Curator C. A. Reeds. The construction of all the models, however, has been done under the direction of Curator E. O. Hovey, except that the core of the "Grand Cañon" model was begun by Doctor Reeds. The cores of the models have been built in the department and have been based on the topographic sheets issued by the United States Geological Survey and by the United States Coast and Geodetic Survey, except for "Porto Rico," which is based upon a compilation by C. A. Reeds, and "Mount Washington," based upon the maps prepared by the state of New Hampshire and the Appalachian Mountain Club. The modeling and painting have been done by Mr. Lester Morgan of Morgan Brothers, following published geological maps of the regions and photographs.

PUBLIC EDUCATION

MAKING THE MOTION PICTURE EDUCATIONAL.—The motion picture, wisely chosen as to subject matter, accurate in its details, and appealing in its presentation, is an invaluable aid in visual education, and yet countless films, intended to be informing, have failed of their purpose because of the distortion of fact or ignorance of the truth which they showed. To try to erect a structure of knowledge on a foundation of half truths or misinformation is building on quicksand. A wise step toward correcting this evil, so that the educational film may be in a position to fulfill its great mission, is the recent appointment of a Viewing Committee of the

National Educational Association, which will cooperate with the Motion Picture Producers and Distributors of America, Inc. The function of this committee (of which Dr. G. Clyde Fisher, associate curator of public education in the American Museum, is the chairman) is to examine films presenting nature study, biology, and geography and to determine their importance as educational media and their accuracy. It is within the province of this committee to recommend the rejection of films found wholly unsuitable or to suggest the retention in whole or in part of films that serve an educational purpose in a worthy way.

A STATUE FOR THE SCHOOL SERVICE BUILDING.—An interesting model, in miniature, of the statue of Dr. William H. Maxwell, former superintendent of public schools of Greater New York, which it is proposed to erect as a memorial in the new School Service Building of the American Museum, was recently on exhibition in memorial hall. It is the work of the well-known sculptor Mr. Charles Eugene Tefft.

In the center of the model is the dignified figure of Doctor Maxwell seated in a chair, the folds of his doctor's gown falling in graceful lines to his feet.

The background is made by a pillared wall, which divides the space into three panels and is in keeping with the dignity and simplicity of the whole design. Two of these panels, one at the left and one at the right, contain mural decorations illustrative of ancient and modern education.

Mr. Tefft's striking figure representing Lake Erie, made for the Buffalo Exhibition, will be recalled; also his figures at the St. Louis Exhibition representing Iowa and Renaissance Art on the façade of the permanent art building; the Fort Lee Battle Monument at Fort Lee, New Jersey, and the fountain at the Botanic Gardens, Bronx Park, New York City. The authorities representing the city system of schools united in their choice of Mr. Tefft for this important Maxwell commission. The model is a promise of something very fine in the finished work.

GIFTS TO THE LIBRARY

GIFTS BY MR. OGDEN MILLS.—Mr. Ogden Mills, ever the good friend of the library of the American Museum, has added to his previous donations a number of volumes that are

prized not only for their rarity and interest but because of their superb illustrations. Among these books are F. Levaillant's *Histoire naturelle des Perroquets*, including the highly valued supplementary volume by Al. Bourjot Saint-Hilaire, with its hand-tinted lithographs. The binding, which bears the stamp of Toovey, the well-known Piccadilly bookseller, has the tooling and finish of Bedford and is in all probability the work of that craftsman. Levaillant's work was published in the early years of the nineteenth century. A work of still earlier date (1785-97) presented by Mr. Mills is M. E. Bloch's *Ichthyologie ou Histoire naturelle des Poissons*, consisting of twelve handsome volumes with colored illustrations. Finally the gift includes T. Martyn's *Psyche*, the quaintly worded subtitle of which reads "figures of nondescript lepidopterous insects, or rare moths and butterflies from different parts of the world."

A BEQUEST BY EMILY F. SOUTHMAID.—By the will of the late Emily F. Southmayd there was bequeathed to the American Museum a set of Audubon's sumptuous *Birds of America*, which because of its historic importance in the literature of ornithology and its superb illustrations, is an acquisition particularly prized. President Henry Fairfield Osborn in a letter directed to Messrs. Evarts, Choate, Sherman & Leon, acting for the executors, conveyed the thanks of the Museum in these words:

"The Trustees have received the superb copy of Audubon's *Birds*, which was bequeathed to the American Museum of Natural History by the late Emily F. Southmayd. This rare and valuable work is a much desired addition to our Library of Natural History and we trust that you will convey to the next of kin our appreciation of the generous action of Emily F. Southmayd."

PEALE'S SUPPRESSED VOLUME.—Through the generosity of Mr. James B. Ford the library of the American Museum has been enabled to purchase a work of unusual rarity and interest, namely the suppressed volume by Titian R. Peale dealing with the mammals and birds collected by the United States Exploring Expedition (1832-42) under the command of Charles Wilkes, U.S.N. This volume was printed by C. Sherman in Philadelphia in 1848. In addition to text illustrations by Peale, it is accompanied by his trial plate of *Procellaria nivea* that differs somewhat from the corresponding plate in Cassin's

edition of the same work, published ten years later. It was chiefly because of Cassin's criticisms that Peale's volume was suppressed, yet Cassin constantly cites it in his own work. Only a few libraries other than the Museum library possess a copy of this rare work, in which 103 species of birds new to science are described. The Museum is particularly rich in published works, manuscripts, and paintings by Peale, including a portrait of himself.



T. M. Peale
U. S. Ship Vincennes
Dec^r 14th 1791

FISHES

THE BIBLIOGRAPHY OF FISHES.—Dr. Bashford Dean, honorary curator of the department of ichthyology, American Museum, has returned from another tour in the East and in Europe and reports a number of very interesting observations. The *Bibliography of Fishes*, which is appearing under his direction, with the coöperation of Dr. E. W. Gudger and Mr. Arthur W. Henn, is approaching completion. Doctor Dean supplies the introduction to Volume I. The taxonomic section will be brief, for it was decided not to repeat the taxonomic work of Jordan and others. The entire bibliography is in print, including the index of the material in the three volumes. The summaries were very carefully prepared, chiefly by Doctor Gudger and Mr.

Henn. When these volumes appear, which have cost ten years' labor and monumental industry on the part of all concerned, namely, Doctor Dean, Doctor Eastman, Doctor Gudger, Mr. Henn, and the no less industrious secretaries who have been engaged from time to time, new life will be given to the whole subject of ichthyology, and this branch of science, which has more or less slumbered through neglect in the colleges and universities, will arise in all its purely scientific as well as economic and medical aspects, for it is being recognized that among the fishes and Protochordata we are to study the beginnings of the principles which govern the physiology and pathology of man.

BIRDS

THE MOTMOTS.—In a *Bulletin* entitled "The Distribution of the Motmots of the Genus *Momotus*," Dr. Frank M. Chapman, curator of ornithology in the American Museum, presents evidence that these sedentary, tree-inhabiting birds originated in Central America, where the motmots are more numerous represented both in respect to genera and species than they are in South America. Their presence in the southern continent is the result, he believes, of three separate invasions, one of which, made by the genus *Baryphthengus*, occurred possibly in pre-Andean or early Tertiary times, and two of which, made by the genus *Momotus*, took place after the elevation of the Andes. The first of the post-Andean invasions was made possible by a Subtropical Zone bridge, that, he believes, once extended over Panama and that subsequently disappeared, probably through subsidence. The second post-Andean invasion originated in the Tropical Zone of Panama. It extended thence through northern Colombia and Venezuela, north of the Andes, to Trinidad and Tobago at a time when these islands were connected with each other and with the mainland.

ANTHROPOLOGY

AMERICAN INDIAN DAY.—In our annual cycle of memorial celebrations, we have dedicated a day to the discoverer of America, to the declaration of our independence, to each of the two great presidents who guided the nation during its times of gravest peril, and to other individuals and events that have been of dominating importance in our history. American Indian Day, May 11, is one of the

recurring observances that deserves more thoughtful attention than it has received. Indebted to the Indian as we are for so much that is picturesque in the past, it is our responsibility to see that his contribution to our common life is not forgotten through ingratitude or neglect. It is a pleasure to refer, therefore, to the ceremonies in commemoration of American Indian Day that were held at St. Mark's in-the-Bouwerie (William Norman Guthrie, Rector). These included a congregational service of worship, compiled from American aboriginal rites and ceremonies, rendered with special remembrance of Alice Cunningham Fletcher; an address by the Rector on the personality and work of this friend and interpreter of the Indian; the reading of an Indian story by Ernest Thompson Seton; and an address on "The Symbolology of Indian Dances" by John Sloan. After the offertory there was a ceremonial planting of the seven varieties of corn, following the Zu'i myth of the Rain Youth and the Corn Maidens, as recorded in the *Zuñi Folk Tales* of F. H. Cushing. This ceremony took place in the east yard of the church. In St. Mark's hall were exhibited specimens of Sioux bead-work and paintings of Indian dances by John Sloan and Edward Willard Deming.

THE QUIPU OF PERU AND ITS FUNCTION.—The department of anthropology has just issued a special publication entitled *The Ancient Quipu or Peruvian Knot Record*. The author, L. Leland Locke, clearly demonstrates that the quipu was used for numerical records only, for which it was well fitted, and points out the utter impossibility of recording history and folklore by this means as the early historians would have us believe. Mr. Locke succeeded in locating forty-nine quipus, of which forty-two are in the collections of the American Museum. Many of these are well illustrated in the volume under consideration.

DR. L. R. SULLIVAN, assistant curator of physical anthropology, represented the American Museum at the ceremonies attending the inauguration of Doctor Marvin as president of the University of Arizona, April 23-4.

ARCHÆOLOGY

BENJAMIN HARRISON AND HIS MEMORIAL.—Word comes from England that a committee has been formed to establish a memorial to the late Mr. Benjamin Harrison, the world-known village geologist and prehistoric

anthropologist of Ightham, Kent. At present there are two suggestions under consideration, namely, to found a scholarship for higher education, open to natives of Ightham and vicinity, or to establish a research fund. In addition, it is proposed to place in Ightham Parish Church a tablet subscribed for by local residents.

Biographical details are few, but in the words of the committee's announcement, "Mr. Harrison was one of Nature's Great Men, who made such a name with such limited facilities as he had." In American phraseology this is equivalent to saying that Mr. Harrison was a man of our own John Burroughs and John Muir type—another, in short, of those happy mortals who observe and interpret nature as the spirit moves them, unhampered by institutional routine and regulations. Inspired in his youth by the astonishing archæological discoveries of Boucher de Perthes, across the channel in France, he devoted a long life chiefly to the search for similar evidence of the antiquity of man in his own Kentian section of England. His collections of rude flints, found in the depths as well as on the surface of his native Weald, and in the Downs, in time became so large that they compelled the attention of such scientific men as Sir Joseph Prestwich, and by degrees some of his ruder forms, known as eoliths, have come to be acknowledged by many prominent students as of human origin. It is seldom indeed that any man, no matter what his circumstances, has contributed so much toward the enlargement of our notions of human prehistory and has lived also to gain recognition for his views. In the words of Professor Arthur Keith, "He made of the picturesque village of Ightham . . . a Mecca for all students of early man."

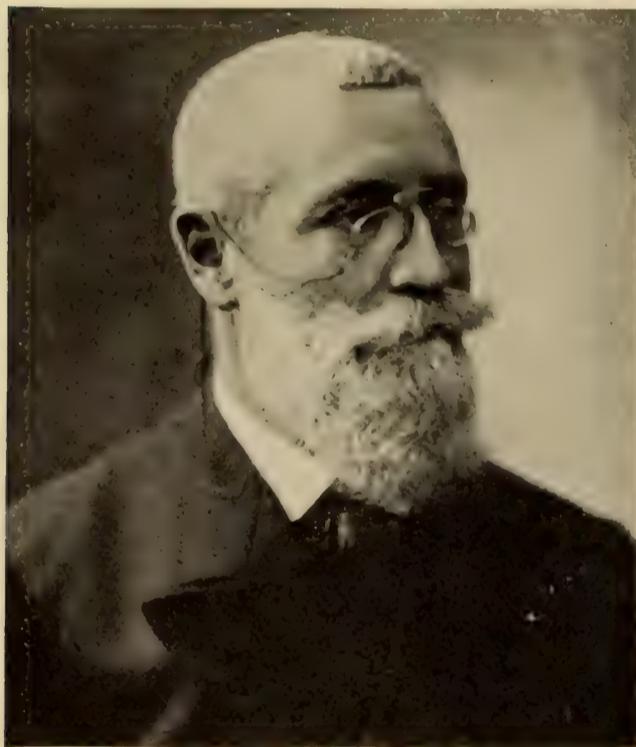
Mr. Harrison died on September 30, 1921, at the age of eighty-three, and is interred in Ightham Churchyard, where his family are erecting a tombstone bearing a carved "eolith" at its head.

The committee respectfully asks for donations to the memorial fund, which should be sent to the Hon. Secretary and Treasurer, Mr. de Barri Crawshay, Rosefield, Sevenoaks, Kent.

PROF. LOUIS CAPITAN, whose picture is shown on page 420 is one of a number of distinguished foreign scientists who recently were elected corresponding members of the Ameri-

can Museum. As dean of prehistoric archæology in France, with nearly fifty years of service behind him, benefiting not only his own country but the world at large, Professor Capitan eminently deserves such recognition as an American scientific institution can give.

A brief sketch of Capitan's career was printed in another connection in the issue of *NATURAL HISTORY* for March-April, 1923 (pp. 200-01). By way of supplement it may be stated here that in addition to the prolonged activity of his labors Capitan's interests have been wider than those of most of his contemporaries. He has been both investigator and teacher. In the former capacity, besides acquainting himself with all the problems relating to prehistoric France by actual research in the field, he has traveled and



PROF. LOUIS CAPITAN

studied not only in the neighboring countries of Europe but also in the United States, Mexico, and Central America. As a teacher he has helped to train the younger generation of workers, has been largely instrumental in placing French archæological investigation on a truly scientific basis, and has written and lectured on the whole wide field of prehistory. In this way he has managed to preserve the sane and unbiased viewpoint which is so often lacking in the man who for one reason or another has been obliged to over-specialize.

Professor Capitan is no longer quite the robust man seen in the picture. The strenuous years of war service have left their mark

upon him. But in spite of his sixty-nine years he lectures regularly at the *École d'Anthropologie* on prehistoric anthropology and at the *École de France* on American antiquities, in addition to giving devoted service on various commissions for the preservation of French antiquities. And his activities are by no means confined to the study, rostrum, and committee room. Last summer the writer had the privilege of traveling and working in his company for nearly three weeks in various parts of France, Belgium, Holland, and England. Professor Capitan arrived at the excavations with the first every morning and was always the last to leave in the evening, even though he usually devoted most of the lunch hour to sketching or other work. As a collector his equal is seldom met. At the end of the day, when finally he had to tear himself away from the "pay dirt," he usually brought more specimens than he could well carry. Lastly, this vigorous, indefatigable Frenchman, so like the proverbial "hustling Yankee," has other claims to sympathetic American interest: he drinks—quantities of water only, and never smokes. N. C. N.

CONSERVATION

PUBLIC INTEREST AROUSED FOR THE MAMMALS.—Since the publication in *NATURAL HISTORY* of the article "Can We Save the Mammals?" by President Henry Fairfield Osborn and Mr. H. E. Anthony and of the very similar article by the same authors, "The Close of the Age of Mammals," in the *Journal of Mammalogy*, hundreds of newspaper clippings and press notices have been received at the American Museum, showing the very widespread and intense, popular interest in this truly vital question. Not only have the newspapers printed accounts of the actual conditions, but editorials in magazines and periodicals far off the journalistic path of the average associated press item have demonstrated that the layman does not want to see the mammals disappear. Most of these accounts, when comment accompanied the statements of fact, accepted the findings of Osborn and Anthony; a few disagreed. In not one instance did a writer believe that we would be as well off without as with mammals.

A statement sent out by the California Biological Feature Service, written by W. E. Allen, presented a resumé of the views of the American Museum as expressed in the "Close

of the Age of Mammals" and was in perfect sympathy with them.

Even the furriers themselves have taken notice of the crisis facing the mammals and some of them appear to appreciate the need for action. An article in the *Fur Trade Review* of April, 1923, discusses statistics on the number of mammals taken by the fur trade, but arrives at rather misleading conclusions, because the writer of that article assumes that the figures given by Osborn and Anthony included domestic fur bearers. The figures cited by these two authors were based entirely upon wild mammals killed. However, the article in the *Fur Trade Review* shows a tendency on the part of the trade to make much of domestic furs, and in the use of such fur bearers as Persian lamb and rabbit lies the possibility of a partial relaxation of the pressure against wild life. The general tone of the article shows that the fur trade can see the danger signals quite clearly itself and it is to be hoped that realization will bring corrective measures.

Other signs of response from the furriers have been letters asking for an expression of views and measures to be taken for relief of the situation. At the request of the *New York Sun*, a short account was written by Mr. Anthony for the editorial page and published May 15. Here it was urged that the greatest chances for saving the mammals lay in educating the people to an understanding of the actual facts, in the passage of protective legislation for mammals, and in calling to the attention of the fur trade and other interests exploiting mammal life the fact that it is sound economic sense to conserve such a valuable resource as our wild mammals.

AN INTERNATIONAL COMMITTEE FOR BIRD PROTECTION.—Mr. T. Gilbert Pearson, president of the National Association of Audubon Societies, who only recently returned from a trip to the Bahamas, where he has been in consultation with the English authorities to the end that more adequate protection may be accorded to the colonies of flamingos on Andros Island, sailed for France on May 12 to further the organization and work of the International Committee for Bird Protection, of which he is one of the founders.

Birds, because of their migratory habits are, with the possible exception of marine mammals, the most fitting subjects for international conservation efforts. Flying, as many of them do, from their winter homes in

one country to their summer homes in another, they are citizens of the world, and the protection that they enjoy in one of their places of sojourn is inadequate if it is offset by a spirit of destructiveness in the other.

Moreover, the dangers to which marine birds are exposed through the oil that is poured on the waters of the sea by ships are not to be underestimated, for annually thousands upon thousands of ducks, gulls, and other water birds throughout the world are killed through alighting upon water thus tainted. Mr. Pearson aided in the passage of a bill by the British Parliament last June, which makes it illegal to pour oil into the territorial waters of the British Isles. A bill of similar application to our own territorial waters, which has been pending in Congress, has had his active support. The passage of an international law is needed, however, to remove this menace to sea birds and one of Mr. Pearson's purposes in going abroad is to advocate the adoption of such a measure.

ROOSEVELT'S INTEREST IN THE CONSERVATION OF WILD LIFE.—The Roosevelt Memorial Association, Inc., is at work on a volume, the purpose of which is to show what Colonel Roosevelt thought and wrote regarding the conservation of wild life. This volume is to contain not only the various published essays and addresses of the Colonel on the subject of the preservation of wild game, but also his letters on this subject to naturalists and other lovers of the great out-of-doors. Will the readers of *NATURAL HISTORY* who are in possession of original letters, or copies of original letters, from Colonel Roosevelt on the subject of wild life conservation, kindly send them to Mr. Hermann Hagedorn, secretary and director of the Roosevelt Memorial Association, Inc., One Madison Avenue, New York City? In doing so, they will not only help in paying this tribute to the memory of Colonel Roosevelt but will also further an interest he had at heart,—the conservation of wild life.

The bureau of research and information of this association is collecting biographical material and would appreciate receiving from the friends and associates of the Colonel, in addition to personal letters, matter that is not yet in written form, that lives in the hearts and minds of individuals,—incidents trivial from one standpoint, but not trivial if they reveal the personality of "T. R." Anything whatever that throws light on the character of this

great American,—newspaper clippings, photographs, pamphlets, books, etc., will be welcome. All of the material collected by the association will be carefully arranged and catalogued for the use of future biographers.

THE AMERICAN MUSEUM'S INFLUENCE UPON ART

THE EXHIBITION OF THE KERAMIC SOCIETY OF GREATER NEW YORK was held in the American Museum April 17-27 and attracted much well-merited attention. It is the first exhibit of the society since the entry of our country into the World War, for that event greatly affected the well-being of the society. Mrs. Nina Hatfield, the president of the society, Miss Anna M. Walling, chairman of the exhibition committee, and Mr. Albert H. Heckman, critic and coworker for the past year, are to be congratulated upon the success of their extremely interesting exhibition.

Copies of antique furniture from Kensington Museum, London, served as background, while the very latest ideas in china, pottery, with the accompanying use of art linens and other decorative features, appealed to beauty-loving eyes. Painted lamps, vases, bowls, and boxes showed new conceptions of old art motifs, many of them inspired or suggested by exhibits of the American Museum.

On the walls hung a series of tiles in quaint designs. These were entered in the competition for the \$25 prize offered by a friend of the Society and awarded to Mrs. Hatfield. These tiles are intended to be used in a decorative way on interior walls and fire places, showing a modern adaptation of an old idea.

Mr. Fry had something unusual to exhibit: on a beautiful circular table were placed violet-colored squares crocheted of linen thread by his father, who is eighty-nine years old. The artistic arrangement of the decorations on this table, so as to secure harmonious color effects, was most successful. Beneath the table, on the floor, was a very large rug, crocheted from dyed rags, the pale blues and violets of which blended in color like the bloom of heather.

Among those deserving special mention were Adelaide Alsop Robineau and Albert W. Heckman. Mr. Heckman's set of bowl and plates showed a daringly successful use of color. He combined red-violet, vermilion, old Egyptian turquoise blue (colors you would expect to war against each other) so skillfully as to produce a most pleasing color harmony.

A number of the works of art were suggested by objects in the collections of the American Museum. Miss Nelson found inspiration for the design on her lamp in the bead work of the North American Indians. Miss Walling's beautiful Italian pottery, a tea set and bowl with cactus motif, were inspired by the cactus in the background of a habitat group of birds. Mrs. Knorblock's much-admired tile design was suggested by a bird motif in Peruvian art. The quaint and effective bowl of Mrs. F. A. Losse also had a bird motif from the same source. A plaque designed by Mrs. Hatfield successfully combined two motifs, that of birds and of waves. Mrs. Law's interesting design of deer beneath a leafy tree was suggested by the cover of one of the guide booklets prepared by Director F. A. Lucas of the Museum. The light of the sun streamed through a transparency hung at a front window, showing with fine effect the sweep and dip in flying of graceful sea gulls. A charming design of a floweret on china could be traced to a detail of a design on an Indian garment.

Officers of the society expressed appreciation for the coöperation of the authorities of the American Museum, especially of Dr. F. A. Lucas, in their efforts to exist as a society during the difficult years of the war, and for the facilities placed at their disposal since, enabling them to make use of Museum treasures and to come closer to their ideal of the beautiful in applied art.

INDIAN POTTERY AND THE STUDENT OF DESIGN.—Although ostensibly and predominantly the field of the American Museum is natural history, its exhibits are being studied increasingly by students of art, who find new inspiration in the forms and color of nature so faithfully reproduced in the Museum groups. A division of the Museum that has for years attracted students of design is that given over to the arts of the Indian. The forms and color schemes that the Indian produced have in many cases been imitated or adapted by visiting classes of art students. An example of this kind was the exhibit, recently on view in the Southwest Indian hall, of American Indian pottery, made, under the supervision of Prof. Charles B. Upjohn, by students of Teachers College, Columbia University. Vessels, the shapes and designs of which were suggested by specimens in the American Museum collections from the Southwest, from Mexico, and from Peru, had been prepared by these

students with rare deftness of touch and appreciation of decorative values. The pottery included ollas, food bowls, tripod bowls, and vessels of different shape, while the ornamentation ranged from variants of the interlocked design to symbolic representations of birds and other creatures.

MEETINGS OF SOCIETIES

IN MEMORY OF JOHN BURROUGHS.—On May 27 members of the John Burroughs Memorial Association and other friends of the naturalist gathered at Woodchuck Lodge, near the boyhood home of the man whose personality still lives in their hearts. In the old cow pasture (now Memorial Field) where as a child Burroughs loved to sit, perched on the friendly rock that today shelters his grave, these pilgrims gathered to express by their presence and through words of reverent regard spoken by Dr. Frank M. Chapman the depth of their feeling for him. Several pertinent poems were read, including Burroughs' "In Blooming Orchards." It is the fate of most men soon to be forgotten. The individual life, like a pebble cast into a pool, creates a few ripples, but a smooth oblivion-like stillness soon succeeds. Once in a rare while a man lives who without effort, perhaps even despising fame, makes so deep an impression on his fellows that the memory of him, instead of diminishing, grows with the passing years. John Burroughs was such a man. The ever-increasing number of those who have applied to Dr. G. Clyde Fisher of the American Museum for the privilege of membership in the John Burroughs Memorial Association is proof that the circle of his influence has not been narrowed through death.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its ninety-first annual meeting at Liverpool, from September 12 to September 19, under the presidency of Professor Sir Ernest Rutherford, F.R.S. Professor Henry Fairfield Osborn, to whom an invitation was extended to be present, expressed deep regret that he was unable to accept it.

WATSON B. DICKERMAN

The American Museum has suffered a great loss in the death of Mr. Watson B. Dickerman, one of its patrons. Mr. Dickerman was for many years greatly interested in trotting horses and was also a very successful breeder.

Among other famous horses, "Nedda," the fastest trotting mare on record, was bred and trained under his care at the Hillendale Farm near Mamaroneck, Westchester County, New York. But his interest was by no means confined to his own farm and stable. After the death of "Lee Axworthy," Mr. Dickerman, recognizing the value of a memorial to the world's champion trotting stallion, generously presented to the Museum funds for the preparation of the skeleton of the great trotter. As the skeleton is to be mounted in trotting action, a vast amount of preliminary study was necessary. The Hillendale stable and private track were placed at the service of Mr. S. H. Chubb, assistant curator of the department of comparative anatomy, American Museum, who spent many days there studying and photographing the horses and who on the basis of those studies is at present engaged in making a lifelike mount of the skeleton of "Lee Axworthy" that will show the position of every bone of the limbs and body when the animal is in full trot.

A PORTRAIT OF WILLIAM A. HAINES

As this issue goes to press, we learn of the valued gift of a portrait of William A. Haines, presented to the American Museum by Miss Emily Somers Haines in fulfillment of a bequest made by her brother. Further acknowledgment of this important acquisition will appear in the next issue of *NATURAL HISTORY*.

Since the last issue of *NATURAL HISTORY* the following persons have been elected members of the American Museum, making the total membership 6904:

Patron: MR. W. K. VANDERBILT.

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BROWN, THOMAS M. E. CLEARY, BERNARD M. CONE, BERNARD HEINEMAN, F. L. HIGGINSON, ROBERT JOHN, S. DANA KITTREDGE, ARCHIBALD R. LIVINGSTON, JAMES F. SANBORN, LEONARD SULLIVAN, BERTRAND L. TAYLOR, RONALD TREE, WILLIAM PITT TRIMBLE, ERNEST C. WAGNER, EDWARD K. WARREN, VANDERBILT WEBB, WARREN B. P. WEEKS, AND REGINALD S. WILLIS.

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NATURAL HISTORY

GORILLAS—REAL AND MYTHICAL

Recent field observations that disprove fantastic beliefs long held regarding this animal

CARL E. AKELEY

EARTHQUAKES

Great quakes of historic time, with an account of the causes of these phenomena

EDMUND OTIS HOVEY

THE JAPANESE EARTHQUAKE EXPLAINED

The phenomenon of September 1 as an incident in the process of mountain building along the coast of Asia

CHESTER A. REEDS

LOUISIANA HERONS AND REDDISH EGRETS AT HOME

A visit to Green Island, off the coast of Texas

ALVIN R. CAHN

NAVAJO LAND

In the hogans and along the trail with the Navajos

WILLIAM DORY

MARY CYNTHIA DICKERSON

A symposium of articles dealing with her wide range of achievement

SNOW WORMS—WHEN SNAKES SHARE FOOD, WHAT IS THE SEQUEL?

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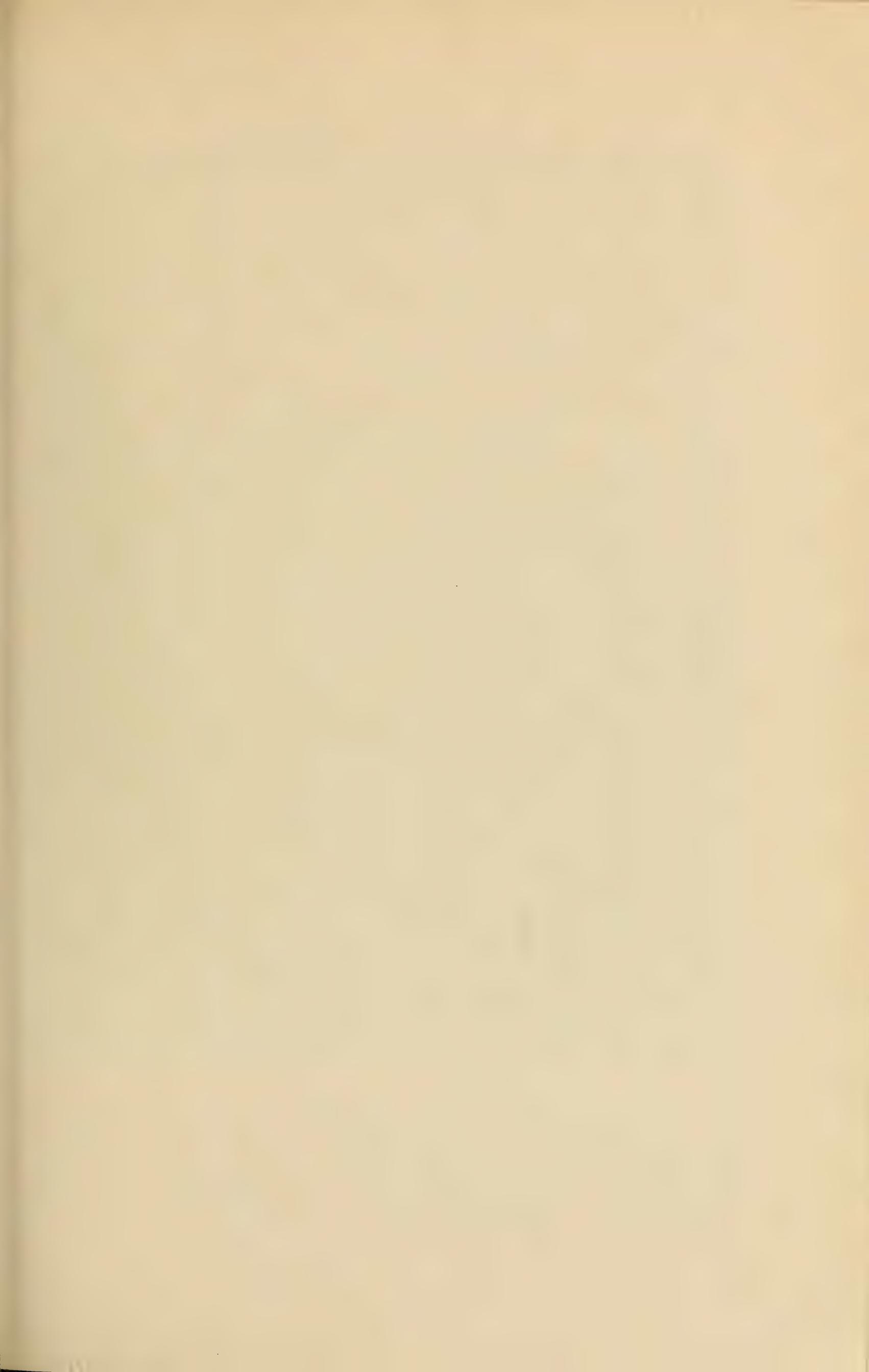
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AN OLD SILVER-BACKED MALE

This gorilla, the first to be collected by Mr. Akeley, is mounted for the group that will find place in the Roosevelt African Hall. He is advancing on all fours—the normal walking position—with his feet flat on the ground and his hands doubled under so that only the knuckles touch the trail. The posture and mild facial expression of this gorilla, the first specimen ever mounted by a man who had actually seen a live gorilla in the wild are in marked contrast to the erect body and the ferocious aspect of the traditional gorilla of story, of taxidermy, and of sculpture.

NATURAL HISTORY

VOLUME XXIII

SEPTEMBER-OCTOBER

NUMBER 5

Gorillas—Real and Mythical

BY CARL E. AKELEY

IT is ordained that the projected Roosevelt African hall of the American Museum shall follow the ideals and customs of modern museum exhibition. Into it shall go nothing but the truth. Forty groups of African mammals and probably two or three times forty species will be represented in their natural environment, doing normal and natural things. And when we say that in this great hall only truths are to be represented, we are committing ourselves to an enormous task; for we mean by such a statement that every detail in relation to an animal, its habits, and environment must be carefully studied at first hand by the men who are to prepare and assemble these groups. A vast amount of toil is involved in physical preparation, but, before that work is undertaken, labor equally great and even more important will be necessary to correct inaccurate theories that have persisted about little-known African animals.

Although, due to the fact that the gorilla is recognized by many as man's closest relative, the study of this ape is perhaps more interesting and more important than the study of any other animal, there is no other African beast that has been the center of so many fables and superstitions. What Huxley wrote about the world's knowledge of the real gorilla is almost as applicable to the situation today as to that of 1863. In regard to the difficulty of obtaining sound knowledge respecting the habits and mode of life of the man-like apes, he says:

... to the ordinary explorer or collector, the dense forests of equatorial Asia and Africa, which constitute the favourite habitation of the Orang, the Chimpanzee, and the Gorilla, present difficulties of no ordinary magnitude; and the man who risks his life by even a short visit to the malarious shores of those regions may well be excused if he shrinks from facing the dangers of the interior; if he contents himself with stimulating the industry of the better seasoned natives, and collecting and collating the more or less mythical reports and traditions with which they are too ready to supply him.

In such a manner most of the earlier accounts of the habits of the man-like Apes originated; and even now a good deal of what passes current must be admitted to have no very safe foundation. The best information we possess is that, based almost wholly on direct European testimony, respecting the Gibbons; the next best evidence relates to the Orangs; while our knowledge of the habits of the Chimpanzee and the Gorilla stands much in need of support and enlargement by additional testimony from instructed European eye-witnesses.

Nor are the inaccessibility of the gorilla forests and the persistence of the myths of an imaginative and superstitious people the only obstacles to the progress of the scientist who would separate the truth from the fiction in our natural history literature. When once an interesting tale has been well told, it is likely to become established through constant reiteration by men who are merely writers rather than observers. The naturalist going into the field to study an animal for the first time usually has read such writings and is under the spell of the erroneous impression that they convey. When he observes an animal in the

distance and is unable to distinguish clearly what it is doing, he naturally interprets its actions in the light of the tale he has read. I have known naturalists who were convinced in this way that they had observed something



A notable representation of the mythical gorilla, the bronze by Fremiet. It was suggested by the legend of the abduction of native women by vicious old male gorillas

which they had not seen at all, and who then confirmed such natural history fiction as eyewitnesses. Early tales of the gorilla, most of them based on hearsay, have so much in common, and the reports of more recent explorers duplicate these early accounts in so many respects, that one is inclined to feel that writing gorilla stories has been a game of follow the leader.

Had the American Museum undertaken to prepare a gorilla group five years ago, using skins which could be purchased in the open market, and planning the group as carefully as possible in accordance with the accumulated data of the past seventy-five

years, I have an idea that that group would have had a much greater appeal to a public thirsting for excitement and sensation, than the group which will result from the knowledge recently acquired. Such an imaginary group would of necessity have shown the gorilla as a ferocious creature in a setting of gloomy forest or mysterious jungle. There would have been one specimen in a tree, another walking erect with a staff or club in one hand, and perhaps a third beating its breast with its fists and opening its cavernous mouth as though roaring with rage. A house or nest, ingeniously constructed somewhere between earth and sky, would have been required to make the picture complete. Taking the records literally, there would have been justification for depicting an old male in the act of crushing with his teeth the barrel of a hunter's gun.

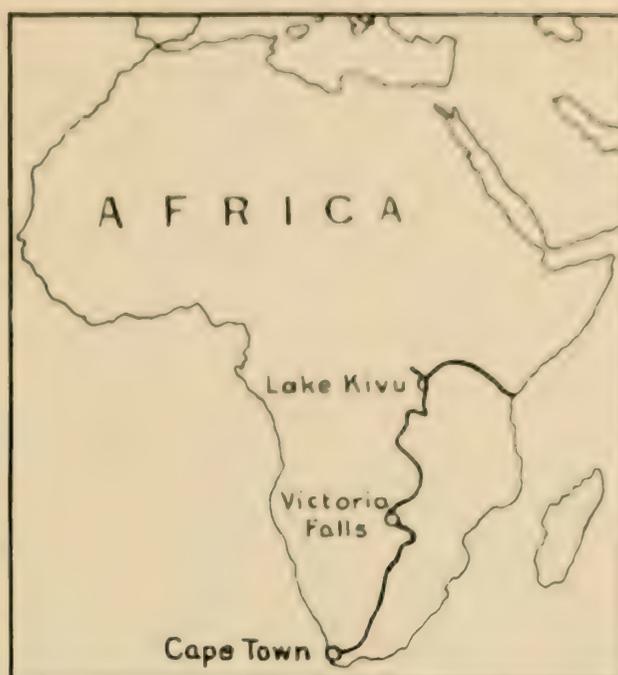
It is not necessary to rely on the imagination altogether in visualizing the gorilla as he has long been conceived. The American Museum of Natural History has been the temporary custodian of one of the old representations so horrible and so realistic that it would terrorize the very animal it is supposed to portray. (Be it said to the credit of the Museum that, when this statue came into its possession, it was put away in the basement.) I refer to the bronze by E. Fremiet, the most striking sculpture of a gorilla that we have. It shows a beautifully modeled animal in the act of bearing away on his right arm a lovely native woman, who, by the way, has more of the earmarks of a Parisian model than of an African savage. The gorilla, of course, is walking erect, on his legs; one hand clasps his captive, the other hand contains a great rock, which presumably he is about to throw at his pursuers. Al-

though they have already succeeded in lodging a huge arrow in his heart, he apparently has an abundance of strength and energy to defy them and to make away with his prize.

While the number of mounted gorillas in the museums of the world is not very great, still many of these museum specimens are almost as misleading as Fremiet's bronze.

The gorilla group in Roosevelt African hall will be a great disappointment to that portion of the public which has expected and would prefer to see the gorilla made as human and as horrible as the imagination has painted him, for it will show the gorilla as a great amiable creature in a setting of extraordinary beauty. In the group nothing but facts and truth will be told—not all the facts nor all the truth, for additional researches will undoubtedly widen our knowledge of this animal—but the story of the gorilla as I found him in November, 1921, near Lake Kivu in the eastern Congo, on the glorious, forested slopes of the extinct volcanoes, Mikeno and Karisimbi. Three weeks with the gorilla is indeed a short time in which to learn his story. I do not pretend that my record is complete; but I was extremely fortunate in my opportunities for observation and in securing specimens and data. And to the tale that is told by my group there will ultimately be added, I hope, the other ninety-five per cent of the gorilla's story.

During the time I spent in the gorilla forest, I was constantly searching for a setting to be reproduced for the gorilla group. In the preparation of a habitat group, it is always a difficult undertaking to find a setting that is characteristic and that in addition has those qualities that contribute to an interesting and attractive composition, one



Map showing the location of the gorilla country and the route taken by Mr. Akeley on his recent expedition. Entering Africa at Cape Town, he traveled northward by rail, by boat, and on foot into the mountainous region just north of Lake Kivu, where he found gorillas

that gives a comprehensive idea of the country and at the same time requires the minimum of expense in reproduction. Until the day that the last old gorilla was shot I had only the vaguest notion of what setting I should choose. It seemed to me that I could find nothing that was adequate. But when the old male of Karisimbi rolled down a steep incline, and came to rest against the base of a great dead tree clothed in mosses and in the rank growth of tropical vegetation, through the branches of which one looked out across a beautiful forested valley to the gorgeous pinnacle of Mikeno on the right and to the smouldering craters of Nyam-lagira and Chaninagongo in the distance, I realized that the old gorilla had found the setting that I sought. At no time has there been thought of looking farther. It is a place much frequented by the gorillas, where some of their favorite foods grow in abundance and where, their hunger satisfied,



The peaks of the gorilla country at sunrise—Visoke summit just visible over the left shoulder of Mikenno (center), and Kirisimbi at the right. The location of the proposed gorilla sanctuary is marked by this triangle of mountains

they bask lazily in the sunshine of their little empire.

The old male of Karisimbi will be shown beating his chest. This attitude should satisfy those who are loath to give up the sensational tales of gorillas until they learn that it does not indicate rage or ferocity. It is merely an expression of curiosity. The animal has seen a movement in the bushes in the valley below him and he rises up and beats his chest and perhaps barks—for the so-called roar of the gorilla of the Kivu region, at least, is best described as a long-drawn-out, throaty bark. The other male, the first gorilla that I ever saw alive, will be shown on all fours in the normal walking attitude. One hand will be poised, as he hesi-

tates in his advance and looks at the observer with the expression that he wore in life—an expression of passive interest. One old female will be lying lazily on her back against the base of the tree. When I came in sight of a troop that was unconscious of my presence, some of them were sure to be loafing about in some such attitude as this. A second old female, feeding on the vegetation, and a youngster of about four years will complete the group.

Before I discuss further the experiences which justify my belief that the gorilla is a good-tempered beast, who expresses himself by a bark rather than a terrifying roar, who touches the ground with his hands in walking and is non-arboreal in his habits, it may



The summit of Chaninagongo draped in smoke and clouds, viewed from the spot on the slopes of Karisimbi where the last old male was killed. This silhouette of the extinct volcano is to be a detail of the painted background for the gorilla group in Roosevelt African Hall

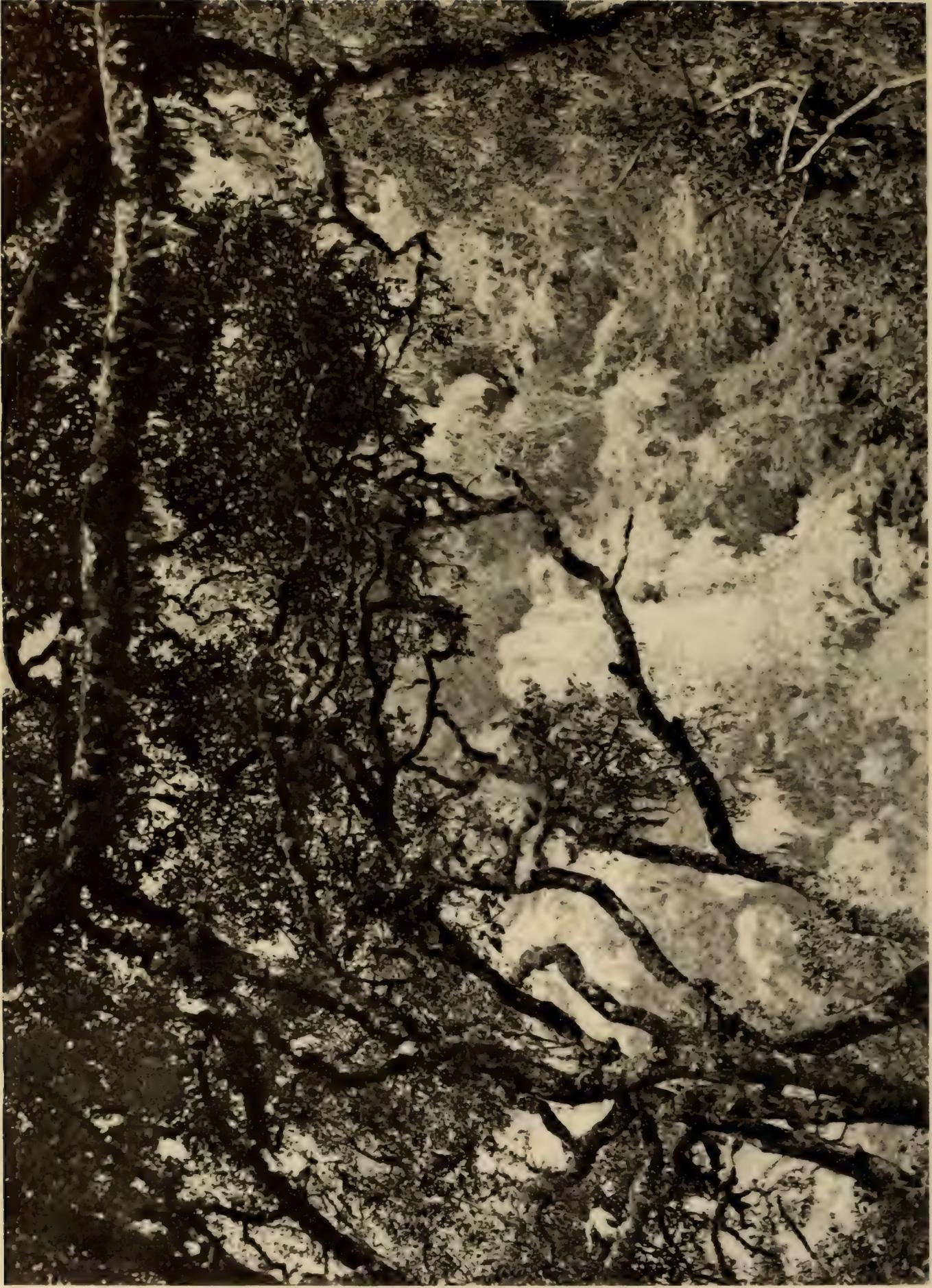
be well to devote a little space to the sources of the prevalent conception which it is my purpose to controvert.

About the close of the sixteenth century, the story of Andrew Battell, an English captive of the Portuguese of Angola, established the idea that the ferocious beast walked erect, slept in trees, and was the terror of the natives. After a description which practically identifies his "pongo" as the gorilla, Battell says:

He differeth not from a man but in his legs; for they have no calfe. Hee goeth alwaies upon his legs, and carrieth his hands clasped in the nape of his necke when he goeth upon the ground. They sleep in the trees, and build shelters for the raine. They feed upon fruit that they find in the woods, and upon nuts.

for they eate no kind of flesh. They cannot speake, and have no understanding more than a beast. The people of the countrie, when they travaile in the woods make fires where they sleepe in the night and in the morning when they are gone, the Pongoes will come and sit about the fire till it goeth out; for they have no understanding to lay the wood together. They goe many together and kill many negroes that travaile in the woods. Many times they fall upon the elephants that come to feed where they be, and so beate them with their clubbed fists, and pieces of wood, that they will run roaring away from them. Those Pongoes are never taken alive because they are so strong, that ten men cannot hold one of them; but yet they take many of their young ones with poison arrowes.

Battell's uncomplimentary opinion of the gorilla was widely disseminated through the exaggerated translation of



THE KIVU FAIRYLAND

One of the wooded valleys of Mt. Mikenno in the home of the gorillas—an enchanted forest of graceful tree trunks, lacy foliage, ferns, beard mosses, and tangled vines. The most beautiful scenery in all Africa, Mr. Akeley believes, is in this mountainous region just north of Lake Kivu in the Belgian Congo



A SCENE ON MT. MIKENO

View of a peak of Mikeno from a trail along a ridge that overhangs one of the mountain's deep-cut valleys. It was on a steep trail at the base of the white cliff on the right slope of the peak that Mr. Akeley killed his second gorilla.

it that appeared in 1748 in Buffon's *Histoire generale des Voyages*. In view of the fact that habits of the chimpanzee have frequently been attributed to the gorilla, it may be well to note that this book regards pongoes, jockos (chimpanzees), and oranges as a single species.

The account of an African missionary, Dr. Thomas S. Savage, based on skulls and information given him by the natives of the Gaboon region, appeared in the *Boston Journal of Natural History* in December, 1847. After giving a substantially accurate description of the gorilla's mode of progress on all fours, he adds that it is "said to be much inclined" to the walking posture. He speaks of their "dwellings" made of a few sticks and leafy branches supported by the crotches and limbs of trees, and of their exceeding ferocity and their habit of always taking the offensive. The native testimony which he records in the following paragraph has probably inspired in part at least the mounting of more than one ugly museum specimen.

It is said that when the male is first seen he gives a terrific yell that resounds far and wide through the forest, something like kh-ah! kh-ah! prolonged and shrill. His enormous jaws are widely opened at each expiration, his under lip hangs over the chin, and the hairy ridge and scalp is contracted upon the brow, presenting an aspect of indescribable ferocity. The females and young at the first cry quickly disappear; he then approaches the enemy in great fury, pouring out his horrid cries in quick succession. The hunter awaits his approach with his gun extended; if his aim is not sure he permits the animal to grasp the barrel and as he carries it to his mouth (which is his habit) he fires; should the gun fail to go off, the barrel (that of an ordinary musket, which is thin) is crushed between his teeth, and the encounter soon proves fatal to the hunter.

It was Doctor Savage who first gave the *Engé-ena* the name "gorilla,"

wisely avoiding the misused term pongo.

There is a striking similarity between the account of Doctor Savage and that given five years later before the Academy of Natural Sciences of Philadelphia by Mr. Ford, another visitor to the Gaboon. Even the episode of the animal's crushing the musket between his teeth is repeated by Mr. Ford, although he discredits the stories of elephant-driving and house-building as tales told to children by the natives. He does not pretend to have seen a gorilla's attack, but he describes the animal in vivid terms as he makes his onset, "with his crest erect and projected forward, his nostrils dilated, and his under-lip thrown down, at the same time uttering his characteristic yell, designed, it would seem, to terrify his antagonist."

The intrepid little French-American, Paul Du Chaillu, was the first white hunter to kill a gorilla. The account of his adventures appeared in print at that stage in the history of tales of travel when publishers, like the motion picture producers of today, feared to rely upon the unadorned truth to hold the public's interest. We have it on good authority, that the narrative was twice rewritten before his editors considered that it had sufficient popular appeal. His stories are the type that small boys carry away to the attic to devour on rainy afternoons. They are still occasionally read and they have done much to perpetuate the first erroneous reports of the gorilla. Familiar with the gorillas's reputation for evil, Du Chaillu naturally enough ran the whole gamut of emotions as he approached his first encounter. That passage from his book which at first reading is most damaging evidence against the great ape, appears as a

harmless recital when all the words and phrases that apply to the hunter's state of mind are dropped out. In spite of their fame as offensive warriors, the first gorillas surprised by Du Chaillu fled into the deep forest. The hunters pursued until they were exhausted but, "the alert beasts made good their escape." And the "charge" of his old male was proceeding hesitatingly, step by step, when Du Chaillu's gun interrupted it.

Although most of the reports of gorillas have been from the west coast, there had come to me considerable corroboration of the rumors that there were also gorillas in the Lake Kivu country of Central Africa. Before I left Africa in 1911, a report reached me that a man named Grauer had come out of the Kivu region with eight gorilla skins. Before my departure for the Kivu country in 1921, I received a letter from Mr. C. D. Foster, who had killed a male and a female and taken a baby on Mt. Mikeno. Prince Wilhelm of Sweden had hunted here, also, and Mr. T. Alexander Barnes was in the Kivu country hunting gorillas for the British Museum when we entered it.

At the time of my departure I had heard little of what these present-day hunters had to say of the Kivu gorilla, but I had never accepted the accounts of the Gaboon gorilla's ferocity. Having seen the "follow the leader" game played in the case of other animal stories by fellow naturalists in my own time, it was not difficult for me to disregard early accounts and enter upon my study of the gorilla with an open mind. If I was prejudiced at all when I entered the Kivu country in the fall of 1921, that prejudice was decidedly in favor of the gorilla. Basing my theory upon my observations of the

habits of the other apes and upon my general belief in the good temper of unmolested wild animals, I was prepared to find in him a decent and amiable creature. I was not disappointed.

I saw no indication that the gorilla is in the least aggressive or that he would fight even on just provocation. I have trailed him through his jungles, come on him at very close quarters, and shot him without seeing the slightest intimation on his part of an intention to start a fight. The first gorilla that I ever saw alive was a lone old male, who might have been expected to show some war-like spirit if that had been a characteristic of his tribe. I saw his face—ugly and wrinkled, but mild and gentle—across the valley and caught a glimpse of his gray back as he went over a log and up the slope through dense vegetation. When I finally overtook him, I was first aware of his presence by his guttural bark. He was crouching motionless thirty feet away in the death-like silence of the sun-lit morning. There was no "devil's tattoo" of chest beating; no threat of a charge—although, had he been inclined to charge, he had merely to drop down on us. He barked four times. My shot cut his fourth bark short. So ended my first gorilla hunt. It had been a thrilling experience, but thrilling because of tradition rather than because of fact.

Those who have maligned the gorilla's good name have cited his "strange, discordant, half-human, devilish cry" and his beating of his chest "with his huge fists till it resounded like an immense bass drum," as his modes of offering defiance. In my opinion both of these habits have been misinterpreted. The only way I can describe the utterance of a gorilla is as a hoarse, guttural, prolonged bark. It



Enlargements from Mr. Akeley's motion pictures, the first pictures of any kind ever taken of live, wild gorillas. Although the animals were aware of Mr. Akeley's presence, they paid little attention to him, the old female even settling herself comfortably in the crotch of the tree as if to go to sleep. The bottom picture shows two of the gorillas with clasped hands, as the old one helps the youngster to descend. The gently sloping trunk on which the gorillas were perched when Mr. Akeley photographed them, was no more than ten feet from the ground

has no resemblance whatever to a roar and there is no resonance in the sound. I doubt if on a perfectly still day it could be heard for more than half a mile. In some cases it is a warning signal to the rest of the band; in others, it is an inquiring challenge addressed to the invader of his domain and has some such implication as the words, "Who are you? What are you doing here?"

I was keen to see a gorilla beat his chest and was fortunate not only in witnessing this action, but also in making a motion picture record of it. In this motion picture the female is shown in the crotch of a leaning tree, to which she had ascended with her two youngsters to get a better view of me. At a time when they were all but indifferent to my presence (although I was in plain sight), she suddenly rose up and beat her chest; then immediately dropped down again. A moment later she was making herself comfortable with the apparent intention of going to sleep if her youngsters would let her. One of the youngsters rose up on his legs two or three times, each time striking his chest once and, as he went down again, hitting the log once or twice with his hands. They made no vocal sounds and I could not hear the beating of the chest from where I stood operating the motion-picture camera, at a distance of perhaps two hundred feet. There was no wind to carry sound either to or from me. The beating of the chest is a nervous expression of curiosity, the equivalent of which we find in the actions of many of the smaller apes and monkeys, such as their habit of beating the ground or their perch with their hands or feet, while they are perhaps making vocal sounds.

The natives of this region have no fear of the gorilla. They wander

through the gorilla country to collect firewood and, during the dry season, pasture their cattle on the open places in the gorilla forest. We found fresh gorilla tracks on the fresh trail of a herd of cattle. Some of my guides and my gun bearer were trappers and hunters in the gorilla forests and were thoroughly familiar with them. At no time did the guides or gun boys show any indication of anything more than casual interest even when we approached very close to gorillas. In direct contrast to the behavior of natives on the elephant trail where they are terrified when unprotected by the rifle of the *bwana*, the gun boy who went with me on the gorilla hunt would hand me the gun as we were getting near a band and would go in front of me unarmed, cutting the nettles out of the way or clearing a path. Then, when he thought I might want to shoot, he would lie down on the ground in front of me. With dangerous game you can depend on your boys' dropping behind you, where they are ready to lead the retreat, if retreat becomes necessary. At no time did I see a gorilla move with a rapidity that would suggest the possibility of his overtaking a man in a fair race. The lumbering creatures with their comparatively short legs are not built for speed.

While I am certain that normally the gorilla is a perfectly amiable, good-natured creature who would not look for trouble, yet I am willing to concede that in regions where he is more or less in competition with the natives for food, and where he is constantly harassed in his efforts to fight hunger, an old male might occasionally become what may be called a "bad gorilla." No doubt from his standpoint a raid on the native gardens is justified, for so far as he knows the food in these gardens is

just as much his as the natives'. Now and then under such conditions a gorilla becomes conscious of his superior strength and may naturally enough grow bold and aggressive. And it is hard to imagine a more formidable opponent than an enraged gorilla. The strength of his arms, as one may judge from the measurements, is tremendous. This strength, backed by the great weight of his short coupled body, would make it useless for an antagonist to struggle against him in a hand-to-hand encounter.

Very few gorillas have been weighed. Mr. T. Alexander Barnes, a thoroughly dependable and thoroughly honest ob-

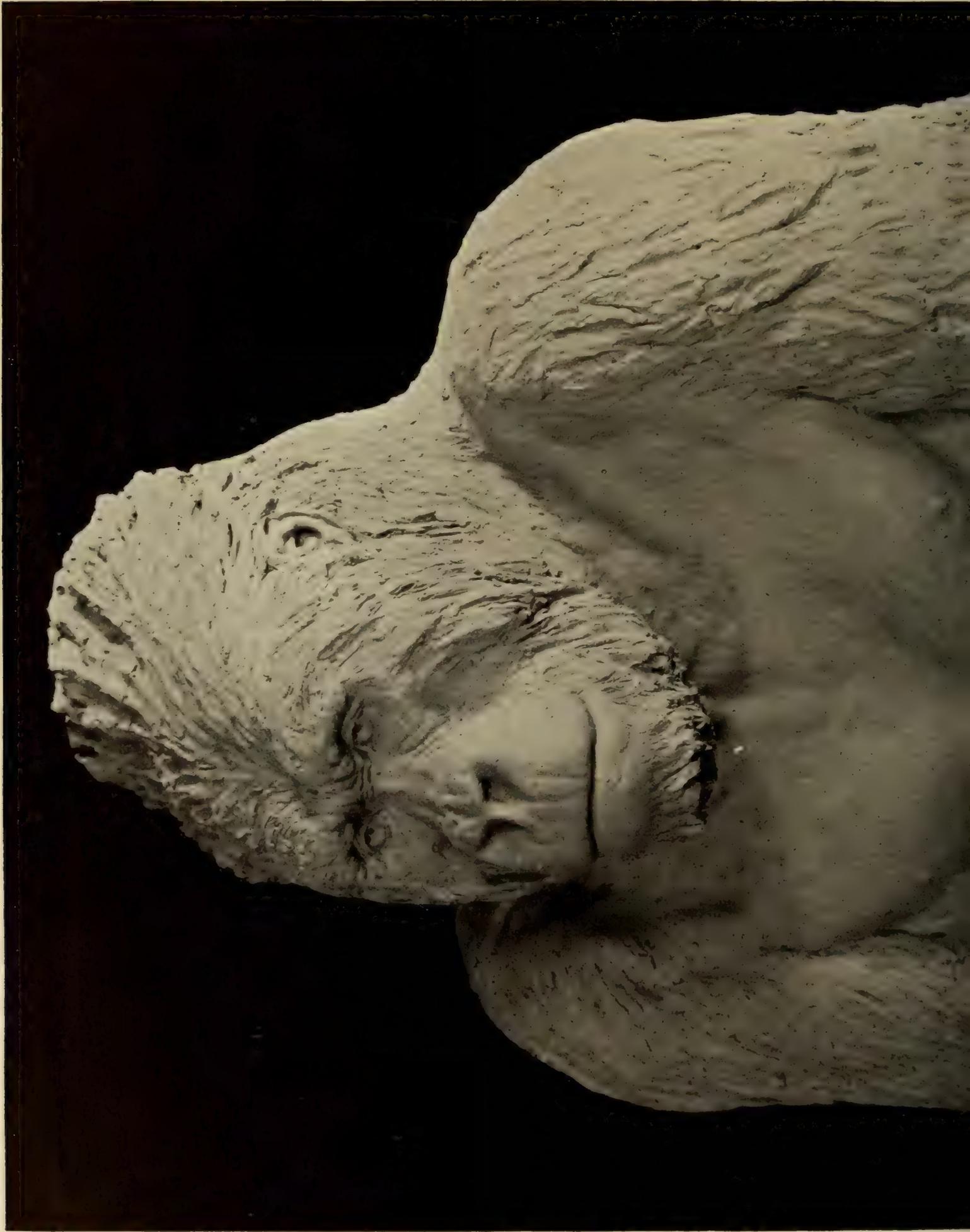


M'Gulu, a guide of the gorilla country, with one of the knives used by the natives in clearing away the nettles or cutting a path through the dense undergrowth of the gorilla forests. Progress is slow where such paths must be made

"THE OLD MAN
OF MIKENO"

A portrait bust of his first gorilla, modeled by Mr. Akeley for casting in bronze. Through his sculptures, as well as through the written and the spoken word, Mr. Akeley has been telling the stories of African wild animal life as he knows it. A number of the incidents of his acquaintance with elephants and lions have already been recorded in bronze.

This bust of a gorilla, the benign expression and deep-set eyes of which are a contradiction of the age-old tradition of the ferocity of the big ape, is the first sculpture completed by the artist in a contemplated series representing gorillas. The bronze is his interpretation of the gorilla's "character," a study intended to convey to others his impression of the creature that he came to know two years ago in Africa.



server in describing a large male from the Kivu which has been mounted by Rowland Ward and Company, states that its weight was approximately 450 pounds. The weight is frankly estimated. As a matter of fact, the measurements of Mr. Barnes' gorilla are somewhat smaller than those of the old male of Karisimbi, which actually weighed 360 pounds. In another case, 700 pounds was alleged to be the weight of a gorilla, the skeleton of which was a little smaller than our Karisimbi male. At least we have a standard now to go by—the measurements of the skeleton of the Karisimbi male and its actual weight. They are given below:

Height	5 feet, 7½ inches
Weight	360 pounds
Chest	62 inches
Upper arm	18 inches
Reach	97 inches
Calf	15¾ inches

We are in the habit of speaking of the gorilla's long arms, but it is more accurate to say that his spinal column and his legs are short. Certainly, because of the greater correlation in the development of arms and chest, the length of the arm should be considered in relation to the thorax rather than to the spinal column. From the arm and chest measurements of man and of the gorilla, it appears that the gorilla's arm is relatively shorter than man's.

Fables of the capture of women by old males who carry them off to their fastnesses in the forest have long been circulated as evidence of the gorilla's strength and ferocity. These tales are as legendary as the fable of the ostrich that hides its head in the sand and believes that it has concealed its entire body, or of the elephant that fears the mouse because it might run up his nose. There is about as much inducement for a mouse to run up an ele-

phant's trunk as to make his way up a fire hose when the stream is turned on with full force. "The silly stories about their [the gorillas] carrying off women from the native towns," wrote Doctor Savage, "... have origin in the marvelous accounts, given by the natives to credulous traders." Eduard Reichenow thinks this fiction may have had its origin in an attack on a plantation, where food is competed for and where women do the agricultural work.

Contrary to popular theory, the gorilla is not a tree-living animal. Those already described as beating their chests before the motion-picture camera, were the only ones that any member of our party saw off the ground. On that occasion, one of the two youngsters climbed a nearly upright tree to a height of about ten feet. (As I write, there are three small boys at an equally great height in an upright locust tree just outside my window.) A few seconds later this first gorilla youngster joined the old female and the other baby in a second tree, the trunk of which slanted so that a dog could easily have run up it. Most of the tree trunks were so covered by moss and other vegetation that they would surely carry the marks if gorillas were in the habit of climbing them, but I saw no indication anywhere of trees having been climbed by gorillas. It is difficult to convince oneself that these heavy, rather sluggish creatures are any more arboreal than man, and I do not believe that they are. Mr. T. Alexander Barnes bears me out in this belief. In the *Wonderland of the Eastern Congo*, he writes, "... they never sleep in trees but prefer to make a nest or shelter on the ground. . . Judging from my observation it may be said that they scarcely ever climb trees and moreover are not partial to fruits and nuts, preferring to

feed on grass herbage and bamboo leaves." Reichenow admits that the gorilla to a greater extent than the chimpanzee is a stranger to tree-living; that he nests always on the level of the ground; that, if he climbs for food or at the approach of danger, he must come down the trunk he ascends, inasmuch as he cannot swing from one tree to another.

I cannot corroborate the evidence of these two hunters that nests are occasionally built by bending over young bamboos or other branches and weaving them together to form a springy platform. In no case did I see such a bed. There were many nests, sometimes as many as eight or ten in a group, some of them protected by the overhanging vegetation of a great tree trunk, while others were scattered

about in the open. However, they consisted merely of a hollowed-out spot where the gorilla had lain. The beds were constructed in the simplest possible manner wherever the gorilla decided to spend the night by drawing together whatever of leaves or debris happened to be within his arm's reach. Apparently none of the nests had been used more than once, as they almost invariably contained droppings that had not been trampled on or lain on. Perhaps the fact that the gorilla always sleep in fresh, clean beds is one of the reasons that they are so splendidly healthy and absolutely free from parasites, external or internal.

There has been a fairly general agreement among naturalists as to the fact that the gorilla progresses on all fours, but the three-and-a-half-century



A gorilla bed on the floor of the forest, made by drawing together the grasses, leaves and debris that lay easily within arm's reach. Mr. Akeley observed many of these rude beds, frequently at the bases of trees from the mossy trunks of which trailed hanging vegetation sometimes screened the sleeping place

old fiction that he is much inclined to the erect posture is still popularly accepted. In spite of the fact that he seems to be evolving toward a two-legged animal, his body leans forward at an angle of less than 45 degrees and his hands touch the ground as he walks. His feet are placed squarely on the heel, bearing most of his great weight, but his fingers are doubled back so that only the knuckles touch the trail. As a matter of fact, the gorilla cannot straighten the fingers unless the wrist

sufficient to loosen their grasp. This peculiar characteristic, a legacy of his arboreal life, is probably a great aid to him as he grasps roots and branches in the tortuous ascent of a steep hillside.

I saw all told from twenty-five to thirty gorillas and got no hint that they ever progress except on all fours. Even when in going away from me they stopped to look back, they remained on all fours. The only occasion on which we saw gorillas in any other attitude was that recorded in my motion pic-



Plaster casts of gorilla hands and foot, made in the field when the specimens were taken. To the left are the hand and foot of a female. Note especially the development of the heel and the position of the big toe. The clenched fist to the right is that of the larger male

is bent. When the wrist is straight, as in the act of walking, the fingers automatically close like the claw of a bird when it settles on a perch. The preserved carcass of a young gorilla was brought back to the studio for reference and study. As a result of treatment, the whole muscular system of this preserved specimen is now more relaxed than it was when freshly killed, but even in its present condition, the weight of the body as it hangs with the fingers hooked over a support is not

tures, when the female and the youngster rose for an instant and beat their chests. It is difficult to imagine one of these bulky animals making progress in an upright position on his comparatively weak legs, and, if he ever does so, it must be with no more ease or grace than a heavily built trained dog would exhibit in making a similar attempt. One could scarcely expect to find an animal adapted for walking erect in that mountainous region; indeed, in that country of precipitous ascents



The lone male of Karisimbi, the gorilla shot by Mr. H. E. Bradley, one of Mr. Akeley's companions. In spite of the animal's great strength and his 360 pounds, he offered no defiance when attacked

through dense underbrush, man himself is frequently forced to drop on all fours in order to make any progress on the gorilla trail.

It is not strange that the average individual pictures the gorilla walking jauntily on two feet. The earliest wood-cuts showed him standing erect and cyclopedias and natural histories have continued to represent him in that way. One of the worst and most recent offenses is to be found in J. A. Thomson's *Outline of Science*, where a colored plate shows a gorilla with a horribly ferocious face walking freely erect. Hæckel in his *Anthropogenie* published a plate of a gorilla skeleton

side by side with that of a man and in the same posture. Museums have mounted skeletons in similar fashion up to the present day. This practice is justified inasmuch as the unnatural pose is for purposes of comparison, but unfortunately the visual image of such skeletons remains in the popular mind long after the explanation accompanying them is forgotten.

The death masks of my five gorillas are a priceless record. The first old male, one female, and the youngster were killed on a ridge of Mt. Mikeno and they bear unmistakable resemblances to one another. The other male and female, killed on the slopes of Kari-

simbi, likewise resemble each other, but their physiognomies are totally different from those of the Mikeno specimens. The feeding grounds of these two ridges were separated by a valley, which the gorillas were constantly crossing back and forth. The suggestion therefore is obvious even from this slight amount of material that the gorillas live in family groups with a tendency to interbreed.

Both of the males in the group were lone males at the time we came up with them. There was a considerable band—how many I do not know—on the occasion of the photographing of the female and the two youngsters. All the others remained out of sight in the vegetation beneath the slanting tree and, although, after completing the picture, I followed them for a considerable distance, catching occa-



Death masks of the five gorillas. Although a great part of their interest lies in the individuality of each countenance, there is marked "family" resemblance in the faces of the Mikeno gorillas (upper left and two lower left), and also in the faces of the Kirisimbi specimens (upper and lower right)



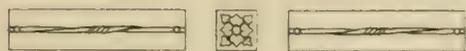
A tangle of tropical vegetation of low growth and splendid trees on the western slope of Mount Mikeno,—a typical view of the dense and beautiful forests of the gorilla country

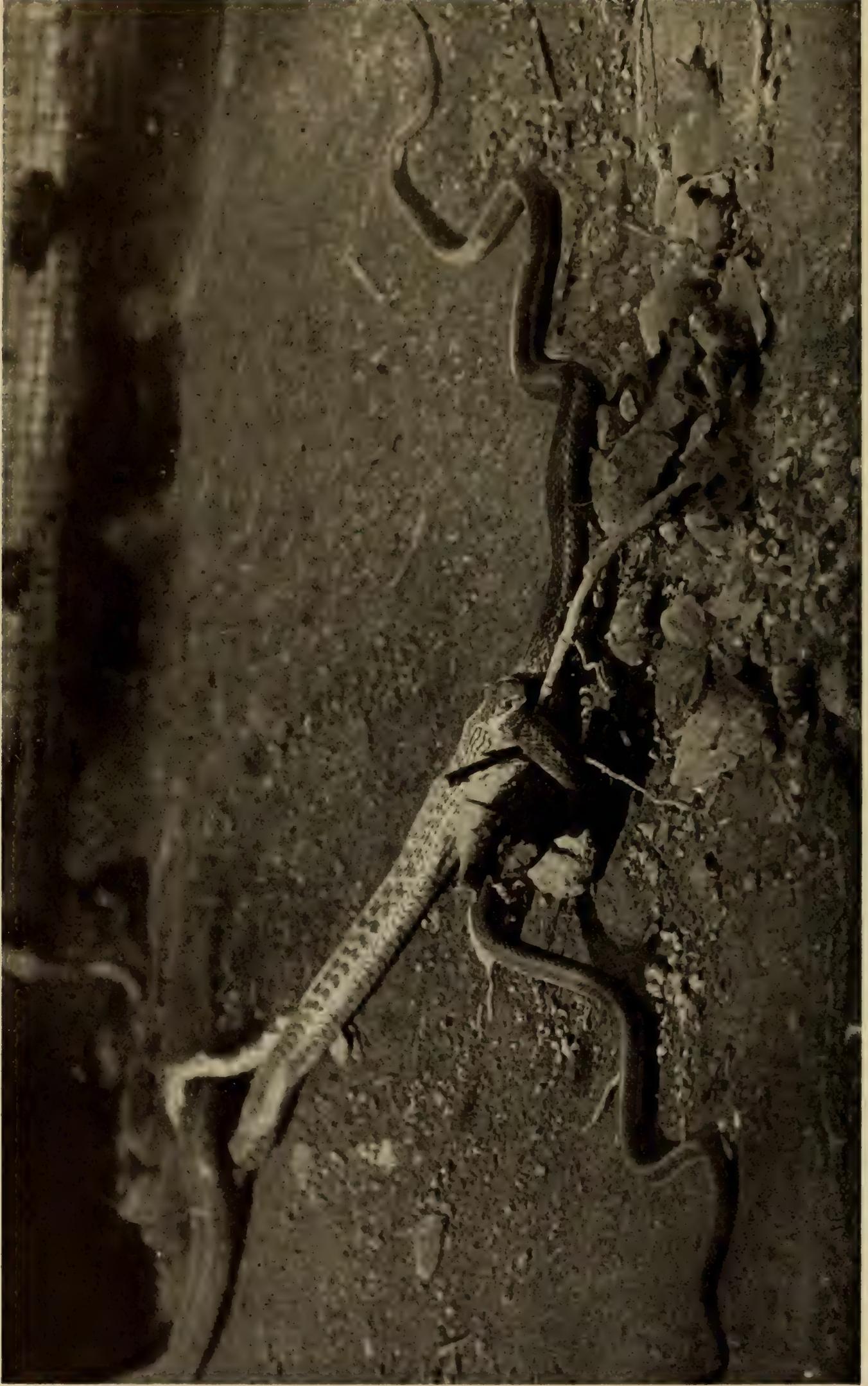


Mr. Akeley's gorilla camp,—the skins in the foreground, the skeletons on the rack, and the preserved body of the young gorilla suspended from the ridge pole of the tent

sional glimpses of them, I saw no male. On the last day in the forest, I set out with the idea of securing one more specimen. Doubting whether it would be legitimate to use the two males already secured in a single group, I wanted to obtain another female in order to have a pair in excess. We found the fresh track of a single old male, which we followed up the slope through the bamboos, and when we finally came up with him, there were in addition to a number of females and youngsters at least two, and I believe three, other old gray-backed males in the troop. There were three in sight at one time and I am fairly certain that I saw a fourth disappear. I realized on the instant that it was perfectly legitimate to use two old males in my group. There was no valid excuse for killing another gorilla. And so, instead of firing my gun, I took the final shot with the motion-picture camera as the troop disappeared over the top of a ridge. Altogether I saw six or seven males at distances varying from ten to three hundred yards and no one of them stood erect and beat his breast.

After my first expedition into the gorilla country, I am more convinced than ever not only that the gorilla is one of the most fascinating and important objects of study in the realm of natural history, but also that his disposition is such as to permit the most intimate observation of his habits. A few days in the gorilla country and one instinctively falls into the way of referring to this amiable giant as "he" in the human sense. A few weeks of casual acquaintance and one is fired with a desire to ferret out the answers to a hundred questions about this little-known relative of man—questions of increasing importance to scientists and physicians in their efforts to understand and aid man himself. Probably no other project of so moderate a size is likely to lead to such immediate and valuable scientific results as that which will make of the Kivu region a sanctuary, where the gorillas under the protection of man may grow more and more accustomed to human beings and where through a series of years they may be observed and studied.





A DINNER TÊTE-À-TÊTE

Three snakes started to feed on the same toad and two of them are following the toad in its descent down the largest of the snakes. The incident occurred at the Boy Scout Camp Museum, Kanohwahke Lakes, Palisades Interstate Park

When Snakes Share Food, What is the Sequel?

By B. T. B. HYDE

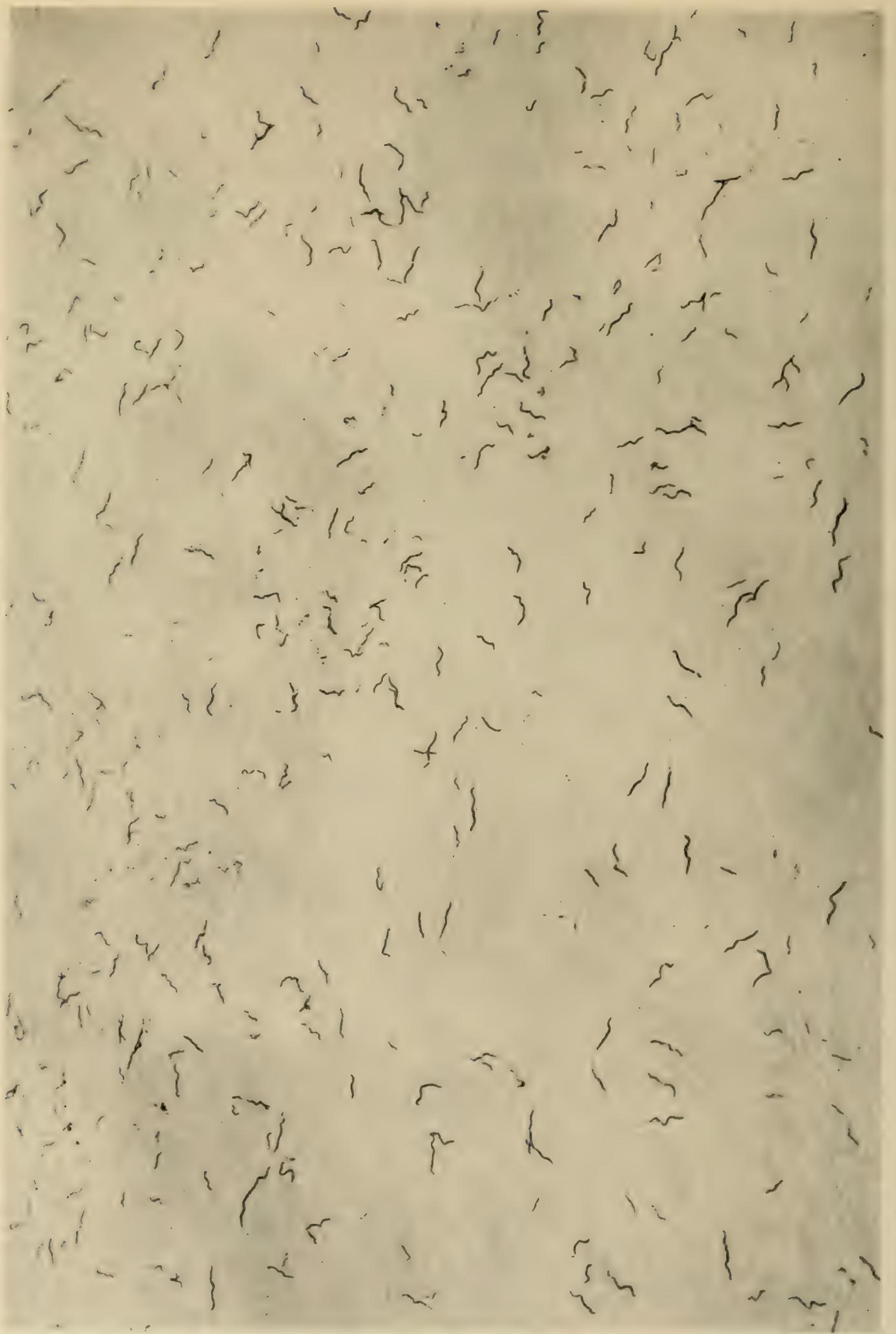
Educational Director, Kanohwahke Scout Camps, Palisades Interstate Park

AN unusual exhibition of an odd trait in snakes occurred the summer of 1922 at the Boy Scout Camp Museum, Kanohwahke Lakes, in the Palisades Interstate Park. One day when toads were being fed to a number of garter snakes, it was observed that one of the smaller snakes seized a toad by its right hind leg, about the same time that a much larger snake decided to begin upon the head of the toad; and not to be left out (as it proved) another small garter snake took possession of the left hind leg. All three were thus feeding from different directions toward a common center, and presently the largest snake had the original meal and its attendant banqueters well down inside him for a distance of about ten inches. At that juncture I was able to secure the photograph that is reproduced on the opposing page. A few moments after the picture was taken, for some reason—perhaps too much action inside the devourer-in-chief—the two disappearing members of the triumvirate emerged again, the original claimant still attached to the toad and as intent as ever upon securing his well-earned repast.

Although it is unusual to find as many as two snakes passing simultaneously into another, it is an observation cited by many that when two snakes are engaged in feeding upon the same creature, one of them often swallows the rival claimant as well as the prey. Mr. F. W. Fitzsimmons, for instance, in his exhaustive study of the snakes of South Africa, reports several experiences with captive snakes in the snake park attached to the Port Elizabeth Museum and tells how at feeding time when two snakes attack the same live animal, the one whose jaws work the more rapidly, keeps on drawing in both the original food and ultimately the other snake. Snake number two seems not to realize the situation and makes no attempt to disgorge; it maintains its hold on the prey and passes into its rival, even though it be the more aggressive of the two, and through its struggles causes the larger snake to be folded back and forth. At times, however, the victimized snake, when part way down its captor, makes its presence felt so forcibly that it is ejected.

The fact that a snake will maintain its hold on its prey and pass with it literally into the jaws of death, is explainable on the ground that when the swallowing process has commenced, a mechanical continuation of it apparently follows. The muscular action once started may be beyond the control of the snake, unless some physical hurt or distraction results in an act of disgorging. A snake that shares a feast with another and in the course of the banquet devours its fellow, passes from frog skin, or in more extreme cases from hair or fur, to snake skin without giving evidence of any interruption of the swallowing process. Perhaps it is unaware of the change of substance or does not permit such distinctions to interfere with its preoccupation, or again it may be that it cannot check the action that has been started.

A DINNER-TIME-ACT—A-TÉTE-À-TÉTE
Three snakes started to feed on the same toad and two of them are following the toad in its descent down the largest of the snakes.



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SNOW WORMS ON THE SNOW

The surface of snow shown is only a small patch in a continuous white stretch more than a quarter of a mile in extent over which the worms were thickly strewn. This photograph was made about June 1, 1907, in a pass on the slopes of Mount Olympus, Washington, and is reproduced herein through the kindness of Mr. Asahel Curtis of Seattle

Snow Worms

ENCHYTRÆID WORMS FOUND IN THE SNOW AND ON THE GLACIERS OF HIGH MOUNTAINS

BY E. W. GUDGER

Associate in Ichthyology, American Museum

IN the spring of 1922, a lecture on the scenic grandeur of our Pacific Northwest was given at the American Museum. I had heard that the picture which forms the frontispiece of this article was to be shown under the designation "snow eels." At that time I was collecting data for an article¹ on "Rains of Fishes," and from what I had heard about this picture, I thought that these "eels" must have been rained down. I attended the lecture and met the speaker. Although this gentleman could give me no first-hand information, he told me that he had secured the slide from Mr. Asahel Curtis of Seattle, and that he understood that the phenomenon it recorded was not of uncommon occurrence on the snows of the mountains of Oregon and Washington. I at once got into communication with Mr. Curtis, who in answering my letter sent me a copy of the photograph, with permission to reproduce it in an article. He also authorized me to make use of the data which he gave me. He wrote as follows:

I made this photograph in 1907 on Dodwell-Rixon Pass, elevation 5200 feet. This pass is at the headwaters of the Elwha and the Queets [rivers] near Mount Olympus. It was taken about June 1, but there was still a great deal of snow in the mountains. We had traveled for a distance of at least two miles over the snow in coming up to the pass and on the Queets side there were miles of snow fields. We had no way of knowing the exact depth of snow on the pass, but from my later experiences I should judge that it was about twenty or thirty feet deep.

¹See NATURAL HISTORY, November-December, 1921, pp. 607-19.

On first going through the pass, we either did not notice the eels or they were not there, but on returning, something like an hour and a half later, we threaded our way through them for more than a quarter of a mile, and practically all of the way they were strewn as thickly as they are shown in the photograph. I had been walking along for several minutes before it occurred to me that I should take a picture of them. We had been having a hard day's trip and we were all very anxious to make camp as we were quite tired. Therefore, we did not relish the thought of unpacking the camera, but the incident was such that I thought I would do so nevertheless. The next time I saw the eels was in the same valley on Humes Glacier, which comes down from the eastern crags of Mount Olympus. This was in August, 1907, and they were swimming in the pools of ice water on top of the glacier. There was a report in one of the Seattle papers that a man from Alaska brought some down with him and he seemed to think that they were peculiar to Alaska, but they have been reported to me from various parts of the state of Washington.

I then wrote Mr. Curtis, pointing out that eels have fins and are fish and that they could have reached the snow fields only by the aid of whirlwinds and storms. He thereupon sent a second letter explaining that these were not true "eels" but were small worms somewhat resembling angle worms. He suggested that I write Mr. Grant W. Humes at Harrisville, New York, who had been his companion on the trip referred to. Mr. Humes, in reply to my letter, gave me the following very clear-cut account:

The creature in question is doubtless a *worm*. It is of tiny dimensions, only about five-eighths of an inch long and perhaps one-sixty-fourth of an inch in diameter and is

shaped much like an eel, which is quite likely the reason that it has been called so by one or more persons who have photographed these creatures. The worms are always jet black in color and have been observed many times by the writer in a certain pass 5400 feet in altitude—always upon the snow and in countless thousands, perhaps millions. . . . As to where they come from or their purpose on that vast snow field, I have no substantial idea.

The name of Mr. W. Montelius Price of Seattle, another companion of this trip, was also given me by Mr. Curtis. A letter to him brought the kind reply that from the point at which the photograph was taken the snow field, probably varying from twenty-five to one hundred feet in depth, extended out about one-half mile, there to meet the earth and rocks of the mountain-side. This snow field was covered with the small black worms and several birds were flying about and regaling themselves by feeding on them.

This matter struck me as being most extraordinary and I thought that I had chanced upon a brand new thing, a phenomenon absolutely unknown hitherto—but I was soon undeceived. On looking into the literature I found that this bizarre thing had been known for many years. The best account of it is that given in 1899 by Dr. J. Percy Moore of the University of Pennsylvania from specimens studied in 1897.¹ His material had been collected by Mr. Henry G. Bryant upon the snow fields of the Malaspina Glacier, Alaska, in 1897. Doctor Moore quotes from Mr. Bryant's notes as follows:

The snow-worms were first observed a few hundred yards from our first camp, on the edge of the snow mantle of the glacier, which at this time (June 17) extended to within a

few miles of the terminal face of the glacier. By the first of August this snow mantle, which in places was six or seven feet in depth, had entirely disappeared, exposing the hard, compact ice of the glacier. The elevation of the first snow-camp referred to was 520 feet above sea level. Here but few specimens of the worms were noted. At our second camp on the snow (elevation 1,260 feet), they were quite abundant in places, as also at our next camp (elevation 1,580 feet), where their presence in large numbers irregularly dispersed presented the appearance of blotches of coarse dust on the snow. Our base-camp was on a small expanse of snow-free ground on the south slope of a range of foothills abutting on the main range at an altitude of 1,750 feet. A few worms were observed on the adjacent snow of the main glacier, at a somewhat lower elevation; but I do not recall seeing any representatives of this species on any of our excursions in the upper snow fields of the region.

During the month of June and early part of July, while the snow is comparatively dry, they appear about four o'clock in the afternoon on the surface and move sluggishly about, their dark color being quite conspicuous against the white background. They remain on the surface during the night; but when the sun appears in the morning they again burrow into the snow. They were widely distributed over the entire snow-field of the glacier, diminishing in numbers toward the edges. There was no uniformity in their dispersion. We did most of our sledging at night, and frequently passed stretches of snow several hundred yards in extent without noticing any specimens, and then would come to irregularly defined areas which seemed to support colonies of them, where the snow showed shadowy, dustlike patches caused by their presence in considerable numbers. As showing their sensitiveness to heat, I frequently observed their active wriggling as soon as a piece of snow containing them was taken in the hand. Later in the season, when the melting is further advanced and the snow saturated with moisture, the worms appear to become more active, and can be observed moving about in the shallow pools and lakelets which form on the surface of the glacier.

When the snow entirely disappeared and the hard ice surface of the glacier appeared, the snow-worms were observed in the water which formed in the narrow crevasses. In

¹Moore, J. Percy, "A Snow-Inhabiting Enchytræid (*Mesenchytræus solifugus* Emery) Collected by Mr. Henry G. Bryant on the Malaspina Glacier, Alaska." *Proceedings of the Academy of Natural Sciences*, Philadelphia, 1899, Vol. LI, pp. 125-44.

my notes of August 2, I find the following: "Collected some black worms to-day in a crack of the glacier--found them in the water of a high, narrow crevasse. Observed them on the edge of the submerged snow at a depth of five feet below the surface."

However, the publication of Mr. Bryant's notes and Doctor Moore's careful study of the worms had been antedated by Mr. Carlo Emery,¹ who had briefly described material collected on the Malaspina by Dr. Filippo De Filippi of the party of the Duke of the Abruzzi during the same summer. But his account of the habitat of the worms is merely incidental and is wholly lacking in the fullness of data found in the accounts of Mr. Bryant and Mr. Curtis.

Two years later Mr. Emery published a fuller account² of these worms, based on Filippi's notes. Filippi found that they appeared in the mornings and afternoons, on foggy days staying later in the mornings and appearing earlier in the afternoons, but were never seen near midday. On bright sunny days Filippi dug as low as fifty centimeters (about twenty inches) in the snow without finding any.

But Emery's account of snow worms on the Malaspina is, in its turn, antedated by a description published in 1893 by Dr. Israel C. Russell,³ who had conducted an expedition to that glacier in 1891. Doctor Russell's brief note is as follows:

In the early morning before the sunlight touched the snow its surface was literally covered with small, slim black worms, about an inch long, and having a remarkably snake-

like appearance. These creatures were wiggling over the snow in thousands, but as soon as the sun rose and made its warmth felt they disappeared beneath the surface. They are not seen when the temperature is above freezing.

Doctor Russell further stated in a personal letter to Doctor Moore that he had seen similar worms on the snow fields of Mt. Ranier, Washington, thus antedating Mr. Curtis' interesting observation near Mount Olympus, Washington. Doctor Russell's note is the earliest record for the Malaspina, but is not the first record for a glacier. Dr. G. F. Wright⁴ in describing the Muir Glacier in 1887, notes the interesting phenomenon that "In the shallower enclosures on the surface [of the ice of the glacier] containing water and a little dirt, worms about as large around as a small knitting needle and an inch long are abundant."

All this is apparently very novel, but it turns out that an essentially identical habit of a worm of the same group had been recorded still earlier. These accounts, dating back to 1884, may be briefly summarized.

In 1884, there was submitted to the celebrated naturalist, Joseph Leidy, a small vial filled with water obtained by melting some natural ice which had been gathered for domestic use from a mill pond in Delaware County, Pennsylvania, and in the minute débris at the bottom of the vial were some small worms *alive*. Next year another sample of water from melted ice was sent him from Morristown, New Jersey, but the worms were dead. However, on Leidy's request, his correspondent sent him a basket of this natural ice. When this ice, which contained a number of air bubbles and water drops, was melted, there were found

¹Emery, Carlo. "Diagnosi di un nuovo genere o nuova specie di Annelidi della famiglia degli Enchytræidæ." *Atti Reale Accademia Lincei*, Serie Quinta. Roma, 1898. *Rendiconti*, Vol. VII (1st. sem.), pp. 110-11.— "Sur un Oligochete noir des glaciers de l'Alaska." *Bull. Soc. Zool. Suisse*, Genève, 1898.

²Emery, Carlo. "On *Melanenchytræus solifugus*" (In Filippo De Filippi: *The Ascent of Mount St. Elias by H. R. H. Prince Luigi Amedeo di Savoia, Duke of the Abruzzi*. London, 1900, p. 224).

³Russell, Israel C. "Second Expedition to Mt. Saint Elias in 1891." *13. Ann. Rept. U. S. Geol. Survey*. 1891-92. Washington, 1893, Pt. II. Geology, p. 33.

⁴Wright, G. Frederick. "The Muir Glacier." *Amer. Journ. Sci.*, 1887. 3. Ser., Vol. XXXIII, p. 5.

in the water quite a number of small, living, actively moving worms. These were earth-inhabiting oligochæte worms, which had probably been caught and imprisoned in the air bubbles when freezing took place. Leidy comments significantly upon the fact that in the ice they were alive and active, but that they died, presumably of warmth, when the ice was converted into water.¹

In the summer of 1893, at Woods Hole, Massachusetts, there were brought to Professor Moore fragments of ice cut from a neighboring pond the previous winter, and this ice contained enchytræid worms and air bubbles like those in the ice examined by Leidy. When the ice melted, the worms thawed out and for a time were very lively, but when the water attained the temperature of the room, they all died—it became too warm for them.

It is known that worms of other kinds, as well as the larvæ of certain insects, have occurred in connection with snow and ice, but the accounts are infrequent and the occurrences are probably accidental. The first of these instances that has come to notice is found in the *Scientific American* for 1850.² A correspondent, writing from Sangerfield, New York, says that on November 18 during a moderate snowfall, the snow being about four inches deep and the mercury registering 34° Fahrenheit, he noticed numerous ordinary earth worms crawling about on the snow and seemingly perfectly at home. This was in a pasture, and there had recently been a heavy rain, so the writer judged (and probably correctly) that the flooding of their holes had driven the worms to the surface.

¹Leidy, Joseph. "Organisms in Ice." *Proc. Acad. Nat. Sci.* Philadelphia, 1884. Vol. XXXVI, p. 260.—
"Worms in Ice." *Ibid.*, 1885, Vol. XXXVII, p. 408.

²W., P. B. "Worms in Snow." *Scientific American*, 1850. Vol. VI, p. 96.

In 1886, Warren Knaus³ recorded the finding at Salina, Kansas, in a block of natural ice of small earth-worms, which Professor Verrill identified as belonging to an undescribed oligochæte species, probably an enchytræid. These worms seemed very comfortable in the ice but promptly died when the water from the melted ice reached 60° Fahrenheit. They were about an inch long and light in color. They normally inhabit the mud at the bottom of shallow ponds and when the ponds freeze to the bottom, they are caught up in the ice.

An anonymous writer in the *Scientific American*⁴ for 1891 relates that two or three times during the winter of 1890–91, in Randolph County, Virginia, the crust of the snow had been found covered with numerous "worms" resembling ordinary cutworms, or larvæ of certain noctuid moths. The mystery was deepened by the fact that on the occasions mentioned the snow had a good strong crust, seemingly forbidding ascent from below. Later, similar observations were recorded from points in northern New York.

Specimens from the latter region were submitted to the distinguished entomologist, Prof. C. V. Riley, who reported that they were the larvæ of two species,—the one a cutworm, the other the common Pennsylvania soldier-beetle (*Chauliognathus pennsylvanicus*). He added that it is no new thing to find these larvæ on the surface of the snow, and quoted Dr. J. A. Linter in the Forty-first Report of the State Museum, Albany, New York, to the effect that larvæ of *Nephelodes violans*, the cutworm in question, have been found on the snow in Sullivan County, New York, and at Rockville, Ontario.

³Knaus, Warren. "Note on an Ice Worm." *Bull. Washburn. Coll. Laby. Nat. Hist.*, Topeka, Kansas, 1886. Vol. I, p. 186.

⁴*Scientific American*, 1891, Vol. LXIV, pp. 116 and 147.

Two more records, and these miscellaneous accounts will be brought to a close. H. Reecker,¹ in July, 1895, found an earthworm, identified as a *Lumbricus*, in a block of natural ice put up in Westphalia, Germany, the previous March. This worm had apparently become occluded in a crevice in the ice when it was packed away and had there remained until released some months later. Alive and active in the ice, it successfully survived the melting process.

In 1896, Emil Sekera² found several dozens of specimens of a common meadow-inhabiting earthworm, a *Dendrobæna* (*Allolobophora*), in a fairly thick fragment of ice formed by snow melting and refreezing on a meadow in eastern Bohemia. Mr. Sekera believed that these worms had come up out of their holes on sunny winter days when the snow was melting and were subsequently caught when the melted snow froze. A number of them were found in a cavity of the ice, and seemed not to have suffered from their enforced captivity.

Two questions have already suggested themselves to the thoughtful reader: (1) On what do the enchytræid snow worms feed, and (2) how do they withstand these low temperatures? As to the first, the Arctic explorer, Nordenskiöld,³ in 1886 probably gave the correct answer. He writes of the Greenland ice cap: "With the exception of a few birds [seen] on the return trip, the only animal observed was a worm living on the different species of ice algæ and therefore probably belonging to the fauna of the inland ice." This worm, so far as is known, has never

been identified but it is probably an enchytræid.

Further, Mr. Bryant notes that though he found no lichens nor algæ associated with the worms on the Malaspina, yet he saw near them patches of the "red snow" so common in high latitudes. As is well known, this "red snow" is due to the presence of the red or resting stage of the microscopic unicellular alga, *Protococcus nivalis*. There is little doubt that it is upon such minute plants that these snow worms feed. Likewise Filippi, on page 107 of his book (see page 453 of this article) notes that this alga was found in parallel grooves in the snow, at one point forming reddish stripes. This, however, was a long distance from the spot where he collected the worms (see page 91 of his book).

Now let us take up the second question as to how the worms withstand the low temperatures, first considering the geographical distribution of the enchytræid worms. According to Professor Moore, they have been described from Asia, Europe, Greenland, North and South America, and New Zealand. They are, however, most abundant in northern Eurasia, in Siberia, Nova Zembla, Spitzbergen, Norway, and Denmark; in a word, in northern and colder regions. It is true some have been found even within the tropics, but they are comparatively few, and the above general statement holds. In short, the particular worms under consideration are animals which have habituated themselves to and flourish in low temperatures, especially in the snow and ice of Alpine or subarctic glaciers.

It is known that many of the lower invertebrates have a large capacity to resist extinction at low temperatures. Numerous experiments might

¹Reecker, H. "Ein lebendiger Regenwurm aus dem Eise." *Zool. Anz.* 1896, Bd. XIX, p. 4.

²Sekera, Emil. "Noch einmal über lebendige Regenwürmer im Eise." *Zool. Anz.*, 1896, Bd. XIX, p. 159.

³Nordenskiöld, A. E. *Grönland*. Leipzig, 1886, p. 193.

be quoted, but the following from Professor Moore performed on a not very remote form of worm is more to our purpose. He says:

During the fall and winter of 1892-3, I kept a large number of living annelids in my bedroom. Among these was an undetermined species of *Limnodrilus*, about thirty specimens of which lived in a tumbler of water. During some of the coldest nights of the winter, when the temperature outside descended nearly to zero, this tumbler remained standing on the sill of a window which was opened for ventilation. In the morning the contents would be a solid lump of ice with a tangled mass of the worms embedded in its center. During the day the ice would thaw and by evening the worms would be actively waving their posterior ends. This alternate freezing and thawing was repeated many times and on one occasion the tumbler was placed in the open air and its contents kept frozen for a week. At the close of the winter all of the worms except three or four were still alive and normal.

Not only do the lower invertebrates comfortably withstand freezing temperatures, but this is true of the lower vertebrates as well. There is a fairly extensive literature recounting the alternate freezings and thawings of fishes which apparently suffer no

hurt by the process. This is true also of the Amphibia. The following unpublished incident in my own experience seems to illustrate the point. In preparing for the next day's dissections by a class of students, I etherized a batch of frogs for about two hours. At the end of that period there were no external signs of life. The frogs were then placed in a little water in a large iron pan and this was set out on a fire escape leading from the laboratory. Next morning, when I reached the laboratory at about 8.15, I found the water frozen and the frogs hard and stiff. In order to thaw them out, I placed them in a sink of lukewarm water and went about my other work. Coming back later (as nearly as I can recall, after an hour or more) I found a very lively company of frogs, apparently none the worse for their experience. Some of them had so far recovered that they were able to leap out of the sink and go hopping around the laboratory. All of the frogs had to be etherized afresh.

And so it is with these worms that inhabit the snow fields—they are "just made that way."



Earthquakes

BY EDMUND OTIS HOVEY

Curator of Geology and Invertebrate Paleontology, American Museum

GREAT earthquakes rank with severe volcanic eruptions as the most terrifying of all natural phenomena. Usually occurring without recognized warning, not infrequently happening in the night, extremely indefinite as to source, extent, and duration, they fill the mind of one experiencing their destructiveness with the horror of utter helplessness. He feels the "solid ground" in violent motion beneath his feet, but perceives no cause for such motion. He sees massive walls and towers sway to and fro and fall to pieces, but he cannot discern the force which is at work. Danger and destruction are all about him and he knows not where to turn or whither to flee for safety. The magnitude and suddenness of the disaster overwhelm him, and he is foolish in his panic.

Earthquakes have been far more destructive to human life and property than volcanic eruptions have been,¹ although it is difficult to calculate accurately the loss of life involved, and the estimates of the destructiveness of a particular earthquake vary widely. Among the more disastrous shocks have been the following: Sicily, 1693, with possibly 60,000 victims; Peking, China, 1731, (100,000); Lisbon, Portugal, 1755, (from 40,000 to 60,000); Calabria, Italy, 1783, (from 30,000 to 60,000); and Messina-Reggio, Italy, 1908, in which according to the official re-

turns the total loss of life was 77,283. Contrasted with these calamities is the loss of life involved in the great volcanic outbursts of Krakatoa, Dutch East Indies, 1883, which destroyed more than 36,000 lives; Vesuvius, Italy, 1631, (18,000); Mt. Pelé, Martinique, 1902, (29,000) and the Soufrière of St. Vincent, 1902, (1400); and other historic eruptions which took a smaller toll of humanity.

No considerable area on the surface of the globe seems to be entirely stable, but certain regions or zones are much more subject than others to the occurrence of earthquakes. If we examine a map of the world upon which their location has been plotted, we note in the Eastern Hemisphere a broad belt of seismic (earthquake) activity extending from west to east through the Mediterranean Sea, Persia, the southern Himalayas, and the Sumatra-Java group of islands, with a branch zone extending from the southern end of the Caspian Sea northeastward half way across Asia. This zone has furnished more than 53 per cent of the recorded shocks. A seismic belt practically encircles the Pacific Ocean, the principal points in it being the Japanese Archipelago, Alaska, California, Southern Mexico, Central America, and the northern and southern Andes. This "circum-Pacific" or "Andes-Japan-Malay" zone has given rise to 41 per cent of the recorded quakes. In the Western Hemisphere, in addition to a part of the circum-Pacific belt, the West Indies and the mountains of Venezuela have been the location of important earthquakes; for

¹Since this article was written and while the author is absent in Australia representing not only the American Museum but the Geological Society of America and the New York Academy of Sciences at the Second Pan Pacific Scientific Congress, the disastrous earthquake of Japan has occurred, supplying new evidence of the terrible destructiveness that from time to time accompanies shocks of major importance.—EDITOR.

instance Jamaica was visited by a great earthquake destroying the city of Port Royal in 1692 and another shock in 1907 laid waste the city of Kingston.

We are in the habit of thinking of eastern North America as being a region free from earthquake shocks, but this is incorrect. New England has experienced about 250 recorded shocks since the Pilgrims landed at Plymouth, and there have been at least four great earthquakes in the eastern half of the continent during the past two and one-half centuries. One of these, which occurred on February 5, 1663, affected the St. Lawrence Valley over an area more than 600 miles long and 300 miles wide according to the *Jesuit Relations*, and the same region was revisited by a disturbance in the second decade of the present century (1914). In 1811-12 heavy quakes occurred in the central portion of the Mississippi Valley, accompanied by considerable subsidence of the earth's crust and the formation of new lakes fifty miles south of the junction of the Ohio and Mississippi Rivers. In 1909 Illinois was shaken so that the inhabitants were much alarmed. The southeastern part of the United States was the center of a heavy earthquake shock on January 4, 1843, the tremors of which were felt at points at least 800 miles apart. On August 31, 1886, occurred the disastrous earthquake at Charleston, South Carolina—a shock which was distinctly felt from New Orleans to Boston and as far west as La Crosse, Wisconsin. Not a building in Charleston wholly escaped injury in this quake and the pecuniary damage was estimated at between \$5,000,000 and \$6,000,000, but fewer than 100 people lost their lives as a result of the disturbance.

New York City, on the other hand, seems to be a very safe place in which to live, so far as earthquakes are concerned, for no shocks other than a slight tremor in connection with the Charleston earthquake have been felt there during historic time and no evidence exists of any earth disturbance in the region since the great Hudson River fault was made, the last movement along which seems to have occurred in Mesozoic time millions of years ago.

Within the United States, California is the region of the greatest seismic activity, 514 shocks having been catalogued as occurring there between 1850 and 1886, but the number of quakes that actually took place was probably much greater, since the region was sparsely peopled during the early portion of the period and many minor shocks doubtless passed unnoticed. San Francisco alone suffered from 254 quakes in this period. The catalogue in all likelihood has at least twice as many entries now. Since the middle of the nineteenth century there have been eleven severe quakes in California. That of 1868, known as the Mare Island quake, had such a disastrous effect upon San Francisco that serious doubts were entertained as to the advisability of rebuilding the city on the same site, but these fears were soon forgotten and the city rapidly rose again. Building was resumed without much regard to the lessons that might have been learned from the unfortunate experience and later construction apparently failed to take any adequate precautions. On April 18, 1906, four square miles of San Francisco, now grown to a community of 400,000 inhabitants, was devastated by a quake which originated in the

San Andreas fault zone lying only eight miles southwest of the main portion of the city. In San Francisco alone about 400 people are known to have lost their lives in the catastrophe, and buildings and other property to the value of at least \$350,000,000 were ruined by the shock or consumed in the fire which followed.

The peninsula upon a part of which San Francisco is built is traversed from southeast to northwest by not less than five known zones along which movement, technically known as "faulting," has occurred again and again. The chief of these zones is the San Andreas, which takes its name from an important lake through which it runs, and it was horizontal movement varying from nine to twenty feet that was the principal cause of the quake. Vertical movement did not exceed two feet at any one place and usually was absent. These five zones all lie in the coastal ranges of mountains, which are composed of a granitic core against which rest extensive beds of Mesozoic and Cenozoic age, upon which in turn lie thick marine Pleistocene and recent strata. The latter are full of the fossil remains of many forms of life that still are to be found in the neighboring ocean.

Mountain building is going on today in California, a fact evidenced not only by the earthquake activities but established by careful instrumental observations. The strains in the earth's crust which are set up by the mountain-building forces slowly accumulate until they finally overcome the resistance of the rock material making up the earth's crust, and rupture results. The sudden freeing of the pent-up forces and the rubbing of the rock on one side of the fracture against that on the other, with all the attendant starting, slip-

ping, and stopping, cause the earth waves which we know as an earthquake. Initial movement may be very slight and the resulting waves are always very small, but the effects produced on buildings may be very serious, just as the light blow of a mallet on a table may cause a ball lying upon it to jump several feet into the air.

In the Sierra Nevada, forming the eastern half of California, earthquakes are likewise frequent. In 1872 there occurred the great Owens Valley quake, which was one of the most severe on record. This was the result of movements in an old fault zone producing cliffs from ten to twenty feet high along a line more than one hundred miles long. Alaska has been the scene of many great earthquakes, one of which near Yakutat Bay in 1899 resulted, it is reported, in the formation of cliffs from twenty-five to forty feet high along its zone of faulting. Similar displacements of the earth's surface have been noted in connection with earthquakes in many other parts of the globe, notably in Japan and in Italy.

All the foregoing earthquakes belong to the great class known as tectonic earthquakes, or those which are a resultant of the action of mountain-building forces. The second great class of shocks are those attending upon volcanic eruptions. A third class consists of those which have been caused by the falling in of the roof of a buried cavity in the rocks. Quakes of the third class have been reported from Switzerland and the Tyrol, but they are always slight in intensity and local in character.

Earthquakes arising from volcanic explosions or associated with eruptions form a much more important subdivision, second in importance only to

the tectonic earth shocks. Whereas the most violent and destructive earthquakes have centered in non-volcanic regions, the most severe volcanic eruptions of historic times have been unattended by severe earthshaking shocks and have given rise to quakes of merely local significance. The islands of Martinique and St. Vincent lie within a markedly seismic zone, but the great eruptions of Mt. Pelé and the Soufrière in 1902-03 were free from earthquake shocks, beyond the trembling of the mountains themselves. Vesuvius has been under close observation as a volcano for more than 1800 years, but the earthquakes attending its most severe outbreaks have been local in extent and comparatively light in degree. Casamicciola on the island of Ischia, near Naples, suffered a disastrous volcanic earthquake in 1883, which destroyed much property and between 1700 and 1900 lives. The history of Mt. Etna has been similar; the disturbances which its heaviest eruptions have produced have rarely been felt on the mainland of Calabria across the narrow Strait of Messina. In 1888 the Japanese volcano Bandai-san burst into violent eruption after a thousand years of slumber. Its awakening was attended by a number of moderately severe shocks, none of which was felt, however, beyond a limited area. The famous volcanoes of Mauna Loa and Kilauea on the island of Hawaii have frequent eruptions of the "quiet class," sometimes accompanied by local earthquakes, but the most violent of these quakes, that of April 2, 1868, was scarcely felt at Honolulu, 210 miles distant. The most violent of all recorded volcanic explosions is that which took place in the Strait of Sunda, August 26-7, 1883, when Krakatoa

was blown to pieces. This outburst destroyed half of the mountain and left soundings of 160 fathoms where part of the cone had stood. It produced sea waves that affected tide gauges half way round the world; it gave rise to air waves that traveled three times around the globe before they ceased to be distinguishable; and it threw dust into the air to such a height that it remained suspended for months,—but the earthquake shocks produced were strictly local in character and were scarcely felt at Batavia, ninety miles from the crater.

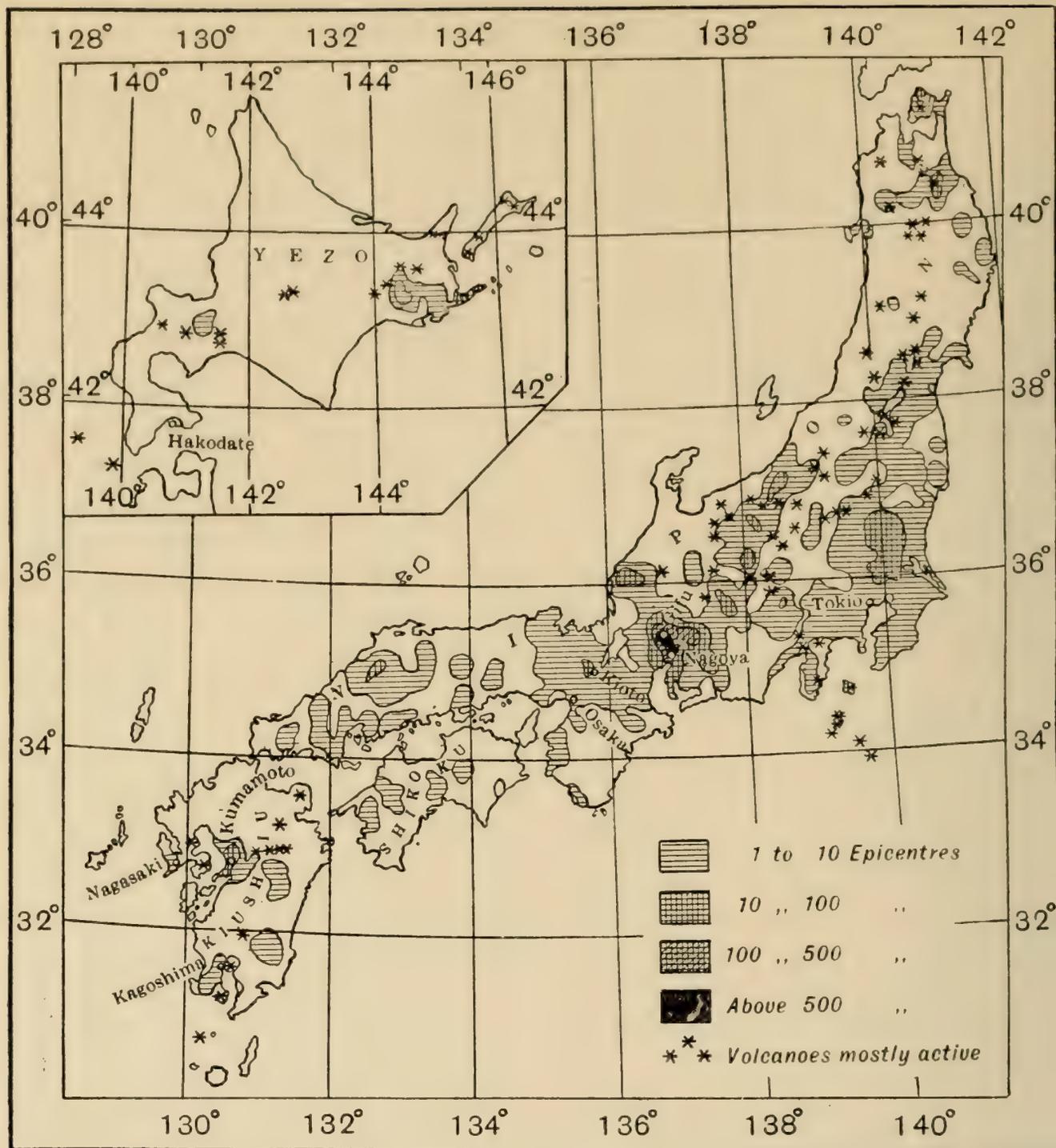
It has not been possible as yet to predict with any degree of accuracy the time when an earthquake will occur. Some regions are subject to frequent shocks while others experience them only at long intervals of time. The frequency of earthquakes, taking into account those of all degrees of severity, is not generally realized. The globe indeed may be said hardly ever to be free from seismic disturbance of some kind somewhere, since the average of all recorded shocks, according to de Montessus de Balloreis more than fifteen per day, and there are between fifty and sixty heavy shocks per year. The bare enumeration by this author of those occurring in 1903 alone fills a book of 600 pages of tabular matter and he has compiled the data pertaining to, and tabulated the position of, 159,781 earthquakes that had been recorded up to the end of 1903.

In addition to the fact that important quakes are the result of mountain-building (tectonic) movements in the earth's crust, they may themselves be the causes of more or less important changes in the surface of the earth. Sharp waves passing through mountain regions have been known to produce landslides, shatter rocks, displace seg-

ments of precipices, open fissures in the soil, or cause subsidence in alluvial regions. Springs, brooks, rivers, and lakes have been formed, altered, or obliterated as a result of earthquake action. Great earthquakes occurring near the borders of the ocean have produced important sea waves, incorrectly called "tidal waves," causing much destruction along the coast and sometimes permanent changes due to erosion and transportation of material. In 1868 a great earthquake sea wave came in at Arica, Chile, and carried the United States warship "Wateree" inland and left her high and dry in the town. A few years later another such wave carried the vessel still farther inland and for many years she was an object of interest to tourists. The great earthquake of November, 1922, off the coast of Chile, was characterized by disastrous sea waves. In February, 1923, a "tidal" wave arrived at Hilo on the coast of Hawaii in seven crests each said to be fifteen feet high, which caused ten deaths and did much damage, but the wave was scarcely felt at Honolulu on the island of Oahu, 210 miles away. The magnitude of these waves in the open ocean is probably to be measured in inches,—they attain destructive size only when they enter the shallow waters near the coast. The recent report of the captain of a steamer that he met a "tidal" wave 115 feet high (the height of a twelve story building) rising from a calm sea hundreds of miles from land may be set down as inaccurate, to say the least.

During the past twenty years the study of earthquakes by means of instruments has spread widely, and observing stations have been established in many parts of the world.

The instruments used are called seismographs and all work upon the principle that a heavy mass of iron or other material properly suspended above the earth will tend to remain stationary when earth waves pass beneath it. The apparatus at the American Museum consists of two such heavy masses of iron so arranged that one is sensitive to waves arriving from the east or the west and the other to those coming from the north or the south. The earth waves are very minute and each part of the machine is provided with a system of levers which amplify their effect and with a needle for recording it. A sheet of smoked paper is drawn by clockwork under the needle, which makes a straight white line when no earth wave is passing. When an earthquake wave arrives, the needle begins to swing to right and left and to make a wavy line, from the study of which the observer can calculate the severity of the quake and its distance from the station. Time is accurately recorded on the same sheet of paper by means of a marking device operated by a clock of special design. Most seismograph stations are equipped with apparatus like that at the Museum or a modification of it, but the exact location of the center of an earth disturbance cannot be determined from a single station. Observations from at least three stations situated at the points of a great triangle must be obtained and carefully compared. Apparatus for determining the location of the point of origin of an earthquake from a single station has been devised by Prince Galitzin of Russia, but the method is too complicated for ordinary use and it has not been adopted to any extent, if at all, by seismologists.



Davison's seismic map of Japan, based on Milne's list of 8331 earthquakes for the eight years 1885-92 inclusive, shows that the number of earthquakes recorded in the Tokio district during this period was less than ten; also that the 88 volcanoes are distributed throughout the mid-western portion of the islands, except the Fuji chain to the southwest of Tokio

The Japanese Earthquake Explained

By CHESTER A. REEDS

Associate Curator of Invertebrate Palaeontology, and Observer, in Charge of the Seismograph, American Museum

AT noon on Saturday, September 1, 1923, Tokio time, the Empire of the Rising Sun was stricken by a power beyond human control. A violent earthquake shook Tokio, Yokohama, Yokosuka, Odawara, Hakone, Chiba, and other points about the Bay of Tokio. Shortly thereafter fires arose in Tokio and

Yokohama and almost entirely destroyed those cities. Seismic sea waves were also reported in some dispatches and contradicted in others. At any rate, the devastated region was completely isolated from the rest of the world for days. There were more than 3,000,000 people in the stricken zone at the time of the catastrophe and the

loss of life and property was so great that even a week or more after its occurrence, reports were still far from being complete.

This great earthquake was registered on seismograph instruments on the opposite side of the earth and at intermediate stations. The arrival of the first set of earth waves in the eastern part of the United States was registered at 10:12 P.M., Friday evening, August 31, the main waves shortly before 11 o'clock, and the last waves at 3 A.M., September 1. It may be stated here that due to the recognition of the international date line along the 180th meridian, the corresponding time in New York and Washington was Friday, and due to the difference in longitude of ten hours the time here was 10 P.M., August 31, 1923. Some dispatches state that in Tokio the initial heavy shock lasted not more than six minutes. Whatever may have been the brief duration, the waves which arose from this shock were spread out for five hours on the seismographs in the eastern part of the United States. According to dispatches from the Imperial Meteorological Station more than a thousand "after-shocks," which were not recorded on distant seismographs, accompanied this quake.

The earthquake map¹ of Japan prepared by Dr. Charles Davison in 1921, and reproduced on p. 462, exhibits in a striking manner the earthquake and non-earthquake regions as well as the location of the eighty-eight volcanoes on or near the principal islands of Japan. This map indicates that the central portions of Japan, where active volcanoes are numerous, are singularly free from earthquakes, the earthquake areas being represented by the more darkly shaded districts.

¹Davison, C. *A Manual of Seismology*, 1921, Cambridge University Press

A perusal of Prof. John Milne's catalogue of Japanese earthquakes, in which 8331 are listed between the years 1885 and 1892, shows that to every quake that was volcanic there were five that were non-volcanic.

The Japanese Islands form an arc or festoon with the convex side facing the



Map after Omori, showing by broken line ovals and numbers the location of 257 strong earthquakes from 1885-1905; also the depth of the sea in meters about Japan (dotted lines)

Pacific Ocean. Furthermore, the submarine features are of special interest. From the contour lines for each thousand meters in depth (the dotted lines on the map shown on this page) it may be observed that the Japanese Sea is shallow, with its greatest depth a little over 3000 meters. The Pacific Ocean, on the other hand, is very deep. The extraordinary basin called the Tuscarora Deep reaches a depth of 8000 meters at distances of from 110 to 240 miles from the coasts. The gradient is unusually steep, being 1 in 27 off the coast of Nemuro, a maritime village on the island of Yezo, 1 in 30 off the northeast coast of Hondo.

or the main island, and 1 in 16 (to a depth of 3000 meters) off the southeast coast of Kazusa and Awa, near Tokio.

Prof. F. Omori, the Japanese earthquake specialist, has listed 221 destructive earthquakes in Japan occurring from the fifth century to the present. Of the total number, 114 originated inland, 47 under the Pacific Ocean, 17 under the sea of Japan, 2 under the inland seas, while the epicenters of 41 earthquakes are unknown. Of these earthquakes 10 were very violent: 3 of them occurred in central Japan, and 7 originated off the southeast coast, each of the latter being accompanied by seismic sea waves. During the same period there were 23 great sea waves on the Pacific coast and only 5 on the Japan Sea.

Similar results followed from Omori's examination of recent strong Japanese earthquakes. From 1885, when the systematic observation of earthquakes was begun, to 1905 there originated in or around Japan 257 earthquakes, some of which were destructive while the rest, although not involving great loss, were nevertheless strong or moderate shocks each having disturbed land areas of more than 25,000 square miles. The principal regions of these strong shocks are represented by the broken line ovals on the map on p. 463. During the twenty-one years referred to, 138 earthquakes originated in the region A, 7 in the region B, 2 in F, 4 in G, 3 in H, 12 in K, 16 in M, 12 in N, and 23 in P, the references being to the above-mentioned map. The most active region at present is thus that marked A, stretching off the east coast of Yezo and Hondo, the number of earthquakes which occurred in it being rather more than half the total number in Japan. It is no great surprise, therefore, to find that the violent

earthquake of September 1, 1923, took place in the Tokio district near the steep Pacific side.

An earthquake has been explained as the result of any sudden displacement within the earth's crust. It may have a tectonic or a volcanic origin. Tectonic earthquakes are due as a rule to the displacements which effect the growth of faults or fractures in the earth's surface. Volcanic earthquakes may be considered as those which are caused by volcanic eruptions or displacements along fractures of the volcanic mass, whether the volcano be active, dormant, or extinct. Thus volcanic earthquakes are of two kinds: first, those which are purely volcanic in their origin, and second, those which are somewhat tectonic in character.

From seismograms taken on certain active volcanoes of Japan, Omori divides the volcanic earthquakes into two groups: (1) those due to earthquakes which were not accompanied by any outburst of the volcano, and (2) those due to earthquakes which were invariably coincident with the explosions. The first group consisted only of simple quake vibrations; the second group began with slow tremors on which, after a few seconds, quick vibrations were superimposed. The earthquakes without explosions were distinctly the stronger, for of the 14,085 shocks of this character recorded from 1911-16, 21% were sensible, while of the 8847 earthquakes with explosions only 0.3% were sensible.

Tectonic earthquakes, the greatest of all, occur in regions somewhat distant from volcanoes or far removed from present or past volcanic action. They are due either to displacements along faults or to the warping of surface beds of rock in the earth's crust. As might be expected, faulting

(the slipping of adjacent blocks of the earth's crust on one another along a fault-plane or fracture) predominates over warping in producing earthquakes. The connection between the crustal deformations and the earthquakes is shown by the coincidence between their times of occurrence and the areas affected by them. It is important, however, to notice that the deformations are not consequences of the earthquakes but rather the primary causes of the earthquakes. The number of earthquakes accompanied by crustal deformation is considerable. In many cases, however, the observations recorded add little to our knowledge beyond the fact that some movement usually of elevation has taken place. The principal reasons for connecting earthquakes with fault slips are the following: (1) with every step in the growth of the fault it is evident that an earthquake must occur; (2) in some great earthquakes the fault displacements are manifest; (3) in all but the weakest earthquakes the areas of greatest disturbance are elongated in form, their longer axes being parallel to the fault lines of the district; (4) the number of earthquakes in any region far exceeds the number of the faults; (5) in a series of associated earthquakes the center of the disturbance migrates to and fro in the direction of the fault; and (6) owing to the variations in the volume and displacement of the rock mass, fault slips are capable of producing the weakest tremor as well as the most violent shock.

The displacements along a fault may be almost entirely horizontal or almost entirely vertical, but in most cases they are both horizontal and vertical. Horizontal displacements are usually manifested by the relative shifting of objects previously in contact

or in line; vertical displacements by the formation of fault scarps.

The great earthquakes which remove over-strained conditions in the earth's crusts occur after short lapses of time at different places in the seismic belt or related earthquake zones. They seldom, if ever, recur at one or the same spot, for the earth's stresses, having been temporarily adjusted at that place, accumulate in the adjacent seismic regions. Thus the Japanese earthquake of December 23, 1854, took place off the coast of Tokaido, while the equally extensive shock on the next day originated from the same earthquake zone 200 miles to the west, off the coast of Nankaido. Similarly sympathetic stresses accumulating in widely separated parts of the Pacific seismic zone have been noted as follows:

- (1) Off the northwest coast of Alaska in 1899.
 - (2) Mexico and Central America, 1900 and 1902.
 - (3) Panama, Colombia, and Ecuador, February 1, 1906.
 - (4) San Francisco, April 18, 1906.
 - (5) Aleutian Archipelago, August 16, 1906.
 - (6) Valparaiso, August 16, 1906.
- (Note that Nos. 5 and 6 occurred on the same date, No. 5 occurring half an hour earlier than No. 6.)
- (7) Chile, November 11, 1922.
 - (8) Six hundred miles northwest of San Francisco on the line of the San Andreas fault, January 31, 1923.
 - (9) South Pacific Ocean, February 3, 1923.

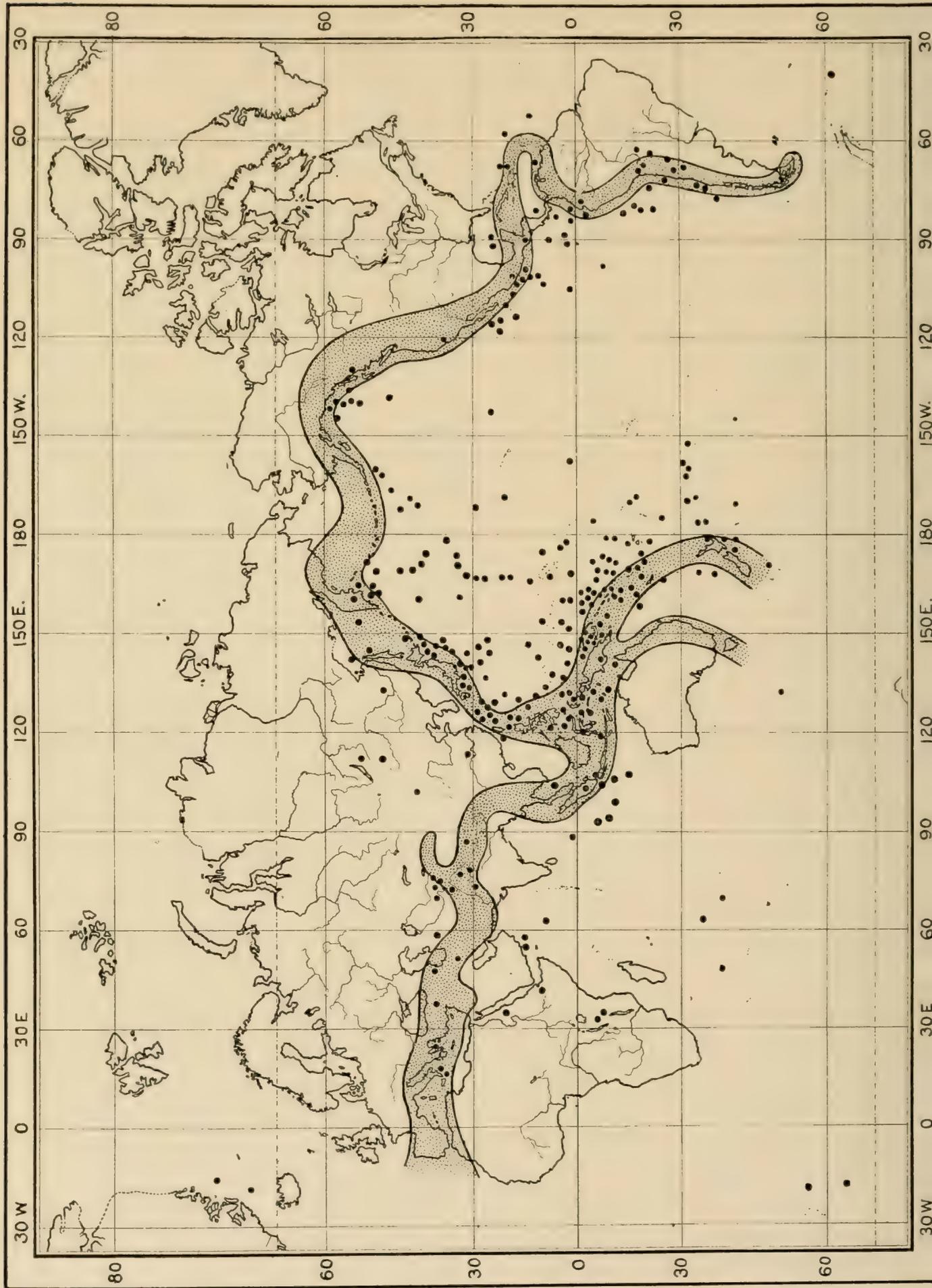
In this connection it is interesting to note that after the great Japanese earthquake of September 1, 1923, a sympathetic quake occurred in Calcutta, India, on September 10, and another one in Paotingfu, China, September 14, 1923.

A larger view of the problem is necessary in order to understand some of the underlying causes of the recent Japanese

SEISMIC MAP OF THE WORLD

During the period 1899 to 1911 there were 276 major earthquakes which were sufficiently severe to be recorded at all seismological stations scattered over the world. Their epicenters are shown on the adjacent map as heavy dots. During the same period 679 additional earthquakes were recorded whose waves reached only one half way around the earth. Their points of origin (not shown) had a distribution similar to that of the major quakes, particularly in the region of Japan.

The close association of recent earthquakes to the belts of sedimentation, dominant folding, and mountain uplift (shaded zones) during recent geologic time (Cenozoic era) is very marked



earthquake and of other earthquakes. In the distribution of earthquakes are to be found the loci of the most pronounced earth movements today, that is, the zones of present maximum change in the strained figure of the lithosphere, or solid part of the earth. In the case of the continental areas we have long known the position of the earthquake districts. The earth's crust trembles predominantly along two narrow zones which lie along two great circles of the earth known as the Mediterranean, or Alpine-Caucasian-Himalayan circle, and the circum-Pacific, or Andean-Japanese-Malayan circle. As to parts of the ocean floor which have been affected by these movements, it is only during the present generation that methods have been perfected for locating the sites of earthquakes beneath the seas. Modern seismographs, or earthquake-registering instruments, now record the sudden major movements of the earth's surface quite independent of whether they occur at the bottom of the sea, upon distant islands, or upon the continents. The centers of large earthquakes, determined by the late Prof. John Milne for some fifty odd stations of the British Association for the years 1899 to 1911, have been entered as heavy dots on the map on p. 466. It will be noted that the continental earthquake districts are extended outward for a distance on the floor of the neighboring ocean and that the disturbances are greater in number for the undersea areas and belts of festooned archipelagoes east and southeast of Asia.

It may be noted further that the two main seismic belts are closely related to the geosynclines, or areas of sedimentation, dominant folding, and uplift during Cenozoic time, that is, during the last era into which geologists

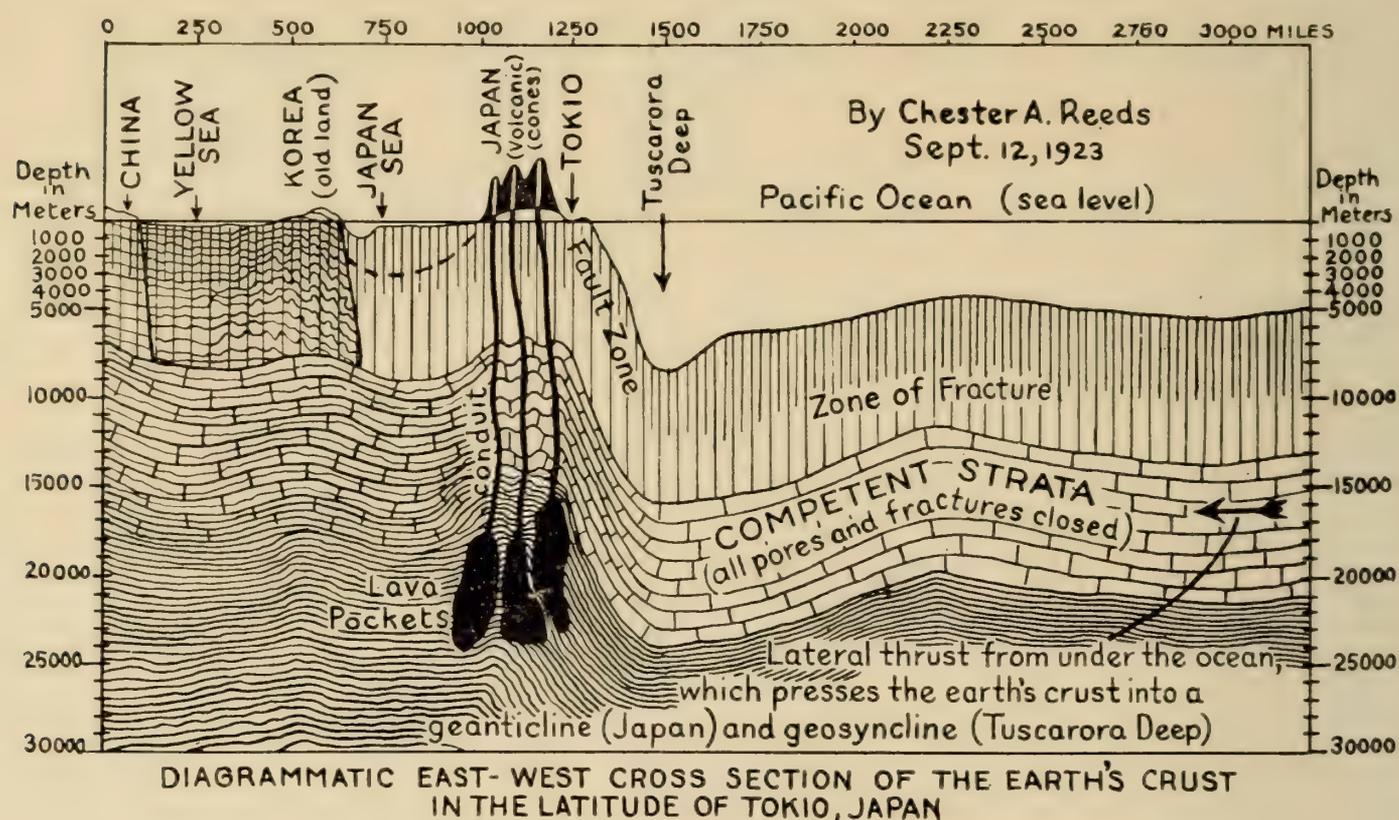
divide geologic time. This area may represent a period starting 3,000,000 years or more ago and continuing down to the present. The areas of dominant folding and uplift during Cenozoic time, as outlined by Prof. Charles Schuchert in 1915, have been superimposed as shaded zones, on the accompanying map of the world. From a careful examination of this map alongside that of a modern atlas, it may be observed that these two major circles of earthquake disturbance include within their limits the arcuate mountain folds known as the Pyrenees, Alps, Carpathians, Caucasians, and Himalayas of Eurasia and the Cascadian and Andean mountain systems of North and South America. These great mountain masses stand before us today as the most lofty mountains of the world. They began their existence in the early part of the Cenozoic era and from their grandeur we might judge that they are almost completed, but from the rather frequent earthquakes that occur in and about them we must conclude that the earth forces which built them are still active although in their relative maturity. The mountains themselves are young and although not all of them are in the same stage of development, they are in their prime. The festooned island groups, however, such as the Japanese archipelagoes and similar arcuate forms off the southeast coast of Asia, as well as the Aleutian and West Indian arcs, represent younger mountain chains of late Cenozoic age which are not yet fully exposed but are rising from the floor of the ocean.

A modern atlas with the depths of the sea indicated, such as Andre's or Stieler's, shows that these festooned archipelagoes of the Pacific are characterized by generally narrow deep troughlike depressions on the ocean

side. For instance, just east of the Philippines one of these troughs is 9788 meters deep, that is, a little more than six miles of depth. The figure on this page represents an east-west vertical section of the Japanese area in the latitude of Tokio, Japan. The section extends eastward from the coast of China across the Yellow Sea, the tip of Korea, the Japan Sea, the main island of Japan, the great Tuscarora trough,

large sheet of paper firmly in position; then by pressing laterally on the opposite margin the anticlinal and synclinal folds will appear. This hidden geologic force which produced the folds still continues to act. It arises no doubt from the downward movement or sinking of certain portions of the lithosphere beneath the Pacific Ocean.

According to Prof. W. H. Hobbs, the development of such folds is responsible



and some 2000 miles of the Pacific Ocean. The most striking features of this cross section are the folds that have been developed in the earth's crust. In geologic terms the elongated Tuscarora "fore-deep" represents a syncline, while the rising mountain range represents the associated anticline. These folds have been developed by a compressive force coming from the more central areas of the Pacific and applied laterally to the competent stratum, which abuts against the older and more settled land of Asia. This idea of folding may be simply demonstrated by holding one margin of a

for the formation of pockets of molten magma from shale beds lying beneath the competent strata in the vicinity of the anticlines as noted in the cross section. Magma pockets situated in this position give rise to the lava of the volcanoes scattered through the western portion of the principal islands of Japan, the chains of volcanic islands to the north and southward, as well as those of other mountain belts situated in the seismic zones of the earth. The volcanoes seem to arise from the back of the anticlinal folds throughout their arc-shaped extent, while the majority of the earthquakes are developed on

the steeply sloping or trough side of the fold, for it is on this side that the rocks are under the greater tensional and compressive stresses. In this belt movements in the earth's surface do not take place uniformly, for stresses which tend to produce such movements are resisted until they have accumulated sufficiently to overcome the resistance offered by the stiff rocks. Thereupon partial relief is obtained suddenly by initial faulting or subsequent slipping of earth blocks on previously developed faults, causing earthquakes. Minor adjustments following shortly after are referred to as after-shocks.

Thus it may be noted that Japan, the land of "cherry blossoms," is an island empire rising out of the sea. To most Americans Japan presents a detached group of mountainous islands beset with numerous volcanoes and frequented by earthquakes. The oceanic waters which surround these islands hide from view the stupendous mountain topography and the structure which powerful earth forces have already built up and which they are still erecting off the coast of Asia. To the writer the young mountain piles which have reared their crests miles above the sea and which are admired in all their grandeur, such as the Himalayas and the Andes, stand as mute guide posts pointing toward the younger generation of mountains which, although for the most part still submerged, are rising along the margin of the Pacific Ocean. Volcanoes and earthquakes are associated with the forces that build mountains, for they perform very much the same function that safety valves do on a

steam locomotive. For centuries Japan has had destructive earthquakes. Omori, who has studied many of them, concludes that the maximum epochs of destructive activity recur on an average every 13 or 14 years. From the nature of the case we may thus conclude that earthquakes will occur in Japan at rather frequent intervals for centuries to come. This prophecy, however, should not dishearten the Japanese nation, for, besides its own progressive development, it can take courage from the fact that the Babylonian, Egyptian, Grecian, and Roman civilizations, developed about the Mediterranean, despite the fact that this region lies in one of the active seismic belts of the world.

The Japanese nation is fully aware of its acute situation, for in accordance with an Imperial Ordinance dated June 25, 1892, the famous Earthquake Investigation Committee of Japan was organized. Its objects were stated to be: "In the first place to investigate whether there are any means of predicting earthquakes; and in the second place to investigate what can be done to reduce the disastrous effects of earthquake shocks to a minimum, by the choice of proper structures, materials, positions, etc." The Committee has included some of the most brilliant men of Japan and other lands and has now worked enthusiastically and tirelessly for a period of thirty years; but it is necessary to admit that no method of forecasting earthquakes has been discovered and that the second endeavor is the only one which had been crowned with some measure of success.



A REDDISH EGRET

The graceful postures assumed by these birds and the beautiful curvatures that result from their ever-changing attitudes may well kindle the admiration of the beholder

Louisiana Herons and Reddish Egrets at Home

A VISIT TO GREEN ISLAND, OFF THE COAST OF TEXAS

BY ALVIN R. CAHN

University of Illinois

PICTURE, if you will, a long narrow expanse of wind-blown sand piled in great undulating wavy hills, fading into the horizon to the north and south. Here and there, black against the moonlit background, clustered groups of mesquite trees throw blacker shadows on the sand. On the top of one of these sand hills stands a lone figure, silhouetted against a rising moon: a booted figure, with a large hat, belted waist, and a cutlass catching the moonbeams. From his vantage point he looks to the east over the waters of the Gulf of Mexico; to the west over the sands of Padre Island to the placid Laguna de la Madre. A massive ship in full rigging, sails furled, rides at anchor in the Gulf. A small boat, propelled by massive figures at the oars, plies between the ship and the island. Half-naked figures leap from the boat as it grinds on the beach and lift from it caskets bound in metal, which they shoulder and carry to land and across the few hundred yards of sand to the water on the west. Here the caskets are deposited in a smaller boat, manned by the lone sentinel from the hill and a single oarsman who pulls out toward a small black spot lying between them and the mainland of the Texas coast. Hours later the boat returns, but with a single occupant, the watcher from the hill, who crosses the island and is hurriedly rowed to the ship. With the moon declining in the west the great ship unfurls sail and slowly heads eastward, to disappear in the gray mists of morning, never to be heard from again.

Years pass over the scene of the buried treasure. Romantic adventurers, hearing the tradition of the buried riches, visit the island, which is now covered with a tangled mass of vegetation, making it conspicuous among the islands in the Laguna Madre and entitling it to the name of Isla Verde, and lives and fortunes are spent in frantic endeavor to recover the pirate captain's buried gold. But Green Island or Isla Verde guards well its secret—if indeed it has one—and the treasure still remains hidden, ramparted now by an almost impenetrable entanglement of *Yucca*, *Condalia*, and prickly-pear cactus, and sentineled by an ever-active host of graceful birds on the wing.

Such is the tradition of Green Island, which lies in the Laguna Madre, off the coast of Texas, about thirty miles north of Point Isabel, and about an equal distance south of Bird Island, the wonderful breeding ground of the brown pelican, which I visited in 1921.¹ With the coming of spring in 1922 came also much interesting and tantalizing information regarding a great heron and egret colony on this romantic island. With the memory of the previous trip still fresh in our minds, it was not a difficult task to reorganize my little party of the preceding spring and hie away to further photographic efforts in a new field.

We were met at Brownsville, Texas, by Mr. R. D. Camp, the warden of the region and the guardian angel of the

¹The reader is referred to the article entitled "Brown Pelicans at Home," by Alvin R. Cahn, *NATURAL HISTORY*, September-October, 1922, pp. 416-29.

breeding birds on Isla Verde. During the entire breeding season and until the greater number of the young are well out of the nest, Mr. Camp lives in a houseboat anchored just off the island, and his presence, backed by a great sign erected by the National Association of Audubon Societies, throws a charmed circle about this newly designated bird sanctuary. It was only the hospitality of Mr. Camp that made my trip possible, as Green Island is very inaccessible and if its shores be reached, very inhospitable.

By auto—a rickety Ford that was suffering from asthma in at least two cylinders, driven by a Mexican who knew as much about machinery as a native Hottentot—we rattled across the great dusty waste country lying between Brownsville and Point Isabel on the coast. Timid sparrows flitted occasionally between the scattered tussocks of grass; wandering burros watched us suspiciously; a lone coyote crossed our path and trotted leisurely away. The rest of the picture was an unending horizon that stretched, an unbroken line, through 360 degrees of space. Once, near noon, a mirage appeared for a few moments, revealing a series of hills overgrown with trees, and water about the foot of the hills. Then the horizon closed in once more. A stiff breeze was blowing off the gulf, and the salt air filled our lungs. After three hours of driving and detouring to avoid bottomless mud puddles left over from the heavy rains of the previous week, we reached the Point, rattled up to the wharf and unloaded. We were at once surrounded by the greater part of the population—about an equal proportion of burros and pigs and an occasional Mexican. The Mexicans and burros were satisfied to watch us passively, but the razor-

backs announced their presence by attacking *en masse* and carrying off our food stuffs in every possible direction. We finally reassembled our belongings and loaded them into a fishing boat which was engaged to take us to the island. Up went the sail, and we were soon dancing merrily over the waves before a favorable wind.

During the five hours that passed before we reached Green Island we watched the slowly changing panorama of distant land unfold and drank luxuriously of the salt air. The Laguna Madre is quite wide in this region, and during most of the trip Padre Island was either entirely below the horizon or appeared as widely separated golden points, hazy in the distance. There was very little life in evidence; mixed flocks of sandpipers hunted along the shores; an occasional laughing gull passed by; black skimmers cut the water about us and were away again to their prospective breeding grounds at some place along the sandy beaches: a thin line of white foam, piled up on the shore of a distant island, proved under the scrutiny of my binoculars to be a colony of white pelicans resting at the water's edge. Ward herons flapped slowly by, heading for the mainland, and still others could be seen through the glasses, standing knee-deep in the shallow water fully half a mile from shore. Once a porpoise undulated across our path and was seen for a few moments as it sought the deeper water of the main channel to the east. Innumerable mullets broke water, shooting straight up into the air eighteen inches or more, apparitions of glistening silver, to fall back again with a splash that sent the spray dancing in the sunlight. It was very hot. The blinding glitter of the water, the merciless glare that enfolded us from all

sides made the constantly shifting patch of shade cast by the sail the nearest thing to comfort we possessed in our crowded quarters. In fact, it soon became so excessively hot that it was necessary for us to shift our positions repeatedly in order to avoid painful blistering of exposed skin. The hours slipped dreamily past until finally, at about four o'clock, Green Island was sighted, a mere speck on the horizon. Because of the gradual dying down of the wind, it was nearly two hours before we were able at last to tie our skiff to the stake from which our houseboat drifted at the end of a heavy rope.

As twilight was nearly upon us, I did not visit the island that night, but contented myself with sitting on the roof of the houseboat and scanning the island through my binoculars. The island rises from a great mud flat, which disappears completely during times of high water, leaving only a narrow sand beach, beyond which begins the vegetation. To the northeast the island rises at a gentle incline to a height of about fifteen feet, to drop off again as an almost perpendicular cliff to the sand beach and mud flat. Much of this flat was out of water, and hundreds of reddish egrets, together with Louisiana and Ward herons, were wading in the shallow water. Here and there among the green tangles of the island I could pick out momentarily the site where a nest must be, as egret or heron appeared for a few seconds outlined against the dark background. Overhead a constant stream of reddish egrets and Louisiana herons winged their way to and from the island in their customary twilight activity. Dozens of great-tailed grackles mixed with the general migration, clucking in familiar black-bird fashion. A few least terns were

busy along the beach, where they had their shallow nests on top of the sandy windrow, and a pair of skimmers dipped past me, calling hoarsely. From high above a black vulture circled slowly down and settled on the only dead tree upon the island. From my perch on the roof I could see that there were a good many birds on the island, but I thought Mr. Camp a little optimistic when he said that there were thousands of breeding birds awaiting my visit on the morrow. However, I was soon to be convinced that he was not exaggerating things in the least!

The next morning was spent in a general survey of the island and in the enjoyment of a truly astonishing sight. Wherever we went, we were preceded by a wild activity on the part of hundreds of egrets and herons, which rose in great clouds before us and settled near by upon the tops of the shrubs, surveying us uncertainly.

As far as the eye could reach the bush tops were alive with graceful forms. Reddish egrets and Louisiana herons were everywhere, the marvelous grace of their ever-changing postures exciting constant wonderment. In a far corner a few pair of black-crowned night herons had their nests hidden in a particularly dense thicket, and appeared for a moment only as they hurriedly escaped at our least approach. Ward herons sprang from their nests with a great squawk as we advanced, and disappeared on heavy wings over our limited horizon. Here and there in the heart of the tangle we could get a glimpse of a secretive form of wondrous white as some snowy egret or reddish egret in the immaculate plumage of the white phase slipped silently from a hidden nest. Through the underbrush we could see also the black sleek forms of the grackles as they slipped

silently from nest to nest, making the most of the absence of incubating egrets and herons to ply their nefarious trade of egg-eating. Frequently, too, one of these large blackbirds would come to the top of some conspicuous perch and there, with much ado, inflate and deflate himself, producing thereby not only a grotesque appearance but also a most peculiar song. From a near-by shrub a gray-tailed cardinal burst into a song of great richness, as if to ridicule the pathetic attempt of the grackle at vocal gymnastics. Everywhere there was life, and everywhere there was beauty and grace and a symphony of sound and color.

On the morning in question our investigations were confined to the outskirts of the vegetation, with excursions along the two paths which Mr. Camp had cut through the brush. It was during this time that I learned the exact nature of the island to which I had come. I had been warned that the vegetation was thick, that there were cacti and "other things" with pricklers; that I ought to wear leather trousers, leather gloves, and a leather coat—which would have been utterly impossible because of the heat. I was prepared, therefore, to find a tangled growth on the island, but down in the bottom of my heart I had doubted whether the brush could be as bad as reported. I had not been on the island five minutes, however, before I realized that the great problem in photographing the birds would be to get near them, for this mass of brush in which the birds nest is nothing but a huge pin-cushion armed with a million needle points, projecting in every direction, at every angle, and at every height. The bushes, some eight or ten feet high, are mostly a vicious species of *Condalia*,

exceedingly branched and covered with short, very stiff, very sharp thorns that tear the skin painfully and cling to the clothing in a most annoying fashion. Among the *Condalia* are scattered luxuriant examples of the famous *Yucca*, or Spanish dagger, which grows about breast high, appearing as a great sheath of long, firm dagger-like leaves tipped with a thorny substance sharper than a Victrola needle. It was one of these villainous thorns that gently pierced my knee cap and made me a very stiff, sick, and unhappy mortal for three days. Beneath the *Yucca* lies a substratum of *Opuntia*, the prickly-pear cactus, running vinelike over the ground, bristling like an angry porcupine, and, porcupine-like, ready to shed hundreds of needles into anything that comes in contact with it. Under the cactus I believe was the ground, though I do not recall ever having seen it! Therefore, before any photographing could be done, it was necessary to bring the machete into play, and slowly, carefully, and very painfully cut paths and by-paths into the thickets and thus clear spaces in which the great ten-foot ladder we had brought along for photographic purposes could be erected near suitable nests. It was from this stepladder that the photographs that accompany this article were taken; without it there could have been no photographs.

Reddish egrets and Louisiana herons predominated, the former being the more abundant. Areas were easily found in which every stage of nest construction and all stages in the development of eggs and young were in progress. Some nests were found in the very first stages of construction; others showed eggs or young, while still others gave evidence that the young had already outgrown the nest and had



The Louisiana heron is a study in grace and poise

A foundation of sticks and twigs would seem to provide rather rough bedding for the nestlings that hatch from the eggs of the Louisiana heron. Much effort is expended in the building of the nest, for it is no easy task to manipulate the long sticks. The number of eggs to a nest averages three, but nests containing as many as four eggs are not unusual



left it for a more adventurous life among the bushes. An explanation of the fact that some nests were just being started was found in the activities of the grackles, which destroy hundreds of eggs of both of these species each year. This havoc is, of course, wrought during the absence of the old birds, and the grackles show an astonishing ability to single out unincubated eggs. During my visit I saw dozens of eggs that were being eaten, but in no case had incubation been in progress more than a few days.



The great-tailed grackle destroys the eggs of both the Louisiana heron and the reddish egret. Three eggs of the former species, drained of their contents by one of these pillagers, are shown in the picture

Yet I seriously doubt whether this is a conscious selection by the grackles of unincubated eggs: I believe that the truth lies in the fact that it is during the time that the egg complement is being laid that the greatest part of the destruction occurs, for it is then that the eggs are left entirely unprotected and the grackles are able to feast long and heartily without interruption. Yet this destruction of the nest causes very little worry to the old birds: indeed, I once watched a grackle break up an egret nest while the parent bird

stood not fifteen feet away, intermittently watching the performance and preening its feathers! Soon after the destruction of the old nest, a new one is begun near by, the sticks being taken from deserted nests or from the ground. The nest-building is rather a slow process, because of the awkwardness of handling long sticks in the tangled brush. Often the birds will work for an hour, poking and fussing with one small twig before it is finally placed in just the proper position. These nests may be built at any elevation from the ground to the top of the brush stratum, although only a minority are constructed upon the ground. The average number of eggs to a set is three; many nests were found, however, that contained four eggs.

The life of the young birds is anything but exciting. Day after day they lie on their shallow platform of sticks under the sweltering rays of a June sun, and the monotony of their lives is broken only by the coming and going of the old birds and, as the nestlings grow older, by innocent sparring matches among themselves. Long before they are able to fly, they leave the nest at the approach of danger and, using beak and wings and legs, climb unsteadily about in the brush, returning to the nest when the excitement is over. Before they are able to climb out of the nest, the babies make a valiant defense against an intruder by hissing and jabbing vigorously with their bills. They are so unsteady, however, that they very seldom hit what they are aiming at. They are a comical sight sitting on their heels, their great feet sprawling before them as they vainly endeavor to keep their balance during the violent exercise of defense. Once they become used to climbing about in bushes, they are

safe, as then it is nearly impossible to capture them: they can go through the tangle much faster than you can.

The old birds took very complacently to the terrifying presence of the great ladder with the camera attached to it and in most cases returned to the nest within the hour. The clicking of the shutter was a source of worry for some time, but once the birds grew accustomed to the sound, it became necessary to throw sticks at them or to clap the hands in order to make them leave the nest. At that, they often returned to their incubating while I was still engaged in changing the plate holder less than six feet from the nest. In returning the birds ordinarily alight on a near-by bush, and from it survey the situation leisurely. Then, by a series of hops they slowly approach the nest, usually (in the case of the reddish egret, at least) with the feathers all erect. They will stand at the very edge of the nest sometimes by the hour, simply for the purpose of warding off the supposed attacks of neighboring egrets that are likewise amusing themselves by repelling imagined intrusions. Bristling, with every feather erect, they jab viciously at the object of their attack, or simply endeavor, by a full display of plumage, to overawe the innocent offender. Thus they pass the time defending their nests against entirely theoretical attacks of their neighbors, whose one idea often is simply to slip back to their eggs as unobtrusively as possible. This erecting of the feathers also plays a part during the mating season, the courtship consisting of much twisting and stretching of the neck, accompanied by much bowing and a complete display of feathers. Both the egrets and Louisiana herons are wonderful sights when they fluff themselves to the utmost.

Because of the fact that the heat is so intense, incubation consists of two types. During the late afternoon and early morning and throughout the night the birds sit upon the nest in ordinary fashion. It is during the heat of the day, however, that the problem becomes not one of giving heat to the eggs or young, but of giving shade and air circulation. During the heat of the day, therefore, it was a common sight to see the old birds standing in the center of the nest with the wings extended and drooping like a canopy over the hatching eggs or squirming young. Strange as it may seem, these youngsters are hardier than the young of the brown pelican, which often die apparently of sunstroke if they happen to hatch during the absence of the old birds. The chief source of mortality among the young egrets and herons seems to be falling out of the nest, and a young bird is permitted to die of starvation or to be consumed by the red ants or a stray coyote that may reach the island during low water, right under the nest, without the old birds showing any sign of comprehending what is going on.

In view of the sticky, prickly character of the vegetation one naturally wonders what effect the thorns and daggers have on the birds. The answer is very simple: no effect at all. The birds slide through the tangled undergrowth and promenade over the top of the thorny mass as if there were nothing at all annoying in the character of the vegetation. Nests were found under and in the *Yucca* clumps, where it was impossible for a hand to reach unscratched, nestled in the heart of the *Condalia* bushes, under great twisted groups of cacti bristling like pin-cushions. On this inhospitable tangle the herons and egrets alight, and over



A reddish egret incubating on a nest that is bastioned by forbidding prickly growths

its uneven surface they hop and flutter without the slightest apparent inconvenience. Their ability to balance themselves is remarkable, and one of the favorite observation posts of the egret is the pinnacle of the fruiting body of the *Yucca*. On this unsteady perch the birds balance themselves even on windy days, and with half-spread wings maintain their equilibrium under the most adverse conditions.

Just where the old birds went for food is a question. On a quiet evening hundreds of them would be seen standing in the shallow water that surrounds their island, but the birds remained almost motionless in the red glow of the setting sun, and there was little evidence that they caught their food so near home. On the contrary, with the approach of evening and the lessen-

ing of the intensity of the sun, the bird usually took wing and disappeared in small groups to the southwest, in which direction undoubtedly lay their feeding ground. The food consists of small fish and frogs, tadpoles and an occasional crustacean, which are probably caught in the marshes of the mainland coast. Before dark the birds were all back and at the nest, and there was relatively little night activity. With the daylight the birds would fly away once more to the feeding grounds, returning again before the heat of the sun was sufficiently intense to endanger their precious eggs or babies. They followed another period of inactivity, during which the birds remained close to the nest, preening their wonderful feathers or playing at repelling intruders.

For nearly two weeks we worked on the island, carrying the great ladder from one end of the place to the other when nests suitable for photographic purposes were located, training the cyclopic eye of the camera now on this nest and now on that, as series after series of pictures were taken. For nearly two weeks the wind blew out of the south, a heavy gusty wind that kept the bushes and birds in nearly constant motion and added untold difficulties to the natural obstacles that already existed upon the island. Rain squalls blew up from the gulf without warning, and drifting cloud masses obscured the sun at unexpected and often critical moments, making the task of photographing the birds as difficult as possible. Torn by *Condalia*, stiff and sore from the *Yucca* jabs, our legs bristling with cactus thorns even as a cactus, bathed in sweat and burned into a nearly unsleepable condition by the merciless sun, we shot picture after picture in this wonderful natural studio. It was my desire to bring back with me life-history studies telling the story of the home life of these two most interesting species, the reddish egret and the Louisiana heron. As it was impossible in the cramped quarters of the houseboat to do any developing, day after day my pack of exposed negatives increased in size as the unexposed diminished, while each night as I changed plates under a blanket, I asked myself wonderingly: "Am I getting what I came for?"

The last evening at Isla Verde I sat once more upon the roof of the houseboat and through my glasses watched for the last time the enchanting activity on the island. Even as I sat, I was rewarded by two never-to-be-forgotten sights.

From the west came in slow majestic flight seven of the great American egrets, which circled the island and alighted amid its green shadows. No sooner had they disappeared than, turning my glasses to the mud flat to the south, I beheld there a flock of fourteen roseate spoonbills, their gorgeous plumage in bold relief against the dark background. The finding of a roseate spoonbill is always an exciting event, and this glorious flock furnished a fitting climax to my visit.

Early the next morning we set sail again for the Point. The wind was unfavorable, and the return trip took nearly eight hours. In the bottom of the boat, wrapped in a rubber coat and protected from the sun as well as from the dancing spray, lay a package containing the photographic results of my little expedition. My mind drifted back to the time when, almost a year before to a day, we were returning from our trip to the pelicans on Bird Island, bearing a similar unknown quantity in the way of pictures, similarly protected against possible injury. Some months ago I asked you to judge *those* pictures; may I ask you now to judge *these*?



THE LOUISIANA HERON APPROACHES HER NEST CAUTIOUSLY



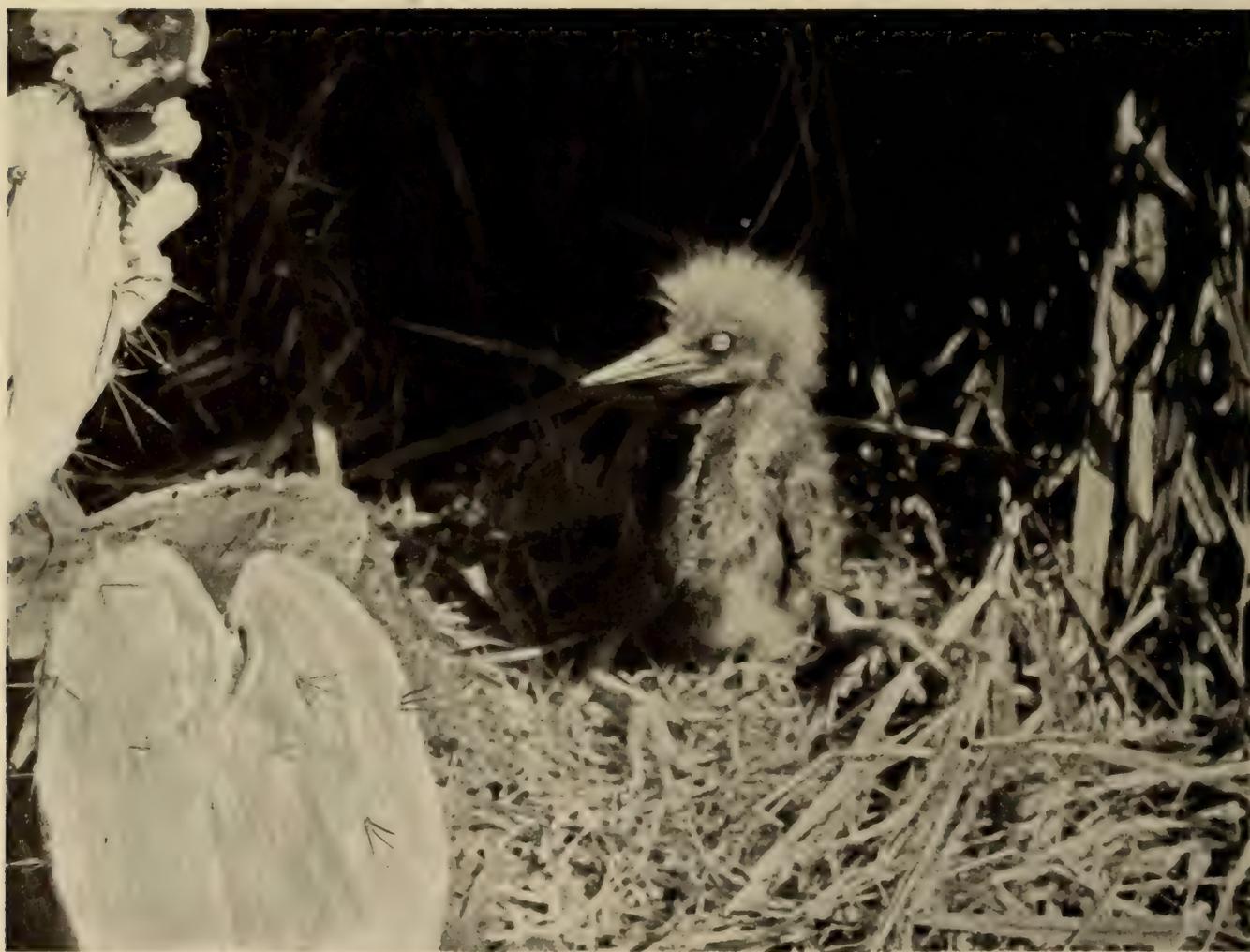
A portrait study of two young Louisiana herons

In this picture of a Louisiana heron the plumage is shown in all its delicate detail. Although clothed in such soft finery, these birds live in the midst of thorny and prickly growths through which they move without injury and even without apparent disarray of their feathers. This display of plumage plays an important part in the defence of the nest and in the nuptial performances. It is of interest to compare this picture with that of the egret on p. 485





Young reddish egrets in the white phase



The young reddish egret is a comical little chap



PORTRAIT OF A YOUNG EGRET JUST AFTER LEAVING THE NEST FOR THE FIRST TIME



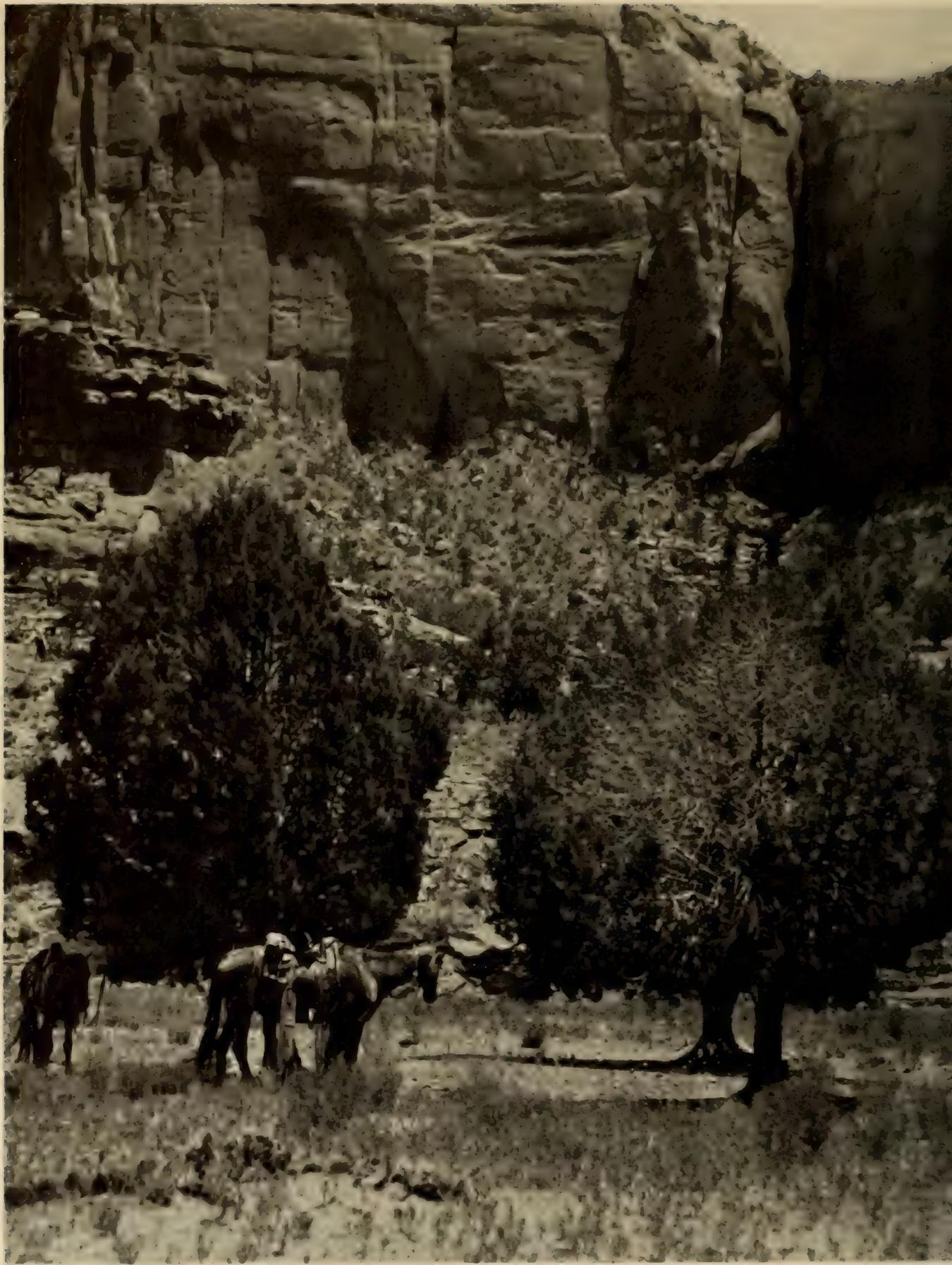
EGRETS HAVE A WONDERFUL SENSE OF BALANCE

Although on a very insecure perch, the bird is able to keep its equilibrium as it thrusts its head downward to examine the nest



A SHOW OF DEFIANCE

An egret, resentful of the presence of the camera near its nest, is trying to frighten away the operator by a full display of plumage



THE WALL-LIKE ROCKS OF NAVAJO LAND

In the cañons the rocks frequently suggest walls of masonry on the face of which rectangular blocks are clearly defined as though carved by some stonecutter's tool. Occasional trees cast a bit of grateful shade, and here the horses, their girths loosened, willingly linger for an interval before the march is resumed

Navajo Land

BY WILLIAM DORY

IT is a land of distance and color. In some regions the rocks and soil are themselves bright, in others the glory is chiefly atmospheric. From Carriso Mountain may be seen brown or greenish plains, and brown or greenish mesas beyond mesas, and then, finally, pale blue mountains fifty or even a hundred miles away. There to the north is the southern end of the Rockies. Other mountains stand apart from these and from one another. Between some of them the world ends in a level blue rim that seems to be the sea until a second look shows that obvious desert melts into it without a shore.

In the Navajo summer in the morning the far-distant mountains and even the far-distant plains glow with colors like those of flowers with the sun behind them or of pale stained glass. One of the colors is a beautiful blue-green, not due to vegetation.

At noon on the plains the sun usually shines with fierce glare out of the unbroken vault of intense blue down upon a yellow world. At sunset ridges may be a brilliant flame, shadows deepest purple, even though there be not a cloud. Dry as the land is, banks of cumulous clouds are not unusual in August, and very often orange sunbeams break through these and spread fanwise over the heavens.

When the sun's disk has sunk below the horizon, there comes the famed afterglow; a long, clear, pink twilight over all things. As the pink fades, the air becomes suddenly chill and man finds a blanket round his shoulders a comfort. When deep night has covered

the earth, and the stranger, like the native, has rolled himself chrysalis-wise in his blanket and has lain down contented on the warm dewless sand, with the silent unfenced dark stretching away on every side, should there be no moon, he looks up at the broad over-arching sky now filled with stars brilliant almost beyond belief. Then the cool clean air after the burning heat brings "sweet sleep down from the blissful skies." Such is Navajo land in summer. The winters are cold.

It is a vast desert high above the sea, with unsocial mountains standing alone, crowned with forests, and flat-topped hills (mesas), bordered by high perpendicular cliffs, and broad plains below, the whole cut by deep rock-walled cañons. Some of the cliff sides are fluted, as it were, and some, especially in the cañons, resemble walls of solid masonry, the rectangular blocks showing.

In some places may be seen piles of wind-blown sand, like the dunes of the seashore; in others a floor of rock strewn with a thin layer of sand; or, again, a floor of rock absolutely bare, its form kept broadly smooth by a myriad sand-grain chisels, driven by the wind. Of course where there is so much wind and dry sand, there are at times sand storms from which both man and beast are glad to find shelter.

The Navajo Reservation is three times as large as the state of Connecticut, but not large enough for the needs of its people,—a country where the small tufts of grass, where there is grass, are of scattered growth, and there is no water for more than a little irriga-



A glimpse into the wooded part of the mountains. In this land of little rain even a stream so feeble and trickling as the one shown has its value

tion. The San Juan River on the north flows past the country the year round, but the Little Colorado River in the south is dry for several months in much of its course. The amount of rainfall, needless to say, depends chiefly on altitude. The lofty heights are too cold for agriculture, and most of the brooks from these heights, as soon as they reach the plains, quickly lose themselves in thirsty sand. It is not that all the ground is infertile in itself, but that water is rarely found. Over most of the country rain falls so seldom that it is longed for and prayed for by the Indians as the greatest blessing the Powers above can bestow. The traveler often meets Navajos herding their sheep and goats to distant pastures or to the water holes they know.

April, May, and June are exceedingly dry, July and August are the months of

most rain, and each rain is brief even then. After a summer shower flowers of great beauty appear out of what was a mere moment before nothing but parched sand, each situation producing in a surprising degree a flora of its own. Then in a little while all is dry and barren as before.

There are open woods of yellow pine on the high mountains, piñons and junipers lower, and below that the open levels. Grass grows best in the high mountains, where it has most rain and ceases altogether at the lowest plains. Down in the cañons large separate trees now and then appear.

"A dry and thirsty land where no water is." A beautiful land. A bare, grim, and desolate land. There is a saying that no one but a Navajo could make a living from so forbidding a country; yet it is an old story that

when an Indian shows by improvement that his land is good, the white man immediately wants to take possession of it.

The Navajo Indian fought the white man long. Navajo attacks upon white settlers in their part of the world were persistent and formidable. The United States sent one military expedition after another against these Indians without permanent results. At length, in 1863, their sheep (also their carefully nurtured orchards) having been destroyed as a military measure, they were starving and a large part of the tribe surrendered. They were carried prisoners to Fort Sumner, New Mexico, where they were kept in captivity four years, during which time a few escaped and about a third of their number died. They said that if free to return to their native place, they would make war on the United States no more. At length, in 1867, they were set at liberty and allowed some sheep and goats with which to begin new flocks. They have been at peace ever since, though still hostile in sentiment to white encroachment on their domain, which now, with established limits, is a "Reservation."

The Navajos are a vigorous, industrious people, who do not share the opinion that work (other than war and hunting) is beneath a man's dignity. They have known something for generations of both dry farming and irrigating on a small scale, and individuals may be seen at present patiently leading water from whatever sources obtainable over little corn-fields—if fields they can be called—patiently building and rebuilding small dams and conduits from sand and sagebrush. These efforts produce some corn, squash, and melons at the least. The Navajo plants corn with a stick,

without general digging. If the soil were much lightened and stirred, the wind storms would blow it away.

Navajo faces are alert and intelligent. The people retain much of their old, proud independence of spirit notwithstanding the presence of several white superintendents within their borders. The government has broken up the old tribal systems of discipline among Indians generally, without furnishing an effective substitute in remote places. Thus the Indians sometimes get a moral discredit which, taken as a whole, they do not deserve. The government, however, appoints Indians from year to year to an office among themselves somewhat resembling our justices of the peace, and these men are said to be useful where their influence reaches.

Unlike their neighbors, the Hopi, who appear always to have been by their own rules monogamists, the Navajo native standard allows a man to have several wives although the practice seems not to have been universal. Today no direct resistance is made to the government's effort to break up polygamy, but it still exists to some extent.

Although the bride's parents are presented with horses by the bridegroom, it is denied that this is a purchase. The native marriage ceremony takes place before witnesses in a dwelling. It consists in seating bride and groom facing each other with a basket of corn meal between them. Across the basket are drawn lines to the four cardinal points, these directions being regarded as sacred, especially the east. Then, after pouring water over each other's hands, the man and woman eat a little meal from each sacred side of the basket and from the middle, beginning with the eastern



A colored headband not infrequently encircles the black glossy hair of the Navajo

side. After this, food is served to the guests.

In common with some other Indian tribes the Navajos have the queer notion, for which they cannot themselves account, that a man must not speak to his wife's mother. A married woman will freely visit her mother, but the mother will not visit her daughter unless she knows that the son-in-law is absent.

The wife holds property entirely separate from the husband. The woman often owns flocks of sheep, and the money she gets from her weaving is her own.

Even at this late day the Navajo Indians in general appearance retain some elements of the picturesque. In figure they are straight and light. Many of the men still wear the hair long, twisted into a knot at the back. When not adopting the white man's broad soft hat, bought at a trading post on the Reservation, a folded band

across the forehead slightly confines the hair and is the only protection of the head from the sun. Though not disdaining civilized "overalls," they generally wear very loose trousers, slit to the knee and often made of cotton print. Strange to say, Dame Fashion, capricious always, decrees that the women shall leave the head bare though she allows them to carry a sun umbrella if they can procure one. A velveteen shirt is so much worn by both sexes as to be almost a distinctive tribal costume in place of the ancient buckskin or other native dress. The women pull the shirt (or more properly blouse or frock) down over a skirt which reaches to the ankles and is full



When in the full glare of the intense sunlight, an Indian half-closes his eyes without screwing up the whole face as a white man does

enough to fall freely on both sides of a horse as they ride astride. The blanket is still worn by Navajos of both sexes as a cloak, but those of their own weave being heavy, are now frequently sold for rugs, while they use for cloaks lighter and cheaper ones, factory-made with gay angular designs to suit the Indian taste.

Navajo dwellings are as inconspicuous in the landscape as ant hills or the nests of birds, and seem as much a part of nature. In summer the *chahao* (shade) is much used; built of brush with the leaves on or of brush and weeds, it is open to every breeze, yet a shelter from the fierce sun. Their more substantial dwelling, the hogan, is built of logs leaning inward, carefully supported, and plastered on the outside with adobe, a natural plaster found on the ground and hardening in the sun. The smoke hole in the roof is a ventilator never shut, and the door opening is closed only with a loose blanket. For building, the logs are first laid out on the ground in a pattern prescribed by tradition according to the type of hogan required, and then raised in a prescribed order. The door is always to the east.

I shall ever remember with pleasure my first sight of the interior of a hogan at night. At the request of Mr. Hunt, a trader at Tisnaspas, a Navajo youth consented for a small consideration to conduct me to "a sing." He led me to the top of a cliff crowned with piñons and dwarf cedars, where a cool breeze blew and where a newly built hogan stood among the little trees. Near by, a number of Indians were gathered round a camp fire, some watching, others sleeping, all under the open sky, protected from the wind by a semicircular fence of cedars put together for the purpose. On the open

side of this fence the firelight showed the nearest of a flock of sheep and goats. A lamb came bleating out of the darkness, was petted by the Indians, and lay down to sleep among them. Two boys, with hands painted white, came forward to greet us as we approached.

As I listened to the music floating out from the hogan, a young man said in English, "You may go in," and



Expert⁷² as blanket-weavers, the Navajos excel also as silversmiths, and necklaces made of silver are a common form of adornment

stepped over to lift the curtain. This hogan was rather larger than is usual, new and clean, its interior atmosphere still fresh even to lungs coming from the keen air outside although there were some twenty Indians within. The fragrance of the small fire of cedar in the middle of the floor was pleasant, and the firelight gave a soft glow to the brown faces of the Indians; figures, raiment, and all making a "luminist" picture in the glancing firelight against the excellent architectural background

of the slanting hogan poles. When the fire sank low, stars could be seen through the smoke hole in the roof. The Indians seemed not at all disturbed by the presence of the white man, who had been courteously bidden to enter. It was the occasion of a ceremonial singing by a medicine

sat at the patient's right, and some ten men, three women, and three boys completed the fire-lit circle. According to custom the women took no part in the singing.

The singing was continued until dawn, with short rests between songs, a longer rest at midnight for a late



THE EARTH-COVERED LODGE OF THE NAVAJO

This hogan, the roof of which is rather flatter than is usual in the house of the Navajo, rests, as is always the case, upon a conical framework of logs. In the construction of the hogan horizontal logs have been laid across the slanting ones to hold a flatter thatch. In the center of the roof is a hole for ventilation and for the escape of smoke. The doorway faces the east in accordance with prescribed custom, a blanket being drawn across the opening

man,—I never found out exactly what for, receiving a scornful negative when I asked afterwards outside whether anyone were ill. Possibly it was to bless a new hogan, but it seemed more personal.

The patient, if such he was, sat with his wife at the back of the hogan. The medicine man, who led the singing,

supper of bread and coffee and roast ribs of mutton—of course eaten with the fingers—prepared by women on the camp fire outside. There was also a pause for prayers, which were solemnly spoken by the medicine man and repeated by the patient, clause by clause. At one time the medicine man touched the patient on various

parts of his body and put something in his mouth.

Navajo singing rises at times to a harsh falsetto, but it is musical and has much weird charm to unaccustomed ears. The weirdness is due partly to Indian rhythms, which are more complex than ours and hard for a white man to learn,—not easy for an Indian.

The Navajos have a superstition that the original primal animals were rational beings, able to talk with humanity and still existing as spirits who may be asked for aid. Mrs. Wetherill also furnishes this less poetic conception—"Oh, big black bear, with your shoes like a knife, stand between me and danger," an



It is hard to imagine the Navajo without a horse, yet in pre-Columbian days neither this animal nor the sheep, both of which today play so important a part in the life of these Indians, were known to them

Whatever may be said of the medicine-man in other respects, it must be admitted that he is a conserver of art, music, and poetry,—and there is real poetry in Navajo prayers and songs. Take for example this prayer to the dawn, which Mrs. Wetherill has kindly allowed me to borrow:

Oh, Dawn, Dawn, beautiful Dawn, chief of the beautiful!

Let it be well before me as I go,
 Let it be well behind me as I go,
 Let it be well beneath me as I go,
 Let it be well above me as I go,
 Let all I see be well as I go.

appeal to the primal, abstract bear, a spirit. The "shoes" of an actual bear are in reality formidable weapons.

The Navajos, like various other Indians, have a ceremony of thanksgiving for the corn at the time that the green ears are ready to eat. One night, as I slept out of doors on a low mesa, I was wakened by strange music and saw a group of men dancing in the light of a half moon,—young men practising for the corn dance, I afterwards learned. Now and then one of them would separate himself from the rest



A pack train outlined against the sky, moving in rather ragged Indian file across the desert

and dance with admirable lightness and grace far out into the shadow of a higher mesa and back again,—a scout to ward off evil spirits, according to white testimony. Ere long the dancers disappeared over the rim of our mesa, the music coming faintly back to me.

At another time, in another part of the Reservation, this time in brilliant moonlight, a small number of men were dancing to a sort of chanting song, punctuated at long intervals by a drum, the men standing in one place, keeping time with their feet and swaying their bodies. As I stood up at a little distance, wearing my blanket, for the night was cool, I saw the shadow of an Indian thrown before him on the sand as he approached from behind. I refrained from turning my head; he came round in front to see who the blanketed figure might be and laughed to behold a white man in a blanket; then in a jocose manner, as if to say, "If you want to play Indian, come on," took my hand and led me among the dancers, where I tried in vain to keep time to the complex rhythm.

Kayenta, or Tyende, as the name is variously spelled, the trading post of Messrs. Wetherill and Colville, is 165 miles from a railroad, the farthest of any post office in the United States proper to receive a regular mail. It enjoys an excellent spring—an all-important matter in this dry country. The dwelling house of adobe brick and plaster is pleasantly cool within, as the southwestern adobe buildings are in summer, yet warm in winter. First seen after days of desert travel, the interior calls to mind some far-away palace of a fairy tale that a traveler through a wilderness comes to unexpectedly: the floors covered with beautiful Navajo rugs, the walls adorned with friezes from Navajo sand-painting designs, and a library of good books, and the luxury of a bathroom.

Mrs. Wetherill speaks Navajo fluently. She has made a sympathetic study of these Indians and has been ceremonially adopted into one of their clans. She has become an authority on Navajo matters.

When I first saw Kayenta, Indians



Now and then an animal would stray out of line, only to be headed off by a rider

had been encouraged to gather near it for games among themselves. Men and women on horseback, arrayed in their most festive garments for a large social occasion, unconsciously fell into pictures a painter would like to study.

One of the games, called by the unpleasant name of "the chicken pull," was played thus—A fowl, previously killed, was buried in the sand up to its neck; the Indian men, putting their horses at full speed, stooped from the saddle and tried to pull the fowl up from the ground in passing without checking their horses. Whoever succeeded in doing this won the game. The same game may be played with a leather strap instead of the fowl. After this game came a foot race for boys.

Some time later I went to Sagie, or Laguna Cañon, with a trustworthy Navajo who spoke no English, to see Betatakin and Kitsiel, the largest groups of cliff dwellings in the cañon that is still called by its Spanish name, Laguna, although there is no lake there now.

Setting out in the afternoon we rode southwestward over the plains for

about four miles, stopped at a water hole, went through an opening in a fantastically indented leaning ridge of yellow rock, and west of it, entered the mouth of our red walled cañon in the great perpendicular face of a mesa. The Tyende seems a tiny stream to have carved out for itself so great a hall. The cañon has so many branches, deep and steep-sided, that they call to little human creatures to wander, lost in those vast winding halls with apparently unscalable walls, all the rest of their natural lives. Here, of old, the cliff dwellers may have played hide and seek with marauding enemies in grim earnest.

We rode on till dark; then the Indian stopped, unsaddled, fed, hobbled, and turned loose the horses, using a handful of lighted weeds as a torch so deftly that no lantern could have served better. Then he made a fire of sagebrush, pointed inquiringly to the coffee pot on the pack saddle, and finding I did not want coffee, refused any supper at all for himself. We sat a few moments by the fire before sleeping, the



A GATHERING AT KAYENTA

Games always prove an attraction and draw large groups of Indians as spectators and participants. On such occasions there are superb displays of horsemanship and the racing and other competitive feats are accompanied by not a little betting, in which the value of a blanket may be the stake

A COUNTENANCE OF RARE
BEAUTY

This young Navajo, whose light, elastic figure is at perfect ease in the saddle, has the straight nose not uncommon among his people, large sparkling eyes, and a remarkably well-formed mouth and chin, the whole countenance lighted by an open look that is prepossessing. By way of asking him for his portrait, the author showed the camera and, for fear of losing him, held up a dollar although twenty-five cents was the usual price for a pose. The Indian gaily intimated that two dollars would be more acceptable. While pictures were being taken of him, the other men of the party, speaking in Navajo, were evidently chaffing him about his good looks and easily earned money, while his own face changed from a slight smile, soft and arch as he gave a side glance at his companions, to merry laughter at their jests





WHERE THREE IS NOT A CROWD
Navajo children get their training in ho:semanship at an age when toddlers of other nations are learning how to walk



RED SKIN AND WHITE IN NAVAJO LAND

Indian rather haughty. It seemed wonderful to be there between those rocky walls with one of the only real Americans, who spoke only his own tongue. I wished I could speak his language. In the course of our trip I was able, now and then, to make a remark or ask a question, partly by signs and partly by using a Navajo vocabulary published by missionaries, and was always understood in spite of my total neglect of grammatical inflections. At first he seemed surprised when I did not fully understand his answers, but I managed to tell him that the book spoke Navajo and I did not, which seemed to amuse him, and after that he used signs more than words.

At dawn he arose and went for our animals, which had drifted out of sight down the cañon in their grazing. Returning, he "saddled up" quickly, with our sleeping blankets neatly rolled. The morning was warm and we were glad to ride on for an hour or two in the cool shadow of the rock before breakfast. The sunlight gleamed on one bit of the rim high above us and crept slowly down until it made on a gigantic scale those triangles and trapezoids of light and shade that sun-loving artists like to depict in scenes from city streets.

Toward noon we were ascending a side cañon and traversing a growth of small trees that shut in our vision. As we emerged from these, the man waved his arm with a large dramatic flourish and smiled, as though he would say: "Behold the wonder my country has to show!" There above us, in a great, evenly arched niche in the cañon wall, was Betatakin, the substantial remnant of an ancient village, under the protecting arch of solid rock,—the dwellings of a forgotten

people, too high for enemies to approach below unseen, and sheltered from the possibility of attack from above.

We had dinner under the little trees that grew at the foot of the cliff, then a long rest during the heat. When it was time to go, I made signs suggesting that we spend the night at the old dwellings. I did so purposely to hear him refuse, as Navajos are said to be afraid of ghosts at night near a dwelling in which any one has died, even a cliff dweller of long ago. Among themselves they either carry the dying person out-of-doors or burn down the hogan after the burial. My guide now sternly refused in Navajo to stay and pointed to the horses. I asked "*Chindi hogan?*" (haunted house); he answered "*Okh*" (yes).

In the afternoon of the following day we halted between small patches of scrub oak, and the man indicated by laying his cheek on his hand and closing his eyes that we would sleep there. Anxious to know whether we were near Kitsiel, I looked up some words in the vocabulary and asked "House of the upright rock far?" He replied in Navajo "not far." As soon, then, as we had "made camp," which we did by merely unsaddling our beasts of burden, and he had driven them up a steep side where there was grass, we walked on to see this old, old town.

Presently the man paused in front of the cañon wall and pointed high up. He waited to let the stupid white man's eyes search the top for dwellings in vain, then touched my arm lightly and laughed, pointing lower. There, in such another niche as the one that holds Betatakin, was Kitsiel, the second largest group of crumbling buildings, another home of vanished cliff dwellers.

Next day while I was near the cliff dwellings alone, I heard from far up on the rocks above, from a place where no one could climb, a wild weird call, neither human nor animal, certainly not that of any animal I knew. I paused to listen; another and different eerie cry came from another lofty point. Some half-human creature of fable might give such a cry as that.

Presently the Indian rose out of the bushes and laughed. I suppose he had been using a whispering gallery in the rocks. Later, while I was absorbed in my work, he slipped near, unheard in his noiseless moccasined feet, and startled me by a sudden exclamation. He gently teased me for lying flat on the ground to pant after mounting the steep side of an arroyo in the heat of the day and for mislaying camera material in plain sight to his sharp eyes. These boyish pleasantries were the more striking in a middle-aged man because his face in repose was grave, even sad, if not glum, the mouth slightly curved down at the corners.

Several observers have said that the Navajo is a more ready laugher than most Indians. Is he gayer by nature, or merely more at ease in the presence of the white man because he has been less interfered with and is living his own life, beholden to no man, in his own country, wherein the white man, not the Indian, is the curiosity?

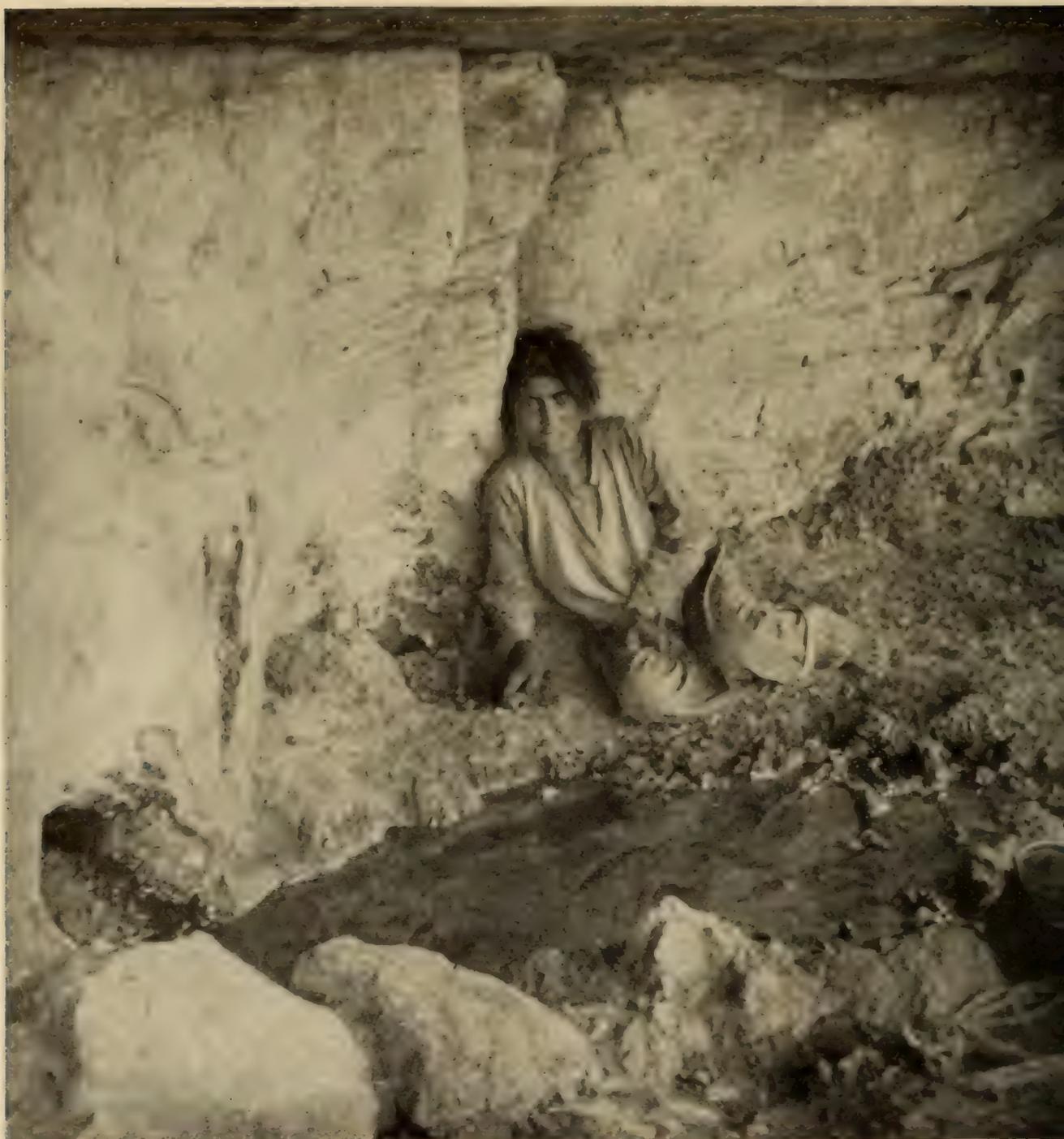
Now here in Sagie Cañon the guide and I began our return from Kitsiel in deep darkness. The sky was clouded over and there was a sprinkle of rain. It was rather thrilling to find oneself skirting the rims of black depths on horseback or suddenly plunging down into them, following someone unseen in the dark. Western ponies are wonderful for picking their way like goats and even sliding on steep rocks without falling.

In the morning, as we made our usual halt for breakfast, two pretty little boys came up, leading a white donkey, their black locks hanging wild. The man seemed very glad to see them, taking them in his arms and embracing their heads, much in the manner sometimes shown on the stage, supposedly representing a custom of ancient Rome. I tried to ask, not from the book but from careless hearsay Navajo, "Are these your sons?"—but ignorantly said, as I learned afterwards, *his* sons for *your* sons. He replied, gravely accepting my queer Navajo for my better understanding, "Yes, these are my his sons." Indian politeness as shown by this incident makes it more difficult to get the language correctly. I prepared to photograph the boys, when the man immediately held a blanket before them and asked me twenty-five cents for the privilege, which, indeed, it was well worth.

As we went onward farther down the cañon, a mounted Indian rode up carrying a shovel and spoke to the man with me, who asked permission to go with the other to bury some one. The Navajos get some person outside the family to bury their dead, if they can, and do not hesitate to ask a fellow tribesman they may meet.

I rode on, the pack mule trotting docilely on ahead. The guide rejoined me before I reached Kayenta. There we parted, with regret on my part that I should see him no more.

From Kayenta back to Tisnasbas I had a four days' journey in the open with an Indian, traveling as we did in a wagon, with a light load of hides. He was a pleasant fellow and we had an entertaining time exchanging English and Navajo names for plants and animals we passed on the way. As the season was August, we met showers



In Navajo land water is rarely found and rain is prayed for as the greatest of blessings. This stony basin, filled with refreshing water that has poured into it slowly from a little natural tunnel in the wall, is a spot where the traveler, be he Indian or white, feels tempted to linger after a long ride. The overhanging roof of rock offers shelter from the hot sun

to cool for the moment the pitiless desert heat. A long way off we could see their beautiful approach across the plain, *walls* of rain coming toward us, "standing rain" the Indians call such. The showers were brief, and wet garments in the desert air are dry again in no time.

The driver's nephew, a boy of about twelve or thirteen years, rode alongside on his pony, herding several horses before him. When rain fell heavily at

night, we all three slept under the wagon. It was an opportunity for observation at close quarters. They were courteous and these two at least had not the odor of the unwashed, for they had the advantage of living near a small stream of some permanence.

By day the boy's sparkling gayety was delightful. He went off into rippling peals of fresh soft laughter at my repeated efforts to get the correct pronunciation of Navajo words. His

gayety and that of another boy I had observed on another trip was a bubbling joy that seemed different from the mirth of most lively white boys, and very different from the subdued ways of Navajo boys at school.

What is to be the future of the Navajos, this vigorous, upstanding, industrious, intelligent people? They have not been pauperized by annuities in exchange for lands; they are numerous enough to avoid consanguineous marriages, against which they have strict rules; they are nearly all of full Indian blood; moreover, they have struck out for themselves new ways to meet the changed conditions of their world, by which they support themselves beholden to no man.

The question is sometimes asked, why does the government do this or that for the Indians? Because after they were dispossessed the United States made them its wards to give them a standing although they were not citizens.

The American ideal of free education for all men did not early include red men, who were considered for many purposes as separate nations. Now all tribes in a tribal condition are given day or boarding schools as wards of the government,—in some cases directly as an act of reparation for lands taken away. The boarding school, including food, clothing, and care, is a government specialty for Indians. Besides those schools on reservations, there are several boarding schools entirely outside, to which selected Indian children are sent with the consent of their parents to their remaining for a term of years. Commonly they cannot return home from these schools in vacations because the schools are distant and the parents are too poor to pay the traveling expenses.

Obviously the Indian can no longer live by hunting; the white man presses him on every side; for mere self-preservation he must learn how to meet the white man's world. The calls of industry, when all impediments are removed, will doubtless draw Indians out into the general world as it has now drawn only a few. Let us hope, notwithstanding, that this race, naturally very distinct, will not everywhere obliterate itself by intermarriage, and lose all power to make further contributions of its own to our national life and thought, and all ambition for high service to its own people.

The civilized man's first idea in teaching the uncivilized has been to obliterate his racial past, the good with the bad, as all parts of one system to be forgotten. There is more willingness today than formerly to accept the good and build upon it. Why take from Indian youth in our schools that help in the battle of life that comes from respecting the best ideals of their own race? To regard a virtue as a trust from one's ancestors is one strong incentive to practice it. Now and then an Indian makes the large claim that Christian morals are such as his people taught of old. Then, too, the Indian sees the beautiful in nature. The unschooled Navajo knows his birds and quadrupeds, and calls the thousand plants of his desert by name, while many a white man goes through the world deaf to such things and blind. Many Indian songs are noble expressions of race thought, and, apart from historic interest, worth keeping for their beauty. The artistic sense shown in the crafts of the tribes, their outdoor life, their sense of social obligation, their love of ordered liberty, their dignity of manner, their reverence for the unseen are precious things, not

lightly to be thrown away, nor incompatible with the best of civilization.

We should bear in mind that what we call civilization exposes primitive peoples to new evils as well as bringing them new benefits.

What has been the red man's own thought of the white man's schools thrust upon him? We hear of an early instance on a Blackfoot Reservation,



A Navajo woman, seated on a sheepskin, weaving one of the rugs for which her people are justly famous

where the mothers rode around the boarding school building singing dirges over the loss of their children as if they were dead. More recently part of the Hopi tribe made tragic protest against the attempt to make their children over into white men. Notwithstanding such instances, red people surprisingly soon came to recognize in the school an advantage offered to their deeply loved children of learning how to "walk the white man's road." At this day,

many Indians desire more schooling and better for their children, more opportunity to enter the public schools where they have the advantage of competition with white children. Some of them, again, who have themselves gone on to our secondary schools and colleges, long to see more of their number stimulated to lead and instruct their own people. A Winnebago, the Rev. Henry Roe Cloud, a graduate of Yale University, and his wife, an educated Chippewa, have a number of Indian young men under their charge at Wichita, Kansas, who are working their way toward a higher education. This is a good illustration in point. The government schools do not attempt to take pupils beyond the work of the eighth grade, with the addition of some industrial training.

Uncle Sam has provided several boarding schools on the Navajo Reservation, placed in various parts of the field, so that parents can visit their children and can take them home for the vacation, which is short. Day schools could not well be generally maintained here, because families wander about with their sheep. There are not enough schools for all the Navajo children although schools for all were promised this tribe in a treaty.

The Navajos, with whose primitive mode of life we have interfered comparatively little, have the best health of any of our Indian tribes. Tuberculosis and trachoma, those diseases that make havoc in other tribes, both acquired from the whites, are present among the Navajos but less frequent with them. At the government school at Shiprock, Navajo land, there was a short row of tents for tubercular boys, so far a return to the primitive from necessity. Trachoma is a very contagious disease of the eye, produc-

ing blindness if neglected, but curable under scientific and persevering treatment. Reservation schools among the tribes have not succeeded in exterminating it within their own walls, where because of the close contact special care is required to overcome it. Notwithstanding certain hygienic advantages, the confinement of school life seems to be more or less a strain on the vitality of primitive children, especially when combined with homesickness. The pastoral customs of the Navajos scatter them in separate families or small groups; and the hogans, though, at times of a contrary wind, oppressive with smoke, are, if not overcrowded, pretty well ventilated through the smoke hole in the roof. Important as good schooling is, health is fundamental; therefore, until schools recognize the necessity of constant fresh air, even of sleeping porch dormitories, may it not be as well that not all Navajo children are in school?

There is crying need on reservations generally for more physicians, nurses, and hospitals. Wide Navajo land has but few. Mr. and Mrs. Wetherill have built a "big hogan" as an infirmary, and also as an example of what a hogan might be, where Navajos could cook over an open fire, as usual, yet have more room to keep their belongings neatly and a chimney to prevent injury to the eyes from smoke. Mrs. Wetherill said they liked it very much.

A boast is often made of the number of Indians of other tribes who have been induced to live in houses and wear the clothing of civilization. The only house they can afford is rarely anything more than a one-room cabin with an earth floor and one small window. Having no knowledge of sanitation, the

Indian keeps windows tightly shut in cold weather, while he invites all his poor relations to share his fireside. This is one cause of tuberculosis. Other causes are insufficient food, hopelessness, idleness, degeneracy from primitive vigor. The Navajos are a busy people; they are not drunkards. Their sheep supply a meat ration in place of the game now extinct.

The Navajo Reservation has been hitherto protected from the white man's greed by its desert character. When the cry comes to "open to settlement" these lands, shall we allow it to be done? Someone asks, "Exactly what is meant by 'opening' Indian lands?" "Opening" means allotting portions to individual Indians, according to the judgment of a commission appointed by the government, and selling what is left over, the so-called "surplus," to white men, the proceeds to be devoted supposedly to the benefit of the Indians. What does experience show happens then? White men rush in to get possession not only of the "surplus" but by hook or by crook of the allotments themselves, taking advantage of the business ignorance of the Indians.

In the case of the Navajos there is no shadow of reason for calling any of the land surplus, for the country, though extensive, is already overstocked by the Navajos themselves. The Navajos understand their own land system and prosper under it. Why should they not continue to hold their lands in common? Some land corporations composed of white men are doing likewise. With liberty in this matter and given a helping hand in sanitation, and protection against criminals, white or red, the Navajos will make something worth while of themselves in their own way, by their own initiative.



MARY CYNTHIA DICKERSON

1866-1923

Mary Cynthia Dickerson

1866-1923

Her Life and Personality

By MAUD SLYE

Of the Otto S. A. Sprague Memorial Institute, University of Chicago

THERE was born at Hastings, Michigan, on March 7, 1866, a little girl that was to look upon her surroundings with strange eyes. Heredity, that little-known but certain force, selecting widely among her forebears, had brought to her diverse qualities that made her almost alien in her environment. Picture to yourself this child, with a great generous heart, an alert observing mind, an intense love of beauty, and an innate craving for the exquisite, trying to find her way and puzzled in a sphere of life that seemed to have little use for any of these qualities except the generous heart.

If I were to select one phrase that would mirror Mary Cynthia Dickerson's heart and soul all her life, I would select the phrase—she tried to find her way. She spent her early life serving the constant needs of three small brothers. From a household where learning was not the tradition, she went through school, never failing in her duties there or in the home. It is easy to see that she must needs have found the beauty she craved in the sunshine, the flowers, and the small living things that she could discover in her intervals for play.

She put herself through college at a time when it was not easy for a girl to do this, teaching for a while until she could save money enough to pursue her studies, then going back to college.

All through her undergraduate days that same generous heart made her give almost worshipful admiration to the intellect of others, while she was always humble regarding her own.

She attended the University of Michigan intermittently from 1886 to 1891, then taught for four years, after which she went to the University of Chicago, graduating in 1897.

After her graduation she taught in the Rhode Island State Normal School, botany, zoölogy, and nature study. Here, in the trips afield which she took with her students, she learned more and more of the minutiae of nature, which she afterward embodied in the beautiful groups constructed by her at the American Museum of Natural History. These groups are as truly works of art as any paintings, and equally truly works of science. At the Normal School, also, she taught hundreds of students to see for the first time the marvels which only a naturalist knows.

It was during this period of teaching in Providence that she collected the data for her two works, *Moths and Butterflies* and *The Frog Book*, and for her series of articles in *Country Life in America*. It was for these books and articles that she developed her marked ability as an artistic and scientific photographer of insects, amphibians, birds, and flowers in the life. With her camera and tramping outfit she would

Details from Miss Dickerson's pictures that appear on pp. 506-09, 513 of this article have been used for purposes of illustration in "The Pageant of Nature" by Miss Dickerson, published in *Country Life in America* during 1906-07, and NATURAL HISTORY is indebted to that periodical for permission to reproduce them



A PORTRAIT OF A SCREECH OWL

go into the country for week-ends, staying at some isolated farmhouse, in order to take photographs of animals engaged in their characteristic activities among their native haunts. No photograph was ever finally accepted by her unless it was both scientific and beautiful.

From Rhode Island she went to Stanford University, where she was instructor in zoölogy for two years. She also assisted David Starr Jordan in some of his work in ichthyology, always broadening her own knowledge. From Stanford University she went to the American Museum of Natural History, where she remained until her final illness. She died in April, 1923.

The catalogued data of a human life are brief and quickly told; the living of them is slow, complex, and puzzling. According to the way in which the individual attempts to solve the perplexities of life we appraise his personality. Of Miss Dickerson it is not easy to paint a portrait that all shall recognize, for there is an urge upon the painter to portray the soul, and here was peculiarly a woman who all her life kept her soul remote from almost every contact.

If we are to paint her truly, we must visualize the ready smile, the hospitality that reached out always in greeting, the generous heart that never failed to help and to give, and the humility of spirit that underlay it all. We must paint the diligent worker,

drudging through details beautiful and ugly alike, never failing in the service of work, from the simplest task to the constructing of a marvelous replica of some little fragment of nature with every minute detail true to exact fact and set in an atmosphere of loveliness. She was always willing to help in the world's drudgery, and always able to create beauty in whatever she undertook.

"I cannot see," she wrote to me during those last two years of darkness before her death, "I cannot see even the shortest distance into the future; some day when I see you, I will tell you of all my puzzlement and sorrow and despair"—a poignant reminder of the little child perplexed to find that the faculties of its heart and mind were not needed in its environment. "What shall I do without my work?" she cried, "Perhaps the doctor will let me go into some sick ward and help take care of people." And here she is again the heroic worker, who even in her own desperate illness cannot bear not to serve.

What an inspiration of selection it was that gave her Mary Cynthia for a name,—Mary, diligent, sweet, generous, ready in service, humble; Cynthia, the aspiring, the ardent seeker after the romance of the world and the romance of the cosmos! In her heart she was Mary; in her soul she was Cynthia; and always she tried to find her way.

Her Unusual Gifts as An Editor

By JOHN OLIVER LA GORCE

Associate Editor, National Geographic Magazine; Vice President, National Geographic Society

IF St. Paul had lived in our day, he would have been an ideal editor, for when, in his First Epistle to the Corinthians, he declared that he had

been "made all things to all men," he laid claim to an attribute which every worthy occupant of an editorial desk most longs to possess. It is an



A CROW TRAIL IN THE SNOW

There is perhaps no more common trail to be seen the day after a storm than that of the crow. The crow's habit of dragging the feet is



IN LATE APRIL FALSE HELLEBORE FAIRLY CONCEALS THE BROOK IT BORDERS



AN UNDERWATER PHOTOGRAPH OF THE LOBSTER

The lobster crawls over the sea bottom, hidden by his resemblance to seaweeds and rocks. In combat he is no match for the blue crab.



SEA ANEMONES

Like flowers, these beautiful sea anemones hang among the swaying seaweeds. At night they stretch out to three or four times their usual length.

editor's chief end to acquire the power, to cultivate the gift not only of seeing each thing and each subject from the author's point of view but in the perspective of a host of readers of diverse interests and varying intellectual backgrounds.

Mary Cynthia Dickerson possessed this gift to a unique degree. There are authors in many parts of America and Europe who will bear testimony to the fact, for few indeed are the manuscripts which passed before her judicial eye and understanding heart that did not profit by her kindly and constructive criticism and her expert sense of their appeal to the reading public.

The successful editor is he whose information is sufficiently broad and whose tastes are sufficiently catholic to discriminate between the spurious and the true. He plays alone the rôle of a Supreme Court of Criticism from which there is no appeal. That which is excised at his hands in most instances is lost to the world of letters forever. It is a weighty responsibility to signal with blue pencil "thumbs-down" to a thought! How potent is this sentence, how revealing this expression, how vital this group of facts? Has the author, familiar with his subject through deep study and close contact, expressed himself in such a way as to convey the right idea most effectually to the less well-informed reader? These are ever-

recurring questions, and the editor who knows the answer is playing a stellar rôle, though to all outward intents an anonymous one in the magazine world.

Had Miss Dickerson devoted her rare talents of observation, analysis, and description exclusively to authorship, her name would occupy a more conspicuous place on the book shelves devoted to natural history, but she chose to live the part of Martha in the household of letters, performing the unspectacular but essential tasks of selection, supervision, and revision. As a result of that unselfish choice, her fame may fade but her influence will continue to radiate in many directions, and every future reader of *NATURAL HISTORY* as well as every contributor to its pages during her editorship will profit by her wise judgment, her wide vision, and her broad scholarship. It is to be hoped that her splendid achievements and her ideals as to the place which *NATURAL HISTORY* should occupy in the fields of science and of letters will prove an inspiration and a beacon to those who assume those responsibilities from which death alone has relieved her.

A great editor is a mental receiving and transmitting station, connecting the author with his myriad-minded public. Mary Cynthia Dickerson nobly performed this exalted function for *NATURAL HISTORY*.

Her Studies of Reptiles and Amphibians

By G. KINGSLEY NOBLE

Associate Curator [in charge] of Herpetology, American Museum

A GREAT painting is more than an expression of harmony, balance, and sequence in line and color. It is a reflection of a great personality. Mary Cynthia Dickerson produced during her association with

the American Museum a series of masterpieces of the highest rank. Her reptile and amphibian groups, so greatly admired by everyone, epitomize her long years of field study and her understanding of art. In each of the

groups she has, to use her own words, "attempted to suggest the spirit" of the scene. The Bull Frog Group and the Tree Toad Group reflect the spirit of the marshland, a spirit that Miss Dickerson knew and loved.

It may be said that Miss Dickerson had a real affection for each creature she studied. No living material other than that which could be properly

Florida Cypress Swamp, where she made studies for her last and greatest group, she writes:

"No pictures and no reading can carry the effect . . . to the mind. It might be on another planet, so different is it from anything else on this globe. In visiting the Sequoia forests of the Pacific Coast, we are filled with wonder at the magnitude of the trees;



A bull frog at rest in an aquarium.—Miss Dickerson supplemented her extensive field observations by careful studies in the laboratory

cared for was ever permitted in her laboratories. She was a keen observer, an admirable student of the habits of all living things. She engaged in research of importance on fishes, Crustacea, and Lepidoptera, as well as on reptiles and amphibians. Miss Dickerson's greatest interest was always in her scientific work and especially in building up a department of herpetology in the American Museum. And yet the artistic side of every phase of this work appealed to her strongly. In reporting upon the facies of the

at the sight of certain cactus growths on mountain slopes in the Southwest we may receive a thrill as though entering some dimly remembered garden of ancient gods; but nothing has prepared us for the influence of the Florida cypress swamp in the full sunshine of the afternoon."

Miss Dickerson carried on most of her field work alone. She was always an independent and highly original thinker. To take but a single illustration of her originality,—one day when mounting one of the water newts in the

act of shedding its skin, her assistants found it extremely difficult to imitate the shed skin in wax, celluloid, or any other medium. When the matter was referred to Miss Dickerson, she suggested at once exactly the right thing—an onion skin.

Long before Miss Dickerson came to the Museum, she had made an enviable reputation for herself by producing one of the most outstanding contributions to North American natural history—*The Frog Book*. It is to this book that every naturalist must turn sooner or later to be thrilled by the charm of her expression, the beauty of her illustrations, and above all by the spirit of nature which she has transplanted into this great work.

Miss Dickerson perhaps displayed her greatest genius in her work in the Museum, especially in organizing the department of herpetology, of which she was made curator in 1919. From the beginning she realized that a department without a collection was not worthy of the name. Hence, she made every effort to bring material together. It was through her zeal that expeditions were sent to Porto Rico, Santo Domingo, Nicaragua, Mexico, and Florida, primarily to secure reptiles and amphibians. She corresponded with many foreign collectors in China, India, New Zealand, Africa, South America, and elsewhere, in an effort to enlarge the collections. As a result, in

ten years the American Museum collection has increased from one of the smallest to the fourth largest museum collection in the United States, and now includes nearly 50,000 specimens.

Miss Dickerson early interested herself in the technical work of the department. She began a series of investigations of West Indian herpetology and published a description of a new amphisbænian from the Isle of Pines. For several years she studied collections of reptiles from Lower California and the Southwest, especially the collection made by the Albatross Expedition of 1911. In a preliminary paper entitled "Diagnoses of Twenty-Three New Species and a New Genus of Lizards from Lower California" she gave a brief summary of her finds, hoping to publish later an exhaustive treatise on the reptiles of the Southwest. Her health never permitted her to finish this second paper.

Miss Dickerson in all her endeavors was highly idealistic. It is gratifying to know that the ideals for which she worked are gradually being realized. A hall to be used exclusively for reptiles and amphibians is now under construction as part of the new southeast wing of the American Museum. Here will be installed her groups. It is hoped that this hall will reflect something of Miss Dickerson's personality, her love of nature, and her deep understanding of some of its smaller creatures.

Her Achievement in Popularizing the Knowledge of Trees and Forestry

BY BARRINGTON MOORE

Editor-in-Chief of *Ecology*

MISS Dickerson's foresight, imagination, and love of beauty, as well as her scientific spirit and indomitable energy, stood out

strongly in her work as curator of woods and forestry. She fully realized the great opportunities offered by this branch of the American Museum's

activities, and planned to create at the Museum a center of popular education and of research in forests and trees. No such center exists in this country, nor, so far as we know, in any other land. There are forest schools in a number of universities for the training of professional foresters, just as there are schools of engineering, law, and medicine. There are a few ranger schools that give the grounding in forestry required by forest rangers, woodsmen, and others who do not need the higher technical training of the college. The forest departments of the Federal Government and of the states, in addition to their other manifold duties, disseminate information and answer inquiries; the forestry associations reach those already interested. But there is no popular, easily accessible source of free information which comes in touch with the man in the street and shows him clearly and simply what the forests mean in his daily life, and what forestry is doing to protect and grow the thousand and one tree products on which our civilization depends.

Miss Dickerson understood the importance of an awakened and accurately informed public interest in our forests, and foresaw the profound influence which the American Museum could exert in this direction through its contact with the vast population of New York. She realized also that the influence would extend far beyond the city itself, because almost everyone in the country visits New York sooner or later. The great benefit to the public which would flow from a forestry center in New York appealed strongly to her imagination.

The importance of popularizing forestry did not blind Miss Dickerson to the value of research. She under-

stood that research is the foundation of education, and the source from which the materials for instruction are derived. She hoped to make the department of woods and forestry a Mecca which leading foresters from all over the world would feel impelled to visit, when sojourning in America, just as students of evolution now come to the Museum's department of palæontology.



Fungus wheels with their spring plumpness and symmetry

As part of her plan of popular education in forestry Miss Dickerson wrote an excellent pamphlet on the subject. Her knowledge of trees and plants was of a high order, and this little book is one of the best popular works on forestry that has ever been prepared. It had been out of print for a considerable length of time, but instead of merely having it reprinted she wished to revise it and bring it up to date. For this purpose she had collected at



The flowers of the tulip tree, *Liriodendron tulipifera*

the time of her death a considerable amount of material.

Her efforts in exhibitions for the department of woods and forestry were concentrated on the Jesup collection of American woods. This collection, brought together by Charles S. Sargent through the generosity of Morris K. Jesup, is unique. It was made just before our magnificent virgin forests had given way to the ax and the flames. The forests from which many of the specimens were taken have been ruthlessly destroyed, and with them the possibility of ever again making a similar collection. The sections are taken from the finest trees, and represent the growth of many centuries. She intended to place on each tree a label which would be not only scientifically accurate but interesting, and would give some indication of

the conditions under which the tree grew in nature. Owing to the limited space, this required a high degree of skill in writing as well as complete information. The plan was carried out for most but not all of the trees in the collection. She devised the special type of labels on green paper with wooden backing which, while affording the information, blend naturally with the tree trunks. The green setting for the colored pictures of blossoms and leaves placed above the trunks was likewise selected with care and good taste. Her keen love of the beautiful found expression, so far as the Jesup collection is concerned, through the remarkable sprays of leaves, flowers, and fruits which, through her efforts, were represented in wax and other materials and attached to a number of the tree trunks. The large magnolia

blossom, which is the most conspicuous example of this work, gave her genuine pleasure.

Although representative of her activities in herpetology, her well-known Florida group should be considered also in connection with her accomplishments in forestry. In arranging the environment of the Florida animals, she recreated within the Museum an

excellent example of a cypress forest. With consummate skill she reproduced the details, even to the under-story of shrubs and herbs, faithfully and accurately, while at the same time creating a truly beautiful effect. In this group she shows her guiding principle, that science must go hand in hand with beauty in order to reach and benefit mankind.



The emergence of the monarch butterfly is illustrated in this sequence. On the extreme left is the chrysalis with the butterfly showing through. In the adjoining picture the first split in the chrysalis is seen. The photograph next in order is of the butterfly crawling forth; the transparency of the chrysalis is well indicated in this picture. On the extreme right is the butterfly a few seconds after emergence. From *Moths and Butterflies* by Mary C. Dickerson; reproduced by courtesy of Ginn and Company

NOTES

FOSSIL VERTEBRATES

EVOLUTION OF THE PROBOSCIDEA.—For the better part of the last twenty-three years Prof. Henry Fairfield Osborn has been especially studying the evolution of four different kinds of fossil mammals, namely: (1) the rhinoceroses, regarding which he has published twelve papers up to the present time, including the description of *Baluchitherium* in the issue of NATURAL HISTORY for May-June, 1923; (2) the horses, work on which was begun in 1904 and has resulted in fifteen papers, concluding with the Memoir on the types of horses in Oligocene, Miocene, and Pliocene times of North America; (3) the titanotheres, discussed in twelve papers, the last to come from Professor Osborn's pen being the monograph entitled, *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, now in press as *Monograph No. 55* of the United States Geological Survey; (4) the elephants and mastodons, work on which was begun in 1900. The last-mentioned group is represented by twenty-seven papers, including a large *Memoir* entitled, *The Evolution of the Proboscidea*.

The *Memoir* on the Proboscidea ranks next to that on the titanotheres as a most exhaustive piece of research, to which Professor Osborn has given a full measure of devotion and effort; it will present the type description of every kind of proboscidean that has been recorded, the fauna embracing all parts of the world except Australia. Since the Swedish naturalist, Carl Linnæus, named the Indian elephant *Elephas indicus* in 1758, more than a century and a half has elapsed in which no less than 53 genera and 276 species have been named from Europe, Asia, Africa, North America, and South America, as well as from the islands of the Mediterranean, from the East Indies, and from Japan. The *Memoir* will contain a wealth of illustrations, including facsimile reproductions of all the type figures of Proboscidea which have been published and a superb series of pen-line illustrations by Mrs. L. M. Sterling, whose first drawings of proboscideans were made twenty-one years ago. Curator R. W. Tower is arranging for the reception of this great piece of typographic and illustrative work by the American Museum press. It will form the first *Memoir* of a new series, in which each *Memoir* will constitute a volume by itself.

THE ELEPHANTS OF SOUTHWESTERN EUROPE.—In Upper Pliocene times, that is, just before the beginning of the Ice Age, a great international congress of elephants assembled in southwestern Europe, in northern Italy, and in southern France. It is probably a mark of the sagacity of these animals that they came from different continents to enjoy the most delightful climate in the world at the close of Pliocene time. Professor Henry Fairfield Osborn had already reached this opinion in the course of preparing the *Memoir*, referred to in the previous note, but it has been more than confirmed in the two small but invaluable contributions just received from the laboratories of Professor Depéret, entitled: "*Elephas planifrons* Falconer" and "*Mono-graphie des Éléphants Pliocènes de l'Europe et de l'Afrique du Nord*." It is shown in these studies that to this region there migrated two kinds of elephants from the Siwaliks of India, a third kind from northern Asia, a fourth, thus far discovered only in western Europe, and a fifth that turned northward from Africa. North America alone was not represented at this congress of proboscidean sages, because at no time was it the homeland or center of migration or dispersal.

Like Professor Osborn, Professor Depéret is an ardent polyphyletist; he believes in many separate lines of descent dating back to very remote times in the Age of Mammals. It is probable that the combined interest of these two writers will give the death blow to old monophyletic theories, such as that which traces the elephant from the *Stegodon*, and the *Stegodon* from the *Mastodon*. Under date of June 7, 1923, Professor Depéret wrote to Professor Osborn feelingly on this point:

Je vous remercie également des éloges précieux que vous voulez bien faire au sujet de mon étude sur les Éléphants pliocènes. J'ai eu la très grande satisfaction de me trouver d'accord avec vous sur la plupart des questions phylogéniques, notamment sur le parallélisme des rameaux des Éléphants et sur la question de leur origine. Il fallait à tout prix couper le cou à cette vieille erreur de la transformation des Mastodontes en Éléphants, par l'intermédiaire des *Stegodon*. Grâce à notre entente commune, je pense que la vérité pénétrera plus facilement dans le monde des paléontologistes. La publication de mon étude sur les Éléphants a soulevé en France déjà un gros émoi et m'a valu de la plupart de mes confrères des Universités des éloges peut-être exagérés. Mais aucun ne m'a été plus précieux que votre approbation.

BURMESE FOSSILS COLLECTED BY MR. BARNUM BROWN.—The remarkable collection of fossils made by Mr. Barnum Brown in the Siwalik Hills of India through the aid of the Mrs. Henry C. Frick Fund has arrived safely in the American Museum. On completing his highly successful work in this part of India, Mr. Brown traveled eastward to Burma and explored the Upper Eocene beds described some years ago by Guy C. Pilgrim for the Geological Survey of India. These beds are of exceptional interest to the American Museum because they contain fossils closely similar to those found in 1922 by the Third Asiatic Expedition in southeast Mongolia and long previously in the Uinta Mountains of Utah.

Under date of April 28 Mr. Brown wrote from Sagaing of his Burmese trip:

At last I am through with the long bullock-cart trip, which lasted nearly two months and covered 150 miles of teak-bamboo jungle over trails that are indescribable.

Through lack of roads I was forced to abandon all thought of collecting in the Irrawaddy series westward, and confined my attention exclusively to the Eocene Pondaung purple clays, the only member that contains vertebrate fossils.

The collection is small, but better than all combined collections made heretofore, and I believe contains all described species. The choice specimens are a complete skull and lower jaws of a small anthracothere [an animal related to the pigs]; lower jaws of *Metamynodon* [a rhinoceros]; upper and lower dentition of *Anthracohyus* from the Eocene, and half of a lower jaw of *Stegodon*, with a good tooth from the Irrawaddy series. This is a curious fauna in which carnivores, insectivores, and rodents are absent.

The conditions of occurrence in the Eocene beds are unique. Vertebrate fossils are confined to highly colored clays at the top of the Pondaung series, and were never found in the sandstones above or below. I have some doubts whether they are a part of the Pondaung Age. These clays are about fifty feet thick, predominantly a brilliant purple; ochrous yellow and white clays form contact with sandstones above and below, and the central fossiliferous part is reddish purple.

Near Myaing the purple clays appear first where the entire pre-Irrawaddy series are on edge, thence northwestward they appear and disappear at intervals in patches a few yards in length according to the amount of folding and displacement that has taken place. A few miles beyond Myaing the underbrush increases to forest and dense jungle, through which it was exceedingly difficult to follow a course. I would frequently ride and walk ten hours without seeing a fossil, for they occur in localized areas with barren places between.

Contrary to published data, I found mammal remains nearly as numerous as those of

reptiles and sufficiently associated to spur one on with the hope of securing good material at the next exposure, but following this purple streak was like chasing a rainbow.

Somewhere in Burma favorable exposures of this purple Eocene bed will develop good material, probably on the westward slope of the Pondaung uplift or northeastward crossing into China, but it will be a long time before these areas are accessible.

Subsequently Mr. Brown proceeded up the Irrawaddy River to examine formations of the more recent Miocene Age. Thence his plans were to go westward and examine the early Pliocene quarries on the Island of Samos, with the expectation of returning to the Museum toward the end of the year.

THE PALÆONTOLOGY OF CHINA.—Dr. A. W. Grabau, formerly professor of palæontology in Columbia University, author of one of the most valuable treatises on stratigraphic palæontology, and now connected with the Geological Survey of China, is engaged in the publication of the *Palæontologia Sinica*, embracing both the invertebrate and the vertebrate palæontology of China. He writes from Peking, April 18, 1923:

The *Palæontologia Sinica* is our pet child and we hope to make a big success of it. The publication is assured for a long time and we have a very good artist to make the illustrations. It is indeed a great pleasure to cooperate with your party and I have had many interesting evenings with Doctor Morris discussing the details of the campaign for the Palæozoic rocks in the Mongolian Geosyncline. The problem is an extremely interesting one and the Third Asiatic Expedition can make a most far-reaching contribution to the geology of Asia by such detailed work on these old rocks. You will be interested in the series of the palæogeographic maps of Asia which we are preparing and which will soon be published by the Survey. They take in every phase of the Palæozoic and give a good picture of the changes in the conditions as they affected Asia in the past. We hope also to have a small number of palæogeographic maps of the Mesozoic and the Cenozoic.

Doctor Grabau is engaged on the description of all the collections of invertebrate fossils brought back to Peking by the Third Asiatic Expedition. Dr. Charles P. Berkey, under date of June 9, 1923, pays a high tribute to Doctor Grabau's work in this field:

I do not know of anyone in the world who is more versatile and ingenious or more suggestive in the field of stratigraphy than Doctor Grabau. He ought to have opportunity, after finishing his work in China, to undertake a revision of the stratigraphy of the world. That ought to be his major life

work and to do it he ought to be supported in American institutions. I devoutly hope that the American Museum of Natural History, together with the research interests of Columbia University, perhaps by securing some special endowment or funds, may be able to establish him in that work on a basis that would insure a valuable scientific contribution of interest to every geologist in the world and to every country.

THE ANNUAL MEETING OF THE PALÆONTOLOGISCHE GESELLSCHAFT for the year 1923 was held in Vienna under the presidency of Professor Othenio Abel and the secretaryship of O. Antonius. The meeting opened in the great hall of the University on Monday, September 24, with an address by Professor J. F. Pompeckj entitled "Die Anfänge des Lebens." Tuesday and Wednesday were devoted respectively to a visit to the palace of Schönbrunn and to a geological excursion. On Thursday evening President Abel delivered his address, "Lebensbild der eiszeitlichen Tierwelt der Drachenhöhle bei Mixnitz in Steiermark." Friday was set apart for excursions to the Kahlenberg and to Klosterneuburg. On Saturday the society visited the Drachenhöhle in Rötelsstein and, under the guidance of Mr. Adolf Mayer, the celebrated Lurgrotte. Other excursions were arranged to the Tertiary of the Vienna basin and to the Sonnwendstein, under the guidance respectively of F. X. Schaffer and L. Kober.

FOSSIL MAMMALS OF THE FAYÛM.—In 1920-21 Dr. Hikoshichirô Matsumoto, professor in the Tôhoku Imperial University of Sendai, Japan, visited this country and spent several months in studying the palæontological collections of this museum. He undertook as a special research the revision and description of the fossil proboscideans and hyracoids in the collection obtained in the Fayûm district of Egypt in 1907 by the expedition in charge of Professor Henry Fairfield Osborn. This is one of five important collections made from the Fayûm, the others being in London, Cairo, Stuttgart, and Munich; but it has been only in small part described. The two most important groups among its fossil mammals were entrusted to Doctor Matsumoto for such description, and the result of his very thorough and able study of the material is now, after a considerable delay due to direct and indirect effects of war conditions, in course of publication in the American Museum *Bulletin*. It will appear in three articles, the first dealing with *Mæritherium*, the second

with *Palæomastodon*, and the third with the hyracoid genera. Preliminary abstracts of his results have been published in the American Museum *Novitates*, No. 51, and in the *Proceedings* of the Zoölogical Society of London, December, 1921.

He discusses at length the difficult problem of the true relations of *Mæritherium* to the ancestry of the proboscideans. The genus has been considered, on the one hand, as a direct or nearly direct ancestor of *Palæomastodon* and the later mastodons and elephants; on the other, as not in the proboscidean order at all but more nearly related to the siremians. Matsumoto takes an intermediate position, regarding the animal as a primitive member of the Proboscidea but not close to the ancestral line of the mastodons and elephants. In his review of *Palæomastodon* he shows that the genus is a composite of two already distinct lines or phyla: one of these, to which the genus name is restricted, has a somewhat shortened jaw and other characters that indicate it as an early ancestor of the true mastodon of North America; the other, to which the name *Phiomia* has been applied, has a very long jaw and other characters appropriate to an ancestor of the long-jawed mastodons, which inhabited all of the northern continents during the later Tertiary Period.

Matsumoto's third paper deals with the Hyracoidea, an order of mammals now nearly extinct, the little hyraxes or coneys of Syria and north and east Africa being the only survivors. In the Fayûm deposits are found remains of a great number and variety of animals allied to the coney, some as large as a pig or even a cow. From this and other evidence it is believed that they were once an important order of herbivorous animals which in Tertiary Africa took the place in part of the modern types of herbivora that had not then reached that continent.—D. W. M.

THE CENTENARY OF JOSEPH LEIDY

The year 1923 is the centenary of the birth of one of the most distinguished scientists America has produced—Joseph Leidy of Philadelphia. The occasion will be celebrated not on Joseph Leidy's birthday, September 9, which falls within a season of the year when formal gatherings are few, but on December 8 by the Academy of Natural Sciences of Philadelphia, with which venerable and honorable institution Joseph Leidy was most closely associated throughout his great career.

Leidy's life work cannot be characterized in a single sentence; it was wonderfully thorough and broad. He was master of several sciences—anatomy, microscopy, helminthology, palaeontology. He was a draughtsman of unusual skill and a writer who had a most scrupulous regard for truthful and accurate description. In contrast to his younger contemporary, Edward Drinker Cope, Joseph Leidy belonged rather to the *École des Faits* of Cuvier than to any school of speculation. It would be difficult to single out the greatest of his several masterpieces, but the volume which will probably endure longest is the great palaeontological memoir of 1869, which is bound to remain a classic because of its accuracy of description, beauty of illustration, and breadth of erudition. Leidy was honored and beloved; he had many friends and no scientific enemies. He lived quietly, unostentatiously, and leaves in our minds the impression of a great personality.

WILLIAM A. HAINES

In the July-August issue of *NATURAL HISTORY* (p. 423) reference was made to the gift of a portrait of William A. Haines whose distinguished rôle in the early history of the American Museum is fittingly recalled in this connection. He was one of those principally concerned in promoting the Museum idea and in making it an actuality. He was a member of a Special Committee of three that was appointed to perfect the organization of the proposed Museum and that nominated the first Board of Trustees. A memorable meeting of this Board took place at the residence of Mr. Haines, in which a plan for subscriptions was formulated and steps taken that resulted in the establishment of the American Museum on an assured footing. Mr. Haines' preëminent ability as an organizer received recognition in his appointment with Messrs. Joseph H. Choate and Howard Potter to the committee that prepared a charter for the new institution, suggested a name for it, and applied to the Legislature for the passage of an act of incorporation. On April 6, 1869, the application was acted upon favorably by both houses of the Legislature, and the American Museum took its place among the institutions of the city and the nation.

In addition to being one of the twenty-one Founders, or original Board, of the Museum, Mr. Haines had the distinction of being the



WILLIAM A. HAINES.—To his remarkable ability as an organizer and his untiring devotion the American Museum is not a little indebted for its start in life. From a painting recently presented to the Museum by Miss Emily Somers Haines in fulfillment of a bequest by her brother

first Chairman of the Executive Committee. His activities were not relaxed even after the establishment of the Museum had been assured, thanks to his invaluable coöperation. Throughout the crucial years of its early history his loyal support was no small factor in promoting the welfare of the institution. When a change of site from the Arsenal in Central Park, where the Museum was first housed, became imperative, Mr. Haines was one of three charged with the responsibility of selecting the spot that should be its permanent home, and subsequently he served as a member of a committee of four that took under consideration the architectural plans that were submitted for the Museum. In 1880, at the premature age of fifty-eight, Mr. Haines was summoned irrevocably from a world that he had enriched by his personality and his labors. Yet before death came, he had had the satisfaction of seeing the institution which he and other public-spirited men had visioned, well started on its career of public service, for six years previously the cornerstone of the first section of the present Museum edifice had been laid by President Grant in the presence of an audience that included three members of the President's

official family, the Governor of the State of New York, the Mayor of the city, and many other distinguished citizens.

THE FAUNTHORPE-VERNAY INDIAN EXPEDITION OF 1923

Colonel J. C. Faunthorpe has suggested that the name of Mr. Arthur Vernay, who has contributed in so many important ways to the success of the expedition in which he has been participating, be coupled with his own in all future references thereto, and President Henry Fairfield Osborn has approved of changing the name of the undertaking from the Faunthorpe Indian Expedition of 1923 to the Faunthorpe-Vernay Indian Expedition of 1923.

Too much stress cannot be laid on the importance of the results achieved by this expedition, thanks to the enterprise and devotion of its leaders. The specimens obtained assure the perpetuation as museum groups of a number of the distinctive animals of India that are on the road to extinction. That the expedition was undertaken only barely in time is evidenced by the exceeding rarity of some of the animals sought, witness, for instance, the pink-headed.

SEARCH FOR PINK-HEADED DUCK.—Colonel Faunthorpe writes from Lucknow, May 25, 1923, that he has thus far been unable to secure specimens of the pink-headed duck.

I regret to say that we have entirely failed to obtain or even hear of a specimen of the pink-headed duck. I had some hopes of obtaining one on the Nepal border north of Oudh as one specimen was undoubtedly shot there two years ago. I quote a letter from a man now resident in the Kheri District on the subject. It was his brother, now in England, who shot it.

"I have heard from Jack about the pink-headed duck. He says he shot a pink-headed duck in the Nimbwa Bojh Swamp, that broad patch of water between the two *bojhis*. He found it with a number of teal and thought it was a red-headed pochard except for the head. It was flying backwards and forwards and at last he shot it. If it had not been for his dog, he would not have recovered it as it fell into thick *narkul*. He took it to camp and showed it to de Carteret, who informed him what it was. He skinned it and de Carteret sent it to the Bombay Natural History Society. It is the only one de Carteret has ever seen."

I spent four and a half years in this district and never heard of the bird during that time. There is, however, no doubt that one specimen was shot last year in the Shahjahanpur District, which adjoins Kheri District on the west, and another specimen two years ago in Kheri District itself. Hence, although enquiries tend to show that it is extinct in Behar and

Orisa, where in old days it occurred most frequently, it is possible that there may be here and there a pair nesting in some inaccessible swamp in or near the Nepal Terai. It is interesting to observe that the specimens shot in Kheri and Shahjahanpur were flying in company with a lot of teal.

THE VANISHING LION OF INDIA.—The lion, which was formerly abundant in India, is now approaching the vanishing point and very wisely the Indian government is not granting permission to shoot specimens except in very special cases. It is the hope that through the good offices of the Indian government such permission may be given to Colonel Faunthorpe next season and that the American Museum may thus come into the possession of a specimen of this rare animal. Of the Indian lion Colonel Faunthorpe writes:

The Gir forest in Kathiawar, Bombay Presidency, is the only place where the Indian lion now survives. In olden days they were not uncommon in central India and as far north as Delhi, and it is on record that one was shot in Allahabad District, or near there as late as 1865. The disappearance of the lion may, I think, be ascribed to two causes—(1), it lived in a comparatively open country and was easily located and shot, and (2) when tigers became abundant, they drove out the lions. In certain parts of the country where heavy jungles still exist, the tiger is in no danger of extinction at present. For instance, in the Kheri District, from which we have just returned, there are certainly more tigers than there were ten years ago.

In another connection Colonel Faunthorpe writes:

Some African lions were introduced into India ten or more years ago. One of the native princes bought some of these lions and turned them loose. It was the intention to feed donkeys to them, but the lions took to eating villagers exclusively. Accordingly efforts were made to destroy the lions and I believe they were all shot.

These African lions are not to be confused with the Indian lion of the Gir forest.

THE MAMMALS OF BURMA.—The final journey of the present season for Colonel Faunthorpe and Mr. Vernay was into Burma. In a letter dated from Lucknow, June 6, Colonel Faunthorpe tells of their experiences:

Up to the time I left Burma we had secured material for a good group of thamin, or brow-antlered deer, namely one large stag, one small stag, two does, and one fawn. This will make a very beautiful group. We had up to the time I left secured only one bull tsine, and Vernay stayed on in order to get another bull and a cow, which I expect he has done by this time. The pursuit of the tsine involves hard work as he is a very active and wary

animal and, when disturbed, travels for great distances. All the tracking was on foot in great heat over extremely broken country. We also obtained a group of the kakar, or barking deer,—a pretty little animal, somewhat resembling the roe deer of Europe.

Among the other animals secured by the expedition in Burma were two kinds of bamboo rat and various kinds of snakes, including two specimens of Russell's viper.

Answering certain inquiries made by President Osborn, Colonel Faunthorpe had written, previous to the letter just quoted, that there are two kinds of rhinoceroses still living in Burma and Siam (1) *R. sondaicus* and (2) the two-horned *R. lasiotis*, related to the *sumatrensis*. Both these animals are much smaller than the great Indian one-horned *R. indicus*, of which the expedition secured a very fine series in Nepal and which occurs also, although rarely, in Assam. There are very few of *sondaicus* and *lasiotis* living in Burma and Colonel Faunthorpe states that the government has recently prohibited the shooting of them,—perhaps too late. *R. sondaicus* occurs also in the almost impenetrable swamps of the Bengal sunderbund, or at least used to be there.

A SURVEY OF THE EXPEDITION.—Mr. Vernay reached England late in June and some excerpts from a letter which he wrote at that time to President Henry Fairfield Osborn may fittingly be quoted in conclusion as a summary of the work of the expedition and as an evidence of the spirit that has actuated those in charge of it.

I arrived in England on Sunday last, and am having prepared a complete list with field notes of the various specimens Colonel Faunthorpe and I have obtained. This will be forwarded in due course. We are very pleased with the results of the expedition, and I think that within the six months we have had all the good fortune that we could possibly expect. Every assistance has been given us by the British government as well as by various ruling princes. Without this help and the extremely able organization conducted by Colonel Faunthorpe, the obtaining of the collection would have been impossible. In birds we have not been particularly successful, as the original ornithologist whom we hoped to obtain, died a few months before our arrival in India. Mr. Jonas [the preparator designated by the Museum to accompany the expedition] has done his work extremely well, and I think all of the skins and skeletal material will arrive in perfect condition. As far as possible the skins have been shipped to the Museum in tin-lined cases, hermetically sealed. The bones have all been poisoned and sent in wooden cases. . . .

We have taken a number of interesting photographs, many of which will be of great assistance in the mounting of the specimens. We have taken actual photographs of the jungle, or whatever might be the character of the place where the animal was shot. We also had moving pictures taken expressly for the purpose of showing environment. The chinkara country, for instance, has a peculiarity of its own, and a few feet of moving pictures will give the taxidermist a better idea of its character than any quantity of ordinary photographs. Our motion-picture films should prove interesting as we have wild elephant within a few feet of the camera, tiger within seven yards of the camera, tiger charging elephant, tiger running across a *nullah*, black buck, swamp deer, chital, nilgai, scenes connected with the ringing of tiger in Nepal, and many others.

In closing Mr. Vernay writes:

The great point of the whole thing is that we do feel that this expedition is really going to have, although in a very small way, the effect of creating in some channels better feeling between our two countries. Although it is only a very small brick in the building of a great friendship which is daily increasing, every brick counts, and if a few other people would supply a bit of mortar here and there, instead of tumbling the bricks down, the world would surely be a happier place.

To my mind England and America stand for the best there is in our civilization today. A perfect understanding between the two countries, an understanding which would be apparent to the whole world, would mean a world peace.

THE THIRD ASIATIC EXPEDITION

LATEST REPORTS FROM MR. ROY CHAPMAN ANDREWS.—The leader of the Expedition, sends the following stirring budget of news from the field:

In Camp, Erhlien (Iren Dabasu)
May 15, 1923.

I returned to camp four days ago and found all well. I can also report progress—in fact, so much progress that it is going to be difficult to get away from here. Just before I left Camp Granger, Morris and I made an exploration trip to the east to follow out the Cretaceous exposure which we suspected must reappear before long. We found it eight miles from camp and also saw much fragmentary dinosaur material lying about on the surface. While I was gone the men prospected the exposure and found a really extraordinary deposit of dinosaur bones. The whole ridge seems to be full of them. We think there is work here for three or four men for an entire season.

Johnson found an enormous "mine" of bones where there are carnivores and herbivores mixed up in a great mass. This makes it difficult to remove the material but there may be enough to mount skeletons of both types.



THE THIRD ASIATIC EXPEDITION ON ITS WAY TO IREN DABASU, APRIL 21, 1923

While the camel train trudges on, the swifter units of transportation are making a halt until repairs have been completed on one of the trucks

They have exposed complete tails of both a carnivore and herbivore lying one on top of the other, as well as complete limbs and feet and many vertebrae, some with ribs attached. Also some skull bones and, at the moment, about 16 jaws with teeth. The "mine" is only half worked out and already there is enough for paper restorations of both types—whether or not there will be sufficient to mount skeletons we do not know as yet. I think there will be, because I am an optimist. Half a dozen complete feet and limbs have been removed and many separate bones in good condition.

The new men are much excited and Olsen says, "Why the whole hill is full of bones. I can't start to work around one before I strike another." Yesterday we packed boxes with what has already been removed and have about 800 pounds. That, you must remember, is with the "mine" only half worked out. There is so much stuff that I will have to send a car back to Kalgan with it—we can't carry it on with us. If we keep on at this rate you might as well start building operations on another wing for the Asiatic Hall! The herbivorous dinosaurs seem to be of the *Iguanodon* type rather than *Trachodon*, and the carnivores are both large and small types. As yet we have found no jaws of the carnivores but the herbivorous jaws are abundant and remarkably complete.

In Camp, Irden Maunah
May 25, 1923.

It is impossible to write with ink for a terrible storm is roaring and the sand sifts on my paper so rapidly that a pen will not write. For five days we have been having the most "beastly" weather I have ever known in Mongolia—terrific gales and such sand storms that we can see only a few hundred yards. The basin below us is simply smoking with yellow clouds of sand and everything in our tent is inches deep in sand. We have been able to work only one day since we came, for the gale has not ceased for five days.

The day after we arrived here—the only one in which we could do prospecting—Granger found the most beautiful titanotherium skull you could ever wish to see. It is the *Diplacodon* type with horn knobs about two inches high and almost as perfect as though the animal had died last week. I understand there is only one other—that at Princeton. Right under the skull was an extra pair of lower jaws of a somewhat larger individual—absolutely perfect. Twenty feet away was another skull but that one seems to be somewhat broken, though it has not yet been excavated because of the weather. On the same day Olsen found and removed a fine palate of the same beast—also several jaws of lophiodonts—all these were found in the *first day's* prospecting, so you see what a rich spot this is.

I went up to see Johnson and Kaisen yesterday. We left them at the dinosaur quarry in Erhlien 23 miles away. They say that the bone is getting better and better the farther they go down. They have enough for

mounts of both large *Iguanodon* and smaller carnivore types—legs, feet, and jaws complete of other individuals and the quarry shows no sign of being worked out. It is a remarkable place.

While I am away in Urga, they will continue to work at Erhlien on the dinosaurs. Olsen, Granger, and Morris will stay at this camp, working in the upper Eocene.

ARCHAEOLOGY

INVALUABLE GIFT FROM THE NATURAL HISTORY MUSEUM AT BRUSSELS.—The American Museum has just received from the Natural History Museum at Brussels an invaluable gift of flint implements representing the entire Palæolithic and Neolithic systems of Prof. A. Rutot, the distinguished head of the archaeological department of the Brussels institution. The collection includes a succession of industries going back to Oligocene time, namely:

- I. Industrie Fagnienne, middle Oligocene, from Boncelles, 52 pieces
- II. Industrie Pre-Chellenne, base of the Lower Quaternary, from Spiennes, near Mons, 51 pieces
- III. Industrie Strepyenne, Lower Quaternary, from Spienne and Strepy, 42 pieces
- IV. Industrie Chellenne, Lower Quaternary, from the valleys of the Haine and the Trouville, 22 pieces
- V. Industrie Acheulenne inferieure, middle Quaternary from the valley of the Haine, 6 pieces
- IIbis. Industrie Reutelienne, Lower Quaternary, from Elonges and Hornu-Wasmes, 26 pieces (Contemporary with the Pre-Chellean.)
- IVbis. Industrie Mafflienne, Lower Quaternary, Exploitation Hardenpont at St. Symphorien, near Mons, 16 pieces (Contemporary with the Chellean)
- Vbis. Industrie Mesvinienne, middle Quaternary, Exploitation Helin at Spiennes, 34 pieces

NEOLITHIC

- A. Industrie Flenusienne, commencement of modern epoch, from La Flenu and Spiennes, 27 pieces
- B. Industrie Spiennienne, middle of the Neolithic, from Spiennes and St. Symphorien, 57 pieces

Each of these industries, certain of which are in dispute among archaeologists, is represented by a valuable series of implements bearing the inscription of Professor Rutot.

This gift greatly strengthens the collection of European archaeology which President Henry Fairfield Osborn, vigorously aided by Mr. N. C. Nelson, associate curator of archaeology, American Museum, has been bringing together for years past. This acquisition will be arranged in a case by itself, showing the entire Rutot System of classification of the Pre-palæolithic, the Palæolithic, and the Neolithic, which has been extensively quoted, as in a recent work of Professor Harris Wilder, *Man's Prehistoric Past*. The gift is another evidence of the very generous feeling which the Belgians and the Belgian insti-

tutions of science entertain for the American Museum. Our readers will recall the splendid ethnological collection presented to the Museum by King Leopold, as well as the coöperation of the Belgian government in connection with the obtaining of the Congo collection.

THE ANTIQUITY OF MAN.—A paper on this ever interesting problem, prepared jointly by Professor Henry Fairfield Osborn and Dr. Chester A. Reeds and published by the Geological Society of America, under the title, "Old and New Standards of Pleistocene Division in Relation to the Pre-history of Man in Europe," has attracted favorable comment in France and Germany. Dr. Ch. Barrois, now the senior geologist of France, wrote Professor Osborn under date of January 20, 1923:

Je vous prie d'agréer mes remerciements pour les beaux et intéressants mémoires que vous avez bien voulu m'adresser. Votre synthèse de nos connaissances sur les divisions du Pleistocène et le préhistoire de l'homme est ce que nous avons de plus complet, de plus judicieux, de plus pondéré en même temps que de plus élevé sur la matière. Je vous en félicite bien vivement en même temps que je vous en remercie. Je le transmets à mon assistant M. Dubois qui étudie depuis quelques années les formations Pleistocènes de nos côtes françaises, et en tirera, j'espère, meilleur parti que moi, à l'âge où je suis arrivé.

Professor Charles Depéret, the leading authority in France on the correlation of the Age of Mammals and of the Age of Man, wrote (June 7, 1923):

Mon cher confrère et ami:

Je suis vraiment impardonnable d'être resté si longtemps sans vous écrire pour vous remercier de l'amicale bienveillance avec laquelle vous avez bien voulu exposer et défendre pour les lecteurs de langue anglaise mes essais de coordination générale des temps quaternaires, en partant de la base des formations marines. Je vous en suis profondément reconnaissant et j'ai la certitude que votre puissante intervention contribuera beaucoup à répandre et à faire triompher la thèse que je soutiens. Naturellement, comme toutes les choses un peu nouvelles, cela suscite des objections et des résistances de la part des anciens, habitués à d'autres idées, et qui ne veulent pas en changer. Mais l'appui que j'ai trouvé auprès de vous en Amérique, auprès de MM. Sollas et Dewey en Angleterre, de MM. Ternier, de Margerie, Kilian, etc. en France, Lugeon en Suisse etc., etc., me font espérer un succès définitif peu éloigné. Je n'ai pas voulu, à dessein, aborder de front les causes premières des changements de niveau des mers et des fleuves, c'est-à-dire en somme les théories de la déformation de la terre; cela m'eût mené trop loin et sur un terrain trop difficile. J'ai préféré m'en

tenir pour le moment au terrain solide des faits. Merci encore et du fond du cœur.

Following the discussion of the antiquity of man in Osborn's *Men of the Old Stone Age* of 1914, the Reeds-Osborn paper of 1922 is another attempt to make a complete synthesis of the thirteen parallel changes in the earth history and the life history of western Europe during the Age of Man. It is very gratifying to know that two of the leading geologists of France welcome this synthesis, are favorably disposed toward it, and do not regard it as an intrusion into their special fields of work.

LES FIANCÉES DU SOLEIL BY V. FORBIN.—The appeal of the dim beginnings of human society is evidenced not only by the strictly scientific studies prepared by archæologists but by works of fiction in which the authors have interwoven romance and fact for the interest and stimulation of their readers. *Les Fiancées du Soleil*, by V. Forbin, is a recent addition to this group of fiction, dealing as it does in vivid style with what from the standpoint of culture is perhaps the most interesting of the early races of man, the Crô-Magnon. Monsieur Forbin's story gives a spirited account of the triumph of the intellect over brute force, of the spirit of invention and reason rising in mastery over the obstacles existing in the rude world at the close of the Glacial Period. Naturally one looks to a work of fiction for a dramatic and artistic presentation of life rather than for a literal rendering of fact, and M. Forbin is too conscious of the proper mission of fiction to permit himself to be fettered by details that might be obstructive to the development of his story. Nevertheless, M. Forbin has the advantage over many other writers of fiction in being genuinely interested in science, an advantage which is bound to manifest itself when he turns, as in the present instance, to a subject that has been a fruitful field of scientific investigation by scholars in Europe and America. To one of these, Prof. Henry Fairfield Osborn, of the American Museum, the book is dedicated by the author.

ARRANGEMENT OF THE ARCHÆOLOGICAL COLLECTIONS.—It is probable that the exhibition hall in the American Museum containing side by side the archæological collections of Europe and America will be named the hall of the prehistory of man. The collections from America are very extensive although in many special fields far behind those of other mu-

seums. The collections from Europe are growing so rapidly that the hope seems justified that there will soon be a very representative sequence from the beginning to the end of the Stone Age and on into the Bronze Age. The collections of New Stone Age have just received a rich accession of Swiss dwelling material, which will be noted in a later number of *NATURAL HISTORY* when the contents of the shipment are more fully known. During the last winter Mr. N. C. Nelson, associate curator of archæology, classified

AWARD OF THE ROOSEVELT MEDAL OF HONOR

PROMOTION OF NATURAL HISTORY.—The Roosevelt Memorial Association appointed the following committee to consider the award of its first three Medals of Honor: Dr. John H. Finley, chairman, Col. William Boyce Thompson, Secretary of Agriculture, Henry Cantwell Wallace, Governor Gifford Pinchot of Pennsylvania, the Hon. Oscar S. Straus, who was Secretary of Commerce and Labor in President Roosevelt's Cabinet, and Mrs. C.



The Roosevelt Memorial Association Medal of Honor, bestowed upon Professor Henry Fairfield Osborn of the American Museum for his "promotion of the study of natural history." The presentation of the medal was made by President Harding shortly before he undertook his trip to Alaska

about 4000 old-world archæological objects and catalogued nearly 3000 of them. A part of this material, such as the type specimens from Chelles, has been placed on view,—but further exhibits are planned when new cases can be prepared for the reception of this collection. The major part of Mr. Nelson's time for two or three years past has been taken up with the American collections. With the constant accumulation of new archæological material it is imperative that proper storage space be provided through the condensation of old material as a preliminary to the proper revision of the collections themselves. Some day the department of anthropology of the Museum will have a larger archæological staff, capable of assisting Mr. Nelson in arranging the archæological material so that it will connect with the prehistory of man as displayed in the hall of the Age of Man and in the exhibits of physical anthropology prepared by Dr. Louis R. Sullivan.

Grant La Farge. The recipients chosen by the committee were General Leonard Wood, especially for his "promotion of the national defense"; Miss Louisa Lee Schuyler for her service in promoting the welfare of women and children; Prof. Henry Fairfield Osborn for the promotion of the study of natural history. The ceremony of presentation took place in the east room of the White House on Friday, June 15, at four-thirty. President and Mrs. Harding, several members of the Cabinet, the French Ambassador, and a large number of representatives of the Roosevelt Memorial Association and other distinguished guests were present. Addresses on behalf of the Association were made by Director Hermann Hagedorn. The medals were handed to President Harding, who with brief and appropriate remarks presented them to the recipients or their representatives. As shown in the accompanying illustrations, the medal, designed by James Earle Fraser, is after the

style of Italian models of the school of Vitore Pisano, of the middle of the fifteenth century. The face of the medal bears a superb head of Theodore Roosevelt, with the years of his birth and death, MDCCCLVIII and MCMXIX, and the words "For distinguished service" above. In the center of the obverse is a flaming sword, across which is written. "If I must choose between righteousness and peace I choose righteousness." Encircling the medal are the words "Roosevelt Memorial Association Medal of Honor." The rim of the medal awarded to the President of the American Museum is inscribed "To Henry Fairfield Osborn for the promotion of the study of natural history." In his brief speech of presentation President Harding said:

It is a very rare distinction to have so pursued one's activity as to earn the devoted and trusted friendship of the late Theodore Roosevelt, and it is a very great distinction, sir, to be at the head of what is rated to be the leading institution of its kind in the world. And now, sir, it is an added distinction to have from this source a mark of tribute and approval which I know that the late Colonel Roosevelt himself would most cordially approve. It is a pleasure to be the agency of transmission, and I beg to bestow the medal in the name of the Roosevelt Memorial Association, with my very cordial congratulations.

The medal was accepted by the President of the Museum as a tribute on the part of the Roosevelt Memorial Association and the President of the United States to the work which the American Museum is doing in the promotion of the love and study of natural history throughout the United States.

The Roosevelt Memorial Association, under the presidency of Col. William Boyce Thompson and the direction of Mr. Hermann Hagedorn, has raised a very large sum for the erection of a national memorial to Theodore Roosevelt in the city of Washington. The character of the memorial has not yet been decided upon, but prominent among the designs under consideration is the monumental statue of a lion by Mr. Carl E. Akeley.

A PERMANENT MEMORIAL TO ROOSEVELT

THIRD MEETING OF THE MEMORIAL COMMISSION.—New York State will not be behind the nation in keeping alive the memory and influence of its most distinguished son. The original Roosevelt Memorial Commission of the State of New York was appointed by Governor Smith and the presiding officers of the State Senate and Assembly in 1920, and

the Commission expects to make its final report to the Governor and the Legislature upon the opening of the Legislature of 1924. The many projects brought before the Commission from all parts of the state and country have been considered with great care and at the second meeting, held in Albany, the following resolution proposed by Mr. Kiernan was unanimously adopted:

Resolved: That it is desirable to adopt a form of memorial which may be utilized for scientific, educational or administrative purposes and thus reflect the chief activities of Colonel Roosevelt's life.

Since the purposes of the Commission were clearly declared in this resolution, no further suggestions have been received as to the character of the state memorial. The Regents of the State of New York were especially invited to prepare and present what may be known as the City of Albany plan of a memorial; similarly the Trustees of the American Museum were invited to prepare and present what may be known as the City of New York plan of memorial. The third meeting of the Commission was called in the American Museum on Wednesday, June 27, to receive the delegates from these two bodies. The following members of the Commission were present: Henry F. Osborn, Chairman, Senator George L. Thompson, Senator Samuel J. Ramsperger, Louis A. Cuvillier, Peter D. Kiernan, George N. Pindar, Secretary.

The City of Albany plan was presented by the Hon. William Bondy and by Dr. John M. Clarke, director of the State Museum. It provides for a new natural history museum, to be erected in the City of Albany on a site presented by the City Council, at an estimated cost of \$5,000,000; it is proposed to call the institution the Theodore Roosevelt Museum of Natural History; it is planned that the eastern wing of the museum shall be constructed first, at an estimated cost of \$1,493,000, leaving the center and western wings to be built at a later date.

The City of New York plan was presented by four speakers as follows: Albert Gallatin, Commissioner of Parks, designated Manhattan Square, to be renamed Roosevelt Square, as the site, to be approached from the eastern side of the city by an intermuseum promenade which, it was suggested, might be called "The Roosevelt Trail"; Mr. A. Perry Osborn, of the Board of Trustees of the American Museum, presented the general object and purpose to be attained by the erection of a monumental

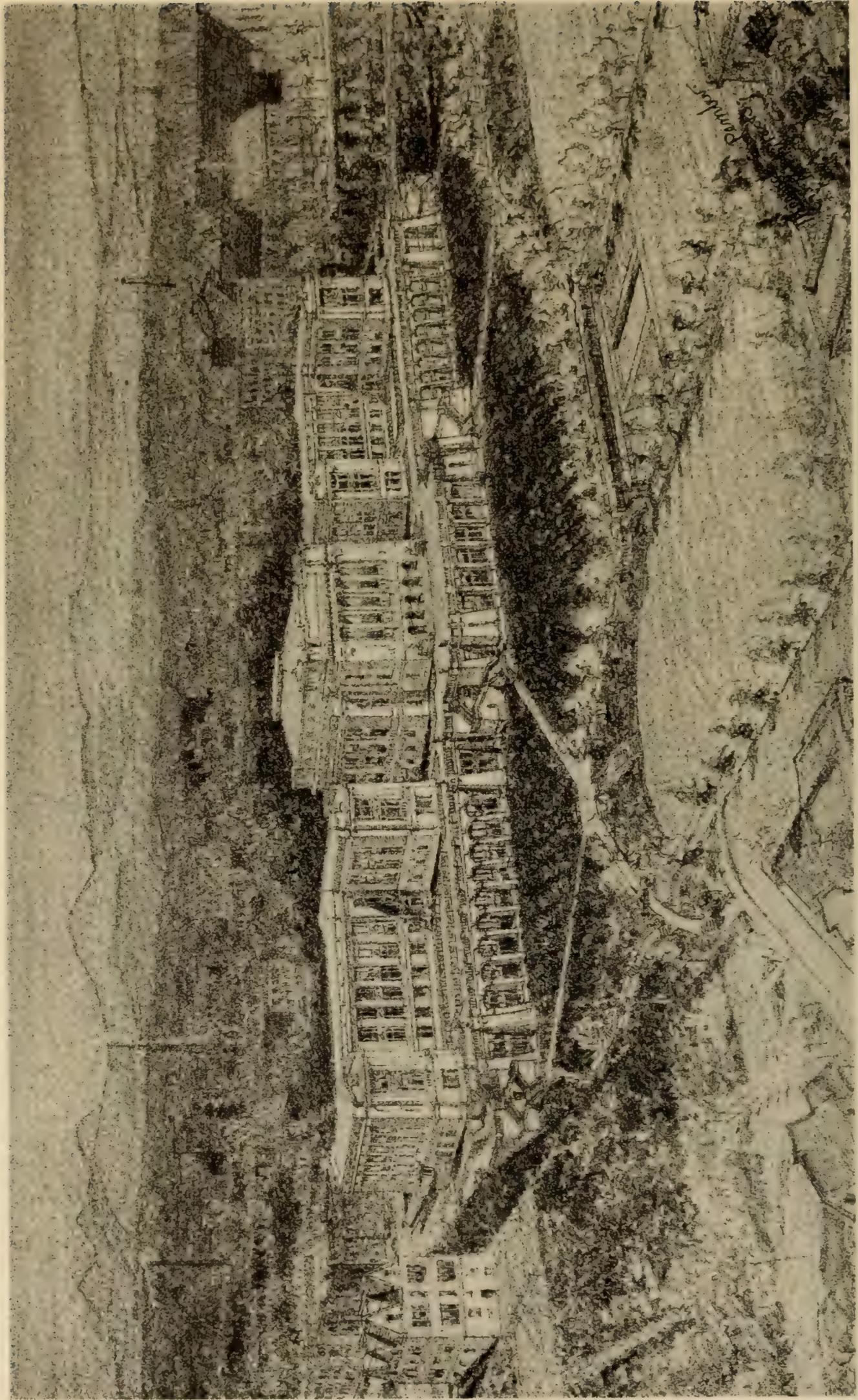


Exterior view



Interior view

CITY OF NEW YORK
 PROPOSED
 THEODORE ROOSEVELT
 MEMORIAL
 Plan
 as presented by the
 Trustees of the
 American Museum
 June 27, 1923



CITY OF ALBANY PROPOSED THEODORE ROOSEVELT MUSEUM OF NATURAL HISTORY

Plan as presented by the Regents, June 27, 1923

building on this site; Mr. Breck Trowbridge, for the firm of Trowbridge & Livingston, architects, described the character of the building, both interior and exterior, as designed to dominate not only the American Museum building group but the west side of Central Park; Mr. Akeley outlined the plan and purposes of the Roosevelt African Hall, of which he is the originator and designer.

After the two plans had been clearly presented and discussed, the Commission held an executive session, in which both plans were more thoroughly considered. It was agreed to withhold decision until the autumn; in the meantime to confer with the State architect and with Governor Smith. This matter is of such interest to the readers of *NATURAL HISTORY*, not only in various parts of New York State but throughout the country, that both building plans are shown on the two preceding pages.

FISHES

COMPLETION OF "BIBLIOGRAPHY OF FISHES."—The great *Bibliography of Fishes*, which has been in progress for thirty years under the direction of Dr. Bashford Dean, honorary curator of ichthyology, American Museum, is at last completed. The sheets of the third or index volume have just come from the printer and as soon as the binding is completed the entire work will be ready for distribution. The President and Trustees of the Museum have strongly supported this monumental undertaking by Doctor Dean and his splendid staff of collaborators, in the belief that this Bibliography will be a permanent contribution, not only to ichthyology and natural history in general but to every branch of human welfare and activity directly or indirectly connected with the life of fishes.

When the publication appears, *NATURAL HISTORY* will give an adequate review of the entire series of volumes. In the meantime it is pleasant to record the praises which the two volumes of the work are receiving from naturalists in various parts of the world. Among these tributes may be cited the following:

"Your bibliography is clearly a work of the greatest importance, not merely to specialists in ichthyology, but to all interested in the morphology of vertebrates in general. Its publication will do much to accelerate the advent of the day when workers on the anatomy of man and the higher vertebrates will realize that a sound morphology of the higher verte-

brates must be founded on a sound morphology of the lowest members of the group Vertebrata." (Prof. J. Graham Kerr, University of Glasgow, contributor of the morphological part of the article on Ichthyology in the *Encyclopædia Britannica*, author of *Text-book of Embryology* and numerous other works.)

"I feel that you are indeed greatly to be congratulated upon this magnificent 'subject catalogue' which will be an absolutely invaluable work of reference to all interested in the morphology of vertebrates. I hope it will not be many months before I have a copy of the new volume on my shelves." (Prof. J. Graham Kerr.)

"You seem to me to have been most successful in condensing so much accurate information in so little space, and I feel sure your work and indeed the whole of the Bibliography will prove of great value to zoölogists." (Prof. Edwin Stephen Goodrich, University Museum of Oxford, author of "Cyclostomes and Fishes" in the *Treatise on Zoology* edited by Sir E. Ray Lankester.)

"I will be most glad to see the final result. I certainly approve of the way it is done. These little summaries of each morphological section will prove of great value. . . it will be worth all of the labor it has cost." (Prof. John Sterling Kingsley, distinguished American comparative anatomist.)

In various stages of this work Doctor Dean has had no less than twelve collaborators, several of whom, like Doctors Eastman and Gudger, have devoted their entire time to it and to all of whom the ichthyologists of the world are under lasting obligations.

GEOLOGY

DOCTOR HOVEY VISITS AUSTRALIA AND NEW ZEALAND.—On June 29 Dr. E. O. Hovey, curator of geology and vertebrate palæontology, American Museum, sailed from Vancouver, British Columbia, for Sydney, Australia. He represented not only the Museum but also the Geological Society of America and the New York Academy of Sciences at the Second Pan Pacific Scientific Conference, which was held in Sydney and Melbourne from August 13 to September 3. He was commissioned by President Henry Fairfield Osborn to relate to the conference some of the striking results obtained by the Third Asiatic Expedition, and to announce the palæontological studies of Professor Osborn and Dr. William D. Matthew and the

geological investigations of Prof. Charles P. Berkey and Doctor Morris. Doctor Hovey also planned to give a statement of the achievements of the Whitney South Sea Expedition and to present the paper by Dr. Chester A. Reeds entitled "Seasonal Records of Geologic Time," which appears in the July-August issue of *NATURAL HISTORY*, pp. 370-380

Doctor Hovey expects to utilize the opportunity which his sojourn in Australia affords, of viewing the famous mining district of Broken Hill, New South Wales, and other places of geologic interest, including a few of those which offer light on the various glacial periods that have visited the continent. His itinerary includes on the return journey a stay of four weeks in New Zealand, where he expects to visit the famous geyser and hot-spring region and one or two of the other volcanic areas in the north island, and the glacial regions in the south island, for the purpose of obtaining information that will be of value in the construction of additional relief models at the Museum. The important museums in the two countries will be visited; exchange relations with those in New Zealand will be established and such relations now enjoyed with the museums of Australia will be extended.

PUBLIC EDUCATION

THE AMERICAN MUSEUM AND THE TRAINING SCHOOLS FOR TEACHERS.—The opportunities offered by the American Museum to the schools of Greater New York are of an unusual character and it is important that prospective teachers should know just what facilities are at their disposal so that their classes may benefit to the utmost. With this thought in mind, the American Museum entertained on June 15 the faculty and graduating class of the New York Training School for Teachers, and on June 27 the faculty and graduating class of the Maxwell Training School for Teachers. Following the precedent of other years, there was a lecture on the Museum's work with the public schools, delivered by Dr. G. Clyde Fisher, a demonstration, respectively by Mrs. Ruth Crosby Noble and Mrs. Grace Fisher Ramsey, of the use of slides and of motion pictures for purposes of instruction, and a tour under the guidance of members of the scientific staff through the several exhibition halls. In conclusion refreshments were served. Director F. A. Lucas gave the address of welcome at the gathering on June 27 and Dr. Gustave

Straubenmüller, associate superintendent of schools, expressed his great esteem for the educational work of the Museum.

CONSERVATION

STATEN ISLAND AND ITS PARK AREA.—It is to be hoped that there may be no hesitation in complying with the suggestion made at a recent meeting of the Staten Island Bird Club, namely, that a part at least of the area set aside for park purposes in Staten Island be preserved in its natural condition. As the population of Greater New York expands, more and more land is denuded of its native wild flowers. Brick and stone and stucco encumber the landscape, or, at best, flowerless lawns and artificially reared plants—many of them foreign to our flora—replace the rightful possessors of the soil. The character of a region is determined not only by its institutions and customs, its historic monuments, and the collective personality of its inhabitants, but by the surface aspect of the landscape. Scotland would be incomplete without its heather, Switzerland would lose something of tangible as well as sentimental value if deprived of the edelweiss. The daisy, the goldenrod, the spring beauty, and the Jack-in-the-pulpit are not to be despised. Animal life, notably in the case of the insects, is not infrequently associated with a particular plant or group of plants, and the destruction of our native flowers and shrubs has therefore resulted in a serious diminution of the creatures dependent upon them. The action of the Staten Island Bird Club is a timely reminder that precautions should be taken to the end that at least a few spots of native interest in our municipalities may escape the all-too-prevalent tendency to root out the growths planted by nature and introduce in their stead the growths planted by man.

SOUTH AMERICA

MAMMAL COLLECTING IN ECUADOR.—On July 14, Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, sailed for Guayaquil, Ecuador, whence he will proceed to the high Andes for a collecting trip of several months' duration. Much attention will be given to the region about Chimborazo and Pichincha (the peak at the base of which lies Quito) and to other elevations which, while less imposing than Chimborazo with its more than 20,000 feet, yet rise to heights greater than those of the loftiest peaks in the Alps. Many of these mountains are either semi-active volcanoes or have been in violent

eruption in the past; they are not links in a continuous chain but more or less isolated heights rising out of a basal plain. Mountains of this character, like islands scattered over the sea, often develop their own peculiar fauna, and one of the objects of the expedition is to ascertain to what extent this insular environment has produced distinct forms of animal life.

Among the animals of more spectacular interest which, it is hoped, may be obtained in these high altitudes is the tiny deer known as the *Pudu*, the closest relative of which is found in Chili, where the more southern latitude affords at lower elevations zonal conditions approximating those of the high mountains near the Equator.

If it is possible to do so, Mr. Anthony wants to make a zoölogical cross section through the easternmost range of the Andes, near the boundary of Colombia and Ecuador. The fauna of this region is not particularly well known and specimens secured there will be valuable for purposes of comparison with those obtained in a similar cross section made through Rio Zamora in southern Ecuador, near the Peruvian boundary.

One of the objects of the expedition will be the collecting of a representative series of specimens from the fossil deposits at Punin, near Riobamba. Here, in an extensive bed of volcanic ash, have been found the remains of the Andean mastodon, camels, horses, ground sloths, deer, and other forms. Through the generosity of Mr. Childs Frick it will be possible to work these fossil beds and obtain from them a representation of this South American fauna for the Museum.

Mr. Anthony is accompanied on the expedition by Mr. G. H. H. Tate, who awaited him when he disembarked at Guayaquil. In a letter which Mr. Tate addressed to Mr. Anthony before the latter's departure, he reported that he was meeting with good success in his collecting in the Sierra de Colonche in western Ecuador. Here Mr. Tate worked in an exceedingly humid forest, the conditions of which were in sharp contrast to those of the markedly arid coastal strip lying immediately to the westward. Practically no zoölogical collecting has been done in this range of mountains and the specimens taken by Mr. Tate are eagerly awaited at the Museum. Although Mr. Anthony plans to return to the Museum about the middle of November, Mr. Tate will continue working over the Ecuadorian field until the spring of 1924.

THE EXPEDITION OF THE "NOMA" TO THE GALÁPAGOS ISLANDS.—Lying for the most part just below the Equator, more than seven hundred miles west of the coast of Ecuador, the Galápagos Islands are rather far removed from the normal routes of travel and but few naturalists have been so fortunate as to reach them and observe at first hand their peculiar fauna and flora, which Darwin described as "eminently curious." In the waters surrounding these islands and on the rocky sea beaches is found a genus (*Amblyrhynchus*) of marine lizards that is highly specialized for life in the sea; the giant tortoises of the Galápagos, which share with the huge East Indian turtles the distinction of being the most spectacular and ponderous of all existing tortoises, although now on the way to extinction, formerly existed there in large numbers; while, thanks to the cold waters of the Humboldt Current, penguins, which we normally associate with the ice-bound shores of the Antarctic, exist on these islands although exposed to the merciless glare of the equatorial sun.

Due to the generosity of Mr. Harrison Williams, through whom the steam yacht "Noma" was made available for the purpose, Mr. William Beebe, director of the Tropical Research Station of the New York Zoological Society, was recently able to visit the Galápagos with twelve of his associates and to make a very full record of the animal life which it contains. The greater number of specimens were brought back alive and have joined that cosmopolitan community of animals, including representatives from practically all parts of the world, which is maintained at the Zoological Park in the Bronx. Other specimens have come into the possession of the American Museum. Among the latter are a family of sea lions, eighteen lizards, and a giant tortoise. This tortoise, captured on Duncan, was the only one of these monsters that the members of the expedition encountered,—a melancholy contrast with former days when, it is said, single vessels would carry off hundreds of these reptiles.

Darwin, who visited the islands in the course of the voyage of the "Beagle," noted the extraordinary tameness of the birds. "All of them approached sufficiently near to be killed with a switch, and sometimes, as I myself tried, with a cap or hat. A gun is here almost superfluous; for with the muzzle I pushed a hawk off the branch of a tree. One day, whilst lying down, a mocking-thrush

alighted on the edge of a pitcher, made of the shell of a tortoise, which I held in my hand, and began very quietly to sip the water; it allowed me to lift it from the ground whilst seated on the vessel: I often tried, and very nearly succeeded in catching these birds by their legs."

Mr. Beebe's experiences prove that as in Darwin's day the creatures of the Galápagos still show little fear in the presence of human beings: "The instantly arresting feature was the astounding tameness of all the creatures. Having never seen human beings they had little fear, the birds and sea-lions being particularly indifferent to us. Perhaps indifference is hardly the word, since in many cases they showed great curiosity about us. Mocking birds would follow us along, hopping from branch to branch within arm's reach; little flycatchers would perch a foot from our faces, in close inspection of our mystifying presences."

DINOSAUR EGGS DISCOVERED

As this issue goes to press, a cable report reaches the American Museum of the remarkable find by the Third Asiatic Expedition, in the course of its explorations in Mongolia, of no less than seventy skulls and ten skeletons of primitive horned Ceratopsian dinosaurs and contemporary carnivorous dinosaurs. This collection, which is one of the most superb brought together in so brief a time, derives additional scientific importance and popular interest from the fact that included in it are three nests and twenty-five dinosaur eggs. This is the first actual discovery of the eggs of dinosaurs and establishes as a certainty what heretofore could be designated merely as a strong probability, namely, the egg-laying habit among the dinosaurs. The expedition also secured a large series of remains of fossil mammals from six distinct horizons in the early part of the Age of Mammals. These are mostly those of new and interesting kinds of extinct animals and will furnish important evidence on the theories of the dispersal of animals from a central Asiatic source.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum, making the total membership 7040.

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COURSES OF POPULAR LECTURES FOR MEMBERS

A series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, is open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are told on alternate Saturday mornings in the fall and in the spring.

MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

The American Museum of Natural History has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its expeditions and disseminated through its publications—of the increasing influence exercised by the institution.

In 1922 no fewer than 1,309,856 individuals visited the Museum as against 1,174,397 in 1921, and 1,038,014 in 1920. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever. The EXPEDITIONS of the American Museum, working during the past year in several parts of Asia—where finds of extraordinary value were made—in South America, Africa, Australia, Europe, in the South Pacific Islands, in the West Indies, and in selected areas of our North American continent, have greatly enriched knowledge. Many habitat groups, embodying specimens secured by these expeditions, are planned for the new Museum buildings, the erection of which has been authorized by the city.

The SCHOOL SERVICE of the Museum reaches annually more than 4,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or “traveling museums,” which during the past year circulated among 475 schools, with a total attendance of 1,648,608 pupils. During the same period 330,298 lantern slides were loaned by the Museum for use in the schools as against 209,451 in 1921, the total number of children reached being 2,582,585.

LECTURES, some exclusively for members and their friends, others for the general public, are delivered both in the Museum and at outside educational institutions.

The LIBRARY, comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

The POPULAR PUBLICATIONS of the Museum, in addition to NATURAL HISTORY, include Handbooks, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit, or series of exhibits, of special interest or importance, or the contents of some hall or some branch of Museum activity.

The SCIENTIFIC PUBLICATIONS of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs*, of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the scientific activities of the departments, aside from anthropology; the *Anthropological Papers*, recording the work of the staff of the department of anthropology; and *Novitates*, devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters.

*A detailed list of the publications, with prices, may be had upon application to the Librarian,
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NATURAL HISTORY

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NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY,
EXPLORATION, AND THE DEVELOP-
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THROUGH THE MUSEUM



NOVEMBER-DECEMBER, 1923

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NATURAL HISTORY

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Australia and Asia

NATURAL HISTORY FOR JANUARY-FEBRUARY, 1924, will be devoted predominantly to **Australia**, the fauna, the flora, and the anthropology of which have a unique interest. Australia is the land of living fossils. There, and in no other continent, are found the egg-laying monotreme mammals, the lowest division of the Mammalia; there the marsupial mammals, represented not only by the familiar kangaroo but by flesh-eating members of the group, flourish as they thrive nowhere else in the world; there the placental mammals, the group which we who live in another part of the globe think of as the mammals *par excellence* are exclusively later-day invaders.

Hardly less interesting than the mammals of Australia, living and extinct, are the birds and the reptiles.

Just to the south of Australia lies Tasmania, where until recently lived the most primitive representatives of modern man, so lowly in physical type that like the mammals of the region they must be regarded as something that has persisted from a remote past, a past that has been largely effaced in other parts of the world.

The American Museum's interest in Australia has been a keen one. In May, 1921, a Museum expedition, consisting of Dr. William K. Gregory and Mr. Harry C. Raven, sailed for that continent, where collecting was in progress until February, 1923. In addition to specimens obtained in the field, a number of exchanges have been consummated with museums in Australia, so that the American Museum is in a position to install in the not distant future an Australian exhibition that will give the visitor a representative picture of that land.

In the January-February number of NATURAL HISTORY Doctor Gregory will describe the character of this exhibition, Mr. Raven will tell of the work done by the expedition, while several of Australia's foremost naturalists will deal with different divisions of their country's wonderful wild life.

THE MARCH-APRIL NUMBER will be devoted to **Asia**, especially to the THIRD ASIATIC, FAUNTHORPE-VERNAY, and SIWALIK HILLS EXPEDITIONS.



THE RHINOCEROS IGUANA GROUP

This group of *Cyclura cornuta* recently placed on exhibition in the American Museum represents the home life of the most powerful lizard in the New World. The species frequents the desert areas of Santo Domingo. The scene represented is the western shore of Lake Enriquillo, a dead sea more than 130 feet below the surface of the ocean

NATURAL HISTORY

VOLUME XXIII

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NUMBER 6

Trailing the Rhinoceros Iguana

HOW THE FACTS PRESENTED IN THE GROUP OF THESE REPTILES RECENTLY INSTALLED IN THE AMERICAN MUSEUM, WERE OBTAINED IN THE FIELD BY THE ANGELO HEILPRIN EXPEDITION

By G. KINGSLEY NOBLE

Associate Curator of Herpetology (In Charge), American Museum

BLANCHED cliffs of jagged corals shut in on both sides the viscid waters of Lake Enriquillo. Under the dazzling glare of a Dominican sun these waters have gradually evaporated, turning first from a brackish solution to a brine, leaving behind miles and miles of scorching *saladas* (salt plains) to dance in the broiling heat. When the sun has reached its fullest intensity, great, dark-skinned lizards here and there slide out from the tunnels which they have clawed through these cliffs of coral limestone. Wagging their ponderous heads in mechanical-toy fashion, they gaze with seeming contentment upon their desolate world.

A portion of this region has been represented in the rhinoceros iguana group recently placed on exhibition in the American Museum, for it was in the vicinity of this shrunken Lake Enriquillo that the Angelo Heilprin Expedition first went to hunt these powerful saurians. Although fully equipped and provided with two Ford cars, the expedition required a month of the most difficult traveling to capture the specimens exhibited and to ferret out the secrets of their strange life.

During a part of the Pleistocene, this whole region was under the sea. A great arm of the ocean then separated southwestern Haiti from the rest of the island. Corals and sea fans vied

with mollusks and tropic fish in splendor and brilliancy of color. Later came an orogenic movement which cut off the strait from its mother ocean and transformed it into two large lakes.—Enriquillo to the east and Saumâtre to the west. Mountain streams poured fresh water into these lakes; the sea life died. With the tropical sun beating down from overhead, the water gradually receded, leaving the skeletons of dead sea creatures ghastly white on the parched plains.

This region has been a valley of death ever since man can remember. At first avoided by the Indians because of its sterility, it later became a refuge for natives that had escaped from their Spanish masters. At one time, six hundred such fugitives gathered about the lake, and under the wise guidance of their chieftain Enriquillo, defied the Spanish for many years. At length a treaty was made and the district turned into an Indian reservation, soon to be destroyed by Spanish treachery.

Today a few natives still gain their living near the mountain streams which flow into these ever-receding lakes. One of the largest of these settlements, known as Duvergé, had been selected as our first base in the search for the rhinoceros iguanas. Toward this village, accordingly, we directed our two Fords one September morning in 1922.

In these small outlying settlements

¹Photographs by G. Kingsley Noble and Ruth Crosby Noble

the most influential man is apt to be the one with the blackest reputation. In Duvergé the village chief was an Armenian ex-bandit who had adopted the name of Juan Herrera. In the neighboring town of San Juan, the rôle of leader had been assumed by "Papa Lavoria." The latter, dressed like a Zouave, had instituted a religious sect,

better. Instead of going in for religion, he went in for Americanism as he conceived it and adopted all the trappings of civilization which went with it. Drawing upon his treasure chest he bought a straw hat, a Ford car, and even set up an electric light plant in his *hacienda*. The Marines wisely gave him an official title and let him wear a



Enriquillo, the dead sea.—No life can exist here except where some mountain stream has worked its way across the scorching plains to mingle with the saline waters. The feral pig in the distance has been startled by the approach of members of the Heilprin Expedition

and had won sufficient fame to have a brand of rum named after him. Although the U. S. Marines had come to Santo Domingo to drive out the bandits, they could not do so if the latter happened to be the leading citizens. The next best thing was to make friends with these marauders of high station, and try to reform them. "Papa Lavoria" would not reform. His crimes continued until he was finally shot in attempting a bold getaway. With Juan Herrera diplomacy had worked

revolver. The added prestige delighted Juan. He set aside his best thatched hut as quarters for visiting Marines or for their American friends. Hence it came about that we were to be his guests while at Duvergé.

Duvergé proved to be a scattering of dingy huts staggering about without reason on the arid plain between Lake Enriquillo and the Sierra de Bahoruco. The enormous load of palm thatch which smothered each hut served as an index to the terrific heat we were des-



Duvergé, at the foot of the Sierra de Bahoruco, was made the first base in the hunt for the rhinoceros iguana



The customs house near Las Lajas on the Haitian-Dominican border, one of the few well-built houses in this region, was devastated by bandits in 1919 and has remained in ruins ever since

tined to withstand during the following weeks.

The morning after our arrival we went with two guides into the hills

a few miles away. Ashy forests of cacti and tamarind growing in dense profusion in the valleys crowded against the base of these hills, but the rugged



The home of the rhinoceros iguana on the western shore of Lake Enriquillo. The burrows are clawed through fossil corals sometimes for a length of forty feet

slopes were only sparsely clothed with vegetation. One of the guides took the lead and without looking to right or left moved swiftly across the hills in a westerly direction. In this desert region of Santo Domingo the rains fall only during a short season, but then the downpour is so violent that it carves deep chasms in the hills. These the natives call *arroyos* (streams), although they are dry throughout most of the year. As I scrambled along over the hills, I felt myself gradually wilt. Dark blotches of perspiration spread rapidly over my khaki trousers. My leather putties turned from tan to nearly black and began to droop in soft, damp folds about my ankles.

We came at length to the brink of one of those dry *arroyos*, one that was a little dustier and more stifling than the others. The acacias which had once

grown here had been scorched out of existence, leaving only their gnarled roots to twist and writhe among the sun-heated limestones. Here and there little clumps of organ cacti had survived by drawing close together, like so many soldiers withstanding a final attack. The guide had stopped and was pointing at something far up in the cañon. At first I could see only the twisted roots of the dead trees. Gradually there took shape in the shadow of one of the larger trunks the crest of a rhinoceros iguana. Slowly the beast raised itself. His deep-set eyes stared coldly in our direction. I noted that he was directly in front of a jagged burrow and quietly I slipped my heaviest charge into the breach of my shotgun. Slowly the stock came to my shoulder a terrific report echoed through the cañon. The lizard reared, then dropped

down the burrow. We rushed up the bank and tried in vain to dig him out.

Next morning we came back with pick and shovel. The burrow went in $13\frac{1}{2}$ feet, gradually turning to the right. At the end was a chamber three feet square and about $1\frac{1}{2}$ feet high. But there was no sign of the iguana. The wounded lizard had obviously escaped during the night.

For a week we searched these cañons. We found that the rhinoceros iguanas dug their burrows only in the stony cliffs or in the vertical walls of occasional sink holes,—never in the sandy *playas* which stretched for miles and miles on all sides. With native help we rounded up a number of half-grown iguanas, but the large ones always escaped us.

As it became more and more doubtful whether we would secure any large specimens, some of the natives came to us and said that out in Lake Enriquillo there was an island abounding in gigantic iguanas. To be sure, no one had been to the island for twenty years. Enriquillo was a dead sea and there were no boats on the lake. In fact, there was no need for boats, as fish did not exist in water 50 per cent more saline than the ocean.

A few days later, however, the town of Duvergé was startled by the sight of a boat carried aloft on a Marine Corps's truck through the heart of the village. Our host, Juan Herrera, was particularly excited and immediately organized a party to assist in exploring the iguana island. Early on the mor-



At home,—a detail from the Rhinoceros Iguana Group (frontispiece). Most of the cliffs which border Lake Enriquillo have a similar composition of fossil corals and shells



To reach Enriquillo the boat had to be dragged across miles of *salada*,—soft, salt-streaked mud, fissured with sun cracks having a regular polygonal form



The unfrequented island in the lake proved to be a great sand flat adorned with enormous candelabra-like cacti

row eight pairs of hands dragged the boat across the two miles of quaking mud that separated the terra firma from the water's edge. The boat would hold only four and it was decided to take Juan, a guide, Mrs.

Noble, and myself. Four miles of open water stretched between the island and ourselves. A strong wind had already sprung up and the waves washed dangerously close to the gunwale of our little craft. I took the oars and had made perhaps a mile when suddenly a great black snout arose from the green waters and shot out ahead of our bows. It was a crocodile perhaps twelve feet in length. The waves striking on his muzzle broke into spray, which glistened in the sunlight. A crocodile in a dead sea, landlocked, and separated from the ocean by forty miles, must lead a precarious existence. Surely he must be very hungry!

Two hours later we reached the island. It was a long sand spit twelve miles in length by a mile in width. Strange candelabra-like cacti confronted our eyes on all sides. As we moved inland, there was a rush and four grotesque saurians charged out from under some fallen cacti. Before they disappeared I noted that they lacked the tusk of the rhinoceros iguana but were equipped instead with numerous whorls of spikes on the tail. They were, in fact, a different species—*Cyclura ricordii*—and one that had been lost to science for more than fifty years. We soon found that these lizards were everywhere on the island. Unlike the rhinoceros iguanas, they dug holes into the flat salt-encrusted playas. Of the rhinoceros iguana we could find no trace. After hunting a half day we gave up and went back to the boat.

By this time the dead sea had become lashed into a mass of white-caps. Dominicans are traditionally poor sailors and Juan was eager to remain overnight on the island, hoping to venture across when the wind abated.

But our friends were waiting expectantly for us on the other shore and so at last we started. The wind continued to rise. The guide and I steadied the boat with our oars. Wave after wave came over the gunwale. Mrs. Noble bailed frantically while Juan hung limply over the side of the boat. In spite of our shouts "*Saca agua!*" Juan remained motionless until the guide reminded him of the crocodiles when he recovered his vitality with startling suddenness. It was soon apparent we could not make the opposite shore, and it was equally dangerous to attempt a return to the island. While Juan alternately swore and prayed, we began to drift straight down the lake with a distance of more than ten miles between us and the lee shore. Four hours later our boat—half full of water—scraped bottom just off a beach. We all jumped out and pulled our specimens clear of the tumbling waves. It was now dark and we had drifted many miles from any habitation. In true bandit fashion Juan lit a fire, and the guide after much grumbling started out in search of the Fords.

A few days later we gave up our search for adult iguanas in the vicinity of Duvergé and struck out for Lake Saumâtre on the Haitian border. It was long after dark when we reached Las Lajas, the last Dominican outpost. In the dim light of Guardia lanterns the half dozen hovels that form this settlement seemed untenable. We were directed with much ceremony to the *casita* of Roque Valdez,—the customs officer and first citizen of the town. It was a dingy hut of three rooms, palm-thatched and adobe-walled, yet the elaborately embossed rum glasses on a massive table were obvious indications that we were in the home of a



The rhinoceros iguana (*Cyclura cornuta*), the largest of the rock iguanas.—It was primarily to work out the life history of this saurian that the Angelo Heilprin Expedition went to Santo Domingo

gentleman. Dinner had already been prepared for us. With surprising relish I consumed my share of burned goat meat, fried plantains, and fresh papaya, then leaned back to take a look around. There at my feet, staring up with eyes of hunger, was the leanest yellow dog I had ever seen. How a hungry dog can stare! The rind of my papaya was still on my plate. Just to avert the stare of those eyes I dropped the scarcely edible portion upon the

clay floor. A snarl, a few gulps, and the rind had disappeared.

The island which we had selected for our hunt in the morning, though not indicated on any map, is nearly a quarter of a mile long and a hundred yards wide. In all our iguana hunts, when we wished to capture the beasts alive, dogs were essential. Various natives had promised me hunting dogs that morning, but of course they did not appear. In my dilemma I came to



The Dominican spike-tailed iguana (*Cyclura ricordii*).—This huge saurian is found in the same region as the rhinoceros iguana, but has very different habits. The photograph was made on the island in Lake Enriquillo by stealthily approaching a wild specimen

think of the lean yellow dog with the terrible appetite. "Was the little dog a hunter? What was his name?" Roque only shook his head and said, "No ser-vee, no ser-vee"—a corruption of *no sirve*, meaning good for nothing, and implying that the dog did not deserve a name. Most Dominican dogs are brought up to chase pigs or goats. The yellow pup had apparently not proved very valuable and had therefore become the object of many a

blow, a slinking shadow in the home of Roque Valdez. Yet this morning any dog was better than none and the worst was worth a try-out. So it came about that "No Ser-vee" became a member of our party.

Just as we were loading our equipment on to the small boat we had brought with us, two Haitian boys came along with a second yellow dog, this one slightly larger and more muscular than Roque's. The boys gave us



MORNING OFF THE COAST OF SANTO DOMINGO

It was on Beata, an island off the coast, that the expedition secured the final details of the life history of the rhinoceros iguana



“BATE 6”

The desert east of Barahona has been marked up into *bates* (an Indian word for yards) and one of the largest sugar companies in the world hopes to secure by irrigation a continuous production of sugar throughout the year. With Haitian labor enormous stretches of country have been cleared of their cacti and scrub, and much cane is already being grown. The great bonfire shown in the picture consumed a quarter of a mile of brush.



The "Mayflower" at anchor off Beata.—An iguana hound kept watch while the men unloaded the boat in preparation for a hunt on the morrow

to understand that this dog was especially trained to hunt iguanas, for on the Haitian side of the island these lizards are highly prized as food.

An hour later the boat grated on bottom close to the island, and dogs and blacks scrambled pell-mell across the few yards of glaring limestone to a forest of cacti that covered the central core. In a moment all had

been swallowed up by the brush and the gray streamers of Spanish moss which swung from the cacti. Separated from the party, I picked my way alone through the forest toward a ridge, the outer edge of this rugged island.

Suddenly a dog's yap broke the silence, followed by a rattle of short barks. There was a scramble, and then an iguana—mouth agape—shot from

the brush, with the "Good for Nothing" dog close at his heels. The reptile turned at bay a yard from the water but the little dog dove at him. Another scurry, and both dog and iguana splashed into the water. The little dog came out as quickly as he went in and stood shaking himself with his tail between his legs. Most yellow dogs are not very heroic in appearance, but when such a dog is very thin and very wet, he excites only pity. Of the iguana nothing was to be seen. Had the reptile been swallowed up by the lake? These saurians live their whole life on land, emerging from their burrows only when the sun is shining brightly. Heat and drought seem essential to their livelihood. They avoid regions of luxuriant growth, or even of moderate humidity, preferring always the sun-baked rocks and scrub of the bad lands. The iguana must surely be drowned, I thought, when after nearly five minutes of patient waiting, there was still no sign of him. Just then a dark object rose slowly toward the surface. Stiff as a bar, and nearly vertical in the water, the iguana was cautiously seeking air. Hardly had the horned snout cleared the surface, when the reptile saw the two excited dogs and the four humans gazing at him. With a gulp he dove again into the blue depths of the lake.

These singular actions made clear to me a problem which had long been a puzzle. Why is it that many of the West Indian islands which are supposed to be volcanic in origin,—to have arisen from the depths of the sea,—are, notwithstanding, peopled by reptiles and amphibians that are never known to approach the sea and hence could not have been carried from the mainland by accident? Here in the

case of the iguana we had an explanation. Although the iguanas in their ordinary round of existence avoid the sea, nevertheless, when thrown by accident into it, they are perfectly at home. Potentially they are water reptiles, even though the daily exigencies of life do not call forth any contact with the ocean. While I was thus musing, one of the Haitian boys had stripped off his clothing and plunged into the lake. A shower of spray, and the boy emerged holding the iguana firmly by the neck. A pair of outstretched hands relieved him of the prize and nimble fingers tightened cords about the booty.

The days that followed yielded other iguanas. Our pack now included many dogs and these hunted well. Each sweltering chase added a little to our growing information regarding these reptiles. Their food habits, the places where they occur, the form of their burrows,—all had to be determined. But while these problems were soon solved, some of the most important questions remained unanswered. Where did the iguanas lay their eggs? Why had we secured no very large specimens? In desperation, we changed our hunting grounds again, first returning to the coast with the specimens we had secured.

Back in Barahona the Marines turned the barracks over to us in which to house ourselves and the iguanas we had taken alive. We tied up the thirty or more captives to the springs of the cots. There they stood solemn and statuesque, peering with sullen dignity at those of the passers-by who cautiously kept their distance, and offering a warning gurgle to the more curious. Bananas were placed before the creatures and these they devoured at a gulp.



At night uncanny sounds arose from the thickets: the hermit crabs of the seabeach were climbing trees in search of prey

At last, with only a couple of weeks left before the boat would arrive that was to take us and our captives back to New York, we decided to make one last effort to find the eggs. A Marine had told us that far down the coast on a little islet called Beata (the blessed one) he had seen iguanas "as big as crocodiles." Not knowing where else to turn, we engaged a little sloop—the "Flor-de-Mayo" ("Mayflower") and the last day of September started out to sea with five men and the two yellow dogs we had brought from Las Lajas. By dusk of the following evening we dropped anchor in a cove on the west side of the island.

Beata is a triangular block of eroded limestone about seven miles in length. Its leeward, or westerly, part is densely covered with a tangle of cacti and bush, while its eastern arm is almost devoid of any cover. Although no one lives on the island, turtle fishermen occasionally stop there and on



The expedition joined forces with a band of pig hunters

rare occasions some hunters come to seek the goats and pigs which have run feral there for many years.

It so happened that one of these hunting parties had just landed on the island. That night we joined forces and thus added six dogs and three men to our iguana party. We were a strange group seated about the camp fire. Half the men were stripped to the waist and all save my two Guardia wore machetes, which shone blood-red in the light of the camp fire. Gradually, above the voices of the men I made out a dry, rustling sound, a crawling noise, as if someone were dragging dead bones out there in the darkness. I seized my hand lamp and shotgun and tiptoed out of the circle. Now the sound came from above my head. My electric light flashed upward, cut a great hole in the blackness. Numerous white balls were moving in every direction up and down the trees. I drew nearer and found—the last thing I would have expected—hermit crabs, usually to be seen only between the tide lines, here clambering noisily over the branches, carrying their shell houses with them.

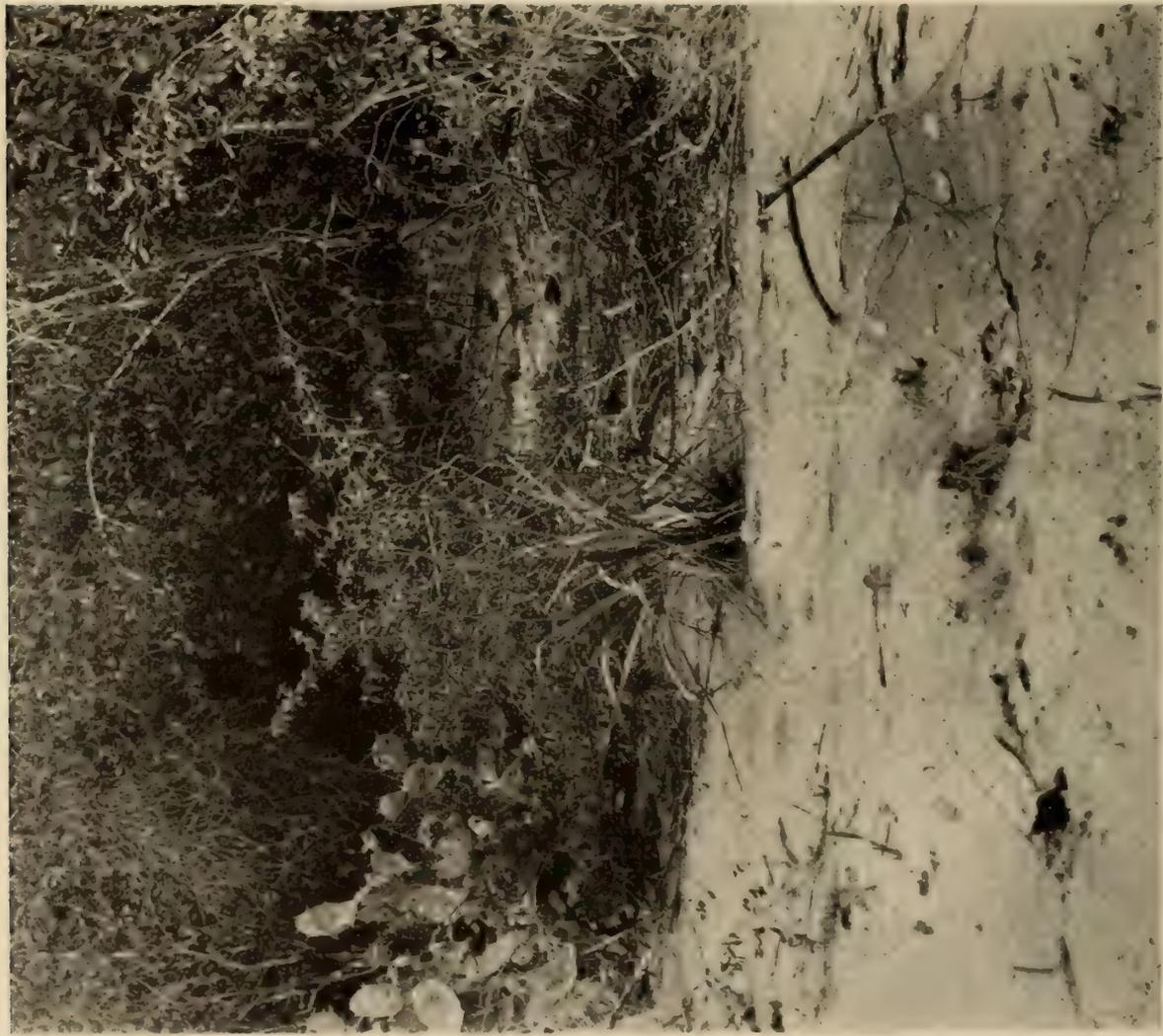
Next morning we waited until the sun was well up and then started out in a body. We had gone only a few steps when, with a yelp, the dogs started something. It proved to be an enormous iguana, which easily waded through the pack and disappeared down a burrow. Then a strange thing happened. The little yellow dog we had brought with us from Las Lajas, the one that had been considered useless by Roque Valdez, plunged headlong down the burrow after the iguana. His barks became less and less audible as he went deeper into the ground. The natives were now very excited. It was impossible for the little dog to

pull out the iguana, and they all began to shout "*Viene p'au, viene p'au.*" But the dog paid no attention. The barking grew weaker and weaker. Then suddenly a shrill yelp arose from the depths, and the little dog came charging out—dripping with blood. He had been badly bitten in the head. We hastened to bandage him up, and at last sent him back to camp with one of the men.

A short distance beyond we came to a little clearing. To the seaward side was a great pile of conch shells, each shell very much weathered but showing the round hole made by some Carib fisherman when cutting out the mollusk. This was obviously the camp site of an ancient Indian settlement. I began to inspect the ground closely and came at length upon some broken eggshells. They were larger than chicken's eggs, but shrivelled and leathery in appearance. They could not be turtle eggs, for most of these have hard shells like those of a chicken. Could they be iguana eggs? Manuel was on his knees and digging. He was nearly down to his arm-pit when he abruptly jerked up and there in his hand was a tiny iguana in the very act of hatching from an egg.



Leiocephalus beatanus, one of the four species of lizards new to science which came to the camp at Beata

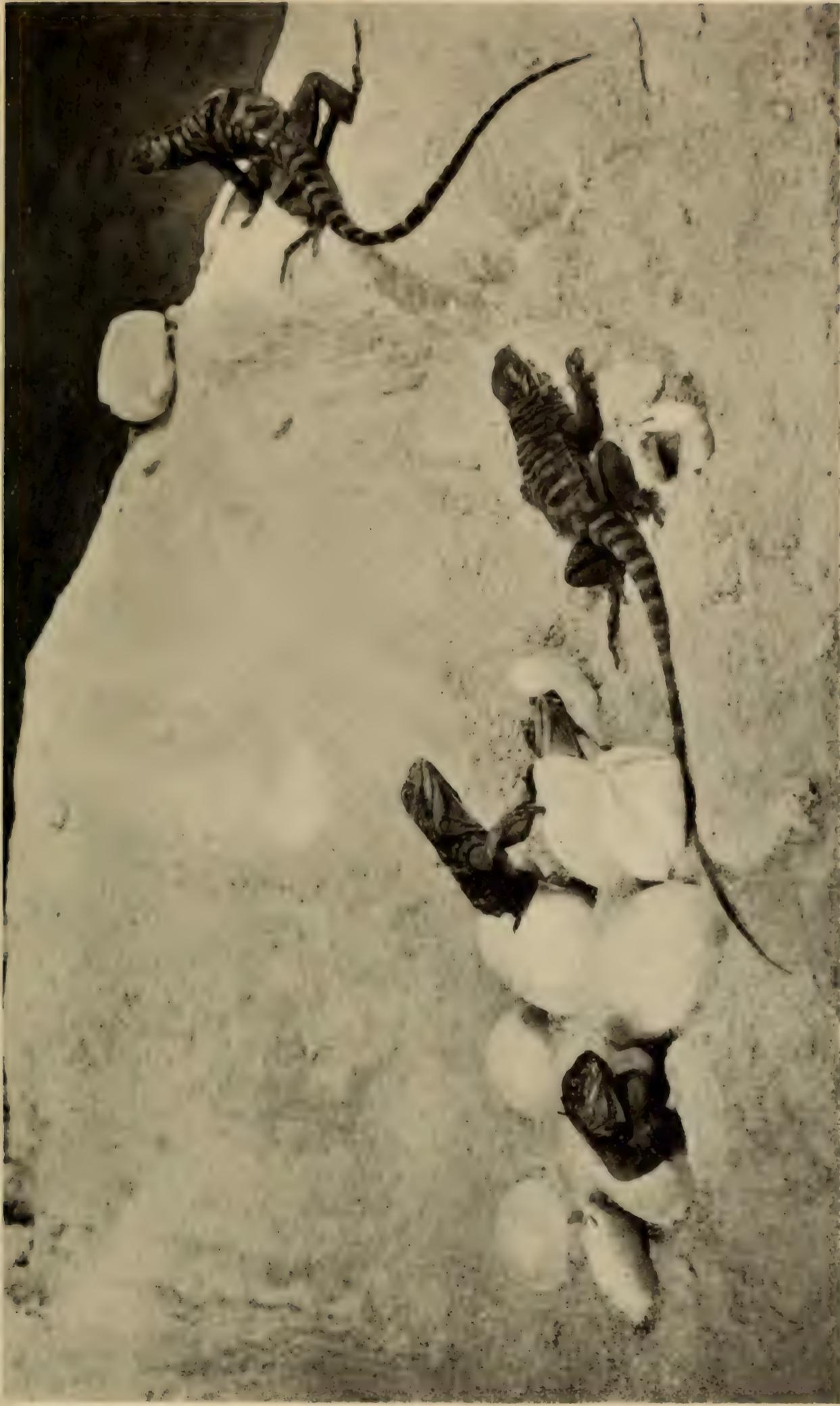


Damp sand and broken eggshells, shrivelled in appearance, suggested that young turtles or other reptiles might have recently hatched.



Manuel began to dig and soon found five nests containing these eggshells—a few with hatching rhinoceros iguanas

THE DISCOVERY OF THE IGUANA EGGS



HATCHING IGUANAS

Some of the little iguanas pull their eggshells with them as they wriggle through the twenty inches of sand which covers them. Most of them, however, leave their shells behind and give no clew to the spot where their mother deposited her clutch of seventeen eggs nine weeks previously. Detail from Rhinoceros Iguana Group (frontispiece)

We now began digging everywhere in the sandy clearing. In a space 150×70 feet we found five nests. Obviously, the iguanas were somewhat gregarious during the breeding season. This was of special interest, for the rhinoceros iguana is supposed to be related to the Central American iguana, which is known to dig holes in sandy areas similar to the one we had just discovered. But the Central American iguana has gone one step further in its gregariousness: the females frequently lay their eggs in the same hole, until there may be more than ten dozen in a single pile.

Not only the nests but the young also gave us a clew as to the relationships of the species. The young had pale eyes and fleshy mouth parts similar to those of some of the less specialized rock iguanas. Furthermore, the young were cross-barred with black very much in the manner of certain species of "black" iguanas (*Ctenosaura*).

While we had been digging, the rest of the party had been scouring the thickets and before noon the men returned carrying two iguanas much larger than those we had seen before, though hardly the size of crocodiles.

That night the crawling sound of arboreal hermit crabs sounded almost joyful to me, and the bats as they whirred through our *rancho*, only a few inches above my face, seemed to understand something of our satisfaction in their island. The morning came and yielded not only more and larger iguanas, but additional data regarding the life history of these saurians. Four species of smaller lizards new to science were captured at

the very door of our shelter. Beata, the unknown, was truly a reptilian paradise.

While the story of our group ends here, the story of the iguanas continues even as I write. More than forty were brought to New York alive and many of these were sent to Bronx Park. The keepers of the reptile house were duly warned of the ferocity of these new arrivals. But Head Keeper Toomey tried the experiment of making friends with them. Within a few months one of the largest of the iguanas had been so won over by this show of good will that when Mr. Toomey entered the cage, he would jump playfully on his knee like a kitten and look this way and that in an almost affectionate manner. After my weeks of chasing and fighting the iguanas in the field, this performance seemed almost incredible. But more surprising still was the change of food habits which Mr. Toomey induced. I had proved that the creatures were purely vegetarian in nature. One day at the Park when the supply of bananas was low, Keeper Toomey gave the iguanas some mice. These they seized quickly, shaking them as a cat might do, and immediately engulfed them in their great jaws. From these experiences it would seem that the rhinoceros iguanas are among the most changeable of reptiles. We had believed them terrestrial and they convinced us that they are at home in the water; we had thought them ferocious and they revealed themselves as affectionate; we had proved them, as we thought, to be vegetarians and they demonstrated to us that they could stalk mice in a most un-reptilian manner.



This picture of a Scotch terrier pulling out of the water a live cod that he has caught is reproduced from a volume by Cornwall Simeon published in 1860 under the title of *Stray Notes on Fishing and Natural History*. Every afternoon this dog would take his stand on certain stones that served as a landing place and wait until the approach of a fish enabled him to make a capture by a swift and accurate plunge upon his prey.

Dogs as Fishermen

BY E. W. GUDGER

Associate in Ichthyology, American Museum

THE wild Canidæ seek their prey in the woods and fields and many tame dogs still do so to some extent. However, early in the long course of his evolution from the status of cave dweller, man tamed the wild dog, and today brings him up as a household animal. And so artificial are some of our modern breeds of dogs, that if they were left free in a wood well populated with rabbits, they would inevitably starve.

Now, if dogs originally hunted for themselves, if they have been trained to retrieve ducks shot in a pond, and to hunt in the water such water animals as otters, then may they not be expected in some instances and under certain conditions to seek their prey in the water, to fish for themselves? A number of accounts of such activities have come to hand and will be set forth herein. These accounts may be

divided into three categories: first, where dogs fish for themselves to obtain food; second, where they fish for sport; and third, where they assist men in fishing.

If dogs ever fish for themselves, one would expect them to do so either where there is practically no other food obtainable, or where fishes are more abundant and more easily caught than any other kind of food. First, then, let us go to the low-lying coral atolls of the South Seas where the birds of the air or the fish in the sea furnish practically the only edible food for dogs; where the inhabitants subsist almost wholly upon the fruits of the coconut palm and *Pandanus* and upon fish. Here the dog (primarily a carnivorous beast) must eat fish or die, and here he must often make his own catch, for his master has frequently enough to do to fish for himself and his family.

At Rutiario atoll in the Tuamotu, or Low Archipelago, Hall and Nordhoff¹ tell us that they "watched a group of Rutiarioan dogs in their search for food. They had developed a sort of team work in the business, leaping toward the shore all together with a porpoise-like curving of their bodies, and were as quick as a flock of terns to see and seize their prey." Furthermore, one of these dogs, the best fisher on the island, always brought his capture to his master to be cooked and would not eat it until it had been cooked.

St.-Johnston² likewise records a similar habit of a dog at Loma-Loma in Lau, an island lying between Fiji and Tonga. This dog was once seen standing waist-deep in the water and snapping at something that was passing. Investigation showed that she was catching fish as they swam by in a shoal. She afterwards became a very keen devotee of fishing, changing fishing grounds with the tides and currents. She likewise trained one of her puppies, who shortly became quite as expert as his mother, often "edging her off his own private fishing-ground when the fish happened to be scarce."

In Siberia, at the season when the salmon are ascending the streams, the dogs find it much easier to catch fish in the water than to seek prey in the woods. I have in times past seen a number of references to this fishing habit as exemplified by the dogs of that region, but unfortunately only two instances have been preserved. Roulin³ says that in Kamchatka during the summer the dogs, which throughout the remainder of the year are fed mainly on

dried fish, vary their food by catching their own fish fresh from the water, wading in belly-deep to do so.

Roulin does not indicate the source of his data, but it seems probable that his informant is Langsdorff,⁴ who, in that part of his travels, dealing with Kamchatka, gives a whole chapter to "Kamschadale Dogs." Concerning their food he says that:

In summer they [the dogs] are generally left to rove at large, and find their own food, when they keep on the seashore, or in the neighborhood of rivers lurking after fish, standing in the water up to their bellies: when they see a fish they snap at it with such a certain aim, that they rarely miss it: in doing this their whole head is frequently under the water. When they can get a superabundance of food, as for instance, at the time when the salmon come up the rivers in shoals, they eat the heads only, as being the finest flavored part of the fish, leaving the bodies to become putrid.

Similarly Guillemard⁵ writes of a sledge dog that being "a good hunter and fisherman, he supports himself upon the game and salmon he catches." He also tells how a particular dog, named Verglaski, would wade out into a stream, filled with salmon living and dead, and watch for a good, active, "clean" fish. This he would catch and retiring to the bank would eat. The half-dead fish (easy to catch) he would totally disdain.

In a part of the world far removed from either of the above-mentioned regions, both in space and physical conditions, namely in Egypt, dogs have a hard time getting a living. Food being lacking on land, they are forced to turn

¹Hall, James Norman, and Nordhoff, Charles Bernard. *Faery Lands of the South Seas*. New York, 1921, pp. 126 and 142.

²St.-Johnston, T. R. *South Sea Reminiscences*. London, 1922, pp. 205-06.

³Roulin, F. *Histoire Naturelle et Souvenirs de Voyage*. Paris [1865], pp. 85-6.

⁴Langsdorff, Georg Heinrich von. *Bemerkungen auf einer Reise um die Welt in den Jahren 1803 bis 1807*. Frankfurt-am-Mayn, 1812, 3 vols.—English version. *Voyages and Travels in Various Parts of the World in the Years, 1803, 1804, 1805, 1806 and 1807*. London 1814, 2 vols., Vol. II, Chap. 14, p. 277.

⁵Guillemard, F. H. H. *Cruise of the Marchesa to Kamchatka and New Guinea*. London, 1886, Vol. II, pp. 82, 123.

to the water. "Fluker," says¹ that numberless times he has seen the half-wild and half-starving pariah dogs fishing on the shores of the lakes of Egypt and the Suez Canal. He adds that a friend of his at Ismalia had a setter dog which became very expert at catching mullets, which she promptly ate.

That dogs fish for sport, for the fun of fishing, may strike the reader as very unusual, but the testimony is clear and convincing. Chronologically the accounts are as follows.

Thomas Tod Stoddart² tells us that attached to St. Mary's Loch Club in Scotland was a dog, a cross between a collie and a Scotch terrier, which used to post itself on the shallow run between two lochs in order to watch the schools of perch which during the spring came in there to spawn. "And when an opportunity occurs, Gipsy will be observed to make a sudden dash towards the bottom with its head, and generally secures a fish, which it carries to land and forthwith kills." Furthermore, if an angler had trouble in landing a trout, the dog on command would plunge in and, seizing it in its jaws, would bring it ashore. Nevertheless, it would never eat a fish unless cooked.

In Yarrell's *British Fishes*,³ 1836 edition, Volume II, page 56, there is quoted, from a manuscript left by Colonel Montague, the story of a water spaniel that caught all the carp in its master's ponds and because of its misdeeds was to be killed. However, a gentleman living some distance away, owner of a famous trout fishery, begged that the dog be given him, for he be-

lieved that such a wily and agile fish as a trout could not be caught by any dog. The spaniel, however, soon convinced his new master that even the trout were no match for him. What was then done with this troublesome fisherman is not stated.

Further, Yarrell in the second edition of his work (1841, Vol. II, pp. 69-70) quotes from a letter written by the Earl of Home to the effect that his uncle had a Newfoundland dog that became an expert fisher of salmon by attending the fishermen at work below a near-by mill dam. The dog used to take position at the opening in the dam made to allow salmon to ascend and catch them as they attempted to pass through. So skillful did he become that "he has been known to kill from twelve to twenty salmon in a morning," which he placed together on one side. And now follows a most interesting thing. It would seem that the dog was so successful that he actually threatened to diminish the supply of salmon in that stream, for we read that "The then Earl of Tankerville instituted a process against the dog. . . This case was brought before the Court of Sessions and the process was entitled 'The Earl of Tankerville versus a Dog, the property of the Earl of Home.' Judgment was given in favor of the dog."

The geologist, J. B. Jukes,⁴ records the exploits in Newfoundland of a dog that evidently fished for the fun of it. We shall let Jukes tell his own story:

He [the dog] sat on a projecting rock, beneath a fish flake or stage, where the fish are laid to dry, watching the water, which had a depth of six or eight feet, and a bottom which was white with fishbones. On throwing a piece of codfish into the water, three or four heavy, clumsy-looking fish, called in

¹"Fluker." *Fishing in Egypt*. Alexandria, [1918?], pp. 87-8.

²Stoddart, Thomas Tod. *The Art of Angling as Practiced in Scotland*. Edinburgh, 1835, p. 119.

³Yarrell, Wm. *A History of British Fishes*. 2 vols. 2nd Ed., 1841, Vol. II, p. 105; 3rd Ed., 1859, Vol. I, p. 283.

⁴Jukes, J. B. *Excursions in and about Newfoundland during the Years 1839 and 1840*. London, 1842, 2 vols. Vol. I, pp. 191-92.

Newfoundland "Sculpins," with great heads and mouths, and many spines about them, and generally about a foot long, would swim in to catch it. These he would "set" attentively, and the moment one turned his broadside to him, he darted down like a fish-hawk, and seldom came up without a fish in his mouth. As he caught them, he regularly took them to a place a few yards off, where he laid them down; and they told us that, in the summer, he would make a pile of sixty or seventy a day just in that place. He never attempted to eat them, but seemed to be fishing purely for his own amusement.

Jukes watched this dog for a couple of hours and noticed that when the fish became shy and did not come up, the dog would put his right fore foot (a white one) in the water and would paddle it about. Jukes' guide told him that the dog did this to "toll" or entice the fish. But our author was never able to decide whether this was so or was the result of impatience.

Cornwall Simeon¹ in 1860 relates, of a Scotch terrier attached to a shooting and fishing lodge in Ross shire, that above all things he loved to go out in the boats with the anglers, and that he always manifested the greatest interest in their catches. In the afternoon after the work of the men was over, the dog would do some fishing on his own account. Taking his stand on the large stones which served as a landing place, he would watch for cod-fish which came up seeking the offal that was thrown overboard after the day's catch had been prepared for the table. Simeon states:

Although he generally saw them when they were some little distance from the shore, yet if they seemed to be coming pretty straight towards him, he rarely made any demonstration until they were well within reach and he had

a fair chance at them. Then he went in with a rush. There was a tussle, a diving, a gripping, and a blowing, and then gradually he emerged, struggling with and dragging after him the unwieldy and reluctant form of a big helpless-looking cod.

To the great disgust of the dog, his captures were, however, always thrown back. The keeper reported that the animal would also catch salmon in the same way. The picture reproduced on p. 559 of this article is from the title-page of Mr. Simeon's book.

George R. Jesse² quotes as follows from an unknown writer in the *Sporting Magazine* concerning a dog which apparently fished for sport only:

A dog which, some years ago, was at the White Hart Inn at Salisbury [England], took his daily walk around the canal surrounding the Close, in search of minnows, which he seized with wonderful avidity. When few or none were visible he scratched up the gravel [in shoal water in the canal] for a considerable extent, and then patiently took his station till some unfortunate gudgeon came in sight [attracted by the freshly turned gravel], on whom he pounced with all the ferocity of a hawk secure of its prey.

Richard Jefferies³ gives an interesting account, too long to be quoted verbatim here, of somewhat similar actions on the part of a pointer belonging to him. Some fish—roach, tench, perch, and a small jack—were kept for a time in a large stone trough from which cattle were wont to drink. After a time this trough became foul and while it was being cleaned, the fish were transferred to a large shallow tub. Here they were distinctly visible, and after watching them for some hours, the dog put her head under the water, removed them one by one and laid

¹Simeon, Cornwall. *Stray Notes on Fishing and Natural History*. Cambridge [England], 1860, pp. 128-32.

²Jesse, George R., *Researches into the History of the British Dog*, etc. 2 vols., ill. London, 1866.

³Jefferies, Richard. *The Gamekeeper at Home*. 2nd Ed., 1880, p. 54.

them un mutilated on the grass. Jefferies put them back in the tub and watched the dog immerse her head and grope around until she found a fish; then out came her head and the fish was placed on the ground. This she did time after time and for fish after fish, the jack giving her the most trouble but eventually being always caught.

The next day she renewed her fishing exploits and soon became so expert that she did not miss a fish. When, however, these were removed to the deeper water of the trough, she no longer molested them as the trough was too wide and the water too deep for her unless she became completely immersed. No attempt was made to teach her; she acted throughout on her own initiative.

But some critic may object that these accounts are apocryphal or at any rate not attested by a naturalist of standing. To this it may be answered: in the first place, that these diverse accounts, spread over a number of years, coming from men who must be accredited as honest, are themselves corroborative and convincing proof; and secondly, that there will now be given an account from the pen of the veteran naturalist, W. H. Hudson, who tells of the following incident in his autobiography.¹

It seems that, when a boy, he was one day on the water front at Buenos Aires as the tide was coming in. He noticed a man and dog approaching. Presently the dog left his master and bounding up to one of the outermost rocks, not yet washed over, where Hudson was standing, took position there and gazed intently into the water. "Suddenly he plunged in, quite dis-

appearing from sight, but quickly re-appeared with a big shad of about three and a half or four pounds in weight in his jaws. Climbing on to the rocks, he dropped the fish, which he did not appear to have injured much, as it began floundering about in an exceedingly lively manner."

The dog repeated this performance five times, evidently for the mere sport of the thing as his master paid no attention to him. The rising tide washed the fish back into the water, and by and by the man whistled to the dog, which bounded off to join him.

Somewhat intermediate between independent action and deliberate cooperation are the accounts next to be given, in that the dogs acted in a sense as conscious helpers to their masters.

The first account of this character is from the pen of Pierce Egan,² who tells of a Newfoundland dog that on one occasion was observed to fish in the river Clyde. A codfish about eighteen inches long was leaping out of the water and thus came to the attention of the dog, which "at a favorable moment plunged into the Clyde and disappeared for a short time. He then made his appearance with the fish in his mouth and delivered it to one of the servants [of his master] with very few marks of violence upon it."

Sir John Richardson,³ quoting from a correspondent of his, gives the following interesting note regarding the habits of the sail fluke (one of the flat-fishes) and the fate that overtakes it: "It does not take a bait, and he only once saw it caught in a net, but it comes ashore spontaneously, with its tail erected above the water, like a boat

²Egan, Pierce. *Book of Sports and Mirror of Life*, etc. London, 1832, p. 284.

³Richardson, John. "Singular Account of the Sail Fluke." *Zoologist*, 1860, Vol. 18, pp. 6993-94. Also in 2nd Supplement to Yarrell's *British Fishes*, 1849 ed. [citation not verified].

¹Hudson, W. H. *Far Away and Long Ago; A History of My Early Life*. New York, 1918, p. 101.



A spaniel that for many years supplied the Pères Cordeliers d'Etampes with crabs and fish is here seen bearing to his masters a characteristic contribution for the larder. So skillful was this dog and so meritorious were his services that a local poet celebrated his exploits in Latin verse

under sail, whence its name. This it generally does in calm weather, and on sandy shores, and the country people near such places [in Scotland] train their dogs to catch it." The fluke, left on the beach by the receding wave, burrows in the sand, from which it is dug out by a dog.

Ernest Menault in his *Intelligence of Animals* (English translation, New York, 1869) quotes from the *Histoire d'Etampes* to the effect that a clever spaniel served the Pères Cordeliers d'Etampes for many years as a purveyor of crabs and fishes. Indeed Menault states that so celebrated was this animal and so many capital dinners had he provided for the friars that in

1714 a local poet celebrated his exploits in Latin verse. The figure with which Menault illustrates his account is reproduced above.

In a book by an anonymous writer,¹ published in 1865, there is an account of a still more remarkable kind of fishing by a dog, namely, that on the sands of the seashore left exposed by the retreating tide. A party of English gentlemen were watching the various methods of fishing carried on at low water at a certain point on the coast of Normandy, when they saw an old woman pass by equipped with a fish-basket and a pickax and accompanied

¹Campbell, J. T. Editor. *Life in Normandy. Sketches of French Fishing, etc.* Edinburgh, 1865. 3rd. Ed., pp. 124-26.

by a dog. They followed her out on the beach to a spot where the sands, instead of being smooth, were covered everywhere with little mounds.

"Go and seek, good dog Trompette!" said the old lady. . . The dog started off, hunting in all directions. In a quarter of a minute he stopped at one of the little lumps, and began to scratch and whine like a terrier at a rat-hole. "See, he has one," said the woman, as she ran towards the dog, brandishing her pick-axe. When she reached the place, she looked to see which way the hole ran, and then began tearing up the sand, which rose in lumps at every blow. After eight or ten strokes out tumbled a conger eel about the same size as those in her basket.

This she killed and put in her basket and cried, "Seek again, Trompette!" This the dog did and in five minutes they had caught five large conger eels. Inquiry elicited the fact that a young dog was trained by being taken out once or twice with an experienced animal; thus instructed by example, it would soon learn to hunt quite well itself.

The instance last mentioned has prepared the reader for the cases, now to be cited, of dogs serving as aids to fishermen in their business. That man should instruct dogs to this end is after all not so strange. He has trained dogs to hunt for him, to drive birds into a net, to catch and bring to him disabled birds, and to dive and hunt for otters. The first statement of the use of a dog for fishing is from an old book on fishing by James Saunders¹ dating back to 1724. His circumstantial account is as follows:

In Devonshire I have observ'd how they fish with a Dog, a way I have never met with anywhere else, but it is in one particular Case, which is thus,

¹Saunders, James. *The Compleat Fisherman, being A large and particular Account of all the several ways of Fishing now practised in Europe.* London, 1724.

they make Pallisadoes and cross Stakes at the Tail of a Mill, the cross Pieces are set pointing inwards like a Mouse Trap to one another, and the Points so close together, that when the Tide comes up, the Fish slide insensibly between the Points, but cannot find their way out again when the Tide ebbs again; so that they are left in the Dock of the Mill Tail, where the sides being walled or wharft with Stone, and the Mill shut down at the higher End, the cross Rails standing athwart the lower End, and pointing so near to one another as above, the Fish are left within, in about a Foot or Foot and a Half of Water only.

When the Tide is thus out, the Fish which are generally Salmon in the Season, and Salmon Peall when the Salmon Season is over, are all to be seen; then they place a shove Net at the end of a Pole, at the lower end of the Dock or Mill Tail, and turn in a Dog, who is bred to the Trade, at the upper End, and he drives all the Fish into the Net, and so dextrous are they at their business, that if a Fish gets into a little Hole or under a Stone, as if it were unwilling to be driven on to its Ruin, the unlucky Curs will wrack them out with their Feet.

The next account is contained in a letter written by William Hamilton from Portrush, Ireland, in 1784,² and records an incident that occurred on a ride from Portrush to the Giant's Causeway. As it is the basis of a number of other accounts, it will be quoted here in full:

We had occasion to ford the river Bush, near the sea; and as the fishermen were going to haul their net, we stopped to see their success. As soon as the [their] dog perceived the men to move, he instantly ran down the river of his own accord and took post in the middle of it on some shallows where he could occasionally run or swim, and in this position he placed himself, with all the eagerness and attention so

²Hamilton, Wm. *Letters Concerning the Northern Coast of the County of Antrim . . . together with the Natural History of the Basaltes, etc.* Dublin, 1790. Part I, pp. 111-12. Also in Pinkerton's *Voyages*, 1809, Vol. III, p. 887.

strongly observable in a pointer dog, who *sets* his game; . . . the fish, when they feel the net, always endeavor to make directly out to sea. Accordingly one of the salmon, escaping from the net, rushed down the stream with great velocity, toward the ford, where the dog stood to receive him at an advantage. A very diverting chase now commenced, in which, from the shallowness of the water, we could discern the whole track of the fish, with all its rapid turnings and windings. After a smart pursuit the dog found himself left considerably behind, in consequence of the water deepening, by which he had been reduced to the necessity of swimming. But instead of following the desperate game any longer, he readily gave it over, and ran with all his speed directly down the [bank of the] river, till he was sure of being again to seaward of the salmon, where he took post as before in his pointer's attitude. Here the fish a second time met him, and a fresh pursuit ensued, in which, after various attempts the salmon at last made its way out to the sea notwithstanding all the ingenious and vigorous exertions of its pursuer.

In this instance the dog seemed to have had two objects in view; either to catch the fish or to drive it back into the net. And though he failed on this occasion, the fishermen reported that it was not unusual for him to run down and catch the fish, and that he was of the greatest assistance in turning the fish back into the net.

This account is reproduced with slight changes in Edward Jesse's *Gleanings in Natural History*, London, 1838, pp. 70-1; in Yarrell's *British Fishes*, London, 1836, Vol. II, p. 24; and in Frank T. Buckland's *Familiar History of British Fishes*, London, 1873, pp. 132-33.

Yarrell¹ also writes that a correspondent of his assured him that in Glamor-

ganshire dogs were used in the manner above indicated to drive salmon into the net. And another correspondent wrote him that he knew a poacher in Devonshire who after setting a tram-mel net at the lower end of a pool in the river, would send his dog (which he had trained to dive like an otter) in at the upper end to drive the fish into the net. The like use of a dog in south Wales is vouched for by a writer signing himself A. Guest.² The details need not be given as the procedure was essentially like that recorded in the accounts given above.

In closing, incidents of this use of dogs are cited from the narratives of travelers among a very degraded and primitive race of people in a far-off part of the world, namely in the Straits of Magellan. In 1768, John Byron³ and the ship's company of the "Wager" suffered shipwreck on the coast of Patagonia. After enduring fearful hardships from cold, hunger, and lack of clothing (which eventually killed off all but a mere handful of the men), the survivors were forced to call on the wretched inhabitants of the country to aid them in fishing—the sea being practically their only source of food. Then they found that the natives made use of their dogs to drive the fish into the corner of an inlet or bay, where they were easily caught. Byron's fullest statement is as follows:

. . . and [they] then went out upon another kind of fishery by the means of dogs and nets. These dogs are a cur-like looking animal; but very sagacious, and easily trained to this business. Though in appearance an uncomfortable sort of sport; yet they engage in

²Angler's Notebook and Naturalist's Record, Series I, London, 1880, p. 10.

³Byron, John. *The Narrative of the Honorable John Byron Containing an account of the great distresses suffered by himself and his companions on the coast of Patagonia . . . also a Relation of the Wager Man of War.* 2nd Ed., London, 1768, pp. 56, 127, and 134.

¹Yarrell, Wm. A. *A History of British Fishes*, 2nd Ed., 1841, p. 59.

it readily, seem to enjoy it much, and express their eagerness by barking every time they raise their heads above the water to breathe. The net is held by two Indians, who get into the water; then the dogs, taking a large compass, dive after the fish, and drive them into the net; but it is only in particular places that the fish are taken in this manner.

Captain Fitzroy¹ had read Byron's narrative and when surveying in the Straits of Magellan about 1836, he was on the lookout for this interesting phenomenon. However, he did not see the Fuegians carrying on such a method of fishing, nor could he obtain hearsay evidence for the existence of such a practice. Nevertheless he gives full credence to Byron's account, for he observed native dogs on otter hunts swim, dive, and pursue their prey most eagerly.

Darwin, who visited the region in the "Beagle," makes no reference whatever to this method of fishing in his *Voyage of the Beagle*. But there is one other writer who substantiates the statements of Byron. Marin² says that in the lateral channels opening out of the Straits of Magellan, the Fuegians use dogs to aid them in fishing and particularly in hunting for the otter. It must be confessed, however, that the account has to do mainly with the pursuit of the latter, the dogs, according to Marin, diving after the otters and following them under rocks and amid the recesses of marine vegetation.

It has never been my good fortune to witness such interesting incidents as those here chronicled and hence this article lacks the personal touch.

¹Fitzroy, Capt. Robert. *Narrative of the Surveying Voyages of H.M.S. "Adventure" and "Beagle" . . . 1826-36 [on] . . . the Southern Shores of South America*. Vol. II, "Proceedings of the Second Expedition," 1831-36, p. 187.

²Marin, Aylic. *Au Loin. Souvenirs de l'Amérique du Sud et des Isles Marquesas*. Paris and Lyons, 1891, p. 117.

However, since I began gathering material for it, there has come to my knowledge a series of experiences which I am fortunate in being able to set forth in conclusion. These were related to me by Mr. Guy V. Ferguson, now a resident of New York City, but in his boyhood days a fellow countryman of mine in western North Carolina. I have known Mr. Ferguson long and well, and I also know the locality wherein the incidents related took place. Full credence can be given to this recital.

The largest stream in my native county of Haywood is Pigeon River, so named because of the great prevalence on its banks in former days of the passenger pigeon. About ten miles north of my home town, Waynesville, the river receives a tributary from the east, Crabtree Creek, and about one mile from this point of junction Crabtree Creek in its turn receives an affluent, Rush Fork, formed of brooks rising on the flanks of Crabtree Bald, a mountain about 6000 feet high. One half mile up Rush Fork, Mr. Ferguson was born and spent his boyhood days, and there the incidents related took place.

Both the river and the larger creek, flowing through miles of farming country, are, and were even at that day, somewhat turbid, while the shorter Rush Fork is clear and sparkling. Into this small stream every spring there come to spawn fishes of the "sucker" tribe, hog-suckers, white-suckers, and red-horse. Now in that day and time our country was full of game and our streams were full of fish, and hence every farmer's boy had a dog, generally a good hunter, and in the case of Mr. Ferguson's dog "Fred," a good fisherman as well.

In the spring, when the fish began to run up in the small creek,

Ferguson and his brother would sally forth with "gigs," or three-pronged Neptune's tridents, to strike these fish, and with them almost always went the dog. Frequently they went at night carrying torches, for then the fishes were more easily caught. In case a stricken fish succeeded in tearing himself from the gig and made an attempt to get away, or in case one scared by the approach of the boys and dog darted ahead on the shoals, the dog would leap forward and often catch it. Presently he became very expert, and in time began to fish for himself.

The chief sphere of operations of the two boys was in the fertile "bottom" (alluvial) land lying immediately along the creek. Here, day after day, when the boys went to work, the dog would come also, to chase ground squirrels and dig out moles, and eventually to fish for himself in the near-by stream. In the creek, the water on the riffles was only a

few inches deep and in the pools rarely more than a foot and a half in depth, and here the dog had great sport. Not infrequently his master would hear a considerable commotion in the stream, joyous barkings and loud splashings, and on running to the spot would find the dog chasing the fishes or perhaps coming out with one in his mouth. His biggest catch was a carp about eighteen inches long which had been carried in some flood from a pond into the river and had at a later time, probably during a heavy rain, made its way up into this small creek; subsequently, the falling waters had left it behind in a pool. It was just about all the dog could do to handle it.

Here, as in so many of the cases cited, the dog was fishing for pure sport—the quadruped striving for the same end as his biped master and accomplishing it in his own way.



Watchful waiting, with aggressive intent.—This picture is reproduced from Richard Jefferies' volume, *The Gamekeeper at Home* (1880). The pointer found diversion in removing the fishes from the tub and in repeating the performance when they were put back in the water (see pp. 562-63)



A NESTWARD FLIGHT

A cicada killer on the wing bearing her inert prey to the burrow she has dug in the soil flanking the pathway. From a painting by Mrs. Edna L. Beutenmüller

A Wasp That Hunts Cicadas

BY WILLIAM M. SAVIN

Illustrations from photographs by the author

DURING the early days of August, 1922, in a meadow near my summer home in New Jersey, the cicada killers, *Sphecius speciosus*, had made a settlement, consisting of more than two score independent nests. With few exceptions these burrows were placed within an area of six hundred square feet. Close by ran a brook and along its banks within fifty feet of the nests grew several trees from which the wasps were accustomed to fly with their captives held clasped against the underside of the body. Conditions were, therefore, most favorable for the study of these wasps.

The female of *Sphecius speciosus* devotes herself to the capture of cicadas, which she stings and paralyzes and subsequently carries to her nest to serve as food for the larva that will hatch from the egg that she lays on this prey. Many cicadas doubtless fall victims to these persistent huntresses. One day within twenty minutes the wasps were seen bearing eight cicadas to their several burrows in the settlement.¹

In the ground (preferably clayey soil) the wasp mother excavates a tunnel having a diameter of about an inch. This slopes gently downward for six inches and then usually makes a turn at right angles. In the long tunnels a number of such turns occur. There is a great variation in their length: some run only a foot, others four feet. The majority of those in this settlement extended for about two feet.

¹As Mr. William T. Davis has pointed out (*Bulletin of the Brooklyn Entomological Society*, Vol. XV, No. 5, December, 1920) *Sphecius speciosus* is an indiscriminate collector of cicadas and will often place more than one species in the same burrow.

Frequently a number of branches are projected more or less forward from a central point in the tunnel, each branch terminating in a round cell about one and three-fourths inches in diameter. The termini observed were always slightly nearer the surface of the ground than were the tunnels. This afforded better drainage and in many instances must have prevented the stored food from becoming moldy through an accumulation of water in the cells.

When excavating the tunnel the wasp walks out backwards, dragging the dirt and placing it loosely in front of the entrance. Sometimes the pile of dirt is about a foot in diameter. As the wasp trails through this dumpheap, she leaves a groove, the presence of which is indication that work on the nest or in connection with its provisioning is still under way. For several days, while these nests were under observation, it showered and the grooves were effaced, making it impossible to determine off-hand whether the tunnels had been completed and the cells stocked.

Each cell is stocked with one or two cicadas, only one egg, however, being laid per cell. Among the cells uncovered in these burrows the greater number contained two cicadas. The female of *Sphecius speciosus* is larger than the male and it has been suggested that the supply of two cicadas is left as food for the larva that will metamorphose into a female wasp, the single cicada being sufficient food for the larva that will emerge as a male wasp.

On one occasion I found in a cell three cicadas that were somewhat



HUNTRESS AND VICTIM

The wasp does not confine her captures to a single species of cicada nor does she apparently take more males than females even though the noisy singing of the male might seem to give him a prior claim, however unenviable, upon her attention

smaller than usual. Possibly the mother was absent-minded in providing the extra one, or again the fact that the prey was undersized may have influenced her to make up through number what the individual captures lacked in bulk.

The egg hatches in two or three days and the emerging larva disposes of the edible part of the cicada within a week or more. It then spins a cocoon about itself, requiring two days to finish the work. The cocoon is made of silk mixed with dirt, which is evenly distributed; it is dark brownish in color and crusty. The larva rests within the cocoon until the following spring when it undergoes pupation, emerging as an adult wasp before the appearance of the cicadas in midsummer.

Stocking the nests with cicadas is no easy task. As the weight of the victim is about twice that of its captor, the burdened wasp is unable to make extended flights on the level; consequently she flies obliquely from a tree to the burrow. In many instances the wasp is obliged to drag a cicada up a tree to a point of vantage before undertaking her downward flight to the nest.

The captive cicadas were for the most part borne from a linden tree, *Tilia americana*, about fifty feet distant across the brook. Some of the wasps before hunting engaged in what were evidently practice flights between the tree and their respective burrows. Occasionally they would visit the nest site without a captive cicada, remaining outside of the tunnel. In such cases the wasp would fly about the entrance in increasingly larger circles, the outer one having a diameter of about thirty feet. This probably gave the insect some impression of the surroundings of the burrow to assist her in her return flight.

Again, starting at a burrow, a wasp would fly five or six feet in a direct line toward the linden tree. Returning to the burrow she increased the next flight by five or six feet. A number of such flights were made until she went from the burrow to the tree in one flight. Each flight was at an angle of about forty-five degrees.

In bearing a victim from the tree to the burrow a wasp would often alight at the entrance and at once drag the cicada into the tunnel. At other times the insect would land a foot, or more, from the burrow among the grasses. The obstacles in her path caused her to flounder about considerably and it was with great difficulty that she reached the nest. On one of these occasions the wasp came across a ragweed, *Ambrosia*, about eighteen inches in height. She dragged the cicada, ventral side uppermost, to the top of it and flew to the burrow two feet distant. Dragging the victim along the ground is evidently burdensome and the cicada hunter apparently embraces the slightest opportunity to fly to her burrow from an elevation.

On two occasions when we dug into the burrows, the proprietress was discovered within. One of the two wasps thus surprised was engaged in making her tunnel, twelve inches of which she had completed. When she was uncovered, she flew out but not at us. Although our destruction of the burrow had left an excavation a foot square, thereby changing the appearance of the surroundings, the wasp returned to her well-nigh demolished tunnel and resumed her work, extending for another foot the passageway with its several branches, the terminal cells of which she stocked with cicadas. The other wasp had completed a four-foot tunnel and was apparently de-

positing a cicada in the end cell when we came upon her in the course of our excavation of the burrow. I judge by the noise she made that she was greatly annoyed; she flew away and did not come back to the nest. On our return to the site we found in the excavation a cicada which the wasp had probably taken from the cell and dropped there. No egg was laid on it.

On two occasions we tried to secure a wasp as she alighted near her burrow with a cicada by placing a jar above her and gently lowering it. In each instance, when the jar was within about an inch of the wasp, she abandoned the cicada and flew away but not toward us. A wasp with her prey was then easily secured with a net.

At times these wasps, it would



The dark hole shown in the picture is the entrance to the burrow of the cicada killer. When excavating the tunnel the wasp drags the dirt out into the open, walking backward. The layer thus formed is sometimes nearly a foot in diameter



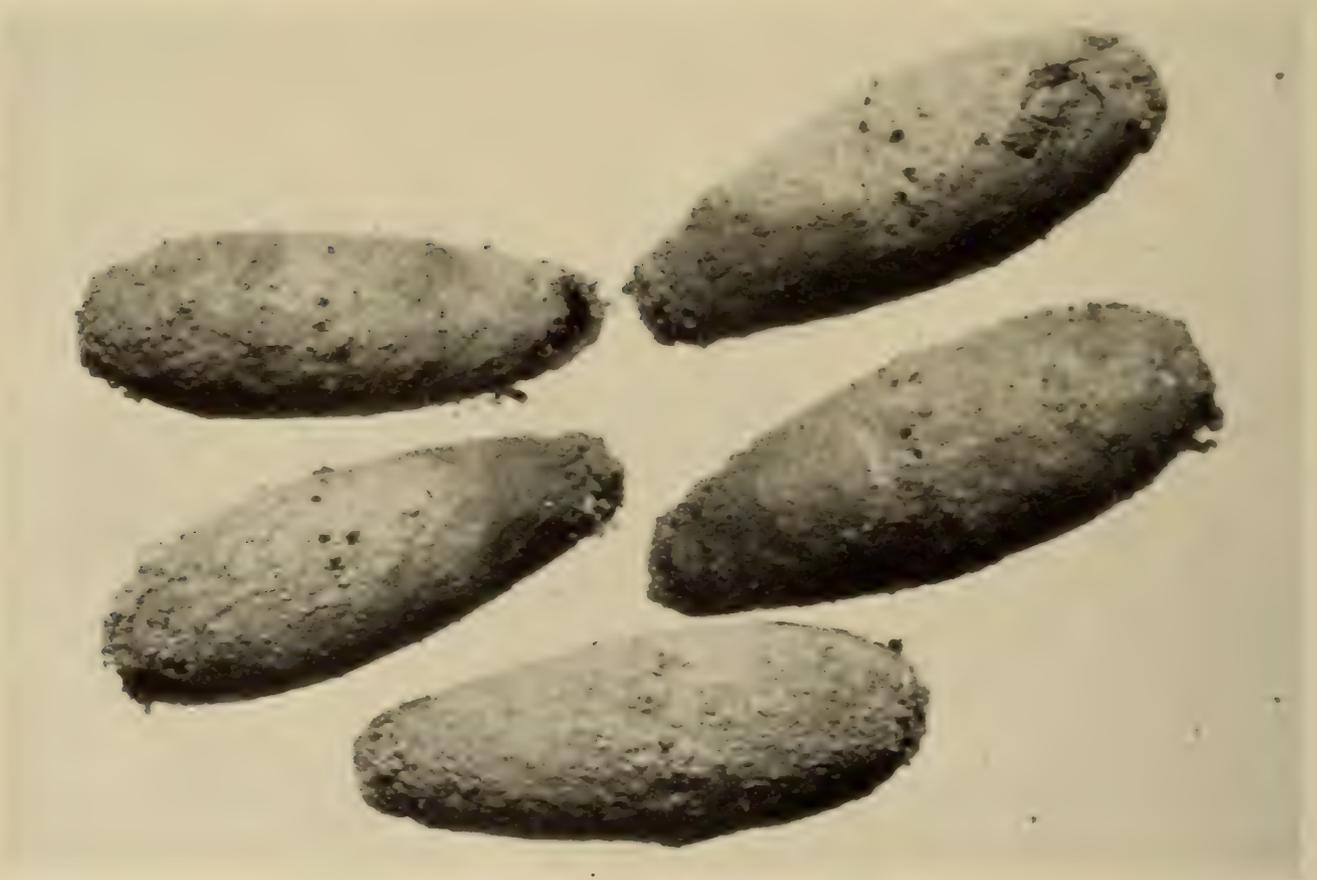
Frequently the huntress stocks a cell of her burrow with two cicadas for the voracious larva that is to be the beneficiary of her prowess. In the above picture the hatched larva may be seen on the side of the cicada to the left



After the larva has reached a certain stage of development thanks to the nourishment obtained through the circular openings it has made on the ventral side of the two cicadas, it foresakes the remnants of the feast and spins a cocoon



The five smaller cocoons (left) were derived from cells in each of which the wasp mother had left only a single cicada. The five large cocoons (below) were taken from a like number of cells each of which had been stocked with two cicadas



When spinning the cocoon, the larva mixes quantities of earth with the silk, giving it the appearance of having been made of mud. A dozen or more pores occur close together on one side of the cocoon, and it has been suggested that their function is to aid in the respiration of the larva



A cocoon of the cicada killer which has been opened to show the larva resting within—its head in the large end. The larva remains in the cocoon until the following spring when it undergoes pupation and later emerges as an adult wasp

seem, keep watch over their burrows from a distance. Once at nightfall, thinking the wasps would not be about and that it would be a favorable time to dig into the burrows, we visited the nests. When we reached the settlement, no wasps were in evidence, nor was the sound of a cicada heard. After working for about five minutes, however, a number of wasps appeared and flew about us as well as the bur-

rows with more show of excitement than when we had worked among them in the daytime.

The cicada killer, *Sphecius speciosus*, does not seem to live up to her reputation for ferocity. During these observations, covering several days, not once did the wasps administer a sting. Like other solitary wasps they seem to prefer to conserve their poisonous fluid for injection into their captives.



Not always does all run smoothly for the larvæ of the cicada killer. Sometimes the burrows become excessively damp and the cicadas placed there turn moldy. They are thus rendered unfit as food and the larvæ, deprived of their sustenance, die.

At times a fatality seems to befall also the adult wasp when in the burrow, and she too may then become moldy, as indicated in the case of the wasp on the left of the picture



Colquechaca's highest peak with an abandoned mining town at its base

The Treasure House of Spain

THE FAMOUS NEW-WORLD MINES OF ORURO, COLQUECHACA, AND POTOSÍ

BY EDWARD W. BERRY

Professor of Palæontology, Johns Hopkins University

HISTORY and fiction both abound with references to King Solomon's Mines, although these were really insignificant compared with those of the Emperor Charles the Fifth, or of his son King Philip, which were wrung from the Incas by a handful of war-hardened adventurers, whose achievements, even when shorn of romance and the exaggerations of the early chroniclers, still seem more like fiction than sober history.

Imagine the little band of fortune-seekers led by the swineherd of Estremadura, Francisco Pizarro, sweltering through the humid morasses from Nombre de Dios to Old Panama, and then transported to the wind-swept Andean heights with their thin air, and the record of their achievements is sufficiently remarkable to offset many

of their crimes. Grant the abjectness and lack of spirit of the Indian population—the natives are unassertive today and must have been so in the past. Nature was seemingly a more relentless foe than the Indians, and the difficulty in overcoming it was scarcely realized in Prescott's day, nor can the obstacles encountered be fully appreciated by any one who has not traversed the old trails. Thanks to the Inca custom of establishing supply houses along the routes, the danger from famine was reasonably remote, but the passes are inconceivably high to those accustomed to the passes of the Alps or Rockies. That which we traversed in going from Huancavelica to Santa Inéz was 16,500 feet, or higher than any peak in the United States. The cold is intense, fuel is wanting, and the

effect of the rarified air is sometimes remarkable. I have seen horses drop dead because of it, and when you consider the armor-laden cavaliers and the burdens that their lowland-bred horses were obliged to carry, it is strange that any of the animals survived.

There was still another adverse factor. Hardy though the Conquistadores were, they were prone to excessive dissipation whenever this was possible, and men so constituted are, according to my experience, the first to feel the effects of altitude. In a trip I made over the Oroya Railroad in 1919 it was not the party of Americans on the train who were affected with "soroche" or mountain sickness, but the natives who presumably, as is their custom, had spent their last night in the City of Kings (Lima) in over-indulgence.

Pizarro's band found much gold in Peru, but this huge amount, wrung as a ransom from the unfortunate Atahualpa, had been accumulated by the Incas through several centuries of washing the gravels of the Andean streams, particularly those of the eastern range, and this was no gauge of the amount to be quickly won by mining operations, as the Spaniards soon found to their sorrow. Their search for gold was disappointing, for although it is present in streams all along the Andean front, and in scattered places elsewhere, modern operations have not proved commercially successful to any considerable extent, largely because of the low grade of the placers as compared to the excessive cost of production in such inaccessible regions. In the Montaña jungles it is not an uncommon thing to come across mining machinery of all kinds, rusting and overgrown, that was brought by hand over the heart-breaking upland trails,

only to be abandoned when funds and health gave out.

What the Empire of the Incas lacked in gold resources, however, it amply made up in silver. This metal is abundant in what is now Peru and Bolivia, and in the eastern and the western Cordillera. The bonanza silver region of Colonial South America was located in what was known as Charcas, or Upper Peru, now the Republic of Bolivia. Three localities furnished the bulk of the silver that poured thence into Spain's coffers, and offered rich pickings for Drake and other buccaneer admirals of Queen Elizabeth, as well as for the host of pirates that subsequently infested the Spanish Main, of whom Morgan was perhaps the most notorious.

These three localities of Upper Peru were Oruro, Colquechaca, and Potosí, and of these the last far outranks any other in the whole world. Oruro, which was the youngest and least important of the three, is situated on the high plateau of Bolivia, or Altiplanicie, as it is called, which here is only 12,250 feet above sea level, but in a region too arid for agriculture. The town itself is now a most ordinary place, consisting mostly of one-story adobe houses, but it is a considerable railroad center and a place of much business. It is 115 miles southeast of La Paz, the present metropolis of Bolivia, and the old trail from Lima to Buenos Aires is here marked every kilometer by huge adobe monoliths. Considerable mining of silver, tin, and copper is carried on in the surrounding hills, but the scarcity of water makes it necessary to do the milling at Machacamarea some miles to the southward near Lake Poöpo. Oruro now has only about one third the population that it had in the Colonial Period and derives its chief importance from



A native woman and her donkey plodding over the mountains. Much of upland Bolivia is of this arid character

the fact that it is a trade center and shipping point for the hinterland, the prospective mineral and agricultural wealth of which is incalculable.

World-famous Potosí is about midway on the old trade route between Lima and Buenos Aires. Since 1912 it has been possible to reach it by train from Rio Mulato, a station on the Antofagasta-La Paz line 108 miles distant. The single train makes one round trip a week,¹ reaching Potosí Saturday night and returning the following Tuesday. At Condor the roadbed reaches the marvelous height of 15,814 feet, but the route is high without being otherwise notable, and the climate is so arid that glaciers are wanting, and the high mountains with their subdued slopes suggest an overgrown hill country, largely without crags or scenic effects. Were it not for shortness of breath or other unpleasant reminders of the altitude, the traveler would not realize that it is the gable of South America.

¹During the last year or two the train has been making four trips a week.

On our 1919 trip, however, we chose to go the way that Gonzalo Pizarro, the first proprietor of Potosí, went, and were eleven days on the trail in making the 162 miles from the town of Uncia by mule, although, to be sure, we were not in the saddle all of that time. Uncia, which is at the present time the largest tin-producing camp in South America, is situated east of the divide of the eastern Andes, and about forty-five miles from Machacamarea on the railroad. A mountain of igneous material intruded through the Devonian shales carries rich tin veins, and the two companies that work them from the two sides of the mountain have an annual production valued at nearly \$50,000,000. Uncia in August has the wind and dust of a typical March day in the United States, not enhanced to the imagination by the thought of the innumerable germs.

Because of the cold nights one does not rise in the Andes until the sun strikes one's lodging, except under the necessity of an early start for a long-day's mule ride. Consequently one

does not see many sunrises, or that most curious effect assumed by mountains in the diffused light of early dawn, when they seem to be cut out of cardboard and unreal as in a play. One is prone to think of the earth's surface as parceled out into regular zones of vegetation and animal life from the equator to the poles, as they are in the geographies, and it is difficult to become accustomed to following an upland trail in a vegetationless Arctic cold, withal under a tropical sun, reach a great gash in the earth's crust, and switchback down three thousand or four thousand feet into a hot valley, where, if there is water, there is a rich and varied vegetation, with humming birds, flocks of parrakeets, and everything normal to the Equatorial Zone. Such a place was the dirty Indian tambo of Morocacha, where we lunched the first day. The tambo is the official wayside inn for man and beast, but mostly for beast, and is a survival of the rest houses of the Incas. Night-fall brought us to Pocoata, another

tiny Indian town, nestled in an out-of-the-way valley. We had covered forty-eight miles in one day—our South American record. A letter to the corregidor or prefect's representative in Pocoata, spared us the tambo and secured for us a bed on the dining-room floor of the corregidor's residence. A short day's ride brought us to Colquechaca, the second treasure house of Colonial days.

Situated at the head of a southwardly-facing valley, amid a group of peaks all of which rise to heights of more than 16,000 feet, the town is small and mean. A thousand feet higher than Potosí, it never attained the wealth, size, or importance of that place. It straggles along a narrow valley; consequently the only approximately level streets are those paralleling the stream, and these are connected by alleys of steps six or eight feet wide, for there are no wheeled vehicles in these Andean towns, and mules find steps of human construction easier of traverse than many of the mountain trails.



The plaza at Maragua, one of the remote little Indian valley towns



The main street of Colquechaca backed by its symmetrical peak.—Three hundred years ago Colquechaca was well known for its rich silver mines. Mementos of its former days of prosperity are the roofless stone walls of many an old house, three fourths of the town being composed of habitations that are today deserted. In several of the principal streets these old houses are being re-thatched and whitewashed, and in years that are perhaps not far distant the community may again rise to prominence as a mining center



Tin washing in the Tarapaya Valley below Potosí.—The Spaniards valued only the precious metals, and in their time tin was neglected. But today the tables are turned, and tin is claiming the attention of the miner in the very region where silver was formerly the chief attraction

Three hundred years ago Colquechaca was a thriving town, noted for its rich silver mines and with a large population. The roofless stone walls of the former habitations still comprise three-fourths of the town, and there are two more ancient and smaller towns now entirely abandoned, higher up among the peaks. Colquechaca was noted for the richness of its ores—pockets and shoots of ruby silver occurring plentifully at irregular intervals in the otherwise rather lean veins.

The mountain mass around Colquechaca forms an area of igneous rocks about eight or ten miles in diameter, which was intruded through the sedimentary red sandstones and shales, and it is a part of the same series of intrusions that follow the eastern Andes all across Bolivia from north to south and that are the source of the silver and tin minerals for which that country is famous. The colonists mined only the silver, but recently a considerable amount of tin concentrates has been produced. The district probably has a great future but its immediate past has been one of decay. The San Bartolome tunnel, which starts at the upper end of the town and penetrates for a mile into the mountain mass, struck a vein with phenomenal silver riches, one which was once worked over a vertical range of about two thousand feet. With the decline in the price of silver toward the close of the last century this, the largest of Colquechaca's mines, was allowed to fill with water, and all of the workings, extending for several hundred feet below the tunnel, have been flooded for more than a generation.

Evidence of former greatness is seen in an immense pump room with its old Cornish pump, and the roomy chapels and shrines, all hollowed out of the

solid rock. Along several of the main streets of Colquechaca the houses have been re-thatched and whitewashed, and the town is becoming reanimated. It is one of the highest mining towns in the world, cold and inhospitable, prone to snow squalls and electrical storms. Autos can now reach it over the valley trail from Challapata on the railroad about eighty miles away, and Sucre, the old capital of the republic, is only about sixty miles by trail to the southeast. Potosí lies about one hundred miles to the southward of Colquechaca, and to reach it requires four days on the trail, stopping at unheard-of Indian towns nestled in far-away deep valleys, as out of the world as if they were on another planet.

To me Potosí will always remain the most interesting town in South America—historically, architecturally, and scientifically. For years I had looked forward to visiting it, and the symmetrical cone of its silver mountain, visible from the divides two days' journey away, stimulated the imagination of the present-day traveler much as it must have done that of the greedy Spaniards of old, whose ghosts, in our imagination, constantly haunted the trails. One seemed to live again with Gonzalo Pizarro and amid the countless dramas of the past. There is no spot in South America that offers more material for the novelist than this city of romance and the trails leading out to the coast and northward across the mountains to Sucre, and I can only hope that some future Ibañez will rise up and make them forever famous.

The trail to Potosí makes its final plunge down from the upland into the Tarapaya Valley twenty-eight kilometers below Potosí, and from here onward the road is good, leading as it

does to Miraflores, where there are famous hot baths—relics of some former igneous intrusion. In a land where hot water is too scarce ever to be wasted in washing, hot springs are a boon. Someone has said that the traveler in South America will feel so much cleaner than the natives that baths will seem unnecessary. This is, of course, a libel, but it is not surprising that with frost every night and no fuel except *taquia*, the droppings of the llama, and *yareta*, a resinous mosslike plant (*Azorella*) any attempt at cleanliness might easily prove fatal, and extreme aridity makes it possible not to take too many risks of this sort.

Prescott writes picturesquely of Inca aqueducts and baths, but so far as my experience throughout the limits of their former empire indicates, the Incas never bathed—at least their descendants never do, and the aqueducts of fiction are mainly irrigation ditches, the building of which is the one art in which the mountain Indians really excel, and the “baths” are invariably storage reservoirs.

The broad trail winds up the Tarapaya Valley between 40° dip slopes of red sandstone. At San Bartolome the trail turns to the eastward through a picturesque gorge, which the Rio Potosí has cut through the red beds, and swings up past San Antonio and Cantumarca—the latter an Inca town—to historic Potosí near the head of its valley, backed by the Kari Kari Mountains and flanked on the right by its historic Cerro, or mountain.

Potosí is hilly, although not so much so as La Paz; nevertheless it is regularly laid out. Its plazas are notable despite the fact that the climate precludes trees. Its architecture is especially picturesque even though many of the ancient dwellings, churches

and other public buildings have been allowed to fall to pieces. All of the better houses are at least two stories in height, and mostly of adobe, which, however, has been supplemented with much stone. Varying combinations of tower, hanging balcony, ornamental cornices, barred windows, and Moorish metal work and stone carving, with the variously gabled and invariably tiled roofs, give an artistic quality and an individual character to each building, reminiscent of Grenada or Seville, and this similarity is rather enhanced by the pronounced sag of the more ancient rooftrees under their weight of red tiles. The Court of Lions at the Alhambra cannot compare with the Cerro-backed plaza shown in the illustration on page 584.

Sufficient water for industrial purposes has always been a problem here as elsewhere in Peru and Bolivia, and at the height of the city's prosperity twenty-seven artificial reservoirs, some of them of immense size, were constructed among the moraines that stretch like fingers down from the Kari Kari Mountains east of the city, to impound the summer rains. There are also thirty-two aqueducts of ancient date, many of which are now in a state of dilapidation.

About the year 1460 the Inca, Huayna Capac, paid his first visit to this region, and in journeying from Cantumarca to Porco—the latter a near-by region which was worked by the Indians for its silver several centuries before the coming of the Spaniard, as is attested by the pre-Spanish slag dumps—got his first view of Potosí, which the Quichua Indians called “Sumac-orcko,” or Beautiful Mountain. The Inca, so runs the legend, was impressed with the idea that a mountain of such grandeur must

surely contain precious metal, and accordingly ordered that it be mined. In obedience to the emperor god the Indian miners made preparations to tunnel into its flanks but were warned away by the Achachila, or spirit of the mountain, and since that time it has been called Potosí, or mountain of great noises—doubtless in allusion to the terrific electrical storms that play around its peak in summer.

Tradition states that the Spanish discovery of silver at Potosí was accidental. An Indian from Porco, searching for a stray llama and camping on the mountain for the night, found the smelted ore in the remains of his camp fire the next morning. Similar apocryphal stories are told of all great mines and inasmuch as there is not a trace of anything on Potosí Mountain that would furnish fuel for even a modest camp fire, we may well discredit the legend. At any rate, the discovery of silver at Potosí was undoubtedly due to its proximity to the Porco silver mines, and active mining at Potosí commenced in 1545. The surficial ores, which were naturally the first to be mined, were found to be phenominally rich, the friar, José de Acosta, estimating that the production from 1545 to 1572 amounted to \$250,000,000.

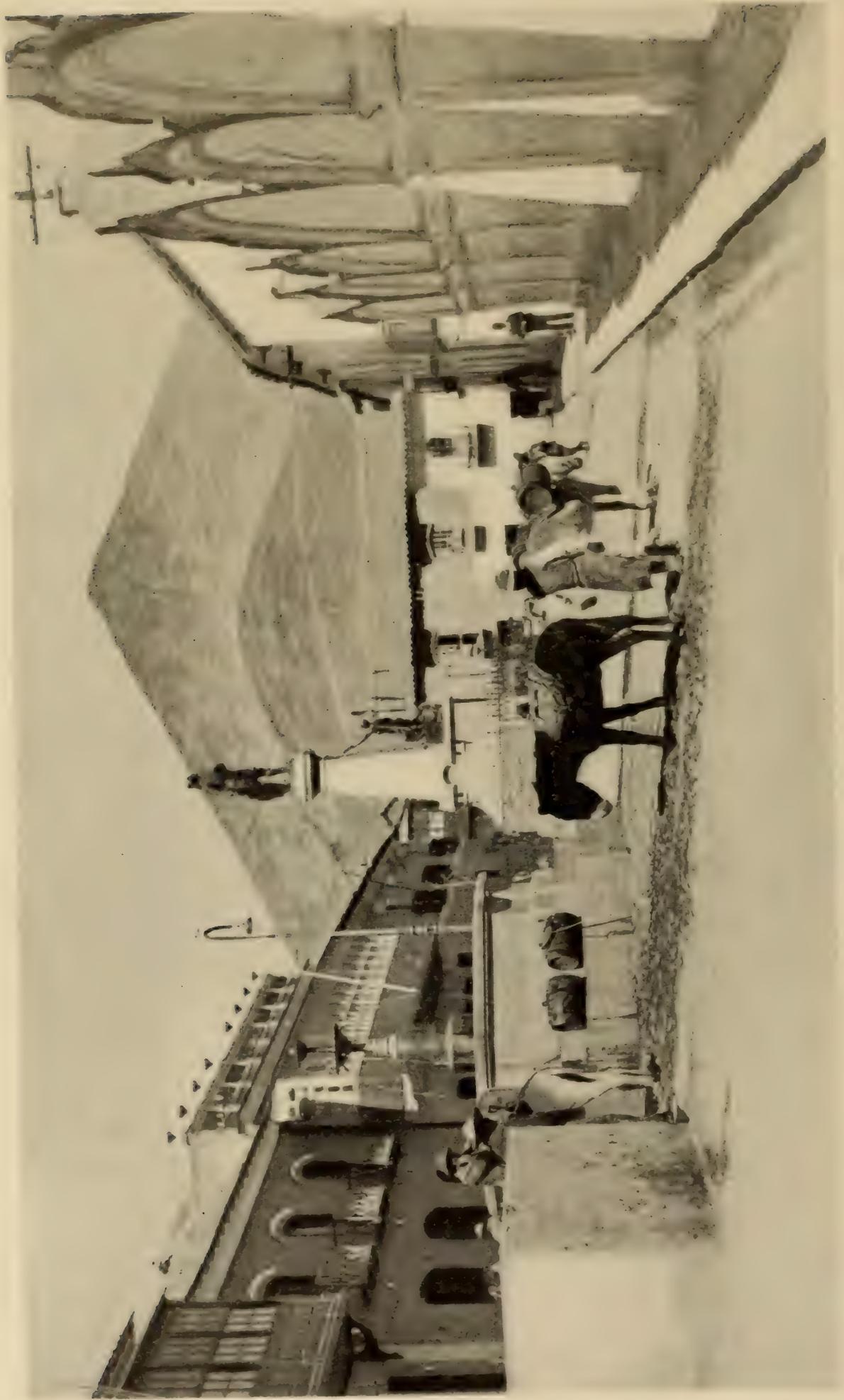
The mineralization is really remarkable—it is said that any hand specimen of the 15,000-foot cone will assay at least a trace of silver, and the actual ores from the innumerable veins contain small amounts of gold and copper along with the larger amounts of silver and tin. Strangely enough the adjacent peaks consisting of the same rock totally lack the metallic ores. The Spaniards were interested in precious metals solely, consequently tin and copper were produced only in sufficient quantities for the amalgams used in

making utensils and the innumerable church bells, which no hamlet in the Andes, however remote, lacks. It is only in recent years that iron from the outside world—for there is none here—has replaced bronze in the native mining industries.

Most of the silver, some say all of it, was recovered by the amalgamation process, the mercury for which came from the scarcely less famous quick-silver mines of Huancavelica in the Peruvian Andes nearly one thousand miles away. The tin which is associated with the silver was allowed to go down stream in the tailings and the 375 years' accumulation of these has formed rich alluvial tin deposits wherever the channels of the Rio Potosí or Rio Tarapaya widened out and formed playa deposits.

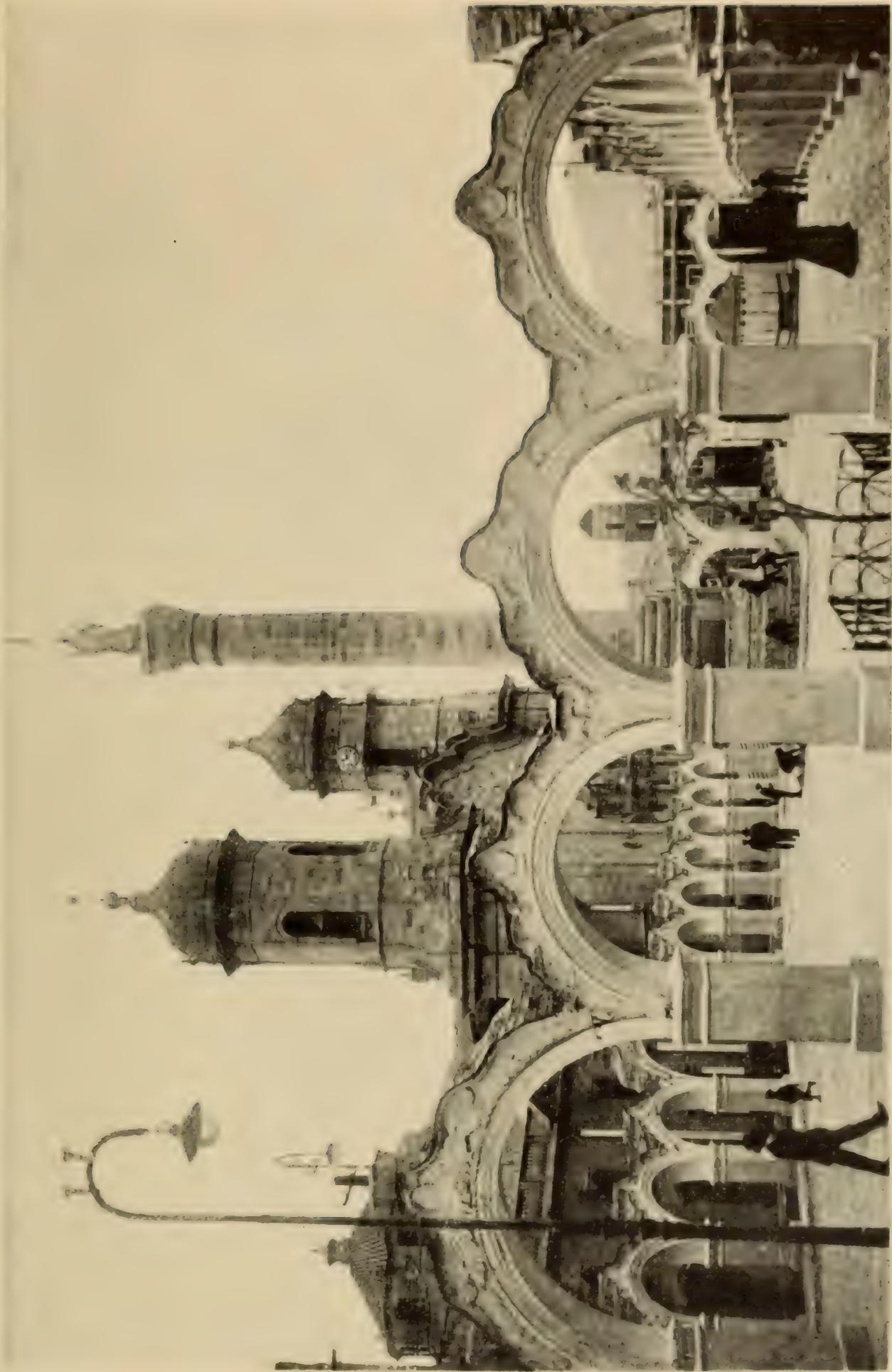
In these effete modern days of industrial civilization tin is a greater desideratum than silver—consequently Potosí is now more of a tin than a silver camp. Some idea of the value of the tin can be gathered from the fact that it is found profitable to wash over the old mine dumps high up on the mountain in the rude *quimballales*, or jigs, with water brought up from town in five-gallon gasoline cans by mules or burros.

A crown tax on the silver produced was imposed in 1556 and this brought great sums into the monarch's war chest, and helped to pay for the Spanish Armada and the wars in the Low Countries. With the working out of the rich oxidized surface ores there was a falling off in revenue and the viceroy, Toledo, was sent out from Spain in an endeavor to improve the situation. Indians were enslaved from as remote regions as Ecuador and many thousands, particularly those from the low-lying countries, quickly worked



THE CONICAL CERRO FROM THE EAST END OF THE MAIN PLAZA OF POTOSÍ

Active mining at Potosí began in 1545. It has been estimated that, in the course of the twenty-seven years succeeding, metal worth \$250,000,000 was obtained from its ores. Originally famed for its production of silver, Potosí today is predominantly concerned with the mining of tin



Courtesy of the Pan American Union

ONE END OF POTOSÍ'S MAIN PLAZA

their lives away in the company of countless llamas. Chroniclers, prone to exaggerate, give the number of Indians that were worked to death in the mountain as 8,250,000.

In 1739 the crown tax was reduced from 20 to 10 per cent. This is clear evidence, not of the beneficence of the monarch but of the increasing difficulty from water and the mounting costs of working at depths. These depths had in some cases reached 1700 feet below the surface and there were no other means of taking out either the ore or the water except on the backs of Indians. Gradually the lower levels became flooded, the protracted struggle for independence, which commenced in 1809 with resulting interruption of mining hastening the process, so that in the nineteenth century production was much less than in the sixteenth century.

Many and conflicting estimates of the amount of silver obtained at Potosí during Colonial times are extant. On the basis of the royal tax collected, which amounted to \$575,780,000 between 1545 and 1809, as shown in various audits of the royal treasury, the production has been figured at \$5,594,000,000, an average of more than \$21,000,000 per year for 264 years. Even allowing for exaggeration, and dividing this huge sum by two or three, the result is still the enormous total of \$2,000,000,000 or \$3,000,000,000 for the entire period, and this does not take into account the very large amount exempt from taxation that went into church service—the massive silver candlesticks and altars still to be seen in the cathedral at Sucre testify to the use of the metal in this manner. Among these are four of an original set of twelve, each of which is more than six feet tall and so heavy that it

cannot be tilted by one man unaided; and in its prime there were sixty churches in Potosí alone. Neither do these estimates take into account the amount which evaded the tax through being smuggled out of the country. There was a regular trade in contraband silver and the amount was sufficient to give the name of La Plata, or Silver River, to the estuary of the Parana and Uruguay on the east coast of South America, and all of this came from Bolivia, and most of it from Potosí.

Forty-eight years after its foundation, that is in 1595, or twenty-five years before the Pilgrims landed at Plymouth, it is said that Potosí had 160,000 inhabitants. This is doubtless an exaggeration—the ruins of today do not indicate more than half of this number in the town itself. It is quite within the range of probability, however, that at the height of its prosperity in the sixteenth century upwards of 100,000 individuals inhabited the district. At any rate, Potosí was, for more than a century, the largest city in the Western Hemisphere. Charles the Fifth conferred on it the title of *villa imperial*, and lovely Sucre, founded a few years before Potosí, was so enriched by the silver from Potosí that it was called the City of Silver (*Ciudad de la Plata*) up to 1840, when the modern name of Sucre was adopted in honor of that famous general of the War of Independence.

Naturally such a profusion of wealth resulted in the most extravagant displays and elaborate *fiestas*, in fine residences, churches, and public works. All of the wood used in construction had to be brought from the eastern lowlands a great distance away, and anyone who has seen the enormous beams in the old mint, or *Casa Nacional*

de Moneda, can picture the toiling swarms of sweating Indians that were required to transport them over the difficult mountain trails. It is related that one Quiroga, who worked the Cotamitos mine, paid a crown tax of \$21,000,000, and from his profits built the cathedral of San Francisco, where his tomb may still be seen. Most of the architecture in Potosí is distinctly Moorish in type, notably the open arcade or flying arches that enclose the east side of the main plaza.

There are three thick old volumes full of tales of Potosí, and the records of litigation that resulted from the old Spanish mining law, which is still in operation at Potosí, would fill a library. Each year, it is said, rival parties smother a few Indians with the fumes made by burning the aji, or native pepper, which some facetious traveler has called the national flower of Bolivia. In the old days rival companies went even further, and at least one rich mine was entirely destroyed by blasts set off by an unsuccessful litigant.

The Mountain, or Cerro Rico de Potosí, to give it its full name, lies south of the town, and its summit is less than three miles from the central plaza. It is a perfect cone of a coarse, igneous rock known as rhyolite, but now so covered with mine dumps from the more than one thousand tunnels on its flanks that the original rock is entirely hidden except at the peak, which attains 15,381 feet, not quite half a mile above the town, which has an elevation of about 13,000 feet. The Cerro truly dominates the town and the surrounding country, as it did Colonial history, and its beautiful ever-changing tints are visible in that arid climate for long distances.

High up on its western flanks it carries tilted lake beds of volcanic

ashes, and these are filled with the relics of a rich subtropical vegetation. This proves not only that the igneous intrusion that is responsible for the silver-tin minerals occurred very late in geological time, but that when this one-time lake was filling with ashes blown hither from the far-off volcanoes of the western Andes, the country was more than a mile nearer sea level than it is at present. At that time the moisture-laden winds from the Amazon basin still swept over what is now Bolivia and made it a forested country—the haunt of the mastodon, sloth, horse, and other extinct animals, whereas all is desiccation now and not even a mule can crop a meal.

The history of Potosí and of the silver city of Sucre, some forty-seven miles to the northeast (eighty-eight miles by trail), furnishes a superb moral for political economists. I suppose that the original operators in the mountain were for the most part what might appropriately be termed the scum of Spain. Sucre, or Charcas, as it was originally called, was founded in 1538 or 1539 by one Pedro Anzures, Marquis de Campo Redondo, by order of Francisco Pizarro. It lies in a genial basin about 4000 feet lower than Potosí and hence is a delightful place. The ambition of most Potosí operators was to acquire such wealth as would enable them to live in luxury in an appropriate establishment at Sucre. Thus that place came to be known as La Plata, which name it retained for three hundred years.

Sucre early had many and rich ecclesiastical establishments—at the present time with a population of from 20,000 to 30,000 there are thirty cathedrals, convents, and other Church institutions, and their wealth passes belief. The University of Chuquisaca was

chartered the year that the Pilgrims landed at Plymouth and is, next to the University of San Marcos at Lima, the oldest in the Western Hemisphere. It once had a great reputation and drew students from as far away as Buenos Aires, but it is now the Colegio Junin, and a *colegio* is not a college but a secondary school.

Today Sucre is the cleanest, most attractive, most Spanish, and most cultured city of the Republic. The head of the Church and the Supreme Court—those two most conservative organizations of society, are still in Sucre, but all of the other machinery of government is at La Paz. I know of no more impressive instance of the influence of wealth in advancing civilization, or in changing in the course of

generations irresponsible adventurers with no respect for law or any form of restraint into conservative citizens, cultivators of literary, historical, and legal studies, supporters of libraries, schools, geographical societies, and a medical school.

Such changes are perhaps a commonplace of history, but nowhere do they stand out as dramatically or more clearly than among the *gente decente*, or aristocrats, of Sucre. Potosí's silver made all of this possible, and Potosí's mines are not only the oldest mines in the world that have been continuously in operation, but they have also produced more riches than any other known mine, and Bolivia may well take pride in them and picture the historic Cerro on its postage.



"The Most Wonderful Plant in the World"

WITH SOME UNPUBLISHED CORRESPONDENCE OF CHARLES DARWIN

BY FRANK MORTON JONES

IN 1867 Charles Darwin received a letter from his American correspondent, Asa Gray, enclosing one which Doctor Gray, in turn, had received from William M. Canby, of Wilmington, Delaware. The subject of the Canby letter was the American insectivorous plant, *Dionæa*, Venus's-fly-trap; and Darwin's reply says,¹ "This letter fires me up to complete and publish on *Drosera*, *Dionæa*, etc., but

when I shall get time I know not." Though he had also written,² "I care more about *Drosera* than the origin of all the species in the world," five years elapsed before Darwin was able to resume in earnest his work on insectivorous plants; then, recalling the American botanist as a source of information in regard to *Dionæa*, and admittedly confusing Mr. Canby's home, Wilmington, Delaware, with the habitat of the

¹*Letters of Asa Gray*. Edited by Jane Loring Gray. Published by Houghton, Mifflin & Co., 1893

²*The Life and Letters of Charles Darwin*. Edited by Francis Darwin. Published by D. Appleton & Co., 1899.

on the *Dionæa*, which I look at as the most wonderful plant in the world.

If you do visit the proper district I shd be very much obliged if you wd open a dozen oldish leaves to see what sized insects they capture.

I am aware that a very minute insect wd start the leaf, but I suspect that they wd generally escape through the apertures at the bases of the spikes

before they are completely interlocked.

With my best thanks,
believe me dear Sir
yours faithfully

Ch. Darwin

Dated from Down, Beckenham, Kent, February 19, 1873, this letter from Charles Darwin to the American botanist, William M. Canby, begins with the admission, "I find that I erred in supposing that the leaves never opened a second time. I did suppose that you resided near the habitation of the *Dionæa* [*Dionæa*], which I look at as the most wonderful plant in the world"

plant, Wilmington, North Carolina, he wrote requesting further information, and especially that field observations should be made on the insect-catching habits of the plant in its native home.

Within the last few months, in a half-forgotten chest in the attic of Mr. Canby's home, this Darwin-Canby correspondence of fifty years ago, relating to *Dionæa* ("which I look at as the most wonderful plant in the world"), has been found. These letters, with the published letters of Darwin and Gray of the same period and regarding the same subject, typically illustrate Darwin's intuitive, almost uncanny, facility in seizing upon apparently minor characters of structure or behavior and in finding there significances hidden from the observers upon

whose evidence he builds his edifice of inference and deduction; and they most forcibly call to our attention the paucity in our literature of direct and detailed field observations on *Dionæa*,—if not "the most wonderful plant in the world" yet undeniably among the most remarkable of all our native flora.

Dionæa muscipula, Venus's-flytrap, belongs to the same plant family as the more familiar *Drosera*, the sundews; but while some species of *Drosera* are almost world-wide in their distribution, *Dionæa*, represented by its single species *muscipula*, is confined, if one excepts hothouse specimens, to a narrow strip of about fifty miles along the coast of North and South Carolina; and even within these limits its dis-



Dionæa is not a conspicuous plant, for its leaves rise, at most, only a few inches above the sand, where they are often half-hidden by other herbage



Only when the slender flower stalk raises its cluster of modest white flowers above the level of the leaves, is the discovery of *Dionæa* always possible without prolonged search

tribution is strictly localized, for it seems to be very particular in the selection of its growing place.

To the non-botanical observer, untroubled by problems of comparative morphology, the "leaf" of *Dionæa* is borne on a flattened or winged petiole; the broadly rounded halves of the leaf

are set at an upward angle to the midrib, and the outer edge of each half bears more than a dozen evenly spaced finger-like spikes; the slightly concave disk of each leaf-half bears three (sometimes more), fine, short, tapering bristles, which are the "triggers" to set off the trap; for the whole structure

is a trap for the capture of insects. Touch one of the trigger hairs twice,



In this photograph one half of the leaf has been removed, to show distinctly the marginal spikes, the three trigger hairs, and the slightly concave and densely glandular area forming the digesting and absorbing surface of the leaf

or any two of them in close succession (gently, even with a hair) and like a closing hand the halves of the leaf clap to, the marginal fingers interlace, and if the capture be of nutrient material (an insect), or if it continues its struggles (for the leaf responds both to chemical and mechanical stimulation), the leaf-halves press more and more closely together, the innumerable glands which stud their upper surface pour out an abundant rosy secretion, which bathes the captive in a digestive juice, and when days later the leaf reopens, the insect has been reduced to a mere chitinous shell from which all the softer parts have been dissolved out and absorbed for the nourishment of the plant.

This is the usual (and apparently justified) interpretation of the activities of *Dionæa*. The mechanism of the closing of the leaf; the conditions under which the digestive liquid is poured out and nutritive material absorbed; even the minute electrical disturbances set up in the leaf in closing,—all these have been made the subject of extended research; but it was in reference to none of these that Darwin wrote Canby. In the closing movement of the leaf one detail had puzzled him. When the trigger hairs are touched and the leaf claps to, it does not at first close tightly; the fingers interlace but do not close to their bases, and a row of crevices remains through which for a time a small insect might squeeze out. Darwin's son actually observed a small ant make its escape in this manner. But after the first quick closing movement, if a capture is actually made, the marginal fingers soon tighten their grip, the leaf edges are pressed into closer contact, and eventually even the form of the imprisoned insect, under the pressure



Why does the leaf of *Dionæa*, in its first quick closing movement, leave a row of crevices between the "fingers," through which a small insect may make its escape, and then very gradually close these orifices? It looks as though the small insects were given an opportunity to escape; but why?

exerted, becomes visible as it bulges out the thin walls. In explanation of these peculiarities of the closing movements of the leaf Darwin had a theory; but his sickly greenhouse plants ("I cannot make the little creature grow well," he wrote¹ Hooker) did not furnish conclusive evidence of its correctness; so his queries to his American correspondent were, "How many times, successively, does a single leaf capture and digest prey? What sized insects do they capture?" Canby replied, writing from memory, six years after his observations had been made: "As to the specific point about the plant capturing large or small insects, the answer is that so far as I am aware it catches everything it can, large or small. . . . As far as I can remember, any insect from the size of a small fly, say a line or two in length, to

a beetle or other insect of *nearly* the length of the leaf would be closed upon and . . . devoured. As to the proportion of 'large' or 'small,' I cannot distinctly remember; but after what I have written it would be fair to suppose that within the limits mentioned above it would probably be almost the proportion of insects in the neighborhood of the leaves, except that insects which habitually fly, as a class, would probably be less liable to capture than those which crawl. . . . Now about the leaves becoming callous and unexcitable after 'catching' an insect, I have several times known leaves to devour insects *three* successive times, never more than that, and then they were the most vigorous. Ordinarily twice, and quite often once, was enough to render them unserviceable."

This reply was not conclusive, and on February 17, 1873, Darwin wrote Canby: "I find that I erred in sup-

¹More Letters of Charles Darwin. Edited by Francis Darwin. Published by D. Appleton & Co., 1903.



The captures of fifty mature leaves of *Dionæa* consisted of Hymenoptera (wasps and large ants), 10; Diptera (flies), 9; arachnids (spiders), 9 (one with an egg sack); Coleoptera (beetles), 9 (each distinct as to species); Orthoptera (grasshoppers, locusts, roaches), 7; Hemiptera (predacious bugs and leaf hoppers), 4; Lepidoptera (caterpillars), 2. The average length of the fifty victims was 8.6 mm., or about one third of an inch

posing that the leaves never opened a second time. . . If you do visit the proper district I shd be very much obliged if you wd open a dozen oldish leaves to see what sized insects they capture. I am aware that a very minute insect wd start the leaf, but I suspect that they wd generally escape through the apertures at the bases of the spikes before they completely interlocked."

And again on May 7 of the same year Darwin wrote: "I thank you very sincerely for the leaves, of which I have examined the [captures] with great interest. The results support my anticipation that the leaves are adapted to allow of the smaller fry escaping. Eight of the fourteen leaves had caught beetles of relative considerable size. There were also a good-sized spider & a scolopendra. Three of the leaves had caught ants. I wish the leaves had been of full size, but I think my results may be trusted."

The examination of the captures of fourteen small leaves, then, is the principal basis upon which Darwin builds his theory of the significance of the initial partial closing of the leaf of *Dionæa*. In *Insectivorous Plants* he reviews this evidence, concluding, "It would manifestly be a disadvantage to the plant to waste many days in remaining clasped over a minute insect, and several additional days or weeks in afterwards recovering its sensibility; inasmuch as a minute insect would afford but little nutriment. It would be far better for the plant to wait for a time until a moderately large insect was captured, and to allow all the little ones to escape; and this advantage is secured by the slowly intercrossing marginal spikes, which act like the large meshes of a fishing net, allowing the small and useless fry to escape."

Before the appearance of *Insectivorous Plants* Gray wrote to Canby thus:¹

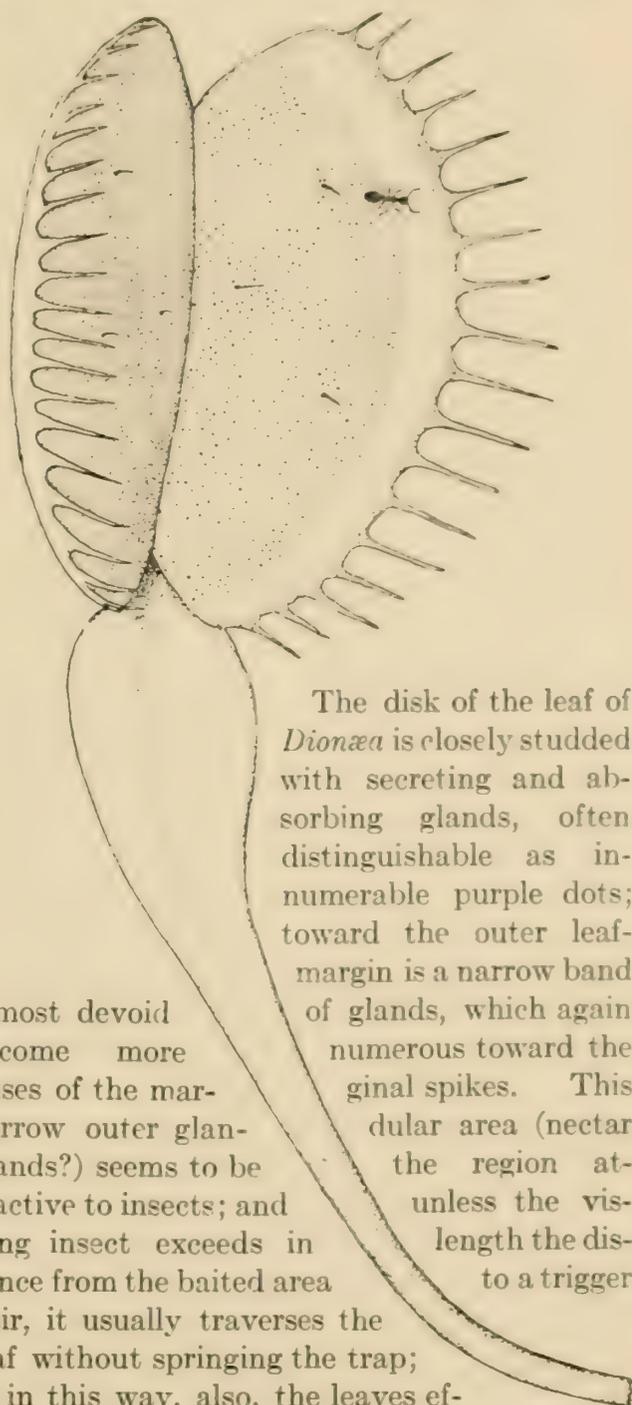
¹Letters of Asa Gray. Edited by Jane Loring Gray. Published by Houghton, Mifflin & Co., 1893.

"Conundrum? Why does the *Dionæa* trap close only part way, so as to cross the bristles of edge only, at first, and afterwards close fully? Darwin has hit it. I wonder you or I never thought of it. . . Think what a waste if the leaf had to go through all the process of secretion, etc., taking so much time, all for a little gnat. It would not pay. Yet it would have to do it except for this arrangement to let the little flies escape. But when a bigger one is caught he is sure for a good dinner. That is real Darwin! I just wonder you and I never thought of it. But *he* did." Gray was right, and "That is real Darwin!" But is it true? Darwin, after examining the captures of fourteen leaves gathered in the field, writes, "I think my results may be trusted." Perhaps by these methods his theory of this significance of the leaf behavior is not susceptible of absolute proof; but it seemed worth while, by further direct observation upon the plants in their native home, and by the examination of a large number of leaves which had made captures, to determine whether an actual sorting out of visiting insects by size does take place.

On May 31, 1921, *Dionæa* was found in full bloom, in abundance, and in fine condition, within a few miles of Wilmington, North Carolina. It was an easy task to gather fifty well-developed leaves with captures; these were opened carefully, and their captures were dropped into alcohol, for measurement and approximate identification at leisure. Of the fifty, only one was less than 5 mm. in length, and only seven, less than 6 mm.; ten were 10 mm. or more in length, with a maximum of 30 mm. We may then safely conclude that the habitual captures of mature leaves range from the largest insect the leaf is able to close upon and

hold, down to those approximately one quarter of an inch in length; and that insects materially smaller than this, if they spring the trap, usually take advantage of the opportunity afforded by the partially closed leaf and make their escape.

One capture not tabulated deserves special mention. When one leaf was opened, its contents were found to be a single wing cover of a large beetle (shown in the center of the plate of captures) and an ant much smaller than any of those captured by the other leaves examined. It is not diffi-



almost devoid become more bases of the narrow outer glands?) seems to be attractive to insects; and if the insect exceeds in length the distance from the baited area to a trigger hair, it usually traverses the leaf without springing the trap; so in this way, also, the leaves effectively sort out their captures by size

The disk of the leaf of *Dionæa* is closely studded with secreting and absorbing glands, often distinguishable as innumerable purple dots; toward the outer leaf-margin is a narrow band of glands, which again become more numerous toward the bases of the marginal spikes. This glandular area (nectariferous) is the region attractive to insects; and unless the insect exceeds in length the distance from the baited area to a trigger

cult to picture the minute ant, desperately tugging the wing cover across the leaf, bumping into the trigger hairs, and refusing to desert its booty until the time for possible escape had passed.

With this evidence of the size of the actual captures of the leaves, it was desirable to determine what insects could be observed upon the leaves, subject to capture; and parts of two days were devoted to this, with some unanticipated results. Ants were the only insects frequently noticed upon the leaves. Nearly all of these ants belonged to small species, 3 mm. or less in length, and consequently smaller than any of those captured by the fifty leaves. None was actually observed to set off the trigger hairs, but we repeatedly sprung the leaf traps with slender grass stems without disturbing the ants, each leaf closing upon its visiting ant, which crept out after the expiration of a few seconds, either between the crossed fingers, as Darwin had surmised and recorded, or at the end of the leaf, where also a slight crevice remains after the first closing movement; and none failed thus to make its escape in time to elude the slow tightening and closing of these apertures.

The plants *were* sorting out their captures by size; but to accomplish this not one method, but two, were employed; and the second and unrecorded method with respect to these small ants was the more effective. Most of these little ants (sometimes two of them on a single leaf) were observed to occupy a uniform position on its upper surface, their heads close to the bases of the marginal spikes. As they moved slowly across this belt of the leaf, they made frequent and prolonged pauses, during which, their

mouth parts were observed under the lens, to be in motion against the surface of the leaf. A larger and winged hymenopteron was observed to be engaged in the same performance. Obviously, they were feeding upon some attractive exudation of the leaf. The behavior of visiting insects is entirely convincing to the observer that a baited area extends across the leaf on its upper surface just within the bases of the marginal spines. This baited marginal band is so situated upon the leaf surface that a visiting insect *in length too small to extend from the bait to the trigger hairs*, usually does not spring the trap. Whether or not these conditions are to be interpreted as adjustments to that end, the effect of this arrangement, in conjunction with the peculiarities of the closing movement by which small insects are given an opportunity to escape, is to limit the usual captures of the leaves to insects approximating one quarter of an inch or more in length.

Living plants of *Dionæa* were exhibited in England more than 150 years ago, even prior to the first published description by Ellis (1775). The voluminous literature of research upon this plant has increased rather than decreased our recognition of its almost unique interest, and is at least proof that *Dionæa* still withholds answer to some of its more fascinating problems. As a hothouse plant it continues to be fairly familiar both here and abroad, but its survival in its restricted native habitat should not be left to chance. Let us hope that means for its preservation may be found, and that for all the future we may have opportunity to "look on *Dionæa* as the most wonderful plant in the world."



Elephants mounted for the Field Museum in 1907-08 by Carl E. Akeley

How Elephants are Mounted

A CHAPTER IN THE HISTORY OF TAXIDERMISTRY

By FREDERIC A. LUCAS

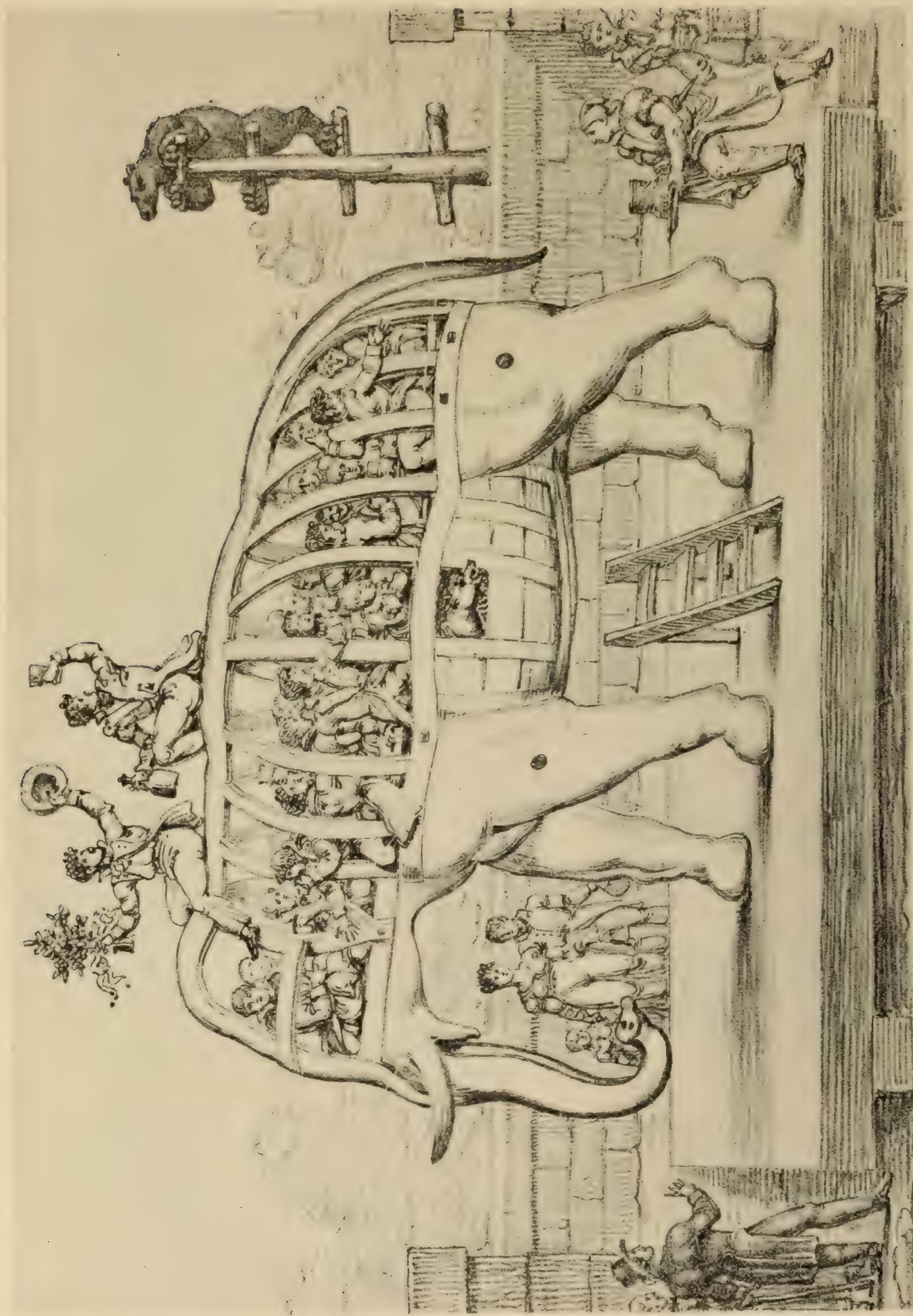
Dr. F. A. Bather, deputy keeper of geology, British Museum, in noticing in the *Museum's Journal* of Great Britain the statement that Director Lucas prepared for the *Fifty-third Annual Report* of the American Museum, expressed the wish that Mr. Akeley's new method of mounting elephants, which is applicable also to other large pachyderms or short-haired mammals, had been described.

That it was not was due partly to the fact that it did not at the time occur to Director Lucas to write a dissertation on taxidermy, and partly from a desire to make the report as brief as possible. It is hoped that the present article may serve as a record of how various elephants have at various times been mounted by various preparators and that Mr. Akeley may in short time be able to prepare a detailed account of his method for the guidance of others.

MOUNTING an elephant is not only the largest but in many ways the most difficult problem with which a taxidermist can be confronted, and it is interesting to note the various ways in which the problem has been met and what appears to be its solution. Just when the first elephant was mounted I know not, but some time before 1813 one was on ex-

hibition in Bullock's Museum, London: unfortunately we have no record of the method employed in mounting it.¹ This is all the more regrettable because it must have been one of the earliest, possibly *the* earliest, example of a

¹This specimen is shown in an aquatint of Bullock's Museum, and is noted in the *Companion to Bullock's Museum* issued in 1813, but while the eighth edition of the *Companion*, 1810, devotes three pages to the "Artificial Forest," which includes a lengthy description of the rhinoceros, it makes no mention of an elephant.



CELEBRATING THE MAKING OF THE MANIKIN

This spirited picture—a reproduction of a lithograph preserved in the Musée d'Histoire Naturelle, Paris—shows a festive gathering held in the manikin which M. Lassaigne, artificer employed in the Jardin du Roi, made in 1817 for the skin of a female elephant

mounted elephant, though as Hanno brought to Carthage skins of the gorilla (?), some ambitious Roman may have preserved the skin of one of Hannibal's elephants.

Not long after the above-mentioned date, however, in 1817, we have a detailed account of the mounting of one of these big pachyderms for the Jardin du Roi—now Musée d'Histoire Naturelle—and what is more, we have a picture of how it was done. Capt. Thomas Brown, whose *Manual of Taxidermy*¹ ran through more than twenty editions has given a rather detailed account of the method employed by Lassaigne, the preparator; he tells us that:

The model which was to fill the skin was made as perfect as possible in its shape. To insure this, models were made of half the head in plaster, as also a fore and hind leg. This structure was made of linden wood, and so ingeniously constructed by M. Lassaigne, that almost the whole parts could be separated. He opened a panel on one side of the body, whereby he introduced himself into its interior, so that he might make its parts more perfect within. Even the head and proboscis were hollow, which rendered this stupendous model so light that it could be moved from one part to another with comparative ease.

The model being completed, the alum water in which the skin had been all the time immersed, was now taken out and made boiling hot, and in that state poured on the skin, which was then allowed to soak in the warm liquor for an hour and a half, when it was taken out still warm and placed upon the model, which they accomplished with some difficulty. But judge of their mortification when it was found that the model was rather too large. To diminish the wood-work they foresaw would run the risk of putting its parts out of proportion. It then occurred to them, that the best thing to be done under

these awkward circumstances, was to take off the skin again and reduce its thickness with knives; they removed all the internal thickenings which came in their way. In this operation five men were occupied for four days, during which time they cut out one hundred and ninety-four pounds weight of the internal surface. During this process the skin had dried, and required again to be immersed in cold soft water; after allowing it to remain twenty-four hours to soak, it was then put on the model and found now to cover it completely; the edges were brought together, and secured with wire nails deeply driven home, and large brads. Except at the edges, the nails and brads were only driven in half-way to keep the skin down to the different sinuosities and hollows until dry, when they were again all pulled out.

The alum with which the water was saturated gave the skin an ugly gray appearance, in consequence of its becoming crystallized. But this was soon remedied, by first rubbing the skin with spirit of turpentine, and afterwards with olive oil.

By the admirable and well executed contrivance here adopted, a specimen has been mounted with all the appearance of life, which, with a little attention, may resist for ages the influence of Time's destroying hand. It is the only specimen of an Elephant in Europe worth looking at, all others being great misshapen masses, completely devoid of all appearance of nature.

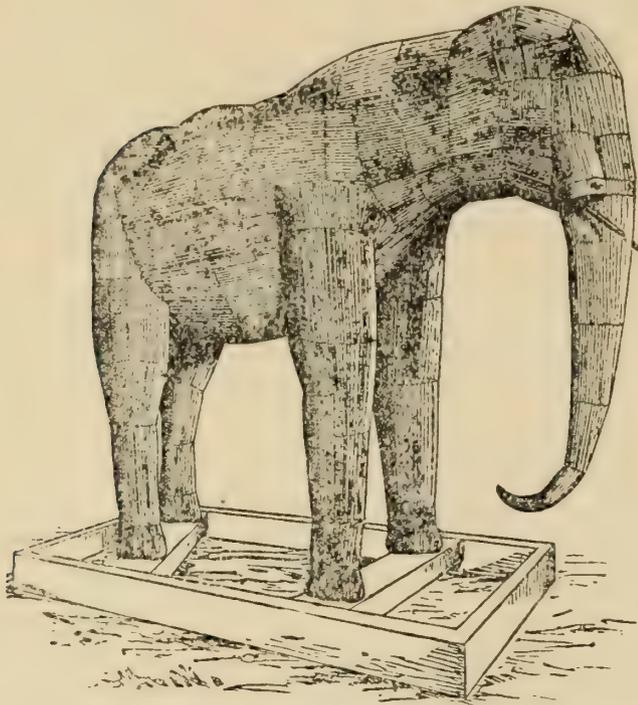
M. Didier tells us¹ that after the lapse of a century the specimen is absolutely intact: in fact, it is the most prominent feature in the post-card giving a general view of the large exhibition hall of the Musée d'Histoire Naturelle. This durability is the more remarkable, for the skin was alum-tanned and in our climate a specimen so treated is apt to go to pieces in a few years; some credit must be given, therefore, to an equable climate and unheated exhibition halls.

This was not the earliest use of a wooden manikin for Mr. Didier records that during the reign of Louis XVI a quagga was so mounted by some artist

¹What has become of all the copies of Brown's *Manual*? Apparently it was the most popular book on taxidermy ever printed, for McCormick notes that there were twenty English editions and several reprints in the United States. And yet it is difficult to get a copy; there is none in the library of the Manchester Museum, whereof Brown was director for several years, none in the library of the Zoological Society nor in that of the British Museum.

¹*Art de la Taxidermie au XX^e Siècle*, p. 11.

whose name has apparently not been preserved, but it seems to have been the first instance of the employment of such a manikin on a large scale. It is to be noted also that Charles Willson Peale mounted some of his short-haired mammals over manikins or forms carved out of wood, doing this, he tells us, to reproduce the muscles as they would be in life.



The wooden manikin of Jumbo, the most celebrated elephant of modern times

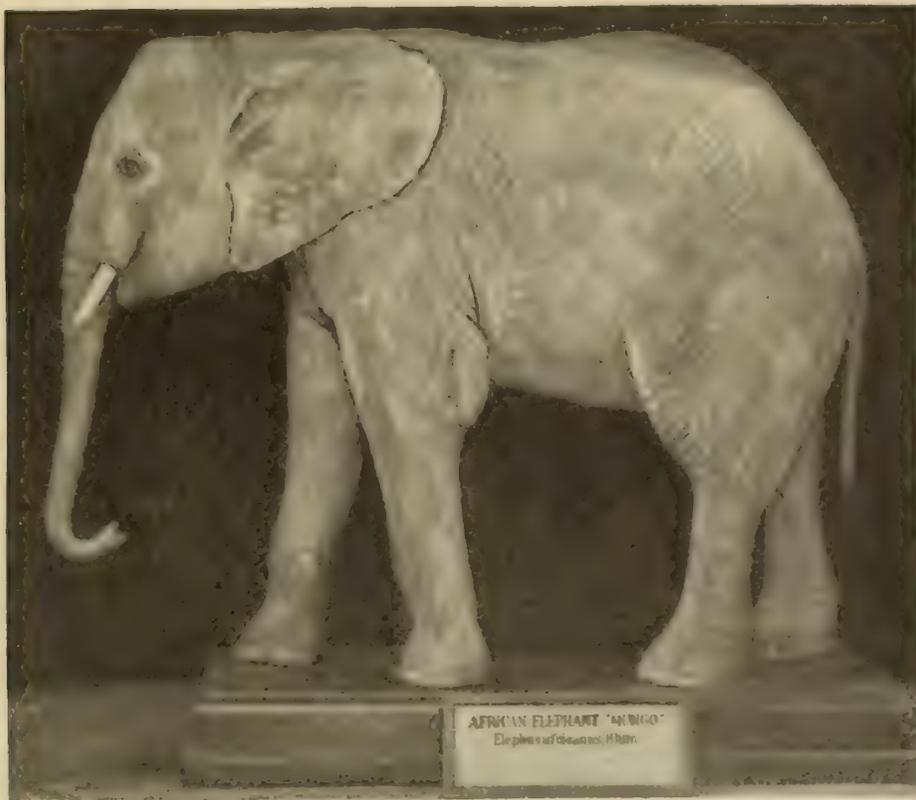
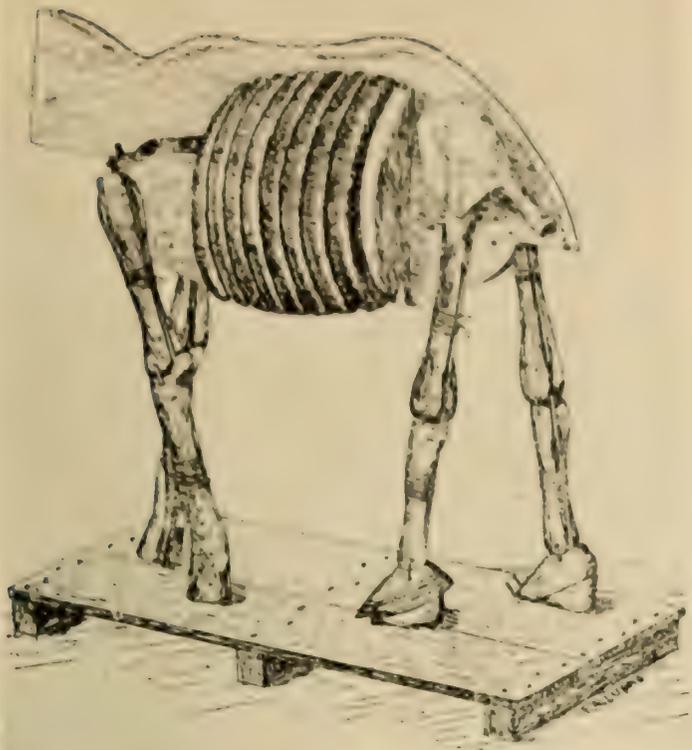
Why, it may be asked, did not Peale devise the simpler, quicker method of modeling in papier-maché and thus anticipate Akeley? This conundrum cannot be answered definitely but it is possible—even highly probable—that lack of materials had much to do with it. There was no wire cloth in those days, paper was scarce and costly, and plaster, we imagine, had to be imported; shellac was unknown—even nails were expensive as they were all made by hand and they were clumsy affairs at best. I remember well my contempt for English hand-made “sprigs” and my longing for machine-cut brads when I was doing a little carpentry in 1869. The modern preparator has no

idea of the handicaps under which his predecessors labored; if he had, he would perhaps marvel at what they did accomplish.

Just about a life span later, in 1886, Jumbo, the most celebrated elephant of modern times, was mounted by Critchley and Akeley over a wooden manikin in a manner very similar to that practiced in 1817—thus does history repeat itself. It is to be noted that in the case of Jumbo it was necessary to provide for rough handling as the mounted skin and skeleton for more than a year formed part of the attractions of the “greatest show on earth” and Jumbo’s “counterfeit presentment” was drawn around the arena as a part in the procession of which he was once the chief ornament. The skin and skeleton of Jumbo, once so closely united, have been in death widely separated—the mounted specimen forming the central feature of the museum at Tufts College, while the skeleton, with its original mountings, is on exhibition at the American Museum.

Still another method was adopted by Doctor Hornaday for the mounting of Mungo, a small African elephant belonging to the Barnum “Shows,” that died accommodatingly in Washington in 1882, shortly after Doctor Hornaday had become connected with the United States National Museum. In this instance a manikin of excelsior was built about a skeleton of wood and iron and over this, faced with clay to take the imprint of wrinkles, was placed the skin. Mungo is still to be seen in the United States National Museum.

Later, in 1907–08, the pair of African elephants in the Field Museum was prepared by Mr. Akeley, who used in this case still another



THREE STAGES IN THE RE-CREATION OF MUNGO

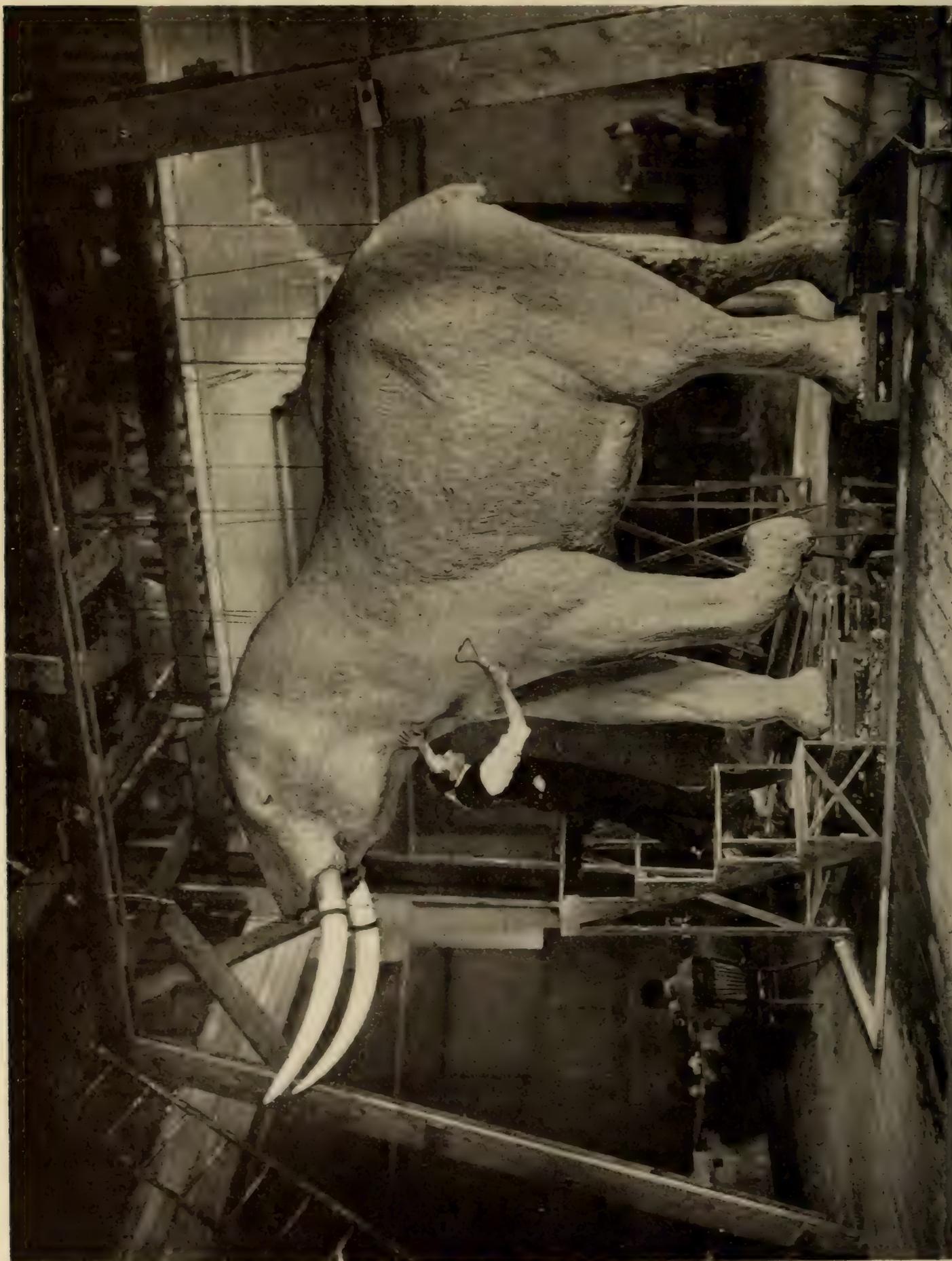
The illustration in the upper left of the page shows the wood-and-iron core of the manikin. To this framework excelsior wrappings were added, so that the manikin might have the necessary bulk and fullness of contour as indicated in the picture in the upper right. In this picture the wooden skull and protruding backbone may be readily differentiated from the parts that are of lighter construction material. The completed elephant is shown below.

Mungo, like the more famous Jumbo, was one of the elephants that contributed to the spectacular appeal of the "greatest show on earth." In 1882 Mungo died and passed from the circus arena into the possession of the United States National Museum, where the mounted elephant still attracts the attention of visitors as the living animal once drew the gaze of the circus crowds

MR. CARL E. AKELEY
AT WORK

Mr. Akeley has done much to revolutionize the methods of taxidermy and elevate it to the level of an art. He is here seen in his atelier in the American Museum perfecting the clay model of an elephant. Extraordinary care must be taken by the artist in the preparation of the model, for it is not a case of adjusting the skin to the manikin but of adjusting the manikin to the skin.

This is but one of the stages in the process of mounting elephants as devised and perfected by Mr. Akeley, a process which assures in the completed specimen not only accuracy of detail and an astonishing similitude to the living animal but durability, lightness, and strength. A brief outline of the process is given in the article





ONE OF THE FINEST EXAMPLES OF MR. AKELEY'S ART

This superbly mounted tusker, with its alert attitude of preparedness for whatever danger may threaten, is an impressive member of the group of elephants mounted by Mr. Akeley for the prospective Roosevelt African Hall of the American Museum

method, that of the manikin modeled in plaster on a framework of wood and wire cloth, in which were reproduced all the muscles and larger wrinkles of the living animal. The skin was fastened to the manikin by a thin layer of plaster, mixed with glue to make it dry slowly, and in this were modeled the finer details. A modification of this process, used by Mr. Akeley and also by Mr. Turner with great success in mounting large mammals other than the elephant for the United States National Museum, consists in modeling in papier-maché on a framework of wood and wire cloth that roughly approximates the form of the animal to be mounted. From the readiness with which changes can be made in such a manikin during its construction, it is particularly applicable to skins without measurements.

In 1914 when Mr. Akeley began his group of elephants in the American Museum he started with a new plan, that of modeling the skin of the animal over clay in which all folds and wrinkles could be impressed, backing the skin with plaster and transferring it to a frame of lattice work, whose interstices would be filled with wire cloth and papier-maché.

This plan was carried out only with the little Toto, for while working on this, Mr. Akeley conceived still another method, so that while the lattice framework was actually made for the female elephant, it was used only as an armature for the clay model—presently to be described—and this specimen was modeled in separate halves. For the information of the reader not versed in methods of collecting and in the art of taxidermy—for it is now an art—it may be said that such bulky beasts as elephants are skinned in sections, the head being cut off in one of the deep

neck wrinkles, and each side skinned and treated separately.

The new and latest method, as worked out by Mr. Akeley in the instance just referred to, consists in modeling the animal in clay, placing the skin on this clay body, and working directly on the skin, impressing its folds and wrinkles into the yielding clay. This of course insures accuracy of form and detail. If the clay form is not correct, the skin will not fit it, while the wrinkles *must* be put in exactly where they occur. It is not a matter of adjusting the skin to the manikin, but of adjusting the manikin to the skin, and any mistake in modeling is glaringly apparent. The skin, like Gaul, is divided into three parts, the head and the two sides, but they are assembled on the clay figure, though details of the head and trunk are executed later.

When the modeling has been completed, the body is covered with a plaster jacket, the sides are separated and laid flat, and the clay is removed. The skin is then lying in the plaster jacket, or rather jackets, and when it is dry, it is shellacked and lined with a thin layer of papier-maché, backed with wire cloth, strengthened where needed with light wooden braces. The two halves are then assembled, the head placed on the body, the skin treated with a thin coat of wax.

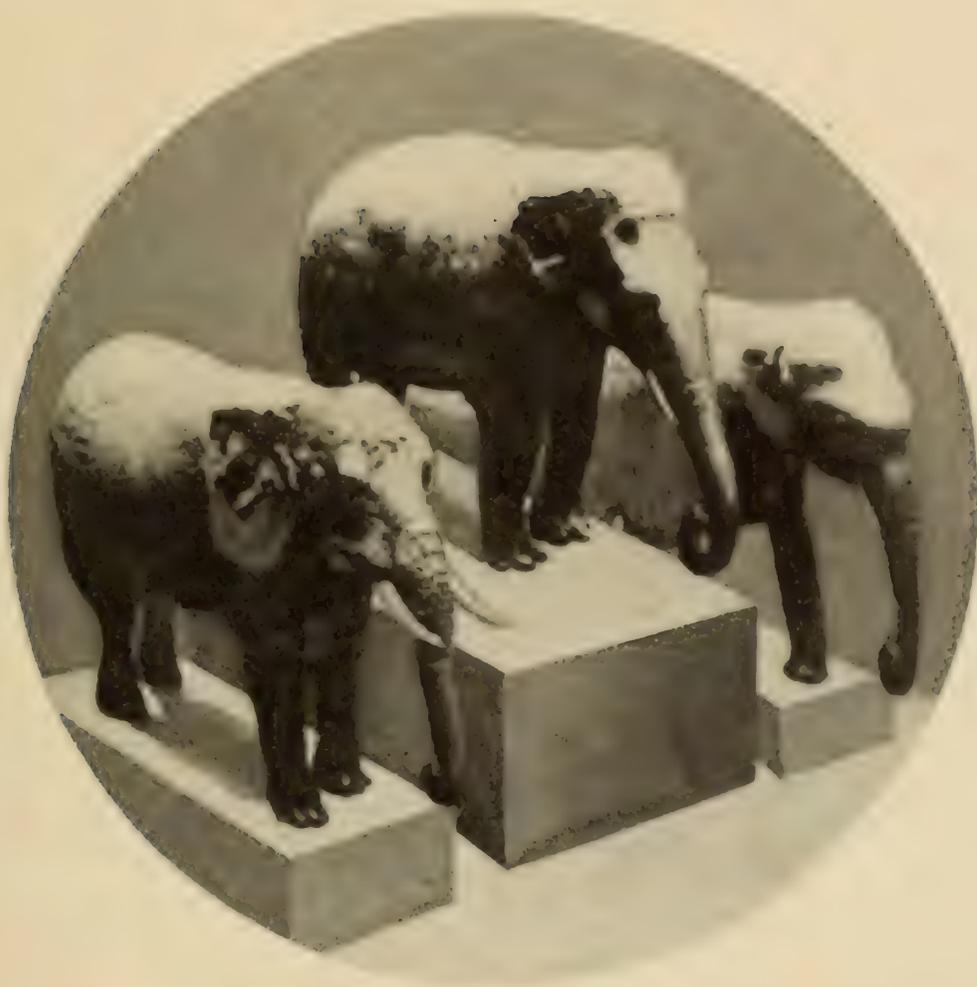
This is the merest outline of the process, and takes no account of the details of skin preparation and the technique of the various elements of the process or of the engineering problems involved in the construction.

Mr. Akeley's latest method seems the final word in mounting big pachyderms, combining as it does accuracy of form with strength, lightness, and, above all, durability in the finished pieces. It is

slow work but the time-consuming part of the task can be done by comparatively unskilled assistants, and the result is a specimen that will not only give the thousands who will never have

a glimpse of Africa an opportunity to see what an elephant really looks like, but that also will serve as a criterion of size and stature after all large elephants have been blotted from the face of the earth.

Finis coronat opus



The central figure in this group of elephants from the Musée d'Histoire Naturelle of Paris is the specimen mounted by Lassaigue in 1817. The making of the manikin of this elephant was rather novelly celebrated as indicated in the picture on p. 598.

The Department of Fishes, American Museum

ITS AIMS AND ACHIEVEMENTS

BY BASHFORD DEAN

Honorary Curator of Ichthyology

THE department of ichthyology is one of the newer departments of the American Museum, dating from 1909, when it branched out of the department of invertebrate zoölogy, bringing with it the reptiles and amphibians which until then had remained in care of the older department. The writer, who had been in charge of fossil fishes in the department of vertebrate palæontology since 1904, was the first curator of the new department, which was to care for both recent and fossil fishes. As the department of ichthyology and herpetology it remained until 1920, when the amphibians and reptiles were set apart as the department of herpetology under the curatorship of Miss Mary C. Dickerson.¹

The personnel of the department of ichthyology has been as follows:

Bashford Dean, Ph.D., professor of vertebrate morphology at Columbia University, curator from 1907-14, and honorary curator since 1914.

Louis Hussakof, Ph.D., assistant and associate curator, 1909-13; curator, 1914-16.

John T. Nichols, A.B., assistant, and since 1910 associate curator.

O. P. Hay, Ph.D., assistant curator of fossil fishes, 1903.

C. R. Eastman, Ph.D., editor of the *Bibliography of Fishes*, 1914-17.

E. W. Gudger, Ph.D., editor of the *Bibliography of Fishes* since 1919 and associate since 1921.

Arthur W. Henn, A.B., associate bibliographer in connection with the *Bibliography of Fishes*, 1916-22.

The earliest materials of the department of ichthyology were scanty,—

an aggregation of uncatalogued dried, alcoholic, and stuffed specimens, which had been housed in one of the basement rooms of the Museum. As the exhibition of fishes, there had been shown up to that time little more than a few stuffed specimens together with a case of casts, which had come to the Museum from the United States Fish Commission in the days of Commissioner Baird. The newly organized department laid out a far-reaching plan of development. It aimed to exhibit in its galleries representatives of all of the principal groups of fishes, fossil as well as living. It designed a series of habitat groups which were to show the visitor how fishes live and move and have their being. It planned many exhibits to show the development of typical fishes from the earliest stages of the egg until the young have attained adult form. It outlined case exhibits planned like genealogical charts to tell even a casual visitor where the earliest backboned animals came from and how in time they developed into modern fishes. It had in mind to clear up mooted points through study in the laboratory of material obtained by expeditions sent to many parts of the world. It had, finally, the wish to bring together effectively a knowledge of all the extensive literature, old and new, which concerned fishes, so that anyone who here sought information could obtain it with minimum effort in the least space of time. In twelve years these lines of development of the department have led to encouraging results.

¹In a later issue of NATURAL HISTORY will be printed an account of the department of herpetology.



A model of the jaws of the huge *Carcharodon angustidens*, set with actual fossil teeth. There were no human beings to devour when this mighty relative of the existing white shark swam the seas

THE COLLECTION OF FOSSIL FISHES

The department first succeeded in obtaining from Columbia University as a quasi-permanent loan the collections of fossil fishes brought together by the greatest American palæichthyologist, Prof. John S. Newberry, constituting, in fact, almost his life work.

These included the fossil fishes of North America with nearly all his described and figured specimens, many of them of great value for popular exhibition. So it came about that the department was soon able to install a gallery in one of the corner rooms of the Museum which reviewed the past history of

fishes and showed the impressionable visitor veritable monsters of ancient seas. This collection was amplified not long after by the fossil fishes which had been brought together by Professor Cope, whose private museum President Osborn had triumphantly secured for the American Museum. With these two accessions, rounded out by careful purchases and by the material collected by several expeditions, the department was able to illustrate the early fishes of the world in a way second to that of no museum on this side of the ocean and excelled by but few foreign museums. To house this collection, catalogue it, and systematize it, proved no small undertaking for the young department.

It was in connection with this work, and for the purpose of giving popular instruction, that there was prepared an interesting series of restorations and models, and a case built to resemble an aquarium with models of fossil fishes therein. At this point we may note the restoration of *Dinichthys*, a giant "fish" that lived in the Devonian seas of Ohio, and a life-size model of the jaws of the big-toothed *Carcharodon*, the "man-eating" shark of the past, set with actual fossil teeth gathered from the phosphate beds of South Carolina. This extinct shark is the most formidable fish known; it reached a length probably of eighty feet. In the interest also of the collection of fossil fishes were undertaken the expeditions to Canada, Ohio, and Kentucky; these expeditions, as well as the purchase of much of our material, were made possible by generous gifts to the department by Mr. Cleveland H. Dodge.

THE EXHIBITION OF RECENT FISHES

In the preparation of a large popular exhibition of typical forms of living

fishes the department found its greatest difficulties. In the first place, fishes are among the most unsatisfactory creatures to mount for general view, and even when they were satisfactorily prepared, there was to be had in the overcrowded Museum but little space in which a suitable series could be shown. We were able at length to share a gallery with the department of birds. We also utilized a back hall that led to certain of the Museum workshops. We were not entirely disheartened, however, for we had room in which to exhibit some fishes that from the viewpoint of popular interest or as representatives of great structural groups had special claims to attention. Here we placed on view stuffed specimens or models from materials which we gathered from many sources. In our limited space we had hard work to show even a few of these monsters of the sea which public exhibition ever demands. To obtain them, several expeditions were sent out, to Florida especially. These undertakings yielded excellent results for the enrichment of our gallery, so that now the visitor may see in lifelike poses and colors casts of sawfishes and swordfishes, sharks of various kinds, the giant devilfish (*Manta*), the great sea sunfish (*Mola*), and even the great pike-like *Arapaima* of the Amazon, the largest living member of the bony fishes of the world.

The former exhibits were in a degree diagrammatic, for who can picture a fish adequately from a dried specimen or from a painted cast? Habitat groups were needed which would show typical fishes in their natural surroundings, breeding, brooding, or feeding. But here, again, we encountered numerous difficulties. Few museums had attempted such a work and a new tech-

nique had to be developed before the visitor could be given the illusion of viewing under-water life. The careful attention given to this subject by Mr. Dwight Franklin, then in the Museum's department of preparation, enabled us to take the first steps in the direction of portraying groups of fishes adequately. From that time, thanks to

young fishes being born of good size, adult in form, and quite able to fend for themselves. Of great popular interest is a case representing certain fishes from the deep sea which like the luminous beetles known as fireflies have evolved their own sources of light. In these models, phosphorescent organs have been imitated by artificial



A detail from the group of luminiferous fishes that exist in the sunless black depths of the sea. Models prepared and mounted by Mr. F. F. Horter under the supervision of Dr. Louis Hussakof

the devoted work of Mr. F. F. Horter, we continued to add important "habitats" to the series. We now illustrate the life habits of representatives of all the more important groups of fishes, from the lowly lampreys through the sharks and ganoids, including the bony gar pike (*Lepisosteus*), the long-nosed *Polyodon*, or spoonbill sturgeon, and the bowfin (*Amiatus calvus*) up to certain modern fishes. Of striking interest is a group showing a blue shark, lolling in Gulf Stream waters, surrounded by a brood of young. The eggs of this shark, like those of most modern sharks, hatch within the body of the mother, the

lights, which appear intermittently, very much as, it is believed, they occur in the depths of the sea. We have not as yet been able to show a series of our local fishes. By courtesy of Director Lucas, some of the more prominent of them have, however, been mounted in special cases near the Museum elevator apart from the main collections.

THE NEW HALL OF FISHES

The new hall of fishes, which will be opened probably in the spring of 1925, will, in the nature of things, mark an epoch in the usefulness of the department. Hitherto, as above indicated, the exhibition of fishes has had but a



THE PADDLEFISH GROUP

A school of paddlefish (*Polyodon spathula*) is seen entering the seine of a fisherman. This fish, which may attain a length of 6 feet and a weight of 160 pounds, is known only from the Mississippi and near-by waters. Its nearest existing relative is found at the opposite side of the earth, in China. The paddlefish is a true sturgeon but one that has undergone many changes. It has lost entirely its armor of bony plates and has developed a paddle-shaped snout, the true function of which is still in dispute.

The paddlefish (or spoonbill sturgeon, as it is not infrequently called) and the gar pike (*Lepisosteus osseus*) in the upper left of the picture represent a nearly extinct group (ganoids), which gave rise to most of the kinds of existing fishes.

The present group was made possible through the generosity of Mr. Cleveland H. Dodge. The materials for it were secured in 1910, at Moon Lake, Mississippi, by a Museum expedition in charge of Dr. Louis Hussakof. The paddlefish were cast by Mr. Otto Block from molds made in the field by Mr. Dwight Franklin. The gar pike was mounted by Mr. F. F. Horter. The background was painted by Mr. Albert Operti



THE BLUE SHARK GROUP

This species, a frequenter of the open ocean, is bluer than those species commonly found near shore; it attains a length of 10 feet. Like most sharks it brings forth its young alive instead of laying eggs. In the group a brood of young fish is represented accompanying the mother as she swims about under gulf weed and other drift that accumulate out in the Atlantic, in the comparatively currentless Sargasso Sea. A thick water-soaked rope hanging from a floating spar adds variety and interest to the group and serves to direct attention, as the eye travels upward along it, to the character of the surface, otherwise easily overlooked. The group is the work of Mr. F. F. Horter and was made under the supervision of Dr. Bashford Dean



Stanley Falls of the Congo River, where the famous fisheries are located

very inadequate space for display. The new gallery will give ample scope for a great exhibition,—one which will compare with the exhibitions of fishes in London or Paris.

The new hall will be 138 feet long by 63 feet wide and 19 feet high, illuminated admirably on the long sides of the room by thirteen windows, each 9 feet wide by 8½ feet high. With this space at our disposal we plan an exhibition which will give the inquiring visitor a résumé of our knowledge of fishes from all points of view, aiming to be instructive, entertaining, and inspiring. It should appeal to the average museum visitor, in furnishing a picture of the wonder and beauty of fishes of many kinds, great and small; from the depths of the sea to the surface; of brooks, creeks, rivers, and torrents; of coral reefs and Gulf Stream; of rocky pools and sandy reaches. It will show fishes

preying and preyed upon; mimicking and poisonous forms; the habits and instincts of fishes; their manifold types of breeding and development. These themes, carefully chosen, may be set forth in suitable habitat groups, arranged along the sides of a corridor that will pass down the middle of the great hall. This corridor, screened from the daylight by its ceilingward-reaching walls will depend for its lighting wholly upon the artificial illumination supplied by the groups, which will appear as great aquaria but picturing dramatic moments in the lives of fishes not ordinarily seen in the usual aquarium. Such types of groups we have already, in a measure, prepared. By such a procedure our fish gallery will be provided with two areas of exhibition: the central corridor, which has just been described, and the peripheral or surrounding gallery, which



Photograph by Mr. Herbert Lane

Here important collections were made by the American Museum Congo Expedition

will provide space for exhibition approximating 320 feet in length and 13 feet in width, having on one side the great windows of the hall and on the other the wall of the central gallery. This wall will be an admirable place for the installation of cases, for it will be brilliantly lighted by the windows opposite to it. Along this space will be introduced a number of cases dealing with the natural history of fishes, and here we plan to arrange a series of exhibits to show:

- (1) The fishes arranged according to their natural classification and importance.
- (2) The structure and physiology of fishes.
- (3) History of fishes, showing the fossil forms and leading up to the existing types.
- (4) The development of fishes.
- (5) The maladies of fishes.
- (6) The game and commercial fishes of the world.
- (7) The means of capture of fishes.
- (8) The commercial products of fishes.

Throughout the entire hall the effort will be made to divide up the themes for exhibition on a *pro rata* basis, so that he who visits it may, even after a short stay, carry away with him more than a general idea of the system of fishes. The outer gallery will appeal to the student, the statistician, the angler, the merchant; the inner "aquarium" will surely be an inspiration to those visitors who are old-fashioned enough to be fond of natural history.

STUDY COLLECTIONS

The study collections of the department have increased notably during the past thirteen years. Three times as much material is now at hand as was available in 1910, and our catalogue includes 8000 cards. The bulk of our accessions are fishes from the West Indian fauna obtained in Florida by the Fabbri "Tekla" Expedition (1910),



The yacht "Tekla," in which Mr. Alessandro Fabbri, accompanied by his brother, Mr. Ernesto Fabbri, and Mr. John T. Nichols, of the American Museum, cruised the Florida Keys in 1910, obtaining extensive collections of characteristically West Indian fishes for the Museum



A devilfish, or *Manta*, being towed behind the "Tekla"

fishes from the west coast of Mexico by the "Albatross" Expedition (1911), under the leadership of Dr. Charles H. Townsend, and from the fresh waters of

equatorial Africa by the American Museum Congo Expedition (1915). Additions of lesser importance have been made from the Arctic, the north and

south Atlantic, the Mediterranean, the eastern, central, and western Pacific, the East Indies, and the fresh waters of North America, South America, and Asia. There have been no acquisitions from the Red Sea or Indian Ocean, our greatest faunal hiatus.

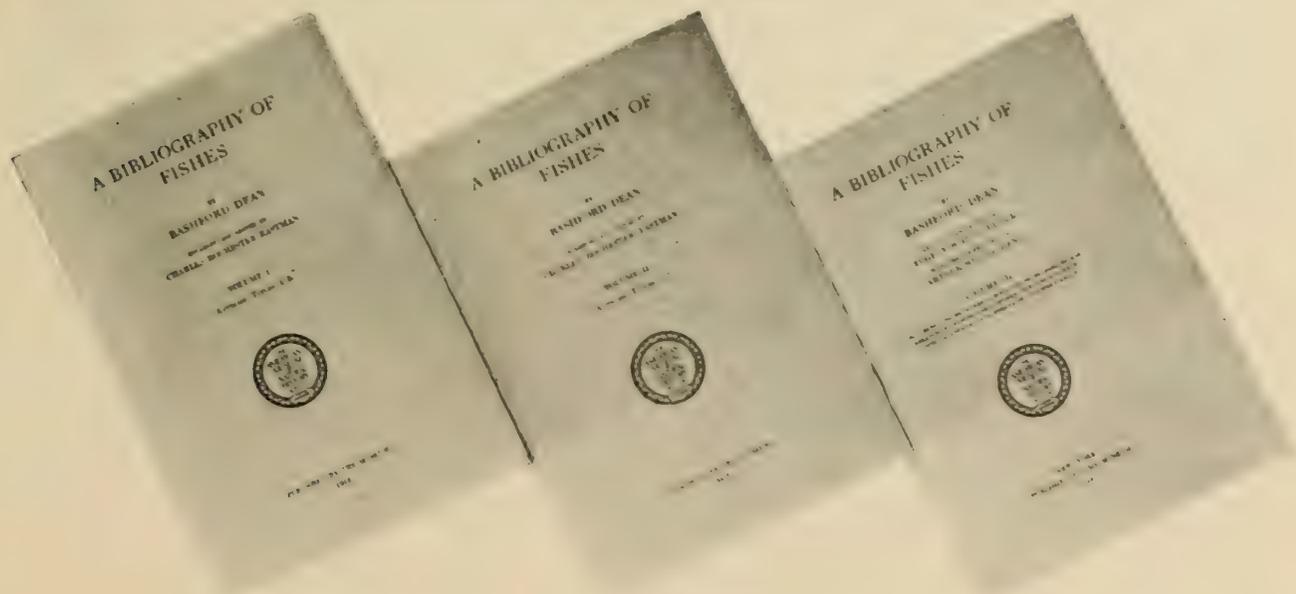
The study collection exhibiting the anatomy of fishes has also increased notably. Several scores of fish skeletons have been prepared and indexed for class use. They are, in fact, under constant requisition, especially for certain courses in the post-graduate department of Columbia University that are given in the Museum by Prof. W. K. Gregory. The laboratory work of the department has yielded not a few discoveries. These appear in several *Memoirs* of the American Museum, which deal with fossil as well as with living fishes; also in a number of smaller tracts, which report the results of our expeditions and describe 70 odd species and 6 genera new to science among recent forms, and in the case of fossils about 40 species and 10 genera.

BIBLIOGRAPHY OF FISHES

Our most important work, the one which we hope will ever remain as a landmark in ichthyology, is the *Bibliography of Fishes*.

Students of fishes everywhere have

long needed a comprehensive catalogue of the vast literature in their field. To meet this need, the department has from the beginning aimed to complete and publish a comprehensive bibliography, which should include an index by the aid of which a searcher would have at his finger tips in minimum time all the information that exists concerning fishes of every kind, living and extinct, of all parts of the world, whether this information be published in English or in any other language. The first two volumes of this bibliography appeared respectively in 1916 and 1917, and jointly contained about 50,000 references arranged under "Authors." A third volume completing the work and including an elaborate subject index of more than 350 pages is now in readiness. Its compilers aimed to digest the subject matter of ichthyology in such a way that it would be available not only to technical students of the fishes, but to popular inquirers as well; also to the student of diseases, of parasites, of general physiology; to the archæologist, the historian, the chemist, the teratologist, the embryologist,—in a word, to anyone whose inquiries are concerned directly or indirectly with any subject related to the great group of fishes.





Photograph by Walter Beasley

PHOTOGRAPHING A SPEEDING RACE HORSE

No difficulty seemed too great for Mr. Chubb to overcome when he was making studies preparatory to mounting the skeleton of "Sysonby," the famous race horse now on exhibition at the American Museum. From a seat suspended fifty feet above the ground, Mr. Chubb took photographs of a race horse speeding below, that he might have accurate records of the motion of the spine and muscles in action. The studies were so successful that the same method was used later when the skeleton of the trotter "Lee Axworthy" was presented to the Museum

Mounting Horse Skeletons to Exemplify Different Gaits and Actions

A GLIMPSE BEHIND THE SCENES AT THE AMERICAN MUSEUM

BY A. KATHERINE BERGER

Assistant Editor of NATURAL HISTORY

NOT so very long ago the osteological exhibition in a museum was merely a collection of sets of bones carelessly put together. No attention was paid to scientific mounting of the skeleton nor was any attempt made to express the living animal in action. As a result these exhibits defeated the very purpose for which they existed. They offered no incentive to the student or to the public even to visit, much less to study and make comparisons between, the different types of animals represented.

For instance, to convey to the spectator, through the mounted skeleton of a horse, some idea of the nicety of adjustment of every bone, and the positions assumed by it in relation to other bones during pulling, racing, trotting, and walking, is no easy task, and before accurate results are achieved, an amount of study, patience, and care is required little dreamed of by the casual observer.

For more than twenty years Mr. S. H. Chubb, of the department of comparative anatomy in the American Museum, has devoted all his attention to revolutionizing osteological preparation of Museum specimens. In the Museum collections is a nearly completed series of mounted skeletons of the Equidæ in which Mr. Chubb is striving to represent with scientific accuracy and in life-like pose every possible type of horse. There is a giant draft horse and, from practically the same stock, although representing another breed, the Shet-

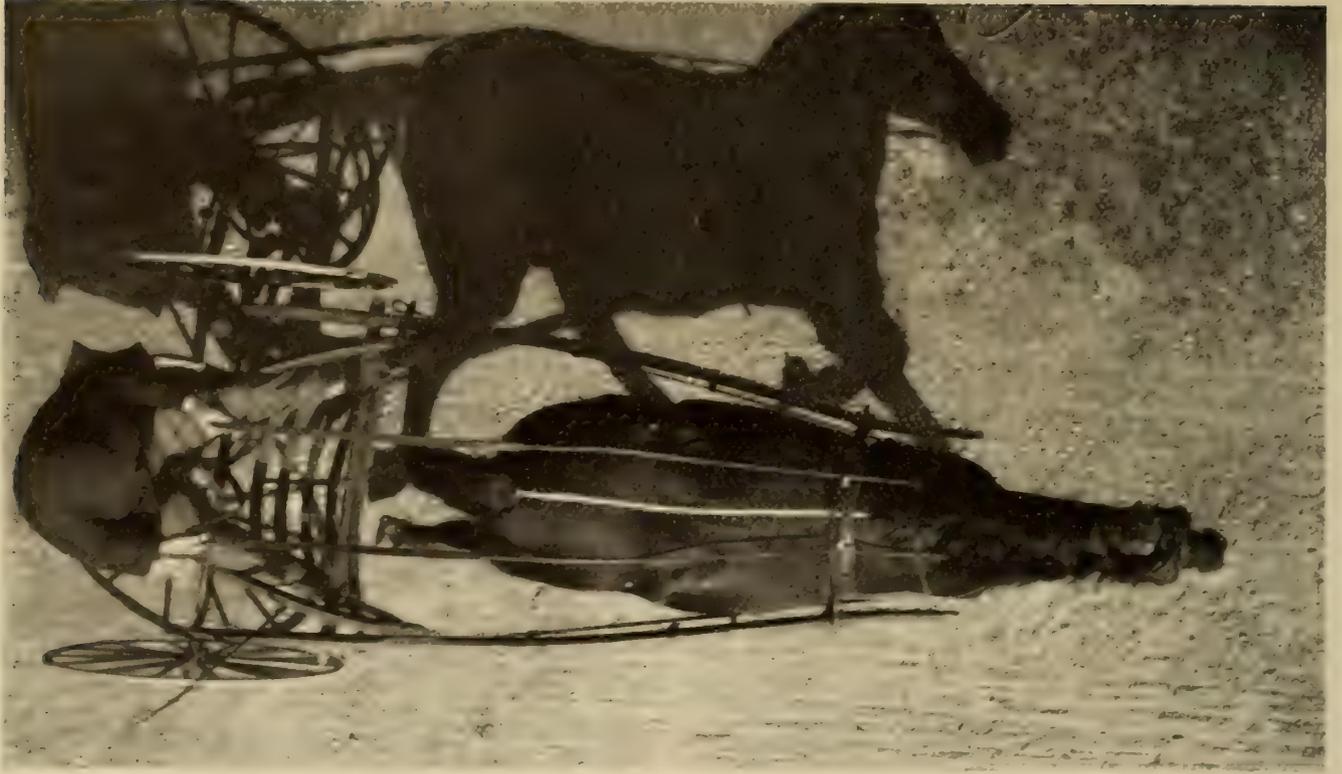
land pony. The big horse has been developed through many generations for extreme size, whereas the Shetland



Photograph by Walter Beasley

A closer view of Mr. Chubb in the swinging seat, the lens of his camera pointed downward in readiness to photograph the horse in action

pony has been reduced in size by man's selection and breeding. A heavy type of horse is shown in the position assumed when drawing a load. In contrast, there is the remarkable horse "Sysonby," known as one of America's most famous race horses, beautifully mounted to show the running gait char-



Photograph by S. H. Chubb

Bird's-eye view of a trotting horse in action.—The white line on the back shows the curving movement of the spine, while marks on the hips indicate the shifting angle of the pelvis with each step in the progressive movement

acteristic of his kind. The pure-blood graceful Arabian, believed to be descended from an entirely distinct wild species, is represented in the skeleton of "Nimr"; and now the skeleton of "Lee Axworthy," the champion trotting stallion of the world (his record being $1.58\frac{1}{4}$) is to be added, practically completing the series of domestic horses. There are only two wild types on exhibition. One of these is a wild ass, or kiang, known as the north Asiatic wild ass, a different species from the African ass from which our domestic ass is descended. The other wild type is the Grant zebra. This series will not be complete until all species of zebras and asses are on exhibition.

"Lee Axworthy," raised on the Walnut Hall Farm in Kentucky, was owned by the Pastime Stable, a concern consisting of four or five men, and was stabled at Castleton Farm, Lexington, Kentucky. The American Museum is largely indebted to Mr. D. M. Look, of New York, owner of Castleton Farm,

for the skeleton of this famous trotter.¹ Mr. Chubb is finding the mounting of the skeleton of "Lee Axworthy" a most interesting study, as it gives opportunity to compare the bones brought into action in the fast trot with those employed in the more natural running gait of the race horse "Sysonby."

A slight idea of the painstaking care with which every contributing detail is studied and worked upon until scientific accuracy is attained, may be gained from some of the activities in connection with the preparation and mounting of the skeleton of "Sysonby." To represent properly the changing curves of the spine of the race horse when he is running his fastest, Mr. Chubb conceived the idea of making photographic studies of a race horse's back in action. Accordingly an arrangement of ropes was prepared and

¹It is to the late Watson B. Dickerman that the American Museum is indebted for funds to mount the skeleton of "Lee Axworthy" and for opportunities to study trotting horses in action. See NATURAL HISTORY, July-August, 1923, page 423.

fastened at one end to the roof of the American Museum and at the other to an adjacent tree. A swinging seat suspended from the rope and steadied by guy ropes afforded an unobstructed vantage point for the accommodation of Mr. Chubb and his camera. A race horse was borrowed for the occasion. Certain points of the animal's anatomy, previously determined upon by Mr. Chubb as best marking the constantly changing curves of the spine and the shifting of the muscles in action, were outlined with white patches which would be clearly visible in the photograph. Even the shadow of the horse cast by the sun at right angles was taken into consideration to help portray in profile the position of the horse's feet and body at the moment of exposure. All being ready, Mr. Chubb was hoisted fifty feet above the ground, and the horse was raced back and forth below him while he took photographic studies of the horse's back.

This new and unusual method of photography, also used in the case of the "Lee Axworthy" skeleton, resulted in a series of studies which proved of great value in establishing accuracy of bone adjustment when the skeleton of "Sysonby" was ready for mounting. These studies were supplemented by frequent visits to race courses where many observations were made of horses in action.

There is much to be done from the moment the skeleton is dissected to the time the bones are finally mounted. Sometimes these tasks are very time-consuming; eleven months were required to prepare the skeleton of "Sysonby" for exhibition.

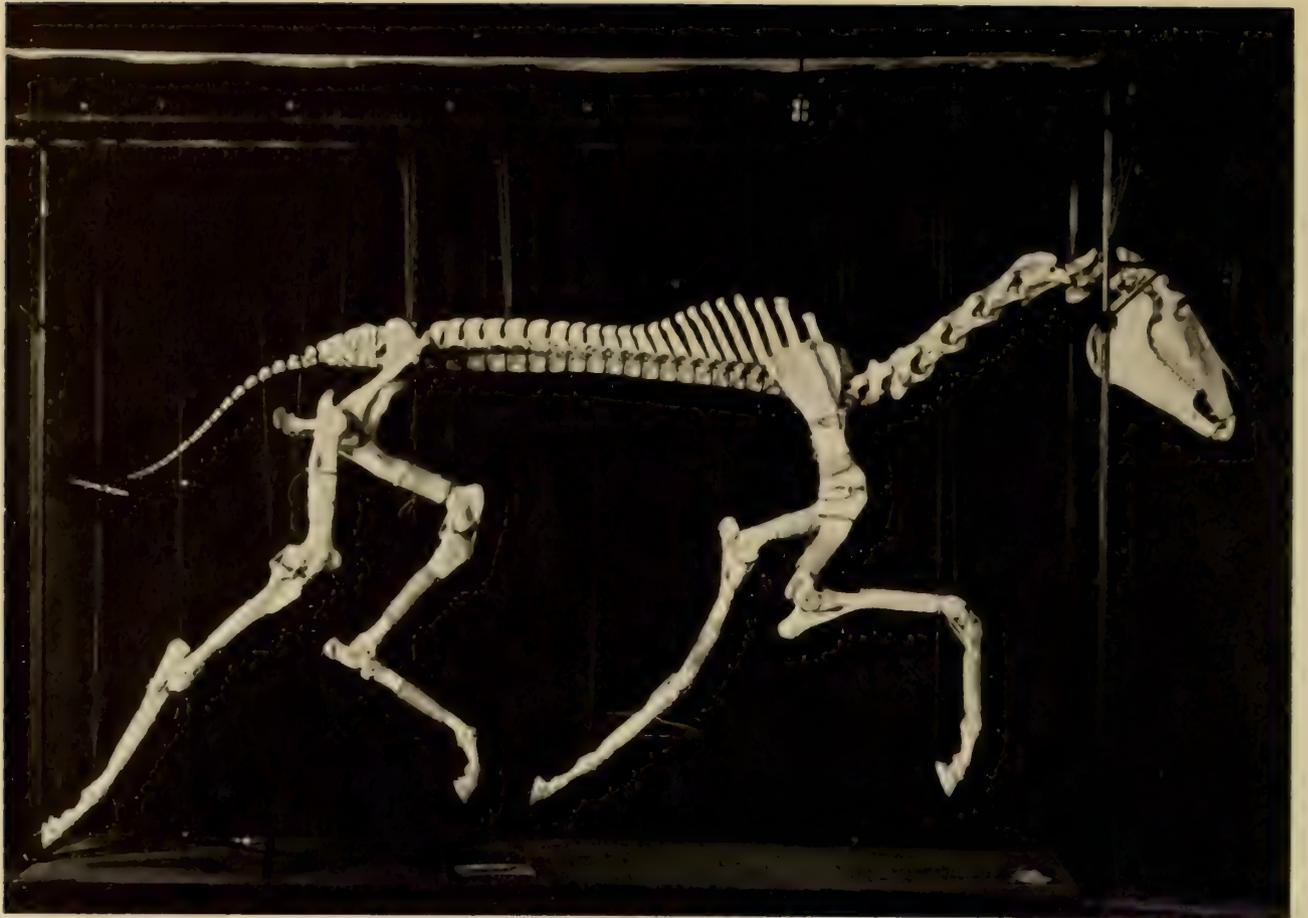
The writer had an opportunity to witness a part of the preparation of the skeleton of the trotter "Lee Axworthy," listening the while as Mr. Chubb ex-

plained the process in progress at the time. Mr. Chubb was seated at a long table busily engaged in scraping from the sternum of the skeleton fragments of flesh and soft tissue that still adhered to the bone. Near him on the floor were several jars containing water in which were immersed various parts of the skeleton.

"I save the sternum or breastbone for the last," he said, "because it requires more time. The bones are connected with ligaments and tendons which must be removed before the actual cleaning and drying can proceed. To hasten the decomposition of the soft tissues, the bones are placed in vessels containing water that is kept at 100 degrees.

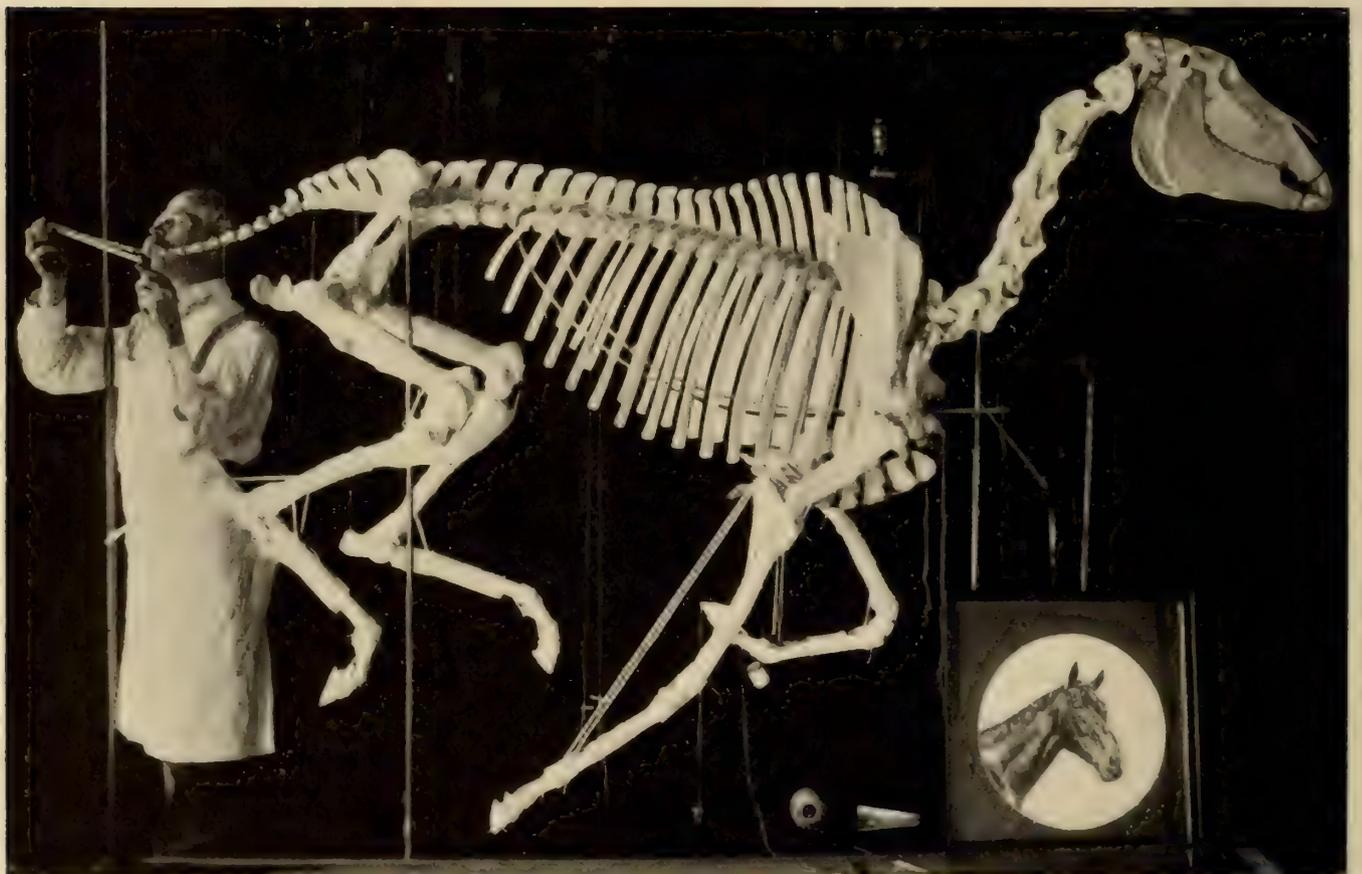
"When sufficiently decomposed the ligaments and tissues are removed and all that remains after dissecting is scraped away as clean as possible. If the surface of the bone dries too rapidly, it contracts and splits, while the inside is still wet. Slow drying is preferable and will prevent such injury by permitting the entire substance to dry evenly. The next step is to free the bones completely from all grease, that they may become spotlessly clean and pure in color before they are articulated."

Immersing the bones in benzine and exposing them while in this medium to daylight and sunshine for a number of weeks will accomplish the desired result most successfully. Under Mr. Chubb's supervision tanks have been constructed of galvanized iron. Around the upper edge of each tank are special grooves into which slides a close-fitting cover of glass, effectually sealing the tank against the entrance of rain water and at the same time preventing evaporation of the benzine. The bones are put in the tanks and covered with



Photograph by S. H. Chubb

The trotting horse, "Lee Axworthy," in the first stages of reconstruction.—In this stage every detail is subject to more or less modification, until the adjustment carries out the action Mr. Chubb has in mind to portray. Note the position of the bones in the fast trot as compared with the running gait of the race horse below



Photograph by Walter Beasley

The reconstruction of the "Sysonby," skeleton nearing completion.—When the bones are finally in satisfactory position and securely fastened, the threads, screws, suspending cords, and other temporary accessories are removed

benzine, the glass covers are moved into place, and the tanks are then carried to the roof of the Museum, there to remain in the sunshine until the bones are pronounced ready for the next step. The benzine must be changed two, three, or possibly four times during this period, because it becomes saturated with the grease and loses its efficacy, and the bones easily get discolored, gummy, and dirty if left too long in the greasy benzine. The whole process may take from six to eight weeks, depending upon the amount of sunshine and the size of the bones.

"After the benzine process," said Mr. Chubb, "the bones are ready for mounting. First, I get a steel rod as nearly as possible fitting the opening and extending the length of the neural canal of the spinal column. This rod I must shape to the curve of the spine. Then the vertebræ are hung tentatively in place. Next, I gradually study the bones of the legs, which I fasten together temporarily so that any change can easily be made in the angle of the joints. The legs are suspended by looped cords passed over the heads of small screws, which are inserted in the bones at various points. The other ends of these cords are passed several times over horizontal rods above. To these free ends are attached small weights sufficiently heavy to prevent slipping, thus affording easy and convenient adjustment. Now comes the delicate task of getting the bones into the position which seems to suggest the action I have in mind, and seems to do it in a perfectly alive and satisfactory way. Getting the ribs in position is a long operation. I take a very small piece of pliable steel rod and fasten to it the

several ribs, each by means of a rubber band. Then I study the little articulations. Finally, when they are all satisfactorily placed, I devise a permanent brace to fit the ribs and hold them enduringly in place. Every step, meanwhile, is checked up and corroborated by constant comparison with a great number of photographs.

"As I get the adjustment nearer and nearer perfection, I see errors in this part or that which were not obvious when the bones as a whole were out of position. It is simply a process of eliminating the errors until the whole becomes perfect. When all is right, I drill small holes where the bones come in contact with each other, and into these holes drive steel wires just tight enough to hold firmly but not tight enough to break the bone. Where there are many little bones, wires are driven in from opposite directions to bind all together as firmly as possible. These wires are driven down just a little below the surface of the bone, and the small holes which result from this operation are filled up later with plaster."

In studying the trotting modifications found in the skeleton of "Lee Axworthy" Mr. Chubb remarked that these might possibly be found in a race horse, but they were not evident in the skeleton of the race horse "Sysonby." On the front pastern (but not in the hind) of the skeleton of "Lee Axworthy" was a slight depression in the bone due to extreme movement of the pastern joint in the trotting action. Said Mr. Chubb, "I can imagine that this might become adaptive and prove of great advantage in that particular action, but we cannot say that it has gone far enough at present to be of great consequence."

NOTES

ASIA

PRESIDENT OSBORN'S TRIP TO ASIA.—President Henry Fairfield Osborn, accompanied by Mrs. Osborn, sailed August 18 from Seattle on the S.S. "Madison" bound for Shanghai. As this issue goes to press, he is homeward bound to assume his administrative duties and scholarly researches at the American Museum. While in Asia he took a prominent part in the activities of the Third Asiatic Expedition. He made a trip to the Gobi Desert to supervise the work in progress there, and had an opportunity to examine the fossil beds and to further the success of the expedition by placing at its disposal his extensive experience as an organizer and his thorough grasp of palæontological problems. It was during his sojourn in the East that the Museum received word of the astoundingly large total of dinosaur skulls and skeletons obtained by the expedition and of the discovery of the dinosaur eggs.¹

President Osborn narrowly escaped the earthquake in Japan by leaving Yokohama August 30 for Kobe. He did not learn of the disaster until the ship on which Mrs. Osborn and he were sailing was emerging from the Japan Sea, for only then was communication restored.

Prof. T. D. A. Cockerell, an honorary fellow of the American Museum, on the other hand, viewed the catastrophe from the harbor of Yokohama. He writes:

"We had about five days in Yokohama, and were on the 'Empress of Australia,' just about to sail, when the earthquake occurred. It was terrific, and with a strong wind blowing, soon all Yokohama was ablaze. The town was *utterly* destroyed. The loss of life must have been very great. We especially regretted the death of Mr. Jenks, U. S. Vice Consul, one of the finest men and ablest officials we had ever met. We soon had the ship filled with refugees, and they were coming on all night and the next day. On September 2, the ship and all of its passengers and crew came near burning up, as a great tank of oil in front of the Standard Oil building got afire, and the oil came drifting toward the ship at a great rate. The steamer was disabled and moved off with difficulty, but she was slowly turned round and out of the way. For about twenty minutes the matter

was in doubt, and we saw the oil just where we had been shortly before. The next day we were hastily transferred to the 'President Jefferson.'"

FROM MOULMAIN TO BANGKOK.—Mr. Arthur Vernay, joint leader of the Faunthorpe-Vernay Indian Expedition of 1923, sailed from New York early in October to penetrate another zoölogical area of Asia in the interests of the American Museum. He and his associates will start from Moulmain, made famous by Kipling, for Karkareik, where elephant transport for the jungle will be secured. From there four months will probably be consumed in travel before the party, which will scour the intervening country, strikes the Meping River and secures boats for the trip to Bangkok, its objective. The territory to be penetrated is a ragged, steeply mountainous one, where there are no human habitations and where the members of the expedition will have to depend on their own efforts to supply their wants. Mr. Vernay will be accompanied in his exploit by two British Army officers—Col. E. Percy-Smith, who will devote himself to the smaller mammals, and Major C. H. Stockley, D. S. O., who with Mr. Vernay will engage in the collecting of the larger game. The expedition is fortunate also in having as one of its members Mr. Willoughby Lowe of the British Museum, who will give especial attention to the birds of the region.

The particular quest of Mr. Vernay in the area of Siam that will be traversed is the Schomberg deer. Antlers of this animal have from time to time been brought out of the interior by native hunters, but little is known regarding it. It has been assumed that the region harbors also a tortoise of vast size. What has been alleged to be the track of one of these reptiles has been seen, but the creature itself, if it exists, has up to the present eluded observation. Perhaps it will be the good fortune of the expedition to bring back definite word regarding it.

The unusual success that attended the recent expedition of Mr. Vernay and Colonel Faunthorpe augurs well for the outcome of the new undertaking. During the months that were devoted to hunting in India and Burma 129 specimens of mammals, representing 42 species, and 250 birds, representing 125 species, were obtained, not to mention

¹See NATURAL HISTORY, September-October p. 536.

reptiles and other forms of life. The expedition received the most generous assistance from the Viceroy of India, Lord Reading, from Sir Harcourt Butler, Governor of Burma, and from the native princes and officials in the several areas visited. In the present expedition the King of Siam, as well as the Governor of Burma, is taking a cordial interest

MAMMALS

THE MUSEUM'S EXPEDITION TO ECUADOR. That the regions of Ecuador selected for investigation by Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, American Museum, are yielding interesting specimens in abundance is evidenced by a statement in a recent letter from Mr. Anthony to the effect that he and his associate in the expedition, Mr. G. H. H. Tate, have been obtaining mammals at the rate of more than four hundred per month. The comparatively rare *Cænolestes*, a genus of marsupials the nearest relatives of which dwell in Australia, is always prized by collectors in Ecuador and Colombia. Mr. Anthony has succeeded in obtaining an unusually large series of this animal. On three different nights specimens were obtained of the rare fish-eating rats, and three weasels were part of the bag of a single day. Deer and wolves were among the larger game taken. Finally—an augury perhaps of similar achievements still in store—the collecting of a single morning totaled fifty-seven mammals.

NEW GENERA AMONG THE CONGO MAMMALS.—Among the mammals new to science discovered by the Congo Expedition, under the leadership of Mr. Herbert Lang and Dr. James P. Chapin, are two of exceptional interest. They belong to groups currently considered as well known,—that is the African genets and the African monkeys. It is to be expected that new species will be found among the material from any region not previously represented in the collections of scientific institutions; but forms so distinct as to require generic differentiation are scarce among the larger mammals.

The unique fishing genet, *Osbornictis piscivora*, named by Dr. J. A. Allen in honor of President Henry Fairfield Osborn of the American Museum, was discovered by Mr. Lang along one of the numerous shallow streams which meander through the rain forest of the northeastern Belgian Congo. This genet is the size of a large cat and has

a chestnut-brown fur, and a dark, bushy tail. That one of the civets should take exclusively to fishing for its livelihood is surprising, as they generally show the feline abhorrence of water. Externally the chief adaptation to this particular pursuit is the bare lower surface of the feet. But the sharp, arrow-shaped premolars and other peculiarities of the dentition indicate that the animal is well able to dispatch such elusive and slippery prey as small catfish and mormyrids.

The other discovery—that of a primate—is of especial interest. The specimen constitutes a new genus and has been described recently by Mr. Lang as *Allenopithecus* in honor of the late Dr. J. A. Allen. In size it resembles the famous Gibraltar monkey, so named because individuals of this species live along the rocks of the impregnable citadel. But although *Allenopithecus* resembles the Gibraltar monkey in general proportions, having a short, thick body and muscular limbs, it is not tailless. Of interest is the fact that it forms a link among the Lasioptygidae between the more terrestrial baboons and the numerous arboreal guenons. This, the first monkey collected by the expedition, was shot by Doctor Chapin just before nightfall, when the steamer was made fast at the edge of the jungle along the Congo River near Bolobo, and was the first wild monkey he had ever seen alive,—a most auspicious beginning for a large expedition which was favored by luck throughout its six years of exploration in the Belgian Congo.

MR. GEORGE G. GOODWIN of the department of mammals, American Museum, spent the month of August and part of September in the Gaspé Peninsula of Quebec, hunting and trapping the smaller mammals, of which he obtained a total of 200 specimens, representing 22 species and including water shrews, pigmy shrews, mink, and other fur bearers. From Montreal to Ste. Anne des Monts he went by automobile, making camp two miles beyond the town on the banks of the Ste. Anne River. Thence he traveled as far as the rough ground would permit by wagon, but was finally compelled to transfer his equipment to a wheelless platform of boards, a raftlike conveyance that, drawn by the horse, managed to ride over the swells of ground and the wreckage of fallen trees that frequently barred the way. Later even this conveyance had to be discarded, and the journey to the base of Mt. Albert in the Shickshock Range

was made on foot. The region is a rough and rocky one, where the mountain trees—for the most part spruce and balsam—have poor foothold and are frequently torn from their anchorage by the strong wind. Swift mountain streams, that rush past the islanded boulders that attempt to obstruct their course, are the haunt of the salmon, the bold leaps of which were a sight to be remembered.

A RARE SIBERIAN MARTIN.—The American Museum has been fortunate in receiving as a gift from Mr. John B. Deane, of the Far Eastern Commercial Corporation, the skin of one of the rarest and most beautiful of martens (*Charronia flavigula borealis*). Although this form was discovered as long ago as 1862 by Gustav Radde in the Bureja Mountains of the Amur region of northeastern Siberia, few specimens have found their way to museums. Equal in size to an American fisher (*Martes pennanti*), it is classed among the largest of the martens, the tanned skin presented to the Museum measuring three feet, six inches from the tip of the nose to the end of the tail vertebræ. The longer, darker hair of the body has that distinctive metallic golden luster to which so many fur bearers owe their high rating in the pelt market. The deep yellow of the throat, broken up by snowy white, and flanked toward the upper parts of the neck by black, the exceedingly long bushy tail, and the dark limbs make the animal ornamental in the highest degree. As sometimes happens, shortly after this valuable skin was presented, the American Museum received another skin, of the closely related southern Indian form. This skin was acquired through the Faunthorpe-Vernay Indian Expedition, which has filled in so many gaps in the Museum's collections of Asiatic mammals.

OTHER MUSEUMS

THE EXPEDITION OF THE FIELD MUSEUM TO CHILE and other parts of South America recently returned to Chicago after an absence of nine months. During the early stages of the expedition much attention was given to Chiloe and other islands off the coast. The northern half of Chiloe is quite thickly settled, but the southern half is wild, uninhabited, and from a zoölogist's standpoint very interesting. The weather favored the members of the expedition and they were able to coast in small boats to the most desirable points. About four hundred specimens of birds and

mammals were obtained during the sojourn at Chiloe. Of the birds, many marine forms were collected by Mr. H. B. Conover, who accompanied the expedition at his own expense; among the mammals there were, in addition to those known to the natives, some they did not recognize.

Perhaps the most interesting mammal obtained at Chiloe was the tiny deer known as the *Pudu*, of which there are only a few specimens in American museums.¹ It is the smallest of the deer family, that is, of the true deer that shed their horns annually. The largest male obtained by the expedition weighed only twenty-four pounds and had horns just three inches long. It stands about seventeen inches high at the shoulder.

In addition to collecting five specimens of this deer in Chiloe the expedition secured the smallest of the South American foxes. Darwin noticed this species on his famous voyage but since then it has remained comparatively unknown. Even the natives of Chiloe doubted its existence and one well educated man on the island who had a copy of Darwin's volume on the voyage of the "Beagle" was rather inclined to insinuate that Darwin had told a fairy story about the fox. Happily Dr. W. H. Osgood, who headed the expedition, was able to vindicate Darwin by capturing a specimen in a trap which he set for the purpose.

Other mammals obtained were a marsupial related to *Cænolestes*, otters, spotted cat, a small series of the coypu (an aquatic rodent almost as large as a beaver), and mice.

Among the frogs and toads collected at Chiloe the most interesting species was *Rhinoderma darwini*, the male of which carries the eggs and the little frogs, when they emerge, about with him in his vocal pouch, which stretches back into a lymph space between the abdominal muscles and the skin. Doctor Osgood gently squeezed a *Rhinoderma* that he had captured and the batrachian opened its mouth, showing it full of tiny little ones that had been forced upward through the pressure.

While the visit to the island of Chiloe had very notable results, the work of the party in several other localities proved equally interesting. While at Santiago, Doctor Osgood examined the collections of the Museo Nacional de Chile with especial reference to

¹A specimen of the Chilean *Pudu* is in the American Museum, and specimens of the Ecuadorian *Pudu* are in that institution and in Philadelphia.

the types of mammals described by Doctor Philippi. He was able to make satisfactory identifications of most of these forms, the inadequate description of which has, heretofore, been a difficulty in the study of Chilean zoölogy. In pursuance of a general policy of establishing relations with the museums of southern South America, he called at the Argentine museums in La Plata and in Buenos Aires, and later visited the Brazilian museums in São Paulo and Rio de Janeiro.

The southernmost station in Chile reached by the expedition was the Rio Nireguao, latitude 45° 20' South, a short distance north of Lake Buenos Aires. Doctor Osgood and Mr. Conover reached this point by crossing the Andes from the coast via the Rio Aysen. In this area, great herds of the guanaco are found on the pampas. The ostrich-like rhea is abundant. Most impressive of all are the vast numbers of waterfowl of all kinds in the lakes and marshes.

Mr. Conover is especially interested in the game birds of the world, his private collection being deposited in the Field Museum. The game birds secured by him, more than three hundred in number, form one of the most valuable and interesting parts of the collection made by the expedition.

Subsequently Doctor Osgood and Mr. Conover went to Buenos Aires. While in the Argentine Republic, Doctor Osgood made two short expeditions, one to the typical pampas country southwest of Buenos Aires, and one to the mountainous province of Jujuy, on the Bolivian border.

The Museum's work in Chile will be continued throughout the warm season of 1923-24, by Mr. C. C. Sanborn, assistant in the division of birds. During the Chilean winter, Mr. Sanborn collected in the northern part of that country.

REPTILES AND BATRACHIANS

COLLECTING SPECIMENS FOR A GILA MONSTER GROUP.—Mr. Arthur I. Ortenburger, assistant curator of herpetology, American Museum, spent the summer in the neighborhood of Tucson, Arizona, collecting reptiles in the foothills of the near-by Santa Catalina Mountains. In this area it was hoped that there might be obtained material for a group of the Gila monster, the conspicuously marked lizard of our Southwest—the only venomous lizard in the world—and the fact that fifteen specimens were taken (of which

eleven were shipped back alive) proves that the hope was well justified. Although incapable of fast locomotion—the fat drooping body being a rather cumbersome load for the short legs—the lizard is one to be approached with caution, for at close quarters it will lunge at its antagonist with the rapidity of a snake. Practically all of the specimens captured were encountered on the broad level shelves that form a kind of terrace on the sloping cañon sides.

By far the most prevalent snake in the area was the desert diamond rattlesnake, *Crotalus atrox*. Of this reptile more than forty specimens were taken, not to mention three specimens of the more uncommon species *Crotalus molossus*, and one specimen of the very rare *Crotalus tigris*. It is a common belief that the rattlesnake invariably sounds its warning upon the approach of a potential antagonist, yet of the forty-five rattlesnakes obtained by Mr. Ortenburger only two took the trouble to give notice of their presence and, even when definitely attacked with a discharge of dust shot to facilitate capture, not more than one in five would give a challenging dry buzz.

It is interesting to note that the black whip snake, *Masticophis piceus*, formerly assumed to be merely a melanistic phase of the western red racer, *Masticophis flagellum frenatus*, was actually more prevalent in the region than the latter.

The most important observations concerning habits were made on the spadefoot toad, represented in the area by two species, *Scaphiopus couchii*, and *S. hammondi*. It was noted that these amphibians—which derive their common name from the fact that they are armed on the underside of the hind foot with a horny projection, which is of aid in digging—spent their days ensconced in the dry soil, in which they burrow, but after nightfall would free themselves of their sandy covering and make their way with active leaps toward the puddles of stagnant rainwater. The male spadefoot bleats like a lamb, and it was this unwonted sound in a region comparatively deserted that first led to its detection.

In all, 1607 specimens were collected, including sixteen tortoises,—a reptile one does not think of as a dweller of the desert.

AUSTRALIA

ACHIEVEMENTS OF THE EXPEDITION OF THE AMERICAN MUSEUM.—The recent return of

Mr. H. C. Raven from Australia makes opportune a review of the work of the Museum's Australian expedition as a whole.

The expedition, consisting of Dr. William K. Gregory and Mr. Harry C. Raven, the latter in charge of field work, left New York in May, 1921. The first object was to open up relations of friendly coöperation with Australian museums and naturalists; the second was to secure a representative study collection of the Australian fauna, especially the mammals; the third and most important was to obtain material suitable for exhibition. The expedition has been very successful in the attainment of all of these objects.

While in Australia Doctor Gregory arranged a number of exchanges, which during the past two years have been largely consummated. The American Museum has sent to several Australian museums accurate replicas of the great skull of *Tyrannosaurus*, original limb bones of the huge *Brontosaurus*, model restorations of *Camarasaurus*, complete and beautifully executed models of two Indians of the Plains, a life-size replica of the skeleton of the great fossil amphibian, *Eryops*, a series of Professor McGregor's restorations of prehistoric men, and other material.

On their part the Australian museums have sent the American Museum a replica of the skeleton of the giant marsupial *Diprotodon*, an original skull of the so-called marsupial lion, *Thylacoleo*, original remains of *Diprotodon* and other extinct marsupials, an extensive series of casts of type specimens of extinct marsupials described by Owen, and some fine slabs containing fossil ganoid fishes of peculiar type. Models of Australian aboriginals with accessories for a group are also promised. The Australian naturalists have been more than generous in helping the Museum to fill the gaps in its collection of mammals, and have sent a number of very important and rare marsupials not hitherto represented. Of scarcely less value has been the exchange of scientific ideas and information and the promise of continued coöperation.

Mr. Raven's field work, which extended from August, 1921, to February, 1923, was highly successful in spite of the difficult conditions at present confronting foreign museum collectors in Australia. Through the liberal policy and active coöperation of the directors of several Australian museums and government officials he was enabled to secure permits to collect a limited and specified number of

specimens in Queensland, New South Wales, and Tasmania. For such active and timely coöperation and assistance Mr. Raven is deeply indebted to the following gentlemen: Dr. Thomas Storey Dixson, president, Dr. Charles Anderson, director, Mr. Charles Hedley and the entire staff of the Australian Museum at Sydney; Prof. Launcelot Harrison, Sydney University; Dr. A. H. Burckitt, of the School of Medicine, of that institution; Mr. A. H. Chisholm, of the *Sydney Daily Telegraph*; Mr. Ellis S. Joseph, Sydney; Mr. Harry Burrell, Sydney. Mr. A. S. Le Souëf, Taronga Zoölogical Park; Mr. Heber Longman, director of the Queensland Museum and Mr. M. J. Coleclough, of that institution; Mr. William Gray, North Queensland; Prof. F. Wood Jones, University of Adelaide; Mr. H. H. Scott, curator of the Victoria Museum and Art Gallery, Launceston; Dr. Ray McClinton, Launceston; Prof. T. T. Flynn, and Colonel Thomas, University of Tasmania; Mr. E. Burles, manager of the Arthur River Sawmill, Tasmania.

Mr. Raven will give some account of his experiences and of the highly interesting Australian mammals in a later issue of NATURAL HISTORY. But here it may be said in a word that as a result of his work the great majority of the genera of Australian mammals are now represented in the collections of the American Museum. This would convey no idea, however, of the excellent character of the material for study and exhibition brought back by Mr. Raven. Besides the beautifully prepared skins of mammals, he has an unusually complete series of skeletons and an even more valuable collection of anatomical preparations and entire animals preserved in alcohol. In addition to these he has a small but representative series of bird skins and a valuable collection of birds preserved for dissection. Considerable embryological material was also obtained, as well as photographs of living animals and notes on their habits.

Plans for exhibits in the proposed Australian section have been adopted and the work of the preparators is well under way. A temporary exhibit of some of the material secured by the expedition has been installed in the hall of woods and forestry.

DR. E. O. HOVEY'S TRAVELS AND OBSERVATIONS.—In a letter written under date of September 4 from West Maitland in New South Wales, Dr. E. O. Hovey, the representa-

tive of the American Museum at the Second Pan Pacific Scientific Congress, held in Sydney and Melbourne, speaks appreciatively of the work done by the Congress and of the hospitality shown the visiting delegates by their colleagues in Australia. Not a few of the American Museum's major undertakings in recent years have been devoted to the Pacific and regions contiguous to it, and Doctor Hovey was privileged to present to the gathering accounts prepared by Professor Osborn and Dr. W. D. Matthew, regarding the Third Asiatic Expedition and a statement by Dr. Robert C. Murphy concerning the Whitney South Sea Expedition. Doctor Hovey also delivered a paper, which he wrote by request, on the rocks of the volcanic Caribbees, and finally he presented an abstract of an article by Dr. Chester Reeds on varve clays and other seasonal records of geologic time, a subject elucidated by Doctor Reeds in the July-August issue of *NATURAL HISTORY*.

In addition to attending the Congress and paying visits, under the friendly guidance of Australian men of science, to the local museums and universities, Doctor Hovey has been able to inspect in their company certain geologic sites of interest. Near Adelaide he viewed the Pre-Cambrian (or Cambrian) and the Permocarboniferous glacial deposits. He spent three days in the famous mining district of Broken Hill, entering three of the great mines. On his way from Broken Hill to Sydney he stopped to visit the Jenolan caves, famous for their beauty of dripstone formation and the magnificence of their chambers. The great copper mine at Mt. Lyell on the west coast of Tasmania was another objective.

Among the excursions of special promise to which Doctor Hovey alluded in his letter was one contemplated to the Great Barrier Reef. Doctor Hovey expressed the hope that this trip, made possible through the generous action of the government of Queensland, would enable him to secure corals from the reef as well as other forms of marine life of interest to the American Museum.

Among those to whom Doctor Hovey is under special obligations for friendly helpfulness and hospitality are Prof. E. W. Skeats, Sir Douglas Mawson, Dr. L. K. Ward, Prof. R. L. Jack, Mr. Charles Hedley, and the Governor of Queensland. But indeed the list would have to be greatly extended to give recognition to all of those who in one way or

another enhanced the interest or contributed to the value of Doctor Hovey's trip.

BIRDS

THE FORTY-FIRST STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION was held at the Museum of Comparative Zoology, Cambridge, October 9-11. Forty-three papers were presented before the gathering, and of these twelve were contributed by the members of the scientific staff of the American Museum. Dr. Frank M. Chapman presented the first paper of the opening session, entitled "The Arrangement of a Study Collection of Birds." A paper on "Midsummer Song Sparrows," prepared jointly by Mr. John T. Nichols and Mr. Rudyerd Boulton on the basis of a statistical study of banding data, was contributed to the Bird Banding Session on October 10.

Five of the six papers that made up the program of the Technical Session were of Museum authorship. In their order of presentation they were: "The Forms and Representatives of *Calonectris kuhli*" by Dr. R. C. Murphy, "Remarks on *Thraupis sayaca* and Its Allies" by Mrs. Elsie M. B. Naumburg, "Life Zone Problems of the New York City Region" by Mr. Ludlow Griscom, "Remarks on the Classification of Birds," by Mr. W. DeW. Miller, "Criteria for the Determination of Subspecies in Systematic Ornithology" by Dr. Frank M. Chapman.

On the afternoon of October 10, Dr. James P. Chapin presented a paper on "Birds of the Kasai District, Belgian Congo," followed in close succession by a "Report on the Progress of the Whitney South Sea Expedition" delivered by Dr. R. C. Murphy.

The closing day of the meeting was signaled by several interesting papers, among them being three from members of the American Museum: "Notes on American Oyster Catchers" by Dr. R. C. Murphy, "Notes on the Summer Birds of Newfoundland" by Ludlow Griscom, "Mutation *vs.* Evolution by Environment in Birds" by Dr. F. M. Chapman.

Dr. Jonathan Dwight, research associate in North American ornithology in the American Museum, was elected president of the Union, and Dr. Joseph Grinnell, of the University of California, and Dr. Alexander Wetmore, of the Biological Survey at Washington, were elected respectively first and second vice presidents. Dr. T. S. Palmer and Mr. W.

L. McAtee were re-elected respectively secretary and treasurer.

VERTEBRATE FOSSILS

FOSSILS FROM THE SIWALIK HILLS OF INDIA.—The collections made, through the generous gifts of Mrs. Henry C. Frick, in 1922 by Mr. Barnum Brown, associate curator of fossil reptiles, American Museum, in the Tertiary formations of the Siwalik Hills of India are now being unpacked and catalogued for study. They include a splendid series of skulls of fossil elephants and mastodons, rhinoceroses, hippopotami, giraffes, antelopes, deer, three-toed horses, and other animals of this magnificent extinct fauna, first discovered ninety years ago and described by Falconer, Cantley, and other English writers. Among the most interesting specimens are three jaws of anthropoid apes, whose exact relations to their modern descendants, or possibly to man, will be a subject for careful and painstaking study. Fossil specimens of the higher anthropoids are exceedingly rare finds in the Tertiary formations, and are of extraordinary interest because they are the nearest known relatives of man existing that far back in geologic time. We may yet discover among them species that we can regard as his direct ancestors. Plaster casts of nearly all the known specimens of these Tertiary anthropoids have been secured by the Museum, but these are the first original specimens to figure in an American collection if one excepts the fossil tooth from Nebraska described as *Hesperopithecus*.

FIELD WORK IN WESTERN NEBRASKA.—A fossil-hunting expedition from the American Museum, in charge of Mr. Albert Thomson, has been operating in western Nebraska during the summer. The expedition has now completed its work and eleven cases of fossils have arrived at the Museum. Most of the work was in and around the Snake Creek Fossil Quarries, where a very interesting ape tooth, the only one known from the New World, was discovered recently. Mr. Thomson reports that the expedition could not find any more ape teeth, but secured a large series of skulls and jaws of three-toed horses, camels, deer, and other extinct animals. The best specimen, he states, is the skull and jaws of a gigantic camel, much larger than the modern Bactrian camel. This is the sixth year that the Museum has worked these quarries, which have yielded many thousands of skulls,

jaws, teeth, and bones, belonging to more than 110 different species of animals.

ANTHROPOLOGY

THE CREATION STORY AMONG THE NAVAJO.—By means of a fund given for the purpose by Mrs. Dorothy Straight, Dr. P. E. Goddard, curator of ethnology, American Museum, made a field trip to the Navajo Indians during the latter part of August and the first three weeks of September. The Navajo are by far the largest American tribe of full-blooded Indians, numbering about 30,000. To a remarkable degree the changes in their mode of living since the coming of the Spaniards in 1540 have been spontaneous. Comparatively few Navajo have as yet come under the direct influence of missionaries or schools. Taking over sheep, they became pastoral but did not entirely give up their pre-Spanish agriculture. From the wool of the sheep they developed blanket weaving originating many designs. The growth and spread of culture as the result of such new contacts is the prime interest of ethnology.

The Navajo, perhaps in part because of their numbers, have a most interesting unwritten literature. Much of this is already known through Dr. Washington Matthew's *Navajo Legends*. There are among the Navajo many schools of "priests," or singers, to use the native term. Each school seems to have a special narrative of events regarding the beginning of things, starting with a lower first world inhabited chiefly by insects. As the narrative unfolds, an explanation is given of the origin of the ceremony conducted by these priests. There exist, therefore, among the Navajo numerous versions of the origin of the world which are in many particulars inconsistent.

During the field trip Doctor Goddard was able to secure from Indian informants a good deal of the creation story which he recorded in Navajo text. This assures its preservation in a more accurate form than is possible in a translation. The Franciscan Fathers of St. Michael's have issued an excellent dictionary of the Navajo language but no texts except songs have been printed.

Dr. Gladys A. Reichard of Barnard College took part in the trip under the auspices of the Southwest Society, paying especial attention to the social and family life of the Navajo.

It is planned to continue the work next summer with the same Indian informants.

one of whom is a man of much influence. He is interested in the recording of his accounts of the origin and growth of the Navajo tribe, so that his grandchildren may read them rather than learn them orally.

BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

The biological laboratory at Cold Spring Harbor is being taken over from the Brooklyn Institute of Art and Sciences by a corporation organized for the purpose. A board of managers, consisting of fifteen individuals, has been formed and among the biologists appointed to this board is Dr. G. Clyde Fisher of the American Museum. The laboratory was organized by Dr. Bashford Dean and directed by him during the first year of its existence. For a third of a century, during the summers, it has offered courses and has furnished opportunity and material for research in the biological sciences. Following Doctor Dean, Dr. H. W. Conn was director for a number of years, and Dr. Charles B. Davenport, who succeeded him, has been at the head of the institution for about a score of years. Coincident with the change in management Doctor Davenport has retired from the directorship, and one of the first acts of the new board was to nominate Mr. Reginald C. Harris to serve as director until the transfer to the new corporation is consummated.

ERRATA

Through an error in the pagination indicated in a footnote on page 507 of the September-October issue of *NATURAL HISTORY* inadequate credit was given, on the one hand, to Miss Mary Cynthia Dickerson for the series of pictures illustrative of her work in nature photography that found place in that issue and, on the other, to Doubleday, Page and Company for their courtesy in permitting the reproduction of these photographs. The pictures that accompanied the symposium of articles headed "Mary Cynthia Dickerson" were all, exclusive of the frontispiece, taken by Miss Dickerson.

FISHES

THE AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS held its eighth annual meeting on October 12, at the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Dr. G. K. Noble, associate curator of herpetology, American Museum, gave an illustrated lecture entitled "Observations on

the Habits of Some Local and Exotic Amphibia." At the business session Mr. John T. Nichols, associate curator of recent fishes, American Museum, was elected president of the society for the ensuing year. In view of his multifarious responsibilities Mr. Nichols asked to be relieved of the editorship of *Copeia*, the magazine of the society, and accordingly Dr. E. R. Dunn was chosen editor in his stead. It is due almost entirely to the initiative of Mr. Nichols that *Copeia* came into being, and had it not been for his ability, energy, and devotion in maintaining its standard throughout the years of his connection with it—a connection which has been coextensive with its existence—it would have failed to take the rank it now holds among scientific publications.

A MONUMENT TO ALFRED G. MAYOR.—A fitting memorial in honor of Alfred G. Mayor (whose death on June 24, 1922, was reported in the July-August number of *NATURAL HISTORY* for that year, p. 380) has been erected on Loggerhead Key, Tortugas, Florida, between the old and new buildings of the Marine Biological Laboratory of the Carnegie Institution of Washington. The memorial was designed by Mrs. Mayor, well known for her work as a sculptor, and was paid for by contributions from those who had enjoyed the hospitality of the station when Doctor Mayor presided over it. The inscription on the tablet, which is of bronze, fastened to a shaft of concrete, reads as follows:

ALFRED · GOLDSBORO · MAYOR
WHO · STUDIED · THE · BIOLOGY · OF · MANY · SEAS · AND
HERE · FOUNDED · A · LABORATORY · FOR · RESEARCH
FOR · THE · CARNEGIE · INSTITUTION · DIRECTING · IT
FOR · XVIII · YEARS · WITH · CONSPICUOUS · SUCCESS
BRILLIANT · VERSATILE · COURAGEOUS · UTTERLY
FORGETFUL · OF · SELF · HE · WAS · THE · BELOVED · LEADER
OF · ALL · THOSE · WHO · WORKED · WITH · HIM · AND · WHO · ERECT
THIS · TO · HIS · MEMORY · BORN · MDCCCLXVIII
DIED · MCMXXII

Thanks to the devoted labors of Mr. John Mills, the chief engineer of the station, the monument is assured a permanence which nothing short of an earthquake can put in jeopardy. Mr. Mills dug through the coral sand that covers the surface of the Tortugas until he reached the oölitic limestone that forms the foundation of the island. Iron pipes were then driven as far into the rock as was possible and around these metal supports the concrete structure, only a portion of which shows above the surface, was reared. The monument is thus literally anchored to the bed rock.



NATURAL HISTORY is indebted to Mr. Frederick G. Kuhlkin for the privilege of reproducing this photograph of the final phase of the recent eclipse of the sun, which Mr. Kuhlkin took at Sheepshead Bay, Long Island, with a No. 3 kodak through an amber-colored screen that had been smoked with a match. The lens was an anastigmat 7.7 and the exposure was $\frac{1}{25}$ of a second.

A CAPTURE OF A WHALE SHARK.—In the issue of *Science* for September 7, 1923, Dr. E. W. Gudger, associate in ichthyology, American Museum, gives an account of a whale shark, captured June 9, 1923, by Mr. Claude Nolan off the Florida Keys. Various hard parts of this shark, the fourth specimen of *Rhineodon* to be recorded from the Florida coast and the fifth from the Atlantic Ocean, were obtained for the American Museum. A sketch of the fish, made by Mr. L. L. Mowbray, accompanied by careful measurements and an exact description, will make possible the construction of a life-size model of the huge shark, which is more than thirty feet in length, for the new hall of fishes. Doctor Gudger has contributed also to the issue of *The Fishing Gazette* for August 18, 1923, an article entitled "Fish Smelling and Tasting of Iodoform—An Explanation."

INSECTS

THE BALTIMORE GROUP.—In the hall of insects, American Museum, there has recently been installed a group representing the life history and characteristic environment of the Baltimore butterfly, *Melitæa phaëton*. As one approaches the group from the right, one glimpses through a vista in the vegetation a representative marsh scene, with the iris lifting its purple tops, the skunk cabbage with unfolded leaves, and a frog alert and ready to leap. The setting has been flashed upon one's

mind, but in the next instant, standing in front of the group, one's attention is absorbed by the insects themselves.

Like other butterflies the Baltimore has its three ages (or four if the egg stage be included) but they are more wonderful in their contrasts than are the seven ages of man. On a leaf is shown a yellow mass of newly laid eggs; on the under side of another leaf is a compact cluster of red. Few would at first thought connect the two, yet the red formation represents the matured eggs, from which the caterpillars are about to emerge. The caterpillars of this butterfly overwinter, and evidence of the winter shelter, or hibernaculum, in which the caterpillars shown in the group have spent the cold months, is afforded by a brown and shriveled cluster of dry leaves held together by silken strands of the insects' spinning. The spiny caterpillars themselves are shown in characteristic attitudes, either crawling over the leaves or pendent from them, ready to pupate. On some of the plants are the whitish chrysalids with their dark and orange markings, and from one of these a butterfly has just crawled and is resting with folded wings. On the broad leaf of a skunk cabbage another Baltimore is seen with its wings spread wide,—a position frequently assumed by this butterfly.

Within the space of a few square feet is thus presented the life cycle of this insect, which, although one of the lesser creatures of earth, presents many phases of interest to observing eyes. The group was prepared under the supervision of Dr. Frank E. Lutz, from field studies made by Mr. F. E. Watson. The insects were mounted by Mr. Charles Wunder; the background was painted by Mr. Albert Operti. The representation of the habitat is due to the skill of various members of the department of preparation, especially Messrs. Coleman, Peters, and Rector.

LOWER INVERTEBRATES

THE UNDERWATER PAINTINGS OF ZARH H. PRITCHARD.—Through the generosity of friends of the American Museum the department of lower invertebrates has received a splendid gift, consisting of five paintings of undersea life by the noted submarine painter, Mr. Zarh H. Pritchard. These form the first installment of a series of twelve, the remainder of which, it is hoped, may be acquired in the future. These exquisite examples of Mr. Pritchard's work were painted by him from

sketches made on waterproof canvases and represent submerged vistas of living corals in the lagoons of Pacific islands, especially those of the Society Group. To secure them, Mr. Pritchard put on a diver's suit and descended into the unusually transparent waters of this region, producing pictures from a viewpoint hitherto known only to divers. He has depicted in oils the delicate hues of the living corals and the graceful arches and caverns which underlie the coral reefs, as they appear suffused with the iridescent light which penetrates the coral depths.

These paintings are now on temporary exhibition in the Darwin hall of the Museum. It is intended to give them a permanent place in the new hall of ocean life, which is now being erected. There they will form part of the setting for the great West Indian Coral Reef Group, which has been projected as one of the striking exhibits in this hall.

Two of the paintings were donated by Mr. Arthur Curtiss James, one by Mrs. William K. Vanderbilt, one by Mr. Paul M. Warburg and Miss Bettina Warburg, and one in memory of Mr. John Wood Stewart, who with Mr. Pritchard went down into the beautiful depths of the coral reefs of Pagopago in January, 1917. Mr. Pritchard's work has been exhibited many times, both at home and abroad, while examples from his brush are to be found in the collections of the late Prince of Monaco and in many other art collections in Europe, America, and Japan.

DREDGING OFF THE CONTINENTAL SHELF.—Dr. Roy W. Miner, curator of lower invertebrates, American Museum, spent a part of the summer at the Harpswell Laboratory on Mount Desert Island, Maine. In company with Dr. Ulric Dahlgren, the director of the station, he made dredgings at the edge of Frenchman's Bay on the continental shelf, in water attaining a depth of about thirty fathoms. With the material scooped from the ocean bottom it is Doctor Miner's intention to construct an exhibition group of *Terebratulina*, in which in addition to these hinged lamp shells there will be shown the representative marine forms such as sea stars, actinians, sponges, and ascidians, that share possession of the dim depths of the ocean with them.

Doctor Miner was accompanied by Mr. Chris Olsen of the Museum's department of preparation, who made sketches of the forms obtained with special reference to reproducing

them as models. In addition to Doctor Miner another member of the scientific staff of the Museum, Mr. Frank J. Myers, research associate of Rotifera, availed himself of the facilities offered by the station for investigations. He made studies of the pond life of Mount Desert Island, with special reference to the rotifers. About 250 species of rotifers, including twelve new to science, were recorded.

Unusual opportunities are afforded the student of marine life at the Harpswell Laboratory, as set forth in an article that Doctor Miner contributed to the issue of *NATURAL HISTORY* for January-February, 1922, pp. 46-55. Ten research rooms and a library of more than 2000 volumes are given over entirely to investigators working in their chosen subjects. The equipment includes salt-water aquaria with cold fresh sea water. A collector is attached to the laboratory whose duty it is to secure the animal and plant forms that may be required. For sea-going purposes there is a gasoline boat with equipment for collecting in deep water. During the past summer the staff of the laboratory started a biological survey of the waters about Mount Desert Island.

CONSERVATION

SAVING THE REDWOODS OF CALIFORNIA.—A signal triumph has been won by the Save the Redwoods League of California in the passage by the Legislature of that state, and the signature by Governor Richardson, of the Bill introduced by Assemblyman Rosenshine and warmly sponsored by the League and its officers,—John C. Merriam, president, Joseph D. Grant, vice president and chairman of the Board of Directors, Robert G. Sproul, treasurer, and Newton B. Drury, secretary. Under the terms of that Bill the state board of forestry is authorized and directed to undertake a survey of the state forest lands with a view to designating those suitable for conversion into public parks. Control will rest with this body to acquire wooded land within the selected areas "either by gift, donation, contribution, purchase, devise, or proceedings in eminent domain." Through this far-reaching measure it will be possible to acquire tracts of great beauty and interest for the enjoyment and inspiration of the citizens of California and visitors to that state.

An instance of the practical operation of the Act is supplied through the recent gift of Mrs. Zipporah Russ, who has set an example for

other public-spirited citizens to follow in presenting to the state of California an unusually fine tract, 166 acres in area and containing 30,000,000 feet of redwood in addition to other timber. The tract is given in memory of her husband, Mr. Joseph Russ, a pioneer of 1852, as a memorial to the pioneers of Humboldt County.

THE WILD FLOWERS OF NEW YORK STATE.—Everybody loves the wild flowers but in our thoughtless acquisitiveness we are endangering many species. When we pluck a flower, we rob it of its opportunity to mature its seed and so to perpetuate itself. Thornton W. Burgess in his recently issued *Flower Book for Children* tries through that amiable fellow student Peter Rabbit to restrain the child from destroying the bright flowers that attract him. But adults too need restraining, and laws are necessary to supplement teaching. Several states already have laws forbidding the plucking of rare and interesting plant forms; it is with the hope of enrolling New York among the states enforcing such restrictions that at a recent joint meeting, of the Torrey Botanical Club, the New York Bird and Tree Club, the American Fern Society, and the Wild Flower Preservation Society of America, a committee was appointed, of which Dr. G. Clyde Fisher of the American Museum is a member, to draft a Bill for consideration by the New York Legislature, to the end that some of our state plants that are in danger of disappearing may be preserved for the enjoyment and interest of future generations.

Since the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum, making the total membership 7090:

Life Members: MESDAMES DOROTHY RYLE DE BERNARD, JOHN HARDEN DORN; MESSRS. LOUIS BAMBERGER, GUY CARY, ROBERT GOELET, AND GOODHUE LIVINGSTON, JR.

Sustaining Members: MESDAMES ELBRIDGE ADAMS AND A. WENTWORTH ERICKSON.

Annual Members: MESDAMES ELENORE AMEND, MARY V. BEACH, MORRIS BERNHARD, M. D. BLITZER, A. O. CHOATE, RUSSEL S. COUTANT, F. P. GARVAN, WM. GREENOUGH, ELVERTSEN HASTINGS, W. A. MCFADDEN, WALTER ROWLAND, JOSEPH T.

TRACY, CHARLES WOLF; THE MISSES MARGARET DEYO, GRACE GREENLEAF LYMAN, PARKER McCORMICK, HYACINTH A. SUTPHEN; DOCTORS JOSEPH H. ABRAHAM, HENRY W. BERG, CAROLINE A. BLACK, GEORGE DRAPER, HENRY ALSOP RILEY; THE REVEREND F. J. BYER; MESSRS. HARRY ABBERBOCK, WM. HALL ALLEN, LEON S. ALTMAYER, FELIX ARNOLD, WILLIAM B. BELL, DAVID BERNSTEIN, SAMUEL D. BLOOMBERG, BAYARD DODGE, R. H. IVES GAMMELL, ROBERT J. GOODENOUGH, HAROLD V. W. HALSEY, EDWARD THORNE HOLLAND, GEORGE H. HUDSON, JOHN KEAN, ROBERT WINTHROP KEAN, CHARLES P. KELLY, WALTER H. KOEHN, THEODORE H. LAMPRECHT, JOHN WALTON LIVERMORE, A. MOORE MONTGOMERY, ALBERT MOYER, JAMES J. PILLIOD, WILBUR M. REDMAN, W. ATTMORE ROBINSON, H. PENDLETON ROGERS, TRYGVE ROVELSTAD, C. ADRIAN RUBEL, RICHARD J. SCOLES, HENRY SETON, JOHN G. TOWNSEND, EDWARD R. WOOD, JR., AND MORRIS YUSSIM.

Associate Members: MESDAMES EDGAR H. BRIGHT, ELDRIDGE M. FOWLER, FRANCIS B. SEARS, SAMUEL R. WHITING; THE MISSES LOUISE H. COBURN, ANNA E. KLUMPKE, SARA F. SADLER; COLONEL CECIL STEWART; PROFESSOR DOCTOR E. D. VAN OORT; DOCTORS R. P. BURKE, A. H. CORDIER, LEONARD H. CRETCHER, JOSEPH T. DE GRANGE, J. A. GORMAN, H. G. KUGLER, ERNST LEHNER, H. H. MORRIS, ALICE A. ROBISON, IVAR SEFVE, J. VERSLUYNS; PROFESSORS ALESSANDRO GHIGI, HIKOSHICHIRO MATSUMOTO, GIUSEPPE SERGI, HARRIS H. WILDER, EDWARD H. WILLIAMS, JR.; MESSRS. A. W. ANTHONY, JR., PHANOR BREAZEALE, EDMUND BREESE, ELISHA BROOKS, D. S. BULLOCK, ARMON BURWASH, DONALD CARLISLE, H. DAY CUSHMAN, RICHARD H. DAY, THOS. G. FARRELL, FRANCIS A. FOSTER, C. E. GOSTENHOFER, W. R. GRANDY, RASMUS HANSON, ALFRED S. HARKNESS, JR., GARDINER HAWKINS, WALTER H. HOFFMAN, NAPOLEON S. HOSKINS, ALBERT D. HUTZLER, FREDERIC T. JENCKS, JOSEPH L. LACKNER, GEORGE LANGTRY, HANDEL T. MARTIN, PAUL C. MILLER, EDWARD NORRIS, HENRY J. NUNNEMACHER, JAS. M. OSTERGAARD, GEORGE J. RANKIN, W. D. REDWOOD, JOHN MACBETH RICHARD, FRANK H. H. ROBERTS, JR., G. C. ROE, ROGER KEMPER ROGAN, HARRY R. SNYDER, JR., ELIHU B. TAFT, SAMUEL W. WEIS, AND FRANK C. WILLARD.

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FOUNDED IN 1868

MEMBERSHIP MORE THAN SEVEN THOUSAND

For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 7000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

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Sustaining Member	annually	25
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Patron		1,000
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Benefactor		50,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: George F. Baker, Jr., Treasurer, American Museum of Natural History, New York City.

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COURSES OF POPULAR LECTURES FOR MEMBERS

A series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, is open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are told on alternate Saturday mornings in the fall and in the spring.

MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

The American Museum of Natural History has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its expeditions and disseminated through its publications—of the increasing influence exercised by the institution.

In 1922 no fewer than 1,309,856 individuals visited the Museum as against 1,174,397 in 1921, and 1,038,014 in 1920. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever. The EXPEDITIONS of the American Museum, working during the past year in several parts of Asia—where finds of extraordinary value were made—in South America, Africa, Australia, Europe, in the South Pacific Islands, in the West Indies, and in selected areas of our North American continent, have greatly enriched knowledge. Many habitat groups, embodying specimens secured by these expeditions, are planned for the new Museum buildings, the erection of which has been authorized by the city.

The SCHOOL SERVICE of the Museum reaches annually more than 4,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or “traveling museums,” which during the past year circulated among 475 schools, with a total attendance of 1,648,608 pupils. During the same period 330,298 lantern slides were loaned by the Museum for use in the schools as against 209,451 in 1921, the total number of children reached being 2,582,585.

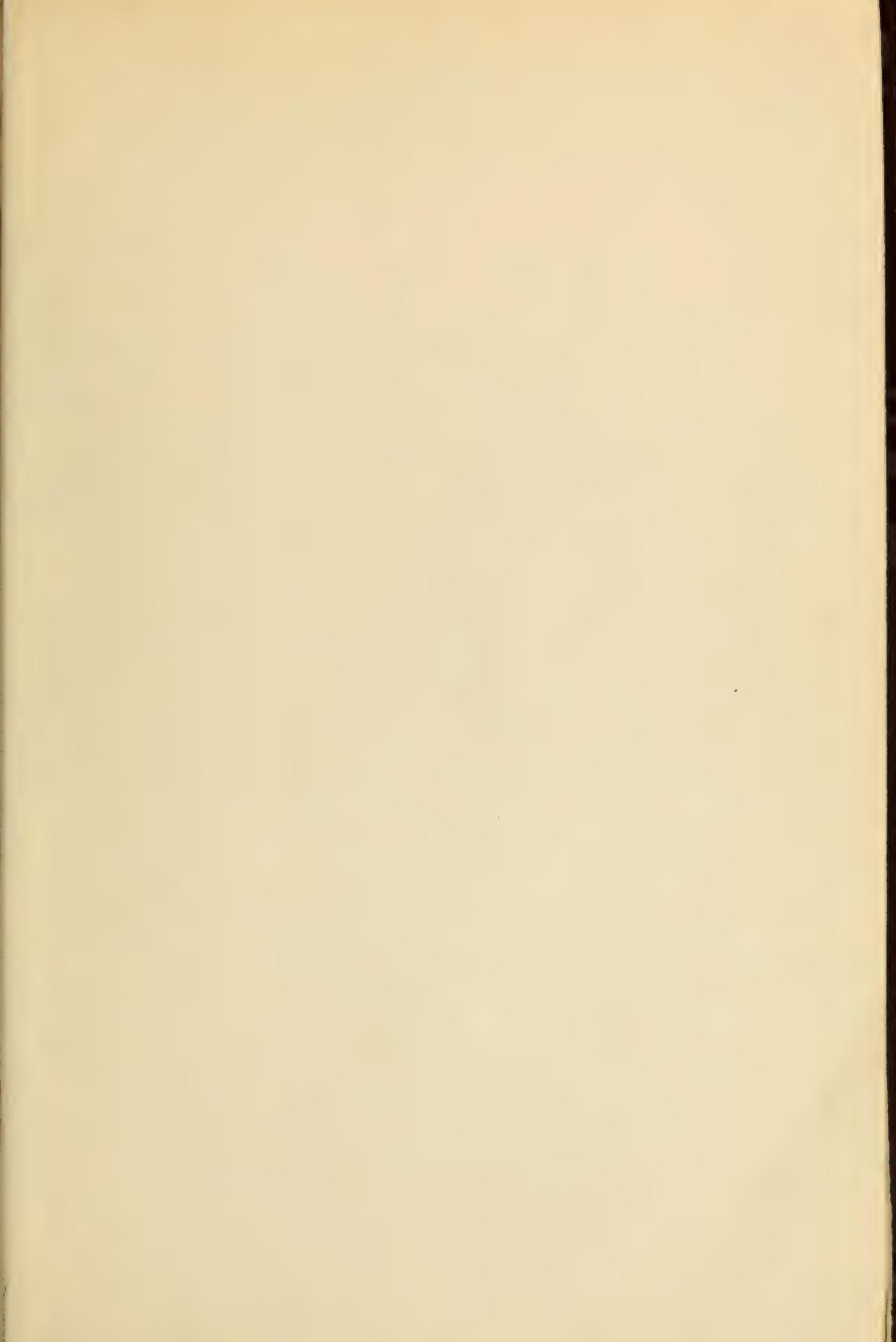
LECTURES, some exclusively for members and their friends, others for the general public, are delivered both in the Museum and at outside educational institutions.

The LIBRARY, comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

The POPULAR PUBLICATIONS of the Museum, in addition to NATURAL HISTORY, include Handbooks, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit, or series of exhibits, of special interest or importance, or the contents of some hall or some branch of Museum activity.

The SCIENTIFIC PUBLICATIONS of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs*, of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the scientific activities of the departments, aside from anthropology; the *Anthropological Papers*, recording the work of the staff of the department of anthropology; and *Novitates*, devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters.

A detailed list of the publications, with prices, may be had upon application to the Librarian,
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