NATURAL HISTORY

THE JOURNAL OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XXVII

1927

Published bimonthly by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK CITY
1927

NATURAL HISTORY

IS SENT FREE TO ALL CLASSES OF MUSEUM MEMBERS AS ONE OF THE PRIVILEGES OF MEMBERSHIP

An illustrated magazine devoted to the advancement of natural history, the recording of scientific research, exploration, and discovery, and the development of museum exhibition and museum influence in education. Contributors are men eminent in these fields, including the scientific staff and members of the American Museum as well as writers connected with other institutions, explorers, and investigators in the several branches of natural history.

CONTENTS OF VOLUME XXVII

January–February, No. 1

March–April, No. 2

May–June, No. 3

July–August, No. 4

September–October, No. 5

NOVEMBER–DECEMBER, No. 6

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY, EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

THE MUSEUM IN FIELD AND STUDY

A. KATHERINE BERGER, EDITOR

JANUARY-FEBRUARY, 1927

[Published March, 1927]

VOLUME XXVII, NUMBER 1

NATURAL HISTORY

VOLUME XXVII CONTENTS FOR JANUARY-FEBRUARY NUMBER 1

Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

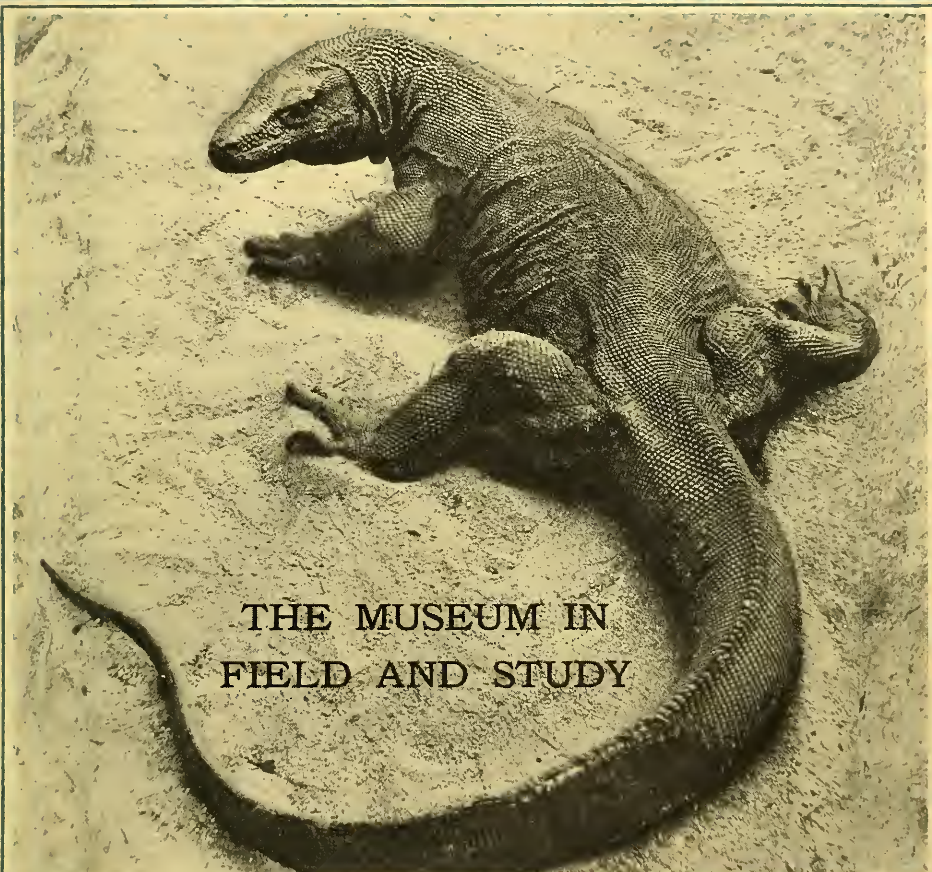
NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

Vol. XXVII JANUARY-FEBRUARY, 1927 No. 1

NATURAL HISTORY



JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION·RESEARCH·EDUCATION

ANNUAL SUBSCRIPTION $3.00 SINGLE COPIES 50 CENTS

FREE TO MEMBERS AND ASSOCIATE MEMBERS OF THE MUSEUM

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1927

Henry Fairfield Osborn, LL.D., President
George H. Sherwood, A.M., Director and Executive Secretary
Frederic A. Lucas, Sc.D., Honorary Director
Wayne M. Faunce, Sc.B., Assistant to the Director and Assistant Secretary
James J. Clark, Assistant Director, Preparation

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

William Diller Matthew, Ph.D., F.R.S., Curator-in-Chief

Astronomy

G. Clyde Fisher, Ph.D., LL.D., In Charge

Minerals and Gems

Herbert P. Whitlock, C.E., Curator
George F. Kunz, Ph.D., Research Associate in Gems
Lea McIlvaine Luquer, Ph.D., Research Associate in Optical Mineralogy

History of the Earth

W. D. Matthew, Ph.D., F.R.S., Curator-in-Chief

Fossil Vertebrates

W. D. Matthew, Ph.D., Curator of Geology and Palæontology
Henry Fairfield Osborn, LL.D., D.Sc., Honorary Curator
Walter Granger, Curator of Fossil Mammals
Barnum Brown, A.B., Curator of Fossil Reptiles
Charles C. Mook, Ph.D., Associate in Palæontology
William K. Gregory, Ph.D., Research Associate in Palæontology
Childs Frick, B.S., Research Associate in Palæontology

Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOOGEOGRAPHY

Frank Michler Chapman, Sc.D., N.A.S., Curator-in-Chief

Marine Life

Roy Waldo Miner, Ph.D., Curator
Willard G. Van Name, Ph.D., Associate Curator
Frank J. Myers, B.A., Research Associate in Rotifera
Horace W. Stunkard, Ph.D., Research Associate in Parasitology
A. L. Treadwell, Ph.D., Research Associate in Annulata

Insect Life

Frank E. Lutz, Ph.D., Curator
A. J. Mutchler, Associate Curator of Coleoptera
Frank E. Watson, B.S., Assistant in Lepidoptera
William M. Wheeler, Ph.D., Research Associate in Social Insects
Charles W. Leng, B.S., Research Associate in Coleoptera
Herbert F. Schwarz, A.M., Research Associate in Hymenoptera

Fishes

William K. Gregory, Ph.D., Curator
Bashford Dean, Ph.D., Honorary Curator
John T. Nichols, A.B., Associate Curator of Recent Fishes
E. W. Gudger, Ph. D., Bibliographer and Associate
Charles H. Townsend, Sc.D., Research Associate
C. M. Breder, Jr., Research Associate
Van Campen Heilner, F.R.G.S., Field Representative

Amphibians and Reptiles

G. Kingsley Noble, Ph. D., Curator
Clifford H. Pope, B.A., Assistant [Central Asiatic Expeditions]
Bertram G. Smith, Ph.D., Research Associate
A. B. Dawson, Ph.D., Research Associate

Birds

Frank M. Chapman, Sc.D., Curator-in-Chief
Robert Cushman Murphy, D.Sc., Curator of Oceanic Birds
W. DeW. Miller, Associate Curator
James P. Chapin, Ph.D., Associate Curator of Birds of the Eastern Hemisphere

Birds (continued)

Ludlow Griscom, A.M., Assistant Curator
Jonathan Dwight, M.D., Research Associate in North American Ornithology
Elsie M. B. Naumberg, Research Associate

Mammals of the World

H. E. Anthony, M.A., Curator
George G. Goodwin, Assistant
Frederic A. Lucas, Sc.D., Research Associate

Comparative and Human Anatomy

William K. Gregory, Ph.D., Curator
S. H. Chubb, Associate Curator
H. C. Raven, Associate Curator
J. Howard McGregor, Ph.D., Research Associate in Human Anatomy
Dudley J. Morton, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

Clark Wissler, Ph.D., Curator-in-Chief

Science of Man

Clark Wissler, Ph.D., Curator-in-Chief
Pliny E. Goddard, Ph.D., Curator of Ethnology
N. C. Nelson, M.L., Associate Curator of Archæology
Charles W. Mead, Honorary Curator of Peruvian Archæology
Harry L. Shapiro, Ph.D., Assistant Curator of Physical Anthropology
Margaret Mead, Ph.D., Assistant Curator of Ethnology
William K. Gregory, Ph.D., Associate in Physical Anthropology
Clarence L. Hay, A.M., Research Associate in Mexican and Central American Archæology
Milo Hellman, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

Roy C. Andrews, D.Sc., Curator-in-Chief
Walter Granger, Curator in Palæontology
Charles P. Berkey, Ph.D. [Columbia University], Research Associate in Geology
Frederick K. Morris, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
Amadeus W. Grabau, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

George H. Sherwood, A.M., Curator-in-Chief

Library and Publications

Ida Richardson Hood, A.B., Acting Curator
Hazel Gay, Assistant Librarian
Jannette May Lucas, B.S., Assistant Librarian—Osborn Library

Education and Public Health

George H. Sherwood, A.M., Curator-in-Chief
G. Clyde Fisher, Ph.D., LL.D., Curator of Visual Instruction
Grace Fisher Ramsey, Associate Curator
Nancy True, A.B., Assistant
Paul B. Mann, A.M., Associate in Education
Frank E. Lutz, Ph.D., Research Associate in Outdoor Education

---

Charles-Edward Amory Winslow, D.P.H., Honorary Curator of Public Health
Mary Greig, A.B., Assistant Curator of Public Health

Public Information

George N. Pindar, Chairman
George H. Sherwood, A.M.
William K. Gregory, Ph.D.
Wayne M. Faunce, Sc.B.
Clark Wissler, Ph.D.

Natural History Magazine and Advisory Committee

George H. Sherwood, A.M., Chairman
Departmental Editors
A. Katherine Berger, Assistant Editor
Clark Wissler, Ph.D. — Frank M. Chapman, Sc.D.
W. D. Matthew, Ph.D. — Frank E. Lutz, Ph.D.
George N. Pindar

PALM TREES AND PINNACLES

These pinnacles of igneous rock, which form the most characteristic physiographic features of Komodo, give silent testimony of the live volcanoes that once were booming here. The low country in the foreground, covered with long grass and gubbong palms, is teeming with deer and wild boar. Yellow-crested cockatoos and a variety of game birds are also plentiful. Here it was that the first giant lizards were seen and captured. This beautiful landscape will be used as a background for the Dragon-Lizard Group in the American Museum

NATURAL HISTORY

VOLUME XXVII JANUARY-FEBRUARY, 1927 NUMBER 1

The giant lizard, *Varanus komodoensis*.—The skin of these beasts forms a veritable dermal armor or coat of mail, for each scale is underlaid by a plate of bone. (Photograph by E. R. Sanborn)

BY DOUGLAS BURDEN
Trustee of the American Museum

FOR a long time there have been various fantastic reports in circulation with regard to the size and habits of *Varanus komodoensis*, a big lizard from Komodo, one of the Lesser Sunda Islands in Malaysia. The first description of the species was given in 1912 by P. A. Ouwens of the Botanical Gardens at Buitenzorg, Java. Since that time only a few skins and no skeletons have made their way to European museums. Except for the original description, nothing whatsoever has appeared which added to our knowledge of these semimythical dragon lizards.

Our desire to study these beasts, coupled with the fact that the American Museum of Natural History had no collection from the Lesser Sunda Islands, and that there were many interesting problems in geology and zoögeography to be worked out in this region, finally resulted in our determining to go to the East Indies. Therefore, with the big lizard as the chief incentive, a small expedition was organized, the personnel of which included Dr. E. R. Dunn, one of the foremost herpetologists of the United States, F. J. Defosse, a great hunter from Indo-China, whose chief task was to capture the lizards alive, and a Chinese camera-man from Singapore, Lee Fai, by name. Mrs. Burden prepared herself to take charge of the still photography. Through the kindness of the Dutch Government, we obtained the use of an official yacht, the S. S. "Dog," for a period of two months.

The Rajah of Sumbawa, a neighboring island, acting on orders from the Colonial Government, assigned to us fifteen Malay hunters. They were a wild outfit, consisting of independent tribesmen from the innermost jungles of the isles,—and rough looking cutthroats they were, their mouths all stained from chewing betel nuts, their lips distorted, and their teeth blackened or gone entirely.

The S. S. "Dog" on which we traveled more than 1500 miles. This official yacht was lent to our expedition by the Dutch Colonial Government

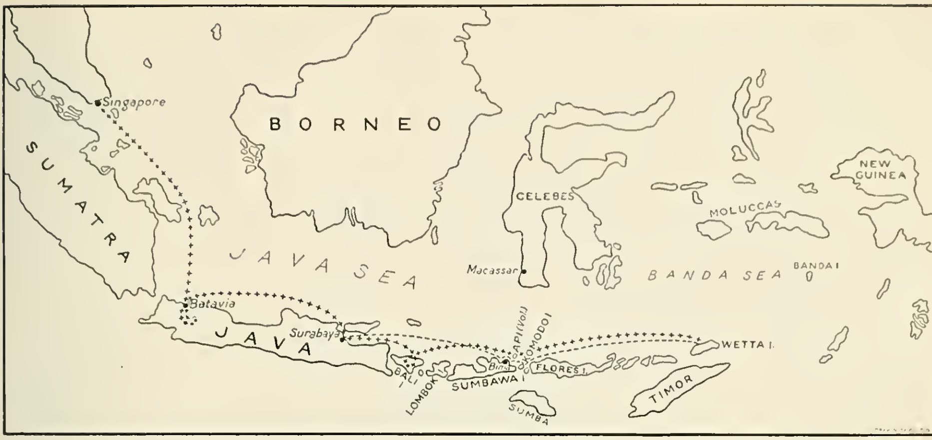
It was in Bima that we unexpectedly had our first sight of *Varanus*. Certain Chinese poachers had been brought in with two large specimens which they had just taken. The lizards caused great excitement among the natives, who had known the beasts only by villainous reputation. The larger of the lizards had increased this ill fame by attacking a horse that wandered too near, and inflicting such damage that the injured animal had to be shot.

On June 9, after a journey of 15,000 miles, we at last sighted the island of Komodo. At the first sign, I hurried up to the bridge and examined the dim outline of mountains through the glasses. In some respects it differed from what my eager imagination had pictured. Instead of lofty peaks, there were great areas of high land. A few wisps of white cloud hung over the mountains, and with the powerful lenses I could discern patches of jungle.

It was an important moment, yet, as I turned to the captain, I noted that he preserved his usual professional calm. I expected him to show at least some realization that we were entering waters which were said to be very difficult of passage, for we were now in Linta Straits, of which Wallace writes that the violent tide rips cause the sea to "boil and foam and dance like the rapids below a cataract, so that vessels are sometimes swamped in the finest weather and under the brightest skies." Already we were entering the zone of rough water, and I could see it boiling and churning between the upraised coral reefs strewn about. But the captain, instead of barking out new and excited orders, stood silent, with an air of entire confidence in the boat and in the orders already given.

On returning to the deck, I found my companions attempting to continue the occupations of the moment, but there was an unmistakable undercurrent of excitement. That wily old hunter, Defosse, was itching to stretch his legs on shore. I could tell by the way he was polishing his rifle and fingering the trigger. Doctor Dunn was restlessly thumbing the pages of his book, while Mrs. Burden, swinging in a hammock, forced herself to continue with her novel as if real adventure could wait. Lee Fai, with true Chinese conceptions of geography, hadn't the slightest notion where we were, but rather expected to reach Manila soon.

After all, however, the period between sighting the island and the actual landing was a long one. There was



The route of the expedition.—The dotted line represents the outward journey from Surabaya, Java, to the little town of Bima in Sumbawa, thence to Komodo (the small island lying between Flores and Sumbawa), and to Wetta. The crosses show the return journey to Singapore by way of Api volcano, Lombok, and the far-famed island of Bali

really no way for us to show the excitement we felt. I have no doubt that those intrepid explorers who finally reached the North and South poles could say little more than, "Well, here we are. What now?"

We were soon threading our way among the outlying coral rocks. The beauty of the scene recalled to my mind a bit of poetry by Oliver Wendell Holmes that seemed to have been meant to describe this very spot:

The venturous bark that flings
On the sweet summer wind its purpled wings
In gulfs enchanted where the siren sings,
    And coral reefs lie bare,
Where the cold sea-maids rise to sun their
        streaming hair.

As we came closer to the island, I could see beyond the scant growths of tall "gubbong" palms naked pinnacles of rock whose black heads reared up to the sky. Their sculpture was bold and their outline fantastic. These wonderful physiographic forms showed us at once that Komodo is not limestone, as has been reported, but volcanic, for these striking features of the landscape are volcanic necks, or plugs, formed by the cooling of molten magma within the vents of volcanos. From the condition of these plugs it was evident that the volcanic action had ceased long since, for erosion had washed away the cone, leaving the more durable igneous core standing aloft as a record of the ancient turmoil.

It struck me that the process of erosion was far more advanced on Komodo than on the other Sunda islands. In the others visited by the expedition it was still in a youthful stage. Since the climatic conditions and the character of the rock are uniform throughout the chain, this difference indicates either that volcanic activity became dormant very early, or that Komodo is actually older than the others—an interesting consideration in determining the reasons for the restricted range of *Varanus komodoensis.*

I soon put aside theorizing, however, for we had slipped suddenly from the churning waters into the calm of a little harbor, and had come to anchor in the lee of a tiny island. After the cramped quarters on the boat, we were eager to land, and the weird beauty of the spot was already beginning to work its magic. The shore

The home of the dragon lizard.—A glimpse of the rugged mountains of Komodo. Under a broiling, tropical sun. it was exhausting work to climb around these precipices

was a curving ribbon of shining sand; beyond, the tall gubbongs stretched aloft like sentinals to the sky.

As we neared the beach, we jumped out of the small boat and waded in to shore. Mrs. Burden and I ran along the edge of the surf casting our eyes this way and that to enjoy the glorious scenes that charmed us at every turn. Everywhere we caught signs of abundant game,—particularly deer and wild boar. They seemed to be countless.

Just as we went on board again, the sun was setting, and the rocky islets and purple sea were catching tints of gold from the sun and showers of color from the changing sky overhead.

Late that night I heard tom toms beating across the water, a thrilling and barbarous rhythm, in a ceaseless monotone. A native prau was anchored in the bay, and the drum beats were a summons to the god of the winds to send good blowing weather on the morrow. The potency of this summons is never doubted by the children of the Eastern Seas.

Early on the morning of June 11 we started to explore the island. Our object was to find a camping site where tracks of the big lizard were plentiful. Defosse and Doctor Dunn set out to the north, while I went directly west over the mountains. Lee Fai, as tired as if he had been laboring for months, remained on the ship in repose.

After many hours of hard climbing, we reached the divide. Here we saw an abundance of game, and I had no difficulty in bringing down a fine buck which we needed as meat.

A day later I discovered a beautiful camping site at an altitude of nearly 2000 feet, where there was an ample supply of good water. It was a glorious spot, so I hurried back toward the bay to announce my find. The return was not without adventure, however, for I had my first encounter with a Komodo wild buffalo or "carrabao" which we had not known existed here. And I found the beast a more pugnacious customer, if anything, than those of Indo-China. I was intent upon locating some blue pigeons whose booming I had heard, and pushed into some thick bamboo jungle at the edge of a water hole. The place was far from deserted. First a flock of ducks flew up, and then there was a terrific crashing off to my right. A native with me cried in terror "Carrabao!" and at the same moment I saw a wild buffalo not twenty-five yards away, headed toward me. His nose was in the air, his horns seemed to be laid back against his flanks, his nostrils were dilated, and from the speed with which he was coming, I saw that he intended to charge me. I had no steel bullets, and as lead bullets were of no use in this case, I took to my heels. I was much relieved when he finally stopped on the edge of a thick jungle whither I had run knowing that these animals will only attack on hard, open ground.

I arrived at the beach dead tired, and found that Doctor Dunn and Defosse had enjoyed a highly satisfactory day. They had found plenty of lizard tracks, and such a variety of bird life that even Defosse felt that Komodo hardly needed the addition of tigers and elephants to make it a sportsman's paradise. The game birds included blue pheasant, jungle fowl, five or six different species of pigeon of untold beauty, turtle doves, quail, ducks, and a yellow-legged running hen which bears a close resemblance to the tinamoo of Central America. Moreover, the noisy yellow-crested cockatoos were always in evidence, flying over the jungle and chattering raucously.

By the middle of June we were comfortably encamped in a spot commanding a wide view. The whole front of our little hut was open to the sea breeze. The roof of woven palm leaves was mellow and bearded with age, and rattled dryly in the wind. From the edge of it dangled all manner of tangled growths amid which a swarm of malignant things found concealment,—spiders, scorpions, centipedes, lizards, snakes,—we never knew what to

Tracks of a large *Varanus* in the mud. In the millions of years to come such tracks as these may well be the fossil imprints of an extinct species

expect next. Very early we found a green pit viper there.

Inside, we soon had many evidences of a real home. Clustered around the lamp on the table was a miscellaneous collection,—ammunition, notebooks, flash lights, boxes of every variety. We slept on a raised bamboo platform.

As soon as we put out baits for *Varanus*, they began to flock around in considerable numbers. Doctor Dunn took his stand where he could not be seen by the creatures and watched them all day. His notebooks soon began to bulge with meticulous notes recording every move of each beast and the exact time of each move. Lee Fai obediently went out under orders to take pictures, but always returned soon, grumbling to himself that "walking much trouble." Defosse was not wholly content with scientific observation; he wanted action. He pulled his mustache; he cleaned his rifle; and his conversation always reverted to Indo-China, and the glorious hunting in the country north of Saigon.

For the rest of us, we found sufficient

excitement for a while in observing the feeding habits of the great dragon lizards. For hours together we watched them from the "bomas" or blinds, as they devoured the bait. Voracious as they were, it was interesting to note what careful watch they kept, especially the smaller ones, who seemed terrified when an adult made his appearance. Whenever we saw a smaller one turn and dash away with lightning-like rapidity, we knew that a big lizard was approaching. For several minutes no lizard would be seen, then suddenly, from behind a tree, a big black head with two beady eyes would appear. For a while it would remain absolutely motionless; only the hawklike eyes would move, peering grimly from under bony "eyebrows," while they surveyed every inch of the surrounding territory. Then, assured of safety, the beast would lower his head, and with his long, yellow, bifurcated tongue constantly darting forth, he would move ponderously toward the bait. As he walked, the impression he gave was of tremendous weight and strength.

Mr. Burden studying Malay.—It was so cool in camp on the summit of Komodo that one could sit in the bright noon sunlight without discomfort

The miraculous Chu, our Chinese boy from Peking, cooking at seashore camp. The palm-leaf boxlike structure —the handiwork of Chu—is an improvised oven

Although the small ones are rather slim and agile, the adults are thickset, muscular creatures with very heavy bodies. After they have attained a length of seven feet their weight in-

Dr. E. R. Dunn of Smith College, a leading authority on reptile life, and herpetologist of the expedition, holding a green pit viper. Komodo can boast of all three classes of poisonous snakes: cobras, vipers, and pit vipers

creases out of all proportion to their length, and doubles, I think, between seven and eight feet.

In the process of gorging, the long sharp claws are used indiscriminately for scraping and tearing, while the thin, recurved teeth with sharp serrated edges are employed to rip off chunks of the meat. The beast maneuvers this by seesawing back and forth on braced legs, giving a wrench at the bait with every backward move. Seen thus, with jaws buried in the meat, and neck curved forward and down, he bears a remarkable resemblance to *Tyrannosaurus* as restored in modern paintings.

Whatever he can wrench off, regardless of size, is swallowed at a gulp. One big fellow took in the whole hind quarters of a deer,—hoofs, legs, hams, vertebræ, and all. If he is surprised when feeding, the result is likely to be disastrous, for the weird beast becomes excited and immediately disgorges.

With such pictures in mind, I tingled with excitement at my first sight of one of the huge creatures in the open.

I was at the foot of the pinnacle country, on a gently sloping talus cone covered with short grass and a few palm trees. This was the very section of the country in which the Duke of Mecklenburg is said to have shot three of the beasts in chance encounter. Here I saw a lizard working his way slowly down the mountain. I scrambled up to a point of vantage, taking care not to expose myself to view, as the eye sight of *Varanus* is much keener than that of a deer. It was a marvelous picture,—a primeval monster in a primeval setting. Had he only stood up on his hind legs, as I now know he can do, the dinosaurian picture would have been complete. Against a background of sunburnt grass he looked quite black with age. As he approached, three pigs dashed away into the distance. Once he stopped for a long time with his nose buried deep in the grass, as if scenting out some shrew or rat or small lizard to add as another choice morsel to his already distended stomach. In my glasses he filled the whole field of vision, and as there was nothing by which to compare his size, I could quite easily imagine him to be twenty or thirty feet long. I was wrong, however, for they do not exceed ten feet in length. I was filled with a longing to bag one of these creatures alive, and after he disappeared from sight, I hurried back to arrange for more active hunting.

It was Mrs. Burden, however, who had the first exciting encounter with one of the lizards. Together with Defosse, she went out early one morning to see if any marauding *Varanus* had been at the bait during the night. Upon reaching the blind, they were dismayed to see that the bait had been torn in half, and the entire hind quarters devoured. It was hardly conceivable that one V. K. was responsible for so much mischief. As there was now no animal in sight, they hunted for tracks around the bait. Defosse followed them around on one side of a hill, while Mrs. Burden searched the other side. Suddenly a movement at the edge of the jungle to her right fixed her attention, and then one of the antediluvian monsters peered out from the cover of the jungle. For a moment he stood so, then with ponderous movements he crawled out into the light of day. At the same instant, Mrs. Burden sank motionless into the tall grass.

As he approached step by step, the great bulk of his body was held clear off the ground, and the black beady eyes flashed in their deep sockets; from time to time, as he stopped and raised himself on his powerful forelegs to look around, she could observe the blistered scars on his bony armor.

"As he drew nearer," she afterward related, "I suddenly realized my predicament. My gun was propped against the blind where I had left it a few moments earlier. Defosse was out of sight, and the great reptile was continuing straight toward me. Should I jump up and run, thus losing the largest lizard we had seen? Should I not rather lie without moving in the chance that Defosse would come back in time to shoot him, or that he would change his course and pass by me unheeded?

"Nearer he came and nearer, his grim head swinging heavily from side to side. I remembered all the fantastic stories I had heard of these creatures attacking both men and horses, and was in no wise reassured.

"The creature was now less than five yards away, and its subtle reptilian smell was in my nostrils. Too late to leap from hiding,—if I did, he would surely spring upon me, rending me and devouring my remains as he had devoured the dead deer. Better to take my chances where I lay, so I closed my eyes and waited.

"Then I opened them in time to see Defosse's head appearing over the hill. The next instant there was a flash, and a bullet buried itself in the great monster's neck. Like lightning he whirled and crashed toward the jungle, but the rifle once more did its work, and he lay still."

Later, upon measuring him, we discovered that he was not quite ten feet long, but he must have weighed around 250 pounds, and in his stomach we found the whole hind quarters of the deer!

We were by now even more anxious to capture alive some of these very large lizards for closer study. Several times the Malays had seen a particularly ugly brute on the edge of the "prehistoric" wood, which they excitedly described as the biggest "boeaja darat" (land crocodile) yet seen. He was a very wary fellow, and we decided that the best way to get him alive would be to build a trap at the edge of the forest, bait it with deer or pig, and then hide close by in a boma, ready to run out and lash him to a pole as soon as he was caught in the noose. Accordingly, Defosse killed an old razorback for bait and the coolies

One of the lizards shot by Mrs. Burden

set to work on the trap. Heavy stakes were pounded into the ground all around the bait, except for a large opening left at one end. The stakes were then lashed together with rattan and the whole contraption carefully camouflaged with branches and leaves. A live tree was selected as the spring pole. The branches were cut, the rope tied to the top, and then, with the combined strength of fifteen coolies, the tree was bent over and the noose set at the opening in front of the trap. To avoid having the trap sprung by some small and unimportant specimen, however, we arranged that the tree should be released only by a string running along the ground to the boma.

A test proved that this would work perfectly; already we visualized the surprise of the old dragon when the noose should snare him and the spring pole immediately snatch him aloft dangling at the end of his tether. The trap was Defosse's handiwork, and a credit to his ingenuity.

We were on hand early next morning, for the bait had already begun to smell. The sun was well up before anything happened to arouse our hopes. Presently a small V. K. appeared and maneuvered around and around the trap, not daring to enter. He was followed soon by a much larger beast about the size of those which we later brought back to the New York Zoo. This one immediately entered the trap and tried to drag the whole boar out, but the razorback had been lashed in place, and could not be budged. Presently I saw him look up and then

Building the trap.—One end of this boxlike trap is left open. At this opening the noose is set. The natives are seen camouflaging the trap with leaves. (From the motion picture)

Setting the trap.—The trap is now completely camouflaged so that it resembles a bush. The natives are bending the spring pole, while Defosse, at the entrance to the trap, is setting the noose. (From the motion picture)

HUNGRY

Varanus komodoensis, as he is frequently seen prowling around foraging among the gnarled mountains of Komodo. In the lowest picture he is seen coming full speed toward the bait. (From the motion picture)

FEASTING

When a dragon lizard attacks his food, he tries to swallow it whole. Failing in this, he rips and shakes it to pieces, greedily gulping great hunks much larger than his own head. (From the motion picture) turn and flee as if the very devil were after him.

Only a very large V. K. could create such panic in one of adult size, so we waited with ill-repressed excitement. There was no reason to lower our voices, as the beast is practically stone deaf, yet a hush fell upon us which became a positive strain as time lengthened into half an hour, and no big beast arrived.

Suddenly a coolie peeping through the leaves at the back of the boma made a strange sound. Others looked, and stirred with excitement. When I looked, I could well understand their feelings, for what I saw was a V. K. so large and so villainous of aspect that I trembled with instinctive repulsion.

He started forward, headed straight for the boma. I could see the brute, now, very well. He looked black as ink. His bony armor was scarred and blistered. Half his tail had been lost in battle. His eyes, deep set in their sockets, looked out from underneath overhanging brows. Now his footsteps were plainly audible. He passed so close to our boma that I could have reached out and touched him.

I was so excited that I wondered at the great calm shown by the hunter Defosse. He was able to give his principal attention to keeping the nervous coolies quiet, and did not seem to share the agony of waiting I felt for the next half hour, while the great reptile was making up his mind whether to enter the trap. He was wary and suspicious. He would put his nose almost in the noose, and then withdraw it. He inspected everything closely, his snaky tongue in constant motion. Then he would walk away abruptly, and sit for five minutes at a time looking into the surrounding jungle. It seemed as though we should never take him.

Then, of a sudden, it happened. He walked straight up to the opening, stepped through the noose, and seized the bait. I pulled the release, and the great dragon was catapulted into the air. Down he came as quickly, his great weight dragging the tree back again. Then it was a contest of strength between him and the tree, which began to crack noisily with the strain as he clawed at the ground, tugging at the rope which was tightened about his middle.

The coolies rushed out to surround him, but he held them off, not only by his fierce lunges, but also by vomiting and foaming at the mouth.

It was now up to Defosse, who had been practising with a lasso for months past. His first throw missed as well it might, for the great beast was leaping in every direction. But Defosse, keeping carefully and coolly out of reach, recoiled his rope as methodically as though he were practising on a tent peg in camp. Awaiting a favorable moment, when the lizard was trying to drag himself away in the opposite direction, Defosse stepped up close behind him, and dropped the lasso neatly about his neck. As soon as the rope was made fast to a stout tree the lizard was ours, and it required only the precaution of roping his tail also, to prevent his damaging anything by its lashings, to enable our coolies to do their share of the work. They now brought their long pole, hog-tied the lizard to it, and carried him triumphantly back to camp.

A special cage had been built for him, and as we thrust him in at one end, we cut the thongs one by one, till he was entirely free but securely enclosed And then came fireworks! Feeling

The long, yellow, protrusible, bifurcated tongue of the varanid lizard is used as a sensory organ

The "rumah" as the natives call it, of *Varanus komodoensis*. The deaf beasts use their long claws to excavate these burrows under rocks and tree stumps, and retire into them for the night himself at first free, and then confined within four walls, he lashed himself into a great fury, vomiting and giving out such a vile smell that we left him.

There was a large air-hole at the top of the cage, which we had covered with the strongest steel netting that could be obtained in Batavia, yet when we came out the next morning to look at him, we found to our dismay that the wire had been ripped off, and the cage was empty. The twisted steel and the gaping hole were evidence of a strength which we had never suspected. Thus we lost the greatest prize of our expedition. We had felt so sure of him that we hadn't even taken the precaution to photograph him.

We caught many other lizards in our traps, but none so big. The Colonial Government had given us a permit to kill or capture only fifteen of the beasts, so we had to release many of those caught. We were enabled, however, during the process to study the habits of the animals. One evening we released five on the beach to test their swimming ability, and to see whether they would take to the sea of their own free will—an important question with regard to their distribution. Of five lizards let loose, one large and one small one immediately fled to the sea without the slightest hesitation. Two others headed for the jungle, while a third ran down the beach for 150 yards, went up into the grass, and then, after looking the situation over, deliberately proceeded to swim far out into the bay. The largest one which had taken to the water submerged for a full two minutes, and then appeared a hundred yards away, swam down the beach for a half mile, and ambled slowly off into the jungle. When swimming, their heads were carried well up above the surface of the water, so that they could be seen at a great distance, but on the whole, we considered them rather clumsy and ineffective swimmers.

On one point we were greatly disappointed. We found no eggs, nor any trace of them. But as part of a large herpetological collection numbering several thousand specimens we did succeed in bringing out twelve dead and two live *Varanus komodoensis*, sufficient to make an excellent museum group.

Concerning the place of *Varanus komodoensis* in evolution, it is interesting to note that these varanoid lizards represent the group from which snakes were evolved, which accounts for their snakelike appearance, their mobile head, and long, protrusible, bifurcated tongue.

According to the most recent investigation, it has been definitely shown that *Varanus komodoensis* is closely related to the Australian monitors which gave rise in Pleistocene times to such monsters as Megalania known to have attained a length of thirty feet.

Islands of the East

By DOUGLAS BURDEN

A series of volcanic islands which have arisen along the axis of the Sunda fold extend eastward from Java toward New Guinea. These are known as the Lesser Sunda Islands. Although they belong to a single group, the extraordinary differences in the people who inhabit them, and also in the islands themselves, are striking

A HINDU TEMPLE IN BALI

The temple gateways form the most characteristic and prominent architectural features of this beautiful and luxuriant island. Bali and Lombok are the only islands in the East Indies where the Hindu religion still holds sway

BALINESE SISTERS

The maidens of Bali possess a natural beauty of form and a lithe grace of movement characteristic of peoples who practice carrying loads on the head. Except for the inevitable sarong, clothes are regarded as a mere encumbrance

BEAUTIFUL BALI

Picturesque doorways where the sunlight splashes through, weird temples outlined against an azure sky, shaded vistas of verdure where it is always cool, and thatched villages nestling in coconut groves are all a part of beautiful Bali, the toyland of the East

A FAMOUS DANCING GIRL OF DEN PASSEAR

The gold headdress crowned with the sacred lotus flower and the gorgeously colored brocade costume form a picture of striking beauty when worn by a graceful Balinese maiden. The dance in Bali is a religious ceremony in which ancient mythological legends are enacted. The little dancer is only ten years old. She has been trained from babyhood, but must cease dancing when she reaches puberty

A CAÑON OF WETTA

The rugged, inhospitable island of Wetta, situated at the extreme eastern end of the Lesser Sunda Chain, is inhabited by Papuans whose primitive culture is in striking contrast with the civilization of the Balinese. No less a contrast with the gentle, luxuriant slopes and peaceful coconut groves of Bali are the mountains of Wetta that have been splintered into a million jagged fragments, and the deep, forbidding cañons cut out of ancient lava flows. These form insurmountable barriers that oppose the travelers' way

A FINE OLD CANNIBAL

"Livid with skin disease, his teeth gone, his eyebrows arched meanly together, and his nostrils dilated, he stood there on splayed feet, with his long finger-nails scratching among the folds of a tattered hide—as rascally an old savage as ever I hope to see.

"With many gutteral explosions and low rumblings and mumblings, he eventually allowed himself to be pushed into the sunlight, and I obtained my picture."—FROM THE JOURNAL OF THE EXPEDITION

FISHING ON KOMODO

The monsters that swam along the shores of Komodo were of such a size that Mrs. Burden lost nearly all her tackle. Eventually she had to use manila rope and a leader of chain. The above is a large grouper probably *Epinephelus pantherinus* (Lacepede)

HOME

"Our hut has come to bear all the earmarks of a true native home. The whole front of it is open to the sea breeze. The roof of woven palm leaves is mellow and bearded with age, and rattles dryly in the wind. All manner of tangled things dangle from it and sway to and fro, and it harbours the richest assortment of crawling life, including scorpions, centipedes, lizards, and snakes. Only this morning we found a green pit viper in the roof."—From the Journal of the Expedition

Samos, near-by islands, and adjacent Turkish coast. The hatched area indicates fossiliferous Miocene deposits with quarries

Samos—Romantic Isle of the Ægean

By BARNUM BROWN

Curator of Fossil Reptiles, American Museum

"BE IT ENACTED THAT THE GREEK GOVERNMENT PERMITS ANY PART OR ALL OF THE FOSSILS COLLECTED IN SAMOS BY BARNUM BROWN TO BE SHIPPED TO AMERICA AS AN EXPRESSION OF THANKS TO THE AMERICAN PEOPLE FOR THE MANY BENEFITS GIVEN."

This order of the Greek Ministry issued in September, 1924, became a law when published in the official journal, and permitted the American Museum to secure the first collection of fossils ever sent out of Greece intact.

With its wealth of antiquities rapidly disappearing, Greece, in order to retain in the country unique examples of its ancient masterpieces, was long ago compelled to prohibit the exportation of antiquities. The wisdom of this policy is recognized everywhere, for the works of any great artist, or school even, are necessarily limited. Unfortunately the restrictions on "antiquities" have been construed to include fossils, examples of which are usually limited only by the amount of search necessary to secure them. In consequence

Picturesque Vathy, the modern capital, is built around the best harbor of the island. The name Vathy means "deep"

In Vathy, the houses, built on narrow, cobbled streets reminiscent of Turkish occupation, are crowded almost to the water's edge and extend up the mountain-sides the two great fossil areas of Greece at Pikermi and at Samos are not as generally known as the classic fossil localities in other countries.

Pikermi lies about twenty miles northeast of Athens and a few miles south of the famous field of Marathon. When the courier on "winged" feet sped to Athens with news of the victory of the Athenians and Platæans over the Persians in 490 B.C., he passed within a stone's throw of this celebrated fossil locality.

Samos is probably an unfamiliar name to most readers, yet there are few cigarette smokers who have not at some time burned incense that was grown on this beautiful island, now celebrated for its wine and tobacco as it was in ancient days for wine and pottery.

Although a minor island, it is one of the most fertile areas in modern Greece and is surpassed by none in climate or in beauty of scenery.

Like a tiny dot on the ordinary-sized map, the island lies close to the mainland of Asia Minor, approximately fifty miles south of Smyrna. Actually it is twenty miles in length and eight miles across at its greatest width, the narrow eastern end being separated from the mainland by the narrow strait of Mycale.

Generally its bold cliffs rise abruptly from the sea along almost the entire coast line, and two great mountains, Kerki and Karvuni, rise respectively 4724 and 3730 feet above sea level, with their connecting elevations forming the backbone of the island. This series of heights was elevated when the island mass was torn from the mainland by a great land movement that at the same time deflected the course of the Maeander River of Asia Minor, which once flowed northeastward across the eastern end of the island.

The surface topography is so irregular that on the entire island there are not more than 5000 acres of level land, and most of the vineyards and tobacco fields are picturesque gardens that cling to the hillsides in narrow walled terraces.

Vathy, a modern town of 15,000 inhabitants, is the capital and chief port, snuggled under the hills in a beautiful bight on the north shore. Of the several smaller towns, Tigani, on the south shore, is of chief interest, as it is built on the site of a splendid ancient city, Astypalæa.

The present population of Samos numbers about 65,000, and at no time in ancient days did the population ever exceed 100,000, but what a wealth of historic events cluster about this little island!

Samos was the mightiest state in Greece in the days of Polycrates, and it was a formidable rival of Athens even in the days of Pericles. In the war of independence the Samians were the first Greeks to take up arms and the last to lay them down.

In ancient days Astypalæa was a city of great importance. Its surrounding walls may still be traced and at points still remain entire. Here was a great harbor, the chief source of Samian wealth, for the ancient Samians were a maritime people and they built so well that the mole and harbor are still in use. The three wonders of the city, the mole of the harbor, the aqueduct of Eupalinus, and the ruins of the noble temple of Hera still exist. Between the temple and the city two miles distant, stretched a road bordered by magnificent baths, noble buildings, and the graves of celebrities of the city. The Heræum was one of the largest and richest temples in Greece and was erected in very early times by Rhœcus,

Modern Tigani ("frying pan") built on the ruins of Astypalæa.—The ancient mole and a Byzantine fortress guard the sea face. The arrow points to the Heræum

Along the hilltop, marking the outer limits of the citadel, the huge Cyclopean wall still stands, in some places entire, defying the elements as it once did the enemies of Astypalæa

A monument to its departed glory, a lone column of the Heræum still stands, its drums askew from earthquake shocks

or by Rhœcus and Theodorus. Like Artemis, Hera was the mistress of the moon, and like Persephone she ruled the springing up of the crops. She was also goddess of marriages.

The Heræum and the aqueduct which brought water from distant springs, part way through a mountain, have been excavated, but the wonderful old city has been only partly exhumed and still contains a buried wealth of historic data. A small museum in Tigani holds some choice Greek and Roman figures, one a rare example of archaic sculpture showing Egyptian influence.

Of the celebrated characters in ancient Greek history Samos produced Rhœcus and Theodorus, archaic workers in bronze; Pythagoras, mathe-

Bases of outer columns along the sides of the temple of Hera

matician and astronomer, driven from his home by the tyranny of Polycrates; Mandrocles, who built the bridge of Darius over the Bosphorus; Timanthes, the great painter; Assius, the poet; and Durus, the historian.

Many pages of Samos' history have been lost, for the island was frequently the pawn of more powerful communities and was at least twice completely depopulated during historic times. Its first inhabitants were descendants of the Pelasgians, but its true founder was Ancee, King of the Leleges, who settled there with the Cephalonians and the Ionians. He planted vineyards and built the city of Astypalæa in memory of his mother.

One of the most famous men of olden times was Polycrates, who reduced the Samians to slavery, but the tyranny of Polycrates brought Samos to its highest point of external prosperity about 536 B.C. He was the inventor of the Samian war galley.

After the death of Polycrates, Samos passed into the control of the Persians. Aeces became tyrant of Samos, and between 404 and 439 B.C. was succeeded by Theomestor, who was set over the island by Xerxes as a reward for his bravery at the battle of Salamis. He was ruler at the time of the battle of Mycale, where the Samians contributed not a little to the victory. During this period, Samos shipping was famed in many seas.

Alternating between the rule of Athens and Persia several times, the history of Samos, like that of all Greek communities, is a continuous record of factional fights between the aristocrats and the democrats. During the long wars which followed between the successors of Alexander, history has little to say of the fate of Samos. During the early Roman conquests the Samians suffered severely. The island was captured by pirates and the temple of Hera was despoiled and destroyed. In 129 B.C. Samos was reduced to a Roman province along with the cities of Asia Minor. Proconsuls and pirates pillaged it in turn and all of its wealth was carried away.

Up to the time of Vespasian, Samos retained nominal independence under all of the emperors, but in 70 A.D. it definitely became a Roman province and until the eighth century Samos was forgotten. The Turkish Tzachos owned it at the end of the eleventh century, then it passed successively into the hands of the Venetians, the Pisans, and the Genoese, and was made a part of the Latin empire in 1204.

In 1453 it finally fell into the hands of the Ottomans. The population visibly decreased and when the last of the Samians had emigrated the island became a mere rendezvous. It was repopulated under Kilijd Ali by people of different islands, and upon his death in 1587, was returned to the Sultan. From this period until the war of independence there was nothing notable in the history of Samos. Through the great European powers, France, England and Russia, Samos in 1835 begged for and obtained from the Sultan Mahmoud an autonomous government. From that time until 1912 Samos was subject to the Porte, after which it came under the Greek government.

So much for the history of Samos.

It is a curious fact that whereas numerous passages are found in the works of ancient authors which prove their knowledge of the presence of fossils on the island of Samos, one does not meet with a single trace of this in modern writers until comparatively recent times. Euphorion recounts in his writings the fact that the island of Samos was inhabited in olden times by wild animals of gigantic size, called naiads, the bones of which still existed in his time. Two natural phenomena had evidently given rise to this myth. The roaring of the naiads which caused the earth to tremble and quake, refers beyond a doubt to the earthquakes which are still frequent in Samos and which were particularly mentioned by some of the ancient authors. The bones of the naiads which existed in the days of Euphorion are without doubt fossil bones. Plutarch, on the other hand, ascribes these bones, which were still to be seen, to the Amazons who had been pursued and slain by Bacchus, and he also adds that the piercing cries were in reality the cracking of the side of Mount Phlion. A Greek physician of Mitylinos, Dr. Achille Stephanides, first identified these bones as those of fossil animals, but they were brought to the attention of the scientific world by Dr. C. J. Forsyth Major, who studied Doctor Stephanides' specimens when he made a systematic collection for the British Museum in 1887 and 1889.

Subsequent to Dr. Forsyth Major's work and previous to the world war, representatives of German and Austrian museums carried on extensive excavations. In 1921 I made a preliminary reconnaissance of the Samian fossil field, locating several favorable spots where bones were exposed. Fine paved roads, built under the Turkish suzerainty, connected many of the villages, but donkeys and a few saddle horses were the only means of getting about.

From Hora northward across the narrowest section of the island, there is a series of sedimentary river deposits totalling nearly a thousand feet in thickness, composed of creamy, buff-colored clays alternating with beds of volcanic ash which are in some places fifteen feet thick. The entire series is unquestionably a river deposit and represents the original course of the Maeander River, now debouching fifteen miles to the south, but which evidently had followed this course before Samos was broken away from the mainland. The village of Mitylinos is near the center of these fossil deposits and is situated at the foot of the

A street scene in Vathy

Threading tobacco leaves on drying poles

Ambelos range of mountains. Along the Potomis stream, several deposits of bones have been located, and frequently where new vineyard or tobacco terraces are being established the farmers uncover them.

In 1923 I obtained a permit from the revolutionary government in Athens to excavate and collect fossils for one year in Samos.

Early one morning in September the trim ship "Muskantha," erstwhile palatial yacht of Egypt's Khedive, nosed along the verdant coast of Samos, and as we anchored in the peaceful Vathy harbor, almost among the buildings, her musical siren echoed and reechoed from every hillside, awakening the famous oracle of the historic isle. There are no trains to break the ennui of island life, but the powerful siren of the weekly mail boat brings farmers from long distances to the port for news.

Many Samians have relatives in America; some have labored there, and I was informed by post office officials that 3000 were pensioners of Uncle Sam. Few speak more than the emphatic words of the English language, but fortunately I secured the services of an excellent interpreter.

What a change had taken place since my last visit two years before! War with Turkey had been disastrous to Greece, and had brought thousands of Greek refugees to the island. Every abode was filled to overflowing, and the steep, narrow streets were busy places. Around the street tables in front of every coffee shop sat groups of people talking politics and the price of tobacco as they sipped their coffee and Oyzo.

Villagers, in national costume, smoking water pipes

Sheep and goats graze the mountain-sides

Christmas day in camp.—This snow was the first Samians had seen in many years. Rarely was there ice on our water buckets during the winter

The tobacco fields of Asia Minor had been devastated, and that year Samos produced several million pounds of the golden leaf. Motor cars now made regular daily trips to the inland villages, and everywhere there was an air of activity and prosperity.

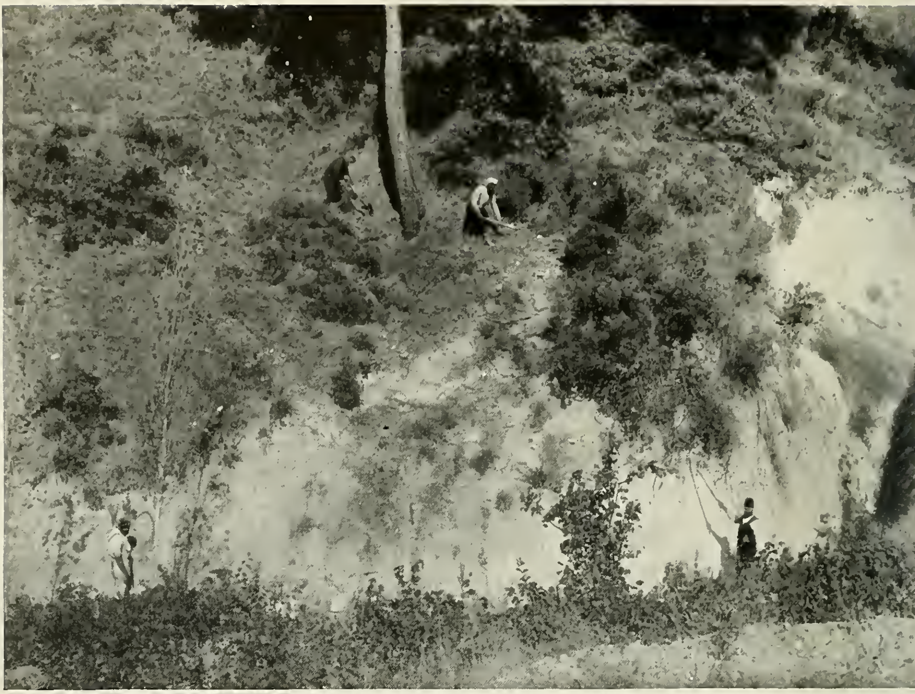
From the inland village of Mitylinos mules packed our camping outfit along the rocky trails to a camp site among the pines. After long search we found a spot level enough for the tents, not far from our first quarry. The natives told us we could not winter in tents because of the heavy rains, but series of drainage ditches defeated their prophecy.

Our advent soon brought scores of refugees seeking employment, and in two days our force was complete, eighteen men digging with picks, and six girls carrying out the dirt in baskets on their shoulders. Our first quarry was a large one, 30 feet long and 50 feet deep, and it took long hours in the quarry to uncover the bone layer before the rains started.

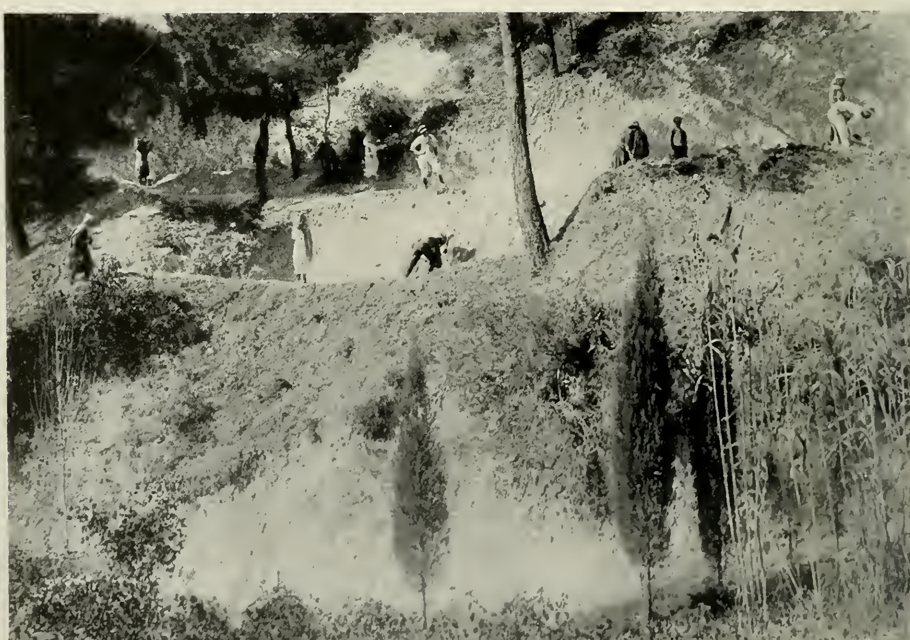
The seasons are very regular in the Ægean, and almost to a day, year after year, the storms start; likewise finish. Two days before our first big storm, countless flocks of geese filled the sky in V formation, migrating in their long journey from the Arctic region to Egypt.

By the time our first quarry was excavated down to the bone layer, about the middle of December, the rains had started, and continued almost incessantly until the middle of March, but rain, snow and winds were not the worst part of our winter, for apparently all the fleas of the island, not already occupied, came to share our quarters.

In October the underbrush was aglow with cyclamen; in November the hills were abloom with heather, and



The hillside before excavation was started.—The two men in the stream bed are pointing to the bone layer



Work of excavating Quarry 1 by a series of terraces.—The bone layer is marked by a helmet on the bank

Eighteen refugee men loosened the ciay with picks. and six women carried it out in baskets on their shoulders

Quarry 1, 60 ft. long, 25 ft. into the bank, 50 ft. deep. Old German quarry shown at left, workmen's tent above

The climate of Samos is similar to that of southern California. Wild flowers grow in greatest profusion. Each day in spring brought forth a new variety of plant or shrub

when the rains ceased, each day of spring brought forth a variety of wild flowers, in color and profusion surpassing any I have seen elsewhere in an equal area.

The people of the island live huddled in villages, reminiscent of ancient days when individual safety depended on numbers. Early spring sees them climbing the stony trails out to their little terraced fields, each followed by his milk goat. They go to cultivate their vineyards, small patches of tobacco, and their meager gardens of tomatoes and beans. It is difficult to wrest a living from these rocky hillsides where there is no pasturage for cattle; hence meat is a luxury in the island diet. Bread, beans, olives, and goat cheese, washed down with native wine, constitute the daily menu of the farmers, who are content with a bare living.

Different was the lot of our quarrymen, destitute refugees, many of whom had been prosperous farmers in Turkey. They were thankful to have escaped with their lives, and eager to work in the quarries. Current wages on the island were low, but the attractive sum of 35 drachmes (70 cents) per day for the men and 20 drachmes per day for the girls secured the best workers. During their working day of ten hours they had four rest periods for eating and smoking.

A large tent was supplied for the community dwelling of the men; another for the girls, most of whom had never been away from home before.

Our camp in the fragrant pine grove was a Mecca for curious villagers, who were astounded at the ingenuity of the "Americanos" who could build buffet, table, bureaus, and chairs out of ordinary packing boxes. Our stove, the only one on the island, always brought forth ejaculations of "Oh

Encasing individual specimens and blocks of fossils in plaster of Paris jackets.— Quarry 1 was a faulted area with fossils at the closed bank side 6 feet lower than those on the exposure

At the end of the season, large blocks, too heavy for pack horses, were carried down the narrow, rocky trails by men

Papa" and "Oreo." Turkish coffee and sweet crackers were a climax to these visits, after which they would wander homeward laden with empty cans, bottles, and old newspapers.

Such luxuries as canned foods could not be found on the island and had to be shipped from Athens. The weekly trip to Vathy, a day's journey of eight miles by mule, brought fresh meat, potatoes, and the welcome mail from distant parts.

When the rains ceased, quarry work was resumed and a large series of fossils was collected from the six quarries that were excavated during our year's work on the island.

Transporting the large blocks from the hills for several miles along narrow rocky trails presented unusual difficulties, as many of the large specimens had to be carried on poles by groups of men in tandem.

The fifty-six large cases of fossils secured comprise skulls, jaws, and partial skeletons representing three species of three-toed horses, rhinoceroses, chalicotheres, many species of antelope and gazelle, samotheres, birds, and a variety of carnivorous mammals, a fauna that was contemporaneous with that found at Pikermi, Greece, and at Maragha, Persia, of Pontian Upper Miocene age.

Our chief diversions were visits to the fascinating ruins of Tigani, and the picturesque monasteries high up in the mountain fastnesses, where we were always welcome. From the eyrie balcony of the Monastery of Uranda we could look across to the hills of Ephesus, where St. Paul preached to the Ephesians, and visualize the stirring events that have marked the vicissitudes of this little island during the history of the ages.

Ephesus:—Amphitheater with view of small agora to the right and road leading to the marble-lined harbor, indicated by the arrow. The cross marks the hill on which St. Paul was imprisoned

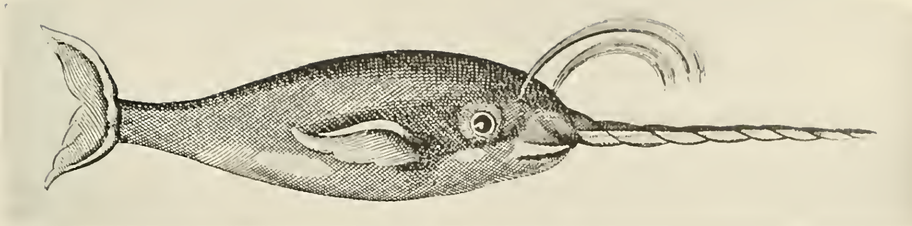


Fig. 1.—One of the earliest pictures of the narwhal or "*Piscis Monoceros*" as figured by Francisci Willughbeii in 1686 as plate ii of his *Historia Piscium*

Northward for Narwhal[1]

By H. C. RAVEN

Associate Curator, Comparative and Human Anatomy, American Museum

And there we hunted the walrus,
The narwhal, and the seal;
Ha! 'twas a noble game!
And like the lightning's flame
Flew our harpoons of steel.
—Longfellow.[2]

IN the middle ages a person setting out to hunt the "mighty Monoceros" probably would not have known in what direction to go, also he might have looked for some terrestrial beast; an animal with the form of a horse, the tail of a lion, cloven hoofs, and a long, straight, spirally twisted horn protruding from its forehead. Such a fabulous creature was made the supporter of the arms of Great Britain by James I.

However, as early as 1655, the naturalist Wormius showed that the long, straight, spirally twisted tusk, so often figured as the horn of the unicorn was in reality the tooth of a small whale, which lived in the ice-bound waters of the north Atlantic Ocean. At one time it was common in the seas about Iceland and Greenland, and was named "narwhal" or *corpse whale* by the Icelanders on account of the pure white coloration of very old individuals.

Eric the Red visited Greenland about the year 983 and soon afterward started a Norse colony on the southwest coast. Certainly these Norsemen must have found the narwhal in Greenland waters, though we have no records of their doing so, and probably they had known of it about Iceland for ages before they reached Greenland. Even so, I believe the ancestors of the Eskimos were very likely the first people to hunt this remarkable mammal.

The Eskimos with the kayak, a completely decked-over canoe evidently evolved for hunting the sea animals, were able to encounter rough water without fear of being swamped, and could sit warm and dry on a fur rug in the bottom of their tiny sea-going craft as they hunted the narwhal.

Early in 1926 Mr. George Palmer Putnam organized an expedition to Greenland of which he was the leader.

[2]From "The Discoverer of the North Cape," quoted by Colin Matheson, 1927, in "Sea Ivory of Old Wales." *Discovery*, VIII, No. 85, p. 10.

[1]Photographs by H. C. Raven

Fig. 2.—The arrows indicate the route followed by the American Museum Greenland Expedition of which Mr. George Palmer Putnam was leader

One of the purposes of this expedition, known as the American Museum Greenland Expedition, was to obtain specimens of the narwhal for exhibition in the Museum's new Hall of Ocean Life. The expedition left New York the latter part of June and reached Holstenborg, Greenland, early in July. The latter part of July found us much farther northward, at Cape York, where we first met the Polar Eskimos. Here, too, we first heard that narwhal were near by, and we saw parts of these animals which had been slain by the Eskimos, though we saw no living ones.

A few days later the "Morrissey" was going at half speed among the icebergs near Northumberland Island on

Fig. 3.—Parker Snow Bay, North Greenland, where the American Museum Crockerland Expedition spent the winter of 1915-1916. On the cliffs to the right, light patches indicate the nesting site of hundreds of murres and kittiwakes, while on the left, water from the glacier tumbles over the moraine

Fig. 4.—Dovekies or little auks, nesting on the talus slopes at Parker Snow Bay, come in with their throats distended with tiny shrimplike animals which they feed to the young birds down among the rocks

account of the dense fog. Thousands of dovekies, or little auks, flew and swam and dived near by, feeding on the countless invertebrate animals, and carrying countless others as food to the young dovekies which were secreted among the rocks on talus slopes of neighboring islands. Through the fog one of our party spied the body of an animal floating at the surface of the still water. A moment later a dory was put over and we learned that it was the body of a narwhal. It may have been dead several months, but the icy waters had prevented its decomposition. This specimen was not perfect externally, but its skeleton was as good as that of any other. Most interesting of all was the discovery that this adult female contained a foetus that was just about ready for birth at the time of the mother's death. The foetus was more valuable than the adult, consequently it was embalmed entire, to be used as the basis for studies on the soft anatomy of this whale which, on account of its boreal habitat, few anatomists have had an opportunity to examine.

I remember very well the night we arrived at Karna. The fog had cleared; there were beautiful cloud effects about Herbert Island to the westward; the sun was low in the north at midnight, throwing a pale pink glow over the icebergs before us and over the several glaciers on the south side of Whale Sound, the warm light contrasting beautifully with the cold blue of the shadows.

On the north side of Inglefield Bay we found quite a large settlement of Eskimos. Through our friend Dr. Knud Rasmussen, the services of these hunters were enlisted.

The Eskimos said in answer to our inquiries that there had been no narwhal here for several weeks past, that they were all up at the head of Inglefield Bay. This was disappointing news but plans were immediately got under way for two of our party to accompany some of the Eskimo hunters up the gulf in search of the narwhal which were the chief desiderata for the Museum. Supplies for the trip were being gathered and loaded into the motor dory, when to our great surprise and delight, several narwhals were seen coming down the bay. Some of them came so close inshore that they passed between the beach where we stood and the "Morrissey" as she lay at anchor. I saw dozens of narwhals coming along, breaking the still surface of the water. The round bullet-shaped heads were forced upward and forward, and a little puff of spray was flying from each blow hole. The glistening blackish backs were exposed for a moment, and as these disappeared, broad, horizontal flukes spread like wings; then the animals completely disappeared, leaving radiating rings of wavelets momentarily reflecting the light of the midnight sun. The narwhals were not speeding but just quietly moving along in small groups. Most often there seemed to be three or four together. Watching them with the binoculars, I saw the members of a group come almost simultaneously to the surface to blow, then dive and again come up about one hundred yards farther on. Sometimes I could distinguish the tusk of a male just as he rose to the surface. The sky and water reflected a beautiful light, and numberless drifting icebergs formed a splendid background for these sleek cetaceans.

Upon sighting the narwhals, we immediately postponed further preparations for the trip to the head of the gulf. Eskimo hunters arranged their gear and put out at once in kayaks in pursuit of the quarry. There was no wild haste on the part of the hunters. Each in his slender kayak paddled swiftly and quietly away from the shore in a direction that would soonest coincide with the apparent course of the animals. We on the shore watched intently, expecting to see the Eskimos hurl their harpoons as soon as they neared the narwhals. They slowed down as they approached the spot where ripples on the water indicated narwhals had risen a few moments before. Then they cautiously followed in the wake of the torpedo-shaped beasts, at a speed sufficient to bring them a little closer to the animals each time they came to the surface to breathe. This required infinite patience, skill in handling the kayak, and an intimate knowledge of the animal's habits.

After following the narwhals for a time, some of the hunters gave up the chase, as the animals distanced them or changed their course, coming to the surface in unexpected places. On one occasion a narwhal came to the surface just behind a kayak and discovered the hunter. It dived at once, and when it was next seen it was far away, going fast, and still in company with its associates which had all apparently received the alarm signal.

Two of the hunters were successful. A big male narwhal was the first to be harpooned. After following it for a considerable distance, until the animal had come up in exactly the right position, a few feet ahead and to the right of the kayak, the hunter skillfully threw his harpoon with such force that it penetrated several inches into the blubber beneath the skin. As the harpoon pierced his skin he gave a convulsive jerk, a splash with his tail, and disappeared under water. The strong seal- or walrus-hide line, one end of which was made fast to the head of the harpoon. was coiled on a little frame above the deck just forward of the sitting Eskimo. The other end of the line was fastened to two objects: first the float, an entire sealskin inflated, and second, the drag, a shallow boxlike structure with sides of wood and the bottom covered with sealskin. Both were on deck close behind him. In diving, the narwhal pulled the line after him. It quickly uncoiled from the frame, but before all of it had run out, the Eskimo pushed overboard the float and the drag.

Fig. 5.—The Eskimo hunter sits comfortably on a fur rug in his kayak with his harpoon beside him, its line coiled on the rack before him on deck

This part of the procedure is espe-

HUNTING THE WALRUS AND THE NARWHAL AT SEA

Fig. 6.—The Eskimo paddles along quietly in his kayak, following his quarry until it rises to the surface in just the right position, a little ahead and to the right; then with agility born of a lifelong training, he hurls his harpoon. A strong seal- or walrus-hide line connects the head of the harpoon with the inflated sealskin float and with a boxlike drag carried behind the hunter

THE PRIZE NARWHAL OF THE EXPEDITION

Fig. 7.—This large male narwhal measured fifteen feet exclusive of the tusk which protruded five feet nine and one half inches.

The narwhal is the only whale which exhibits a striking secondary sexual character in the form of a specialized tooth.

The function of the tusk has not been determined, but there have been many suggestions as to its use to the narwhal: as a pick with which to break through the ice of Arctic waters; as a spear on which to impale fishes which form its food, and as a weapon to be used in battles between the males. The last seems the most likely, as neither the females nor young have a protruding tusk cially dangerous, for if the kayak should swing around to the right, or if the narwhal should turn to the left before the hunter was able to push over the drag and float and get clear of them, they would certainly be fouled and drag the dusky huntsman to inevitable death.

Fig. 8.—Heads of male (lower) and female (upper) narwhals. (1) shows the position of the eye; (2) indicates the location of the aperture of the ear, which is just large enough to admit a broom straw

The whale, with the barbed head of the harpoon embedded beneath its skin, plowed through the water at a great rate, towing the float and drag on a tense and vibrating line. The Eskimo with apparent unconcern paddled along behind. A few strokes brought him to the shaft of his harpoon which had functioned properly, slipping out of the socket in the harpoon head, after expending its force against the narwhal. The kayak was so low that the hunter picked the shaft from the water without even bending down, and placed it with its throwing stick beside him on the deck.

Paddling along in the general direction taken by the narwhal, the hunter soon caught sight of the tell-tale float. He immediately started in that direction. It was perhaps a minute between the time the float bobbed up and the time the animal appeared at the surface to blow. The narwhal came up several times before the Eskimo caught up with it. However, it was not long before the excitement and exertion began to tell on the narwhal. It did not dive so deep, nor stay down so long. The float, of course, indicated what the animal was doing.

The Eskimo inspected his lance as he neared the narwhal, in anticipation of delivering the death blow. The float was up and being pulled along the surface at a lively rate. The hunter seemed almost to move aside to let the narwhal break the surface of the water. Then, with lightning quickness, the little flat-faced man thrust the lance deep into the shining back just between the flippers. There was a great commotion in the water and it looked as though the frail kayak would be crushed by a blow from the heavy flukes. The narwhal dived again but stayed down a very short time. When it reached the surface, frothy blood was pouring from the blow hole and from the wound in its back. Twice more the lance was thrust into its lungs. It floundered, was unable to dive, and after a few convulsive quivers lay still.

Shortly after the narwhal had expired, another Eskimo paddled up alongside of the first one, then together they tried to tow it to shore, but progress was very slow against the silent strength of the tide. It was very early in the morning, between two and three

Fig. 9.—The Cape York Eskimos lives at the foot of a talus slope beside a great glacier which pushes into the bay. From this point of vantage they are constantly on the watch for animals of the sea

o'clock, when Bob Peary learned that the animal had been killed. With characteristic vigor and enthusiasm he immediately set out in the motor dory with a couple of Eskimos, and about four o'clock he returned, awakened me, and said "I have just brought a big narwhal alongside, a male. The Huskies (Eskimos) have killed another which they say is just around that point to the east. Now we are going after that one,—probably have it here for you in an hour."

As I had turned-in in a hurry, dressing that morning consisted of putting on my shoes and coat, consequently I was on deck in about two minutes. The mate and the two men in his watch were there, too, and there were several Eskimos aboard, plenty of hands to help in getting the prize on deck. A stout piece of rope was made fast around the tail just ahead of the flukes and the "Morrissey's" fore and main throat halyards were hooked into this. After an hour of pulling and hauling we raised the animal out of water and lowered it to the deck.

This fine specimen measured just fifteen feet from the tip of the nose to the notch between the flukes, exclusive of the remarkable tusk which added five feet nine and one half inches, protruding straight out in front from the roof of the mouth. The first thing I did was to make photographs and measurements of it. Later in the day, Mr. Limekiller, taxidermist of the expedition, made plaster molds of all the more characteristic parts of the animal's body, such as the head, flippers, flukes, rudimentary dorsal fin, etc. With the aid of these casts, measurements, and photographs, a very accurate model of the narwhal will be made for exhibition in the Hall of Ocean Life.

POLAR BEARS OF BAFFIN BAY

Fig. 10.—Very early one cloudy September morning as the "Morrissey" sailed southward along the east coast of Baffin Island, the keen-sighted sailor on watch reported three bears on a small iceberg distant about two or three miles. With binoculars it was possible to see a large bear and two small ones. When the "Morrissey" approached the iceberg, the small bears moved about restlessly or stood close beside the mother

Fig. 11.—Shortly after we approached the iceberg on which these bears were, they whined a little and took to the water. Efforts to drive them back on the ice, in order to get more pictures, were futile. They swam a long distance with ease and good speed. Finally the mother bear was killed by Art Young with bow and arrows as a trophy, and the two cubs were roped and captured alive by Carl Dunrad and presented to the New York Zoological Society by Mr. Putnam

Before I had finished measuring this animal the other one was towed alongside and we immediately set about hoisting it aboard. This was a female and of course lacked the projecting tusk characteristic of the male, and was somewhat smaller. The color of these two specimens differed decidedly. The male was almost black along the midline of the back, there was some dark brown intermixed with the black, the sides were mottled blackish and white, the dark color appearing as if it had been put on by the strokes of a brush. The darker markings were fewer on the lower parts of the sides, and the belly was pure white. The female had a little white on the belly but on the sides gray replaced the white, and the still darker markings showed through this. The foetal specimen already mentioned was dark slaty gray all over. I thought the differences in color between the adults was a sexual one. The Eskimos, however, insisted that it had nothing to do with sex, that it was merely a matter of age.

Besides these specimens other narwhals were later secured for us in the same manner by the Eskimos. The total narwhal collection amounts to five adults, a young one probably not more than a few weeks old, a large foetus, an embryo about ten inches long, and skulls of other specimens. Much anatomical material was preserved besides the afore-mentioned embalmed foetus: an embryo in utero, the brain of an adult, the head of an adult male, male and female urogenital organs, a stomach, and flukes and flippers.

The adult narwhal has but two teeth. In the female these are straight, tapering, usually less than a foot in length, as large round as a pencil at the tip, and sometimes more than an inch in diameter at the base; the surface is rough and warty and the teeth are composed entirely of dentine. They remain buried in the upper jawbone throughout life. The right tooth of the male resembles those of the female, the left one (or very rarely both) grows from a persistent pulp and is sometimes more than two inches in diameter at the base and eight feet in length. The largest tusk we secured measured exactly seven feet, of which five feet, nine and one half inches, projected beyond the skin. The tusk of the male narwhal affords the only instance among the Cetacea of a striking secondary sexual character.

At the present time the narwhal along the Greenland coast follow the edge of the ice, that is they keep close to bays which are covered with ice. As the bays of north Greenland freeze completely in the latter part of the summer, some, at least, of the narwhal move southward. They arrive off south Greenland in October or November and leave again to go northward in April.

To judge from my own observations, the food of the narwhal is principally fishes. One of the specimens I examined contained remains of the Greenland rock cod, small flounders, and questionably salmon.

The narwhal is of great economic value to the Eskimo. The Eskimos we met seemed to prize the raw skin, which is about an inch thick, above any other food. They eat the entire outer surface of the animal. The layer of blubber, four or five inches thick beneath the skin, is used for fuel, while most of the flesh is fed to the dogs. The tusk of the males is used in the construction of various implements and utensils and for trade with white men whenever opportunity offers.

What Is Inherited?

THE BEARING OF SOME RECENT EXPERIMENTS IN THE AMERICAN MUSEUM ON THE PROBLEM OF AN ANIMAL'S INHERITANCE

By G. KINGSLEY NOBLE
Curator, Department of Amphibians and Reptiles, American Museum

HOW can a single cell of protoplasm, such as an amphibian egg, produce within a few days' time such a highly organized animal as a tadpole? No signs of the many structures of the animal are visible in the egg. The processes of heredity and development must be closely interwoven and may well be considered together in attempting to answer the age-old question: What is inherited?

The frog or salamander begins life as a single cell, the fertilized egg. The sperm brings to the egg little besides nuclear matter. Its acrosome, or point, has been formed by the transformation of certain cytoplasmic materials and the middle piece by others. But there is at present no definite evidence that these substances play any part in heredity. The hereditary factors of the male parent are brought in by the sperm nucleus while those of the female are located in the nucleus of the egg. The nuclear matter of both parents is composed largely of a number of bodies called chromosomes. These are now known from the combined researches of genetics and cytology to be the bearers of the determiners of heritable characters. The determiners are called genes. They lie in a linear order along the chromosomes. It is the segregation and recombination of the chromosomes during successive generations which gives the orderly sorting out and predictable regrouping of the so-called unit characters so readily observable in domesticated animals.

The real nature of the gene, however, is still unknown, but the latter has been compared to a protein body. We may liken each chromosome to a laboratory table with a row of chemical reagents, the genes, in bottles along the length of it. In the laboratory of the body cell there are two series of such tables (the chromosomes), one set derived from the female and one from the male parent. Each bottle on every paternal table corresponds in position to one on the homologous maternal table. Usually the reagents may be alike in each pair of bottles, but occasionally something has happened to one reagent or the other and it is found to be a different substance, but one related to that in the corresponding bottle of the other table.

When germ cells are formed at the time of maturation and cell laboratories are produced with only half the number of tables (chromosomes) found in the body cells, it happens by the rules of chance that certain germ cells will have chromosomes with chemicals different from those found in others, for each germ cell after maturation comes to contain some maternal and some paternal chromosomes, one or the other member of each pair of chemical tables just described. The individuals resulting from the fertilization of these chemically different germ cells are equally different. Almost every species found in nature is, therefore, composite, for it includes a number of genetically distinct strains.

It would seem hopeless at first glance

to ascertain the original complement of chemicals in any one individual. Careful breeding experiments of geneticists, however, have disclosed the specific effects of certain genes. The results produced in later generations after one chemical has spontaneously changed into another may be very marked. More often, however, many small and insignificant changes in many parts of the animal's body result from the mutation of a single gene. These changes may be of the same size and extent as the differences which systematists seize upon to define subspecies or species. All the heritable differences ever described in animals have been found when fully analyzed to have been caused ultimately either by changes in the genes or in the whole chromosomes.

A gene, however, is not a substance which will give rise to an organ or a part of an organ. It is the combined effect of all the genes working together which produces any one organ. The genes are the hereditary factors, but they are part of a cell system which acts as a whole. This is well shown in the recent work on sex determination. It is a balance of the genes of one or more sex chromosomes working against those of the other chromosomes which conditions a reaction in the developing egg, resulting later in the development of one sex instead of the other.

The chromosome complex is handed on by cell division to all the cells of the body. As the cells of the skin have the same number of chromosomes (except in certain unusual cases) as the fertilized egg, the question arises: What has determined that they shall become skin instead of remaining germ cells? In brief, what determines the differentiation of cells?

The frog's egg even before fertilization has a certain organization which affects the pattern of differentiation. It has an apico-basal polarity as shown externally by the distribution of the pigment. As development continues and the egg rotates, this polarity becomes the antero-posterior axis of the embryo. Polarity is a phenomenon characteristic of most cells and its occurrence in the unfertilized egg is no more mystical (or better understood) than the same condition in the skin cells. Many investigators have concluded that polarity is inherent in protoplasm itself and is due to the polarization of the ultimate structural particles of the oöplasm. Nevertheless, the polarity may be altered by gravity or other external forces, as Morgan and others have shown.

A second axis in the frog's egg is established at the moment of fertilization. The egg becomes bilateral on the appearance of a gray crescent (caused by the retreat of pigment into the interior) opposite the point of penetration of the spermatozoan. Thus, before the male and female nuclear matter have come together in the act of fertilization, both the antero-posterior and the transverse axes of the future embryo are already established.

Cleavage, or the division of the egg into cells, begins with a definite relation to the first of these axes, but is soon modified by the quantity of yolk present. At the end of cleavage the egg has grown no larger but it has distributed its chromatin as nuclei throughout the egg. The chromatin may have increased in amount by growth, but in some Amphibia the increase is not marked. The cleavage period is one of rearrangement of chromatin as regards the cytoplasm of the egg but not a period of visible differentiation.

Nevertheless, a certain amount of differentiation must have taken place at the moment the gray crescent was formed, for this region now takes the lead in active cell proliferation. It becomes the dorsal lip of the blastopore. The embryo, at the moment this region is beginning to proliferate, is not a mosaic of potential parts. If the region which would become the eye is transplanted into the region which would become the gills of another specimen it promptly develops into gills. As development continues the situation changes. Now when the potential eye is transplanted into the gill region, it becomes an eye. During this short interval of time the potentialities have become fixed. Spemann and his associates have analyzed this problem of fixation further. A piece of the dorsal lip region of one species of newt was transplanted into the indifferent ectoderm of another. Here it asserted itself and formed partly out of its own cells (distinguished by their color), but mostly out of the tissues of the host, a partial embryo. The growing dorsal lip region is endowed with a superior power by which it can organize not only adjacent tissues but even the indifferent tissues of another species of animal into which it has been grafted.

The nature of this organizing influence is not known. But it is important to note that what a cell becomes is dependent as much on the influence of an adjacent part as on its own chromatin constitution. This holds equally true as development continues. The first rudiment of the brain is organized out of the indifferent ectoderm by the dorsal lip tissue, turned in to form mesentoderm. As the brain develops, it produces a pair of optic cups which come to lie under the adjacent ectoderm. Here, in some Amphibia at least, each cup induces a lens to form even out of foreign ectoderm brought by the experimenter into its immediate vicinity. If we call the original dorsal lip tissue a primary organizer, we may well call the optic cup which it forms a secondary organizer, for it in turn has the power of organizing indifferent tissues. Thus, it appears that tissue first organized may become in turn an organizer. Development is a progressive adjustment of cells to surrounding cells.

Most organs are determined long before they appear as visible structures. Organized cells may influence the development of tissues in other parts of an animal's body. Thus, Harrison has shown that the factors which call forth the development of the salamander balancer, that characteristic process on either side of the mouth of the early Ambystoma larva, are early localized in a certain region of the ectoderm. This takes the lead in balancer formation and Harrison suggests that it may possibly affect the underlying tissues by enzyme action. As development continues, the balancer attracts a twig from the mandibular branch of the fifth nerve. If the balancer rudiment is transplanted to an abnormal position it may attract a twig from a more posterior nerve or even from similar nerves in a frog tadpole.

Development is, therefore, a highly epigenetic phenomenon, each part being built up out of the coöperative action of preceding parts. Throughout all the changes of development the original chromosomes, quantitatively divided many times and distributed throughout the body as the most conspicuous part of cell nuclei, are present, giving the distinguishing specificity to each developmental stage. A hereditary alteration in the equipment of genes will give a corresponding alteration in some or all of the stages of development.

Any stage of development may be affected by the external environment. Genes are present, but only able to produce their effects when certain environmental conditions are present. Geneticists have shown numerous mutations carried concealed by different stocks and only appearing when certain optimum conditions of food, moisture, or temperature are realized. Without suitable environment, no characters can appear. Certain viviparous salamanders regularly produce more young than they can bear. The embryos that happen to be in unfavorable parts of the oviduct never develop beyond a certain point.

The primary and secondary organizers of the developing embryo seem to act by producing an internal environment which stimulates the development of those tissues which happen to lie in the proximity of that influence. The nature of this environment is entirely unknown, for no one has yet succeeded in isolating a part of it distinct from the tissue producing it. As the embryo develops, there arises still a third group of organizing centers. These are the glands of internal secretion and they usually differ from the secondary organizers in that they affect many parts of the body at one time. They are in some ways more satisfactory to study than the other organizers, for their secretion may be isolated as a distinct substance and analyzed chemically.

The glands of internal secretion include the thyroid, the parathyroid, the adrenal organs, the pituitary, the thymus, the islets of Langerhans in the pancreas, and the gonads. Some of these glands consist of two or more parts having very different functions. If an animal should inherit an abnormally large or small gland of internal secretion, it would have a profound effect on the animal's body. The functions of some of these glands may be considered in more detail.

Perhaps the best known endocrine gland in the Amphibia is the thyroid. The hormone secreted by this gland produces metamorphosis. In other words, it causes in a very short time pronounced changes in the skin, skeleton, digestive tract, musculature, sense organs, and behavior. If the thyroid be removed from an amphibian larva no metamorphosis will take place. The thyroid, however, is affected in turn, by other internal "environments." A removal of the anterior lobe (actually posterior in position in Amphibia) of the pituitary prevents metamorphosis; in the absence of this lobe the thyroid fails to function and frequently degenerates rapidly.

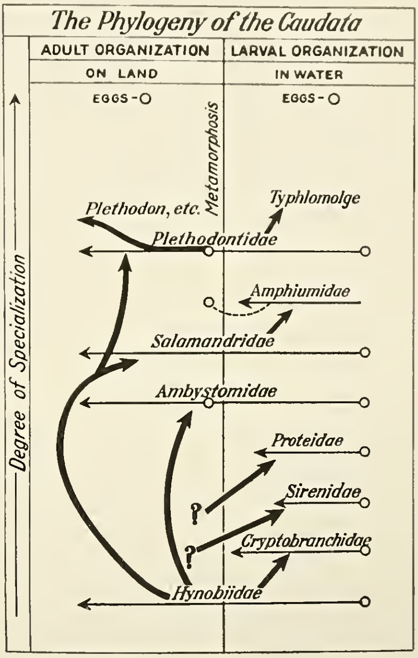
The hormone of the pituitary has no effect on metamorphosis except as it affects the functioning of the thyroid. The pituitary has other functions to perform. The anterior lobe has a profound effect on growth and, as shown by Uhlenhuth, the addition of anterior lobe substance to the body of the salamander produces gigantism. Acromegalous men and the ponderous dinosaurs seem to owe their gigantism to their enlarged pituitaries.

The *pars intermedia* of the pituitary has a totally different influence on the body than the *pars anterior*. Its secretion produces an expansion of the black pigment cells, or melanophores, of the skin, resulting in a darkening of the coloration. A removal of the pituitary results in a contraction of the melanophores and the animal becomes ghostly white. In the normal daily color change of Amphibia the hormone of the *pars intermedia* probably acts against the hormone from the adrenal organs, for the secretion of the latter is well known to bring about a contraction of the melanophores.

Without attempting to analyze the functions of the other endocrine glands, it is of interest to pass on at this point to animals as they occur in nature. The older naturalists finding such bizarre creatures as *Proteus*, the blind cave salamander of the mountainous region east of the Adriatic, were sure that here was a splendid example of the effect of the environment. "Common sense" made it clear that any animal such as *Proteus,* living in subterranean waterways would have no use for the structures of the land animal, for melanophores or for eyes. The failure to use these structures caused them to degenerate and in time this defect was inherited.

A closer examination of the problem showed, however, that some salamander larvæ of other species, which would ordinarily metamorphose, frequently failed to do so in nature even under environmental conditions which permitted metamorphosis in their brothers and sisters. In these cases the thyroid was found to be deficient in size or structure. This led the Dutch anatomist Versluys recently to examine the thyroids of all the neotenous urodeles, that is, all those groups which never metamorphose. He found some of the genera had actively secreting thyroids while in others the thyroid was apparently incapable of functioning. He concluded that the thyroid of the first group was deficient in the metamorphosing principle, and that all permanent larvæ, including Proteus, owed their neotenous condition to a deficiency of the thyroid.

In the American Museum, however, the problem was attacked by the experimental method. The thyroids of *Siren*, *Cryptobranchus*, and *Amphiuma* were fed to *Ambystoma* larvæ deprived of their thyroids. Within fourteen days all of the animals began to meta-



A salamander which has become a permanent larva is merely juvenile, not necessarily primitive. The phylogenetic relation of the permanent larvæ is expressed in the above diagram, which also shows the different developmental levels attained by the various families

morphose, proving conclusively that the thyroids of these forms were not deficient in the metamorphosis-inducing principle. Further, young and old specimens of these same genera, as well as very young larvæ of Necturus, were kept for months in a solution of iodothyrine, known to produce a metamorphosis in *Ambystoma*, but without result. Injection experiments and attempts to metamorphose the very young hypophysectomized *Cryptobranchus* showed conclusively that the

FROM NATURE'S LABORATORY

An albinistic permanent larva produced by Nature. *Proteus anguinus*, the blind salamander of Europe, is a product both of its heredity and of its environment, for the latter "molds" what the former provides. This effect of the environment is, however, never transmitted to the next generation

FROM THE MUSEUM'S LABORATORY

An albinistic permanent larva produced in the laboratory: a tiger salamander deprived of its thyroid and pituitary glands early in life. These glandular deficiencies bring the same apparent result that Nature has obtained by the method of mutation tissues of these permanent larvæ were not sensitized to the thyroid hormone. In some way these urodeles had become immune to the action of their own thyroids.

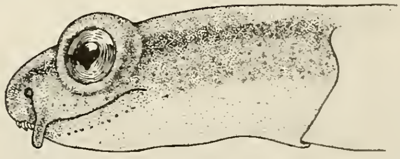
But, how could such an immunity have been brought about? Immunity as a genetic factor is well known. A change, a mutation in one or more of the genes has made certain laboratory animals resistant to the action of certain diseases. And the same thing has been witnessed in nature. When the plague was destroying thousands of rats and men in the Orient some years ago, there suddenly appeared a strain of rats resistant to the plague. The data at present available seems to indicate that the permanent larvæ owe their neoteny to a mutation of some gene which rendered their tissues non-sensitive to the action of their thyroids.

This does not mean that all neoteny is due to genetic factors. Urodeles, such as the axolotl or even the common two-lined salamander, owe their protracted larval period to the non-functioning of the thyroid. All urodeles that lay their eggs at high altitudes show a tendency toward neoteny, for the cold waters prevent the thyroid from functioning and the larvæ do not metamorphose. If any of these larvæ, however, have thyroid substance fed to them, or if a sudden rise in the temperature permits their thyroids to function, they will metamorphose within two or three weeks into land animals. It is clear that in this case an environmental factor, cold temperature, is causing, at least for a limited period, the same result as the genetic one in the other group.

Proteus, itself, illustrates admirably how greatly the environment may affect the outward appearance of an animal, covering up, so to speak, the features which are determined by the genes and which would appear under other environmental conditions. If *Proteus* is kept in the light for a time it will become completely pigmented. Each individual apparently inherits a complete equipment of tyrosin or other chromogen base. But its oxidizing enzyme which would convert this into melanin can act only on a prolonged exposure to light. This is different from the conditions in other Amphibia which may become pigmented even in the absence of light. No doubt, all Amphibia contain in their genetic make-up numerous potential characters which are destined never to appear unless special environmental conditions present themselves. In other words, the developmental expression of the same heredity complex may vary with the environment, but in cases where this variation occurs, the heredity complex is not altered in the slightest. It is carried unimpared and ready to produce the more usual results when environmental conditions permit.

In some cases, the result of a genetic factor (but not the factor itself) may be completely reversed by environmental influences. This is well shown in the case of sex reversal where an internal "environment" said by some to be of a nutritional, by others of a hormonic nature, is known to have reversed the sexes of various salamanders, frogs, and toads. A change in the character of the gonads results in a host of changes in the body of the animal. By transplanting a testis into the body of an adult female salamander we have caused cloacal glands, the structures which produce the spermatophores of the male, to develop in the female cloaca. The removal of the testis in the male caused its monocuspid premaxillary teeth to be replaced within six week's time by shorter bicuspid ones. Most secondary sexual characters are well known to be controlled by secretions from the gonads.

The analysis need not be carried further. It is clear that characters are never inherited as such but appear only after a long series of interactions between the hereditary components and a series of internal and external environments. Heredity gives an animal more potential characters than can ever develop. Environment determines which of these shall appear, but it cannot produce characters which are not provided for by heredity. The actual inheritance of an animal is thus ultimately dependent on the original complement of genes. But what determines the gene complement? Do mutations always arise spontaneously or may the environment cause a change in a gene? The recent work of Harrison on induced melanism in moths, and the work of Guyer and Smith on heritable eye defects in rabbits make it seem possible that under certain conditions a gene may actually be affected by an abnormal environment. But this change is not adaptive, it is rather to be compared with alterations in the chromosomes which have been produced by X-ray irradiations, except that the defect seems to be localized to a single gene. The attack on the nature and mutability of the gene goes forward, but so far it has taught only in regard to adaptations that they are chance associations. Certainly most adaptations, and, so far as our experimental data show, all inheritable adaptations have arisen independent of the environment. Even such highly adapted mechanisms as the "sucking disks" of tree frogs we now know from studies made in the Museum's laboratories to have arisen before some groups of frogs became aboreal and are retained by others which have reverted to an aquatic habitat. Animals make the best of what nature gives them. The blind *Proteus* with its juvenile habitus and deficient pigmentary and optic equipment has sought the only habitat where negatively heliotropic and thigmotactic habits would take a permanent larva. Nevertheless, *Proteus* is a product of its environment, for if it had not sought the caves, its translucent skin would have become densely pigmented. *Proteus* like many other living organisms might have been a far different and, according to salamander standards, a better animal in another environment. What more can be said of Man?



The dwarf salamander *Manculus*.—The elongated teeth and cirrus are secondary sexual characters found only in the male

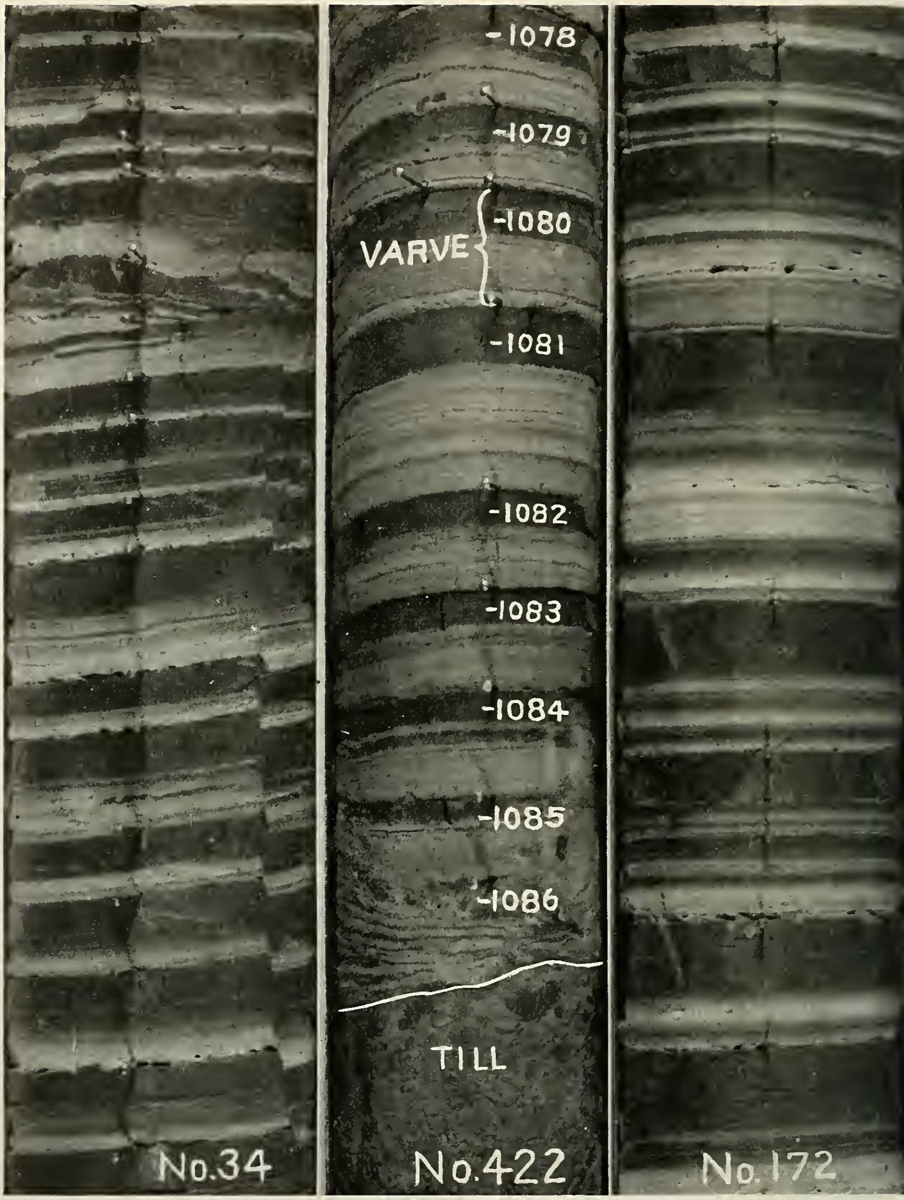


FIG. I. VARVED CLAY FROM THREE GLACIAL LAKE BEDS NEAR NEW YORK CITY

The thick dark bands denote the winter accumulation; the intervening lighter colored layers represent the summer deposition. A pin at the upper edge of each of the dark winter bands marks the limits of each varve. The distance between pins thus represents a varve, or annual deposit.

Section No. 34 contains eighteen varves deposited in glacial Lake Passaic one half mile north of Mountain View, New Jersey. An offset in the layers near the right margin represents a fault; the joining of two dark winter bands in the upper right of the section is due to a lateral slide.

Section No. 422 is a bottom sample taken from clay deposited in Lake Hackensack, one mile north of Little Ferry, New Jersey. The bottom varve (-1086), which rests upon the glacial drift or till, has been disturbed by a slide. The numbers with negative sign represent the author's count of the varves below a datum plane for the Little Ferry district, described in *American Museum Novitates* No. 209, 1926. This section was cut by a special clay sampling tool, at a depth of ten feet, below the lowest working level of the Gardiner clay pit.

Section No. 172 from the Archer pit, Haverstraw, New York, shows nine varves deposited in Lake Hudson. The varves in this sample are thicker than those in the other two samples. Sections No. 34 and No. 172 are gray in tone, while No. 422 is of a pronounced red color. The color of the clays is ascribed to the difference in the color of the underlying rocks, which were scored and scoured by the advancing glacier.

Glacial Lakes and Clays Near New York City

By CHESTER A. REEDS
Curator of Invertebrate Palæontology, American Museum

INTRODUCTION

THE writer's attention was first directed to the need of an exploration of the glacial lakes and associated clays in the vicinity of New York City, on the occasion of the visit of Baron Gerard de Geer and his party to the American Museum of Natural History in the summer of 1920. Baron de Geer[1] came here from Sweden for the specific purpose of examining the seasonally banded clay deposits in the Hudson River valley, from Haverstraw northward, and to compare the time element of the American deposits with the thousands of years which he had established for the deposition of similar clays in Sweden. Since there were no exhibits of such material in the American Museum, or in any other museum in the United States, it was desirable that a series of sections of American clays should be assembled in New York.

The clays are unique in that they are bilaminar for each year (Fig. 1). One lamina represents the amount of "summer" deposition, the other the "winter" accumulation. Taken together, the paired bands constitute a varve or annual deposit.

The clays are of glacial age, since each layer had its origin in an annual retreat stage of the ice of the last glaciation. They were developed as follows: As the ice melted and retreated slowly northward during the warm summer months of each year, the swollen rivers which flowed out from under the ice mass picked up the fine sand and clay particles and transported them to fresh-water lakes which occupied the lower portions of the enclosed basins in front of the glacier. As the stream currents on entering the still waters of the lake gradually lost their power to transport their load of sediment, the fine sand and coarse clay particles settled down over the lake bottom to form the sandy summer layer. During the cold winter months of each year the ice-front became stationary, the englacial and subglacial stream courses either ran dry or congealed, and little, if any, sediments were transported by the rivers into the lakes. The surface of the lake also became encrusted with ice and snow, and the fine clay particles, which had been held in suspension in the milky water following the summer incursions, slowly settled to the bottom to form the bluish, reddish, or dark winter layers composed of pure clay. Before the end of the winter season, the lake waters cleared, and a sharp line of demarcation was established between the top of the "winter" layer and the base of the succeeding "summer" layer. This well-defined line is of value to the collector or student in separating the seasonal layers into varves or annual deposits.

LITTLE FERRY AND HAVERSTRAW CLAYS

In the summer of 1923, the writer, with Mr. P. B. Hill as field assistant, sectioned the clay banks in five pits along the west bank of the Hackensack River in the vicinity of Little Ferry, New Jersey, and brought samples of all of the exposed varves to the American Museum for preservation and study.

[1]James F. Kemp, "Baron Gerard de Geer and His Work," NATURAL HISTORY, Vol. XXI, pp. 31–33.

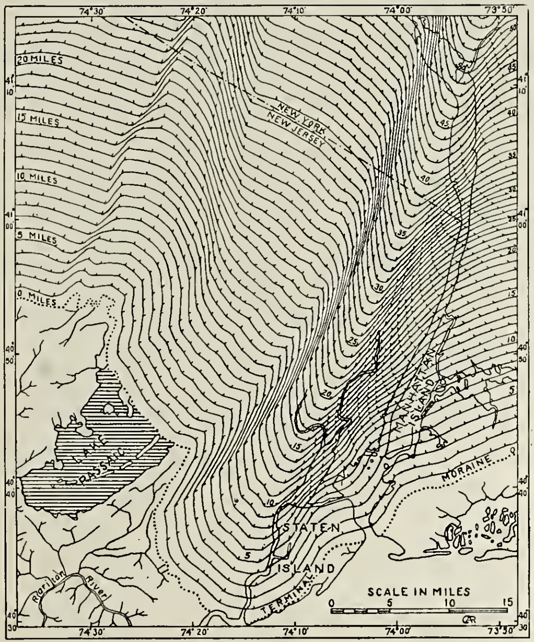


Fig. 2.—Sketch map showing maximum extent of the ice of the last glaciation in the vicinity of New York City; direction of ice advance (dotted radial lines); probable waves of advance and retreat of the ice, measured in mile stages from the terminal moraine; outline of extra-morainal Lake Passaic

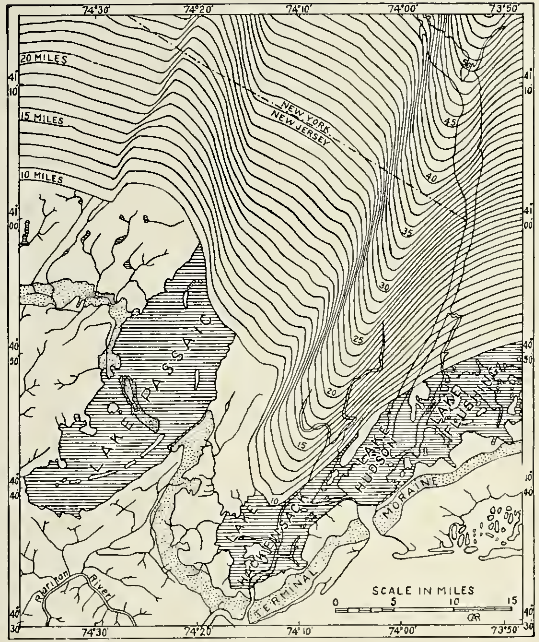


Fig. 3.—Sketch map of the probable position of the ice-front in the vicinity of New York City after having retreated ten miles from the outer margin of the terminal moraine; Lake Passaic well developed; early stage of lakes Hackensack, Hudson, and Flushing

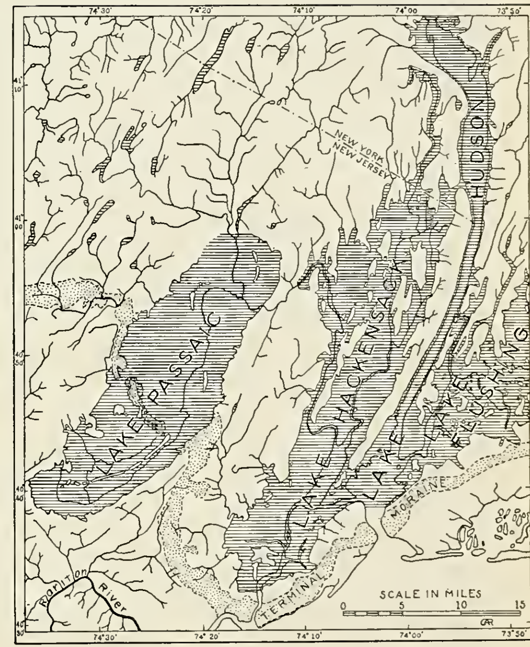


Fig. 4.—Sketch map of maximum extent of glacial lakes Passaic, Hackensack, Flushing, and Hudson in the vicinity of New York City, shortly after the retreat of the ice of the last glaciation. The terminal moraine, present drainage, and smaller glacial lakes are also noted

In the field, varves were found in great abundance in all the pits, but no one excavation contained all of them. A composite section from the five pits[1] gave us forty-five feet of clay and a continuous series of 2550 varves, representing as many years for the deposition of the material as the ice-front retreated slowly northward up the Hackensack valley.

In 1925, the writer, with Mr. Lewis W. MacNaughton as field assistant, sectioned the clay banks in five different pits at Haverstraw, New York, and two near Dutchess Junction on the Hudson. The various banks were not conveniently situated for piecing together a continuous section; however, more than 1500 separate and distinct varves were obtained in the samples procured.

The clay pits near New York City having been sectioned, an entirely different method of sampling the near-by clays was developed and tried successfully in 1926. Open clay pits were seldom worked with steel form and copper tray as in the previous years; instead deep holes of small diameter were bored, followed by an ingenious slicing tool which cut an undisturbed section of the clay and fed it into copper trays, each two feet long. This method made it possible for us to obtain samples in selected places, even the first varves that were laid down on the bottom of the lake (Fig. 1, No 422).

ADVANCE AND RETREAT OF THE ICE

An examination of the map (Fig. 2) will show that the southernmost point reached by the ice of the last glaciation was Prince's Bay, Staten Island, and Perth Amboy, New Jersey. The terminal moraine, which indicates the southern limit of glaciation, is not only well-developed at Perth Amboy, but it extends northeastward across Staten Island and Long Island, and northwestward through Summit and Morristown, New Jersey. The front of the glacier thus assumed a sinuous lobate outline due no doubt to the rather broad open features of the Hackensack valley, throughout the fifty miles of its north-south extent, as compared with the narrow and deep defile of the Hudson River, the major stream, to the east. The Palisade ridge along the east flank of the Hackensack valley, and the Watchung Mountains and New Jersey Highlands along the northwest margin, tended to retard the glacier as it moved southward in those areas. The directions of ice movement, derived from the glacial scratches or striæ, are indicated in Figure 2 by the dotted radial lines. The Hackensack valley thus became the main line of advance of the glacier, and being lower in elevation than the adjacent areas, it contained the greatest thickness of ice.

At the present time no one knows how long the ice-front stood at the terminal moraine; we can merely guess and say several thousand years. Neither does anyone know definitely what positions the ice-front occupied at successive stages of the annual retreat northward. We can assume, however, as a working hypothesis, that it retreated equally along the entire sinuous front. On the map (Fig. 2) the assumed stages, at intervals of one mile, have been indicated, following in reverse direction the same radial lines (dotted) along which the ice is known to have advanced. According to this theory the ice-front at any one position, for example, the ten mile stage (Fig. 3), was very irregular, with the ice-tongue in the Hackensack valley

[1]Reeds, Chester A., 1926, "The Varved Clays at Little Ferry, New Jersey," *American Museum Novitates*, No. 209, pp. 1–16.

persisting after the adjacent highlands had been cleared of ice. Such a working hypothesis is very helpful in attempting to correlate contemporaneous varves in lakes having the same latitude.

GLACIAL LAKE PASSAIC

When the ice-front reached its maximum extent, a glacial lake known as Lake Passaic partially filled the natural basin to the south of the terminal moraine, in the vicinity of Summit and Morristown, New Jersey. Its southern shore followed the recurved basaltic rock of the second Watchung Mountain at an elevation of 345 feet (Fig. 2). The lake waters did not rise above this height, for the Moggy Hollow outlet at the southwest corner permitted the water to flow out into a tributary of the Raritan River and eventually into the sea.

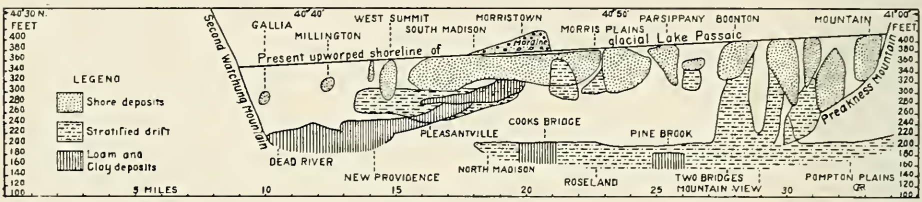


Fig. 5.—Profile drawing sho ving up varped shore-line and vertical distribution of the stratified deposits in glacia Lake Passaic. Data from glacial geology sheets of the Passaic and Raritan Folios, U. S. Geological Survey

As the glacier retreated northward down the valley of the upper Passaic River, the waters of Lake Passaic followed the ice-front as far as Pompton Plains (Fig. 4), and filled the entire basin lying between the Watchung Mountains and the New Jersey Highlands up to an elevation of 360 feet above sea level. The present lowest point in the lake basin is 160 feet above mean tide, so that the lake during its maximum extent must have had a depth of 200 feet. In some places the shore-line of this glacial lake is faintly preserved; in others it is well-developed, and must have existed for a considerable period. For a detailed mapping of the shore-line and deposits of this well-known glacial lake, one should examine the Passaic and Raritan Folios of the United States Geological Survey, and Volume V of the New Jersey Geological Survey.

As the glacier retreated from year to year, varved clays were deposited in certain areas on the floor of the lake, particularly in low places near where the subglacial streams debouched. The basin has not been fully prospected for glacial clays, but the writer in 1922 observed a few varves close to the terminal moraine in Morristown, and in a clay pit at Whippany. Some four hundred varves, many of which were contorted, were also examined in a clay pit one-half mile north of Mountain View, New Jersey.

UPWARPED SHORE-LINES OF LAKE PASSAIC

Since the glacier disappeared from eastern North America, the shore-lines of former glacial Lake Passaic have been warped upward 67 feet (412 feet less 345 feet) more at their northern end than along their southern margin (Fig. 5). The lake had an extent of 30 miles along its northeast-southwest axis, or 26 miles on the meridian. This represents a differential upwarping of the region in the vicinity of New York City, in a north-south direction, of approximately 2¼ feet per mile, or twenty feet in nine miles. This marked change in elevations of the land is known to have affected all the territory occupied by the continental glacier in central and eastern North America, extending from a zero or hinge line in central New Jersey up to approximately 1000 feet to the north of Quebec, Canada. Such differential changes in elevation are not confined to eastern North America, for it has been noted that the glaciated territory of northwestern Europe has been upwarped in a similar manner. Where the relief of the land was affected most, it is believed that the ice was thickest. It was the removal of the load of ice and certain subcrustal or isostatic movements that took place within the earth, that in all probability brought about the changes in elevation.

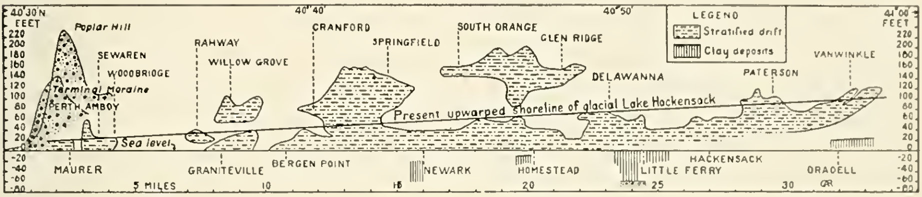


Fig. 6.—Profile drawing showing upwarped shore-line and vertical distribution of the stratified deposits in glacial Lake Hackensack. Data from the glacial geology sheet of the Passaic Folio, U. S. Geological Survey, and the author's field notes

GLACIAL LAKE HACKENSACK

The main lines of railroad that approach New York City from the west, cross the Hackensack meadows just before reaching the Hudson River. No doubt many a traveler who has seen this broad expanse of marsh has asked the question: Why is this? Prior to 1922, when the writer began his investigation on the geochronology of the clays, glacial Lake Hackensack had not been outlined or recognized. The commercial value of the clays, however, had been noted by various state and federal geologists. Twenty to thirty years ago brick yards were established at various points in the northern half of the Hackensack valley but at present all these enterprises have been discontinued except in the vicinity of Little Ferry, where large open pits have been excavated below sea level. To the south of this point the basin is for the most part covered by salt water or salt-water marshes.

The varved clays, however, were deposited in a fresh-water glacial lake and not in an arm of the sea.[1] While the shore-lines of this glacial lake have not been traced in detail in the field. we know the amount of post-glacial upwarping for the Lake Passaic basin, and can apply that data with profit to the Hackensack valley.

Glacial Lake Hackensack, as shown on the sketch map, Fig. 4, was outlined by the writer in 1924, and presented in abstract the same year at the Ithaca meeting of the Geological Society of America.[2] The approximate shore-line starts with the Maurer delta deposit which rises from sea level to 30 feet, inside the terminal moraine less than two miles north of Perth Amboy. With this delta as a bench mark, the 20, 40, 60, 80, 100, and 120 feet contour lines on the topographic maps were followed for nine miles each, the

[1]Antevs, Ernst, 1925, "Condition of Formation of the Varved Glacial Clay," *Bull. Geol. Soc. Amer.*, Vol. 36, pp. 171–172.

[2]Reeds, Chester A., 1925, "Glacial Lake Hackensack and Adjacent Lakes," *Bull. Geol. Soc. Amer.*, Vol. 36, p. 155.

last one of which encompasses the northern end of the Hackensack valley. The reason for changing contours every nine miles is that the amount of post-glacial uplift of the ground averages two and one quarter feet per mile, or twenty feet in nine miles. Lake Hackensack as thus outlined contains not only a number of ridges as islands, but also the glacial clays and the stratified sands, gravels, and delta deposits which rise to successively higher and higher elevations in passing from south to north.

Fig. 7.—Varved clay of Lake Hudson smoothed for sectioning, Washburn and Fowler clay pit, West Haverstraw, New York

The glacial clays which occupy only the lowest levels are reported in deep wells in south Newark; at Homestead the top of the clay is 10 feet below sea level; at Little Ferry approximately at sea level; at Oradell about 15 feet above; at Norwood 30 feet above; and at West Nyack 50 feet above tide.

The delta deposits and stratified sands and gravels, which occur at such discordant elevations that heretofore they have baffled explanation, also rise to higher and higher levels in going northward. For example, the delta deposits in North Hackensack occur at an elevation of 40 to 50 feet above sea level, while farther to the north the sandy delta plains in the vicinity of Tappan rise from 60 to 80 feet above sea level. To show the vertical relations of the various stratified deposits, as mapped on the glacial sheet of the Passaic Folio, to the newly outlined shore-line of Lake Hackensack, and the relation of similar deposits in Lake Passaic, Figs. 5 and 6 are presented. It is surprising how well these varied deposits fall in below the shore-lines in both lakes. The exceptions in the Hackensack valley are the deposits at Willow Grove, Cranford to Springfield and South Orange to Glen Ridge, which occur at higher elevations, and which were in all probability deposited not in Lake Hackensack, but in small lakes which lay at higher elevations hemmed in by early retreat stages of the ice-front and the back slopes of the terminal moraine and of the Watchung Mountains.

GLACIAL LAKES HUDSON AND FLUSHING

The same bench mark and methods of induction and deduction that were used in establishing the outline of Lake Hackensack were applied to the territory immediately to the eastward of the Hackensack basin and northward of the terminal moraine. The results of this endeavor, as noted on Figs. 3 and 4, give us the suggestive outlines of variously connected bodies of fresh water which we have designated as Lake Hudson and Lake Flushing. Varved glacial clays are not known to be exposed above sea-level in Lake

Hudson south of Haverstraw, New York. There and to the northward they are well-developed, at, below and above sea level (Fig. 7). In Lake Flushing, they have been noted by Dr. E. Antevs[1] in the valley of the Quinnipiac River at New Haven, Connecticut, and reported at Fishers Island farther eastward in Long Island Sound. Logs of various wells in Brooklyn and to the eastward yield records of clay lying below the overlying sand and gravel beds.

In New York City blue clay was encountered in 1925, by the engineers of the New York Central Railroad in test borings on the right of way at the foot of West 14th Street, 44 to 72 feet below sea level. Blue clay has also been found in borings along the east bank of the Hudson River off West 10th Street at 98 to 162 feet, and off West Houston Street at 92 to 128 feet below sea level. The exploratory borings for the Hudson River tunnels of the Pennsylvania Railroad also revealed the presence of extensive beds of clay immediately overlying the basal till in the filled channel of the river at depths of 175–200 feet on the west side, 125–175 feet on the east side, and 200–275 feet in the east central portion (Fig. 8). Clay is also reported overlying morainal material in the bottom of the filled East River channel. Since the relation of these submerged clay deposits to the underlying till is similar to that found by the writer at Little Ferry in the Hackensack basin, he assumes that they are banded and of glacial origin.

[1]Antevs, Ernst, 1922, "Conditions in New England During the Deposition of the Varve Clay," Amer. Geogr. Soc. Research Series No. 11.

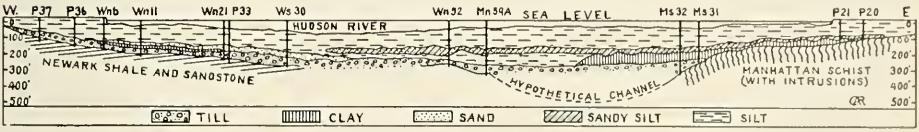


Fig. 8.—Cross-section of the deposits in the Hudson River, developed from exploratory borings for the Pennsylvania railroad tunnels, Thirty-second Street, NewYork City. (After G. S. Rogers)

POST-GLACIAL STRATIFIED SANDS

The varved clay deposits at Mountain View in Lake Passaic are overlaid by some five to ten feet of stratified sands. This is also true at Little Ferry in Lake Hackensack where beds of sand 5 to 20 feet in thickness overlie the varved clays (Fig. 9). At New Bridge, near the west bank of the Hackensack River, and at Oradell, gravel 5 to 20 feet in thickness appears above the clay deposits. At Haverstraw in Lake Hudson, and at points northward, beds of sand and gravel, varying in thickness from 2 to 25 feet, rest upon the varved clays (Fig. 10). The stratified sands at Croton Point, Harmon, and Peekskill are very thick and rise to elevations a little over 100 feet, the approximate position of the shore-line of Lake Hudson at these places. They represent delta deposits made in the lake. Sandy varves about one foot in thickness, observed on Croton Point in borings made near sea level, indicate late glacial age.

Contractors, who have erected buildings on Manhattan Island, know that the southern one-third of the island and the Harlem and Dyckman sections are for the most part covered by stratified sandy deposits, which vary in thickness from a few feet to 100 feet. In the Subway excavation at 134th Street and

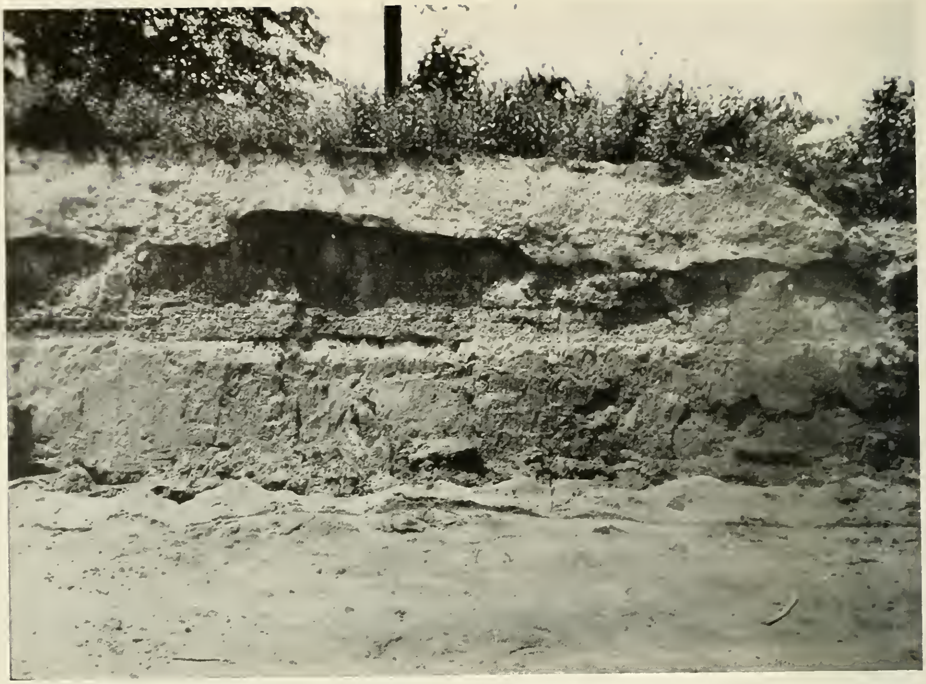


Fig. 9.—Post-glacial stratified sands, eight feet thick, overlying the varved glacial clay of Lake Hackensack. Mehrhof Brothers' clay pit, one mile south of Little Ferry, New Jersey

Fig. 10.—Post-glacial sand and gravel (a tributary delta deposit) overlying varved glacial clay of Lake Hudson, Hornbecker's sand-pit, West Haverstraw, New York

St. Nicholas Avenue, stratified sands were exposed in January, 1926, the uppermost stratified layer being 26 feet above mean sea level. Special interest is attached to this locality because the skeleton of a horse *Equus caballus* was found by the writer, embedded in the bank (Figs. 11 and 12). The skeleton lay on top of the highest stratified bed and in some six feet of unstratified yellowish gray clay which may have been washed down in post-Columbian time from the hill-side below the site of the College of the City of New York.

In the excavation for the New York Telephone building at Barclay, Vesey, and Washington streets, New York, bed-rock (Manhattan schist) was encountered seventy-five feet below high tide on the Hudson River side and sixty-five feet on the eastern side. Between the bed-rock and the surface, stratified gray and red sands were noticed with occasional pockets of pebbles and a few ice-transported bowlders. At a depth of 45 feet below high tide, a bed of peat eighteen inches in thickness was observed by the writer, interbedded in the coarse sand, and associated with it the prostrate trunks of several juniper trees, *Juniperus communis*, some ten

Fig. 11.—Skull of horse, *Equus caballus*, found at base of the post-glacial clay. Subway excavation 134th Street and St. Nicholas Avenue, New York City

Fig. 12.—Stratified post-glacial sands west bank of Subway excavation 134th Street and St. Nicholas Avenue, New York City. Skeleton of horse, *Equus caballus*, probably 300 years old, found at elevation marked X

feet in length. The bark and a number of the branches still adhered, indicating that the trees and peat had grown *in situ*. Dr. Arthur Hollick[1] of the New York Botanical Garden examined a cross-section of the trunk of one of the trees and counted some two hundred rings representing as many years for its growth. These objects indicate that during their period of development the sands containing them were at sea level. The present position indicates later subsidence of the region.

The stratified beds of sand and gravel which rest upon the varved clay deposits are, without doubt, of post-glacial age. Since this is true where the clay is exposed, it is also evidently true where the clay beds are concealed from view by sands and silts, as in the Hudson River opposite 10th, 14th and 33d streets, New York, and in the East River channel. The stratified sandy deposits which occur at higher levels in Manhattan and Brooklyn are also considered to be of post-glacial age.

CONCLUSION

In conclusion it may be stated that, following the retreat of the ice of the last glaciation, glacial lakes occupied the basins between the terminal moraine and the various annual positions of the ice-front. The more notable of these lakes in the vicinity of New York City were glacial lakes Passaic, Hackensack, Hudson, and Flushing. As the ice retreated from year to year, varved glacial clays were laid down on the bottoms of these lakes. The presence of more than 2500 varves in the Hackensack valley indicates that the rate of retreat was slow, probably 100 feet per year. As the load of ice was gradually removed, the region was differentially uplifted approximately two and a quarter feet per mile from central New Jersey northward into east central Canada. This post-glacial uplift rejuvenated the streams and caused them to transport and deposit gravel, sand, and silt over the seasonally stratified beds of clay. Following the differential uplift of the land, the presence of a peat bed and tree trunks in the post-glacial sands forty-five feet below high tide in lower New York City, indicates that the region about the mouth of the Hudson River has gradually subsided. These various geologic events immediately precede the present day; how far back they go in time we can but estimate, yet the exploration and the counting of the clay varves which are in progress are affording a precise record of the annual retreat stages of the ice and the duration of the glacial lakes.

The present investigation has yielded not only an interesting series of Museum specimens, but also a new chapter in the palæogeography of the region. Further study will reveal additional data, a more accurate geochronology and a better understanding of glacial and post-glacial events.

[1]Hollick, Arthur, 1926, "Report on a Tree Trunk and Associated Lignitic Débris Excavated in Manhattan Island," *American Museum Novitates*, No. 213, pp. 1–6.

Fig. 1.—Nest of the butterfish, *Pholis gunnellus*. Here the egg mass guarded by the female fish is shown in the reversed upper valve of a dead oyster shell. A number of live limpets were attached to the inner surfaces of both valves. Photograph from exhibit in American Museum

The Nest and the Nesting Habits of the Butterfish or Gunnel, *Pholis gunnellus*

By E. W. GUDGER
Bibliographer and Associate, Dept. of Ichthyology, American Museum

ONE frequently reads in the daily papers brief notices of small fishes found in dead oyster shells, and only a few weeks ago a clipping of such a notice was sent to me by a correspondent. The matter never became very real, however, until December 16, 1924, when Nagele Bros. Inc., of 1066 Madison Avenue, New York City, sent to the department of ichthyology a dead oyster shell containing a little fish partly coiled around a ball-shaped mass of eggs. This shell with its contents had been dredged in Peconic Bay, at the eastern extremity of Long Island, on December 14. The fish and the eggs were dead, but the weather being cold, both were in perfect condition. The specimen, at once recognized as a gunnel nest, was taken to the department of preparation, where a sketch in colors was made of the shell with its attached limpets, of the fish, and of the egg mass. The fish and the eggs were then preserved in formalin.

It is a pleasure here to express our hearty appreciation of the courtesy of Nagele Bros. in sending this unique specimen, and all the more, since this is by no means the first interesting fish which they have contributed to the department.

PREPARATION OF THE GROUP

As soon as the little fish and the egg mass had become hardened by the formalin, a model of the fish was made and another of the eggs, exact in size and coloration; the shell was cleaned of mud, the limpets extracted from their shells and these latter reattached to the oyster shell in their exact positions. Then the fish and the egg mass were replaced in the "nest" just as they were when they came to us, and some artificial water was poured into the shell. Thus we have an exact replica of the gunnel in its "nest." Figure 1 shows the fish and nest as it will appear on exhibition in our new fish hall.

DESCRIPTION

The oyster shell (110 mm. long), as found on the bottom of Peconic Bay, was upside down, and the little fish and its egg ball were in the hollow of what is normally the upper or concave valve of the shell. The egg mass lay slightly forward of the middle of the valve longitudinally, and considerably nearer the back edge of the shell (that side next the observer) than the front. It was in about the deepest hollow of the shell. In order to estimate the eggs accurately, I found it necessary to tear the ball to pieces. Careful count then showed that there were 686 ova, a truly surprising number for such an apparently small mass. Unfortunately no measurements were made of these eggs before placing them in formalin, but, after they had been in this preservative for about seven weeks, repeated measurements showed that they were slightly (a mere fraction) over 2 mm. in diameter. Each egg contained an embryo in the black-eyed stage, coiled around the yolk. There are no filaments of attachment on the shells, but evidently when the eggs are extruded, the shells are glutinous and stick fast to all the other egg shells with which they come in contact. The eggs are certainly rounded up into a ball by the fish; how this is done will be described later.

Dissection showed that the guardian fish is a female. In European waters both sexes of this species are reputed to guard the nest, and the same thing is presumably true here. The warden of the nest shown in Figure 1 is 117 mm. (4.63 inches) in total length, and 13 mm. (0.5 inch) in greatest depth. Mounted as found, she lies in the shell with her head in the region of the hinge and her tail at the broad extremity. The first section of the body of the fish (about 47 mm. long) is comparatively straight, then the tail bends abruptly outward and forward, and in this sharp bend the egg mass is partly enclosed. This bent portion of the body measures about 30 mm. The remainder of the tail (about 35 mm. long) extends backward in a line roughly parallel with the anterior part of the body, the caudal fin lying on the shell in a somewhat horizontal position.

HISTORICAL ACCOUNT

Nilsson is quoted by various authors as saying that the gunnel spawns in November, but as no writer gives a specific reference to him, it has been impossible to verify this. However, it is undoubtedly true of our waters, since the eggs of our specimen on December 14 had embryos in the black-eyed stage, from which one would judge that they were at least two weeks old. Couch alleges that Peach found the ova of the butterfish in June attached to the under side of a stone in the harbor of Fowey, near Plymouth, in Cornwall, England. Since, however, there is no statement that the eggs were rolled into a ball, and since the only proof that he had was the presence nearby of a supposed parent, and furthermore, since all other observers have found the egg-laying season confined to the winter months, one is forced to conclude that Peach was in error—his ova must have belonged to some other fish.

The first definite notice of the ova of *Pholis* is from the pen of Wm. Anderson Smith (1886). In March, 1883, between tidemarks on the shores of Loch Creran in western Scotland, he found "lumps" of ova and with each a pair (male and female) of suckerfishes, *Lepadogaster decandolli*. At first he thought that these were the eggs of the suckers, but as he knew that the eggs of those fishes were pinkish in hue and were more or less evenly spread over the stones, and since these eggs were in ball-like masses and "pale and opalescent" in color, he recognized them as the ova of *Centronotus* (the old name for *Pholis*); hence he decided that the lepadogasters had merely sought refuge under the stones where *Pholis* had deposited her eggs.

In a later article (1887) Smith fixes the breeding season as extending from about the middle of February to about the same time in April, March being the month of principal activity. The balls of opalescent ova (about the size of a walnut) entirely unattached but attended by both parents, may then be found under loose stones on the seashore at low tide. He thinks that the parents get no food save as the tide brings it to them, and that they undergo at least partial starvation. This I have found true of the male of the toad fish, *Opsanus tau*, which lays its adhesive eggs inside a *Pinna* shell or some other such hollow receptacle, and guards them. It is also true of the marine catfish, *Felichthys felis*, the male of which incubates the eggs in his mouth and does not feed at all during the period of gestation (about 80 days).

Smith further adds a thing which has not been reported by any other observer, that in captivity both parents lie coiled around the ova with heads and tails reversed, and that as the development of the ova proceeds the circle expands. When the young are hatched and free swimming, the parents (in captivity, at least) pay no further attention to the young but seek to get away from the light.

More definite is the information given by McIntosh and Prince (1890), who say of the ova of *Centronotus gunnellus* that:

> At St. Andrews they have hitherto been obtained amongst the rocks in March, masses about the size of a walnut . . . occurring in the holes of *Pholas* [the boring mollusk], the adults in each case being coiled beside them. The ova adhere together like those of *Cottus* or *Clupea harengus*, and have a diameter of 0.076 inch [1.9 mm.]. . . .

Further on in this paper they say of the same fish that:

> Masses of ova about the size of a Brazil-nut [English walnut rather] have more than once been found in cavities (holes of *Pholas*) at the Pier Rocks [St. Andrews], with the parent fishes coiled beside them. The examples specially dealt with occurred on March 14, 1887.

Here, then, we have evidence of a long breeding season such as would be expected in the cold waters of Scotland.

Still more definite is the report of Holt (1893) whose work was also done at St. Andrews. Beginning in November, he made constant search at low tide among the rocks but found no nests. However, he did collect a number of the fish, which were placed in aquariums and kept under observation. Early in February a female was noticed with enlarged abdomen, and a fruitless attempt was made to "strip" her. Shortly thereafter unfertilized eggs were found in the aquarium and artificial fertilization was attempted but failed. On February 10, when attention was again called to the aquarium, one of the fish had spawned, the eggs had been fertilized, and the female was engaged in rounding up the mass of eggs into a ball. Of this process

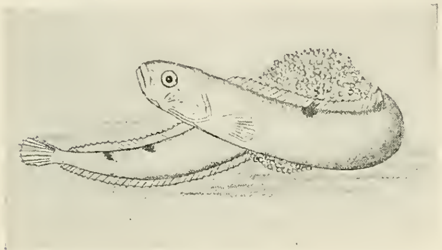


Fig. 2.—The first figure ever published showing the egg mass surrounded by the body of the parent butterfish (either male or female). After Holt (1893)

Holt gives a beautiful figure which is reproduced herein as Figure 2. The process he describes as follows:

> The body was bent so that the head rested on the back of the caudal region, the ball of ova being held in the loop so formed. In this position she sometimes rested for a short time, at intervals constricting her body so tightly that the egg mass slid over her back, only to be again encircled. I did not on this occasion observe that any assistance was given by the male. Several males were present in the same vessel, and I do not know which one fertilized the eggs.

Holt was fortunate in having another female spawn on February 22. He notes that the eggs were treated in the same way and adds that:

> This time, however, the male parent, much smaller than the female, took turns with the latter in compressing the eggs. The two parents did not seem ever to interfere with the eggs at the same time, but if one left them, the other very soon approached and encircled them. From the fact that the first clutch of ova, which were not fertilized, were also not rolled together by the parent, I suppose that the male is largely responsible, or takes the initiative, in this process, probably also fertilizing them at the same time. The object is evidently to prevent the ova, which are adhesive only when first extended [*sic*—extruded?], from being scattered and lost, and it may be supposed that the operation is performed before the eggs are deposited in the narrow crevices in which they have been found.

Holt comments upon the unusual fact that both parents take part in the formation of the egg ball and in the later care of the "nest." His conjecture that the male constricts the egg mass at the same time that he fertilizes the eggs seems sound, since this would certainly bring about a thorough admixture of eggs and sperms, insuring a high percentage of fertilization. However, his suggestion that the egg-ball is made and then placed in the constricted places where usually found, seems hardly probable to me. The question at once arises as to how the ball could be carried, lifted, and guided into crevices and into holes bored by *Pholas*. Furthermore, in our specimen, the two shells of the oyster were in place and closed when brought to us. If they had not been closed, fish and egg mass would have been lost when the oysterman's dredge was hauled or in the course of transportation the ninety miles to the city. And if the shell were closed, how could the fish have opened and held it open while the egg mass was being carried into it? The shell was lying with the upper valve below, and with the lower and lighter valve above. The two valves do not fit accurately, and it seems entirely possible for this active little blenny to have insinuated its snout between the edges of the valves and to have raised the lighter upper (really ventral) valve enough to have permitted the entrance of its slender eel-like body. Thus everything goes to prove that in our specimen

Fig. 3.—Photograph of the gunnels and their nest in a dead oyster shell from Helgoland. As in the American Museum specimen, the eggs and guarding parent are in the hollow of the overturned upper valve. After Ehrenbaum, 1904

at least the eggs were extruded and the ball formed within the shell, the "nest."

The eggs of Holt's specimen when still young (i.e. immediately after the formation of the perivitelline space) measured 1.75 mm. in diameter, while the clear, translucent colorless yolk had a diameter of 1.37 mm. These accurate measurements were evidently made with a micrometer eyepiece or slide, and are of no small value. Of equal interest and of more value to us, is his beautiful figure of the fish encircling the eggs as seen in No. 2 herein. His figures and descriptions of the development stages need not detain us, since they are apart from the purpose of this paper.

Our next, practically our last, and certainly our most illuminating data comes from Ehrenbaum (1904) who studied the fish at Helgoland. Ehrenbaum's photograph is reproduced herein as Figure 3 and his account is quoted as follows:

> The nut-sized egg balls are deposited from November to January in rather shallow water, mostly within empty oyster shells, or in holes bored by *Pholas*, and are there guarded by the parent fish. The eggs are whitish opaque, iridescent, on the surface, and in Helgoland are 1.9–2.2 mm. in diameter, with a 1.7 mm. yolk mass, which leaves quite a large perivitelline space. In the yolk, surrounded by a detritus-like mass, lies the oil globule 0.53-0.63 mm. in diameter. From January to the end of March, the larvæ hatch out with a length of about 9 mm. . . . By May or June the young have attained a length of from 25–30 mm.

The "knifefish" (so called because its body is shaped somewhat like the blade of a knife) is very abundant at Helgoland, and Ehrenbaum set himself the task of working out its breeding habits. Of his observations he writes:

> It is easy at all times of the year, with the exception of the winter months, to collect the fish in the shallow waters on the west side of the island and on the reefs—where one finds it in the holes bored by *Pholas* in the chalk cliffs, holes like those at St. Andrews. But there was never any success in finding egg clumps of this fish in these localities and particularly in shallow water. They were always found only in water about 24m. deep and moreover in one locality only—the Helgoland oyster banks, which lie about 4 miles southeast of the reefs. In 10 years only six times have I found the walnut-sized egg clump which proved to be that of *Pholis*

gunnellus and I was not at any time successful in getting the parent fish with it. At first the egg balls were only seen lying loose among the haul of the oyster dredge, but later it appeared that more normally they were in the empty oyster shells and were caught with these.

When the same kind of shells with their egg balls were put in the aquarium where there were "ripe" *Pholis,* one or even more fishes would regularly place themselves within the empty shells as shown in the photograph from life (Pl. XIII). It is possible, as Holt has observed, that the fish were guided by some instinct that impelled them to guard the eggs. I could not make out whether the male or the female played the more important role in this guarding. One could only have been sure of this if the ripe fish had deposited their own eggs in the empty oyster shells. Even then one could not be certain since apparently the fish could not shed their spawn, and regularly died after a certain time.

However, that the fish do regularly deposit their eggs within empty oyster shells and then stay in the shells to guard them, I was assured by Oberfischmeister Decker, who has often observed this occurrence on the Sylter oyster banks and has often caught fish and egg ball together in the empty oyster shells. The Sylter banks are neither so distant nor so deep as the Helgoland ones, and it may be explained that it is easier to take the fishes in the oyster dredge there, whereas, when the dredge has to be drawn through a greater distance, they escape into the water more easily through the meshes of the net. According to Decker's statement the butterfish and its eggs are also a common occurrence on the oyster banks in the shallow waters of north Friesland.

Ehrenbaum kept numbers of these fish in aquariums in his laboratory, hoping to see the method of spawning and the making of the egg ball. For a long time he was unsuccessful, but on January 28, 1904, after the above was in type, a mass of eggs was laid, fertilized, and underwent normal development. These eggs varied in diameter from 1.98–2.11 mm. with an average of 2.06 mm. Ehrenbaum noted with surprise that the parent fishes were very careless in guarding these ova, but this is possibly explicable on the ground that they were free in the aquarium and not sequestered in a "nest"—they were in an abnormal habitat and the behavior of the fish was for that reason abnormal.

It is interesting to point out that in Ehrenbaum's photograph both parents, the egg ball, and the oyster shell are shown almost in natural size. One of the parents rests on the bottom just outside the shell, with its body bent in semi-coils almost exactly like the body of our fish. The other fish with the egg mass in front of it is found within the empty oyster shell as in our specimen, but with the head at the gaping mouth of the shell and the tail in the region of the hinge. But most significant of all is the fact that fish and egg mass are in what is morphologically the upper valve of the shell and are covered by the lighter ventral valve—exactly as in our specimen here in the Museum. The reasoning given for this state of things for our specimen is, of course, entirely applicable here.

Ehrenbaum further notes that the egg laying takes place late in the calendar year; that butterfishes taken then have the sexual organs "ripe," and that their coloring is very vivid, particularly so in the males. Then he specifically records the following facts:

> The egg balls that I saw were all taken in December and January,—the earliest on December 23. In these particular eggs, however, the embryos were quite far developed, about 10 days before hatching, so that the eggs must have been laid in November. The date of the latest collection was on January 17. The size of these eggs ran from 1.92–2.17 mm., and the average diameter varied [presumably for each lot] from 1.99–2.12 mm. Each egg contained a large oil drop, clear as water, with a diameter of from 0.53–0.63 mm. All these measurements somewhat exceed those given for British specimens.

Two other citations may be noted—both from J. T. Cunningham. In a book published in 1896, he briefly refers to the nesting habits of the gunnel and reproduces Holt's figure already given herein as Figure 2. Again in 1912, in a work in which, as joint author, he wrote the section on fishes, Cunningham synopsizes the data with regard to the breeding habits of *Pholis gunnellus*, and on plate XXVII he gives a figure which, as may be seen in No. 4, is very interesting and attractive. In his text he refers to Holt's observations and then (separately) refers the reader to this figure. Next he speaks of Ehrenbaum's studies of the oyster shell "nests." There are three figures on Cunningham's plate XXVII, of which the first and second are copied from Ehrenbaum. The third figure (that of the butterfish and egg ball) is probably made up from Ehrenbaum's photograph.

In conclusion, attention may well be called to the fact that the American Museum group is the only known gunnel "nest" on exhibition in any museum; and that in it the only reproduced parts are the perishable fish and ball of eggs. Furthermore this is but one of a number of small "groups" which

Fig. 4.—The butterfish coiled around its egg mass. After Cunningham, 1912

we plan to install in the new Hall of Fishes in the Museum, each to portray the most interesting phenomenon in the life history of some particular fish—and, if possible, to show some episode in its domestic life.

BIBLIOGRAPHY

Couch, Jonathan. 1869. *A History of the British Fishes.* 2nd ed. Vol. II, p. 237.

Ehrenbaum, Ernst. 1904. Eier und Larven von Fischen der Deutschen Bucht. III. Fische mit festsitzenden Eiern. *Wissenschaftliche Meeresuntersuchungen,* 1904, n.s. Vol. 6, Abth. Helgoland, pp. 160–165. pl. 13.

Holt, E. W. L. 1893. Survey of Fishing Grounds, West Coast of Ireland, 1890–1891: On the Eggs and Larvae and Post-Larval Stages of Teleosteans. *Scientific Transactions Royal Dublin Society,* 1893, 2 ser., Vol. 5, pp. 42–47. pl. 10, fig. 76.

Lyddekker, Richard, Cunningham, J. T., Boulenger, G. A., and Thomson, J. Arthur. 1912. *Reptiles, Amphibians, Fishes, and Lower Chordates.* London, 1912, p. 326, pl. XXVII.

McIntosh, W. C., and Prince, E. E. 1890. On the Development and Life-Histories of the Teleostean Food and other Fishes. *Transactions Royal Society Edinburgh,* 1890, Vol. 35, pp. 676 and 867.

Smith, W. Anderson, 1886. Notes on the Sucker Fishes, *Liparis* and *Lepadogaster. Proceedings Royal Physical Society Edinburgh,* 1886, Vol. 9, p. 145.
—1887. Domestic Habits of Butterfish (*Blennius gunnellus.* Linn.) *Proc. and Transactions Natural History Society Glasgow* [for 1883–86]. 1887, n.s. Vol. 1, 137–140.

DICYNODON PLATYCEPS BROOM, FROM NEW BETHESDA, CAPE COLONY

One-fifth natural size

The skull was found about ten yards away from the greater part of the skeleton and may not belong to the same individual, but it is undoubtedly the skull of the same species and of an animal of similar size. The fragments of the fore limbs were also found some yards away, and may not belong to the same individual, but they, too, are of the same species. All the rest of the skeleton was found associated

Fossil Hunting in the South African Karroo

By R. Broom, F. R. S.
Corresponding Member of the American Museum of Natural History

Some time during 1912, I resolved for various reasons to dispose of my collection of fossil reptiles to the American Museum. I had come out to South Africa in 1897 to work up the wonderful reptiles of the Karroo, and to try, if possible, to solve the problem of the origin of mammals; but it was not until 1900, when I settled at Pearston, that I was able to do any collecting or even to handle more than half a dozen specimens. Pearston is not rich, but I found enough specimens to keep me well occupied, and I began to send off numerous papers to London dealing with the fossil forms.

One or two English scientists in those early days seemed to appreciate the work I was doing, but it was from America and Germany that the principal encouragement came. The great importance of the Karroo fossils in the geological history of the world had been recognized years before. Owen, more than eighty years ago, first revealed the wonderful half-mammal half-reptile types. In 1888 Seeley visited South Africa under the auspices of the Royal Society and, with the assistance of Mr. T. Bain, collected many new, interesting forms and greatly added to our knowledge. His discovery of many new, strikingly mammal-like reptiles showed that the Karroo reptiles were much more important than had been realized, and the scientific world became intensely desirous of still more knowledge of them. Just before the Boer War, the American Museum was planning a fossil hunting expedition to the Karroo, but by the time the war was over, in 1902, I was in the field and had already done considerable work. Professor Osborn, who for some years had been deeply interested in the problem of the origin of mammals, wrote me kind letters of encouragement and of appreciation of the work I was doing. For a number of years I was attached to the Capetown Museum, and was unable to repay my debt of gratitude to America, but, after going to the Transvaal, in 1910, I hoped to get together a collection that would find a resting place in the American Museum, and one of which America would be proud.

I had a good representative collection from our lower fossil beds, and I got a fairly good one from the higher beds, but little was known of the fossils of the intermediate period, and there was no good collection in any museum. I learned that fossils had been seen at New Bethesda, a little village about forty miles north of Graaff Reinet, and, as this was almost certainly on the horizon I wished to study, I made a journey to it at the end of 1912. The village is situated in a deep valley on one of the upper tributaries of the Sanday's River. The surrounding hills are composed of shales and sandstones, with here and there layers of igneous rock. Though not entirely barren, the shales of these hills I soon found were very poor in fossils. But in the village, the river, which for the greater part of the year is dry, has a flat bed of shale about 200 yards wide, and this I found to be exceptionally rich. I don't know how long it would take an expert museum collector to collect from an area 50 to 200 yards wide and three-fourths of a mile long, but it took me the best part of a month working hard every day. The

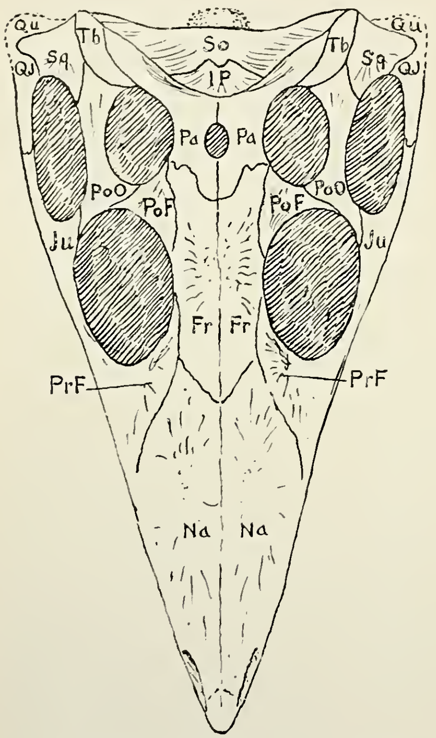


Fig. 2.—Skull of *Youngina capensis* Broom. About one and one-half times natural size

most striking specimens were skulls of a fairly large new species of *Dicynodon* which I named *Dicynodon platyceps*. It is a mammal-like reptile about the size of a half-grown pig, and of a somewhat similar robust build. The dicynodons are represented in the Karroo by many species—some as small as a rat and others nearly as large as a tapir. They had horny beaks like the tortoise, but with, in addition, usually a tusk in the male. Specimens were found of young animals of all ages, some as small as kittens.

One or two interesting skulls were found of the carnivorous types belonging to the Gorgonopsia,—a suborder of reptiles very near to the mammalian ancestor. Some remains were also obtained of a small Pareiasaurian,—a little form about five feet in length, with a broad head and the back covered with bony plates. But by far the most interesting discovery I made was the skull of a small new type of reptile, which I named *Youngina*.

Youngina is a lizard-like animal with a pointed skull of a primitive and most interesting type. The crocodiles, the dinosaurs, and many early reptiles have in the back region of the skull two large temporal openings. The lizards have only an upper one, but it looks as if there has been a lower one lost by the non-development of the lower bar; hitherto, we have had very few specimens which throw light on the early development of the lizard skull, and this skull of *Youngina* is the oldest known in good condition with two temporal openings. Two other specimens of *Youngina* have since been found, and the writer holds that it is the representative of a new order of reptiles which he calls the "Eosuchia." This order he believes contained the ancestors of the crocodiles, the dinosaurs, the birds, and the lizards. If he is correct in this, the great importance of *Youngina* in the evolution of the reptiles will be manifest.

I spent a few days on the farm Wilgebosch about four miles from New Bethesda and on a higher horizon. Here I found a number of new and interesting specimens, including the fine carnivorous skull which I named *Scymnognathus angusticeps*. Mr. I. H. Martins was also a guest at this farm at the same time, and, taking a keen interest in fossil hunting, he gave me much help. It was he who discovered the beautiful little skull which I named after him, *Ictidoshinas martinsi.*

As Wilgebosch is only about five miles from Compass Berg, the highest mountain in Cape Colony, Mr. Martins suggested that we climb it, as I might not again have so favorable a chance. We agreed to go the following morning. At 6 o'clock the mountain peak was covered with mist, but at 8 it began to clear. We got a pair of horses and started. The usual ascent is by the northwest side, where the climbing is not dangerous, but is very troublesome because of the broken nature of the ground, so we resolved to ascend by the east side. We rode as far up the base as possible and tied our horses to bushes, and ascended by a long, steep gully. The mountain, which is 8000 feet high, is formed by a huge sheet or mass of igneous rock so arranged and weathered that the north side has an irregular slope of about 45°, and the south side has an abrupt precipice of 2000 feet. The climbing was neither difficult nor dangerous till we reached the top of the crest overlooking the precipice, but here we seemed cut off from the very top, only 100 yards away, by a bridge about 30 yards long and 8 or 10 yards wide. Its top had a slope of 45° toward the 2000-foot precipice and there was only a ledge less than a foot wide on which to walk. After some hesitation and a ten-minute rest, we risked it. But at the end of the 30 yards we seemed balked again. We climbed up the few yards of slope to find a precipice of some hundred feet on the north side. With my help Mr. Martins climbed first over a projecting block which overhung the precipice, and then helped me up over the same block. Soon we were at the top, and had a glorious view for over 100 miles around. We descended by the same dangerous track as we had come, as it would have been difficult to get our horses otherwise. Near the bottom of the mountain I found another good *Dicynodon* skull. We were back at Wilgebosch in time for dinner. Coming down the mountain, I saw

Fig. 3.—*Scymnognathus angusticeps* Broom. This is one of the South African reptiles from New Bethesda closely allied to the better known Russian *Inostranceria alexandri*

burrows of the little garden mole, and was greatly interested, as I knew it must be a very rare species or a new one. I told Miss Jansen, the farmer's daughter, and asked her to try to get me one. When I returned to South Africa in 1916, I found she had a specimen in spirits awaiting me. It turned out to be the rare *Chrysochloris schalteri* which I had named some years before from near Beaufort West. Only six specimens have been seen, and this specimen is now in the British Museum.

I always think it is well for the fossil hunter or other naturalist not to confine his attention to one group only. When in the veldt after fossils, I always keep my eyes open for rare plants and have been able to add a considerable number of new species to the South African flora; and one of the most conspicuous aloes of the northern Karroo has been named after me, *Aloe broomi*. When one has gone fossil hunting and has drawn a blank, as often happens, it cheers one to discover a new or rare lizard or mammal or to find a new plant. Not long ago, when after fossils, I found a rare, succulent *Hoodia dregei* which was discovered in 1830 and has never been seen since. Even the ordinary tourist would find a new joy in life, if he took a keen interest in field botany or some branches of natural history.

A Journey in South America

By T. D. A. COCKERELL
Department of Biology, University of Colorado

WE went to Siberia because Mr. A. Kuznetzov discovered fossil insects on the banks of the Kudia River. For similar reasons, it appeared necessary to visit Argentina when we learned that Mr. G. L. Harrington had found insects of Tertiary Age in the rocks at Sunchal, in the Province of Jujuy.[1] The matter was of peculiar interest, as until very recently no fossil insects of any kind were known from South America. The first to be found were two species from the Rhætic beds near Mendoza, in the foothills of the Andes. These were discovered by Dr. G. R. Wieland, of Yale University, in 1917, but not published until 1925. One of them, a very fine specimen, belongs to the Homoptera; the other is fragmentary and dubious.[2] In 1923 I described two small flies from amber found in Colombia, of uncertain age, but not earlier than Tertiary. Ameghino, as I learned from Doctor Spegazzini, had some impressions of Pleistocene insects from Argentina, but they were not described, and cannot now be found.

Mr. Harrington's discovery was made in the course of his investigations for the Standard Oil Company. Going up a narrow trail in the Santa Barbara district, examining the greenish beds so prominent in that region, he was surprised to find a layer or pocket of well-preserved fossil insects, nearly all beetle wing-covers. Not only were these the first South American Tertiary insects, with the dubious exception of the amber flies, but they were of considerable importance as a possible means of dating the deposit, hitherto supposed unfossiliferous. Most of the specimens were sent to Dr. R. S. Bassler at the U. S. National Museum, and were transmitted to me for study.[3]

Thus it came about that on June 13 we took passage from New York on the S. S. "Vestris" of the Lamport and Holt line. For reasons of economy we went second class, and had no occasion to regret the arrangement. Indeed, it was especially fortunate, as I found next to me at table the enthusiastic Swiss anatomist Dr. Ernst Huber, now of Johns Hopkins University. The officers of the ship, from the captain to the cabin steward, did everything possible to make the voyage pleasant and interesting. As we crossed the line Father Neptune and his beautiful daughter came on board, and after the initiation ceremonies we were all presented with certificates, promising aid and comfort from the powers of the sea whenever needed. Actually, I have not felt the slightest tendency to sea sickness since that time. Neptune, when not engaged in his regular duties, appears on earth disguised as a noted polo player, a fact in natural history perhaps now first recorded. As we passed through the region of sargasso weed,[4] we tried to secure

[1]Cockerell, "Tertiary Fossil Insects from Argentina," *Nature*, Nov. 14, 1925, p. 711.

[2]A figure published by F. Kurtz (Act. Acad. Nac. Cienc. Cordoba, VII) of a fossil from Cacheuta, in the same vicinity, appears to represent the end of the wing of an Orthopterous insect related to *Elcana*, of the European Lias. Dr. Wieland kindly furnished me with a photograph of this figure, with the comment that it was surely an insect, though named as a plant (*Baiera argentina*).

[3]Seven beetles and a caddis fly were described; *Proc. U. S. National Museum*, Vol. 68 (1925) Art. 1.

[4]*Sargassum*, a genus of large floating seaweeds with very numerous species.

Rhætic locality at Minas de Petroleo, Argentina. (Photograph by D. O. King.)

some by means of an improvised wire hook on the end of a string. Many trials were unsuccessful, but at last a persistent passenger secured a piece, and with the aid of a small microscope we were able to demonstrate the presence of various small animals. Later on, the captain interested himself in securing samples of the ocean bottom for us, which he brought up on the sounding lead. The surface waters, expected to be full of plankton, were barren so far as our few examinations showed.

We had a day and a half in Rio de Janeiro. I have elsewhere[1] described my visit to the Institute Oswaldo Cruz, one of the finest scientific establishments I have ever seen. However, it was not possible to do any natural history work of consequence at Rio, but I managed to collect a number of insects and snails in a vacant lot just across from the docks. Most conspicuous were the Orthoptera or grasshoppers.[2]

On the evening of July 3 we had a short time in Montevideo, where we saw armadillos and snails offered for sale as food. The snails were *Helix lactea,* or a closely related form, introduced from southern Europe, where it is much eaten.

It was dark on July 4 when we arrived in Buenos Aires, and we made our way to the hotel in a storm of rain. Although it was not freezing, we had rarely felt so cold, coming as we had out of the tropics, and not being suitably dressed for such weather. The hotel was not heated, and we thought we were in for a rather uncomfortable time. From this discomfort we were rescued by Mrs. Harrington, the wife of the discoverer of the fossils. Mr.

[1]*Nature,* Dec. 26, 1925.

[2]For determinations of species collected or observed I am greatly indebted to Messrs. Rehn (Orthoptera), Aldrich (Diptera), Wetmore (birds), Rohwer (Hymenoptera), Dyar (mosquito), Killip (flowering plants), Seaver (fungi), Arthur (fungus), Barber (beetles), Bartsch and Henderson (marine shells), Williams (moss), Maxon (fern), and Rose (cacti).

Harrington was exploring in Bolivia, but he had spoken of us, and we were invited to the home at Haedo, a suburb of Buenos Aires, whence I came in daily on the "subterraneo" to do what business was necessary in the city. This was our first experience of the extraordinarily kind treatment which we received everywhere we went in South America.

It was a great pleasure to meet several of the prominent scientific men of Argentina, whose names had been familiar to me for many years. Dr. E. L. Holmberg, the veteran student of bees, was extremely cordial, and allowed me to examine his collection freely. He is a most versatile man, who has worked in literature as well as science. He presented to Mrs. Cockerell an autographed copy of a book of poetry, in which he narrated the legends of the country. He expects to publish more on *Coelioxys*, his favorite genus of bees, and on the wasp-genus *Cerceris*. His published work on bees has been accurately done and clearly set forth, forming an important contribution to the knowledge of the Argentine fauna.

The Natural History Museum, directed by Dr. Doello-Jurado, is full of interesting things. Unfortunately, owing to crowding, it is divided into two sections, some distance apart. It is expected that a new and suitable building will be provided later. Dr. Doello-Jurado is a specialist in mollusca, and has developed an excellent collection of the species of the country. He showed me a small white *Helix* (in the broad sense) from Mendoza, which he was about to publish as new. In the museum I also found the well-known entomologist Juan Brèthes, whose writings on Hymenoptera I had been using for many years. We took time to see the botanical and zoölogical gardens. In the latter we were pleased to see living rheas, the "ostrich" of the country. These were the Argentine race, and were labelled *Rhea americana rothschildi*, a name given by Brabourne and Chubb in 1911. It happens, however, that in 1878 Lynch Arribalzaga and Holmberg proposed a *Rhea albescens*, which was nothing more than albinistic specimens. Wetmore (1926) points out that this was certainly of the Argentine form, which accordingly becomes *Rhea americana albescens*. In our subsequent journeys we saw no wild rheas, but they must be rather abundant, to judge from the great numbers of feather dusters, made of rhea feathers, offered for sale. The other species, Darwin's rhea, is now placed in a separate genus *Pterocnemia*, and the little-known name *pennata* of d'Orbigny replaces the familiar *darwinii* of Gould, which was based on a proper description of the bird. When later I met Mr. D. O. King at Mendoza, he told me of seeing rheas high up in the Andes in that region. He supposed them to be like those of the plains, but Doctor Wetmore tells me that they are really different, the *Pterocnemia tarapacensis garleppi* of Chubb. The species *P. tarapacensis* is from Chile, and the original *garleppi* is from much farther north, in Bolivia.

Taking the train, we went to the city of La Plata to see the famous museum, and especially the eminent naturalists C. Spegazzini and C. Bruch. The former is a botanist who has described innumerable fungi, many cacti, etc., and also has a good knowledge of zoölogy.[1] The entomologist Bruch, specializing in Coleoptera and ants, has perhaps the most perfectly prepared and arranged collection I

[1]Since we left we have had to lament the death of Doctor Spegazzini.

ever saw. At the time he was very keen about a large genus of Tenebrionid beetles, and had borrowed specimens from the British Museum to complete his monograph. He had prepared excellent photographs of all the species. He also had some very remarkable beetles obtained in ants' nests. The problem is, at present, how to publish all this admirable work. The museum, with statues of sabre-toothed tigers at the entrance, has been described by others. It was surprising, even after all we had heard, to see the many skeletons of extinct Argentine mammals, especially ground-sloths.[1] We were interested to note in La Plata a broad avenue named after the palæontologist Ameghino, who described so many vertebrate fossils.

After about a week at Buenos Aires, we took the train for San Pedro de Jujuy, far to the north, near the Bolivian border, and almost on the tropic. We had been advised that for facilities we should have to depend on the Leach Brothers at San Pedro, so I had called on the manager of the Leach firm in Buenos Aires. Shortly before we left, he produced a telegram, and said he could congratulate us on being invited to the Estancia. How much reason he had for his congratulations, we came to appreciate later, for the open-hearted hospitality exceeded anything we could have imagined or hoped for.

The Leach firm has had a remarkable history. In the Province of Jujuy it was discovered long ago that sugar cane could be grown to advantage. In the effort to develop the industry, machinery was imported from England, and a young engineer, Roger Leach, came out in an advisory capacity. He remained at San Pedro, and after a time it appeared that for various reasons the enterprise was not succeeding very well. Leach was convinced that success was possible, and so he and his brothers (four eventually came out) raised a loan and bought the business. They did so well that the money was repaid, with interest, in five years. It is now about forty-five years since the arrival of Roger Leach, and there has been built up a great series of estates or farms in the Province of Jujuy, raising not only vast quantities of cane, but also fruit, and even operating an asphalt deposit, from which the town of Jujuy has been excellently paved.

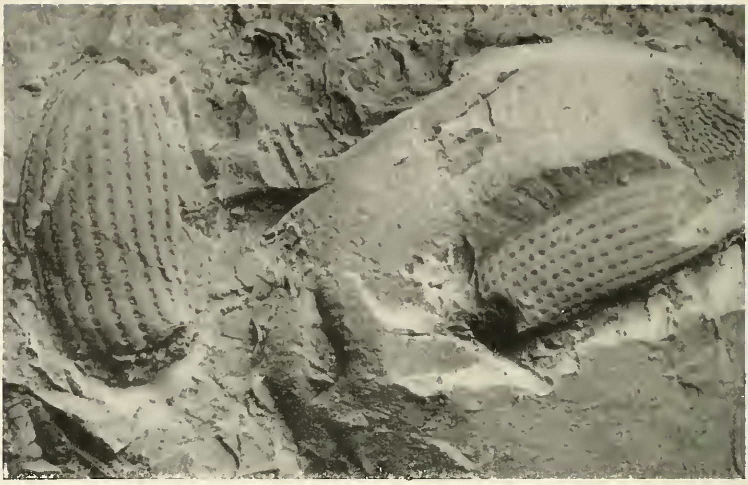
We were taken over the great sugar mill, and there I met Mr. Stephen Leach, and spoke of the wonderful work accomplished. He modestly disclaimed any particular merit, saying that he and his brothers had merely come to make money. Feeling that this was not the true explanation, I asked some who were in a position to know, and they told me that money appeared to mean little to the Leach brothers, who lived in the simplest manner, and devoted themselves to the welfare of the business and of the employees. What, then, is the underlying motive which has prompted and maintained such labors, extending over so many years? No doubt it is the same as that of the scientific man, the artist, or the statesman; the desire for self-expression and the accomplishment of worth-while things. I emphasize this point, because it illustrates the fact that public service, of one sort or another, is capable of satisfying human desires; and further, that an ostensibly private establishment like that of the Leach brothers operates as a public service,

[1]The extinct ground-sloths of Argentina are being elaborately described by Lucas Kraglievich of Buenos Aires. Recently I received from him two papers recording important discoveries.

especially if conducted as it has been. Just as we think of Harvard and Yale as great public institutions, though legally private corporations, so it comes about that big business has aspects in which it differs little from publicly owned enterprises. On the other hand, democracy cannot conduct its affairs without employing experts. If the Leach estates were turned over to the people of the vicinity tomorrow, their history would resemble that of many estates in Russia. Bernard Shaw humorously remarked that Scottish widows could lay an Atlantic cable, and did so, by getting people to do it for them. Thus, and thus only, may technical industries be maintained and in any event the experts must be given powers as use-owners. The subject is a fascinating one, and I should like to write a book on the Leach estates; not at all in defence of capitalism, but as a study of the means whereby great functions may be developed in society, and of the underlying motives and interplay of human interests.

Going up in the train, we had the great advantage of being accompanied by Mr. Eugene Stebinger of the Standard Oil Company, who was on his way to Bolivia. Knowing the country, he helped us in many ways, and we were indebted to him for the loan of a small water-proof tent, without which we could hardly have maintained a camp at Sunchal. Passing over the great pampas, I was pleased to see the pampas grass, familiar on English lawns from childhood days, growing wild. We had to change trains at a small town called Perico, and strolling down the street, I found a large colony of earwigs (*Doru lineare* Esch.) under the bark of a Eucalyptus tree. The species was originally described from Brazil, but is very widely distributed, even entering southern Texas and Arizona. Arriving at San Pedro, we were met by Mr. Roy Gordon Anderson, under whose hospitable roof we were to stay. Mr. Anderson is specially concerned with the stock interests of the estates, including the development of polo ponies. He and his wife keep open house for visitors of many kinds, who seem to be constantly coming and going. It was the time of the sugar harvest, and every one was busy. Thousands of Indians were cutting the cane. I was interested to learn what I could about the insect enemies of the cane in that region. They have a moth-borer, and at times the migratory locusts do fearful damage. I could not find any mealy-bug; and various other pests common elswhere appeared to be absent. The region is quite isolated from all other sugar-cane districts, which is a decided advantage. Though it was nearly the middle of the southern winter, the Anderson garden contained flowers and fruits. There were some of the common introduced scale insects. The fungus *Phragmidium disciflorum* was found upon the roses. I noticed a flourishing group of tall lantana bushes, and wondered whether there might be danger of their spreading and becoming a pest, as in the Hawaiian Islands. A search in the immediate vicinity revealed no seedlings. It was in the Anderson garden that I caught the only bee of the Argentine journey, a small species which I have described as new, *Halictus hiemalis*. In the warmer months there must be a rich bee-fauna, undoubtedly with many yet undescribed.

At the nearby settlement called Esperanza, where the sugar mill is situated, the estates maintain a hospital, and here I met Dr. Wm. C. Paterson, who is making a study of the



Fossil beetle elytra from Sunchal, much enlarged. The larger one is *Otiarhynchites aterrinus*. Photograph by R. S. Bassler

local mosquitoes. He showed me a fine species which he believed to be new. In the summer *Anopheles* abounds through all this region, and there is a good deal of malaria.

We now had to proceed to Sunchal, in the Santa Barbara mountains, a considerable distance east of San Pedro. Mr. Harrington had sent me a sketch map of the route. Mr. Anderson picked out for us a most excellent man, Daniel Rios, who took charge of the mules and helped us in camp. We were taken in an automobile as far as there was a road, well beyond the village of Santa Clara, and found Rios with his brother waiting for us. We had come through a dry region of cacti and scrub, with here and there a small palm. The large blue-green *Opuntia tuna-blanca* of Spegazzini was very conspicuous. Peccaries live in this open forest; we passed a man by the roadside with two which he had shot. Leaving the car, we took to the mules, and were soon in a very hilly country, going up and down steep trails, on which it was none too easy to keep our seats. After some hours of this, we were not sorry to stop for lunch. All afternoon we rode with increasing weariness, but in the evening reached our destination. Sunchal is not a town, but merely the name of a locality on the map, where there is a single, very poor ranch house. We pitched our tent in the orchard, under a tree. The ranchman was away, but the women treated us kindly, though they must have wondered what brought us there. Perhaps they were not altogether unfamiliar with wandering geologists, for the oil people go everywhere. It was striking to see the poverty and, as it seemed to us, wretched condition of the people, while their animals and poultry appeared most flourishing. The face of the older of the two women was horribly deformed from the Uta or Leishmania disease. Dr. Paterson thought it possible that the transmission of this disease might be due to buffalo gnats, species of *Simulium*. He had observed that where it developed there always seemed to be a running stream, suitable for the larvæ of

Simulium. There was just such a stream by the house at Sunchal, with water-cress growing in it.

We did not quite understand Mr. Harrington's directions, and it was more by good luck than intelligence that we found the deposit on the first morning. When we stopped for lunch on the way over, between Santa Clara and Morteras Pass, a little of the greenish rock was observed in the roadway, and in it we found an imperfect beetle elytron, resembling *Anthonomus sunchalensis*, but with the apex more pointed. The Harrington locality is some distance up the gulch from Sunchal, in a westerly direction. The trail branches at the bank of the little stream, and it is necessary to turn to the left, crossing the stream at this point. The exposure is on a hillside, right on the trail. Five minutes walk beyond, where a large tree has fallen over the trail, is another good exposure, rich in fossils. It was at this latter place that we found the little fish *Corydoras revelatus*, an armored catfish, the first member of the family Callichthyidæ to be found fossil. It is, of course, a fresh-water form. The rock represents solidified mud, which comes out in small blocks, with a conchoidal fracture. The insect remains are numerous, but fully 95 per cent beetle elytra. It is very rare to find two elytra together, and we get the impression that most of the specimens may come from the excrement of fishes. The fossils are preserved without compression. All the species so far discovered are small. Two of the elytra, belonging to the Cerambycidæ or long-horn beetles, are beautifully marked; one appears to belong to the existing Neotropical genus *Haruspex*. Aside from beetles, we obtained the forceps of an earwig (*Psalis*), part of the wing of a male cricket, a small plant-bug (apparently *Corizus*), and two species of Fulgoroid Homoptera, one referred to a new genus, the other to the existing genus *Ormenis*. There were also characteristic hind legs of a jumping Orthopterous insect. Undoubtedly much more material will be collected later on, now that the locality is known. I left exact particulars both at the museum at Buenos Aires, and with Doctor Spegazzini. The green rock extends over a large area, and I understand that remains of insects have been found farther south. It is interbedded at intervals with layers of heavy limestone at the Harrington locality. From the train I was able to see apparently the same kind of rock similarly interbedded, a short distance north of Perico. I also saw apparently the same deposit north of Tucuman, in many places weathering to make greenish soil.

This deposit appears to represent an ancient (Tertiary) lake, into which muddy rivers flowed. In its upper part it shows streaks of red, which increase until we come to an entirely red deposit, this gives the name to the Rio Colorado, which flows near Sunchal. We assume that we have clear evidence of increasing aridity, culminating in what were wind-blown desert sands, apparently wholly unfossiliferous. Above this is a thick yellowish deposit, still more recent. The insect-bearing shale, which we may term the Sunchal Formation, must be considered Upper Tertiary, very possibly not earlier than Miocene. As to the formations below it, I have no special opinion of my own. We followed up the gulch, and found older shales without distinct fossils. Still beyond, the rock is Devonian, and we were shown a very good trilobite picked up as "float" in the same gulch. The folding and faulting in this region is excessive, so that it is very easy to make mistakes in geology. In a letter dated October 1925 Mr. Harrington says: "Have you any idea as to the age of these (insect-bearing) beds? That really is the 'question that agitates the public mind,' and I have been puzzling my head for the last five years over the age of the beds above the micaceous, fissile, black Devonian slates, and hope that the results of your studies here may throw some light on it. You know the limestone some distance below the beetle beds or variegated shales contains some turritelloid forms that I have forgotten the name of, but it appears that that particular genus may range down almost to the Triassic as well as up nearly to the top of the Cretaceous or thereabouts. Between that and the Devonian slates we have found no fossiliferous beds throughout the whole range of the territory from Jujuy to northern Bolivia east of the Andes."

The turritelloid shells, not found near Sunchal, were figured and named by the Argentine palæontologist Dr. Guido Bonarelli. He ascribed them to marine genera characteristic of the Triassic and Jurassic. From the figures I got the impression that they were fresh-water or non-marine forms such as we get in North America in the Cretaceous and especially the Eocene. Dr. T. W. Stanton, on being consulted, said he would not venture a definite opinion, but his impression was similar to mine. The general outcome would be, that this part of South America has been a land area for a very long time.

Bonarelli figured a "problematical fossil," which he did not venture to name, but which was suggestive of the Precambrian algæ types (such as *Collenia*) figured by Walcott in 1914. We found a characteristic block of this material, much too heavy to bring away, close to the fossil locality. It is supposed to be very much older, but I had the impression that it might have come out of the interbedding Tertiary limestone.

Although we were nearly on the tropic, the weather was cold, and there were few insects about. During a good part of the time we were in a Scotch mist, and all night the moisture condensed on the branches of the tree above our tent, producing a monotonous drip, drip, drip. The forests represent a dilute tropical biota, with magnificent trees, but no palms, nor were any monkeys seen. Great flocks of green parrots flew about, making a good deal of noise. At the ranch house they had one in captivity, and the notes I made on this enabled Doctor Wetmore to determine it as *Amazona aestiva*, originally described by Linnæus from southern Brazil. A fine looking jay, of large size, with a high pointed crest, and pale yellow under side, was *Cyanocorax chrysops*, probably (says Doctor Wetmore) of the subspecies *tucumanus*. I also saw what I took for a large rusty-red woodpecker, but it was really a passerine bird with the habits and appearance of a woodpecker, presumably *Xiphocolaptes major*. Doctor Wetmore, who corrected my erroneous impression, remarked that "the birds are wholly woodpecker-like in appearance and action," so they represent an astonishing case of "convergent evolution." I had often read of the Dendrocolaptidæ, and was particularly pleased to have seen one, and to have been appropriately deceived.

Close to the tent a large shrubby groundsel, *Senecio brasiliensis*, was in full flower. Its leaves were infested by a rust-fungus. Two species of large columnar cacti (*Trichocereus*) were conspicuous in open ground. A *Solanum* (potato genus) with large broad lanceolate leaves, white flowers and red berries, was the leading herbaceous plant on the forest floor in the gulch. The ferns were many and varied. The nettle *Urtica darwinii* recalls the voyage of the "Beagle," though Darwin never visited this particular region. The common dandelion, of course introduced, was reminiscent of home. Two characteristic compositæ were *Onoseris hastata* (described from Bolivia) and *Tagetes tenuiflora* (described from Ecuador). In general, the plants and animals appeared to range principally northward, though often south as far as the vicinity of Tucuman. There was hardly any resemblance to the flora later observed in the vicinity of Mendoza.

The greatest disadvantage came from the abundance of ticks and those larval mites often called chiggers. We not only suffered severely at the time, but could still feel some of the effects after getting back to Colorado.

When we came to make the return journey, we thought at first to take two days, and spend a night in the forest. But at the spot we had in mind there was no suitable forage for the mules, so we pushed on as far as the village of Santa Clara. Here night overtook us, and we were also thoroughly tired out. Asking permission to camp in the field in front of the best house we saw, we were recipients of the hospitality of Mr. and Mrs. Juan Tache, who did everything possible for us and would take nothing in return. The next morning an automobile came from Mr. Anderson's, and we were soon in San Pedro. Leaving San Pedro for the south, we took occasion to spend a night in Jujuy, the capital of the Province, and make the acquaintance of a local naturalist, Mr. Carlos Schuel, who has charge of the "Museo Provincial." The next day, having to change at Tucuman, we looked up the traffic manager for advice, and found a very cordial Irishman, from County Clare. We spent only a few days in Buenos Aires this time, but were fortunate in making the acquaintance of Messrs. Carlos A. Lizer and Everard E. Blanchard, specialists in scale insects and plant lice respectively.

On July 29 we left Buenos Aires, going directly westward across the plains to Mendoza, in the vicinity of which is Wieland's Rhætic locality, where he got two fossil insects. Arriving at Mendoza, we hastened to look up Mr. D. O. King, a member of the local railway administration, but also an extremely keen geologist, well acquainted with all the strata in the region. He is an Englishman, son of King of the Indian Geological Survey, and grandson of the geologist who is now especially remembered in connection with *Homo neanderthalensis*. Mr. King at once interested himself in our project, and through him we met Dr. Edwardo Carette, director of the public museum. Through the mediation of Doctor Carette, the Board of Education very kindly supplied an automobile with driver, to take us out to the Minas de Petroleo, the fossil insect locality. It was an all day trip, and the party included Doctor Carrette, Mr. and Mrs. King, Mr. Julio Mácola, and ourselves. The precise spot was found, and very soon we were getting out extremely fine fossil plants, and also finding plenty of the mollusc-like crustacean, *Estheria mangaliensis*. But with all our labors, we failed to find any remains of insects, and I very recently heard from Mr. King, saying that he had searched since we left, without success. They appear to be extremely scarce, but undoubtedly more will eventually be found.

Messrs. Carrette and Mácola are skilled botanists, and were able to give me the names of the various plants growing in the locality. As is well known, this desert flora has many features which recall that of Arizona and Northern Mexico. About forty species were identified, six of them being cacti. It was especially interesting to see two kinds of creosote bush, *Covillea divaricata* and *C. nitida*. Just

Rhætic plants from Minas de Petroleo, Argentina. (Photograph by Coulson.)

as in Arizona, the olive green bushes form a conspicuous feature of the landscape, extending up the valleys, and growing at intervals almost as if planted. In Arizona there is a very characteristic lac-insect (*Tachardiella larreae* Comstock) on the creosote bush, but at Mendoza the local lac (*Tachardiella lycii* Leonardi) is on *Lycium chilense*. We found the *Lycium*, but not the lac. The indications are that *Covillea* originated in the south, and spread northward in one species. The closely related genera inhabit the southern Andean region, and it is there that the genus shows some diversification, *C. nitida* being very distinct and peculiar. The same sort of thing appears to be true of *Prosopis*, or mesquite. We have in our southwest a few forms coming up from Mexico, representing two very different types often separated generically. At Mendoza we observed three species, *P. alpataco*, *P. striata* and *P. strombolifera*, the latter being a screw-bean, like our southwestern *P. pubescens*. One of the Andean forms is so like the North American *P. juliflora* that it has recently been proposed to regard them as identical. Doctor Rose writes that he doubts this conclusion, and considers that further critical study must be given to a number of closely related species in South America. He also thinks our *Covillea* distinct from all those to be seen in Argentina, though *C. divaricata* resembles ours very closely indeed. When we consider that on the west coast of South America desert conditions prevail almost to the equator, it is not so difficult to see how members of the Andean desert flora may have spread northward in earlier times. Whether the seeds may have been carried by migrating birds over part of the distance I do not know. There is a strong argument against actual continuity of desert at any time from Peru to Guatemala, not only in the nature of the country, but also in the failure of many types, especially of insects, to spread from the one region into the other. This whole problem of the northern and southern desert biota is of the greatest interest, and would well repay a lifetime of study.

The Mendoza country, in the first half of the nineteenth century, was the hunting ground of Gillies, who used to send plants to Hooker in England.

Aconcagua, 23,050 feet, the highest point in the Western Hemisphere, as we saw it when crossing the Andes from Mendoza, Argentina, to Valparaiso, Chile. (Photograph by D. O. King.)

Consequently, among the plants observed at Minas de Petroleo were *Trichocereus candicans* (Gill.), *Verbena scoparia* Gill. and Hook., *Berberis grevilleana* Gill. and Hook., and *Collinguaya integerrima* Gill. and Hook. However, Gillies did not succeed in recording all the plants; thus we observed the cactus *Malacocarpus catamarcensis*, the specific name of which was given by our friend Spegazzini.

On looking up the Mendoza plants in the Index Kewensis, I found that very many were said to come from Chile. This is misleading, and apparently due to the fact that when they were described Chile did not have its present boundaries, nor indeed were they distinctly settled. It used to be easier to get to Mendoza across the Andes than over the plains, and thus the whole country was, in a manner, tributary to Chile. The flora of the two sides of the Andes in this latitude is very different, as we were able to observe when we went across. It is a singular thing that in the more southern part of the Andes, as about Mendoza, it is the east side which is arid, while the west is much moister; whereas northward, in northern Chile and the whole length of Peru, the west coast is extremely arid, while the eastern slope is moist tropical.

Not to rely too much on impressions from the train, I took for comparison Jaffuel and Pirrion's list (1923) of the Flora of the Marga-Marga Valley, inland from Valparaiso. Of the forty species definitely noted at the Minas de Petroleo, the following are in the Marga-Marga list: *Lycium chilense*, *Proustia pungens* (but represented on the Mendoza side by a distinct variety *ilicifolia*), *Baccharis rosmarinifolia*, *Schinus dependens*, *Marrubium vulgare* and *Xanthium spinosum*. The last two, being common introduced weeds, are of little significance. In addition, the following observed genera were represented by different species in the Marga-Marga list: *Berberis, Cassia, Gochnatia, Verbena, Lippia, Fabiana, Collinguaya* and *Tillandsia*. The rows of lombardy poplars, much planted on both sides of the Andes, were observed to be much infested with mistletoe on the Chilean side. Perhaps the most striking point of difference is in the Cactaceæ, which abound in species and individuals in the region of Mendoza, but in the Marga-Marga Valley are represented only by *Trichocereus chiloensis* (Colla), which is common, and an undetermined "*Echinocactus*."

The journey across the Andes, on the Transandean Railroad, is a wonderful experience. The beauty of the snow-capped mountains and the rich colors of the rocky slopes can hardly be described. We were fortunate in getting a good view of Aconcagua, 23,050 feet, the highest peak in the western hemisphere. Coming down on the other side, we found spring in Chile. We spent a night at Los Andes, in order to have a daylight ride across Chile to Valparaiso. In Valparaiso we found a most excellent hotel with extremely moderate charges, and had a short time to see something of the city. We climbed up on the heights back of the town, and finding a good many flowers, expected to see some of the native bees. In this we were disappointed, but we got some very beautiful flies. We sailed from Valparaiso August 5, on the "Santa Ana," and on August 7 had a chance to go ashore at Antofagasta. This was the most barren place I had ever seen. When I started out with my net, one of the passengers, who had been there before, laughed at me for expecting to catch anything. "You may," he said, "possibly get some fleas in town!"

I had never seen a desert where there was nothing to be had, so I walked boldly on to the rocky slopes back of the town, expecting to see some sort of desert flora. I could not find a blade of grass, or any green thing, except a small seedling *Mesembryanthemum*, with nine leaves. I caught two insects, a pallid Thysanuran and a small moth. Returning to the town, we examined the small park, full of flowers, and the few gardens. These are watered, I understand, from tanks brought down on the railway. About the gardens were some common weeds, *Malva rotundifolia* (mallow), *Erodium cicutarium* (alfilaria) and *Sonchus* (sow thistle). From under stones and dead leaves we got some interesting Tenebrionid beetles, and under dead birds on the shore carrion beetles, *Dermestes vulpinus* and a prettily colored *Saprinus*, the latter new to the U. S. National Museum. Certain flies found along the beach are reported by Doctor Aldrich to represent new genera of Ephydridæ and Sarcophagidæ. Before returning to the ship, we collected marine shells at the water's edge. The most interesting, found in considerable numbers, was the little *Rissoina helena* Bartsch, described in 1915 from two specimens with no better locality than "Peru." It was thus an addition to the Chilean fauna. The other shells were ordinary enough. An excellent summary of the marine shells of the Peruvian Province, including northern Chile, was given by Dall in *Proceedings U. S. National Museum*, 1909.

We did not go ashore at Arica, but stood for a time close to General Pershing's ship, near enough to be cheered by the sound of our national air, played by the band on board.

Coming to Ilo, at the southern end of Peru, we were halted in the evening in order that disinfectants might be pumped into the hold, an apparently futile proceeding. Many moths and some other insects came to the ship's lights, and I made quite an interesting collection. It was essentially a sand-hill fauna, with *Deilephilia*, *Agrotis* (sens. lat.) and other things reminding one very much of the sand-hill Lepidoptera of Europe. On August 10 we reached Mollendo, and there left the ship to proceed by rail to Arequipa. Before leaving Mollendo, I examined a heap of stones in a very arid spot, and found a spider and a Thysanuran. The Thysanura are primitively wingless insects, often appearing fond of hot places. One species, for instance, occurs in bakeries. Did the first terrestrial insects have such habits, and if so, does that in part explain why we do not find them fossil, as we might expect to do, in Devonian strata?

The journey up to Arequipa was very interesting, and has been described in various books of travel. The train goes for some distance near the shore, enabling us to see a rather extensive sand hill flora. Then it turns inland, and crosses a perfect desert, which is here and there irrigated, and is then very fertile. At Ensenada cotton is grown and at Tambo sugar-cane was brought to the train. Presently we began to ascend the steep foothills, which are covered with verdure at an altitude of about 1,000 to 1,500 feet. This is the result of the fogs coming in from the sea. There is a great dearth of woody plants, but some cacti, and brightly colored flowers. The flora is by no means the same as that about Arequipa. Leaving this region, we came to another desert, with the famous crescentic dunes of blown sand. It was evening by the time we reached Arequipa, after a truly eventful journey. The extreme aridity of this coast is explained by the high mountains, which precipitate the moisture to the east, and the cold Humboldt current, which causes the rain from the Pacific to fall before reaching the coast. At rare intervals, this current is in some way deflected or changed, and warm water flows near the shore, resulting in torrential rains. This had happened a few months before we visited the country, and we could still see the effects at Arequipa and elsewhere. Such rains are destructive to buildings and vegetation, but were the current permanently altered in such fashion, the climate of the whole coast would be entirely changed. The character of the fauna and flora shows that such conditions as now obtain have remained essentially constant for a very long while.

We spent a night in Arequipa, and then started for Cuzco, which my wife was especially anxious to visit. The first day's journey is to Juliaca, 12,550 feet altitude, not far from Lake Titicaca. The ascent from the Arequipa Valley is rapid, and we pass through a region of desert vegetation, with many flowers, and eventually come out on the roof of the world, the home of the llama, where the vegetation is mainly bunch grass. But unfortunately, these matters suddenly ceased to interest me, for at an altitude of about 13,500 feet I succumbed to the dread malady "soroche," or mountain sickness. The symptoms have often been described, and I need only say that I was completely prostrated. Very rarely, a passenger dies under these circumstances; the majority experience more or less discomfort but many are immune. Fortunately, my wife was not affected, and other passengers in the car were as kind and helpful as possible. I remember especially Mr. A. G. Maurique of Arequipa, who was indefatigable. We went over the highest pass, Crucero Alto, at 14,688 feet, and in the evening arrived at Juliaca, where I could do nothing but go to the hotel. After a very wretched night, I was carried to the morning train, and prostrate on soft llama rugs, returned in disgrace to Arequipa. It was of course a very great disappointment, in addition to the discomfort, for who knows what we might have seen and discovered in that high country? Even after reaching Arequipa (7,550 ft.) I had to spend a couple of days in bed. On the third I cautiously walked around the plaza, and witnessed a very interesting religious procession. After that I felt recovered, and was able to go about as usual. We were established at the Hotel Wagner, where we were very well taken care of, and had most comfortable quarters.

The Arequipa Valley is fertile under irrigation, much as the Salt River Valley in Arizona. The surrounding country is much like the Arizona desert, with scattered vegetation of many species. The city is a fine one, and to me was more attractive than Lima. Although the people in general are poor, and often wretchedly clothed, they seem cheerful, and are orderly. I saw no one drunken or behaving in an objectionable manner. Everywhere we were treated courteously. As one walks round the plaza, the magnificent cone of the volcanic Mt. Misti comes into view above the cathedral. This particular view is certainly one of the finest in the world; one is reminded at once of the pictures of Fujiyama in Japan. Misti is, however, 4,973 feet higher above sea level. We visited the Protestant Evangelical Mission at 414 Calle Mercadores, and were much interested in the good work being done. United States "culture" reaches the Arequipans in the form of movies, and one of the first things noticed was a huge announcement that Carlitos Chaplin was to be seen upon the screen. We denied ourselves this pleasure, but later, one evening, went to the movie at a venture, not knowing what was offered. What we saw was "The Ghost of Slumber Mountain," in which the dinosaurs come to life. We had seen the same film in Boulder several years before.

Naturalists are scarce in Arequipa, and the surrounding country is full of undiscovered things. Happening to go to the railway station to return the unused tickets from Juliaca to Cuzco, I found Miss Corry, who told me that her father, the chief engineer of the Southern Railways of Peru, was very much interested in botany. Unfortunately he was away at the time. Mr T. A. Corry was very helpful to Doctor Rose when he was investigating the cacti of the region, and we were much pleased to find at Tingo the fine species with lemon-yellow flowers, now called *Corryocactus brevistylus*. We were especially fortunate in making the acquaintance of Dr. Edmundo Escomel, a leading physician of the city, who is enthusiastically devoted to natural history, and has made many discoveries. His house is a veritable museum, and he has sent out specimens to specialists in various countries, so that his name often occurs in the literature. On the day we first met him, we had been to Tingo, and had captured the handsome black bee *Anthophora escomeli*, while we had been bitten unmercifully by the elegant little buffalo gnat *Simulium escomeli*. Several species of Hymenoptera, a neuropteron, a mosquito, a moss, and a large frog found in Lake Titicaca, have all been named after Doctor Escomel. He has had little time for taxonomic work, being overwhelmed by patients, especially since in the goodness of his heart he treats the poor without charge. He has however specialized in the blister-beetle genus *Pseudomeloë*, which was used medicinally by the ancient people of the country.[1] He had recently revised the Peruvian species, six of which he had first described, while another, discovered by him, was named in his honor by Denier. Having seen these beetles in his collection, I was astonished to find at Tia Baya another species, not there represented, abundant on the little boraginaceous plant *Coldenia parviflora*. I had, in fact, discovered a new species of *Pseudomeloë* in Doctor Escomel's own district! He has since described it as *P. cockerelli*. Later, I found a single specimen of this new *Pseudomeloë*, on the same plant, at Yura.

We made many trips to Tingo, a suburb reached on the street car. It was by far the best collecting ground we found. We got twenty-three species of bees, of which ten were new to science, including a very remarkable new genus, with Australian affinities, captured by my wife.

From Tingo an omnibus runs to Tia Baya, where we spent a good part of one day. Only one new bee was obtained, but we got the new beetle already mentioned, and some other interesting things. A remarkable little cactus turned out to be *Arequipa leucotricha*, the generic name given by Britton and Rose in reference to the city near which it occurred. Another excursion was out into the desert toward Mt. Misti. It was excessively dry, but there were several flowers, including the handsome Bignoniaceous *Tecomaria arequipensis* (Sprague). A *Grindelia* or gum-weed looked very like our common Colorado species; Mr. Killip finds nothing like it in the U. S. National Herbarium, but suggests that it may be the *Grindelia peruviana* which is mentioned in the literature, but seems not to have been described. The curious fungus *Battarea digueti* Pat. reminded me of very similar forms I used to find in the deserts of New Mexico. I was much surprised to find a moss (*Anomobryum filiforme*) and a fern (*Notholaena arequipensis*) growing under excessively arid conditions. Williams had already recorded the same species of moss from a dry hillside at Santa Rosa, Peru. The fern was described a few years ago by Doctor Maxon.

Just before leaving Arequipa, we took the train and went up to Yura, 8,450 feet, a place famous for the hot medicinal baths. We got only one new bee not obtained elsewhere, but found the plants very interesting, many quite analogous to those of New Mexico and Arizona. The *Encelia canescens* showed two distinct forms, growing side by side. In one the foliage was greenish white, in the other light green, in great contrast. Doubtless they are Mendelian segregates, but the former would be expected to be adapted to more arid conditions. Near the warm stream was a great quantity of *Mesembryanthemum*, and we found *Mimulus* in flower. There were two handsome species of the potato genus, *Solanum phyllanthum* and *S. radicans*. A dodder (*Cuscuta*) looked like those of the United States. *Senecio teretifolius* was a groundsel allied to a species of our southwest. Although both the Mendoza and Yura floras reminded us

[1] Called Ychuccaspa in the Quichua language; see *Bull. Soc. Path. Exotique*, XVI, (1923), p. 621.

in many respects of the deserts of North America, they did not remind us of one another. Yura is very much poorer in woody species than the Mendoza district. A species of mistletoe referred to *Phrygilanthus cuneifolius* was found in both regions, though the plants seemed to me to be appreciably different. At all events, the seeds of this genus are readily carried by birds, so we should expect a wide distribution.

On August 24 we were back at Mollendo, and took passage on the "Santa Elisa" for New York. The next day we had a short time at Pisco. As we walked down the long pier, we heard what seemed to be the grunting of innumerable pigs beneath us. Looking to find what kind of sea-pigs there might be, we observed that the noise came from black cormorants (*Phalacrocorax vigua*). The immediate vicinity of the town was unfavorable for collecting.

On August 26 we landed at Callao, and had time for an excursion to Lima, where we saw the Zoölogical Gardens, but did no collecting. The next day we stood off Salaverry, which is on a barren sand bank, though the hills back of town, at 1,000 feet or more, are green and shrouded in fog. The last stop in Peru was at Paita, quite at the northern end of the country. In about an hour we captured six species of bees, four of them new to science, and one of the others including an undescribed sex.

Going up the coast of Peru, we passed the Guano islands, so well described in Murphy's *Bird Islands of Peru* (1925). The number of water birds was amazing. Those especially noted about the ship were pelicans (*Pelecanus thagus*), cormorants (*Phalacrocorax bougainvillei*), gulls (*Larus dominicanus*) and the so-called cape pigeon (*Daption capense*). We also saw sea lions (*Otaria byronia*). Mr. Chas. D. Fagan, the wireless operator on the "Santa Elisa," is a most enthusiastic ornithologist, and on his trips up and down the coast has obtained some rare and interesting birds,[1] including Hornby's petrel, long known only from a single specimen. The birds come on board the ship, attracted or bewildered by the lights.

A day was spent going through the Panama Canal. During our passage a wasp (*Polybia occidentalis* var. *albopicta*) and some other insects came on board. We reached New York on Labor Day, and after a visit to the New York Botanical Garden left for Boulder.

It was a long journey, packed with varied experiences, worth while equally for the scientific results, the knowledge of physical conditions, and the delightful contact with all sorts of interesting people.

On the way down, I wrote the following poem, which was printed on the menu card of the "captain's dinner," the night before reaching Rio de Janeiro. The "fairies" referred to are the characteristic translucent-winged butterflies.

Gone to Brazil! O mystic word!
Visions of spice and of star-lit skies.
Ocean blue where the tropic bird
Shines in the sun as it flies.
While over the land from the sea-washed strand
To the forests of palm and vine,
Strange fairies preside and silently glide
Like the ghost of a being divine.

[1]See Wetmore, *Condor*, XXV (1923), p. 170.

A Museum Pilgrimage

By HERBERT P. WHITLOCK
Curator, Minerals and Gems, American Museum

When that Aprille with his showres swoot
The drought of Marche hath percéd to the root.

. . . .

Thenne longen folk to go on pilgrimages.
THE CANTERBURY TALES

IT has been said that a museum curator should have, among other qualities, "the acquisitiveness of a rag picker," which I take to mean not only the knack of gathering in good things for the collections of his museum, but the gift of appropriating from here, there, and everywhere the ideas that will render these collections more obvious and intelligible. The ideas may come from a well displayed shop window, but they are far more apt to be inspired by what may be seen in some other Museum—any museum whether devoted to art, history or science, provided it be a good one, where care and thought have guided the installation.

So it was that having a longing, like Chaucer's goodly fellowship, to go on a pilgrimage, the middle of April found me on my way to France determined to see what I could of the museums of France, Spain, and Italy, and to glean from these many shrines of Art and Science those impressions and suggestions of arrangement and presentation which are no small part of the stock in trade of every museum worker.

Paris, which was my first objective, is preëminently a city of fine museums; here the wealth of culture which has always characterized this queen of cities finds expression in an assemblage of important collections of great variety. My chief interest being in science museums, it was natural that my first visit should be to the Natural History Museum in the Jardin des Plantes. Here I found a museum with an atmosphere and tradition which plainly bespoke the classic age of Science. In these famous halls I felt almost prepared to meet the shade of the Abbé Haüy, whose historic collection of minerals is preserved here; or that of Cuvier, whose house near by in the Rue Cuvier is still preserved with a care which seems as strange as it is beautiful to the eyes of a mere New Yorker. But the Jardin des Plantes can boast of other things besides the Haüy Collection. There is a very complete collection of minerals particularly rich in those from French localities and including a superb suite of the gem minerals from Madagascar. Also noteworthy is a series of cases devoted to the minerals occurring in certain rock types (such as the minerals of eruptive rocks). Supplementing this is a fine series of rock structures.

In the section of anthropology my attention was drawn to a well displayed series of casts of the hands and feet of the races of men, a highly significant and original installation. As in most of the natural history museums that I visited, the collection of birds was large and fine and especially rich in tropical birds.

Not far from the Jardin des Plantes, at the rear of the Jardin du Luxembourg is l'Ecole des Mines which houses a mineral collection said by some authorities to rival that of its neighbor the Natural History Museum. A wall case series displays the large and fine specimens of this collection after the manner of the wall case key exhibit in our Morgan Hall. There are also many exceptional pieces in the general collection exhibited in flat cases. On the whole this collection of minerals is a classic and historic one, rich in its associations with the men who have laid the foundations of mineralogical science.

In treading this hallowed ground on the left bank of the Seine, as all good pilgrims should tread it, Paris taxicabs to the contrary notwithstanding, I spent several very profitable hours in the Musée de Cluny, examining a very famous collection illustrating old French culture. Here were displayed many objects illustrating the antique use of precious stones in Gallo-Roman and Merovingian art. By far the most important of these are the seven crowns of Visigoth kings, set with roughly shaped gem stones, and constituting perhaps the finest known examples of the use of precious stones in the jewelry of the seventh century. The handbook by Edmond Harancourt, curator of the Musée de Cluny, printed in English as well as in French, is not only an admirable guide book to the collection, but a model which might well be studied with profit by any one engaged in the difficult task of preparing a museum handbook.

The crowning glory of Parisian museums is, of course, the Musée National du Louvre, and hither I next turned my steps to see the Salle des Bijoux Antique, a notable collection illustrating the historic use of gem stones. Here I found a splendid assemblage of engraved gems and ring mounts displayed on moiré silk of the same shade as that used in our Morgan Collection. The Egyptian gold jewelry in this section of the Louvre well repays a visit, containing, as it does, finer pieces than any others I have seen. Among the cases in the adjoining gallery I saw one in which small silver figurines were displayed on a stepped supporting diaphragm, the upright elements of which consisted of mirrors which reflected the back portions of the specimens. Such an arrangement is very effective for the display of small objects which should be seen on all sides.

From the Louvre it is only a step to the Bibliotheque National in the Rue de Richelieu. Here I found the best series illustrating the historic evolution of gem engraving, within my knowledge. This begins with Babylonian and Assyrian cylinders and shows successively Asiatic, Greek, and Roman intaglios, ring mounts, the inscribed talismanic seals of Arabia, Turkey, and Armenia, Gnostic intaglios down through Christian engraved gems, and Medieval intaglios and cameos to modern equivalents. It forms an almost unbroken exposition of the art of the gem engraver. Each example is accompanied by a sharp impression in plaster and the group labels are lucid and well chosen. Nor does this collection lack notable specimens among its hundreds of examples, since here I found the splendid antique cameo, representing "The Glorification of Germanicus" one of the largest and finest cameos known. As one would be led to expect of so good an installation, the handbook which describes it is well written and well illustrated.

In the Musée Carnavalet (Fig. 1), which is fairly close to the Louvre in the Rue Sevigne, I had my first view of a typical "museum of culture" which is an extremely common type throughout

Fig. 1.—A garden court in the Musée Carnavalet. Enclosed gardens are fairly common among the museums of France and Italy. They are always well kept, and add much to the dignity and attractiveness of the building

France, Italy, and Switzerland, and probably throughout the whole of Europe. In America we would call this kind of a museum a "historical" museum; in Italy where it flourishes it is called a "civic museum" (Museo Civico). The Carnavalet Museum is in reality an old Paris residence turned into a home for objects illustrating the history of Paris, particularly the epoch of the Revolution, in much the same way that Jumel Mansion is maintained in New York or Washington's home at Mount Vernon. Some of the rooms have been reproduced in their original furnishings in a way analogous to the rooms of the American wing of the Metropolitan Museum, or similar restorations in the Boston Museum of Fine Arts. One of the charming features of the Carnavalet Museum I must mention because I found it repeated with variations so often in the course of my travels. The plan of this old house is such that the main edifice encloses four courts or gardens—not merely places where the public may eat lunch and scatter papers, as too often is the case when such things are attempted with American museums, but real gardens where one may saunter, and review what one has seen, may read and digest the guide book, and take away, as I did, something more than the mere impression of beautiful costumes, Revolutionary relics, and those clever little scale models of sections of old Paris.

Among the very many things that Paris holds tucked away from the eye of the casual tourist is a small but very interesting museum devoted to the religions of Japan, China, and India. This is the Musée Guimet in the Place d'Iéna. Here I saw a collection rich in interest and exceptionally well lighted and displayed. A feature which impressed me as most unusual was the number of pieces that were mounted without case protection. I found, later, that this practice was by no means confined to this museum, but was used in many of the Italian civic museums with a freedom which seems very surprising to one familiar with the American public. In one of the long galleries, lighted from the side, is installed a number of busts on square pedestals of the usual type. What is unusual, however, is the use that has been made of the side light. The pedestals are slightly turned so that the heads displayed catch the light in three-quarter aspect instead of the usual half aspect. Figure 2 explains this innovation which is far more effective than it sounds.

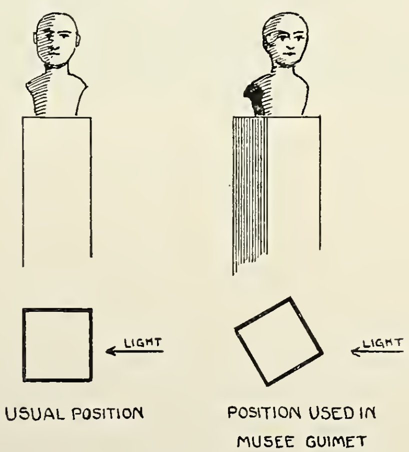


Figure 2

Five minutes' walk from the Place d'Iéna takes one to the Palais du Trocadéro, which contains two museums that are well worth a visit of several hours apiece, although, like the Musée Guimet, they are not generally featured in a tourist's itinerary. The most impressive of these is the Museum of Comparative Sculpture, where casts of practically all that are important among French architectural monuments are arranged by periods.

For lighting and interest of arrangement this museum is by far the best which I had the privilege of studying. The overhead lighting is admirably suited to bring out the detail of the architectural reproductions exhibited, many of which are twenty feet in height. Great skill has been displayed in the arrangement of reproductions of portals and façades which are employed to divide the long curved hall (220 yards in length) into smaller elements, one opening into the other. This installation presents a most interesting and impressive solution of the problem of treating a long and relatively narrow exhibition space. Nothing is under glass.

The Ethnological Museum, also in the Trocadéro, deals with the peoples of the world, with a strong emphasis on the people of France. A striking feature of this installation is the exhibit of costumes, shown on life-size figures distributed throughout the collections. In dealing with the peoples of America, single figures are used to illustrate the aborigines of North, South, and Central America. The peasantry of France are shown in a series of attractive groups under glass, exceptionally well mounted and labeled. I was delighted to find in this series a group showing the peasant lapidaries of the Jura Mountains polishing semiprecious stones. In this section also the collections of headdresses, foot gear, and other elements of costume and employments are well arranged and displayed.

I also visited the magnificent collection of French armor in the Musée de l'Armée, a collection of great importance and interest, but one which taught me nothing new in installation.

At Bordeaux, where I broke my journey en route for Spain, I found a small natural history museum, of which the outstanding feature of installation is the ethnological section. This contains a good collection of weapons and other elements of culture from French colonial possessions, notably from Senegambia and New Caledonia.

On reaching Madrid I lost very little time in finding my way to the National Museum of Natural Sciences in the Palacio de la Industria. This is a modern museum in which modern methods of group mounting and display have been followed to a certain extent. There are several good animal and bird groups. The large mammals are shown in wall cases six feet deep, and divided into panels five feet wide. Each panel contains a group of species (such as *Felis*), and instead of a label, each specimen bears a number corresponding to a numbered list of the species in the group. This list is mounted against the glass front of the case. From an educational point of view there is quite an advantage in this method of labeling, for the visitor is continually led to place a particular specimen among its related species. The collection of minerals is installed in cases of the desk type, in a room lighted from above. Ordinarily such an installation would be marred by very bad reflections from the glass of the cases. In this instance, however, the effect of the strong Spanish sunlight is minimized by a dark curtain suspended in a horizontal position under the middle third of the ceiling skylight, in the manner shown in Figure 3.

Among the museums of Madrid I found one which was rather unique,—the Museo Naval, in the building devoted to the Minister of Marine and close to the Royal Palace. I had never before seen a naval museum, and was delighted to find here a really fine collection of ship models, beautifully constructed to scale, and illustrating Spanish vessels of war from the galleons of the fifteenth century to the most modern warship. The collection, which is admirably lighted and displayed, might well be considered a good standard for this type of museum.

Coming out of Spain on the eastern side of the Pyrenees, I made a stop at Marseille in order to see the natural history museum of that very delightful port. It proved to be a good example of a local science museum, excellent in certain departments. There are, for instance, good local collections of fossils, including a fine series of fossil insects from the Eocene of Aix-en-Provence. The local birds are also well represented and there is a quite complete series of Mediterranean fishes. Some of the halls have been decorated with mural paintings depicting restorations of extinct life, and some of the geology halls with examples of natural scenery such as a glacier, a waterfall, a tropical forest.

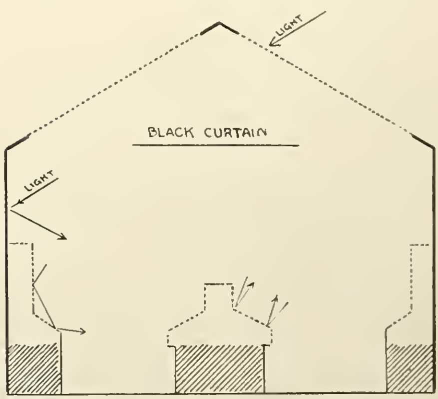


Figure 3

At Genoa, my first stop in Italy, I happened upon another museum of the type of the Guimet in Paris, but much smaller and less pretentious. This was the Museo E. Chiossone in the Accademia della Belle Arti. In the display of the collections of Chinese and Japanese art objects, which constitute the exhibits of the Chiossone, great taste has been exercised. I found noteworthy the use of background diaphragms which is suggested in sketch diagram in Figure 4. In the example studied the material displayed consisted of Chinese masks; as an installation suggestion, however, the idea seems susceptible of a wider application.

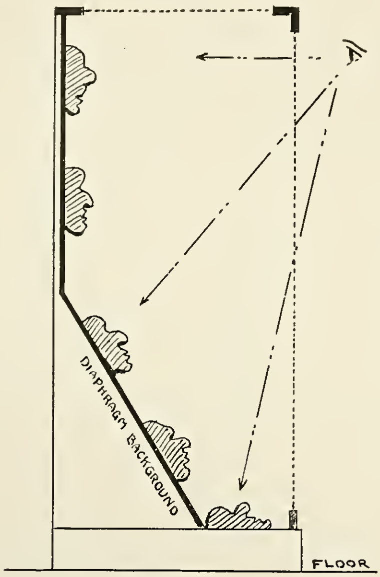


Figure 4

It is a considerable jump from Genoa to Rome, my next halting place, but a jump necessary at one time or another, since Italy is long and narrow, and one must see it journeying either south or north.

There are in Rome many museums of art and archæology, but few science museums; so, accommodating myself to conditions, I made the most of the archæological museums, and brought away from the National Museum at Rome what I consider the most valuable idea among my notes.

This is another museum, which, like the Carnavalet, encloses a charming garden, which was at the height of its June splendor when I saw it. Although mainly devoted to sculpture, the National Museum contains a small but important collection of Roman jewelry and small objects in amber. It was while I was studying these that I found the very unique treatment of supporting glass shelves upon diaphragms which I have sketched in Figure 5. The installation in this upright wall case consisted of supporting a glass shelf on a background diaphragm of convenient height, say 12 inches; then another diaphragm and glass shelf, and so on to the top of the case. This constitutes what a patent lawyer would call a "basic" idea. Its application to any installation using glass shelves is practically limitless, and its use where Roman pottery was shown was highly effective.

My way north from Rome took me first to Perugia, that fascinating hill town, beloved of all good tourists who know their Italy a bit more than superficially. Perugia supports a museum of Etruscan-Roman art which is rich in beautiful things. Among the Etruscan antique objects, I found a number of examples of the use of gem stones in Etruscan jewelry. It was extremely interesting to compare this series, and the one which I had just seen in Rome, with the Egyptian forms from the Louvre collection, and from what I remembered of the Metropolitan Museum's series. In every instance where emeralds were used as beads I noted that the stone had been left in its rough (hexagonal crystal) form and merely pierced for stringing. This was in marked contrast to the practise used for other gems which were invariably shaped into some primitive bead form.

There is also a tiny natural history museum in Perugia which, despite its small size, displayed a series of old crystal models illustrating the theories of Haüy regarding crystal structure. As one who makes crystal models, I

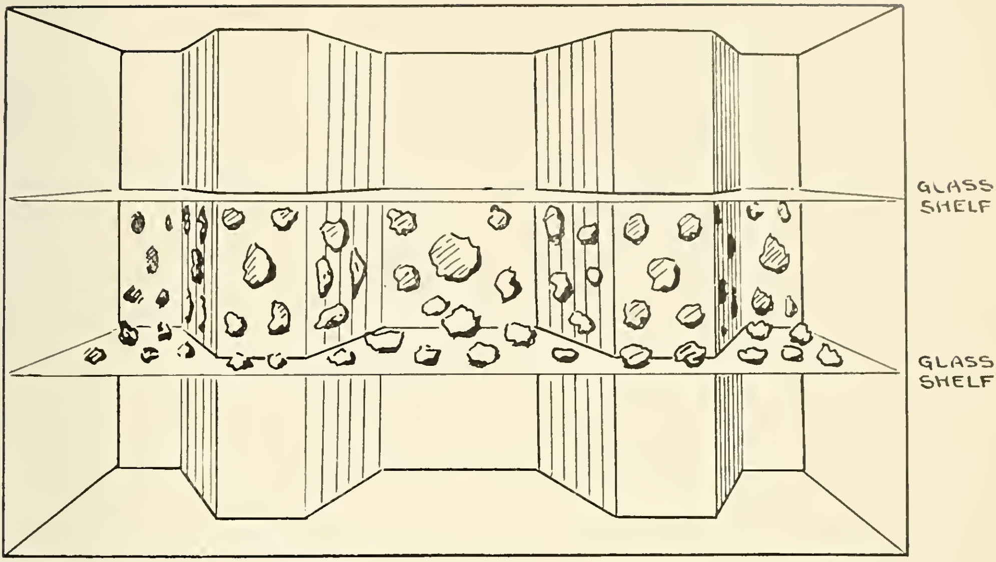


Figure 5

gazed with appreciation and reverence on these beautifully constructed cardboard solids and speculated as to how long they had been there, and whose patient labor had produced them.

One thinks of Florence as the Italian city *par excellence* of the art museum. I can, however, bear witness that there are also science museums, and good ones, to be found in Florence, if one will but seek them out. The Natural History Museum of Florence in the Via Romana, in reality only houses the zoölogical and anatomical sections,—the sections of geology and mineralogy having been removed to separate buildings. The collection of invertebrates is large and well lighted as is also a splendid collection of the birds of Italy. By far the best installation is that of a series of wax models of anatomical preparations and dissections, beautifully made and well arranged and displayed. These fill several rooms, and constitute a good example of the importance laid upon anatomy in several of the science museums which I visited. In the entry to the Natural History Museum I found a number of exhibition cases filled with astronomical and physical apparatus preserved as relics of such famous scientists as Galileo and Torricelli,—a veritable shrine for such a pilgrim as myself.

The mineral collection of the University of Florence, housed in a building adjoining the Piazza San Marco, is a fairly large collection, well lighted and displayed. A feature of this museum is the collection of minerals from Elba, which includes many species not to be found in most collections from this highly interesting locality. A similar collection of the minerals of Tuscany (largely from Bottino) is projected, and the material is at hand awaiting installation.

In the Florentine National Museum, which covers a field of culture analogous to that of our art museums, I again found much to interest me. The collections, which are exceptionally well displayed, are rich in Medieval and Renaissance examples of the use of gems.

On the lower floor of the Pitti Palace, one entire room is devoted to objects in carved amber. This, as one would suppose, is mostly the dark Sicilian amber which is becoming increasingly more difficult to obtain. There are also in the neighboring rooms on this floor several pieces of carved rock crystal (some by Cellini) which are very fine.

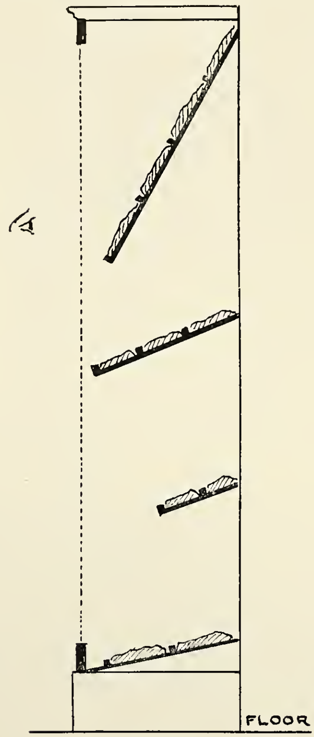


Figure 6

At Bologna, the next museum city on my line of travel north through Italy, is to be found one of the oldest universities in Europe. Here I visited a geological and a mineralogical museum, both parts of the University, and each in a separate building, although within a stone's throw of each other in the Via Lamboni. In the geological museum, dedicated to G. Capellini, a former director, is an effectively displayed collection rich in Italian fossils and rocks. The section devoted to fossil plants is especially complete. There are also fine examples of *Ichthyosaurus* both in original and in casts, and many skulls and several complete skeletons of the cave bear. Room XI contains a fine cast of *Diplodocus carnegici.* A feature of this installation is the complete series of rocks and fossils from specific regions, many of the series being accompanied by explanatory relief maps. I sketched an upright case, which was being employed to display rock specimens, because the arrangement of inclined shelves to present a group of surfaces normal to the line of sight seemed novel and certainly was very effective. Figure 6 shows this shelf arrangement, applicable to slabs of fairly uniform thickness.

The Mineralogical Museum of the University of Bologna upholds the tradition of its neighbor the Capellini Museum of Geology in emphasizing local mineralogy. Here are to be found some exceptionally fine series of occurrences from Italian localities arranged by provinces. Of these the sulphur and gypsum from Romagna, the series from the Island of Elba, the Sardinian phosgenites, cerussites and anglesites, and

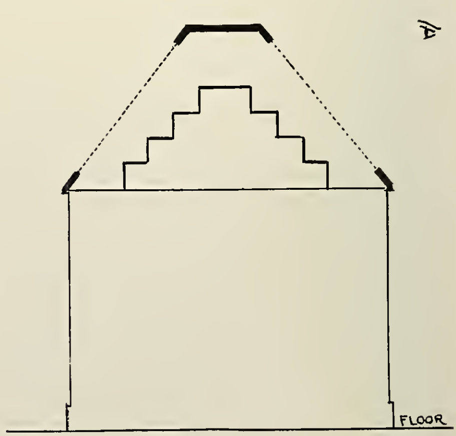


Figure 7

the Bottino and Bavino minerals are finer than any I have as yet seen. There is also a good general series displayed in stepped cases with inclined fronts. So effective is the method of display in these cases, that I have added as Figure 7 a diagram of one of them from my notes. Most of the collection was brought together by Bombicci during the latter half of the last century, and is rich in his type material.

Padua, another city of north Italy, made famous by its old and renowned University, was not to be passed by in my wanderings. The old University of Padua turned out to be one of the most interesting things that I saw in Italy, rich as it is in relics and associations. Here are preserved, among many historic links with the classical period of scientific growth, the first surgical or clinical theater ever constructed, and the actual wooden steps by which Galileo mounted the scaffold to make his famous renunciation, with its still more famous reservation. I found a good local collection of fossils arranged stratigraphically and also by provinces, with, in some instances, a relief map of the region covered by the series placed at the end of the case to show the stratigraphic relations. The cases containing this collection were of sufficient interest to warrant a sketch, which I have reproduced as Figure 8. In the palæontological section of this little museum is a fine series of fossil fishes from the Oligocene, and some undescribed vertebrate material from the Oligocene of Venetia. In this section, also, is a splendid series of skulls of the cave bear.

Traveling is mostly made up of a succession of contrasts, and certainly the contrast was strongly marked between Padua, the old-world university city, and Milan the beautiful "Paris of North Italy," which was my next objective. Milan boasts of the finest and most modern science museum in Italy, the Civic Museum of Natural History in the Public Gardens, Corso Venezia, Fig. 9. This is not only the largest and best in Italy, but it stands out from all others that I saw in the orderly arrangement and sequence of its collections. This sequence is so significent that I give it here in detail. The rooms numbered successively to the left of the entrance are designated as follows:

Room I, Minerals (General); Room II, Regional Minerals and Rocks; Room III, General Palæontology;

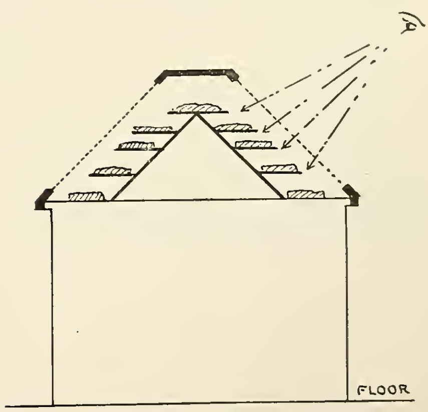


Figure 8

Room IV, Lombardy Rocks and Fossils; Room V, Lombardy Fossils; Room VI, Comparative Anatomy; Room VII, Comparative Anatomy; Room VIII, Mollusks and Brachiopods; Room IX, Insects and other Invertebrates; Room X, Mammals; Room XI, Italian Mammals; Room XII, Regional Minerals and Decorative Stones.

The apparent lack of sequence with reference to Room XII disappears when we consider its situation at the *right* of the entrance, the round of the numbered rooms bringing us back to the starting point; this brings it in near relation to Room I.

I found in Room I a very well selected general collection of minerals comprising between 3000 and 4000 specimens, well displayed in wall cases (on shelves) and inclined-front stepped cases. The cases of the latter type were freely used throughout the entire installation for small specimens, with or without a stepped interior equipment, and I found the type so generally effective that I have sketched it in Figure 10 in its application to the display of mineral specimens. The only criticism of this variant of the inclined front case is that the deck has been built too high to accommodate children. Room I also contains some well arranged supplementary collections illustrating crystallography, physical properties of minerals, and mineral structure and pseudomorphs.

Room II contains a splendid series of rock types, mostly representative of Italian occurrences, and a series showing rock structure. Both of these are particularly well selected and contain many striking examples.

In Room XII is a collection of about 2000 minerals arranged by localities and representative of the important deposits of Europe. This suite is valuable for comparison and for study of special problems. Around the walls is a beautiful collection of Italian marbles.

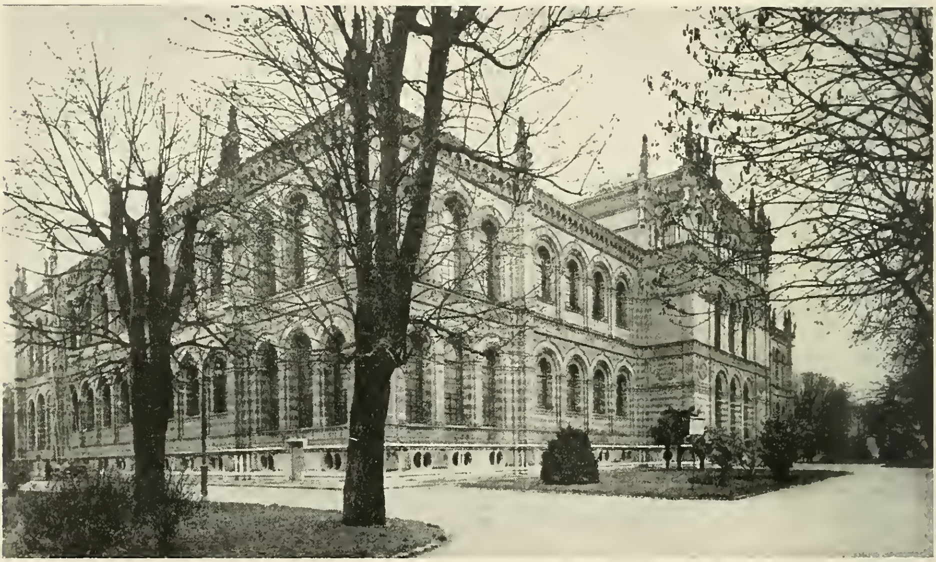


Fig. 9.—The Civic Museum of Natural History at Milan. Turning to the left on entering, one passes through a series of twelve rooms, returning to the entrance shown at the right

Visitors to Milan, after seeing the Cathedral, usually devote their next half day to the art and history collections in the "Castello." This installation gives a very successful solution of the problem involving the use of a historical building as a repository for art objects, without sacrificing either the impressiveness of the historical monument or the effectiveness of the art collection as a record of culture. What little glass casing is used is unobtrusive and well disposed, and there is no crowding, except possibly in the instance of the room devoted to furniture.

I also saw in Milan the large and well equipped Archaeological Museum (Via

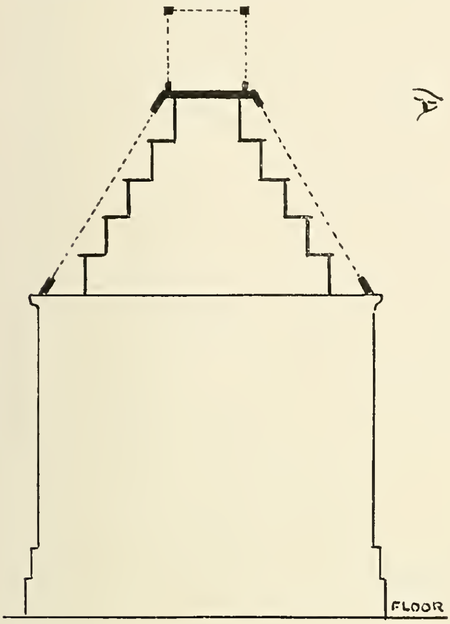


Figure 10

de Brera) which is thoroughly modern in type. The Egyptian section in particular is deserving of high praise. It includes a tomb restoration similar to that in the Metropolitan Museum. Prehistoric archæology is also treated effectively and in detail.

A civic museum of local culture, thoroughly characteristic of Italian museums of this type, is that of Turin, the next point of my itinerary. The collections are largely devoted to local Medieval and Renaissance culture. Much of the material is very attractively displayed, as for instance, the collection of eighteenth century book bindings, displayed in upright cases. The diaphragms used in this installation seem to me to be of such general application that I have reproduced my sketch of them as Figure 11.

Turin can also boast of the most modern of all museums, a World War Museum. This is located in the War Monument known as the Mole Antonelliana. As would be natural with such a recent installation, the material is comprehensive and complete in detail. There is much which should constitute a standard for similar installations, notably the elaborate relief models of the sections covered by the Italian-Austrian battle-fields.

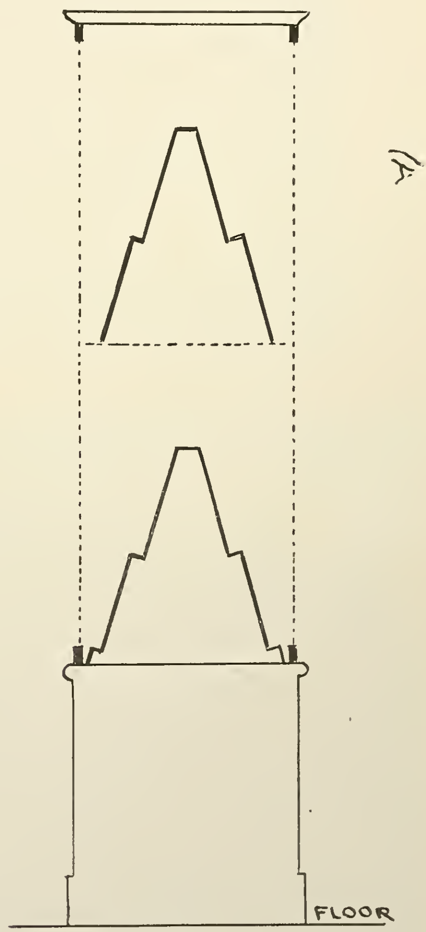


Figure 11

Geneva, which I next visited, is a city which is rich in small museums of various types. The natural history museum of the University, in the Promenade des Bastions, contains collections of comparative anatomy which are notably complete and well displayed. The section of mineralogy has several striking exhibits, especially the superb group of Swiss quartz crystals in the entrance hall.

The museum, however, which would alone justify one's turning aside to visit Geneva is the splendid Museum of Art and History in Rue des Casemates (Fig. 12). This museum displays in a thoroughly up-to-date manner the complete history of Swiss culture. The halls devoted to the local Stone, Bronze, and Iron ages are well developed, and the material is displayed with great judgment. From this early culture the series is carried through Roman and Middle Age halls, to the most modern expressions of Swiss art and industry. The collections are very comprehensive, and are without exception arranged with great taste and intelligence.

In the Botanical Gardens is located the Musée de l'Ariana, a small but attractive building containing a somewhat "Mid-Victorian" collection of art objects, which is, on the whole, displayed with care and effectiveness.

The chief collection of the Ariana Museum is an especially fine series of ceramics which I certainly found worth a visit. The halls are well lighted and the whole atmosphere of the place has a charm which invites one to linger. And linger I did for the whole of a glorious peaceful afternoon, for Geneva was the end of my pilgrimage, and when one has seen so much in so many places, the effect on the mind is somewhat similar to the effect on the body, of one of those famous Spanish dinners. There is grave danger of "museum indigestion."

Fig. 12.—The Museum of Art and History at Geneva. An imposing museum of a very modern type, in which the historical development of Swiss culture is featured

James Furman Kemp, professor of geology at Columbia University for thirty-five years, and one of the foremost geologists of the United States

James Furman Kemp
1859-1926

By CHESTER A. REEDS
Curator of Invertebrate Palæontology, American Museum

PROFESSOR KEMP was a remarkable man. Everyone who came in contact with him admired him, and instinctively felt that he was a personal friend. On the campus and in many gatherings he was known as "Uncle Jimmy," a sobriquet which had its origin in the great affection his students had for him. As a teacher he possessed a wide knowledge of geology and related subjects, exceptional facility in presentation, and a rare combination of kindliness and serious concern, coupled with a never failing buoyancy and humor. His inimitable manner, ready tact, and elegant form of expression made him particularly desirable at important meetings. Organizations with which he was affiliated looked to him for counsel and conferred many honors upon him. He was actively engaged in his professional duties until the morning of November 17, 1926, when he was stricken as he was about to board the train at Great Neck, Long Island, for Columbia University.

He was born in New York on August 14, 1859, and came of a line of Scotch and English forbears. His parents were James Alexander and Caroline (Furman) Kemp. After graduating from Adelphi Academy in Brooklyn in 1876, he went to Amherst, where he graduated with the degree of A.B. in 1881, after which he came to the School of Mines, Columbia University, where he received the degree of Engineer of Mines, with the class of 1884. Then followed graduate study at Munich and Leipzig. Returning to America, he taught geology at Cornell University from 1886 to 1891, when he became assistant professor. Coming to Columbia as adjunct professor in 1891, he was appointed head of the department of geology on the death of J. S. Newberry the following year.

His *Ore Deposits of the United States and Canada*, issued in 1893, passed through many editions. In 1895, his *Handbook of Rocks* appeared and went through many editions. In addition to his writings on economic geology, he also contributed much to the knowledge of pre-Cambrian rocks and to the application of geology to engineering problems. He was consulting geologist on the new Croton Dam, and the Catskill Aqueduct for the Board of Water Supply of New York City. As a recognized authority on ore deposits he was often called as an expert in litigation over the ownership of ore-bodies by mining companies, and was repeatedly called into consultation by the Anaconda Copper Company, and the Calumet and Hecla.

He became a member of the Mining and Metallurgical Society of America in 1891, served as a member of the Board of Managers, 1896 to 1898, vice-president, 1903 to 1904, director, 1905 to 1914, and president in 1912. He was an Original Fellow of the Geological Society of America, and its president in 1921, president of the New York Academy of Sciences, vice-president of the American Association for the Advancement of Science, a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Century Association, the National Research Council, Washington Academy, Washington Geological Society, American Geographical Society, School of Mines Alumni Association, American Association of Petroleum Geologists, the Society of Economic Geologists, a corresponding member of the Academy of Sciences of Oslo, Norway, Geological Society of Belgium, and Geological Society of London.

He was non-resident lecturer in ore deposits at Johns Hopkins, 1905–1906, in economic geology, Massachusetts Institute of Technology, 1907–1908, and in geology, McGill University, 1910. For many years he was associate editor of *Economic Geology*, and the *School of Mines Quarterly*. In 1926, he was spokesman for the American delegation at the International Geological Congress held at Madrid, Spain.

He was for years manager and scientific director of the New York Botanical Garden. He loved flowers. On November 4, 1926, he wrote me: "I was sorry to miss the Section meeting of the New York Academy of Sciences Monday evening, but as I had no classes, I spent the day digging up my gladiolas and dahlias out at Great Neck, and I was too tired to go to the city in the evening. In fact my dahlia crop and banking roses kept me busy all day Tuesday as well."

He was actively connected with athletic activities at Columbia, and was interested in all sorts of outdoor sports, but especially golf and fishing. His clubs were Columbia University and Century.

In 1906, Amherst, his Alma Mater, conferred on him the degree of Sc.D. *honoris causa*, and in 1913, McGill University awarded him the degree of LL.D.

He married Kate Taylor of Kingston, Rhode Island, in 1889. He is survived by his widow and three children, James Taylor, now metallurgist with the American Brass Company at Waterbury, Connecticut; Philip Kitteridge, rector of an Episcopal Church at Glendale, California; and Katherine Furman (Mrs. Chase Donaldson).

Professor Kemp will be missed deeply not only by his immediate family and relatives, but also by thousands of friends, many of whom gathered at the impressive funeral services in St. Paul's Chapel, Columbia University. He had an affectionate regard for all of his students, and was greatly beloved in return. His place is among the great teachers.

News from the Field

AFRICA

Mrs. Carl Akeley, from her camp on the slopes of Mt. Mikeno, at an elevation of 11,500 feet, writes that she has been continuing the work begun by Mr. Akeley in securing material for the accessories and backgrounds for the groups to be used in the African Hall.

Mr. Leigh, she says, has finished the gorilla background, and is completing the color notes for the wonderful varied vegetation of the region, of which Mr. Raddatz has made many fine molds.

The work has been carried on under great difficulties, for at the elevation at which the camp is located, the temperature varies from 44° to 36° Fahrenheit, while, in addition, there is almost constant rain, and the wind is so strong that the tents are frequently loosened from their moorings. Any "indoor" work is carried on over little charcoal fires, the workers wrapped in all the clothes they possess. But when on rare occasions the sun does shine, the view over the forest is glorious.

Mrs. Akeley plans to visit another gorilla locality and also Lake Hannington, and hopes to complete the work and sail from Mombasa by February 22.

Mr. and Mrs Martin Johnson, who found in pneumonia a more dangerous foe than the elephants and lions they had been photographing, were, at last accounts, recuperating at the foot of Mt. Kenya.

Mr. Johnson also met with a serious accident in the explosion of some flashlight cartridges, but in spite of illness, accidents, and bad weather, reports that he has been far more successful than he had hoped, and "unfortunately" may return within the year. Among other subjects Mr. Johnson reports the best elephant and giraffe films he has ever made, as well as films and many single photographs of rhinos, hartebeests, wart hogs, and zebras.

Incidentally, Mr. Johnson mentions that Mr. Pomeroy has been wonderfully successful in obtaining material to complete the group of greater and lesser kudu.

AMERICA

To Panama for Birds.—Mr. Ludlow Griscom sailed February 3 on his second expedition to Panama, in continuation of his study of the bird life of that country. Mr. Griscom is accompanied by Mrs. Griscom who will devote special attention to photography, and by Mr. Maunsell S. Crosby. Paul F. Covel, of the Museum's department of preparation, is taxidermist for the expedition.

ASIA

Word from the Morden-Clark Expedition.—Great relief was felt by the American Museum and the many friends of Wm. J. Morden and James L. Clark when, on January 5 a cablegram was received from Peking announcing that the Morden-Clark Expedition party had come to the end of its successful journey from Bombay to Peking on January 1. The object of the expedition, which was financed entirely by Mr. Morden, was to secure a series of *Ovis poli* for a Museum group, as well as ibex, antelopes, and any other interesting mammals from that remote region.

Ponies and yaks, the only beasts of burden that can go through the very deep snow or climb the rocky hills at such high altitudes, were the principal means of transportation from Gilgit to the *poli* country, where Mr. Morden and Mr. Clark were the first white visitors in twelve years, and probably the first Americans ever to have gone there.

Many remarkable still and motion pictures were taken of the wild animals and the country, which abounds in glaciers and sheer mountain peaks, some points rising to a height of 25,000 feet.

At Aktsoi, the party saw a number of *poli*, but were able to secure only two fine big specimens out of a herd of twenty. While their camp was located in this section, they frequently hunted at elevations of from 15,000 to 16,000 feet.

Later, on the trip to Shabachi, a sufficient number of *poli* were captured for a Museum family group, and some individuals which will be presented to other institutions. The average length of the horns ranged from 50 to 56 inches in length, the longest obtained being 57¼ inches. Besides the *poli*, the expedition collected marmots, bear, and wherever possible, specimens of birds.

It had been planned originally that the expedition should join forces with the Central Asiatic Expedition in order to insure greater safety in travel and larger collections of fauna and flora from this almost inaccessible country. Because of conditions in China, however, the Central Asiatic Expedition could not get through, and Morden and Clark had to proceed alone. Despite their many difficulties, they accomplished all they set out to do, and their return to America late in February, is awaited with keen interest.

Mr. Clifford Pope returned from China, late in November, thus completing his second period of work with the Third Asiatic Expedition as collector of reptiles, amphibians, fishes, and mammals. About the middle of December his collections reached the Museum.

Mr. Pope spent this last two-year period in Fukien Province where he found a rich and very interesting fauna. The collection of amphibians contains some 4000 specimens, in which about 30 species are represented, while in the 2500 reptiles there are nearly 75 species.

Devoting much of his time to life-history studies, he secured many series of developing frog eggs which show important stages in the embryology of the species concerned.

In spite of rumors to the contrary, this branch of the expedition's work was almost unaffected by the disturbances in China. The herpetological survey of the Min River Valley was completed, from sea level at Foochow to the heights of the Fukien-Kiangsi divide where the waters of the Min have their source. Mr. Pope plans to turn his attention to Yunnan and Kweichow provinces early in 1928.

News from the Laboratory

AMPHIBIANS AND REPTILES

The Museum's Fund for Experimental Research.—Museums with their large collections have always been the chief source of information in regard to animals as they occur in nature. The first question in the study of an animal is, what is it? And the next is how, or why. The most precise way of finding out why animals do this or that, or have one structure or another, is to experiment with them both in nature and in the laboratory. In former years the experimental work has been left to the universities, but recently the method has been successfully employed in museums, as one of the articles in this issue of Natural History shows.

Mr. William Douglas Burden, a Trustee of the American Museum, has realized the great importance of the experimental method in museum research and has kindly lent his motion picture, "The Dragon Lizards of Komodo," to the Museum for the purpose of inaugurating a fund for experimental work. Already several lectures have been given in New York in which this film has been used. A fund of ten thousand dollars is required to carry on the work.

ASTRONOMY

Through the generosity of Mr. S. B. Grimson, a 5″ Brashear telescope has been lent to the department of astronomy. This has enabled the department to observe objects in the sky, among them Jupiter and his satellites, Mars and our moon.

On January 28 arrangements were made by Dr. Clyde Fisher, in charge of astronomy, and members of his department, for the observation of the occultation of Saturn by the moon. Before sunrise the sky was quite clear and Saturn could easily be observed as the moon neared the planet. By the time of immersion, which occurred soon after 7:00 A.M. it was somewhat hazy, and after Saturn was hidden from view, the cloudiness increased, so that it was impossible to observe emersion.

A practical proof of the sun's rotation is now being carried on, the telescope being used in projecting the sun's image upon a screen. A record is being kept of the position of the sun spots from day to day, their change of position demonstrating the rotation of the sun on its axis.

EDUCATION

Conference of Museum Educators.—A movement has recently been started for frequent conferences of museum educators in New York City and vicinity. The first meeting was held at the Metropolitan Museum of Art in December, and the second one on January 25 in the new School Service Building of the American Museum of Natural History. About fifty educators attended each meeting. The latter meeting was opened at ten o'clock with an address of welcome by President Henry Fairfield Osborn. The first paper presented was by Mr. Henry W. Kent of the Metropolitan Museum of Art on "The Development of the Educational Department of the Metropolitan Museum of Art." After a short discussion, Dr. Arthur Harmount Graves of the Brooklyn Botanic Garden spoke on "The Value of Real Objects in Nature Education." Dr. Clyde Fisher of the American Museum of Natural History followed with an address on "The Future of Motion Pictures in Education," illustrated by pictures of Dr. Fisher's children with their animal pets.

The afternoon was devoted to a preliminary inspection of the School Service Building and to some of the exhibition halls in the Museum, where the educational activities of the Museum were more fully explained.

Exhibition of Current Biological Research.—The Section of Biology of the New York Academy of Sciences revived an old custom at its December meeting. A series of demonstrations of some results in current biological research were displayed to the great satisfaction of the five hundred members and friends who attended the meeting. Twenty-two demonstrations ranging from the dissection of cells and the injection of Amoebæ to the origin of the human dentition were shown in the new School Service Building of the Museum. Because of the large numbers attending the meeting and the undeniable enthusiasm of those who in a very short time were able to gain considerable insight into the research work being done in New York, it was decided to have a similar type of program at a later meeting.

Many institutions contributed to the success of the occasion. Demonstrations were presented by members of the faculty of Columbia University, Cornell University Medical College, New York University, Bellevue Medical College, College of the City of New York, and the American Museum.

At the last meeting of the Academy February 15, Dr. Alexis Carrel of the Rockefeller Institute for Medical Research, summarized the field of tissue culture and exhibited a series of remarkable motion pictures showing the activities of living cells outside the body.

The New York Association of Biology Teachers held its January and February meetings in the commodious auditorium of the new School Service Building. At the January meeting announcement was made of the several aids for biology teachers which the Museum has prepared for free circulation among the city high schools. Included in the new material available for this purpose is a series of small insect habitat groups, made under the direction of Dr. F. E. Lutz. Dr. E. V. McCollum, of the department of chemical hygiene, School of Hygiene and Public Health, Johns Hopkins University, spoke on "Nutrition and Health." The February meeting was addressed by Dr. W. K. Gregory on "The Palæomorphology of the Human Head."

FISHES

Mr. W. K. Vanderbilt has presented to the department of ichthyology one of two identical small sharks to serve as type for a new species related to the black-mouthed dogfish, of Europe. These were taken incident to Mr. Vanderbilt's work with the "Ara," at some 200 fathoms depth, on the continental slope off Florida. Like *Zenopsis ocellatus* (related to the European dory) and *Catulus retifer* (related to the European dogfish), this new species represents the European shore fish fauna on the continental slope of America in a transition belt between shore and deep-sea fishes, and is not related to any American shore-fish. It thus touches on a problem of considerable theoretical interest in the distribution of life.

INSECTS

Dr. Frank E. Lutz and Mr. Herbert F. Schwarz of the department of insect life, attended the Christmas meetings of the national scientific societies in Philadelphia. Doctor Lutz was elected president of the Entomological Society of America and representative of the American Society of Zoologists on the council of the American Association for the Advancement of Science.

MAMMALS

Chinese Mammals.—The collection of mammals from the Third Asiatic Expedition has been enriched by a series of 682 well prepared specimens obtained by Mr. Clifford Pope in Fukien Province, China. These were secured in three localities in the Min River Valley, ranging from sea-level to an altitude of more than 6000 feet. New to the Museum's collections are four skins of the golden cat, *Felis temminckii dominicanorum* La Touche, occurring at an altitude of from 4000–6000 feet in the bamboo and hardwood forests of southeastern China.

MINERALS

A New Use for Colors of Gem Stones.—To demonstrate the possibilities of using the colors of gem stones for commercial purposes, and especially for automobile bodies, a prominent firm of paint manufacturers arranged with the department of minerals of the American Museum, for a loan exhibit consisting of more than twenty examples of natural gem stones, to be displayed at the recent automobile show in New York City. Included in the group was a wide range of colors from the soft gray of flint to the deep rich red of jasper. In one slab of agate there were at least seven distinct colors so harmonized and blended that it would be quite possible to use any two or three in perfectly balanced combinations for automobile body and trim.

Recent Important Exploration Lectures

ANTARCTIC

The interesting features of exploration in the great Antarctic continent were presented to the members of the Museum by Sir Douglas Mawson on January 14. Sir Douglas' material includes superb photographic records of Antarctic animal life, including penguins and several species of seals. More than 1000 members had to be turned away because of lack of room.

AFRICA

Prince Wilhelm of Sweden delivered his first lecture on African exploration to a New York audience on the night of January 22, at Carnegie Hall. Those fortunate enough to be present enjoyed a vivid record, both in still and motion pictures, of Africa's big game animals, of its tiny pigmy peoples, of the dances and ceremonies of its natives, and their methods of smelting iron and making pottery. A fine "close-up" of a weaver bird building its nest was especially interesting. Prince Wilhelm is to be congratulated on the valuable scientific data collected during his trip, which was inspired, he said, by Theodore Roosevelt.

MT. EVEREST

The members of the Museum enjoyed a rare treat in listening to the account of Captain John Noel of the Mt. Everest Expedition of 1924. Captain Noel gave his lecture first on November 7, but so many members had to be turned away because of lack of seating capacity that Captain Noel kindly repeated his lecture on December 23. By means of still and motion pictures, he showed the heroic efforts that were made to ascend Mt. Everest. The climbers had to abandon the attempt when they reached 28,000 feet, 1000 feet from the summit. Captain Noel's pictures are superb, and give a wonderful description of the country and the Tibetan people.

GREENLAND

On the evening of January 13, Mr. George Palmer Putnam, leader of the American Museum Greenland Expedition, gave to members an illustrated account of the results of the season's field work. This expedition secured a fine series of narwhal, walrus, and other mammals, and birds, needed for the Museum's new Hall of Ocean Life. Mr. Putnam's lecture attracted such attention that he gave it twice in order to accommodate the members desiring to obtain admission.

EAST INDIES

The first showing of the pictures of the dragon lizards of Komodo, secured by the Douglas Burden East Indian Expedition, was given at the annual meeting of the New York Academy of Sciences December 21. Mr. Burden secured a complete series of these giant lizards.

New Members

Since the last issue of Natural History, the following persons have been elected members of the American Museum, making the total membership 9340.

Benefactor

Mr. Percy R. Pyne.

Associate Founder

Mr. Geo. F. Baker, Jr.

Associate Benefactor

Mr. Walter Douglas.

Honorary Fellow

Baron de Cartier de Marchienne.

Patrons

Mesdames: Charles J. Liebman, Elizabeth C. Marmon, Dorothy Binney Putnam.

Doctors: Frank S. Mathews, Frank Overton, Alexander Hamilton Rice.

Messrs: George T. Bowdoin, James L. Clark, O. G. Jennings, Charles J. Liebman, J. Horace McFarland, J. S. Morgan, Jr., Kenyon V. Painter, David Binney Putnam, Irving K. Taylor.

Fellows

Mrs. W. B. Dickerman.

Messrs: Joseph Boyer, John J. Riker.

Honorary Life Members

Major L. B. Roberts.

Mr. D. Stewart.

Life Members

Mesdames: Clarence M. Hyde, H. S. Morgan, John T. Pratt, Wharton Sinkler, Ludwig Stross.

Doctor: L. D. Ricketts.

Messrs: Ilsley Boone, Percy Bullard, G. Lister Carlisle, Jr., Robert E. Carrick, Richard Eugene Fuller, Samuel Heilner, Livingston E. Jones, John J. Raskob, Sturgis G. Redfield, Jr., J. C. Thaw, Gustave R. Tuska.

Sustaining Members

Mesdames: James Fenimore Cooper, George W. Porter.

Messrs: Harold D. Bentley, Walter Bockstahler, Geo. H. Church, Clayton Mark, C. B. Warren.

Annual Members

Mesdames: Marie L. Carscallen, A. E. Clegg, Chester L. Colton, A. O. Corbin, Clinton H. Crane, James B. A. Fosburgh, Edward Schafer, Harold W. Stimpson, Robert J. Turnbull.

Misses: Lillian Lefferts Bartlett, Juliette de Coppet, Mildred Kamsler, Constance Kinney, Helen L. Latting, Louise Boyd Lichtenstein, Helen Miller Noyes, Christine Sforza, Janet Thornton, Elizabeth Ward, Sophie Wolkwitz.

Doctors: I. J. Ballin, Joseph Brettauer, A. H. Ebeling, Julius Goldberg, John D. Kernan, Wm. Pfeiffer, Sumner Shailler, Edward Wheelock.

Colonel: James Brady Mitchell.

Messrs: George W. Adams, Ernest H. Anthes, John W. Auchincloss, Louis Bachmann, John Hopkinson Baker, C. W. Barlow, John A. Beeler, Lawrence Bennett, Chas. E. Birge, George Blagden, Louis M. Bloomingdale, Francis Blossom, Arthur F. Broderick, Albert Buchman, J. O. Bulkley, J. Campbell Burton, L. H. Paul Chapin, Harry H. Clark, James P. Cleaver.

Messrs: A. O. Corbin, Jarvis Cromwell, S. A. Crone, William Davey, Horace A. Davis, Dwight H. Day, John S. Dodge, Evan C. Dresser, Chas. P. Dring, John H. Foster, Otto Froelicher, Arthur D. Greenfield, Arthur C. Gwynne, W. S. Hammesfahr, Charles F. Harris, Randall G. Hay, Edwin M. Herr, Lloyd W. Johnson, Ernest L. Jones, Arshag Karagheusian, Fred'k, W. Kelsey, George N. Lenci, T. C. Leonard, Samuel Lichtenberg, George MacDonald, H. E. Manville, Jr., William C. Metcalfe, Morton Morris, F. A. Newbury, A. L. Newman, Frank S. Parker, John Polachek, Russell Preckett, Philip J. Roosevelt, J. Rosenfeld, James C. Saylor, Hugh Charles Sicard, Samuel D. Stein, Henry C. Steneck, Robert P. Stephenson, Charles H. Stoll, Frank J. Tappen, Allen O. Whipple, Jr.

Master: Louis Neilson, Jr.

Associate Members

Doctors: Ellinor H. Behre, Jeanette Allen Behre.

Mesdames: Bertha Bowlby Bohn, Robert G. Callison, Jennie D. Harms, Helen K. Hodson, Marjorie D. Hollingworth, M. C. Kemp, Levi Packard, Edith F. Shahan, James R. Whiting, Henrietta N. Young.

Misses: Emma Anderson, Sarah R. Atsatt, Jessie Auringer, Agnes Reeves Butler, M. E. Creaser, Frieda M. Hantel, Gertrude A. Hughes, Catherine Kendig, Gertrude Lear, Clara Wheeler.

The Reverend: C. W. Freeland.
Professors: Augusto Bonazzi, S. J. Case, A. H. Clark, Francis Daniels, Arthur S. Dewing, John C. Donaldson, Willard M. Porterfield, Jr., Luther C. Scott, Charles D. Test,
Doctors: William Ray Allen, Harvey P. Barrett, Clarence W. Bassett, E. J. G. Beardsley, Frank N. Blanchard, D. Julian Block, A. J. Boucek, J. Mackenzie Brown, Thomas C. Brown, C. H. Bunting, Alexander T. Bunts, Ralph W. Chaney, Percy W. Cobb, Barnett Cohen, L. J. Cole, N. S. Davis, 3rd., John D. Detwiler, Ernest C. Dickson, W. R. Dunton, Jr., E. Melville Du Porte, Frederick Ehrenfeld, Hugo Ehrenfest, Frederick Etherington, George W. Goler, Hugh M. Kingery, Charles C. McCoy, A. W. Moore, John J. Peters, Philip E. Robinson, Lewis Rumford, Albert E. Taussig.
The Honorable: James R. Macfarlane.
Messrs: C. N. Abernethy, Carl B. Adams, Helmer Pareli von Wold Kjerschow Agersborg, Frederic F. Allen, Richard W. Angle, Jay A. Auringer, B. C. Batcheller, Judson S. Battelle, Ward Leonard Berry, W. W. Boardman, Jr., A. W. Borchers, Robert H. Brown, Edwin H. Bryan, Jr., E. J. Bryan, Wm. H. Buettner, Raymond Buss, Irving Cannon, Erlon R. Chadbourn, Henry B. Chase, Jr., Nelson S. Chen, R. P. Conkling, A. Beresford Connell, Fredk. W. Cook, P. W. Creaser, H. A. Crossland, D. S. Davidson, Garrett Davis, Tolbert J. Davis, C. S. Day, Edward DeGaris, W. T. Dempster, John Smith Dexter, John N. Dighton, Charles F. Doucette, William S. DuVal, Leland H. Dykes, Theodore H. Eaton, Jr., R. L. Emerson, Harry M. Eudowe, J. W. Fecker, J. A. Flemer, F. W. Freeman, Henry V. D. Gibson, Raymond M. Gilmore, George C. Hayes, Edward Healey, Walter P. Henderson, Donald Hooker, D. Ralph Hostetter, Arthur Iddings, Bror Eric Johnson, Edward Hall Knobel, E. Gorton Linsley, William S. Lord, William P. McEvoy, J. S. McLees, Neil C. McMath, Chas. H. Merriam, Louis McL. Merryman, Nathan T. Milliken, Edward E. Minor, Frank P. Morrison, Nathaniel C. Nash, Jr., Walter Nordhoff, J. Arthur Pancoast, Silas R. Penrod, Thomas Lockwood Perry, Jr., J. Louis Pertsch, E. E. G. Roberts, Robert W. Robinson, C. W. Seabury, Clarence Simpson, Dick Spurway, Frederick A. Stebbins, Sol. A. Stephan, G. F. Stork, Malcolm Taylor, Jr., E. H. Urban, O. A. Van Denburgh, Jr., M. S. Verner, Frank Hawley Ward, Charles G. Watkins, Edward H. Watson, Carl V. Weller, Geo. B. Wells, Herbert Frazer Welsh, Edward Wenzel, C. W. Whitney, Ralph Woodward.
Master: Jack Quistgaard Petersen.

THE AKELEY MEMORIAL NUMBER

MARCH-APRIL

The March–April number of Natural History will be largely a memorial number, devoted to an appreciation of Mr. Akeley and the varied lines of work in which he was interested: it will include some of the addresses made at the Memorial Meeting, among them that of Baron de Cartier de Marchienne, who spoke of Akeley as a conservationist, and especially of the Gorilla Sanctuary he was instrumental in obtaining, and where he now rests.

Some of the many inventions of Akeley are discussed by F. Trubee Davison, and F. A. Lucas tells something of the career of Akeley as a taxidermist, in which he did so much not only to place taxidermy among the arts, but what was even more important, to make its results permanent.

Mrs. Mary Hastings Bradley, who was in Africa with Carl Akeley, gives some interesting reminiscences of the expedition to the Kivu region to obtain gorillas for the group in the American Museum of Natural History.

Mr. Edgar R. Waite, of the Australian Museum, tells how the native Australian uses the boomerang, a weapon well known by name, though generally associated with politics but whose use and principle are little understood.

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

MEMBERSHIP MORE THAN NINE 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 9000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843 in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herpetological survey of the Central Asiatic Expedition by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthrop collection of mammals in, **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the incomparable work of Carl E. Akeley on the Eastman-Pomeroy Expedition in Kenya and Tanganyika; in **Polynesia**, the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies**, Douglas Burden's collection of giant dragon lizards; in **North America**, the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for Corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America**, collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. a total of 2,057 reels of motion pictures were lent oaned to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES**, some exclusively for members and their children, others for the schools, colleges, and the general public, are delivered both in the Museum and at outside educational institutions.

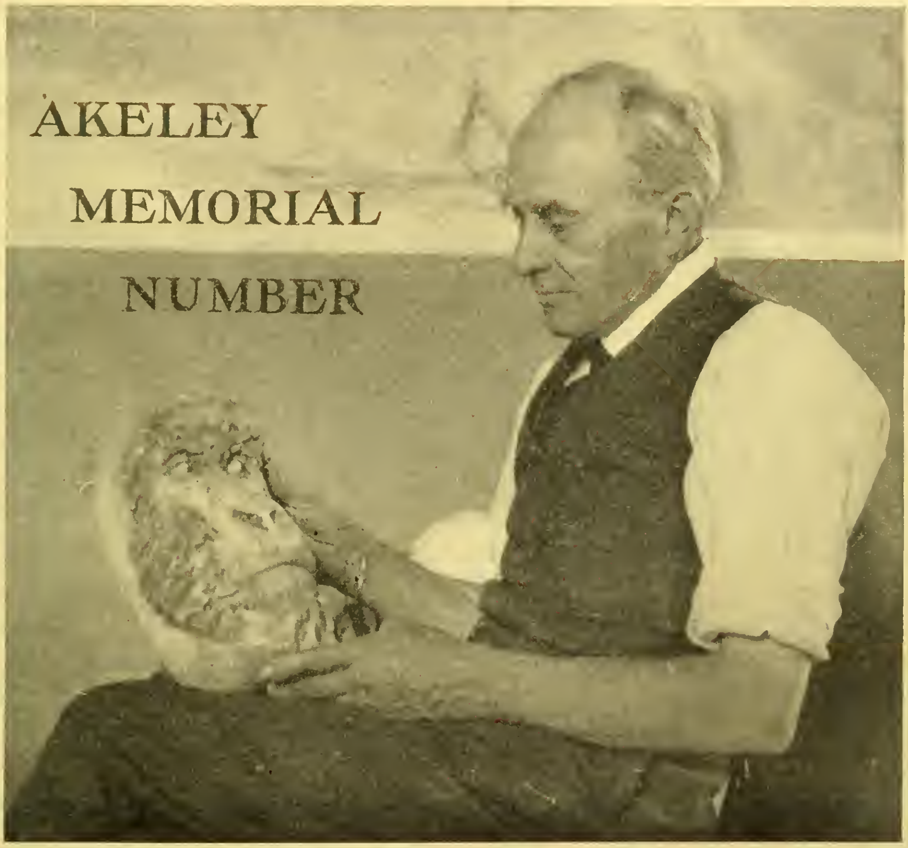
The **LIBRARY**, comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

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.

Vol. XXVII MARCH-APRIL No. 2

NATURAL HISTORY



JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION·RESEARCH·EDUCATION

ANNUAL SUBSCRIPTION $3.00 SINGLE COPIES 50 CENTS
FREE TO MEMBERS AND ASSOCIATE MEMBERS OF THE MUSEUM

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY, EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

AKELEY MEMORIAL NUMBER

FREDERIC A. LUCAS, EDITOR

MARCH-APRIL, 1927

[Published May, 1927]

VOLUME XXVII, NUMBER 2

NATURAL HISTORY

VOLUME XXVII — CONTENTS FOR MARCH-APRIL — NUMBER 2

Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

To a Traveler*

The mountains and the lonely death at last,
Upon the lonely mountains: O strong Friend!
The wandering over, and the labor passed,
Thou art indeed at rest:
Earth gave thee of her best,
That labor and this end.

Earth was thy mother, and her true son thou:
Earth called thee to a knowledge of her ways,
Upon the great hills, up the great streams; now
Upon earth's kindly breast
Thou art indeed at rest:
Thou, and thine arduous days.

Fare thee well, O strong heart! the tranquil night
Looks calmly on thee: the sun pours down
His glory over thee, O heart of might!
Earth gives thee perfect rest:
Earth, whom thy swift feet pressed:
Earth, whom the vast stars crown.

*Lines by Lionel Johnson, quoted by Kermit Roosevelt at the Akeley Memorial Meeting, December 23, 1926.

Photograph by Julius Kirschner

CARL AKELEY

From his last photograph, January, 1926

"He had breadth of vision and depth of vision, but most of all he had simplicity, and this it seems is the mark of true greatness."—H. J. SPINDEN

NATURAL HISTORY

VOLUME XXVII MARCH–APRIL, 1927 NUMBER 2

The Gorilla Sanctuary, Parc National Albert and adjoining territory. The three volcanoes at the right are included in the boundaries of the preserve

Akeley, the Conservationist[1]

By BARON DE CARTIER DE MARCHIENNE

FOR many years Carl Akeley has been one of the leading conservationists in America. He was one of the charter members and also a member of the Board of Directors of the John Burroughs Memorial Association which has done so much for the conservation of bird life. He took a prominent part in forestry conservation, notably in the conservation of the great Redwood trees. He was a very active member of the National Parks Association and an influential promoter of their ideals, namely, to preserve nature and win all America to its appreciation and study; to promote the use of national parks for popular education and scientific investigation; to protect wild birds, animals, and plants, and to conserve typical areas under primitive conditions.

As an indication of his varied activities for conservation I may mention that he was an active member of the

[1]This and the following four articles are from addresses made at the Akeley Memorial Meeting held on December 21, 1926, at the American Museum.

New York State Forestry Association, the American Scenic and Historic Preservation Society, the National Audubon Society, the Roosevelt Memorial Association, and other similar associations. In all of these societies, Akeley was more than a member, he was a leading spirit, and in his lectures, in his books, and in his numerous articles, he earnestly and effectively pleaded the need of conservation.

The location of the Gorilla Sanctuary, Parc National Albert

The movement for conservation in America, in which Akeley has played so great a part, has found a hearty echo in Europe and especially in those countries which have tropical colonies, where animal life still exists in its natural environment. In this connection I may mention the work now carried on by the Belgian Cercle Zoologique Congolais, under the presidency of Doctor Derscheid of Brussels, who is at the present moment in Africa, where he saw Akeley a short time before his tragic death. I should also mention the activities of the Nederlandsche Commissie voor Internationale Naturbescherming which, under the very competent guidance of Mr. P. G. van Tichoven, of Amsterdam, has inaugurated an international movement for conservation.

During the last years of Akeley's life it was my great privilege not only to have the pleasure of his personal friendship, but also to be associated rather closely with him in our efforts to preserve the fauna and flora of the Belgian Congo.

Akeley, like Saint Francis of Assisi, had a great and kind heart, full of sympathetic understanding for "God's humbler creatures." Although he was counted "a mighty hunter," he never killed for the sake of killing. He could kill wild beasts for protection, for food, or for the legitimate purposes of science; but his soul revolted against the wanton destruction of innocent animals or rare species whose conservation is necessary for scientific study.

As he told me, Akeley, during his trips to Central Africa, became especially impressed by the brutal slaughter of the gorillas by so-called "sportsmen" who destroyed these inoffensive animals for no other purpose than to boast of a bigger bag than rival hunters. Akeley had discovered in his rambles that a few hundred gorillas had taken refuge in the Kivu District, and when King Albert decided that a sanctuary for the fauna and flora of those regions should be created there, no one greeted this idea more enthusiastically than our friend.

No doubt King Albert, when planning this sanctuary which is called Parc National Albert, was influenced by his past experiences when he traveled far and wide in this country. The main idea of His Majesty is that the flora and fauna be maintained in their natural surroundings so that they may be studied under the most favorable conditions by the reputable scientists of the present day and of future generations. The Parc National Albert, in which Akeley was so interested, now embraces the three volcanoes, Visoke, Karissimbi, and Mount Mikeno. In the creation of the Parc National Albert we have had the constant advantage of Akeley's experience, as well as the most valuable collaboration of Doctor Merriam, Doctor Osborn, Doctor Hornaday, and others.

Before sailing on his last fateful journey to the Congo which he loved so well, Akeley was received in Brussels by King Albert, who explained to him at length his views on the organization of the national park named after His Majesty. Alas, death has prevented Akeley from accomplishing his design to follow the river Congo to the sea, as did that other illustrious American, Henry Stanley, nearly fifty years ago. He would have seen with his own eyes the wonderful development achieved since that time and often against almost insuperable obstacles through Belgian efforts in Central Africa. This sanctuary of fauna and flora so dear to Akeley's heart will be one of the resplendent gems of the Colonial Crown which Belgium owes to her great and far-sighted sovereign, Leopold II.

Immediately upon receiving the sad news of Akeley's death, I cabled to my Government requesting that through telegraphic instructions to our agents in Africa, every aid and comfort be extended to Mrs. Akeley and that all possible facilities be accorded her for her return to America, or to enable her, if she should so desire, to continue the supervision of the work in which her husband was engaged. In response I have received a cable assuring me that the proper instructions have been despatched to Africa and that everything will be done to carry out Mrs. Akeley's wishes in whatever she may wish to do. I know our officials in Belgium and in Africa will do everything in their power to aid Mrs. Akeley and to show their appreciation of the great work Akeley had achieved for the Belgian Congo and in which he had the devoted assistance of his wife, herself a distinguished explorer.

Akeley died on the slopes of Mount Mikeno in the Belgian Congo in the midst of the "Sanctuary" which he had planned and which was the realization of one of his fondest dreams. His death was that of a happy warrior who dies on the field of duty in the struggle for the betterment of the world. Although he was not spared to see the full realization of all his ideals, he knew that the victory was won. As he himself once said: "The slowest and most laborious stages of preparation are now past; the future will show concrete results."

He laid down his life in a great work, not only for his fellow men but for all his fellow creatures. When he closed his eyes on Mount Mikeno, he must have had the supreme satisfaction of knowing that he had achieved success for his cherished ideals, and that the work he had accomplished would be an enduring benefit to the whole world.

What Akeley has done will leave a lasting mark on the activities with which he was associated. His achievements in the realm of science and in the domain of art, his work for the conservation of animal life, will live after him, and will be to him a monument more enduring than any that could be raised by the hand of man. His memory will ever be in our hearts and will be an inspiration to those who come after him to carry on the work to which he devoted his courageous life and to fulfill the high ideals which he has set before us.

Theodore Roosevelt and Kermit on the Uasin Gishu Plateau with the old cow elephant for Akeley's group at the American Museum of Natural History

Akeley, the Explorer

By KERMIT ROOSEVELT

CARL AKELEY lies at rest on Mount Mikeno; we sorrow at his loss but almost everyone of us will say, "When the time comes, what fitter end? What explorer could ask for better?"

Akeley's was a well-rounded life, and one of great and varied achievements. It has left his name in varied branches of effort; some of them are in fields where there is no limit to what may be yet achieved. In art and invention this is so, but in exploring as we now know it, there is a very definite limit, and it is fast being reached. The great waste spaces in the world become yearly more easy of access. The blank places on the map, across which were written that mysterious and enticing word "unexplored," each year grow less, and until we find access to new worlds, these blank spaces cannot be replaced. Today there remain unknown but a few stretches in South America and in Asia, as well as areas in the arctic and subarctic regions, which are yielding to the type of effort put forth by Byrd and Amundsen and Ellsworth.

When Carl Akeley was born, Africa was still the "Dark Continent." Vast tracts of it were totally unknown, and much of what was known was still a frontier country. The call was irresistible and Akeley followed. Many years of his life he spent in Africa. It seems a long time ago,—as a matter of fact it is now eighteen years,—since my father and Akeley collected for this Museum the group of elephants which stands in the entrance to the great African Hall.

I remember that day on the Uasin Gishu well,—a fair, fresh morning on the African highlands. We soon struck the trail of a herd of elephants which Father and I had seen the previous day. For ten miles we tracked them, up hill and down, through bamboo forests and mimosa jungles, and when we caught up with the massive beasts, and the shooting began, we nearly came in for a first-rate charge at twenty-five yards.

Akeley in New York looked as if he belonged in the jungle; and in the jungle he was an integral part of his surroundings. Lightly built, but powerful and sinewy; the slight stoop only increased the hint of latent force; keen and straightforward of feature; alert and intelligent; and endowed with a ready humor. Akeley was the beau ideal of the naturalist explorer.

His interest in the conservation of wild life eventually centered itself upon the preservation of the gorilla; an animal that would soon fall before the advance of man into his habitat; and one cannot but feel how fitting it is that Akeley should have his last resting place in the sanctuary which he was so instrumental in establishing.

In paying this small and inadequate tribute to Carl Akeley dead, I would not wish to close without a word to Mrs. Akeley living. Bravely she has gone on to complete the task which he had so nearly finished. What her devotion to his ideals must cost her, we can but inadequately estimate, but our feeling of sympathetic admiration could not be more deep and sincere.

NANDI SPEARSMEN FACING THE CHARGE OF THE LIONS

Akeley, the Sculptor

By JAMES EARLE FRASER

AKELEY was a recognized sculptor and a member of the National Sculpture Society. Naturally with his many other achievements he had not the time to devote to this work that he wished, and it is amazing that he should have been able in that limited time to arrive at such a mastery of so difficult an art. Many of you know of his various pieces of sculpture, most of them devoted to animal subjects. One of them which is outstanding in my mind is the wounded elephant protected and helped out of danger by his companions, entitled "The Wounded Comrade." This group is massed and designed so beautifully and is so perfect in its feeling that it would be a worthy group for a Fremit or a Bayre. Rarely did either of these great artists convey more of the note of wildness than is in Akeley's work. His animals are alert, fearful, and disturbing.

Many other groups are as interestingly modeled and felt; for instance: "At Bay"; "Stung"; "The Lion and the Buffalo"; "The Charging Herd."

"The Chant of African Natives Over a Slain Lion," is most impressive and dramatic. His group of life-size lions is a powerful piece of action and none but an artist and one who had sculptural instinct could pose and group the animal subjects of his taxidermy which are shown in this Museum and in the Field Museum of Chicago. To have done this work not only must he have been a sculptor but one who had studied animals in the wild state rather than those caged or confined in parks. These groups are invaluable from this standpoint and different from any other museum groups I have seen.

Mr. Akeley's study of the animal in its natural surroundings made him eminently fitted as an animal sculptor, but he also had a monumental feeling toward the art. I had hoped some day his colossal monument to Roosevelt would be accomplished and placed in a proper setting. It would have been profoundly impressive. It was not the ordinary conception and it covered much of the life of the man it was to honor. Its scale was enormous, the lion which was the central figure being forty feet long with surrounding architecture of great proportions. It is unfortunate that America has not this unusual monument to her great President. Perhaps it may yet be realized. Had this monument been carried to completion it is likely that Carl Akeley would have been admittedly greater in sculpture than in any other field of his achievements.

THE CHARGING LIONS

THE REQUIEM

Akeley, the Inventor

By F. TRUBEE DAVISON

GENIUS is very rare, and because of its nature, there is no absolute or even relative standard by which it can be determined. But frequently we find it generously bestowed by contemporaries only to find that it is repudiated by posterity. Because of this fact, it seems to me that when we undertake to ascribe genius to anybody, we should do so with hesitation and with conservatism. I think that all who knew Akeley intimately, who knew of his work, would unite in saying that he certainly had a touch of genius.

History describes a goodly number of individuals who stood out above their fellow men for one reason or another, and the gifts which have brought this distinction have generally been confined to a comparatively limited though important field of human activity. It is very seldom that an unusual capacity in diverse ways is to be found in one man.

Akeley certainly filled a unique place in modern American life. His point of view, his method of attack, were strictly scientific; his practical mechanical resourcefulness was almost uncanny. These qualities he possessed to a rare degree, but further than that, he united with them the conception and the execution of the artist. With these natural qualities, stimulated by a superb character, is it any wonder that his works are so important and so unique?

It is also difficult to attempt to analyze the characteristics of a friend, and it certainly would be futile to do so in this case. I do think that when we are reflecting upon Akeley's work as an inventor, it would be impossible to appreciate it to the full without recalling one characteristic that was to me his outstanding one, and that was the unequivocal desire to ascertain the truth, and to pass it on to his fellow men.

Those who knew him intimately and worked with him and loved him, could not fail to be conscious, and fully conscious, of that characteristic. I remember very well sitting with him one day at the Club after luncheon. We were discussing the African Hall. He was telling me of the projected expedition to Africa to obtain the groups which were to fill that great hall. I asked him about the specimens that were already available, but that had not yet been mounted. He told me about a compromise that had been suggested in order to overcome the shortage of a bull member of an antelope group, by placing together the skins of two females, and in that way make the whole into a possible resemblance of the male, the falseness of which, it was suggested, none but an expert might detect. I have never heard any human being flayed as was the individual who made that suggestion. Akeley would far rather have quit his profession than to have adopted what was to him a dishonorable subterfuge.

He was, of course, primarily a naturalist, and his interest lay chiefly, as we all know, in the mammal life of Africa. His love for it, his complete belief in its beauty, his desire to have it known as it is and not as the sensationalist would like to have it, his anxiety to record the existing wild life before it became a story of the past, all combined together to make his chief aim that of telling his fellow country men the truth about that continent. And it was toward this goal that he was always plodding, often under real discouragements, but always hopeful for the future.

Certainly during the past year and one-half, this great ambition seemed to be more nearly within his grasp. We know that on this final trip his faith was not unjustified, and it seems to me that it remains for us to see to it that it is realized.

In carrying out his purposes, his extraordinary bent as an inventor put him in a position to devise new ways and means of overcoming difficulties. This life work, together with the temporary needs of his country during the war, was primarily responsible for the mechanical developments that must be attributed to him. The national emergency offered a new but temporary field for his inventive genius and it proved to be a very fruitful one.

His inventions fall roughly into four different groups; the development of the cement gun, the war inventions, the motion-picture camera, and his extraordinary method of taxidermy which has completely revolutionized that art.

The circumstances surrounding the invention of the cement gun are rather curious, and while they have no direct bearing on his work at the Field Museum at Chicago, still it might never have been produced had he not been there.

When he returned from Africa to the Museum, in 1905, it was located in the old Columbian Exposition Building which was made of stucco. The outside of the building was constantly peeling off. This gave it a very disreputable appearance. Akeley, of course, was loyal to that institution and wanted to do everything within his power to preserve its dignity. When this condition was brought to his attention, he put his resourceful mind to work to seek a remedy. To use his own words: "I got to thinking about it, and in the many experiments of one kind and another that I had tried in working out methods of manikin-making, I had among other things used a compressed air spray, so I thought it would be possible to make an apparatus that would spray a liquid concrete on the side of a building, and it worked." The result was that some friends financed the manufacture of the air-spray, and today it has a very large and important commercial use.

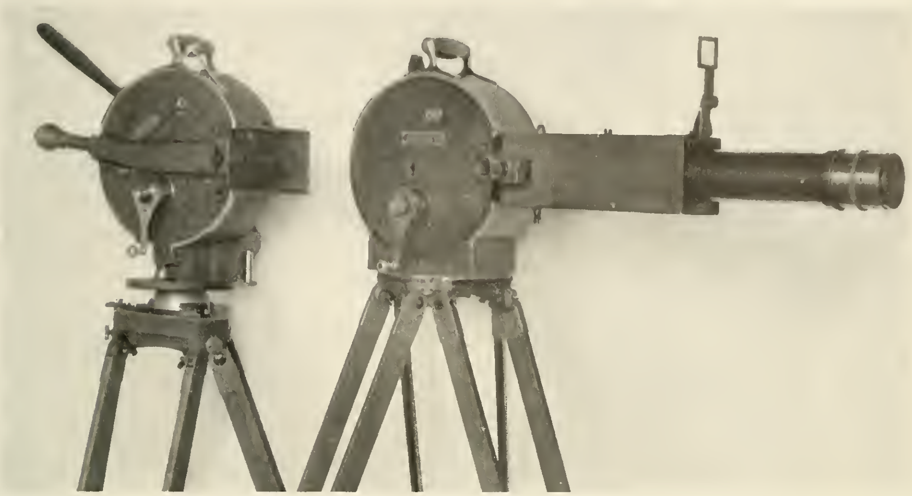
Furthermore, it was one of the hundreds of inventions that were used by the government during the war, for the gun proved invaluable in the building of concrete ships.

When the call to arms came in 1917, Akeley, of course, was too old to be an active soldier in the field, but with his special training and unusual abilities, he found many ways of doing his bit. The Akeley camera, about which I shall speak more in detail, proved to be the one that would fill the need of the army, and the output of the factory was contracted for by the Government. Akeley was also made a Consulting Engineer, Division of Investigation and Research Development of the Engineers Department in the Army, and in addition to that, a Special Assistant to the Chief of the Concrete Ship Division in the Emergency Fleet Corporation.

His activities were not centered in Washington; and as you can imagine, he did all he could to stay away from there. His time was spent in the laboratory and in the shop. We can

The first model of the Akeley Camera, which was patented in 1916 well imagine that his usefulness in these various capacities was valuable, and the records show that he was remarkably helpful in developing, for instance, searchlights and searchlight mirrors of rotary control, enabling the operator to direct the rays of light toward any object in the sky and follow up its movements. The records further show that several other devices were patented by the Government under his name during the war period. This ends the very inadequate story of his very full wartime activities in so far as the activities themselves are concerned. The seeds that he sowed then are still bearing fruit and will continue to do so.

There are all kinds of scientists, but Akeley was not one of those who was simply interested in the philosophy of his subject. He was not content to enjoy its fascinations and let it go at that. He had a larger vision, and wanted to make those things which were wonderful and inspiring to him equally so to his fellow men. He sought every method conceivable to translate accurately to them what he saw with his trained eye, and in this mechanical age he was quick to grasp the possibilities of the motion-picture camera.



Mr. Akeley's two cameras, —a standard "Akeley" and the "Gorilla" camera—also an Akeley—especially fitted with a telephoto lens

One of his expeditions, as many of you will recall, was in 1909. He went to Africa then primarily to obtain moving pictures of the Nandi spearing lions. He found that the motion-picture camera of that day had made great progress, but that there was none in existence which would enable the man in the field, as contrasted with the operator in the studio, to record speedily and accurately fast moving events which were taking place in unexpected quarters. The ordinary moving picture director has control over his subjects, but the man who is taking pictures of wild life in the fields finds it a very difficult problem; his subjects are not interested in his problem, and in fact, as anyone who has tried will know, they seem to do everything possible to conspire against it.

That Akeley learned, and learned well, during the trip of 1909. He determined to do what he could to devise and to build a camera which would overcome those obstacles. The result was the camera which is now known the world over as the Akeley Camera It required years of study and work, and today it stands a living monument to its inventor, one who produced it with his own mind and with his own hands, not for profit, but to enable him and others to tell the truth more accurately to those millions of people who did not have the same opportunities that he had. It is today unquestionably one of the greatest instruments of its kind in existence, and for the particular purpose for which it was designed it has no equal. It is found in the studio, in the home, on the athletic field, and in the most remote corners of the earth, the peaks of the Himalayas, the South Seas, the Arctic circles. It has provided a fascinating textbook for countless numbers of men, women, and children, and very particularly the children. Furthermore, as I mentioned, the Government of the United States found it important for its use in war and is continuing to do so in peace.

Akeley was generally considered as being chiefly associated with museum work. That was his principal life, of course, and in it he saw the medium by which he could realize his ambitions. He was born in the rural sections of New York State, and while he was still very much of a youngster, he came under the influence of an Englishman named Bruce, whose hobby was taxidermy. Soon afterward, as Akeley himself said, "I announced to the whole world that I was a taxidermist." The hope that he might become associated with Wards Natural Science Establishment, so-called, in Rochester, led him to travel to that city in search of employment. That was forthcoming and the foundation was laid for a very distinguished career in that profession.

It didn't take long, however, for his overpowering instinct for the truth to assert itself, and certainly the methods of taxidermy of that day fell far short of the ideal. They consisted, as Akeley described them, "of first treating the skin, then wiring and wrapping the bones, which were inserted in the legs of the animal while the body was hung upside down and stuffed with straw until it would hold no more."

The problem was not so much the crudeness of the method of the procedure that rankled in Akeley's mind, as the fact that the finished product was absolutely unreal and could not be expected to give a real impression of the mammal it was designed to represent. So Akeley set his inventive mind to work, with the result that he revolutionized the technique of that profession, and brought in accuracy, beauty, and realism, which carry with them the mystery and romance of wild life.

This development was worked out over a period of four years while Akeley was working at the Field Museum in Chicago, although the preliminaries were accomplished prior to that time while in Milwaukee. His first big groups (and many of us have had the privilege of seeing them) are the four seasons; the groups of American deer which are now located in the Field Museum. They are among the most beautiful and significant groups in that institution today, and stand as a lasting tribute to Akeley's early genius and work.

They are but the first of a long series, and their creation marks a fundamental milepost in improved facilities for bringing nature to the millions who are not fortunate enough to be able to penetrate the wilds.

This new method has become the standard by which taxidermy is measured today. There is no stuffing, and no hanging together with wires; the sculptor rather is given an opportunity to reproduce his model down to the very last muscle, and the animal when completed is lifelike, light, durable, and will last for an indefinite time in a setting which is an exact reproduction of its habitat.

The African Hall was the great goal toward which he was working; all else was preparatory. Therein he vizualized some forty groups of African mammals, realistic and picturesque, the backgrounds painted by a competent artist on the scene itself, with bushes, trees, and other natural flora scientifically made or else preserved to give a complete and detailed story. The work is begun, and begun in a manner that only Akeley could have conceived. It must be completed, and it must be completed in the Akeley way. His was a great soul, a great character; his was a great vision, and his inventive genius has provided the tools to make that vision a reality.

Akeley cement guns in action

THINKING ABOUT THE GORILLA
Taken in 1925, shortly after Mr. Akeley's return from the Gorilla Expedition

Akeley, the Man

By GEORGE H. SHERWOOD

CARL AKELEY was a *self-made* man in the fullest meaning of the word, and attained his eminent position in the world through his own efforts by dint of hard, painstaking work and an unshakable faith in his ideals. His entire career was one continuous struggle in the face of many obstacles, insurmountable except for his indomitable will.

He was born sixty-two years ago on a little farm in western New York. Because of poverty his schooling was limited to two years in the State Normal School. In his autobiography he says that by all the rules of the game he should have been a farmer, but that for some reason he was more interested in the birds and chipmunks than in crops and cattle. When about thirteen years of age, he obtained a book on taxidermy, which he eagerly studied. His imagination was fired with a burning desire to give a true representation of the birds and other animals around him, and taxidermy became his ambition. He even took some lessons in painting in order that he might paint realistic backgrounds for his stuffed birds—probably the first experiments with painted backgrounds for taxidermic groups. This was the beginning of modern taxidermy, which he more than anyone else has raised from a mere trade to a real art.

At the age of nineteen, desiring a wider field for his ambition, Akeley quit the farm and obtained employment in Wards Natural Science Establishment at Rochester. Here he learned what might be called the "upholstery" method of taxidermy. He wanted to try out his original ideas for mounting animals, but his efforts were frowned upon because of costs.

From Rochester Akeley went to the Milwaukee Museum. Here he found an opportunity to put some of his ideas into effect in spite of the opposition of the authorities, and he mounted his first group—a Laplander Driving his Reindeer over the Snow. This led to his proposing other groups, but his plans were tolerated rather than encouraged, until his friend William Morton Wheeler became director of the Museum. This marked the beginning of the Akeley method of taxidermy, which has revolutionized the art and stands as Akeley's greatest contribution to museum development.

In 1895 Akeley was called to the Field Museum in Chicago, where he remained fourteen years. This period witnessed the establishment and perfection of his method of taxidermy, which resulted in the splendid series of groups now in that museum. His first trip to Africa in 1896 with Daniel G. Elliot gave birth to that love of Africa which dominated his life to the end.

In 1909 Akeley joined the staff of the American Museum of Natural History and continued in its service until his death. It was while he was collecting his superb elephant group for the Museum that he first conceived the project of a great African Hall, which should stand as a permanent record of the fast disappearing wild life of Africa. For twelve years he labored toward this goal, with many discouragements, until the last African expedition was made possible through the generosity of Messrs. George Eastman, Daniel Pomeroy, and Colonel Wentz.

It was in this hard school of experience that Carl Akeley was trained and developed into the many-sided genius to whom today we pay our tribute of honor, admiration, and affection. Great, however, as are his achievements as nature lover, explorer, conservationist, sculptor, and inventor, it is the loss of Akeley the man that overwhelms us.

His was a rugged, virile personality, tempered by a deep sentiment and a whimsical humor which endeared him to his friends. He was a clean, hard-hitting fighter, who won our admiration for his fearlessness in defense of his convictions, whether we agreed with him or not. At times there was a steely glint in his eyes, but this denoted determination—not venom, for he always was a generous adversary. He possessed a tenderness of heart and a hatred of cruelty which made him an outspoken champion of all wild life but free from any maudlin sentimentality. He had a depth of character which held him to his ideals and would brook no compromise with expediency. His devotion to these standards often meant great personal self-sacrifice, from which he never shrank.

Those fine traits of character which guided Akeley in his untiring efforts to attain perfection in his own work made him a loyal and dependable friend. It was indeed a real privilege to know him intimately. Among my most cherished memories will live those moments which witnessed a new creation from his fertile brain. When his hero and idol, Colonel Roosevelt, died, Akeley, was broken-hearted and was quite incapable of working. A few days after the funeral he summoned me to his studio. As I entered I saw in rough clay a sketch of the world, surmounted by a majestic lion, in which were expressed dignity, strength, courage, fearlessness. This was his first conception of the Roosevelt Lion and, as he with deep emotion explained to me its purpose, never shall I forget the joy that beamed from his face because he had found a means of expressing his love for his dear friend.

The great charm of Akeley's personality was a sweetness and gentleness of nature, accompanied by a sympathetic understanding which led both old and young to seek his advice and counsel. Never was he too occupied with his own affairs to be interested in yours. There was a subtle indefinable something in Akeley which enabled him unconsciously to impart to those around him something of his enthusiasm, something of his idealism and something of his determination to achieve, which inspired them with new courage, new hope, and greater effort. A few days ago I received a letter from a successful business friend in the west. He wrote, "Whatever there is in me of decency and worth-whileness I owe to Akeley more than to any other man in the world."

I believe that the greatest *invisible* monument to his memory is the gratitude in the hearts of a host of friends who have thus profited by their contact with him.

His love for his fellow man, his keen appreciation of the works of nature, his joy in expressing his creative impulses gave to him perpetual youth of thought. Over his desk hangs this appropriate motto: "Whom the gods love die young does not mean that they die when they are young, but that they are *young* when they die." So it was with Akeley, the Man. All honor to him.

Carl Akeley's Early Work and Environment

By WILLIAM MORTON WHEELER

THE mature constructive activities of an unusual man whose fame becomes established during his lifetime are apt to be so widely known that they can be readily reported and appraised, but it is more difficult to evaluate the long years of struggle and preparation that necessarily precede the successful climax of such a career. This is eminently true of Carl Akeley, whose greatest achievement lay in his revolution of taxidermy, an art of obscure origin and long and gradual development in esoteric museum laboratories to which, for obvious reasons, the general public is not welcomed. The critical period in Akeley's life extended from the beginning of 1884 to the end of 1890, and as I was privileged to be his bosom friend and almost constant companion during that period, I gladly comply with Doctor Lucas' request to contribute to this memorial number of NATURAL HISTORY. And since, moreover, I happened to have kept a voluminous diary covering those years, I can precisely date most of my statements. If, in what follows, my own personality obtrudes too conspicuously, I beg the reader's indulgence for two reasons: first, because we were so intimate that I was necessarily an active, daily element in Akeley's biological and social environment, and second, because as I peruse my diaries for the first time since they were composed with all the effusive detail of youth, my present contracted ego seems to belong to quite a different person.

I was born in 1865 in Milwaukee and lived there till I was nearly nineteen. The cerevisiacal fame which that city enjoyed in those preprohibition days unfortunately quite eclipsed the fame of its temperate and highly intellectual German population and excellent school system.

Owing to my persistently bad behavior soon after I entered the public school my father transferred me to a German academy founded by Peter Engelmann, an able pedagogue who had immigrated to the Middle West in 1848. The school had a deserved reputation for extreme severity of discipline. To have annoyed one of the burly Ph.D.'s, who acted as my instructors, as I had annoyed the demure little schoolmarms in the ward school, would probably have meant maiming for life at his hands or flaying alive by the huge Jewish director, Dr. Isidore Keller, "curled and oiled like an Assyrian bull."

After completing the courses in the academy, I attended a German normal school which somehow had come to be appended to the institution. A few weeks before my father's death in January, 1884, an incident occurred which was to influence my whole subsequent life and indirectly Carl Akeley's. Prof. H. A. Ward, proprietor of Ward's Natural Science Establishment in Rochester, New York, which was not so much a museum as a museum factory, learned that there was to be an exposition in Milwaukee in the fall of 1883 and that the local German academy, which I had attended, possessed a small museum. He decided, therefore, to bring a collection of stuffed and skeletonized mammals, birds, and reptiles, and an

CARL AKELEY

From a photograph taken in 1888, shortly after Akeley went to the Milwaukee Museum attractive series of marine invertebrates to the exposition, and to persuade the city fathers to purchase the lot, combine it with the academy's collection, and thus lay the foundation for a free municipal museum of natural history. I had haunted the old academy museum since childhood and knew every specimen in it. Indeed, Dr. H. Dorner, my instructor in natural science, had often permitted me to act as his assistant. Of course, I was on hand when Professor Ward's boxes arrived, and I still remember the delightful thrill with which I gazed on the entrancing specimens that seemed to have come from some other planet. I at once volunteered to spend my nights in helping Professor Ward unpack and install the specimens, and I worked as only an enthusiastic youth can work. He seems to have been dully impressed by my industry, because he offered me a job in his establishment. I was quite carried away with the prospect of passing my days among the wonderful beasts in Rochester. Not the least of Professor Ward's attainments were his uncanny insight into human nature and his grim business and scientific acumen. He offered me the princely salary of nine dollars a week, six of which were to be deducted for board and lodging in his own house.

I entered Ward's Establishment February 7, 1884. My duties consisted in identifying, with the aid of a fair library, and listing birds and mammals. Later I was made a foreman and devoted most of my time to identifying and arranging the collections of shells, echinoderms, and sponges, and preparing catalogues and price lists of them for publication. Such is the present state of conchology that my shell-catalogue is still used by collectors. At this time Akeley entered the establishment as a budding taxidermist, and for once Professor Ward's estimate of human nature seems to have been at fault, for as Akeley informs us in *In Brightest Africa*, he was given a salary of $3.50 a week, without board and lodging. He attached himself to William Critchley, a young and enthusiastic artisan, with the voice and physique of an Italian opera tenor, who had attained the highest proficiency in the taxidermic methods of the time, but did not seem to give promise of advancing the art. In the course of a year Akeley had more than mastered all that Critchley could teach him, and was longing for wider opportunities than could be offered by an establishment, which, after all, was neither an art school nor a scientific laboratory, but a business venture. But even so, there is reason to believe that its standards of workmanship were higher than in any of the museums that had grown up in various parts of the country.[1]

The relations between Akeley and myself soon ripened into a warm friendship. We were nearly of the same physical age, but I was the younger and more unsettled mentally, for he had been reared by sturdy parents on a quiet farm and I had been brought up in a bustling city with a superheated atmosphere of German Kultur. He was very strong and healthy, had an inexhaustible capacity for work, a great fund of quiet humor, and a thoroughly manly disposition. He seemed to have been born with unusual taste and discrimination and an intuition which could dispense with mere book-learning. Of all the men I have known—and my profession has brought me into contact with a great many—he seems to me to have had the greatest range of innate ability. Although he

[1]Save in the United States National Museum.

later became an unusual sculptor, inventor, and explorer, he would probably have been equally successful in any other career.

In the course of time our relations settled into those of affectionate older and younger brothers. I cannot recall that we were ever even on the verge of a quarrel, and this must have been due to Akeley's self-restraint and sympathetic tolerance, because I was often irritable and unwell in those days. Owing to the fact that we did not work in the same building, our companionship was largely limited to evenings and Sundays. As I read the diaries of 1884 and 1885 I marvel at the multiplicity of our youthful interests and occupations. I cite a few passages to illustrate how we spent some of our spare hours.

"MONDAY, Jan. 6, 1885. Worked on the glossary for the shell-catalogue all day. In the evening went with Carl to hear Bob Ingersoll in his lecture "Which Way?" We were much pleased with him and his wit. The lecture cleared from my mind a host of prejudices against this man who is after all a *real he man*. Weather cold."

"SUNDAY, Feb. 15, 1885. Rose late. Took a walk with Carl and then went to church (Unitarian) with him to hear Doctor Mann give a magnificent sermon on the text "Out of Egypt will I call my son." Worked on algebra and read Virgil after dinner. Then walked down West Ave. with Fritz Mueller [a former schoolmate whom I was coaching in Latin for entrance to Johns Hopkins. He was the living image of the famous physiologist Johannes Mueller and probably belonged to the same family]. Tired on my return. Fritz read to me Jean Paul Friedrich Richter's 'Kampaner Thal.'"

"THURSDAY, Feb. 26, 1885. Worked on the shell-catalogue more diligently than on previous days, but am still low-spirited. In the evening read the conclusion of the Æneid and some of Zeller's "Deutches Reich" with Louis Akeley [Carl's brother who was attending the University of Rochester and whom I was coaching in German]. To bed at a quarter of twelve."

"MONDAY, March 23, 1885. Worked all day on the foetal Marsupials: kangeroos, koalas, opossums, etc. Labelled all the foetuses and pouches. In the evening walked with Fritz and on returning read with him about 100 lines of the third book of the Æneid. The evening ended with an acrimonious dispute and I went to bed in high dudgeon."

"THURSDAY, March 24, 1885. Worked all day in Prevotel's shop, changing and labelling the alcoholic fishes. In the evening attended the meeting of the Geological Section of the Rochester Academy of Sciences. Mr. Preston read to us about a quarter of Geikie's "Primer of Geology." After the meeting walked with Mr. Shelley Crump [an amateur conchologist and prosperous grocer of Pittsford, New York, to whom I had become greatly attached]. To bed at eleven."

And this is an account of a week-end with Mr. Crump:

"SUNDAY, May 23, 1885. From 10 to 12 worked with Professor Ward in the shell-house, labelling Echini—the last time I saw him [for many years]. In the afternoon Mr. Crump and his friend Doctor Dunning called on me. I walked with them to Brighton and thence took the train to Pittsford. We read together some recent papers on Pasteur by Tyndall and others and then walked along the Erie Canal bank where I collected two species of Valvata."

"MONDAY, May 4, 1885. Rose late. Read some of Burrough's 'Wake

Robin' before breakfast.' Then conversed with Dr. Dunning on Shakespeare's 'Sonnets' [Dr. D. was blind and with the aid of his wife was preparing a volume on the sonnets]. At 9:20 took the train for Rochester and went to work in the shell-house, finishing the family Nassidæ and part of the Volutidæ."

"Tuesday, June 23, 1885. In the morning read Bluntschli with Louis Akeley. In the afternoon went with Carl, Will Critchley, and Mr. Crump to see the tobacconist Kimball's beautiful collection of orchids. Succeeded in making a Catasetum discharge its pollinia! In the evening read Bluntchli again after having seen Mr. Crump off on the West Shore train. Returned much fatigued. My eyes begin to pain me."

Of active, industrious young men there seem to be two types. One of them accepts a given environment and is not only satisfied with its routine and constantly recurring human contacts but prefers it to any change. These young men are apt to marry early and to become the conservative and contented *fond* of our society. Those of the other type, probably endowed with a more unstable if not more vivid imagination and with a peculiar defence reaction, or subconscious dread of being owned by people and things, soon exhaust the possibilities of their medium, like fungi that burn out their substratum, and become dissatisfied and restless till they can implant themselves in fresh conditions of growth. Akeley and I were of this latter type, and by the spring of 1885 had decided to leave the establishment at the earliest opportunity. I departed June 29 and returned to Milwaukee, but Akeley remained, apparently because the death of the elephant Jumbo, which was to be mounted for Tuft's College, recently founded by Barnum, had just presented an opportunity for a new kind of taxidermic exploit. He and Critchley were put on the job, but Akeley naturally became the dominant member of the partnership and was soon absorbed in the problems of large mammal taxidermy which were to occupy him for so many years. His superb neuromuscular organization seemed to have been specially designed to give plastic expression to the refractory hide of the huge quadruped, and the successful accomplishment of the task furnished the inspiration for his later work in Africa, the Field Museum, and the American Museum.

Soon after my return to Milwaukee my old friend, Dr. George W. Peckham, who had long been making important contributions to arachnology and was beginning his well-known studies on the behavior of the solitary and social wasps, persuaded me to take a position as teacher of German and physiology in the high school of which he was principal. Peckham was a very learned and charming man, deeply steeped in the evolutionary literature of the time and keenly alive to the possibilities of the new morphology that had been inaugurated by Huxley in England and a host of remarkable investigators in the laboratories of the German universities. Every year he most conscientiously read, as a devout priest might read his breviary, Darwin's *Origin* and *Animals and Plants under Domestication*. We became very intimate, and I find from my diaries that for some years I regularly spent my Sunday mornings in his house drawing the palpi and epigyna of spiders to illustrate the papers which he wrote in collaboration with his equally gifted and charming wife. I was privileged to collaborate with them in one paper (on the Lyssomanæ) and to help them during the summers in their field work on the wasps at Pine Lake, Wisconsin. Under Peckham's management the biological work of the Milwaukee high school was carried far beyond that of any similar institution in the country. There were classes in embryology, with Foster as a text. We possessed a Jung microtome and the paraphernalia for staining sections and demonstrating the development of the chick, and, of course, the classes in physiology were required to master Huxley and Martin. While at Ward's I had purchased Carnoy's *Biologie Cellulaire* and had imbibed from it an intense but rather ineffectual interst in cytology. Then most fortunately, Mr. E. P. Allis established his "Lake Laboratory" in his residence near the high school and appointed Prof. C. O. Whitman as its director and Dr. William Patten, Dr. Howard Ayres, and Mr. A. C. Eycleshymer as assistants. These gentlemen were, of course, actively spreading the gospel of the new morphology. Doctor Patten, only four years my senior and fresh from Leuckart's laboratory in Leipzig, taught me the latest embryological technique and suggested that I take up the embryology of *Blatta* and other insects. I find that I devoted nearly all my spare time to this work till 1890.

In the meantime the Milwaukee Public Museum had been established according to the plan suggested by Professor Ward, and I saw an opening for Akeley as its taxidermist. I persuaded him to come to Milwaukee and live with me. He arrived November 8, 1886, and although he was not officially appointed to the institution till November 20, 1888, he was given a certain amount of its work. We converted a barn on my mother's place into a shop and here he worked at least during the evenings for several years. I was made custodian of the museum September 19, 1887, and held the position till August 29, 1890. By that time my association with Peckham, Whitman, and Patten had converted me into a hard-boiled morphologist, and I was induced by Whitman to accept a fellowship at Clark University, where he had become professor of zoölogy a year earlier. Till October 1, 1890, when I left Milwaukee for good, Akeley and I had spent so many happy hours together that the parting was painful. After leaving the high school I had fitted up a laboratory in the house and when my eyes grew weary with the microscope I repaired to his shop and read to him while he worked or more rarely he read to me. My diary mentions the volumes we read and I wonder at Akeley's patience and apparent pleasure in listening to Bryce's *American Commonwealth*, translations of Æschylus, Max Nordau, and similar high-brow stuff. I patiently read a whole small library for at that time I had serious conscientious objections to beginning a book without reading its every word. Perhaps Akeley really heard only occasional important fragments and had found that he could carry on his own trains of inventive thought better when we were together and I was making a continual but not too disturbing noise.

After we separated in the fall of 1890 I was to see Akeley only at long intervals. I had hoped to be able to provide him at the museum with every opportunity for his work, but the city's appropriations were small, and we were unable to undertake the mounting of the elaborate groups which he was constantly building in his artistic imagina-

SPRING.

This and the following three groups of Virginia deer representing "The Four Seasons" were placed on exhibition in the Field Museum of Natural History in 1902. Courtesy of the Field Museum of Natural History

SUMMER

AUTUMN

WINTER

tion. He was able to develop his technique on a small scale, however, so that when the opportunity came some years later at the Field Museum, he had no difficulty in creating his fine groups representing the four seasons of the Virginia deer, and was fully equipped to undertake his African groups as soon as he could secure the necessary specimens and data on their habits and habitats. I feel certain, therefore, that the eight years he spent in the quiet and sympathetic Milwaukee environment where he led a secluded, abstemious life, and worked twelve to fourteen hours a day, were the most important period of his development both as a taxidermist and as a sculptor.

It appears that I was also the cause of his leaving Milwaukee. While on my way in 1893 to work in Boveri's laboratory in Würzburg, I visited the British Museum of Natural History, and was conducted through it by its director, Sir William Flower. After viewing some of the taxidermic atrocities exhibited in that Elysium of glass cases, I remarked that we had in America the most accomplished young taxidermist in existence. Most Englishmen would have dismissed this as a mere piece of Yankee boasting, but there must have been something in my voice or manner that arrested Sir William's attention, since he asked for Akeley's name and address and, as I later learned, requested him to come to London. But while he was passing through Chicago on his way to the British Museum, Akeley visited the Field Museum and was intercepted and engaged by its curator of zoölogy, Dr. D. G. Elliot.

In 1894, soon after returning to the University of Chicago where I was then instructor in embryology with Professor Whitman, I learned that Akeley was at the Field Museum. I naturally looked forward to a renewal of our old intimacy but was informed that this was impossible. It seems that Professor Elliot, whom I had never met, disliked the zoölogical department of the university, probably because of its strong morphological bias and the outspoken contempt of a few of its members for taxonomy, and I was naturally included as a *persona ingrata*. Moreover, he realized that he had captured a prize in Carl Akeley and was afraid that the secrets of his technique might leak out and be appropriated by some other museum. He therefore forbade any visits and kept Akeley closely confined, and as he worked every day and far into every night, I was able to see him only once or twice during all the years I was still to remain in Chicago. Professor Elliot's procedure was not devoid of humor, because I was, of course, perfectly familiar with Akeley's methods and could have made no use of them even had I wished to do so. Many years later fate brought an ironical atonement when the National Academy of Sciences conferred on me a medal which had been established by this same Professor Elliot!

To appreciate fully the educational and æsthetic significance of Akeley's work would require a serious review of the history of taxidermy, and this unfortunately has never been made the subject of careful investigation. As a means of preserving domestic pets and the trophies of the chase the art may be ancient, but could have had little importance till extensive natural history cabinets were established in Europe during the seventeenth and eighteenth centuries. Of the first work on taxidermy, written by Réaumur[1] no copy

[1]Mémoires sur la préparation des objets d'histoire naturelle, 1745.

has been found, but it may exist wholly or in part in English translation as an article in the *Philosophical Transactions of the Royal Society*.[1] I have found in the library of the American Museum a publication containing a number of Réaumur's letters,[2] in some of which, addressed to J. F. Séguier, one of his correspondents in Italy, he gives directions for treating birds, etc., for shipment to him and describes his method of preparing them for the cabinet. The dead birds were sent packed in kegs with much salt, alum, or wine vinegar as preservatives, and his method of mounting them consisted in giving them a natural posture and then baking them in an oven till they were quite hard and dry. Another naturalist of the time, a German botanist, simply bisected his birds along the sagittal plane, spread out the two halves and pressed them like plants in his portfolios! Of course the *Dermestes* must have been delighted with collections made according to these wonderful methods, which were really processes of mummification and not taxidermy. Probably mammals, since their skins could be removed more easily than those of birds, were actually stuffed at that time.

The museum curators and their assistants throughout the greater part of the nineteenth century in France, Germany, England and the United States somehow managed to develop taxidermy to the stage in which it was vegetating when Akeley began his work. The duty of the poorly paid curator had always been to amass, hoard, name, describe, and label as many different defunct animals as possible, and the duty of his famulus the even more poorly paid taxidermist, was to impregnate them with lethal chemicals in sufficient quantity to discourage the museum pests and to try to give them a semblance of life. The result was pathetic when it was not ludicrous, because the taxidermist, at least in museums open to the public, was confronted with the stupendous problem of making dead hides thrilling to the common run of humanity, and the curator, if he was a scientist, necessarily pursued the method of all science, namely, that of abstraction, which has never been attractive to the great majority of our species. He was mainly interested in animals in isolation from their natural environment and behavior and reduced to so much fur, feathers, horns, hoofs, bones, etc., which he could measure and describe in an esoteric jargon intelligible only to other curators in other museums. Akeley, of course, hugely enjoyed the taxidermic exhibits of those days. I remember walking with him through a certain museum and coming upon a stuffed lynx. The creature had been upholstered to about four times its volume in life, its fur had long been a happy hunting ground for *Dermestes*, and one of its glass eyes had become dislocated, so that it was wall-eyed. Just then a sunbeam stole through the dusty pane of the case and fell on that unfortunate orb. The pathetic but fiery glance which it emitted and which seemed to concentrate within itself the whole tragedy of contemporary taxidermy, threw us both into convulsions of laughter.

From the beginning, Akeley clearly realized that any animal mounted for public exhibition can have neither educational nor æsthetic value merely as a stuffed hide, furnished with a pair

[1]Divers Means of Preserving from Corruption Dead Birds, Quadrupeds, Reptiles, Fishes and Insects, *Phil. Trans. Roy. Soc.* 45, 1748 (1750) pp. 304–320.

[2]Edited by G. Musset in the *Ann. Soc. Sc. Nat. Acad. La Rochelle* 21, 1884, pp. 177–258, and 22, 1885, pp. 89–191; reprinted as a volume of 183 pages in 1886.

of glass eyes, attached to a turned wooden pedicel, and provided with a label giving its Latin and vernacular names and the name of the locality in which it was slain. He was thoroughly convinced that an animal is meaningless, except to a hard-shelled zoölogist, unless it is presented in such a manner as to convey something of its real character, or *ethos*, which is manifested by its specific motor behavior in a specific natural environment. The development of the taxidermic "group" follows naturally from such a conviction. At the present time, owing largely to Akeley's intensive study of mammalian habits and musculature and his achievements in animal sculpture and the construction of groups, no curator, in the United States at least, would dream of tolerating those indecent, not to say immoral, stuffed beasts which were lined up in the museums of the Victorian age. Furthermore, Akeley's conception was, in a sense, prophetic of a change which through the influence of the ethologists, behaviorists, physiologists and psychologists, has now pervaded the whole field of the biological sciences, so that we have come to see that an organism cannot be isolated, even conceptually, from the peculiar environment to which it has become adapted during æons of geologic time, without a serious misunderstanding of its true nature.

In conclusion I feel that I must again apologize for the large amount of autobiographical material in this article. Probably my old comrade would have pardoned this as he condoned so many of my faults. The last time I saw him, before he left for Africa, never to return, he said, "Will, I want you to go to Africa with me so that we may end our careers, as we began them, together." This remark, I believe, was neither a premonition nor an utterance of what has been called the subconscious will to death, but the expression of a desire that we might journey together to some delightful spot in the land he so ardently loved and be reunited in our old age, as we had been united in youth, by our common interest in animal life.

"THE CHALLENGE."—Awarded first prize by Theodore Roosevelt at the first Sportsman's Show, New York, 1895. Owned by Dr. H. M. Beck. By courtesy of Doctor Beck

Akeley as a Taxidermist

A CHAPTER IN THE HISTORY OF MUSEUM METHODS

By FREDERIC A. LUCAS
Honorary Director, American Museum

IT has fallen to me to write of Akeley as a taxidermist, and while the result is by no means satisfactory to me, I have at least recorded some of the more important contributions he made to methods of museum display: I can only plead that I have written as Providence endowed me and not as I should have liked to have done.

While Akeley was successful as a hunter, an inventor, and a sculptor, yet it is as a taxidermist that he will be best known and remembered. Taxidermy was Akeley's chosen field; from first to last, from the beginning of his career to its end, he devoted himself to improving taxidermy in every branch, artistic, mechanical, scientific; above all he strove to make its results permanent. If, as we have been told, genius is an infinite capacity for taking pains, Akeley was most emphatically a genius in his taxidermy: every step from field to museum; skinning, shipping, tanning, modeling, constructing the manikin, and clothing it with skin, making the foliage, building the cases, providing them with light and ventilation, each and all bear the impress of the mind and hand of Akeley.

To repeat the words of Mr. Ward, he did more for taxidermy than any other one man, and but for him, museum exhibits would not be what they are today.

❧ ❧ ❧ ❧ ❧ ❧

In spite of the thousands of words, many of them obsolete and many practically useless, recorded in our ponderous dictionaries, there are some that seem still to be needed, among them one to define the modern taxidermist and another for what for want of a better word we call a manikin, though here, perhaps, the need is for a more gracious term for the graceful girls and stately dames who condescend to show us how garments of various descriptions should be worn. But, as I have written elsewhere, if he who delves among books in dead and living languages to decide which of the numerous, many-syllabled names some small creature is rightly entitled to bear, does not object to being called a taxonomist, he who toils over the skins of creatures great and small to make them live again, should not object to the rightful name of taxidermist. Some have styled themselves animal sculptors, but this does not distinguish the taxidermist from the artist whose work is translated into lasting stone or enduring bronze. Animator might be suggested for one who puts life into such a hopeless looking object as the skin of a rhinoceros, but for the present we will stick to taxidermist.

So we have only the word taxidermist to cover all grades of preparators including those who have been aptly styled perpetrators, whose work can only be considered as art because it certainly is not nature.

As for manikins, these range from inanimate forms of wood and plaster, covered with the skins of wild beasts to those of flesh and blood, draped or undraped in silks and satins on whom are displayed the triumphs of the dressmaker's art. There have been forms carved in wood, or on a large scale, laboriously built after the manner of a small house; there have been shapes of iron and excelsior and tow, covered with clay in which were impressed details of anatomy; there have been casts of dead animals of paper or plaster, hollow or solid, and there have been some excellent forms consisting of a skeleton of wood clad in wire cloth on which the muscles were modeled in papier maché, but it remained for Akeley to combine their excellencies and omit their defects in the Akeley manikin.

❧ ❧ ❧ ❧ ❧ ❧

Akeley has told in his reminiscences how he became a taxidermist, but he has not told us that in my early days I, too, had ambitions in that line, though circumstances decided otherwise; as for Akeley, he shaped circumstances instead of being shaped by them. We both drew our inspiration from the same source, though Akeley did not know it. We do not always realize how the threads of our lives are interwoven with those of others, oft-times with those of people of whom we have never heard, and that Akeley and I should meet after many years was due to Prof. J. W. P. Jenks, whose name even was unknown to Akeley; for Professor Jenks imparted to my uncle his simple methods of taxidermy and my uncle taught me; also he published the little book on taxidermy, "price one dollar," to which Akeley refers and from which he learned taxidermy up to a point where he felt justified in having business cards printed stating that he "did artistic taxidermy in all its branches."

In one little particular Akeley errs in his memoirs, in thinking that the

JOHN WALLACE.—One of the earlier well-known commercial taxidermists of New York. Courtesy of U. S. National Museum

painted background he introduced in a group of birds, almost at the outset of his career, was the first of its kind: like other "inventions" this has been "discovered" several times, and even when he was painting the background, the Booth collection—begun in 1858—was well advanced.

As Booth wrote, "the chief object has been to endeavor to represent the birds in situations somewhat similar to those in which they were obtained, many of the cases, indeed, being copied from sketches taken on the actual spots where the birds themselves were shot." And half a century earlier that universal genius, Charles Willson Peale, himself a taxidermist, wrote, ". . . it is not only pleasing to see a sketch of a landscape, but by showing the nest, a hollow cave, *or a particular view of the country from which they came,* some instances of the habits may be given." Had Peale lived a hundred years later he would have been a leader in museum methods.

Like Akeley I, too, went to "Wards," preceding him by fifteen years, "graduating" five years before he came; and it was many years before we ever met, for it was not until 1912 that our paths came together and we became associated in the American Museum of Natural History.

How Akeley came to "Wards," as Ward's Natural Science Establishment was briefly styled, he has recorded in *In Brightest Africa* and elsewhere, and here he worked from 1883 to 1887, not a very long time, but long enough to convince him that it was no place for him to develop his ideas of what taxidermy might be.

Even that time was shortened by a few months which he passed in the workshop—by no stretch of the imagination could it be called a studio—of John Wallace, a New York taxidermist who probably stuffed, most literally, more animals than any other one man.

Naturally, a commercial establishment, and particularly one that dealt mainly with the preparation of single specimens for museums, offered little opportunity for artistic, or naturalistic, —call it what you will,—taxidermy. For that was the era of the single specimen, the time when Coues wrote, "'Spread eagle' styles of mounting, artificial rocks and flowers, etc., are entirely out of place in a collection of any scientific pretensions, or designed for popu-

Carl Akeley and J. William Critchley.—Taken in 1885, the year in which they mounted Jumbo

lar instruction. . . . Birds look best, on the whole, in uniform rows, assorted according to size, as far as a natural classification allows."

The severely simple was considered the proper style for museums, and one curator, whose name stands high in the list of zoölogists, objected to the introduction of a bone as an excuse for a little action on the part of a coyote.

Truly *tempora mutantur*, and there are times when I feel that now-a-days too little attention is being paid to single specimens and that their importance is not recognized, nor their value to a large proportion of visitors sufficiently appreciated.

A physician once told me that one of

a doctor's most important duties was to tell his patients what *not* to do—so if Akeley did not gain much positive knowledge at Wards he saw many things that might be improved, and he did have an opportunity to study the problem of mounting large mammals, even if he did not have an opportunity to put the results of his observations into practice.

It was probably during his stay at Wards that Akeley reached the conclusion that the taxidermist had evolved from the upholsterer (as a matter of fact I have been asked "Who upholstered that specimen?") and that the process of evolution had not gone very far. At any rate, he soon recognized that it was not possible to get good results from the methods then in vogue, which consisted mainly in turning an animal upside down and most literally "stuffing" it full of straw. Having recognized this fact, he set for himself what was to prove his life's task—the devising of processes by which the then existing order of things might be remedied.

It was at Wards that he first took part in mounting an elephant, the once famous Jumbo, whose name has been embodied in literature and handed down to posterity in dictionaries as a synonym for something big: And yet the majority of the present generation never heard of Jumbo. Had Rip Van Winkle lived in the present rapid age he might well have uttered his plaint—"Are we so soon forgot?"

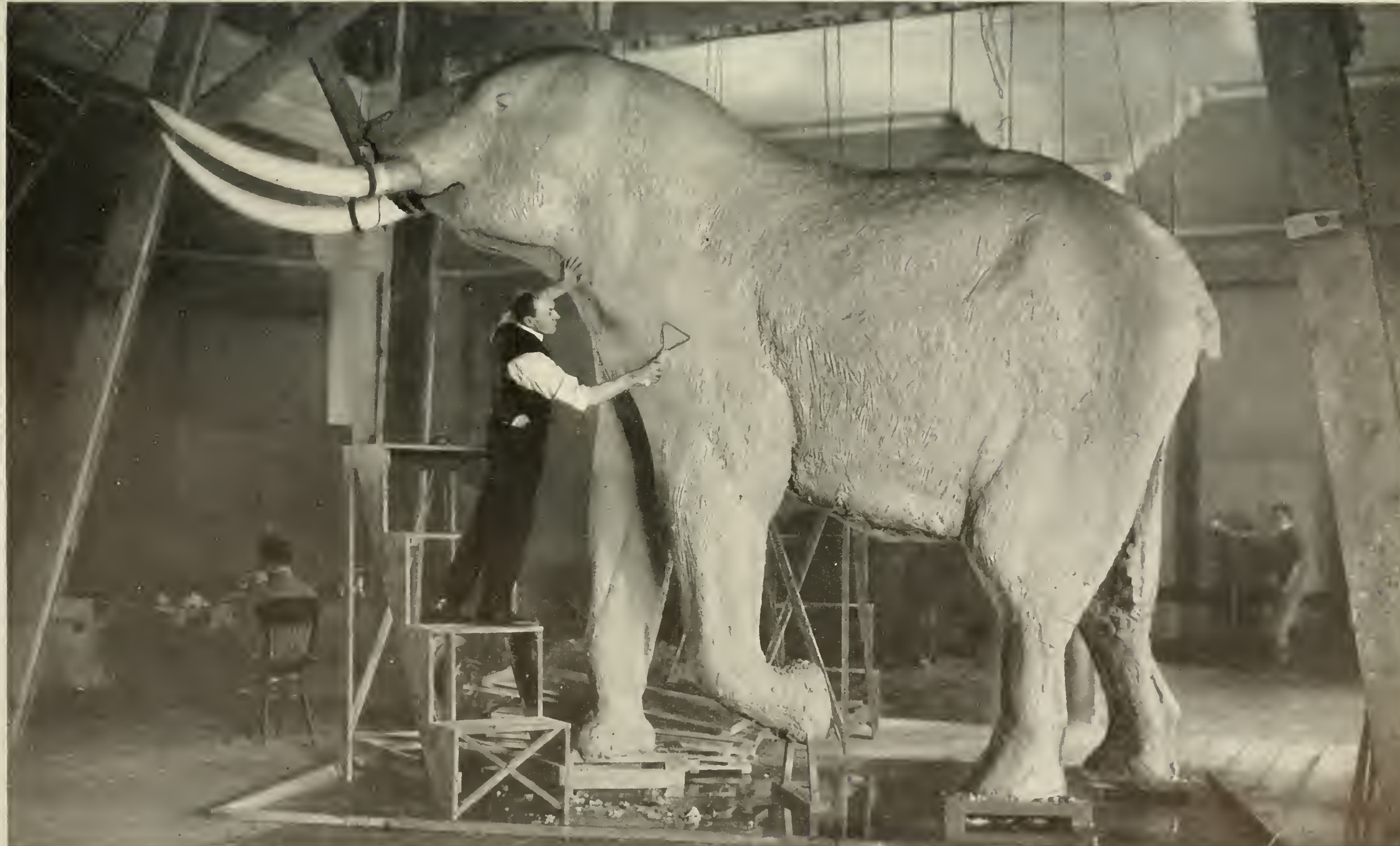
In mounting Jumbo, Akeley was under the direction of his senior, J. William Critchley, and the elephant was mounted much after the fashion of the specimen in the Museum of Natural History, Paris, put up more than a century ago. Critchley was a versatile and skilled taxidermist, according to the standards of his day, who had few equals in mounting birds, and few superiors with the average mammal; he was selected on the advice of Doctor Hornaday as chief taxidermist for the growing Brooklyn Museum in 1903. He died in 1910.

However, before Jumbo was finished, it was Akeley who was supplying the ideas, but it was not until 1913, many years later, that he devised the method now employed for such large animals as rhino and elephants.

It was a tenet of the old-time taxidermy that skins must be tanned in a salt and alum bath both to "set" the epidermis and to dry hard so that they would retain their shape when dry. This method was not conducive to the longevity of specimens, and especially of our larger quadrupeds, which, if exposed to the changing atmosphere of our museum halls, soon went to pieces.

My doubts as to the permanency of museum specimens was aroused by an English report on bookbindings which reached the conclusion that nothing save Sumach Tanned Morocco leather was durable: and to tan a rhino—much less an elephant—with sumach seemed a somewhat difficult proposition.

When the big hippo Caliph, for twenty odd years a resident of the Central Park Zoo, was being mounted at the American Museum of Natural History (this was before my time), I remarked, as Cassandra might have, that it seemed a pity to cover such admirable modeling with skin that was pretty sure to go to pieces—as it did not many years later. For Caliph, prepared with great skill after methods long followed, slowly disintegrated under the stress of our dry-heated halls and within a decade was stripped of his skin, though still exhibitable on account of his excellent modeling.



MODELING THE BIG BULL FOR THE GROUP OF AFRICAN ELEPHANTS INTENDED FOR THE CENTER OF THE AFRICAN HALL

Small wonder that, having so often seen specimens go to pieces, I had serious doubts on the subject of museum exhibits and was inclined to feel that it was a waste of time and money to mount animals doomed so soon to come to an untimely end; of what avail to make an animal live again if its second lifetime was to be no longer than the first, possibly even shorter.

Here again is where Akeley contributed to the improvement of museum methods, and after a little experimenting found that there was on the market a vegetable tan that fulfilled all the desired conditions and was just what he needed for such huge creatures as rhinos and elephants, a matter of great importance, since Akeley's latest methods of mounting large mammals, in which the skin was modeled directly upon the clay, depended largely on the successful tanning of the hide which must remain soft and flexible for many days and yet not even suffer the loss of any epidermis.

The final test is yet to come, for so far it has not been tried on a hippo, though there is no reason to believe that it will fail here, provided Akeley's careful procedure is followed.

It was while at Wards that Akeley, or rather the Museum World, had a narrow escape, for his friend, Professor Webster, advised him to study for entrance to the Sheffield Scientific School with the intent of following a professional career. His failure to do this was due to a breakdown in health which prevented him from taking the examination, and while later, at Milwaukee, he was encouraged by Professor Wheeler to try again, fortunately the plan fell through; I say fortunately advisedly, for while there are multitudes of professors there are or have been few really good museum men, and only one Akeley. Still, it is doubtful if he would have remained a mere student, for owing to his mechanical bent he liked to do things with his own hands, to carry out his own ideas rather than follow those of others.

After four years Akeley "graduated" from Wards, not because of what he had learned but because it offered no scope for his ever growing ideas, and in 1888 he followed his friend, Professor Wheeler, to Milwaukee.

In the Milwaukee Museum he had a little more scope for his talents, though at first hampered by museum traditions, and here he installed his first habitat group—of muskrats,—in the making of which he tells us he was tolerated, rather than encouraged. Later, when Professor Wheeler became director of the Museum, Akeley was given the freedom he desired, though not until he went to Chicago did he have full scope for his talents.

Now, I am somewhat hazy as to just when Akeley began to be recognized as a leader in taxidermy and to whom belongs the credit for that recognition, but certainly in 1892 Mr. W. H. Holmes, then on the staff of the Field Museum, selected him to mount a horse—and no animal is more difficult to mount—for one of the exhibits in the U. S. National Museum at Chicago in 1893. What may be called Akeley's first public recognition came in 1895, at the first Sportsman's Show held in New York, where he obtained the first prize for the head of a Virginia deer entitled "The Challenge," the most admired game piece in the exposition. Here again was a crossing of life's threads, for Theodore Roosevelt, who fourteen years later was to take part in an elephant hunt with Akeley, was the judge who awarded him the prize.

From Milwaukee, in 1895, Akeley

THE SLOPES OF MOUNT MIKENO, THE RESTING PLACE OF CARL AKELEY

Copyrighted by the Amer. Mus. of Nat. His.

AKELEY'S AFRICA
Paradise Valley, from a photograph by Martin Johnson

went to what was then the Field Columbian Museum where he had a chance to put into practice ideas and methods that had been awaiting an opportunity, and after his first African expedition, in which he showed his skill as a collector, year after year he installed the groups that were figured in the reports of the rapidly growing institution. Here, as an incident, he invented the cement gun, one of the few inventions that brought him any financial returns, and here his fertile brain devised many improvements in museums and museum methods, some of which are still untried.

It was at the Field Museum, in 1902, that Akeley installed his "Four Seasons," four groups of the Virginia deer amid their appropriate surroundings in spring, summer, autumn, and winter. These, begun during his stay in Milwaukee, had long been in course of preparation, and when they were secured by the Museum, Akeley, as is often the case with inventors, found that while he "had come out even on expenditures for labor and material, for his own time and for profit there was nothing." That he met with similar experiences later in his career was due to the fact that he placed excellence first and profit last, and if, in the course of a piece of work, he saw a way in which it could be improved, he never failed to use it, though at the loss of time and profit to himself. This was probably the principal reason why the taxidermy establishment carried on by Akeley in Milwaukee was not successful, although it had the support of the Museum; really good work is so expensive that it cannot be carried on commercially at a profit.

The "Four Seasons" were originally mounted to be seen by daylight, for at the time of their construction electric lighting was still young and only gradually finding its way into museums, and then in very simple forms.

A point to be borne in mind is that our predecessors in museum work were sadly handicapped by the question of lighting and a goodly share of the credit for the beauty of modern museum groups is really due to the development of electric lighting; here, as in other branches of museum methods, Akeley was quick to recognize its possibilities, and had in mind many devices for the projected African Hall.

It was while engaged upon the "Four Seasons," whose surrounding foliage called for many thousand leaves, that Akeley devised the simple, rapid, and economical methods of making leaves now so universally employed in American museums, and introduced the use of metal molds to replace those of plaster that so soon deteriorated.

The Mintorn brothers, and their sister, Mrs. Mogridge, had developed a method of reproducing foliage and flowers, employed by them in the British Museum bird groups, and later brought by them to the American Museum of Natural History, where it was used in the small bird groups that in their day stood for high-water mark in groups. The results obtained by the Mintorns were very beautiful but, as time showed, they would not stand the test of our varying museum atmosphere, with its summer's moisture and winter's dryness, but curled up, so in the American Museum of Natural History they have in most instances been replaced; moreover the process was somewhat complicated and involved the use of a mysterious "fabric," which later proved to be mousselaine de soie, and it has given way to the simpler, more durable method of Akeley.

Akeley patented his process for reproducing leaves, but never, to my knowledge, asked any royalty for its use; in fact, I do not think that he ever received any money from those who employed his methods or accepted any fee for imparting them to others. Not only this, but at the Chicago meeting of the American Association of Museums, in May, 1908, he explained in detail the making of the manikin, an explanation which led Mr. H. L. Ward, then director of the Milwaukee Museum to remark, "this address of Mr. Akeley . . . seems to be epoch making . . . the man of whom I can say without fear of accusation of flattery that he has done more for taxidermy in America than any other one person, gives to us, friends, acquaintances, and strangers, a full and detailed exposition of his method of mammalian taxidermy."

The lure of Africa and the opportunity to secure and install a full group of elephants drew Akeley to the American Museum of Natural History in 1909, and when, in 1912, he returned from a three years' collecting trip, he and I were together for the first time. And here I saw him develop his last, and most revolutionary process for mounting great mammals, a process that was not perfected until the work of mounting the first elephant was actually in hand, when Akeley discarded the frame already made for the manikin, abandoned his original plan, and proceeded to carry out the method then and since used for big quadrupeds. The group intended for the center of the African Hall bears testimony to the success of the method, and the Asiatic elephants and other large mammals mounted for the Asiatic Hall, show how well it has been followed by his associates.

It was while engaged on this group of elephants that he perfected his plans for the African Hall, which had long been uppermost in his thoughts, which he looked forward to as the culmination of his life's work, but which, it was decreed, must be left for others to carry into execution.

Like many another genius, he did not live to see the realization of his fondest hopes, to see his vision of a great African Hall taking tangible form: he was cut down at the very moment when success seemed near and his dream about to come true. The mind that planned and the hand that executed are stilled in death, the mortal part of Akeley reposes on the distant slopes of Mount Mikeno, but his spirit lives, and the work to which he devoted so many years and so much of his best thought will be carried on by those to whom he imparted his ideas and imbued with his enthusiasm. And on them devolves the task of executing a fitting monument to his memory.

Groups in the Field Museum and Elsewhere

While a large share of Akeley's time during his connection with the Field Museum was spent in the preparation of groups of animals obtained during the expedition to Africa in 1895–1896, yet other desirable pieces were added as opportunity offered. Due largely to existing conditions these were "open groups," intended to be seen from four sides. A special expedition was made to secure a notable pair of African elephants

POLAR BEARS
Mounted by Carl Akeley in 1900
Courtesy of the Field Museum of Natural History

MUSKRATS AT HOME

Akeley's first "habitat group" mounted about 1893. Courtesy of the Public Museum of Milwaukee

LESSER KOODOO

The first of the African groups, mounted by Akeley in 1897. Courtesy of the Field Museum

WART HOG, NORTHEASTERN AFRICA
Mounted by Carl Akeley in 1901. Courtesy of the Field Museum

AFRICAN BUFFALO

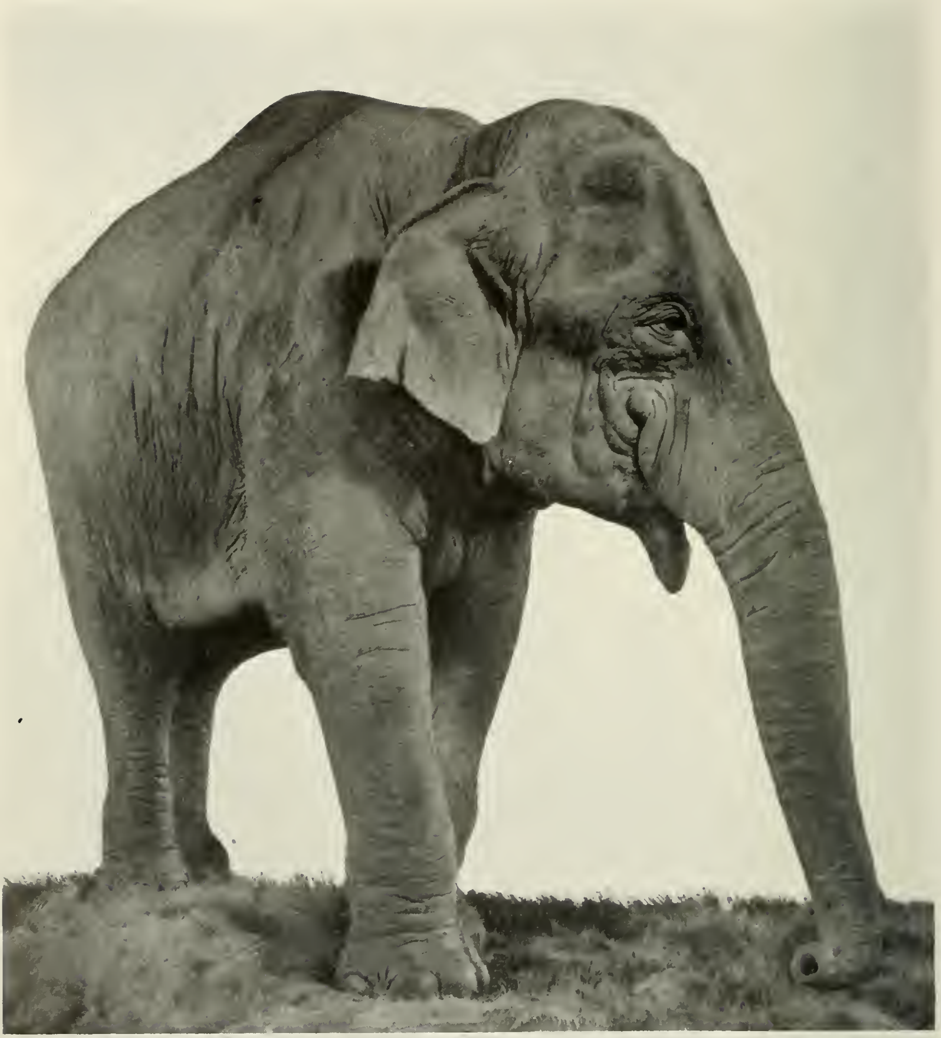
Mounted in 1914. The last group made by Akeley for the Field Museum

INDIAN WILD OX; BANTING

Obtained by the 1923 Faunthorpe-Vernay Expedition for the Asiatic Hall of the American Museum. Mounted by J. W. Hope. A good example of the delicate modeling obtainable by the Akeley method

INDIAN RHINOCEROS

Obtained by the 1923 Faunthorpe-Vernay Expedition for the Asiatic Hall of the American Museum. Mounted by Robert H. Rockwell by Akeley's latest method. Not only does this permit great detail in modeling, but the finished specimen is very light. This rhino weighs very little more than did his skin alone



ASIATIC ELEPHANT

Obtained by the 1923 Faunthorpe-Vernay Expedition for the Asiatic Hall of the American Museum. Mounted by Louis Jonas. Photograph taken to show the fine modeling of the head: such results can be obtained only by Akeley's method in which the skin is modeled directly upon the clay

Proposed background for the gorilla group. In the foreground is the spot where the "Old Man of the Mountains," largest gorilla, was captured. Chaninagongo looms smouldering in the distance

In Africa with Akeley

By MARY HASTINGS BRADLEY

ALL through Carl Akeley's letters to us during 1920 and 1921 there ran an ever increasing longing to return to Africa. He wondered that he had been so long away. The dream of the great African Hall was always in his mind, and he wrote of plan after plan for groups and bronzes; then the gorilla took possession of his imagination.

Not one gorilla in any museum in the world was mounted by a man who had ever seen a wild gorilla, and not a specimen of the central or mountain gorilla was in any museum in America. Akeley began to dream of a group of the great apes that would dominate the African Hall; his letters were full of plans shaping to realization, and at last his urgent, "Will you come?" made us sweep away those obstacles that interpose between every-day living and the opening of the door to adventure.

There were six of us who set out in June, 1921; Mr. Akeley, Miss Martha Miller, his secretary at the Museum and our very good friend, my husband and myself, and our five-year-old Alice, with Miss Priscilla Hall of Chicago as Alice's guardian.

Akeley had a whimsical humor in including a child in the party of gorilla seekers. His belief in Africa made

SUNRISE OVER THE GORILLA MOUNTAINS

The three mountain peaks—Visoke, Mikeno, and Karissimbe—comprise the gorilla sanctuary. The photograph was taken from the rim of the volcano Namlagira him wish to take her, and our belief in him relied upon his judgment. He wrote, "You see, one of the points of our expedition is that we are going to take the bloom off the heroes who have gone before, because we tackle what, in the public mind, is the most hazardous, the most difficult thing that the African jungle has to offer. We cannot posisbly come out of it as heroes, taking women and a baby, but we can pull the other heroes off their pedestals —which is quite as much fun."

We sailed from New York to London where our mountain of equipment was waiting, then from Southampton, August 12, on the "Kenilworth Castle" for Capetown. The voyage was memorable for our shipboard acquaintance with General Smuts; he was much interested in the gorilla expedition and in Akeley; they were men who knew how to value each other's strength, integrity of purpose, and resourceful energy.

From Capetown we took the train north. The veldt, barren of its old wild life, was depressing to Akeley; he felt that the real Africa was gone. The first wild animals we saw or heard were the baboons near the grave of Cecil Rhodes.

Victoria Falls was of absorbing interest to Akeley photographically, for with the Akeley camera he could photograph the whole story of the waters—following the rush of them over the brink to the chasm below, then up in air to the ever-changing cloud of mist that fell again. Only the Akeley camera could do that. This motion-picture venture, which my husband shared, was to be the record of what Akeley called the "high spots" of our trip—and literal high spots they proved.

We entered the Congo by rail, at Sakania, more rail brought us to Elizabethville and—ultimately—to the upper Congo, called the Lualaba River. The steamer on which we had expected to travel was hung up on some sand bar, and we were lucky to get stowed in and on a steel barge, towed by a small river boat, for our river journey.

The Lualaba was very beautiful, and the most beautiful things to Akeley were the tall borassus palms, the loveliest trees in Africa. For hours we glided between high ranks of them rising like wraiths from the river mist; then they gave way to lesser palm, acacias, and swamps of feathery papyrus.

The bird life was marvelous. There were clouds of black ibis that settled dramatically upon the bare-branched, yellow-flowered trees, and rayed out like a storm before the on-coming steamer; there were egrets, golden-crested crane, heron, goose, eagle, plantain eaters, shoebill stork,—an infinite variety.

From Kabalo, a river post, after a five-day wait, a last bit of train took us to Albertville on Lake Tanganyika; then, after more days of waiting—quite a feature of African travel Akeley used to say—the steamer "Baron Dhanis" took us to Usumbura, at the northern end of the lake.

Our real safari began here. With two hundred goatskin-clad porters, our equipment on their heads, and our ragged camp boys, we six whites started the march north over the Rusisi mountains into the Kivu. On this safari we had to deal with a very different situation from that in British East, where expeditions are the order of the day, and trained gun boys, tent boys, cooks, and porters are for hire. This was the Congo and the interior; no one came here but the official or missionary with few personal servants. There were no trained boys to be had,

LIGHT AND SHADOW ON THE SLOPES OF MOUNT MIKENO
Gorges and ravines such as these are typical of the gorilla region, which is at least 9000 feet above sea level

and porters would go but short trips from their villages.

The Belgian officials gave every assistance, but they could not conjure trained field servants out of the middle of Africa, and our camp life was a succession of emergencies, so different from the organized performance of British East to which Akeley was accustomed that he was baffled and exasperated. He was so eager to show us Africa at its brightest that our makeshifts with service grated horribly upon his standards. We had four cooks in as quick succession as we could achieve, and after some peculiarly joyless version of dinner, Akeley's reminiscences of his old chefs would have surprised them with his fervor, and his old boys shone with brighter and brighter luster. He missed Bill, his old English-speaking boy, gun boy and interpreter, very genuinely.

We were marching during the Rains and the narrow paths were heavy with sticky, red mud.

"I hate a bird," said Akeley suddenly. His gaze followed a bird soaring ahead. "Just spread their wings and go—never get in the mud at all. Damn birds!"

We had brought bicycles, for Akeley had used them in British East; they were of real use to us later, but now were carried. We had no transport but our feet, for Akeley refused to use the chairs in which whites usually traveled in the interior; he scorned being carried.

I think that he accepted wheels because there was effort in propelling them; he had a hatred of anything easy and self-indulgent. His feeling that one had to work for a thing made him feel that one must work, by walking, to have a right to Africa. His physical strength was great and he was eager to prove it undiminished. Day after day his determination poured out that strength in the sheer mechanics of walking; fever began to rise and often he got to bed as soon as we made camp.

It was part of Akeley, that unsparing determination; he had arrived by it, and I know that it had its way with him to the end.

On the eighth day we saw Kivu, loveliest of African waters, and the lake realized even his dreams. The air was crystalline during the Rains and the color was sheer magic. We journeyed north in a launch arranged for by the Belgian government, and from Lake Kivu Akeley had his first glimpse of the triangle of old volcanoes that were his objective—Mikeno, Karissimbi, Visoke—rising from the clouds of the storm beating upon us. On those heights he hoped to find his gorillas.

He was worried until he could be on his way to them, and he was pressed for time by lecture engagements made for his return. Every day counted. And the chances were incalculable.

We camped at Kissenyies, the Belgian post of four whites, and as soon as thirty porters came in, Akeley went ahead three days to the mission of White Fathers at the base of Mikeno, then with guides from the sultan Burunga, he started up the mountain.

We sent on relays of beans to feed his men up there; we made a trip around the mountain to meet T. Alexander Barns coming down with three gorilla specimens for the British Museum; then, as soon as we had porters, we followed to the mission, where we left Alice and Miss Hall, and went up Mikeno to Akeley.

Runners had already brought the good word that he was finding his gorillas, but the news he wrote of his ill

AKELEY'S CAMP AT THE BASE OF MOUNT MIKENO AND MOUNT KARISSIMBI
In the distance the morning mist is just clearing before the castle peak of Mount Mikeno

THE GORILLA CAMP

Some gorilla skins are hanging up to dry, while others are spread out in the foreground. A small gorilla preserved complete in formalin and salt is hanging from the tent health made us do a two-day climb in a day of nine hours to join him.

Those days on the gorilla mountains had a quality beyond anything that any of us had known. The beauty of the heights was an enchantment. We were in an upper forest, above the dim twilight of the bamboo, a forest unlike anything else in Africa. Fantastic trees with heavy crotches and long, outreaching arms burdened with heavy moss . . . a netted jungle of undergrowth sometimes breaking into waves of delicate bloom . . . chasms, whose clifflike sides would have been arid in other climates, Akeley pointed out, but here were clothed in wild luxuriance.

It was a forest out of an old fairy tale, Akeley felt, and the gorillas were its giants. He gave his sentiment free rein; the place appealed to all the fancifulness of his beauty-loving nature. I have never known him more content than with those days, exhausting as they were.

The tangled greenery through which we made our way, day after day, seeking traces of gorilla, was burning with nettles and sodden with rain; we were from 10,000 to 12,000 feet up, and the nights were piercingly cold in the chill damp; the days were June when the sun shone, raw November in the fog. There was scarcely enough dry firewood for the cooking. The guides deserted but were sent back by their sultan, the porters were threatening to run away. There was never a moment to be lost, either in the hunting or the photographing, or in the preparation of the skins, the drying of the skeletons, the embalming of the young gorilla which Akeley had undertaken.

Akeley always worked like ten. Few men could have done what he did on those mountains. He was profoundly satisfied with his experiences; there were five gorillas for the group, a male and two females that he had shot, the male of Karissimbi that my husband shot, and the young gorilla that the natives speared—and everything in the behavior of the gorillas hunted or observed (and we saw them singly and in bands) confirmed his belief in the Credo that he had written on his way to them.

"I believe that the gorilla is normally a perfectly amiable and decent creature. I believe that if he attacks man it is because he is being attacked or thinks that he is being attacked. I believe that he will fight in self defense and probably in defense of his family; that he will keep away from a fight until he is frightened or driven into it. I believe that, although the old male advances when a hunter is approaching a family of gorillas, he will not close in, if the man involved has the courage to stand firm. In other words this advance will turn out to be what is usually called a bluff.

"I believe, however, that the white man who will allow a gorilla to get within ten feet of him without shooting is a plain darn fool."

Another cause for Akeley's satisfaction was that he took the first pictures ever made of wild gorilla. This he accomplished with the "Gorilla," a motion-picture camera he had prepared expressly for the forest conditions of light.

The rarest day of the experience was the day that my husband killed the big gorilla—the lone male of Karissimbi. Carl Akeley, Herbert Bradley, Martha Miller, and I were all in that hunt, and the mountain-side on which it took place, where the gorilla fell, was the spot that Akeley pronounced the most beautiful in the world.

Castle peak of Mount Mikeno. Part of the gorilla sanctuary

We were high on the slopes of Karissimbi, space around us like a sea. Mikeno rose on our right, its rocky summit vivid against a sky of burning blue. Below us stretched a world of mysterious forest, shimmering lakes and distant mountain ranges, and before us the cloud and fire of the volcano Namlagira flamed like a funeral pyre between the branches of the dead tree at whose base lay the gorilla.

It was a dramatic thing, that dead gorilla in that place of unearthly beauty, and Akeley said, "I envy that chap his funeral pyre." He always said that when his time came he wanted "to lay his bones in Africa," and the only comfort now to his friends is that if the end had to come, it came where he would have wished, and he lives in Africa's eternal keeping.

In a letter to us in 1923 Akeley wrote, "That morning on the slopes of Karissimbi was the high spot of my African experiences."

We were camping in the saddle between Karissimbi and Mikeno—the camp that was to be Akeley's last camp—and on several mornings the marsh before the tents, from which we got our water, was skimmed with ice and Karissimbi's peak was powdered with snow. With the shooting of the big male Akeley felt the work for the group was accomplished; the collection of background he left until he could return with a painter. Although with license for ten gorillas, he took but five.

"The Boiling Pot" of the active volcano Namlagira, photographed from within the crater

Already there was forming in his mind that dream of a sanctuary for gorilla which King Albert made true.

For months we had watched the fire from Namlagira reddening the sky, and Akeley had noted that the wind came always from one direction blowing the fumes south. The expedition of the Duke of Mecklenburg had been up to the crater in 1907, but since the later eruption of fire no one had explored it, and the natives' declaration that it was impossible to cross the lava plain which separated Namlagira from the base of the gorilla mountains strengthened Akeley's determination to do it.

From the White Fathers we obtained guides and set out. That lava plain, emanating from small cones and subsidiary fissures, was a chaotic drift of ragged and broken rock, slippery with lichen, and overgrown with sparse grass that concealed only too well its treacherous crevasses. The guides took us across, but had no intention in the world of leading us up to that crater of fire; it was only by Akeley's driving the unruly headman out of earshot while the rest of us violently shepherded the reluctant porters up the heights, that we made the ascent.

We made camp above timber line, in lava rock and alpine growth, then we four whites ascended for an unforgettable first look into that crater. We were on the brink of the mountain top, looking down into a chasm about six miles in circumference, a colossal chasm blown out by at least three distinct eruptions into three abysses, separated by bastion-like walls of rock, stratified and colored, variegated by cinder slopes and table-lands of yellow sulphur beds, spouting steam, and billowing clouds.

In the center rose a citadel rock, the Castle, as we called it, amber in the light. Through the Portal, a break in the inner walls, we saw the fire that came from the only active crater. The abyss was filled with boiling lava, from which came a booming roar like a heavy surf, as constant explosions broke through the swiftly forming crust.

The next day we gained admission to the crater by a little dip in the rim, through which we clambered down on ledges and terraces, out across sulphur beds. At first we used commendable prudence, roping ourselves together and testing every step—more than once a foot went through the brittle crust—but after the first hours we took our separate chances. We spent three days within the crater, one night on the rim, in the shelter of a bowlder, directly above the boiling pot, and another night in the crater itself, on a little ledge clinging to the rocky wall, facing the opening in the rocks through which glowed the fire.

Mr. Akeley set the camera down on a cinder slope on the edge of nothing at all, and we photographed the crater, both with motion pictures and stills, in its own light. We were looking down into the crater of boiling lava, a great mass crusted with cooling, darker lava, patterned with gleaming cracks of pure gold, that darted and shifted as the stuff seethed and boiled and broke into fountains of fire, or rolled into molten rivers of hissing flame.

As night came on, the cloud above that cauldron became a glow of rose, vivid, unearthly—a rose of hell, Akeley called it—that made an inferno of those rocky walls, throwing into relief every jutting ledge and rock, filling with mysterious shadow the deep recesses and dark distance. High above the crater that rose-red cloud streamed out against a sky its fire made black. . . . We sat on that ledge half the night, the glory of that spectacle in our eyes, the thunder in our ears.

Mikeno and Namlagira were the high spots; what followed were the usual hunting experiences. We went out to the Ruindi plains south of Lake Edward after lion, buffalo, and elephant. From the Ruindi we saw the wall of mountains west of Edward sheltering that wild country that was the goal of our second trip into Africa. We marched out from the Congo from Ruchuru across the mountains into Uganda, by Kabale and Lake Bunyoni, that vivid blue lake framed in black euphorbia trees that was second only to Kivu in Akeley's appreciation. It was the only place in the world, he said, where lotus, papyrus, and bamboo met. Motor cars met us at Mbarara, and after that came the boats and trains of the British territory.

Near Victoria Nyanza, Akeley showed us a grove of trees where he had rested once on a march, with "J. T." in his arms and wild monkeys had chattered down at them from trees. Now a noisy little train was puffing there and a fat Indian babu in his yellow turban was lording it over the blacks. So fast had Africa gone.

That was the spur that goaded him on in his preparations for the African Hall that was to be a memorial to Africa, a memorial now to Carl Akeley, who more than any other man gave a true vision of the African wilderness to the world.

Photograph by Martha Miller Bliven

An African flat-topped *Acacia* tree

Epilogue

By HENRY FAIRFIELD OSBORN
President, American Museum of Natural History

WE wish that Carl Akeley could have lived to see the present number of NATURAL HISTORY with the glowing tributes of nine of his admirers, colleagues, and friends. To very few is it given to attain an international standing and to be known and admired on two great continents. Akeley's love of Africa and African life grew upon him year by year from his first great journey with Daniel Giraud Elliot, which resulted in the superb groups in the Field Museum.

Much as he loved his own country, Africa became his paradise, not only of great mammals but of nature in her grander forms and moods, and of the natives in the courageous aspects of their lives. As Herbert Ward, in the superb bronzes depicting the nobler expressions of the African native, has put into enduring bronze his tribute of admiration, so Carl Akeley in the three· scenes of the African hunt has portrayed the unflinching courage of the Masai native, as well as the final heroic charge of the lion and lioness upon their intrepid foe. Often have I heard him speak of his admiration for these Masai hunters.

Akeley's first love was perhaps for the elephant, but in his closing years he conceived a great admiration for the lion, and his final work on the lion group is perhaps overtouched with sentiment. Often did he dwell upon the nobility of the elephant, its courage in the charge, its sympathy in removing the wounded comrade. Little wonder, with sentiments like these, that he entitled the chief literary work of his life *In Brightest Africa*. Little wonder that, in the confines of the great city of New York, he longed for the sweep of the African plains and savannahs, for the unspoiled beauty of the African forests, for the majestic march and trumpeting of the elephant, and for the dauntless charge of the lion.

It was Akley's wont to concentrate his imagination and creative power, as well as his energy, upon one great object at a time. Soon after he joined the naturalists of the American Museum, he began to plan the African Hall, and worked upon this day and night until the faultless plan was achieved. This was immediately published so that the thought of a centrally darkened space with outlooks into vividly lighted and wholly naturalistic scenes of African life at once became the motive for similar designs in other museums.

Then he sought to surpass himself and his own great animal designs by discovering a new method which would enable him to give the last living touches to his models, after the manner of the sculptor in clay. He himself told me that the clay method flashed into his mind while he was starting on a theater party with a group of friends, who laughed when he suddenly exclaimed, "I have discovered a new and far superior method of modeling and mounting animals." This is the now commanding Akeley method, which he imparted to several of his pupils in mounting the African elephant group, and through which for the first time these pachyderms give the entire semblance of life to mounted animals, especially in the delicate display of the muscles of the face, of the eyes, and of the nostrils.

There followed a two-year period of trial and error, of dauntless experimentation, inventing the now world-famous Akeley camera—the peer of cameras of the field. During the war, this same fiery intensity was given to the great Akeley reflector which was to be his principal contribution to the cause of the Allies.

Immediately following the death of Theodore Roosevelt, he turned the entire force of his genius into the designing and setting of the giant leonine statue which he believed best to envisage the commanding spirit of his beloved friend. Certainly the greatest disappointment of his life was the report that the Theodore Roosevelt Memorial advisers had decided that this great design could not be accepted after his two years of unparalleled labor. At the very close of this memorial effort, he produced what he believed to be the most commanding figure of a lion, a copy of which shall be placed in or near the Roosevelt Memorial Hall.

Finally, it is delightful to record that, only a brief twelve months before his death, there came the long cherished opportunity actually to begin the execution of his African Hall plans after years of baffling discouragement which would have crushed all the ambition of the less courageous and less persistent personality.

⁂ ⁂ ⁂ ⁂ ⁂ ⁂

Our first thoughts on hearing of Akeley's passing on the slopes of Mount Mikeno were that it was given to him to pass away near the scene of his greatest achievements and to be buried where he most wished to lie. The lines of Stevenson's "Requiem" come to our minds;

> Under a wide and starry sky
> Dig the grave and let me lie.
> Glad did I live and gladly die
> And I lay me down with a will.
>
> This be the verse you grave for me:
> "Here he lies, where he longed to be;
> Home is the sailor, home from the sea,
> And the hunter home from the hill."

It is fitting, too, that Carl Akeley lies within the area which through his idealism and through the idealism of Baron de Cartier de Marchienne has become for all time the sanctuary of the mountain gorilla. Had it not been for Akeley, these monarchs of the ape world would doubtless all have perished as trophies of the hunter and spoils of the various museums of the world. Akeley not only redeemed the anthropoid tribe, but he redeemed the reputation of the gorilla from the misrepresentations and exaggerations which from the time of Du Chaillu had made these inoffensive animals the personification of brutality and of satyrism, as portrayed in the sculpture of Fremiet. For this undeserved reputation Akeley substituted a benignity of domestic life, portrayed in his masterpiece the Gorilla Group, disturbed only at the approach of a foe which threatens the family.

⁂ ⁂ ⁂ ⁂ ⁂ ⁂

In closing this series of tributes to Carl Akeley—the Conservationist, the Explorer, the Sculptor, the Inventor, the Patriotic Citizen, the Idealist, the Typical Self-made American Man, I wish to express once more the everlasting debt which all the museums in America owe to the life work of this remarkable man. We may only estimate the full measure of our debt by considering what the standards, not only of this Museum but of all museums of America, would have been without the sweep of his great achievements, which gave us a wholly new conception of the mammalian kingdom and of the close portrayal of nature in animal habitat groups.

May we not consider that the most appropriate dedication of the African Hall shall be to the memory of the man who conceived it and practically gave his life for it—Carl Akeley. The climax of Akeley's life ideals is embodied in his plans for the African Hall. The peak of his life ambition was reached when he started out with two of his greatest benefactors and two artists to give entirely unrestricted rein to the beginning of this central and crowning effort of his life—the African Hall. Like the great leader of the Hebrews, he passed away after many years of undaunted courage and effort at the very moment when the promised land was in sight,—in fact, within his very grasp.

NOTES

CARL AKELEY

Colleagues, comrades, and friends of the late Carl Akeley gathered together at the American Museum on the afternoon of December 21, 1926, to pay a series of tributes of admiration for his character, and of devotion to his memory. President Henry Fairfield Osborn presided. The speakers presented the versatile genius of the man whose name they had come to honor, and Carl Akeley as explorer, sculptor, inventor, and conservationist, was memorialized. These addresses appear as a series of articles in this issue of NATURAL HISTORY.

Numerous tributes came from various parts of the United States and from abroad, by telegram and by letter, and were read by Director Sherwood at the beginning of the meeting. They are as follows:

From Mr. Akeley's co-worker and friend, Martin Johnson, in a cable from British East Africa:

Akeley's death a terrific blow, a great tragedy, and a personal loss that I shall always feel. I am thankful he found a last resting place in the spot he loved.

From Stanley Field, president of the Field Museum in Chicago:

We sympathize with the American Museum of Natural History and the scientific world in the loss of Carl Akeley.

From James Gustavus Whiteley, Consul of Belgium.

It is gratifying to think that, although he was not spared to complete his work with his own hand, he must have had the satisfaction of knowing that his cherished ideal was well started and cannot fail to be realized.

From Mr. S. M. Hunter of Chicago:

Mr. Akeley, in a letter of March, 1910, from Uganda, writing us of Roosevelt used these words: 'Lord, but he is a man.' In an association of thirty years I can say the same of Akeley.

From Mr. and Mrs. H. E. Bradley of Chicago:

Akeley's works live after him, but Akeley is gone and we mourn the friend.

From Dr. Herbert J. Spinden, Peabody Museum at Cambridge:

He had breadth of vision and depth of vision, but most of all he had simplicity, and this, it seems, is the mark of true greatness.

From Mr. Joseph N. Teal of Portland, Oregon:

I loved and admired him both as a man and as an artist. His untimely death is an irreparable loss to his family, his friends, and the world.

From Roy Chapman Andrews:

His warm and loyal heart made him a dear friend, his brilliant mind an inspiring colleague, and his genius a notable figure in the life of the nation as well as the Museum. Akeley never can be replaced.

The following telegram received from His Majesty, King Albert of Belgium, was read by Baron de Cartier de Marchienne:

On the occasion of the Memorial Service held in honor of Dr. Carl E. Akeley, please convey to President Osborn and the authorities of the American Museum of Natural History the expression of my sincere sympathy. The death of this eminent naturalist and explorer is a great loss for the entire scientific world. Pray extend to Mrs. Akeley my heartfelt condolences.

(Signed) ALBERT.

The following resolutions, passed by the Holland Society Trustees were read by the President of the Holland Society, Dr. Fenton B. Turck:

At a meeting of the Trustees of The Holland Society of New York, held on the ninth day of December, 1926, the following Resolutions were unanimously adopted in reference to the death of Carl Ethan Akeley recipient in 1922 of The Holland Society's medal for distinguished service in the science of exploration:

Resolved, That the eminent achievements in Natural History of Carl Ethan Akeley have been glorified by the modesty, the persistency, the disregard of self and, above all, the undaunted courage with which his heroic and notable service in the cause of science invariably has been rendered. The splendor of his accomplishment is emphasized by his tragic death while still ardently engaged in the prosecution of his lofty aims. But, as in the case of all great spirits, in death he remains victorious—since already he had rescued from oblivion so large a part of the Natural History of the wilds of Africa and preserved it for use in future scientific study and investigation throughout the world.

Resolved, That this expression on behalf of The Holland Society of its deep sorrow in Mr. Akeley's untimely death, in the midst of his great undertaking, be extended to his colleagues in the American Museum of Natural History and to his wife and family and devoted friends.

Resolved, That a copy of these Resolutions, suitably engrossed, shall be presented to the American Museum of Natural History for permanent record in its African Hall.

At the request of Mr. James B. Ford, the president of the Explorers Club, Mr. Kermit Roosevelt read a short memorial which had been prepared by the Club:

The members of the Explorers Club record with deep sorrow the death of their colleague and former president Carl Ethan Akeley.

In Mr. Akeley were combined the imagination of the artist with the discriminating hunger for simple truth which is the ideal of science. He carried high purpose into the field of exploration in his beloved Africa, inspired by a passion that his fellow men might henceforth be enabled to catch glimpses of the peerless wild life of that great continent as if through his own fortunate eyes.

A man of multifold genius—naturalist, sculptor, engineer, inventor, father of indispensable methods in modern museum exhibition—Mr. Akeley lived to see the success of many aspirations, expressed not only through the labor of his own brain and hand, but also through his influence upon able disciples. His lectures and writings rallied enthusiastic followers to the causes for which he gave his life.

Blessed with a genial and harmonious spirit, he was never too absorbed in his own trials, or in the vision of his aims, to counsel, encourage, and befriend those who sought assistance. He died as he himself might have wished, in the beautiful sanctuary to which his zeal had given birth, and in the comradeship of those nearest his heart; but we, his friends, lament his passing and the loss to the world of his gifted and productive mind.

THE AFRICAN HALL EXPEDITION

Mrs. Akeley, who before her marriage to Carl Akeley in 1924 was Miss Mary L. Jobe, continued her husband's work for four months in the field, from November to February. Although this was her first trip to Africa, she worked side by side with Mr. Akeley throughout the entire expedition. She had led numerous exploring expeditions in Northern British Columbia, and in 1925 the Canadian government named one of the highest peaks in the Canadian Rockies Mt. Jobe, in her honor. She has given the following brief report of the African Hall Expedition. Her complete report will follow in a later issue of Natural History.

May 12, 1927

It was in January, 1926, that Mr. Akeley and I left New York en route for Africa to begin the work of his expedition for the African Hall of the American Museum of Natural History. As he so often expressed it, he had never before been so happy as, after so many years of effort, he was at last experiencing the complete fulfillment of his life-dreams.

The expedition was made possible through the generosity of Mr. George Eastman of Rochester, Mr. Daniel E. Pomeroy of New York, and the late Colonel Daniel Wentz of Philadelphia. When we left New York it was planned that these three gentlemen and Dr. Audley Stewart, Mr. Eastman's physician, should join us early in May, 1926; and also that in March, Mr. Akeley's staff of two taxidermists, (Messrs. R. H. Rockwell and R. C. Raddatz) should arrive to assist in collecting specimens and accessories for six groups of animals, and that two landscape artists, Messrs. William R. Leigh and A. A. Janssen, should come for the preparation of studies of African landscapes for the backgrounds of these groups in African Hall. These plans were carried out except in the case of Colonel Wentz who, in February, when on the eve of departing for Africa, was called to the Great Beyond. Our reunion in Africa was greatly saddened by his loss.

During the months of May, June, and July, the sportsman's party of Messrs. Eastman, Pomeroy, and Stewart, and our collecting party were either working in close proximity, or were meeting at frequent intervals. The sportsmen were getting their own bag and contributing certain specimens to the Museum's groups, while our party was collecting many specimens, and accessories and making studies for the painted backgrounds for five animal groups.

At this time in Kenya, and on the northern frontier, Mr. Akeley often worked far into the night in order to preserve the specimens. In August Mr. Akeley and I, with Mr. Raddatz, joined the Eastman-Pomeroy party, also the Martin Johnsons in the great game fields of western Tanganyika.

It was in this district that Martin Johnson obtained his great lion pictures, assisted by Mr. Akeley, who considered it most important to give his personal help in securing these records of wild animal life which he believed to be invaluable to natural science, and which, owing to the rapid extermination of the game,

Scenes from Akeley's Africa

REPRODUCED FROM PHOTOGRAPHS TAKEN BY MARTIN JOHNSON DURING THE PRESENT MARTIN JOHNSON AFRICAN EXPEDITION

MRS. MARTIN JOHNSON—"OSA"

Copyrighted by the Amer. Mus. of Nat. Hist.

MRS. JOHNSON AND THE BIG CROCODILE

ZEBRAS AND OSTRICHES

A fortunate snapshot of wild life on the plains of Africa

A HANDSOME SUBJECT FOR THE CAMERA

The bait hung about five feet above the ground, and as the leopard struck at it, he released the flashlight

YOUNG LION

He is gazing, unalarmed, into the light of the flashlamp which is turned on him

AFRICAN BUFFALO

This old bull carried away the flashlight wire with his horns as he stooped to drink

BLACK RHINO

A scarred old fighter on the shores of Lake Paradise

Above — A spotted hyæna taking his own picture as he stops above the bait
Below — A jackal stepping on a disc switch as he contemplates the bait overhead

would all too soon be impossible to acquire. In the interim of photography, he collected specimens for a group of plains animals, a double group, and one lucky day when he and I were out alone, he secured a complete band of nine wild dogs. In all those activities he worked incessantly and with the greatest enthusiasm. Then he suddenly became ill with fever. I nursed him for a week in our very hot camp, until his fever had subsided, and then took him in his bed in a motor lorry to Nairobi for medical attention. He had no recurrence of fever. One of the best physicians in Kenya pronounced his condition one of fatigue and not of infectious illness. After three weeks in the Kenya Nursing Home, I took him to our home in Nairobi, and there, as he was greatly improved, we prepared for our trip to the Belgian Congo, which from the very beginning he had been most eager to undertake.

Accompanied by Messrs. Leigh and Raddatz and Dr. J. M. Derscheid, a Belgian biologist, we made the trip from Nairobi, 800 miles to Kabale, Uganda, in motor lorries and in one light car. For this trip Mr. Akeley packed his own lorry and one other and worked with untiring energy in repairing bridges, where occasionally our heavily laden motor lorries broke through.

After leaving our motors at Kabale, we all went on foot with porter safari a distance of about one hundred miles into the Gorilla Mountains of the Parc National Albert. It was very strenuous. However, on one day only Mr. Akeley became so exhausted he had to be carried. Later at Rutshuru he spent one whole day making motion pictures for the White Fathers on the occasion of the opening of their new church, and two days later he spent an afternoon repairing a motor cycle for one of the White Fathers at Lulonga Mission. He never spared himself in the slightest degree.

After we reached our camp at an elevation of 9500 feet, he was exhausted and spent one day in bed, but he remarked more than once how happy he was at being again in the Kivu, surrounded by appreciative companions and ready for the completion of his gorilla work. He walked into his last camp on the saddle between Mounts Mikeno and Karassimbi. He said that at last he was "on his old trail," and "in the beautiful forest of the gnomes and fairies." While on this climb we heard the bark of a gorilla close to the trail. Often he called my attention to the lovely moss-hung trees, "the oldest forest in the world."

The day of our arrival at our high camp, at an elevation of 12,500 feet on the slope of Mount Mikeno, he told us of his 1921 experiences and apparently enjoyed being in his old camp. That night he had a chill followed by a fever, which quickly subsided. The next two days, which were very cold with heavy storms of hail, he remained in bed, saying that he felt tired and wanted to rest, but that he had no pain whatever. On the morning of the 17th of November, after a very quiet, restful night, an intestinal hemorrhage occurred, he became greatly weakened, and at noon the end came.

Three or four times while in Africa he had told me that he wanted "to go in the harness," and "to be buried in Africa." His wishes were fulfilled. In the eight months in the field, to use his own words, he "accomplished more than in *any two years previous in the field*," and his mortal body rests in his last camp, in the Parc National Albert, which place of conservation of animal and plant life his mind first conceived, and which he considered "the most beautiful spot in all the world."

The remaining members of the expedition, Messrs. Leigh, Raddatz and Dr. Derscheid, and I worked on in the Kivu for six weeks, completing as best we could Mr. Akeley's plans for background, accessories, photographs for the gorilla group, with the survey and scientific observations of the animal life of the Parc National Albert.

After finishing the work in the Belgian Congo, Messrs. Leigh, Raddatz, and I went to Lake Hannington, in the Great Rift Valley, Kenya, completed the background, collected the accessories, and made the photographs for the group of Greater Koodoo. Mr. Pomeroy had previously obtained excellent greater koodoo specimens. Fortunately I secured photographs of the great flock of pink flamingos which Mr. Akeley had so greatly desired, and which necessitated journeying 110 miles on foot over volcanic slag. The mercury from 8 A. M. until 4 P. M. was 115° in the shade—a great contrast after working for six weeks in a temperature of 34° to 44° on the slope of Mount Mikeno in the Belgian Congo.

—MARY L. JOBE AKELEY.

WHILE ON THEIR WAY to Africa in February, 1926, Mr. and Mrs. Akeley were received by King Albert of Belgium and by Prince Leopold, both of whom, since the creation of the Parc National Albert, have shown the greatest interest in the work of this party.

When Mrs. Akeley reached Europe in late March of this year, she was informed by Mr. William Phillips, then American Ambassador to Belgium, that King Albert of the Belgians wished her to come to Brussels. On April 8 Mrs. Akeley had an audience at the Palace with his Majesty on the occasion of his birthday. At this time, in the execution of one of the last wishes of her husband, she presented to the King a painting of the Parc National Albert, Belgian Congo, and at his request gave him a verbal report of the expedition. The painting shows the "Parc" itself and the active volcano Namlogira, which Prince Leopold climbed in 1925. The picture was painted by Mr. William R.

Leigh, one of the artists of the Akeley-Eastman African Expedition.

On the occasion of this visit, Mrs. Akeley was decorated with the Cross of the Knight of the Order of the Crown, by M. Jaspar, Premier and Minister of the Colonies, representing the King of Belgium. This honor, the King's own decoration, is rarely presented, and only in a few cases before has it been given to a woman. The honor was bestowed in commemoration of the work of Mr. Akeley in the Kivu, and as a recognition of Mrs. Akeley's work in continuing for seven weeks on the high slopes of Mount Mikeno and bringing to completion Carl Akeley's plans.

The aim of their mission to the Belgian Congo was to explore in detail the large reserve of fauna and flora called the Parc National Albert, comprising the volcanoes of Karissimbi, Mikeno, and Vissoke. and to secure accessories and background for the Gorilla Group. This territory was established as a Gorilla Sanctuary largely through Mr. Akeley's efforts.

President Osborn presented to the Board of Trustees at their recent meeting the following letter from the Belgian Government, inviting the American Museum to particpate in the plans for the scientific development and research of the Kivu region:

April 27, 1927.

Dear Doctor Osborn.

The Albert National Park (Parc National Albert) established in the Belgian Congo for the protection and scientific study of the native flora and fauna has made good progress since its organization by the Royal Decree of March 2, 1925.

The results of the Mission headed by Mr. Carl Akeley, whose premature death was such a sad loss to the development of scientific exploration, will soon be brought to Brussels by Doctor Derscheid who helped Mrs. Akeley to continue the task initiated by her late husband to collect data on the topography, the fauna, and the flora of the Parc National Albert.

I understand that Doctor Derscheid will return to Brussels at the end of May, bringing with him considerable information, not only on the climate, the fauna and the topography of the Parc National Albert, but also on the secondary game preserves and the great game reserve of the Ruindi. I understand that Doctor Derscheid made a special study of the conditions in which scientific missions might, in the future, work in the Parc National Albert, in spite of the very rigorous climate; and he has located good camping grounds and also collected precise information concerning the habitat of the gorillas. He has climbed all the volcanoes which form an essential part of the Parc National Albert. Doctor Derscheid intends returning to Kivu in a few months and hopes to get in touch, in Brussels, with your representatives, so as to eventually settle the organization of the American scientific coöperation in the Belgian Congo through the farsighted statesmanship of his Majesty King Albert.

I would feel very much obliged if you would let me know, at your leisure, what your views are on this subject.

I have the honor to be,

Your obedient, humble servant,

Baron de Cartier.

In response, the Trustees unanimously adopted the following resolution:

Resolved, That the Trustees desire to express their appreciation of the action of his Majesty King Albert of Belgium in establishing the Parc National Albert in the Belgian Congo, for the protection and scientific study of the native flora and fauna, and the American Museum of Natural History will be glad to coöperate in carrying out the plans for the scientific development and research in this area.

The American Museum is keenly interested in this great movement for the conservation of the native flora and fauna of the Parc National Albert, a project which was so dear to the heart of Mr. Akeley, and all true nature lovers will forever be indebted to his Majesty King Albert for his broad-mindedness and wisdom in establishing this sanctuary.

Paintings Made for the African Hall Are Exhibited at Nairobi.—All the paintings made on the Carl Akeley 1926 Expedition for the African Hall were exhibited at the Kenya Arts and Crafts Society, Nairobi, February 17, in accordance with a promise made by Mr. Akeley. The exhibition won enthusiastic admiration from the people of Kenya, to many of whom the exquisite beauty of the surrounding country was a revelation, for few travelers penetrate into the remote regions shown in the paintings. The artists who had been specially chosen by Mr. Akeley to make these studies are Mr. A. A. Janssen and Mr. William R. Leigh.

Carl Akeley experienced to the last all the joys Africa could offer him, as is evidenced by the following abstract from a letter written by Martin Johnson, November 17, 1926, to Mrs. Robert Gordon McKay:

Akeley and I had some wonderful experiences among the lions in Tanganyika a few weeks ago. We had such luck that we can scarcely believe it true and I think Carl will always class these lion experiences along with his gorilla discoveries.

We were camped together for nearly three months with George Eastman and Dan Pomeroy and Doctor Stewart. Carl was busy securing the specimens for the Muesum groups, Osa and I were getting movies and the rest

Carl Akeley, Martin Johnson, Pat Ayers, and Phil Percival, at the lion camp in Tanganyika. Photograph by courtesy of Mrs. Robert Gordon McKay

were shooting, then Carl's boy "Bill" led us to a most wonderful valley where we found lions galore and, they never having been molested, we had no trouble photographing them. You know this life is meat and drink to Carl and me and here was a situation that we had dreamed of but never expected to have come true. I think both of us went a little off our heads when we photographed them playing, sham fighting, feeding off zebra, rolling in the grass, yawning, and even roaring; one charged and made a great picture. In fact, we got them doing everything lions do. Day after day we went back to this valley and never drew a blank.

There was only one fly in the ointment, none of the lions had very good manes and they were mostly in places where the light was poor, but I have just finished developing the films and I am perfectly satisfied.

Through the Courtesy of William Phillips, Ambassador to Belgium, we are able to give the following extract from the diary of Doctor Derscheid, who was with Akeley at the last.

Thursday, November 18—Kabara Camp. The unforeseen end of this friend of us all has completely overwhelmed us.

Back in 1912, Carl Akeley had been crushed by a charging elephant, and it is a question as to whether he had ever entirely recovered his strength. His mind, on the other hand, had remained young and enthusiastic, his ideal ever lofty, and, the disproportion between his physical resistance and the task imposed upon him by his conception of a work to be realized and his iron will, became more and more accentuated. In his own words, all of his recent excursions into East Africa were mere child's play compared with the present expedition, fraught with difficulties due to the special nature of the country. His death was really caused by over-exhaustion, from which his body, already tired, was unable to recuperate. He saw in the present expedition the culmination of his African work. His strength supported him until he had reached these volcanoes, which he considered as the most splendid part of Africa, this "Parc National Albert," which had been created upon his initiative and, in large part, according to his advice. He held out on the steep declivities of the bamboo forest, and in the mud of the marshes, across the thickest of the jungles, until he reached his old camp in the pass separating the two majestic volcanoes, Karassimbi and Mikeno. There on the site of his old camp his mortal remains repose. His anxious impatience to reach this old camp as quickly as possible, his insistent desire, in spite of all obstacles, to push on from the Ruëru camp to the Mikeno camp, show the powerful attraction which this locality held for him. He had brought the best painter he was able to find, in order to record on canvas this incomparable site. This was the goal he was determined to reach, from which he would permit nothing throughout the course of the whole long route to hold him back, and this is where we shall leave him to sleep.

THIRD ASIATIC EXPEDITION

A cable received from Dr. Roy Chapman Andrews announced that he, Walter Granger, and Mr. Nelson were safe in Peking. Doctor Andrews added that Macknezie Young had suffered the loss of the ends of three of his fingers through frostbite incurred while in Mongolia. Mr. Granger wrote March 24, from Hongkong, that the collections made by himself and Mr. Nelson were being forwarded to the American Museum. These collections, from Yunnan Province, include stone implements, pottery, fossils, bird and mammal skins, fishes, and reptiles.

IN MEMORIAM

In the death of Dr. Walter B. James, the American Museum of Natural History has lost one of its most beloved Patrons and Trustees. Doctor James's interest as a Trustee of the Museum was intensified by an inherent love for all branches of natural history, centering naturally, however, about biology and public health. As a member of the Executive Committee, the Committee of Building and Plans, the Pension Board, and the African Hall collections, he rendered very conspicuous service.

The members of the Board of Trustees, at their last meeting, May 2, 1927, paid the following tribute to Doctor James:

> The Trustees desire to record their deep sense of loss through the death of their co-Trustee and friend.
>
> Doctor Walter B. James
>
> who passed away on April 6, 1927. Doctor James was elected to the Board in February, 1911, and served as a member of the Executive Committee from 1911 to 1913. He was also a member of the Committee on Buildings and Plans from 1912 to 1927; of the Nominating Committee from 1920 to 1927; and of the Pension Board from 1916 to 1927. Throughout his Trusteeship, he was intensely interested in all of the activities of the Museum and was always earnest and painstaking in his duties as a member of the various committees.
>
> His advice and hearty cooperation were always valuable, especially where the welfare of our employees was concerned.
>
> The same qualities which distinguished him as a Trustee of the Museum made him a valuable and influential citizen in the community.
>
> His colleagues on the Board greatly miss his genial presence and valuable counsel.

Charles Sprague Sargent, dendrologist, died on March 22 after a two weeks' illness, at his Brookline estate, Holm Lea. Had he lived until April 24, he would have been eighty-six years of age. He had been director of the Arnold Aboretum since 1872, and professor of arbori-culture at Harvard since 1879. The books by which he is best known are his *Manual of Trees of North America*, and his elaborate *Silva of North America*. He was generally recognized as the foremost authority on trees, and the American Museum of Natural History was fortunate in having him plan the Jesup collection of North American woods. He was aided in this work by his wife, who made the colored drawings of the foliage, flowers, and fruits. Mrs. Sargent died eight years ago. An excellent bronze bust of Professor Sargent, by C. S. Pietro, stands at the entrance to the Forestry Hall of the American Museum.

ASTRONOMY

Astronomical Society Formed at the American Museum.—The need for an amateur astronomical society in New York City was overwhelmingly demonstrated by the attendance of more than 500 people at the initial meeting called for the purpose of organization. The meeting was held in the American Museum of Natural History on the evening of May 10, and was presided over by Dr. Clyde Fisher. Professor Henry Fairfield Osborn, president of the American Museum of Natural History, made the welcoming address. He stated that the greatest gift a philanthropist could bestow for the intellectual uplift of the community would be money for the construction of an astronomical hall for the Museum, where the public could study the marvels of the sky. Other speakers were Dr. Oswald Schlockow, district superintendent of public schools of New York City; Mr. John A. Kinsbury, secretary of the Milbank Memorial Fund; and Mr. George H. Sherwood, director of the American Museum of Natural History.

Of the audience present, 340 signed applications for membership. President Osborn asked to be enrolled as the first life member, and his request was followed by a dozen others. Additional applications are steadily coming in every mail with suggestions and good wishes from every source.

Doctor Fisher was elected temporary president.

The next meeting will be held at the American Museum of Natural History on Thursday evening, May 26, at 8:15 o'clock.

A Series of Paintings in oil illustrating the magnificent prominences of the chromosphere of the sun has just been placed on exhibition in the Pro-Astronomic Hall. They are the work of Mr. Howard Russel Butler, N.A., who painted the three solar eclipses as well as the Lunar Landscape and the Aurora Borealis.

The chromosphere of the sun is composed of the light gases, hydrogen and helium, which float above the photosphere. These gases, being incandescent, have a wonderful rose color and are frequently, by explosive action, thrown high above the limb of the sun, sometimes as much as several hundred thousand miles. These eruptions are known as hydrogen prominences. They are constantly occurring and take on extraordinary forms.

They were first seen during total solar

eclipses, when the moon obscured the photosphere and made visible the prominences and the corona. Now they can be seen in the spectrohelioscope, an invention of Dr. George E. Hale, who has erected an observatory in Pasadena for the use of his instrument.

Mr. Butler had the good fortune to see the hydrogen prominences of the eclipse of June 8, 1918, at the United States Naval Observatory Station at Baker, Oregon. He then made careful notes of the color as seen by the naked eye and through a powerful field glass. He has also had the opportunity of studying these phenomena through Doctor Hale's spectrohelioscope. He conceived the idea of a frieze of hydrogen prominences to be placed ultimately in the proposed Astronomic Hall. The extraordinary forms and the vivid coloring produce a most decorative effect, and by varying the scales in the pictures, a uniform arrangement is obtained.

On the east wall of the Pro-Astronomic Hall are shown the great prominences observed during the eclipse of 1918, commonly known as the "Heliosaurus" and the "Eagle." The former was about 400,000 miles long and reached a height of 47,000 miles. The scale of this picture is one inch to 1700 miles and the lunar diameter used in the picture is forty-three feet.

On the west wall is a series of five paintings, the central one representing the great explosion of hydrogen that took place April 25, 1895, as recorded at Kenwood Observatory, and which attained a height of 281,000 miles. The scale of this picture is one inch to 5600 miles. Other pictures of this series represent the eruptions of September 23, 1919, as recorded at Yerkes Observatory. The scale is one inch to 1700 miles. July 9, 1917, based on a photograph taken at Mount Wilson, the scale being one inch to 2500 miles. October 8, 1920, at Yerkes Observatory, one inch to 2400 miles. July 15, 1919, Yerkes Observatory, one inch to 5300 miles.

In each case Mr. Butler has placed a disk representing the relative size of the earth, which runs from the size of a silver dollar to a disk 4¼ inches in diameter, showing that the earth in every case is insignificantly small in comparison to these gigantic tongues of incandescent hydrogen. A system of lighting has been used which makes the prominences glow like fire.

These two gorgeous friezes make a most attractive exhibit and already many visitors are enjoying them. Eventually, they will be installed in our proposed Hall of Astronomy.

Ancient Methods of Measuring Time.—A unique collection of ancient and modern sundials, hour glasses, and astrolabes has been placed on exhibit in a special case in the Pro-Astronomic Hall. Unusual material for study is provided in the variety of instruments and the wide range of time covered in their manufacture. Silver pocket dials with compass, delicately engraved, a French astrolabe by Reinold, dated 1581, for observing the altitudes of planets and stars, an instrument used by mariners called "gnostique" which was designed by Messin in 1615, Chinese sundials and ancient Japanese pocket dials and compasses are shown , as well as examples of ivory book dials, and two universal ring dials, one by Chapoto, Paris, dated about 1600, the other English, dated 1620.

BIRDS

The Chapin-Sage Expedition.—In a letter recently received from Dr. James P. Chapin he writes that in company with DeWitt L. Sage they secured, on the mountains of Ruwenzori, most of the montave species of birds known to occur on the explored eastern side. In describing the progress of his work Doctor Chapin writes that he found,while descending from the heights of Ruwenzori, anything but uniform conditions. In making the ascent of the slopes one traverses "life zones." Circling about the base one passes from one "faunal area" to another and then on to a third which may belong in a distinct subregion of the continent, for Ruwenzori is virtually a wall rising between east and west Africa. On the return trip the expedition traversed the band of lowland forest (a long day's march in width at its narrowest place) which extends from the Semliki River up the western slope of Ruwenzori till it merges with the montave forest. North and south of this band are areas of almost impenetrable elephant grass, with many west African birds.

Still farther south, along the base of the range, the grass grows finer and the savannas become covered with large acacia trees. This is the most pleasing country of the whole region, and it begins to exhibit east African birds. Rounding the south end of the range and approaching Kative, the plains become still more open, with only large clumps of tree-euphorbias. If this district were in more direct communication with the arid areas east of Lake Victoria, it would doubtless have zebras and ostriches. This type of country invades the Congo just along the northern shore of Lake Edward, bringing with it many east African birds.

In all about one hundred days were spent in the whole region of Ruwenzori. Of that time nearly one half was spent in arduous travel. On forty days of the trip a fair day's march was made without counting excursions from camp in search of birds. On some days the party climbed as many as 4400 feet, and once climbed 3500 feet and then down again the same distance.

Doctor Chapin and Mr. Sage have not suffered from any tropical ailment, or indeed from any other.

The following excerpts from Doctor Chapin's letters describe vividly some of the experiences of the expedition.

Mt. Iterere, 14,300 ft.,
West Ruwenzori, Nov. 26, 1926

My dear President Osborn:

You gave me my first taste of mountain-climbing when you sent me with George Bowdoin to the Canadian Rockies in 1915. And now my old longing to see Ruwenzori has been fulfilled. Of course the birds are the special reason for my being here, but who would not be thrilled by snowcaps and glaciers in such profusion as here?

We have pitched a little tent on a mountaintop; it is evening now and I am keeping warm by a little oil stove. But from this point, when the continual fogs permit, one sees mounts Stanley and Baher gloriously displayed at about six miles distance up a deep valley.

Today, by climbing a mountain 15,000 feet high, directly between here and Mt. Stanley, I had as splendid a view as one could desire, peaks weighted down with tremendous caps of snow, glaciers hanging in valleys so steep that one wonders why they don't fall, sheer black cliffs, rock slides, and below us, glacial lakes. The highest lakes on Kenia and Ruwenzori are not robin's-egg blue as are the lakes in Europe and America, but olive-green, for some curious reason. Just below this camp is another lake, nearly black.

Sage and I first came up here together, and deposited a bottle where other travelers (including my friends Bequaert and Heller) have done in the past. This is the end of the trail, and not much of a path at that, five days for carriers from the base of the mountain at 4000 feet. Then Sage come up to spend a night, because the best chances of seeing the peaks are at dawn and sunset. Now I have had my turn here, and have been favored exceptionally by the weather.

Here we are in the Senecis zone, which corresponds to the Paramo of the Andes. From 13,200 feet down to 9500 feet is the zone of tree heaths and wet moss, truly a terrible place now, wet and cold, almost devoid of birds. Sage is in our camp at 12,300 feet waiting for me. I pity him. There is not a level spot for a tent; like all that zone of vegetation it is a mess of old dead heath trunks, buried in wet moss, with holes everywhere. Getting from our tent to the fly that serves as kitchen and dining room, I have twice fallen through to my waist. Today is the first day since we have been on the mountain (nearly two weeks) that I have been dry all day.

Below the heath zone are the bamboos and ordinary mountain forest, where birds are abundant. But below the mountain forest and extending up to 6500 feet in most places, is the elephant-grass, another disagreeable tangle.

So the mountain has its glories, and its discomforts. I should not use mountain in the singular, Ruzwenzori is a whole range, 50 miles long, with almost innumerable mountains. It is great to be here.

* * * * * * * * * *

Kalongi, 7000 ft., West Ruwenzori (highest village in Butagu Valley)
December 22, 1926.

Dear Mr. Sherwood:

Just a month after the sad event, I received a letter from an old friend, Mr. Boyton, then at Rutchurn, telling us of the death of Akeley on Mt. Mikeno. I know no details, save that Boyton said it was from the effects of dysentery. But having seen so much of Akeley in East Africa, we felt a great shock at the suddenness of this bad news. We were not even sure that he was back in the Kivu. . . .

After many delays, we actually began to climb the mountains here on November 14. It was still raining hard. At Kalongi we camped in a cascade of mud, in fact it was so uncomfortable that we had our porters build us a house of bamboos and grass while we were waiting for a guide and a few mountain porters to take us higher up. At 9000 feet we had a fairly comfortable night's camp, but up in the tree-heath zone, at 12,000 feet, it was miserable. Cold and wet, not a level spot for a tent, fallen trunks with holes between them buried in moss.

At 13,800 feet, the end of the trail, we had brief glimpses of the peaks through clouds. This was on November 23. We went down to the tree-heaths again, and were miserable. Again Sage went up on the 25th. There came a sudden change in the weather. The peaks stood out in all their glory. On the 26th it was dry and warm, and I climbed to 15,000 feet.

Lack of food for the men forced us to come down to this camp. The dry season is now securely established. We have busied ourselves collecting, and have secured many fine birds (including *Francolinus nobilis*, *Malaconotus lagdeni*, *Caprimulgus ruwenzorii*, and *Micropus aequatorialis*) a number of rodents and so on.

We hope to get enough men and food together to make another quick trip up to 15,000 feet, if not to the snow line. Then we shall be ready to return to the Semliki Valley and Beni, to continue on towards the Kivu. There is now a road to the west of Lake Edward, and no one travels by way of the lake any more.

15,000 ft., West Ruwenzori
Jan. 4, 1927.

Dear President Osborn:

I believe I wrote you from Mt. Itereré on November 26 last, and told of climbing to 15,000 feet. Now I am camped on that mountain and have just returned from a days' trip across the deep valley northeast of us, to the glaciers of Mt. Stanley.

One very large glacier descends to about 14,800 feet, not more than a mile from here. I was able to climb up alongside it to 15,500 feet when I found myself between two large glaciers, for another one flows down to the northward.

Above me towered the snow-covered Alexandra Peak, and no mountain scenery has ever seemed wilder to me. Overhead two ravens circled and cawed, justifying a bird-lover's presence amid these remote rivers of ice.

DeWitt Sage is waiting for me down the mountain. We could not secure enough porters for both of us to come up this time together. Our work on Ruwenzori has been brought to a successful conclusion, and we shall go back at once to the Semliki Valley.

Kalongi, 7000 ft.,
West Ruwenzori,
January 7, 1927

Dear Doctor Chapman:

. . . We now move toward the Kivu, but you have no idea how difficult travel can be—and how slow—in this part of Africa. No beasts of burden save negroes. No roads worthy of the name, and long delays in every post. It usually takes twelve to fourteen days to get the porters we need, and they have to be changed about every seven days.

From the heights of Ruwenzori I once made out two of the Kivu volcanoes across Lake Edward, but the day after Akeley's sad death, a friend in the Kivu wrote me of it, and the letter took just one month to reach me on the slopes of Ruwenzori.

I think it is easier to work in the Kivu volcanoes than on Ruwenzori, distances are shorter, natives more plentiful, as well as food. But it is almost impossible to say how long our work will take there.

. . . The Belgians have done everything possible for us, even to giving us free hunting license (Permis de Chasse Administratif).

This trip has been the realization of some of my finest dreams, and I cannot tell you how grateful I am to Mr. Sage and also to Doctor Sanford for arranging it.

The Library Acquires a Rare Bird Book.—Through the generosity of Mr. Ogden Mills the Library has acquired the excessively rare first edition of William Turner's *Avium Præcipuarum, Quarum apud Plinium et Aristotelem mentio est, breuis & succincta historia*—Coloniæ, 1544. Turner has been styled the father of British ornithology and this is the first book on birds which treats the subject in anything like a modern scientific spirit. His object in writing the book was to determine the principal kinds of birds named by Aristotle and Pliny. He has added copious notes, the great value of which consists in the fact that he is always careful to tell whether he observed the birds he describes in England or elsewhere. For this reason his comments are of great historic importance to the student of ornithology.

FISHES

A Motion-picture Film of the Whale Shark *Rhineodon typus*.—In the summer of 1926 Mr. Mack Sennett, motion-picture producer of Los Angeles, California, led into the Gulf of California an expedition equipped with a newly invented submarine motion-picture camera. With this he made the most remarkable film of fishes in their aqueous abode that has ever yet been produced. Through Mr. William Beebe's influence this film was shown before the Museum staff. Some fifty feet of it portrays a whale shark majestically swimming along. Doctor Gudger got in touch with Mr. Sennett and he has kindly presented to the Museum through Doctor Gudger that part of the film picturing this great shark. The film has been studied at slow speed and found to give the details of practically all the structures of *Rhineodon* except those of the tail. Data for this are at hand and Doctor Gudger thinks that we are now ready to go forward with the completion of our model of this great shark.

MAMMALS

The Irving K. Taylor Expedition.—A cable from the Taylor Expedition stated that the party had reached its destination on the White Nile and had then turned back. On the way they had to fight their passsage through the sudd, that dense mass of vegetation swept down by the White Nile, which at times completely chokes the river and has been known practically to fill the river bed for miles. The obstruction has been removed several times with great labor and at great expense in order

THIRTY-SIX YEARS AFTER THE FOUNDING OF THE DEPARTMENT OF VERTEBRATE PALÆONTOLOGY

Opening of the Dinosaur Hall, on the fourth floor of the new Asiatic Wing. This hall is one of eight which will encircle the southeast court of the American Museum. These will give a complete life-history of the earth to permit steamers to ascend the river. Mr. Taylor reports that, because of it, for three days they could do nothing but sit on the pilot-house and look for animals they could not go after.

The expedition has been successful in obtaining the specimens that they originally planned for, including about 200 mammals, more than 400 birds, and some fishes and reptiles, and only one kob is needed to complete the series of antelopes. Mr. Anthony is busy making cases to hold the numerous skins, skulls, and skeletons that have been collected and are drying on board. Three skinners are employed, as everything must have immediate attention after being killed to keep it from spoiling. The expedition has secured 2100 feet of motion pictures and more than 100 stills, but they were disappointed that at this season the waters of the Nile were so high that the whole region about it had grass from 6 to 15 feet tall so that even whole herds of elephants could be hidden from view in it.

Mr. Anthony writes that the expedition left for Port Sudan on April 4 for a month's hunting in the Red Sea Provinces. They will take reservations for England on May 17, and expect to reach New York early in June.

Progress of the Faunthorpe-Vernay Collection.—Colonel Faunthorpe writes to President Obsorn from Bombay on December 3, 1926, regarding his recent additions to the Faunthorpe-Vernay Collection:

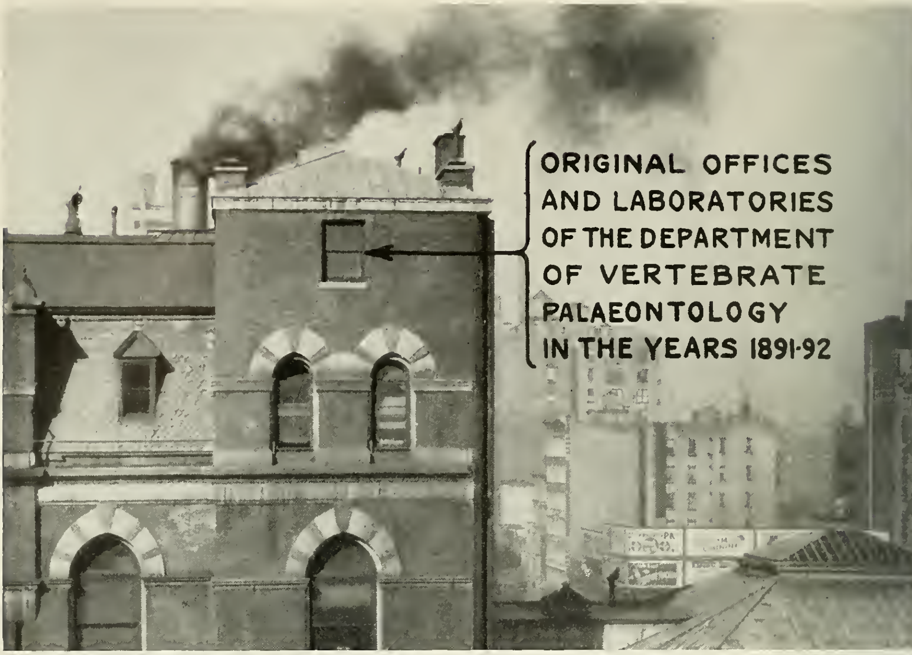
> I am glad to be able to report that I have just completed the wild boar group with a very fine boar. You already have a sow and young one. The four horned antelope buck I hope to get. We have doe and fawn. These small animals are much more difficult to get, when you want them, than the big ones. For instance it took a lot of work to get a good parah (hog deer) stag last winter.
>
> I have a special expedition planned for wild dogs in February; it is *very* difficult to get shots at these brutes. I have an idea for a group of red dogs (vide Kipling) pulling down a sambur or attacking a leopard which would be a great attraction I think. The dogs chase and kill leopards I *know*. The jungle tribes say they also chase and kill tigers but there is no *authenticated* instance of this on record. I spent a week last winter hunting them without result.

Mr. S. H. Chubb, of the department of comparative anatomy, is now engaged in mounting the skeleton of a large Russian wolf hound in a running position, which is to be placed near the skeleton of the running horse.

EXTINCT ANIMALS

The Hall of Dinosaurs.—The opening of the Hall of Dinosaurs on March 9 was the occasion of a nationwide celebration through the press and locally through crowds of visitors of all ages, numbering nearly 19,000 people on Sunday, March 13. The opening ceremony included a brief address by the President, who told of the thirty years of labor involved in making this great collection, and paid a very high tribute to Curator Barnum Brown, to whom the greater part of the collection is due. In the summer of 1897, the half skeleton of *Diplodocus* was found in the Como Bluffs and a year later the famous Bone Cabin Quarry was discovered and worked for many years. This is the largest single deposit of dinosaur bones, with the exception of the great quarry at Vernal, Utah, which has yielded so many fine skeletons. The first great achievement of the department was the mounting of the skeleton of *Brontosaurus*, at the time considered a great event, which made known the existence of dinosaurs to the entire people of the city of New York and, in fact, throughout the country. At the time, probably not nine people in this city knew what a dinosaur was, while now "dinosaur" has become a household word. The arrangement of the Hall of Dinosaurs has been in progress during the past year and the south end of the hall is in its final arrangement. The north end of the hall, however, is only temporarily arranged at present, since this section will in time be devoted to the Jurassic dinosaurs exclusively. The impression that has been created, as shown in the accompanying photograph, is certainly a majestic one.

In connection with this celebration, it is interesting to recall the very modest beginnings of the department of vertebrate palæontology in the small attic room of the old section of the building. Here, at the top of an elevator shaft, Curator Osborn and Assistant Curator Wortman worked for two winters cleaning up and preparing the first collections made by Curator Wortman in the Wasatch Beds of Wyoming. From this small beginning and this simple collection, the department has expanded during the last thirty-six years until now it is planned to fill six great exhibition halls, surrounding the southeast court of the Museum. The collections already amassed will more than fill these great halls. The building activity of the City can hardly keep pace with the world-



The modest attic room of the American Museum, in which the department of vertebrate palæontology was founded in the year 1891

wide collections made yearly by the department of vertebrate palæontology.

MEETINGS OF SOCIETIES

American Philosophical Society.—President Henry Fairfield Osborn represented the American Museum, the Cambridge Philosophical Society, and the New York Academy of Sciences at the two hundredth anniversary of the founding of the American Philosophical Society, held at Philadelphia April 17–30. He received the appointment of vice-president of the society. At this meeting Dr. Roy Chapman Andrews was elected to membership.

The Friday evening session was devoted to an address by President Osborn on "Recent Discoveries Relating to the Origin and Antiquity of Man." During other scientific sessions papers were read by Dr. Cark Wissler on "Age Changes in Anthropometrical Characters during Childhood and Adult Life," and by Dr. W. K. Gregory on "The Origin of Man from the Anthropoid Stem—When and Where?"

National Academy of Sciences.—At the annual meeting of theNational Academy of Sciences, held in Washington the last week of April, Prof. William K. Gregory was elected to membership.

Pan-Pacific Conference.—Mr. Chauncey J. Hamlin, a Trustee of the American Museum, represented the Museum at the Pan-Pacific Conference on Education, Rehabilitation, Reclamation, and Recreation, held in Honolulu, during the week of April 11–16. This conference was called by the President of the United States in conformity with a joint resolution of Congress for the following purposes: (1) to establish a basis of coöperation for the promotion of peaceful arts and pursuits among the countries participating; (2) to provide a medium for exchange of knowledge on the subjects under discussion; (3) to afford a wider field of service for certain technical activities; (4) to be of assistance to the territories of the several participating countries.

John Burroughs Memorial Meeting.—John Burroughs' ninetieth birthday anniversary was observed on April 2, at the annual meeting of the John Burroughs Memorial Association in the auditorium of the American Museum of Natural History. Dr. Clyde Fisher, president of the association, presided.

A feature was the presentation of the medal of the association to Ernest Thompson Seton for his four-volume work *The Lives of Game Animals*. This medal is awarded each year to the author who has produced what is considered the best piece of nature literature.

At a business meeting which followed the program, the officers and six members of the Board of Directors were reëlected. Professor William Lyon Phelps of Yale University was chosen director.

PROFESSOR OSBORN'S RESEARCH CLUB

THE RESEARCH CLUB of the American Museum has continued its weekly meetings throughout the past season. The purpose of these gatherings is to give the staff members opportunity to discuss informally reports of current biological investigation in this and other institutions.

PAPERS PRESENTED DURING 1926–1927

THE PRESENT STATUS OF THE ORIGIN OF MAN.—In describing the present status of the origin of man, Dr. W. K. Gregory discussed the three theories concerning man's origin: (1) the aboreal, (2) the independent terrestrial, (3) the polygenetic. He stressed the anatomical evidence, especially that to be derived from the brain, the hand, and the foot. He discussed the dentition of *Dryopithecus*, and concluded that man's ancestors were undoubtedly arboreal and probably closely allied to that genus.

INVESTIGATIONS IN EAST ANGLIA.—Prof. Henry Fairfield Osborn discussed the rostrocarinate flints found by Mr. J. Reid Moir at the base of the Red Crag formation in England. They were very probably fashioned by human beings who lived before the end of the Pliocene. Professor Osborn has made a very thorough field study of Pliocene man in England.

EPITOME OF RECENT RESEARCH WITH REGARD TO THE ANTIQUITY OF MAN.—Prof. Henry Fairfield Osborn declared that man is ten times more ancient than we formerly imagined. As a result of the discoveries of tools and ornaments in Nebraska, he is led to believe in the great antiquity of man as a tool maker. Man may now be carried back in this country to the Middle or Lower Pliocene. The ape family very early branched off from the anthropoid common stock, the apes becoming more aboreal and the human stock more terrestrial. Until more evidence comes to light, *Dryopithecus* should be placed on the ape side of the fork.

EVOLUTION OF MAN BY FOETALIZATION.—In Dr. L. Bolk's recent book, man's evolution is described as essentially a process of foetalization or retarded development. Dr. Harry L. Shapiro strongly disapproved of this point of view. The Chihuahua hairless dog has its skin devoid of hair, but who would describe the beast as representing the foetus of another variety? Many of man's structures are less specialized than those of the apes, but many others, such as his nose and brain, are more advanced. Mongoloid idiots and cretinous individuals may be foetalized, but not our friends and colleagues.

EVOLUTION OF MAMMALIAN MOLAR TEETH.—Two papers on this well known and much debated subject were discussed by Dr. H. E. Wood, 2d. The first, by Dr. W. K. Gregory and G. G. Simpson, on some Cretaceous mammal skulls from Mongolia, is of the greatest interest, for it describes the first good Mesozoic mammal skulls ever found. The authors are to be congratulated on their paper. The second paper presented was a review of the premolar analogy theory. It was written by Doctor Gregory and described ten structural stages in the origin of man's dentition.

THE SIWALIK BEDS.—Dr. W. D. Matthew gave a report of his recent investigations of the fossil fauna from the Siwalik beds of northern India, including a list of correlations between this fauna and other faunas.

ORTHOGENESIS.—Prof. Henry Fairfield Osborn reported a remarkable case of directional evolution as illustrated by the skull of a Mastodon recently found in Nebraska. This skull, which was more than six feet in length, has an extraordinarily elongated lower jaw with shovel-shaped incisors. The specimen represented an extreme development of the Palæomastodon phylum of Proboscidea.

EVOLUTION BY LAW.—Prof. Leo O. Berg has published a book on "Nomogenesis," or "evolution by law." It did not appear to Dr. E. W. Gudger, who reviewed the book, that Berg has discovered what this law, or laws, might be. To state that evolution is the result of certain inherent processes acting according to laws is merely restating the problem in other terms. To rule out chance and natural selection in evolution is absurd.

The Mechanics of Vertebrate Development.—Dr. G. Kingsley Noble reviewed the epoch-making work of Spemann and his associates on the "organizers" of development.

Mutation of Species.—Dr. Willard G. Van Name discussed the classical studies of W. Schmankewitsch on the transformation of the little crustacean, *Branchinecta*, into *Artemia*, by increasing the salinity of the water. He pointed out that more recent investigations had showed that this was actually not the transformation of one genus into another, but merely the modification of *Branchinecta* by severe treatment.

Field Studies of South China Amphibia.—Mr. Clifford H. Pope described the breeding habits of the frogs and toads of southeastern China. He stressed the habitat preferences of the forms considered and indicated the importance of these preferences in evolution.

The Migration of Birds and Fishes.—Dr. R. C. Murphy and Mr. J. T. Nichols led a discussion on the modes and causes of animal migration. Doctor Murphy reviewed some of the recent papers of Wetmore, Rowan, Wachs, and Thomson. He pointed out that, while the maturing of the gonads might be considered the releasing mechanism of migration, the nature of the stimulus inducing and directing the periodic movements of animals was unknown. Mr. Nichols compared bird and fish migrations. The temperature factor is of great importance in the movements of fishes. Further, fishes often migrate to feed and not necessarily to spawn. Prof. Selig Hecht compared the migration of new-born turtles into the sea with other types of migration, especially with regard to the directing factors concerned.

Classification of North American Birds.—Mr. De W. Miller reviewed the work which he and Doctor Wetmore have been pursuing on the classification of birds. Gadow's classical studies serve as a basis for their final scheme, but recent discoveries have aided in making this system a more natural one.

Distribution of Central American Birds.—Mr. Ludlow Griscom reported on his recent field work in Panama and discussed the problem of life zones in Central America. The Caribbean and Pacific bird faunas are unlike. This finds its basis chiefly in the different vegetation zones. Mr. Griscom is mapping the life zones of the region and has made considerable progress in this work.

The Fauna of Angola.—Mr. Rudyerd Boulton reported on his recent field work in Angola. He discussed the distribution of the bird and fish faunas of this country. Field observations on the nests of palm swifts and upon the mimicry of the drango by a flycatcher were of great interest.

Field Study on Birds in Panama.—Dr. Frank N. Chapman gave an inspiring address on research possibilities at the Barro Colorado Station. During the last season he made a detailed study of the habits of a colony of oriole-like birds, *Zarhynchus*. He emphasized the great importance of bringing back ideas to the Museum, as well as specimens. The former are frequently more important by far in advancing biological knowledge. Doctor Chapman also availed himself of the opportunity of making observations on mammals and ants. His report was illustrated by a series of impressive photographs.

NEW BOOKS

Fishing from the Earliest Times [to 500 A.D.], by William Radcliffe.—So great was the demand for the first edition of this remarkable and invaluable work (which I reviewed in this journal in 1923) that a reprinting became necessary. Fortunately author and publishers (Murray in London, and Dutton in New York) took advantage of the opportunity to make this a new edition and thereby have made the fishing fraternity and all who are interested in the early history of angling their everlasting debtors. In this second edition the few errors of the earlier issue have been corrected, additional data brought to light by later researches have been incorporated, and best of all, a bibliography has been added including works published as late as 1926.

In my review of the first edition, I referred to it as a source book of the greatest value and expressed regrets that the author had not given a bibliography in definite form, instead of putting his references as footnotes. This Mr. Radcliffe has done in the new issue, and the fifteen closely printed pages of references to 430 authors are of the greatest value to the student who wishes to consult the original sources. Incidentally, it gives one a clear idea of the enormous amount of reading and research which the author has done to get the materials for his book, and hence is an index of its thoroughness and value. Unfortunately the author has not chosen to accept the other criticism made by myself and others to add to his title page the date bracketed at the beginning of this review, and thus clearly to delimit the extent of his researches.

One cannot put too high an estimate on this unusual book. That others agree is shown by the fact that in ten days after issue, 1250 copies of the new edition were sold. It is now, and for many long years will continue to be, the standard work dealing with the archæology of angling. And since the work ends with the year 500 A.D., I join with many others in wishing that Mr. Radcliffe might give us a second volume bringing the subject down to the present time.

No angler interested in the history of his art can afford to have this work absent from his bookshelves. Also to it must go students interested in ichthyolatry and ichthyophagy among the ancients, in the latest data concerning the Christian and other ancient fish symbols, in the curious mediæval figures of Jonah and the whale, in the efforts of the Roman emperors to fix the price of fish, in the fish taboo in Egypt, in the earliest recorded contract of fishing, and in the charming stories of the dolphin and the school boy. These and many other equally interesting subjects are all to be found in Mr. Radcliffe's book.
—E. W. Gudger.

Fresh-water Fishes of Hainan is the subject of a paper by John T. Nichols and Clifford H. Pope, now on press. Thirty new forms are described, all of which were collected by Mr. Pope on his trip to Hainan in 1922. All the fish known from Hainan are included, and each description is accompanied by a line drawing. These sketches add greatly to the value of the paper, and it is hoped the publication will encourage further investigation of this interesting fauna by Chinese students in South China. This paper completes the report on new material brought to light by preliminary study of all fish collections of the Third Asiatic Expeditions, excepting those obtained by Mr. Pope in Fukien Province, 1925–26, which reached the Museum only last December.

A New Handbook on the home aquarium has just been published, *Fishes in the Home,* by Miss Ida M. Mellen of the New York Aquarium (Dodd, Mead, & Co.). Whereas there are a number of authoritative books on this subject, the present small volume of 178 pages should fill a distinct need and have wide circulation. It is attractively printed and illustrated, very readable, and contains much practical information. Anyone who keeps fishes in an aquarium will enjoy reading and later have occasion to refer to it in detail, in such matters as stocking, care, and feeding, or treatment of sick fishes. In view of the varied subject matter therein contained, it is much to be regretted that the book is without an index. Though lacking the compass for an exhaustive treatment of aquarium fishes, a very fair survey is presented of those species from various parts of the world appropriate for aquarium culture. The home aquarium offers an opportunity such as is obtainable by no other means to have close at hand a bit of wild nature, for instance, a fragment of scintillating aquatic life from the tropics of one or the other of the three major continents, Asia, Africa, America.

A salt-water aquarium offers so many difficulties compared to the fresh-water, that it should be undertaken only by persons in a position to give the matter some time and study. These will also be interested in *A Handbook to the Marine Aquaria*, a pamphlet of 69 pages just issued by the, Horniman Museum and Library, Forest Hills, S. E., London. It is possible, though not an easy task to keep in an aquarium various forms of marine invertebrates as well as fishes for study, creatures of rare beauty, as well as interest. This handbook further contains contributions to the life-history or habits of several forms of British marine life.
—J. T. Nichols.

How to Hunt with the Camera.[1]—To the devotee of the camera any new book on the subject of photography holds an irresistible appeal; to the individual who knows little or nothing about the instrument, yet who loves nature in all its forms, photographs of living animals, birds, insects, and flowers shown in their haunts, give a thrill of pleasure and perhaps of wistfulness to know something of the art whereby such scenes are caught and imprisoned in a photographic negative. To both of these, *How to Hunt with the Camera* has been addressed by William

[1]*How to Hunt with the Camera.*—A complete guide to all forms of outdoor photography. By William Nesbit. E. P. Dutton & Co., New York, 1926.

Nesbit. And not to these alone, but also to the sportsman and the hunter who, exchanging his gun for a camera, finds a keener joy in the satisfaction of his hunting impulse through the skill and patience demanded by this method of winning his trophies of the chase.

Mr. Nesbit has gathered together valuable information based on actual experience, and covering virtually all forms of outdoor photography. The illustrations include many fine pictures by Radclyffe Dugmore, Geo. Shiras, 3d, Martin Johnson, Carl Akeley, Frank Chapman, Raymond Ditmars, William T. Hornaday, Hobart Roberts, and other successful photographers of wild life.

Technical points are illustrated by carefully worked out diagrams, sketches, and photographs, and every effort is made to coach the picture huntsman for work under trying and difficult conditions. The chapters on cameras and lenses are especially practical.

A partial "Who's Who" includes short biographies of those, principally in the United States, who have been active in the field of nature photography.

—A. K. Berger.

SCIENCE OF MAN

Mr. Reginald Pelham Bolton, who has long been distinguished for his archæological and historical studies of Manhattan Island and its vicinity, and to whom the Museum is indebted for a large part of its archæological collections from Manhattan, has presented an interesting series of archæological specimens from the Cumberland Mountains in Virginia.

Mr. George C. Vaillant who has been appointed assistant curator of Mexican archæology, expects to leave soon for North Africa and plans to return in time to take up his duties at the Museum about July first.

Dr. Waldemar Jochelson, who has been the guest of the Museum during his visit to America, is now preparing to return to Russia, where he has accepted a position as division curator of the Museum of Anthropology and Ethnography of the Academy of Sciences, Leningrad, and as lecturer on Ethnology at the Leningrad University.

Mr. Erich F. Schmidt, assistant in archæology, department of anthropology, has joined the field party of the Oriental Research Institute of the University of Chicago, to assist in an archæological reconnaissance of Asia Minor.

Dr. T. Wingate Todd of Western Reserve University, Cleveland, recently visited the department of anthropology, spending some time in making age determinations for a large part of our prehistoric skeletal collections from Southwestern United States. About 500 skeletons were examined and it is expected that Doctor Todd will return some time in the future to complete his examination of the material.

SCHOOL SERVICE

Formal Opening of the School Nature Room.—The opening of the School Nature League Room on May 3 in the new School Service Building of the American Museum was the fulfillment of a dream begun many years ago by the founders of the League.

As early as 1892 the seed of the School Nature League was planted by Mrs. John I. Northrop when she organized the Natural Science Committee of Hunter College Alumnæ. Under Mrs. Northrop's leadership the idea grew, and in 1917 the School Nature League was organized "to increase a knowledge and appreciation of nature in the children of our public schools." Headquarters were established in P. S. 75, Manhattan, and a number of nature rooms were started in many schools throughout the city. In 1920 Mrs. Northrop wrote, "What we have done is just a beginning; there should be a nature room in *every* school." More than thirty nature rooms have now been established in New York City schools, and the seventy-third flower show of the League, May 3–5, marked the establishment of a permanent nature exhibition room, set aside by the American Museum especially for this purpose. A detailed account of the beginning of the Nature League was published in Natural History, Vol. XX, pp. 264–276.

Through the efforts of directors and friends of the League, a wealth of blossoms and plants were contributed for the flower show. Daffodils, jonquils, pansies, roses, snap-dragons, cacti and other interesting plants from California, Calceolarias, Magnolia, and Schizanthus were among the striking cultivated flowers; and wild violets, hepatica, trillium, jack-in-the-pulpits gave a delightful touch of the real out-of-doors. A prize was offered by the League for the best exhibit prepared by a public school, and this was won by P. S. 93, Amsterdam Avenue and 93d Street. The winning exhibit, entitled "Lincoln Camp," represented a woodland scene: a log cabin surrounded by trees in which minature birds perched, rocks with a brown bear climbing over them, bushes which half-concealed a small deer, ferns in which a rabbit played, a mossy pond in whose waters wild ducks were swimming.

At the formal opening of the Nature Room Prof. Henry Fairfield Osborn, Honorary President of the League, paid tribute to the work of that organization and to its founder, Mrs. Alice Rich Northrop, and introduced its president Mrs. William C. Popper. After a brief address by Mrs. Popper, the children of P. S. No. 15, of which Miss Margaret Knox is principal, presented a spring pageant which was thoroughly enjoyed by an enthusiastic audience, and which reflected much credit to the children and to their teachers.

Interested friends are cordially invited to visit the School Nature League Room on the second floor of the School Service Building, to learn what is actually being done to develop knowledge and love of nature among the school children of New York City.

Natural History is hoping to publish in a later issue a more extensive article about the work of the League.

The Canadian Government Motion Picture Bureau and the Natural Resources Intelligence Service Department have made the American Museum of Natural History the depository for ten reels of motion pictures and several lecture sets of lantern slides. These cover the industries, agriculture, and scenic beauties of the Dominion and will be circulated without charge among the public schools of New York City as are the other motion pictures and slides in the Museum's Visual Instruction Library. The films and slides now available are:

Motion Picture Films

Apples of Annapolis	1 Reel
City of Loyalists	1 Reel
Digging up the Past	1 Reel
Harvest of the Sugar Maple Tree	1 Reel
Money-making Industry	1 Reel
Mountaineering Memories	1 Reel
Salmon Fishing on Restigouche River	1 Reel
Story of a Can of Salmon	1 Reel
Through the Norway of America	1 Reel
Where Beauty Dwells	1 Reel

Slides

Set 63—Newer Commercial Canada
Set 64—Canada—Coast to Coast
Set 65—Manufacture of Pulp and Paper
Set 66—The Canoe in Canada

Teachers desiring the use of these new materials in visualizing to their classes the natural and industrial resources of Canada or the geographical features of the Dominion can obtain them upon application to Mr. George H. Sherwood, curator-in-chief, department of public education, American Museum of Natural History.

APPEAL FOR BACK NUMBERS "OF NATURAL HISTORY"

The Library of the American Museum receives frequent requests for complete files of Natural History which it is no longer able to furnish. Should any subscriber care to donate copies of earlier issues, the gift will be very much appreciated, and postage will be refunded to the donor. Address the Librarian, American Museum of Natural History.

NEW MEMBERS

Since the last issue of Natural History, the following persons have been elected members of the American Museum, making the total membership 9505.

Associate Founder

Mr. William J. Morden.

Associate Benefactor

Mr. Julius F. Stone.

Fellows

Mrs. James B. Clemens.
Mr. Walter P. Chrysler.

Life Members

Mrs. Sarah C. W. Hoppin.
Miss Cynthia Church.
Mr. J. Ernest Williamson.

Sustaining Members

Mesdames: S. Durlacher, F. W. Senff.
Messrs. William V. Creighton, Roland L. DeHaan, Charles M. Fair, Arnold Gottlieb, F. E. Hagemeyer.

Annual Members

Mothers: Mary Elizabeth and M. Theodore.

Doctor: Carrie Weaver Smith.

Mesdames: James I. Barr, H. F. Bray, Bhima Burton, William E. Carlin, Robert D. Coombs, Leo S. DePinna, Franklin Edson, Maximalian Elser, Jr., Henry Evans, Roy K. Ferguson, A. L. Green, George Morton Grinnell, Charles A. Hengerer, Lena Hessberg, I. F. Landay, Isidor Lazarus, Frederick G. LeRoy, Ann Lincoln, John C. Minor, Marcus Rottenberg, Paul Sheldon, Elizabeth E. Simmons, E. M. Treman, John Winkin.

Misses: Louise Auchincloss, Hester Bancroft, Grace C. Bower, Minerva Dickerman, Madeleine I. Dinsmore, Elizabeth Fulton, Sarah D. Gardiner, Edith M. Hadley, Laura Jacobsen, Harriette Melissa Mills, Alice L. Seixas, Delia A. Stebbins, Rosalind Wood.

Doctors: V. M. Cady, Edward L. Dillman, W. W. Morrison, Thomas W. Salmon, Henry James Spencer, Walter F. Stillger, Kenneth B. Turner, Solomon Wiener.

Messrs: J. Chas. Andrews, B. J. Barry, Arthur D. Berliss, Wm. H. Brevoort, Jr., Wm. G. Brooks, Gilbert G. Browne, Charles M. Cannon, Irvin S. Cobb, Sigmund Cohn, Dudley M. Cooper, William W. Coriell, Peter Donchian, Charles J. Dunlap Walter G. Dyer, P. J. Eder, Harry Eising, Bennett Ellison, Irving M. Engel, Samuel F. Engs, Wm. W. Evans, Marco Fleishman, Walter Frank, George A. Fuller, J. L. Goldsmith, Jerome D. Greene, Louis Guenther, Robert T. Hatt, Sidney P. Hessel, John W. Hession, Paul B. Hoeber, Frederick Hoff, John Young Hunter, R. C. Kerr, Albert M. Lee, Duncan MacD Little, C. Lobo, Lorens Logan, John S. McBride, W. Frank McCourt, Edward Reeve Merritt, Edward A. Norman, Henry Osthoff, Jr., Jesse Perrow, Robert W. Prosser, F. M. Rosenfeld, Victor H. Stempf, Sereno Stetson, Henry E. Stubing, Frank M. Taylor, Walter W. Taylor, Myer L. Victorius.

Associate Members

Doctor: Louise Fillman

Mesdames: Francis Alger, Sr., John Carrol Blackman, Eileen S. Grubb, Cora E. Kranebell, Oscar F. Long, Laurel Peters, Ed Sewell, Eva A. Southwick.

Misses: Dorothy Amann, Grace C. Armstrong, Frances L. Bell, Catherine Compton, Ruth E. Conklin, Dorothy Gundelach, Grace Ware Holbrook, Caroline I. Jameson, Wilhelmina P. Stephan, Joan Trevelyan.

Professors: Floyd C. Fairbanks, P. W. Fattig, M. C. Findlay, Gaetano Rovereto.

Doctors: Donald C. Barton, Raymond Voorhees Brokaw, Carl H. Bryant, Amos W. Butler, George R. Cowgill, E. Davenport, Nelson C. Davis, George S. Duncan, Charles A. Elliott, Charles Russell Ely, E. G. Feusse, F. C. Howard, Theophilus S. Painter, V. A. Reed, C. J. van der Horst.

Colonel: John R. Fordyce.

Captain: L. W. Curtis, U. S. N.

Messrs: Richard A. Addison, Hugh E. Allen, Leo Balzereit, Jr., John L. Beal, Edw. L. Caum, John S. Charleson, Will L. Clark, James Culbertson, Peter de Fremery, Ira Edwards, M. H. Eisenhart, Frank Haberl, Sr., Nels Hanson, T. Pierrepont Hazard, Geo. H. Himes, George W. Hunter, John F. Johnson, Clifton Kamnetz, Harold Kohler, G. Douglas Krumbhaar, Henry J. Lalley, Ike Lanier, William A. Linn, James McCormick, Jr., John E. Meals, J. N. Onial, Charles W. Parmelee, Oscar E. Roeseler, R. T. Romine, J. Bradley Scott, R. Eliot Stauffer, Frederic H. Taber, G. M. W. Teyen, Robert P. Turner, Albert Erasmus, Lambrechts vanWyk, Monroe B. Wetmore.

Master: Donald Pechman.

THE SOUTHWEST NUMBER

MAY-JUNE

The May–June Number of **Natural History** will be devoted principally to the archæology of the southwestern United States. It will include a paper by Clark Wissler on the Aztec Ruin National Monument, and one by A. V. Kidder on the Cañon del Muerto excavations.

There will be a discussion by A. M. Tozzer on American archæology, with special reference to the chronological aspects of archæology in the Southwest and Middle-America.

Discoveries shedding new light on the antiquity of man in America are dealt with in articles by J. D. Figgins and Harold Cook, and Earl Morris writes about an aboriginal salt mine at Camp Verde, Arizona.

"North to 88 and the First Crossing of the Polar Sea" is contributed by Lincoln Ellsworth.

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

MEMBERSHIP MORE THAN NINE THOUSAND FIVE HUNDRED

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 9000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843 in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herpetological survey of the Central Asiatic Expedition by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthrop collection of mammals, in **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the incomparable work of Carl E. Akeley on the Eastman-Pomeroy Expedition in Kenya and Tanganyika; in **Polynesia**, the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies**, Douglas Burden's collection of giant dragon lizards; in **North America**, the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America**, collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. a total of 2,057 reels of motion pictures were lent oaned to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES**, some exclusively for members and their children, others for the schools, colleges, and 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.

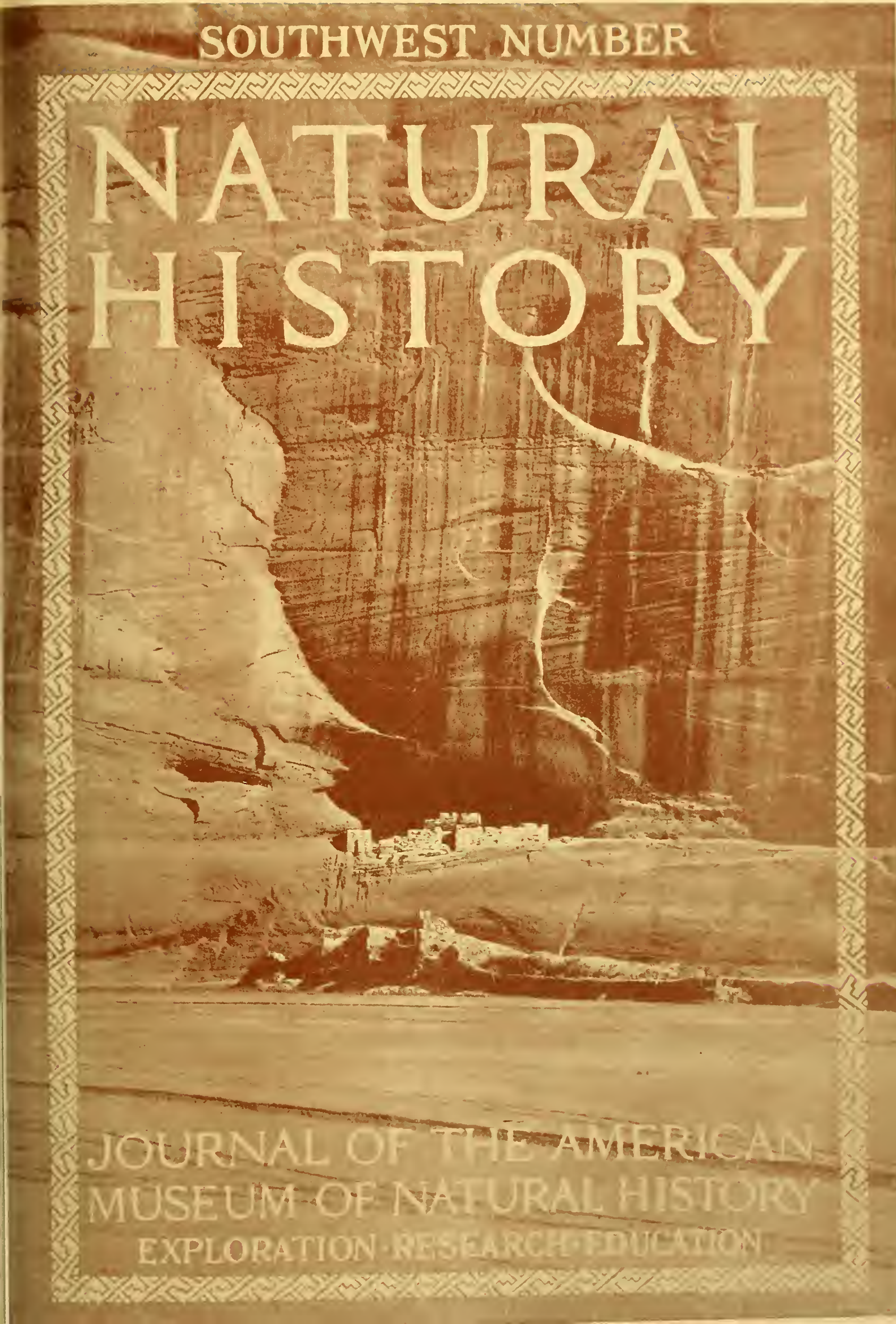
The **SCIENTIFIC PUBLICATIONS** of the Museum, based upon its explorations and the study of its collections, comprise the *Memoirs*, of quarto size, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued since 1881, in octavo form, dealing with the 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.

For a detailed list of popular and scientific publications with prices apply to:
THE LIBRARIAN, AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK CITY

Vol. XXVII MAY-JUNE, 1927 No. 3

SOUTHWEST NUMBER

NATURAL HISTORY



JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION · RESEARCH · EDUCATION

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1927

Henry Fairfield Osborn, LL.D., President
George H. Sherwood, A.M., Director and Executive Secretary
Frederic A. Lucas, Sc.D., Honorary Director
Wayne M. Faunce, Sc.B., Assistant to the Director and Assistant Secretary
James L. Clark, Assistant Director, Preparation

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

William Diller Matthew, Ph.D., F.R.S., Curator-in-Chief

Astronomy

G. Clyde Fisher, Ph.D., LL.D., In Charge

Minerals and Gems

Herbert P. Whitlock, C.E., Curator
George F. Kunz, Ph.D., Research Associate in Gems
Lea McIlvaine Luquer, Ph.D., Research Associate in Optical Mineralogy

History of the Earth

W. D. Matthew, Ph.D., F.R.S., Curator-in-Chief

Fossil Vertebrates

W. D. Matthew, Ph.D., Curator of Geology and Palæontology
Henry Fairfield Osborn, LL.D., D.Sc., Honorary Curator
Walter Granger, Curator of Fossil Mammals
Barnum Brown, A.B., Curator of Fossil Reptiles
Charles C. Mook, Ph.D., Associate in Palæontology
William K. Gregory, Ph.D., Research Associate in Palæontology
Childs Frick, B.S., Research Associate in Palæontology

Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

Frank Michler Chapman, Sc.D., N.A.S., Curator-in-Chief

Marine Life

Roy Waldo Miner, Ph.D., Sc.D., Curator
Willard G. Van Name, Ph.D., Associate Curator
Frank J. Myers, B.A., Research Associate in Rotifera
Horace W. Stunkard, Ph.D., Research Associate in Parasitology
A. L. Treadwell, Ph.D., Research Associate in Annulata

Insect Life

Frank E. Lutz, Ph.D., Curator
A. J. Mutchler, Associate Curator of Coleoptera
Frank E. Watson, B.S., Assistant in Lepidoptera
William M. Wheeler, Ph.D., Research Associate in Social Insects
Charles W. Leng, B.S., Research Associate in Coleoptera
Herbert F. Schwarz, A.M., Research Associate in Hymenoptera

Fishes

William K. Gregory, Ph.D., Curator
Bashford Dean, Ph.D., Honorary Curator
John T. Nichols, A.B., Associate Curator of Recent Fishes
E. W. Gudger, Ph. D., Bibliographer and Associate
Charles H. Townsend, Sc.D., Research Associate
C. M. Breder, Jr., Research Associate
Van Campen Heilner, F.R.G.S., Field Representative

Amphibians and Reptiles

G. Kingsley Noble, Ph. D., Curator
Clifford H. Pope, B.A., Assistant [Central Asiatic Expeditions]
Bertram G. Smith, Ph.D., Research Associate
A. B. Dawson, Ph.D., Research Associate

Birds

Frank M. Chapman, Sc.D., Curator-in-Chief
Robert Cushman Murphy, D.Sc., Curator of Oceanic Birds
W. DeW. Miller, Associate Curator
James P. Chapin, Ph.D., Associate Curator of Birds of the Eastern Hemisphere

Birds (continued)

Ludlow Griscom, A.M., Assistant Curator
Jonathan Dwight, M.D., Research Associate in North American Ornithology
Elsie M. B. Naumberg, Research Associate

Mammals of the World

H. E. Anthony, M.A., Curator
George G. Goodwin, Assistant
Frederic A. Lucas, Sc.D., Research Associate

Comparative and Human Anatomy

William K. Gregory, Ph.D., Curator
S. H. Chubb, Associate Curator
H. C. Raven, Associate Curator
J. Howard McGregor, Ph.D., Research Associate in Human Anatomy
Dudley J. Morton, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

Clark Wissler, Ph.D., Curator-in-Chief

Science of Man

Clark Wissler, Ph.D., Curator-in-Chief
Pliny E. Goddard, Ph.D., Curator of Ethnology
N. C. Nelson, M.L., Associate Curator of Archæology
Charles W. Mead, Honorary Curator of Peruvian Archæology
Harry L. Shapiro, Ph.D., Assistant Curator of Physical Anthropology
Margaret Mead, Ph.D., Assistant Curator of Ethnology
George C, Vaillant, Ph.D., Assistant Curator of Mexican Archæology
William K. Gregory, Ph.D., Associate in Physical Anthropology
Clarence L. Hay, A.M., Research Associate in Mexican and Central American Archæology
Milo Hellman, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

Roy C. Andrews, D.Sc., Curator-in-Chief
Walter Granger, Curator in Palæontology
Charles P. Berkey, Ph.D. [Columbia University], Research Associate in Geology
Frederick K. Morris, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
Amadeus W. Grabau, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

George H. Sherwood, A.M., Curator-in-Chief

Library and Publications

Ida Richardson Hood, A.B., Acting Curator
Hazel Gay, Assistant Librarian
Jannette May Lucas, B.S., Assistant Librarian—Osborn Library

Education and Public Health

George H. Sherwood, A.M., Curator-in-Chief
G. Clyde Fisher, Ph.D., LL.D., Curator of Visual Instruction
Grace Fisher Ramsey, Associate Curator
William H. Carr, Assistant Curator
Nancy True, A.B., Assistant
Paul B. Mann, A.M., Associate in Education
Frank E. Lutz, Ph.D., Research Associate in Outdoor Education

---

Charles-Edward Amory Winslow, D.P.H., Honorary Curator of Public Health
Mary Greig, A.B., Assistant Curator of Public Health

Public Information

George N. Pindar, Chairman
George H. Sherwood, A.M.
William K. Gregory, Ph.D.
Wayne M. Faunce, Sc.B.
Clark Wissler, Ph.D.

Natural History Magazine and Advisory Committee

George H. Sherwood, A.M., Chairman
Departmental Editors
A. Katherine Berger, Assistant Editor
Clark Wissler, Ph.D. — Frank M. Chapman, Sc.D.
W. D. Matthew, Ph.D. — Frank E. Lutz, Ph.D.
George N. Pindar

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY
EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION
THROUGH THE MUSEUM

SOUTHWEST NUMBER

CLARENCE L. HAY, EDITOR

MAY-JUNE, 1927

[Published July, 1927]

VOLUME XXVII, NUMBER 3

NATURAL HISTORY

VOLUME XXVII CONTENTS FOR MAY-JUNE NUMBER 3

Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th Street and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

MOUNTAINS OF THF SUN, ZION CAÑON
Painted by Howard Russell Butler, N.A., at the invitation of the Union Pacific Railroad

NATURAL HISTORY

VOLUME XXVII MAY–JUNE, 1927 NUMBER 3

The Aztec Ruin National Monument

BY CLARK WISSLER

Curator-in-Chief, Department of Anthropology, American Museum

WHEN museums were young and our country still had a frontier, the archæologist roamed at will. When he went collecting, he dug up graves, leveled down mounds, and toppled over ruins, bringing away whatever interested him. Unfortunately, he thereby destroyed these relics of the past, so that no one could study them again. But, in the course of years, the collector himself began to be appalled at the trail of destruction his digging left behind. So it is not strange that a new conscience was created and that today an archæologist must be a conservationist as well as an explorer; as far as possible he must leave things as he found them, bringing away with him only such objects as may not safely be left behind. In our great Southwest, where are many hundred prehistoric ruins, it is now expected that the explorer not only leave the walls standing as he found them, but prop or otherwise reinforce such as are in danger of falling. Some years ago, the Government declared a policy of exempting from settlement all tracts bearing interesting ruins and designating them as National Monuments, that these precious relics of a past age be preserved for the enjoyment of the traveler and student.

In 1909 Mr. Archer M. Huntington proposed that the Museum undertake an archæological survey of the Southwest. Accordingly, the writer developed a plan for the work, secured an adequate field staff, and inaugurated the explorations which proceeded without interruption until 1921. In the course of these explorations, Mr. Earl H. Morris, well known to readers of NATURAL HISTORY through his interesting articles upon the ruins of our Southwest, joined our field staff and was attached first to Curator Nelson's party. Together Nelson and Morris examined a large ruin near the little town of Aztec, in the far away northwest corner of New Mexico, and at the end of the season, upon the return of the party to the Museum, Nelson strongly recommended the systematic excavation of this ruin. It is interesting to note that Morris grew up in the Southwest, among its deserts and beside its ruins. While yet a mere boy he began to explore these relics of the ancients and soon he looked upon an archæological career as his life objective. Living near this great ruin at Aztec, he dreamed of some day excavating it. However, at that time the farm lands surrounding this ruin were owned by John R. Koontz, a man of unusual vision, who permitted no one to trespass upon the ruin. In his declining years he sold these lands to H. D. Abrams, who even more than his predecessor realized the scenic and scientific value of the ruin. When, following Nelson's suggestion, the writer approached Mr. Abrams for permission to excavate the ruin, Mr. Abrams made it clear that unless the Museum would

THE RUIN AT AZTEC BEFORE EXCAVATION

When the Museum party arrived at the ruin, it was overrun by brush, and looked like a long, low hill covered by a thicket. The tops of the highest standing walls in the middle gave the only indication that a ruin was concealed therein. The whole surface of the ruin was revealed, as shown above, after the brush was cleared away and burned. The view is from the top of a small hill on the north side, looking across the ruin and the narrow valley to the town of Aztec, hidden in the trees

EXCAVATIONS IN PROGRESS

The first task was to clear away the loose stones from the fallen walls and to shovel out the earth which had originally formed the floors of the upper rooms, together with what had drifted in with the winds of many years. It was necessary also to clear the court down to its original level and, in order that eventually the ruin could stand as an exhibit, all the loose débris was carried away in wagons. The standing parts of the walls were capped with cement and otherwise strengthened. In many of the rooms were burials and pottery

VIEW OF THE NORTH WING FROM WITHIN THE COURT

In a part of the north wing of the ruin some of the third, or last, story walls are standing, as shown here. The two doorways seen above the wagon are entrances to the second-story rooms. For the most part, first-story rooms are entered through the roof, so that should an enemy reach the court, the ladders could be drawn up to the roofs of the first story. The walls are of dressed sandstone and neatly laid. The corners are true and since a number of small pieces of sandstone, each tied to a cord, were found in excavating, it is believed plumb lines were used

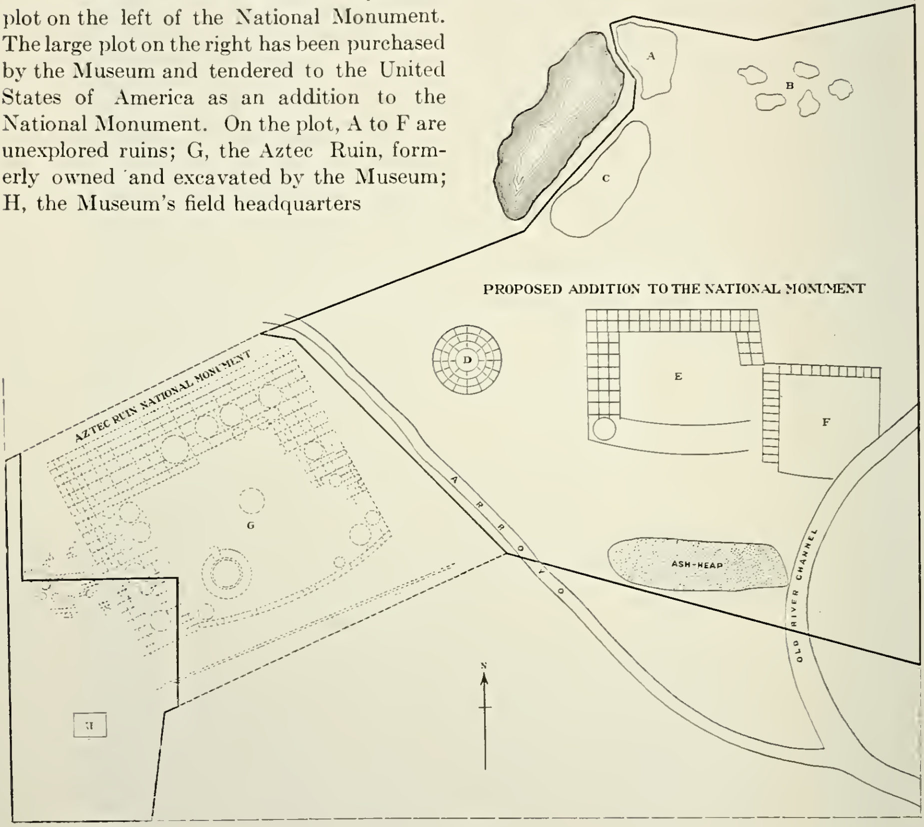
VIEW OF THE SOUTHEAST SECTOR OF THE RUIN

Systematic excavation was begun at the southeast corner of this E-shaped ruin, or at the far left in the view, page 196. The ground plan of the ruin, presented in the text, shows a row of one-story rooms, skirting the front of the great court. This serves as a defense wall, entrance being by ladder only. An excavated section of this wall of rooms is shown in the foreground. To the left, well back in the court, is the low, circular roof of a large kiva, or sunken ceremonial room. This kiva was cleared out and the roof restored as in modern pueblos; through a trap door at the top one may descend by ladder in the aboriginal way. To the right, across the fence is a thicket concealing another ruin guarantee to cap the standing walls with cement and otherwise leave the ruin as a permanent exhibit, he would not grant the request. And he went further, for he stipulated that a part of the collection resulting from the excavations was to remain for deposit in a future museum at the ruin.

This high-minded attitude on the part of Mr. Abrams appealed to Mr. Huntington and plans were developed to carry out our explorations in full accord with the owner's ideal. Work began in 1916 with Earl. H. Morris in charge and continued through to 1922. As our explorations progressed, it became clear to Mr. Huntington and to Mr. Abrams that the future of the ruin devolved upon its passing into the hands of the Museum or some other suitable agency, and in 1920 Mr. Huntington, purchased, in the name of the Museum, the plot of land upon which the ruin stands. During our operations at the ruin Morris lived in a small house erected as our field headquarters, which was now replaced by a small stone structure adjacent to the ruin, but on the Museum's property. Later, for the better protection of the ruin, Mr. Huntington presented it to the United States Government and President Warren G. Harding proclaimed it a National Monument in

THE AZTEC RUIN NATIONAL MONUMENT AND THE PROPOSED ADDITION

The Museum's field station occupies the plot on the left of the National Monument. The large plot on the right has been purchased by the Museum and tendered to the United States of America as an addition to the National Monument. On the plot, A to F are unexplored ruins; G, the Aztec Ruin, formerly owned and excavated by the Museum; H, the Museum's field headquarters



January, 1923. However, that portion of the property bearing our field headquarters was retained by the Museum and here Morris still resides, keeping close watch over this great archæological treasure.

Now we come to the final chapter in this story. The Aztec Ruin is but one of a group, no doubt once a prehistoric city, since close by are six other ruins, not to mention others scattered about at slightly greater distances. As time went on, the desirability of adding these six closely associated ruins to the National Monument became clear, and accordingly negotiations were entered into with Mr.Abrams for their purchase. Unfortunately, Mr. Abrams died before these negotiations were completed, but from his heirs the Museum purchased this additional plot and will eventually present it to the United States Government as an enlargement of the Aztec Ruin National Monument.[1]

Thus, by this act of conservation the preservation of this unique group of ruins is assured, and Mr. Huntington's great contribution to archæology brought to full completion. It is expected that, in the near future, excavations will be made among the six ruins in this new addition, several of which promise well: for example, (see D on plan, p. 200) the circular structure with a central room, surrounded by three successive bands of rooms; nothing just like this has been found in all the Southwest before. The previous excavations of Earl H. Morris in the main ruin brought to light much new evidence as to how these ancients lived; also they enriched the Museum by many unique objects, the most important of which are now on exhibit in our hall for the Southwest But the best exhibit is the uncovered ruin itself, for everyone who takes an automobile trip to the West can now visit it, walk through its vacant rooms, descend into the mysterious kivas, and thus acquire an insight into the prehistory of our country.

[1]On June 8, 1927, the Trustees of the American Museum of Natural History adopted a resolution transferring the ruins at Aztec, New Mexico, to form part of the Aztec Ruin National Monument previously presented through the generosity of Mr. Archer M. Huntington.

THE MONUMENTS

Two natural rock pillars on the sides of Cañon de Chelly, on the way to the site where the excavations of last season were carried on. Cañons de Chelly and Del Muerto rise in the Chuska mountain range near the Arizona line and converge on the Arizona side, so that their mouths are about side by side

The Museum's Expeditions to Cañon de Chelly and Cañon del Muerto, Arizona[1]

By A. V. KIDDER

Chairman of Division of Anthropology and Psychology, National Research Council, Washington, and Director of Southwestern Research, Phillips Academy, Andover

Note.—The unique collections and scientific results announced in this article pertain to the Ogden Mills Archæological Survey of the Southwest. After the discovery in 1923 of rich materials in Mummy Cave, as described in the text, a survey of the whole locality was requested by Mr. Mills. The Museum's archæologist, Earl H. Morris, directed the excavations from the beginning, and though in 1924 he resigned from the Museum staff to join the Carnegie Institution in Washington, he still finds time to supervise the Museum's work on this project.

EVERYONE realizes nowadays that the story of mankind stretches back over a period much longer than was reckoned by the scholars of a former generation; but few people, I think, fully appreciate either the vastness of man's antiquity, or the shortness and the pitiful incompleteness of the written record. These facts, however, are brought home to the archæologist with insistent force, because upon his shoulders rests the task of piecing together the history of man through a stretch of time so long that the period covered by the oldest books seems but an eyewink. And the materials with which he has to work are so rare, so fragmentary, and so difficult to interpret, that, when in some favored region he comes upon remains which are not only abundant and well preserved, but best of all, are historically significant, it is but natural that he should feel repaid for long years of seemingly barren effort.

Such a happy hunting ground for the archæologist is to be found in the northeastern part of Arizona, particularly in the twin gorges Cañon de Chelly and Cañon del Muerto. In these cañons men lived for uncounted centuries,—lived there first as almost savage nomads, developed there the germ of a sedentary farming culture; added to that culture materials and inventions which brought them to a high state of comfort and well-being,—brought them, indeed, to the very threshold of what we term civilization. And finally they disappeared, driven from their age-old strongholds by some savage enemy, perhaps the ancestors of the very Navahos who occupy the country today.

During the two thousand years or more that the ancient people lived in de Chelly and del Muerto, they clung to the caves,—first, no doubt, for shelter against the elements, and later for protection against marauding enemies. Hence the relics of generation after generation: ruined houses, refuse-middens, graves, guarded from rain by the overhanging cliffs, and kept from decay by the dry air of Arizona, lie piled upon each other in the caverns, the earliest at the bottom, the later above, in such a way that the student, digging downward, can read backward the silent record, and reconstruct stage by stage the slow growth of perhaps the most interesting of native American cultures.

Aside from their archæological interest, de Chelly and del Muerto are

[1]Photographs taken by A. V. Kidder and Earl H. Morris, during the Ogden Mills Archæological Survey of the Southwest.

scenically outstanding in a country of extraordinary cañons. Heading in the Chuska mountain range, they cleave their tortuous way through a formation of red and yellow and gray sandstones, their cliffs rising sheer from narrow, sandy beds, to vertical heights of six and seven hundred feet; and, where side gulches break in, erosion has run riot in dome and pinnacle and high-perched natural bridge.

Today the cañons are occupied by Navaho families who tend little peach orchards, and cultivate patches of corn in the sheltered bays of the cliffs. Still semi-nomadic, the Navaho of a half century ago were almost professional marauders, who periodically raided the peaceful Pueblo towns, and the little Mexican settlements to the south. It was a reprisal for one of these raids that gave del Muerto, the Cañon of the Dead, its sinister name, and, incidentally, provides us our earliest actual date in the history of the cañons. In the winter of 1804 or 1805, so Mr. Morris was told by the Indians, a Mexican punitive expedition massacred a hundred or more Navaho women, children, and old people who had taken refuge in a cave while their fighting men were away on a raid. Nearly fifty years later comes our next glimpse of the region, again due to the turbulence of the Navaho. The Americans, having taken over New Mexico in 1846, became responsible for the protection of the Pueblos and Mexicans, and because of a series of harryings by the Navaho, an expedition under Colonel Washington of the regular army marched from Santa Fé across the northwestern desert and made treaty with the raiders at the mouth of Cañon de Chelly. Simpson's account, published in 1850, gives us our first written record of the gorge, and of its finest cliff-dwelling, the famous White House.

The final pacification of the Navaho came in the sixties as a result of Kit Carson's expedition, memories of which and of the temporary captivity of the people at Bosque Redondo in the Pecos, still linger among the older tribesmen.

Contents of a burial cave in the walls of Cañon del Muerto. The mouth of the cave is immediately behind the ledge against which the collections are grouped. Both pottery and baskets were found here. Mr. Morris is at the left; Mr. Owens, field assistant, at the right

Upper picture, the White House ruin, Cañon de Chelly, as seen from the cañon floor. Lower picture, a near view of one wing of the White House ruin

Archæologists visited de Chelly sporadically from the mid-seventies on, and in 1897 appeared Mindeleff's classic description of its ruins, and those of del Muerto. No digging was done, however, and it remained for the Day brothers, sons of an Indian trader of Chin Lee, to discover the riches of the caves.

The Day brothers worked for years,

and amassed a very fine collection of mummies, textiles, pottery, and basketry, which was purchased by the Brooklyn Institute Museum. Then came the Antiquities Act of 1906, forbidding unauthorized excavation in ruins on Government land, and for nearly twenty years there were no further investigations. Everyone thought that the Days had thoroughly ransacked the sites, and attention was at that time chiefly devoted to the great pueblo ruins to the east and the newly-discovered cliff-house country in the Navaho mountain district to the north.

In 1923, however, Charles L. Bernheimer and Earl H. Morris visited del Muerto while on theMuseum's Third Bernheimer Expedition to the Southwest. In the rubbish-strewn slope below the great Mummy Cave cliff-house, they found evidence of extensive remains, untouched by looters, and in excellent preservation. As a result of this discovery, Mr. Morris returned to the Cañon in the following autumn and inaugurated a series of yearly expeditions which have resulted in acquiring for the Museum the finest collection of early Southwestern remains in existence, and better still, have succeeded in throwing a flood of light upon several of the least known periods of Southwestern history.

To understand the importance of Mr. Morris' finds, it is necessary to review, very briefly, the story of human development in the Southwest.

The barren uplands of the San Juan country, poor in natural sources of vegetable foods and with little game, could never have supported a large population without the assistance of agriculture. Hence, we must suppose that for uncounted centuries the region was occupied, if indeed people lived there at all, by a scattering of roving bands living a hand-to-mouth existence. No certainly identified remains of these postulated "first families" have yet been found, and our earliest glimpse of the tribes of the region is of a people who were just emerging from nomadism. They built, so far as we know, nothing in the way of permanent houses, but they had learned to grow corn, presumably, in a haphazard sort of way. They had no pottery, no cotton. They did not use the bow and arrow, but hunted and fought with light stone-tipped lances hurled with short wooden spear-throwers. Life, apparently, was mostly in the open, but they resorted to the caves to store such grain as they harvested; and, of most interest from the archæologist's point of view, they also buried their dead in the caves, accompanied by the finely woven baskets which have led to the naming of these pioneer farmers the Basket Makers.

How long ago the Basket Makers lived we can only guess, but it can hardly have been later than 1000 years before Christ, because their remains are found covered by the relics of four or five succeeding cultures, all of which had passed away long before the first white man came to the Southwest nearly 400 years ago.

The Basket Makers were a medium-sized, long-headed folk, and the next culture stage was inaugurated and carried on by a people so similar in physical type that there is little doubt that they were their direct descendants. Pottery and crude houses of stone slabs were introduced or invented by the post-Basket Makers, and these two innovations, plus the corn already cultivated by their predecessors, formed the foundation, so to speak, upon which the later structure of Pueblo culture was built. The post-Basket Maker,

Two burials showing pottery and baskets, Cañon de Chelly. In each case the objects shown were deposited with the body, presumably as mortuary offerings

therefore, is perhaps the most interesting and important period in all Southwestern history.

At this point there comes a serious thinning out in our knowledge. A new people seem to have entered the country, a round-headed race presumably, although the skulls that are found in their graves are so strongly deformed by cradle-board flattening that their normal shape is difficult to determine. They took over the old culture complete and added to it cotton; perhaps they were also the first users of the bow and arrow. They improved the making of pottery and they clustered together to

Stencilled figures of hands on the wall of Cañon de Chelly near Sliding Rock ruin

form the earliest pueblo-like settlements. Horizontally laid stone masonry for wall-building began to come into use and the dwellings gradually changed from the older type of pit-house to the above-ground structure of later times. This was the pre-Pueblo Period.

As population increased the villages grew in size, primitive wealth in pottery, in beads, and in hoarded corn was accumulated, and there arose the necessity for defense of that wealth against more impecunious neighbors. Houses were strengthened and were built on mesas, or ledges, and in caves, situations not readily subject to surprise attack. This was the Early Pueblo Period; it began, apparently, during the first millenium of our era, and merged gradually into what has been called the Great Period, when there were erected such enormous structures as the Aztec Pueblo and Pueblo Bonito, Cliff Palace, and Betatakin. These once flourishing communities ran their course and were abandoned, probably shortly after the year 1000; there ensued a time of tribulation, a wandering of the peoples, and a redistribution which resulted in the final settlement of the Pueblo Indians in the towns discovered by Coronado in 1540.

Throughout the thousands of years of the history here so scantily sketched, Cañon del Muerto and Cañon de Chelly were occupied, and their caves have yielded to the shovels of Mr. Morris' expeditions facts of inestimable value for the reconstruction of that history.

In 1923 the Museum party started work in Mummy Cave, a colossally sculptured cavern some ten or twelve

CENTRAL RUIN IN MUMMY CAVE, CAÑON DEL MUERTO

The slide of rubbish to the right, extending down toward the cañon floor, yielded the first great collection. Here were found woven sandals, baskets, pottery, and other examples of the arts and crafts of the early cañon dwellers in the time of the Post-Basket Makers

LOOKING UP CAÑON DEL MUERTO FROM MUMMY CAVE

Other ruins and caves were discovered in these cañon walls, all of which have added to our knowledge of the successive culture periods of our prehistoric Southwest. It was while passing through this part of the Cañon that Charles L. Bernheimer and Earl H. Morris, returning from the expedition of 1923, discovered the rich deposits at Mummy Cave

LOOKING UP CAÑON DE CHELLY FROM THE RUIN BELOW THE WHITE HOUSE

The embankment in the foreground and the similar one above were constructed last season by the Museum's field party, to prevent the seasonal floods from completing the destruction of the ruin and its valuable rubbish heap. Each year the rising waters have cut into the lower ruin, and it is hoped that this dike will so direct the current as to save what remains

A WATERFALL IN CAÑON DE CHELLY

The walls are so high that little more than spray reaches the ground below. The country round about is semi-arid because the rain falls only during one brief season, but at such times this fall becomes more pretentious, and over the relatively dry bed of the cañon rushes a formidable river miles above the mouth of del Muerto, and just below the cave where the Navahos were killed by the Mexicans. As is shown in the insert the back of the cave is occupied by cliff-house structures. These date from the middle and later parts of the Great Period. The steep slope below the houses was covered with a fanlike talus of refuse, the surface layers of which were naturally the product of the last years of occupancy.

The excavations in this heap were exceedingly prolific. It proved to contain many early burials, as well as the remains of the crude, slab-walled dwellings of the post-Basket Makers. The digging was as difficult as such work can possibly be. The high-arching roof of the cave had kept all moisture from the deposits, and dust rose so chokingly and so blindingly at every touch of the shovel that respirators and goggles had constantly to be worn. Moreover, the whole mass lay on a smooth rock declivity at an angle of 45° or more, so that it was constantly slipping and sliding, and the danger of serious avalanches was a very real one.

In spite of the discomforts of such work, no digging, in the Southwest at least, can compare with it in interest. For among the trash of straw and twigs and corn-husks that make up the body of the deposit are literally thousands of specimens of perishable nature, never found in ancient sites that have been exposed to the weather. Sandals, featherwork, textiles, basketry, wooden implements, forgotten caches of corn, worn-out cradles, broken toys; all preserved so perfectly, and all carrying so vivid a human interest that one develops a feeling of intimacy with the old people which is not only sentimentally fascinating, but is archæologically extremely valuable.

Mummy Cave yielded most important data as to the Basket Makers, the post-Basket Makers, and the pre-Pueblos. The greatest finds, however, were made late in the first season and during the second season at Se-ha-tso, the Cave of the Winds, a few miles down-cañon.

Se-ha-tso is a long, shallow shelter overhung by a tremendous arch of cliff and guarded by a thin, winglike projection of the cañon wall. It proved to contain literally hundreds of post-Basket Maker houses and storage cists and numbers of burials. Of the latter Mr. Morris must be allowed to tell. It would be wrong for anyone but their discoverer to describe the grave of the old priest chief, the hoard of brilliant medicine feathers, the inexplicable burial of the jewelled arms, the mummy of the sacred eagle with its shrivelled food-offerings.

Of these things and many more Mr. Morris must tell. It will be fascinating reading. He must also tell of the third year's work at Mummy Cave and at Se-ha-tso; and of last autumn's excavations at White House, the largest and finest of the de Chelly cliff-dwellings, and of how the wing-dam was built to turn away the summer floods that had so nearly destroyed the lower pueblo. All of this is for him to tell. I can only point out, as Mr. Morris in his excessive modesty will certainly not do, that the work was admirably conceived and most admirably executed; that its results, when published, will go far toward making clear the now very nebulous but historically exceedingly important post-Basket Maker and pre-Pueblo periods; and these excavations will materially stiffen that chronological backbone which Doctor Tozzer in his article rightly states to be so necessary to the body of American prehistory.

Time and American Archæology[1]

BY A. M. TOZZER
Professor of Anthropology, Harvard University

FOR many decades the study of American archæology was in a very nebulous state characterized, in many cases, by inaccurate observation, bold assumptions, and a general ignorance of the more scientific approach to the subject. These defects have, in great part, been remedied by a wider vision, a more careful training of investigators, more accurate observation, and a gradual tendency to place archæology among the more exact sciences.

American archæology has also suffered a certain stigma for its failure to produce a literature as its handmaiden with an accompanying chronology to give a certain vigor to its findings. It must be admitted that archæological data have an inert quality, a certain spinelessness when unaccompanied by a more or less definite chronological background. The psychologists may be able to tell us why we must have dates accompanying objects of antiquity to make them seem interesting and of value, whether these objects consist of furniture, a piece of pewter, or specimens coming from the graves of our early inhabitants. This paper is an attempt to give American archæology an internal skeleton and thus to raise it to the status of a vertebrate.

It should be pointed out at once that the classification and nomenclature applied to European archæology cannot be used for the New World. This is not due to the scarcity of the data but to the fact that there are no metal ages in America. Iron was unknown as a metal before the advent of the white man[2] and the smelting of copper was not practised except in certain regions on the western coast of South America, Central America, and parts of Mexico. Bronze, the resultant of a deliberate attempt at mixing copper and tin, was even less widely distributed.

There are two aspects of chronology the first of which is a relative one, self-contained, and dissociated with any larger aspect of time-relation. In northern New England and the maritime provinces of Canada as well as in other parts of the eastern United States, there are well-defined evidences of an earlier and a later pre-Columbian occupation, but there are at present no means of bringing these different cultures into the general background of history.

The second variety of chronology and the one that has far more interest for us here has to do with definite epochs correlated with our own time-system, prehistoric passing over to the historic.

In the study of archæology as a whole there are four elements of control; geology, palæontology, stratigraphy, and the development of types from cruder to more developed forms. Geology and palæontology may be disregarded here as the question of primitive man in America, in the real sense of "first," does not concern us. No attempt will be made to prove or disprove the much-discussed question

[2]The Eskimo and the "Mound Builders" of Ohio made some use of meteoric iron.

[1]This paper, without illustrations and in a modified form was published in the *Proceedings of the Massachusetts Historical Society*, Vol. LIX, pp. 283–292. Boston, 1926.

of the presence of man in the New World in geologically ancient times.

Stratification is of the utmost importance as showing successive occupation of the same site, each stratum indicating a more or less distinct culture allied with a time-element. In the Southwest, Doctor Kidder and Mr. Guernsey of the Peabody Museum have found four different levels of culture.[1] On the original floor of caves has been found the evidence of a people called "The Basket Makers" who were without pottery but were expert in the making of woven objects, textiles, baskets, and sandals. They were at the very horizon of agriculture with only one variety of corn. Above this there are data indicating two cultures differing slightly from each other with a first knowledge of pottery-making, this art developing rapidly. There are also included several varieties of corn indicating a more varied agricultural life. Finally there comes the top-most stratum, commonly called "Pueblo," with pottery and several of the other arts finely developed together with an abundant agriculture, developed under very adverse conditions. Until a few years ago, the Cliff-dwellers and other Pueblo peoples belonging to the last epoch, were the only early inhabitants recognized in this region. More intensive research has thus added three new elements in the archæology of the Southwest.

Stratification has also come to our assistance in Mexico.[2] Four and five meters below the present floor of the Valley of Mexico and in some cases under many feet of volcanic deposits there has come to light the so-called Archaic culture, characterized by clay figurines and several types of pottery. Most botanists interested in the question of the beginning of agriculture in America are now agreed that a grass, called *Teocentli,* found wild on the highlands of Mexico, is probably the progenitor of cultivated maize which the first American colonists found, on their advent, over the greater part of the New World. It is probable that the Archaic peoples were responsible for the artificial cultivation of this grass, the invention of agriculture, and also for the dissemination of this new industry over the arid portions of Mexico and Central America.[3]

The "Archaic" people are probably by no means the primitive or first inhabitants of this part of the New World. The ceramics and more especially the clay figurines made by them show much skill as well as evidences of weaving in the bands and fillets in which the heads of the figures are swathed. Their culture is far ahead of that of the Basket Maker of New Mexico who had not reached a pottery horizon. It is impossible to ascertain the language spoken by the "Archaic" peoples but there is little evidence that it was the same as that spoken by the Toltecs and Aztecs. Figurines characteristic of the Archaic culture are found in Honduras and Salvador and modified types as far south as Nicaragua and Costa Rica with a possible extension into South America.

Returning to the Valley of Mexico, above the Archaic horizon is found the Toltec culture, the greatest of all Mexi-

[1]Guernsey, S. J. and Kidder, A. V., Basket-maker Caves in Northeastern Arizona, *Papers of the Peabody Museum*, Cambridge, VIII. No. 2, 1921, and Kidder and Guernsey, Archæological Explorations in Northeastern Arizona, *Bulletin, 65, Bureau of American Ethnology*, Washington, 1919.

[2]Tozzer, A. M., The Domain of the Aztecs and Their Relation to the Prehistoric Cultures of Mexico: *Holmes Anniversary Volume*, Washington, 1916. Spinden, H. J., Ancient Civilizations of Mexico and Central America: *Handbook Series* No. 3, American Museum (2d. ed.), New York, 1922. See also Summary of the work of the International School of American Archæology and Ethnology: *American Anthropologist*, N.S., Vol, 17, 384–395, 1915.

[3]Spinden, H. J., The Origin and Spread of Agriculture in America: *Proceedings of the 19th. International Congress of Americanists*, Washington, 1917

can civilizations, and over this and only for a few inches on the surface appear the evidences of the Aztecs. As will be shown later, the Aztec and Toltec periods can be definitely dated. Stratification also gives definite results on the succession of cultures in Peru, showing that of the Inca as a very late product.

The second chronological approach to the study of archæology is the investigation of the development of stylistic methods of decoration, mainly on pottery, of architecture, and of other products of man's activities. By an intensive study of the different ceramic wares of the Pueblo culture and after taking into account the various data available, a definite sequence of pottery types and of decoration has been established from pre-Columbian down to modern times.[1]

When successive forms of the artistic impulse are found in connection with definite strata there is abundant proof of a time sequence as the basis of this development. When, as in the Maya area, various changes in architecture and in design go hand in hand with datable monuments, there is a solid foundation for history.

Another approach to this chronological study is the migration of objects far from their original place of manufacture, trade pieces, foreign to their present habitat but easily recognized as coming from afar. Red coral, for example, from the Mediterranean is ound in graves of the early Iron Age in England. Dated Egyptian scarabs, found in Crete, were a great factor in establishing the entire chronology of the Ægean culture. The close association of objects in the same deposit prove that they are, in a sense, contemporaneous. This does not necessarily mean that they were made at the same time but that they were deposited at the same time. Heirloom pieces of carved jade, dating back several centuries, have been dredged from a great natural well in Yucatan. These are not later than the objects with which they are associated but, as a matter of fact, they are very much earlier than most of the associated remains. If sherds of a jar with a very special type of plaster cloisonné decoration are found in Pueblo Bonito in northern New Mexico and the home of this type of technique is in the Zacatecas region of Mexico, and, furthermore, if this same pottery is found in a late period of a site in northern Yucatan, there is every reason to suppose that a contemporaneous feature can be assumed here. Movement in the other direction from the Maya region to the northward is shown by one of the finest of Maya jade ornaments found at San Juan Teotihuacan. This probably originated in the southern part of the Maya area as it is carved in the best Old Empire style, traveling from Guatemala to northern Yucatan and thence to Mexico during the Toltec period of Yucatan. Gold figurines, definitely made in Colombia, Costa Rica, and Nicaragua, and found in late Maya deposits, again help in the elucidation of a relative chronology. No metal objects of any kind have ever been found in the early Maya sites so that it seems quite clear that the knowledge of metallurgy came from the south at a comparatively late period.

These stray pieces also show the great importance of trade relations in early times, stretching in this case from Colombia in the south to northern New Mexico in the north, a distance of about

[1]Kidder, A. V., An Introduction to the Study of Southwestern Archæology with a Preliminary Account of the Excavations at Pecos: New Haven, 1924.

Archaic head, Valley of Mexico.—Front and profile, slightly larger than actual specimen. This type represents the earliest known examples of clay modeling in Middle America

Examples of Middle American Art

PHOTOGRAPHS BY DR. CLARENCE KENNEDY FROM ORIGINALS IN PEABODY MUSEUM, CAMBRIDGE

Archaic head found by Mrs. Zelia Nuttall under lava flow at Coyoacán, Valley of Mexico

Archaic head found by C. L. Hay near Atzcapotzalco, Valley of Mexico

LIMESTONE HEAD, COPAN, HONDURAS

Head of youthful Maize god, part of a façade decoration, dated about 515 A.D. Magnificent example of First Empire stone-carving. Height 18 inches

STONE HEAD OF GARGOYLE-LIKE SERPENT, COPAN, HONDURAS

Probably a corner ornament from Temple 21, dated about 525 A.D. Typical work of the First Empire of the Mayas. Height 19 inches

CLAY FIGURINE FROM CAMPECHE, MEXICO

Figure representing a Maya woman when the Maya civilizatlon was at its height. The fine modeling and strong characterization have a portrait quality. Height about 8 inches thirty degrees of latitude or about three thousand miles.

The factors of stratification, stylistic development, and the association of objects from widely separated areas are all useful in establishing a relative chronology of a site or a series of sites, but it is only by means of dated monuments correlated with Christian chronology that we arrive on satisfactory historical ground. The Maya area in southern Mexico and northern Central America presents evidence of an elaborate calendar as shown in the hieroglyphic inscriptions, the most remarkable achievement of the intellect in the New World. It is in these inscriptions that a literature is provided American archæology.

The material for the study of the hieroglyphic writing includes stone inscriptions carved on stelæ and altars set up in front of the various temples, on the door-lintels of buildings, a few painted inscriptions, three codices dating back to pre-Columbian times, and the so-called Books of Chilam Balam, manuscripts written in the Maya language but with Spanish characters. These are in many cases copies of original documents reduced to writing after the advent of the Spaniards.[1]

There were two steps necessary in the elucidation of the Maya calendar as shown in the hieroglyphic inscriptions, the first of which was the determination of the calendar giving a relative chronology, the position of the different monuments in an inclusive series within the Maya area. This succession is definitely correlated with the stylistic development of stone carving and of architecture. We are thus certain of the historical development of the Maya civilization.[2]

The second step was a correlation between the Maya and the Christian chronology. In both these fields the late Charles P. Bowditch, played a very large part. From his pioneer work, so admirable and so necessary, advances have been made in this study by several others, among them being S. G. Morley of the Carnegie Institution, and H. J. Spinden of the Peabody Museum. The latter has shown conclusively that the Maya calendar began to function in 613 B.C.[3] The earliest dated inscription is on a small jade statuette of 96 B.C. The oldest Maya remains are found in the district of Petén in northern Guatemala.

The First or Great Empire of the Mayas (Fig. 1) began about the first century before Christ and continued until about 650 A.D. All the great cities of the south flourished within this period and an extension of the First Empire to the northward began about 300 A.D., following the eastern coast of the peninsula of Yucatan. Sites with definite dates have been found at Chetumal, Tuluum, Coba, and at Chichen Itza.[4] Jaina on the northwest coast was also probably a First Empire site. It is important to note that the stone stelæ and lintels in northern Yucatan on which the dates are recorded, all seem to be re-used stones. No buildings contemporaneous with this first occupation of this part

[1]Tozzer, A. M., The Chilam Balam Books and the Possibility of Their Translation: *Proceedings of the 19th International Congress of Americanists*, Washington, 1915. Also, Tozzer, Maya Grammar: *Papers of the Peabody Museum*, Cambridge, IX, 182–192, 1921.

[2]Spinden, H. J., A Study of Maya Art: *Memoirs of the Peabody Museum*, VI. Cambridge, 1913.

[3]Bowditch, C. P., The Numeration, Calendar Systems and Astronomical Knowledge of the Mayas, Cambridge, 1910. Also by same author, On the Age of the Maya Ruins: *American Anthropologist*, (N.S.), III. 697–700. Morley, S. G., The Inscriptions at Copan: *Carnegie Institution of Washington*, Washington, 1920, especially Appendix II. See also Morley's Bibliography in this volume. Spinden, H. J., The Reduction of Mayan Dates: *Papers of the Peabody Museum*, VI, No. 4, Cambridge, 1924, and other writings.

[4]The site of Coba was re-discovered in 1926 by the Carnegie Institution Expedition and the dated inscriptions, read by Morley, are from 363 to 412 A.D. The Chetumal date (333 A.D.) was reported by Thomas Gann in *Man*, V. 26, No. 37, London, 1926.

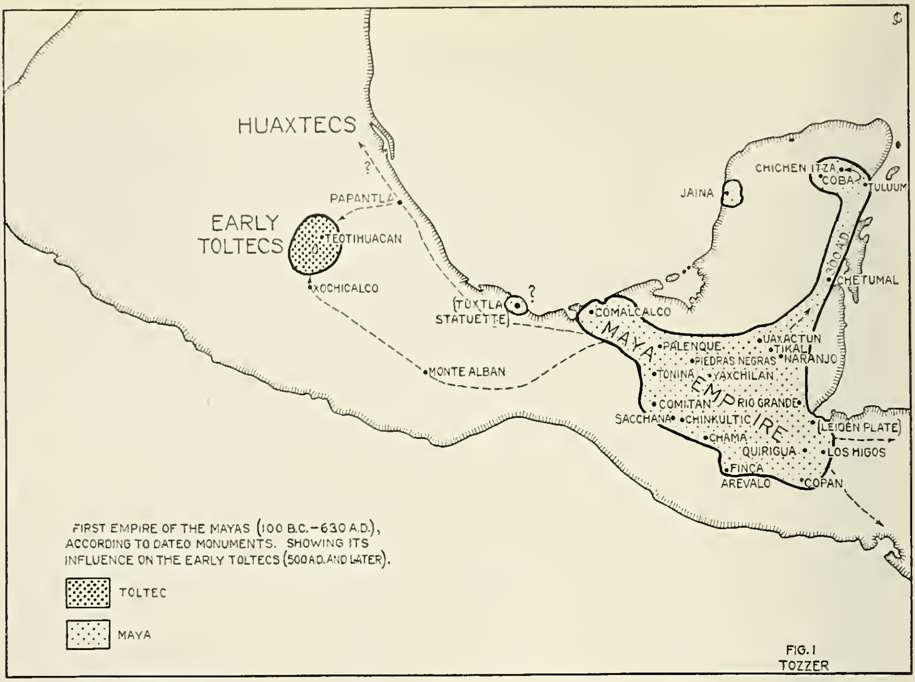


Fig. 1.—The First Empire of the Mayas shown by dated monuments and a suggestion of the Maya influence on the early Toltecs

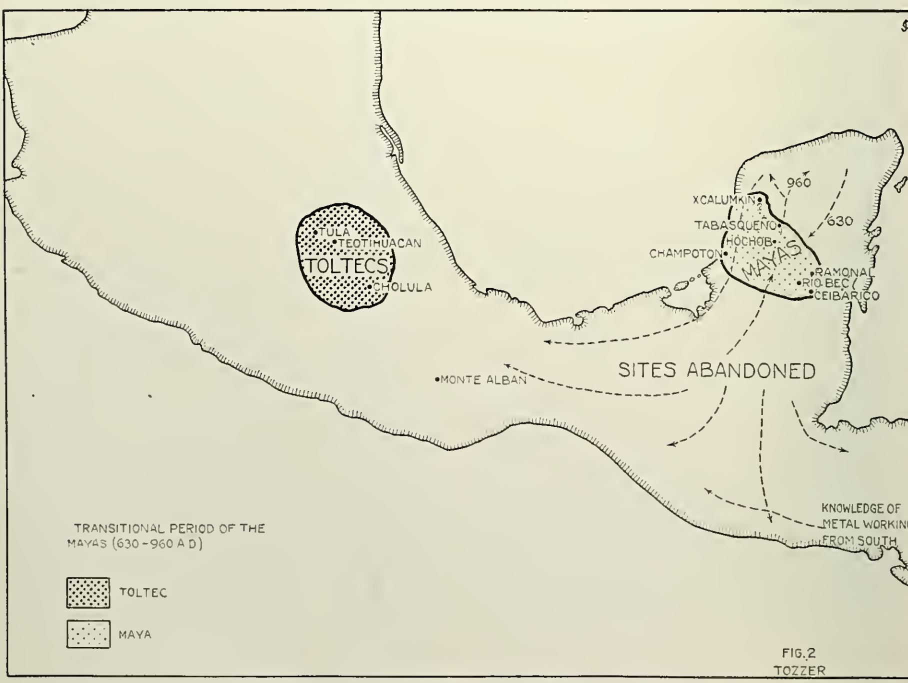


Fig. 2.—The Transitional Period of the Mayas showing the abandonment of many of the First Empire sites with movements northward and southward

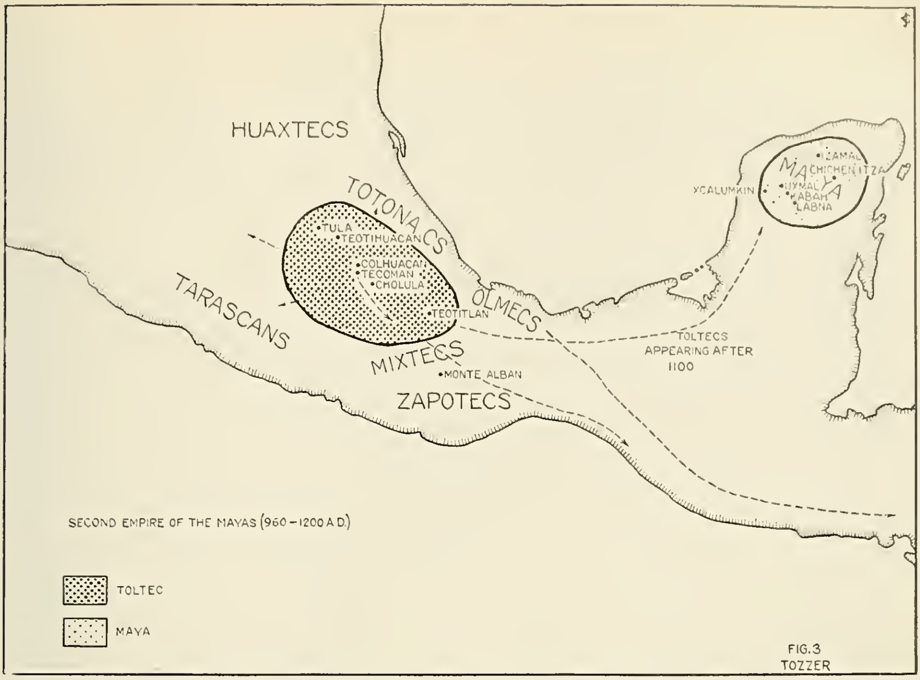


Fig. 3.—The Second Empire of the Mayas with the first appearance of Toltec influences which later were to play a large part in Maya history

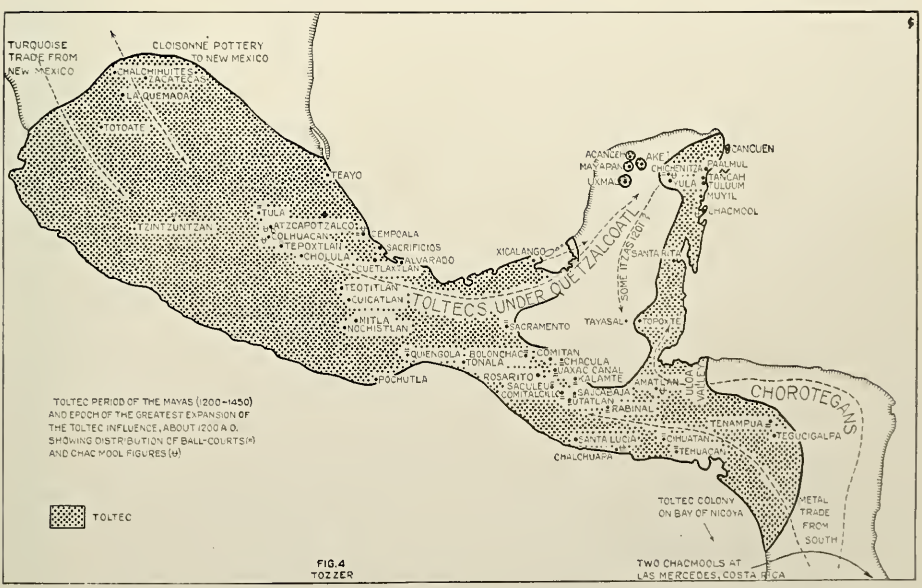


Fig. 4.—The Toltec Period of the Mayas showing the submergence of the Maya by Mexican influences and the extent of the greatest expansion of the Toltecs based somewhat on the distribution of Ball-courts and Chac Mool figures

of the country, even at Chichen Itza, have yet been found.

In the first half of the seventh century the southern cities seem to have been abandoned as no late dates occur there. The ancient chronicles in the Chilam Balam Books state that the inhabitants of northern Yucatan also left their homes about 630 and moved southward, not to return until 960. This has been called the Transitional Period (Fig. 2) and the sites at Chom-

Fig. 5.—Tikal, Guatemala: Temple II. Total height about 140 feet. Type common to First Empire, 100 B.C.-630 A.D. Restoration by F. F. Horter under direction of Dr. H. J. Spinden in the American Museum of Natural History

Fig. 6.—Rio Bec, Quintana Roo, southern Yucatan. Temple typical of Transitional Period, 630–960 A.D. Photograph by R. E. Merwin and C. L. Hay, Peabody Museum Expedition, 1911–12

poton, Tabasqueño, Hochob, and others in that vicinity, together with Rio Bec and others discovered in that region by Doctor Merwin and Mr. C. L. Hay, are probably to be placed in this epoch. It is also fairly certain that some of the wandering Maya peoples went southward along the Gulf of Mexico, while still others moved southward to the Guatemalan highlands and eastward into the Uloa Valley and Salvador.

The Second Empire of the Mayas 960–1200, (Fig. 3) found its home in northern Yucatan at which time the most famous of the cities there, with the exception of Chichen Itza, were founded. The Toltec influence had arrived in Yucatan before the fall of Chichen Itza in 1191. It was probably about this time that some of the Itzas migrated southward to Lake Petén in northern Guatemala where they were found by Cortes in his remarkable march to Honduras and where they remained unconquered by the Spaniards until 1697.

The Toltec Period, 1200–1450, (Fig. 4) in northern Yucatan really began with the trimuph of Quetzalcoatl-Kulkulcan over the Itzas. This figure was for a long time considered to have been purely mythological, dimly related to certain historical events, but, as is common with all culture-heroes, a vague and nebulous individual. Doctor Spinden has lately shown[1] that Quetzalcoatl, far from being a myth, was a very real person—"one of the great characters of history, a compound of warrior, priest, administrator, and scientist." He served as leader of a force of Mexicans who put down a rebellion of the Mayas in 1191, subduing Chichen Itza and making it a Toltec city. It was he who created much of the pomp and ceremony later used by

[1]In Encyclopædia Britannica (13th ed.) under Archæology, XVII, Mexico and Central America.

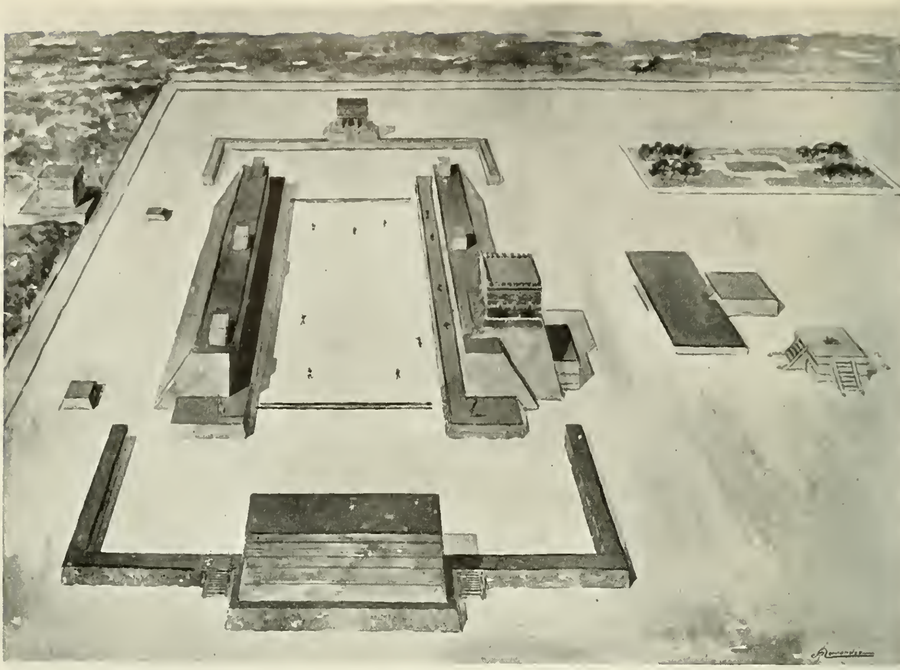


Fig. 7.—Chichen Itza, Yucatan—Ball Court group. The Ball Court is typical of the Toltec period, 1200–1450 A.D. See distribution of ball courts in Fig. 4. Restoration by M. A. Fernandez, courtesy of the Government of Mexico

Fig. 8.—Chichen Itza, Chac Mool figure. Typical of Toltec Period. See distribution of this type in Fig. 4

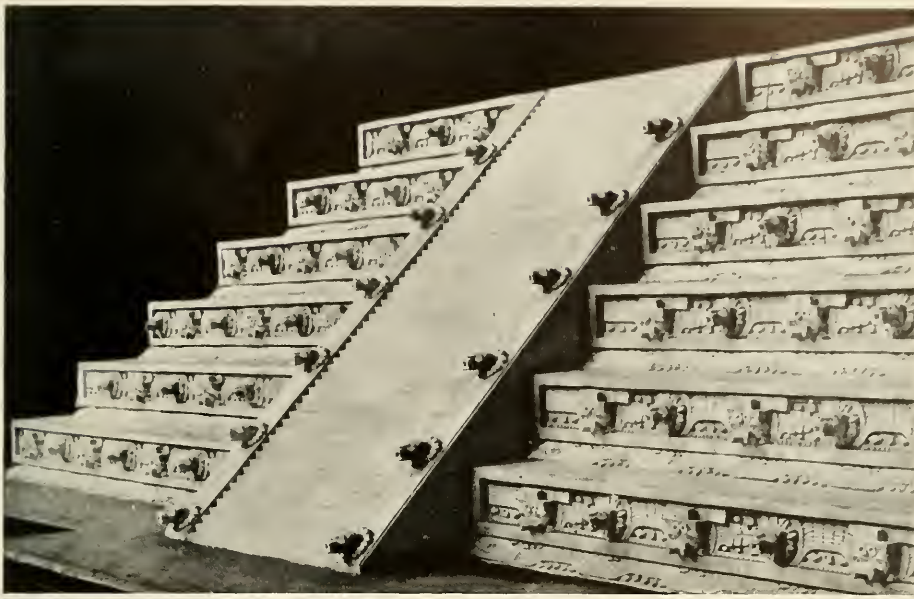


Fig. 9.—San Juan Teotihuacan, Highlands of Mexico. Temple of Quetzalcoatl. Restoration by Manuel Gamio. Courtesy of Department of Public Education, Mexico

the Aztec rulers and described with such vividness by the Spaniards.

The Toltecs brought with them a new religion and new art forms, and the period from 1191 to 1450, when Mayapan fell and the Maya civilization practically ceased to exist, was marked, especially at Chichen Itza, by a very strong Mexican influence. It has been possible to identify in the frescoes and bas-reliefs at this site the battles of the Toltecs over the Mayas and the subsequent making of peace. The portrayal of the Maya and Mexican types is distinctive in all the carvings. Chichen Itza has the longest *recorded* history of any city in the New World, ancient or modern, of over eight hundred years. The Toltecs in Mexico proper had ceased long since to be a leading nation on account of civil wars.

The arrival of the Mexicans in Yucatan with definite dates on the Maya side enables us to supply them with an historical background for the latter part of their history, thus supplanting to some extent their mythological dates of origins and of migrations. The early Toltecs had been strongly influenced by offshoots of the early Maya culture, perhaps at the breaking up of the First Empire (Fig. 1), which reached them from the south and west as shown by Maya details occurring at Monte Alban and Xochicalco. There was also a migration of Maya features northward along the coast of the Gulf of Mexico through Alvarado, the Totonacan area, and Papantla.

The calendar of the Toltecs and later of the Aztecs undoubtedly was derived from that of the Mayas. The constantly increasing sphere of influence of this people (Figs. 2, 3) was centered in the important site of San Juan Teotihuacan which had its greatest period from about 1000 to 1200 A.D. The most extensive expansion of the Toltec power came after 1200 (Fig. 4)

Fig. 10.—Chichen Itza. Façade of the Temple of the Warriors. Building typical of late Toltec period of the Mayas. Courtesy of the Carnegie Institution of Washington

and included practically all of the non-Maya-speaking peoples of central and southern Mexico, Guatemala, and as far south as Honduras and Salvador in addition to the successful conquest of Chichen Itza and all the other Maya sites on the east coast of Yucatan. Thus the Toltecs, receiving the seeds of culture and the calendar from the early and southern Mayas, later played a large part in shaping the destinies of the northern Mayas in the last period of their history.

The Aztecs who receive most of the credit in the popular mind for the achievements in cultural lines in Mexico were very late arrivals on the scene. They did not reach the shores of the lake, on an island of which they were later to build their capital, until 1325. They came as a wild hunting tribe from the north, remaining undisturbed until 1351 when they suffered defeat and enslavement at the hands of the Toltecs. Their period of expansion and preëminence did not begin until 1376, and even in 1519 under Montezuma, they held only a fraction of the territory that was included in the Toltec empire in 1200. Every feature of their life was borrowed from the Toltecs and several of the Toltec cities in the Valley of Mexico never were completely subjugated by the Aztecs.

There are several dark spots in the picture I have tried to draw. We do not know what led the Mayas to abandon their great cities in the south and move northward. The exhaustion of cultivatable land may have been one of the reasons. We are also ignorant as to the events which led up to the fall of this civilization about 1450. Civil war, the injurious effects of the presence of foreigners, and, in all probability, epidemics of yellow fever were all possibly contributory.

The darkest spot, however, is our ignorance of the beginnings of the Maya peoples. It is certain that those responsible for this civilization were American natives, and that their development is not due to any influence outside the New World. The impossibility that such a culture could grow up *in situ*, as it were, is always brought forward by those who think they see superficial similarities between the Mayas and certain Mongolian peoples. The calendar alone, which no one has tried to prove originated outside of America, shows the mental equipment of the Mayas, the presence of genius in their midst. A few naturally gifted individuals, a knowledge of agriculture, and a good environment are probably alone responsible for the beginnings of the Maya civilization.

It will be remembered that the Archaic peoples were probably at the horizon of agriculture and our next step must be to find a connection between them and the Mayas. Dr. S. K. Lothrop of the Heye Museum has lately found in Central Salvador an early Archaic horizon from twenty to forty feet below a deposit containing a mixture of pottery forms of the First Maya Empire, late Archaic, and other types. It is probable that similar conditions are to be found in the Uloa Valley, although here a redistribution by water seems to have taken place. Further research in this general area ought to yield most important results.[1]

There must, necessarily, have been long centuries of slow beginnings and small achievements by the early Maya before they burst upon the world a century before the beginning of the Christian Era with a highly developed civilization, characterized by great cities, an elaborate art and architecture, a highly organized theocracy, a remarkable astronomical knowledge, and a calendar system which was in actual operation for more than 1900 years until it was destroyed by the Spaniards. Marginal corrections were applied to take care of the variation on the Maya year and of the true solar year, a means more accurate than our method of interpolating days. It should be pointed out that it was not until 1582 that the Julian day was invented, which corresponded to the Maya day count, 2000 years after the same principle had been adopted by the Mayas.

With the definite chronology thus established and its day-for-day correlation with the Mexican cultures, there is every reason to hope that, with the study of the migrations of objects and stylistic contacts, there will come a time when the sequences of cultures in our own Southwest and also those of the great civilizations of South America will be attached to the historical fabric.

Finally, as the result of modern research, a certain readjustment of values comes out clearly: the small contribution made by the Aztecs to the ancient cultures of Mexico, the large part played by the Toltecs with their far-reaching empire, and the far greater primary impetus and development of a great civilization with astronomical knowledge and a calendar by the Mayas, who handed all this on to the other peoples of Middle America.

If there are included in our history the present inhabitants of Yucatan and the Lacandones of Guatemala, also a Maya people, who still carry out many of the pre-Columbian religious practices,[1] a definite historical background has been supplied to American archæology, starting in the sixth century before Christ and extending in an unbroken series for more than 2500 years.

[1]Indian Notes and Monographs, V. 6 No. 5, Museum of the American Indian, Heye Foundation, New York.

[3]Tozzer, A. M., *A Comparative Study of the Mayas and the Lacandones*, New York, 1907.

WOMAN AND CHILDREN AT GANADO, VISITING THE TRADER'S STORE

The costumes and the cradle-board are of the old style, now disappearing. Mother and children are well equipped with beads and silver work. The silver ornaments are made by pueblo men, from silver obtained from coins, usually Mexican

An Anthropologist among the Navaho

BY BEATRICE BLACKWOOD
Of Oxford University

IN the Southwest, the process of absorbing the Indian in the white population is as yet only beginning. Particularly is this true among the Navaho. Numbering at least 25,000, they are at the present time, contrary to the general view, increasing by multiplication and not by addition from without. They have a lien on a stretch of country almost twice the size of Massachusetts, part of which is about two hundred miles from a railroad, and though their clothing and diet have been somewhat modified by the presence of traders' stores, they still to a great extent live their own lives in their own way, resentful of attempts to bring them into line with the Twentieth Century.

Last summer it was my privilege, as the holder of a Laura Spelman Rockefeller Memorial Fellowship, to spend some weeks on the Navaho Reservation. My immediate object was to obtain a series of physical measurements of Indian women, who, like the women of other races, have in the past been largely neglected by anthropologists. "Set a woman to catch women" is my maxim, and it seems to succeed. As the measurements have not yet been tabulated, no statistical results can be given at present, but possibly a sketch of the conditions under which the work was done may be of interest.

The Navaho are suspicious of strangers, and, except for members of the younger generation who have been to school, most of them are ignorant of any language but their own. Conditions are therefore more complicated than in the pueblo villages, where the people are more or less accustomed to visitors, and frequently speak either English or Spanish, or both so that it is generally possible to get along without an interpreter. With the Navaho, on the contrary, the first essential is to choose the introducer carefully. If you have with you someone whom they know and like, you will succeed in persuading them to be measured, unless one of them suddenly turns shy and refuses, in which case no one else in that group will come forward, and you must pass on to the next. But as the hogans are widely scattered, you get a fair choice with each family. The isolation, however, works against you in another respect, in that a great deal of time is consumed in traveling from one hogan to another, even if you are accompanied by someone who knows where to look for them.

The Navaho are always curious, of course, as to why their measurements are wanted, but the explanation that one is trying to find out which tribes are the tallest, or the best-looking, will usually suffice. It is wise, however, to use a technique which is simple and can be carried out quickly, or one's subject may get up and walk off like the hedgehog croquet-balls in *Alice in Wonderland*. On the whole, the Navaho women regarded my procedure with amusement. Unexpected difficulties occasionally presented themselves, as when the home provided positively nothing for the subject to sit upon, not even an upturned bucket. Sometimes the most violent objections came from the smaller children, who

Above.—Mother and child, full face and profile. The method of hairdressing somewhat hides the head flattening

Below.—At the left, old style, woman with child on cradle-board; at the right, new style, leaving the hospital at Fort Defiance with a baby a week old seemed to think their mother was being hurt, and frequently set up a howl which could only be quieted by candy.

For taking their skin-color, I used the Milton-Bradley Color Top, which was described in a recent number of Natural History. This was a great attraction, and did much to win the good will of the Indian. Much of the darkness of an Indian skin is due to tanning, and when the color is tested on the inner side of the upper arm, which is protected by the long sleeves they always wear, the difference is startling. Much astonishment was expressed when the top, arranged to match the unexposed skin, was spun against the back of a well-tanned wrist.

The Navaho are very far from being uniform in physical type, even within their own tribe. Though they do not mix much with either whites or Mexicans, there is probably the blood of several Indian tribes in their veins, owing to their raiding propensities. In stature they are, in general, taller than many of the other Indians of the Southwest, and there does not seem to be so marked a difference between the height of the men and the height of the women as is noticed by the observer among the Zuni, for example. Leading a restless, and not too well-fed existence, they remain, as a rule, slender, and frequently have the appearance sometimes described as "raw-boned." Though they may be extremely handsome in their youth, they do not often retain their good looks into middle life.

Body measurements, other than stature and sitting-height were out of the question in most cases, owing to the voluminous clothing the women wear even during the summer. They are more conservative in this matter than are the men, who have in general

Women's work.—(Above) Shucking corn and grinding it on a metate. Chin Lee. (Middle) Digging a well with a gourd spoon. Cañon de Chelly. This is not such an undertaking as it seems for the well need not be more than 18 inches deep. (Below) Weaving. Chin Lee

Desbah comes to school

adopted white man's dress except for special occasions, while their wives still affect the velvet shirt or jacket which was formerly the usual garb of both sexes, and an enormously wide pleated skirt which sweeps the ground. The little girls are almost exact replicas of their mothers.

For the first year or so of their lives, the babies pass their time strapped to a "cradle-board" so tightly that no movement of the limbs is possible. The effect of the pressure on the baby's soft skull is to produce a permanent flattening at the back, sometimes so marked in the adult that the greatest length of a head, when measured by the callipers, is hardly more than its greatest breadth. Most of the older Navaho show more or less clearly the results of this practice. The younger generation is beginning to learn modern ways of treating a baby, so the number of abnormally flattened heads is probably on the decrease. They are also learning by slow degrees to make use of hospitals, nurses, and hygienic methods. It would be impossible to provide a hospital for every Navaho, but medical help is available at all the agencies and most of the schools, and there are a number of field nurses. Even where there are facilities, it is still very difficult to persuade the sick to enter the hospital, though their reluctance is less than it used to be. The mother and twins shown in the photograph had a hard fight for their lives in the hogan seen in the background, and were saved through the efforts of the nurse from the school at Chin Lee.

The Navaho Reservation includes some of the most uninteresting, some of the wildest, and some of the most wonderful country in the southwest. Much of it is flat desert, covered with scrub grass, sage brush, and sand, with a mesa or two in the distance. With such a background, it is easy to pass close to a Navaho home without seeing

Bah and her twins. Chin Lee

VIEWS ON THE RESERVATION

The uppermost picture shows the well at White Cone. The two lower pictures show types of Navaho hogans near Cañon de Chelly. The hogan in the middle to the right, is similar to that in the large Museum group in the Navaho exhibit

Hogans in Cañon de Chelly. The peach trees seen in the background are from seed introduced by the first Spanish priests who undertook missionary work in our Southwest some three hundred years ago. Farther up the cañon are the ruins mentioned in the text

it unless one knows how to look for it. The wildest country is in the northwest corner, reached from Kayenta. It is so rocky and waterless that not even the Indians can live in it, though there is evidence that it was inhabited in prehistoric times. The most fascinating part of the Reservation is the famous Cañon de Chelly, with the adjoining Cañon del Muerto. Here is not only marvelous and colorful scenery, not only the fascination of prehistoric cliff-dwellings, but also the interest of present-day Indian life. Quite a number of Navaho make their homes in the Cañon, feeding their flocks and harvesting their corn wherever the width of its floor permits, and adding their quota to the millions of pictographs on its walls, as their ancestors did before them.

It is generally recognized by those who know them, that the Navaho are among the finest of the Indians of the present day, putting up a good fight in the struggle for existence, and making the best of the resources they have at their command. My experience with them, brief as it was, certainly left me with that impression, and I look forward to the day when I may be able to return.

The Antiquity of Man in America[1]

By J. D. FIGGINS
Director, Colorado Museum of Natural History

WHEN we analyze the technical opposition to the belief that man has inhabited America over an enormous period of time, we find it is not only restricted to an individual minority, but it also appears to be traceable to the results of a too circumscribed viewpoint,—a failure to appreciate properly *all* the evidence, and a seeming unwillingness to accept the conclusions of authorities engaged in related branches of investigation. It is a fact, of course, that the nature of the material evidence upon which opinions are based is an important factor, and when such evidence is not abundant, it is obvious that students cannot successfully restrict their studies if they would avoid the dangers that arise through a lack of continuity in one or more threads of evidence.

This appears to be very well illustrated by individuals learned in physical anthropology, comparative craniology and racial relationships. The chief denials of man's antiquity in America appear to have their origin in those sources of investigation. Such criticism would doubtless have weight and value were skeletal evidence abundant. But such evidence, representative of the periods antedating that which is regarded as "modern," or since Pleistocene times, is exceedingly meager. Indeed, it is far too scant to make possible intelligent comparisons and safely arrive at definite conclusions. Therefore, to be of value, it is essential that it be supplemented by those branches of the sciences that are capable of fixing geologic time periods —the sole means of bridging the weaknesses that occur in the thread of evidence represented by skeletal remains. Without this aid, opinions are not only venturesome, but distinctly misleading, if given publicity.

Readers of the discussions relative to the antiquity of man in America must frequently wonder because of the antipathy for the acceptance of evidence of that character, and often they may have inquired "Why should we not expect to find such evidence, since there are neither conditions nor facts that interfere in the slightest with such an expectation?" Obviously then, denials of the antiquity of man in America, without convincing proof that we could *not expect* to find such evidence, are purely supposititious.

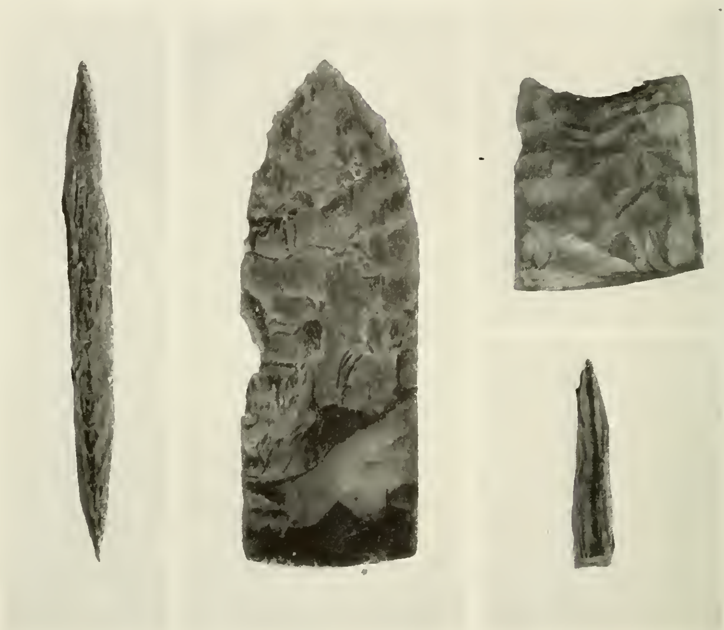
However, the purpose of the present paper is not a discussion of the relative merits of arguments previously advanced, but a presentation of new evidence of man's antiquity in America. As the writer has not made a special study of this subject, his opinions regarding the importance of the evidence would be valueless, and for that reason he expresses none. He merely views it in the light of substantiating earlier finds of a like and similar nature, and as pointing the way to other and more important discoveries. His task is the recording of the facts as he knows them.

In 1923 Mr. Nelson J. Vaughan, a resident of Colorado, Mitchell County, Texas, in a letter to the writer, described a deposit of bones in the bank of Lone Wolf Creek, near his home. Upon request, Mr. Vaughan forwarded examples to the Colorado

[1]Photographs by the author.

Museum of Natural History for determination. These proved to be fossilized parts of an extinct bison, and the following season, 1924, Mr. H. D. Boyes was sent to the locality for the purpose of making excavations.

was firmly fixed in the latter, undercutting took place. Then, with the use of tackle, the blocks were released from their bed and turned on edge for the purpose of removing the excess matrix, and planking over the bottoms



No. 1 No. 2

FIG. 1. ARTIFACTS ASSOCIATED WITH FOSSIL BISON ON LONE WOLF CREEK, MITCHELL COUNTY, TEXAS. ALL NATURAL SIZE

No. 1—Found beneath cervical vertebræ. No. 2—Found beneath left femur

After the removal of the overlying formation (studied and elsewhere described by Mr. Harold J. Cook, honorary curator of palæontology, Colorado Museum of Natural History) and the finding of portions of the skeletal remains associated, it was deemed most expedient to remove them in sections. This was accomplished by working down until the fossils were exposed, cutting channels through the deposit at intervals, thus forming "blocks" of considerable size, these, in turn, being encased in burlap and plaster of Paris. A heavy crate was then introduced, and when a block

of the crates. During these operations, the nearly complete skeleton of an adult bison was uncovered, quite articulated and lying on its left side. This was divided into sections and taken up as described above.

When the excess matrix was being removed from the under side of the first block, (the one containing the cervicals, a few dorsals, their attached ribs, and the forelimbs), a complete arrowhead[1] was discovered (illustrated in Fig. 1, No. 1) lying between the fifth and sixth cervicals and nearly in

[1]The term arrowhead is used in a broad sense, since the artifact may have been a spearhead.

contact with the latter. As the matrix was very hard, being composed of cemented sands, gravels and clays, and necessitating the constant use of hammer and chisel, the arrowhead was detached and broken into two main fragments and numerous small slivers before it was discovered. Most of these parts were recovered and have since been assembled without other restoration. In removing the section containing the dorsal vertebræ and ribs, a second arrowhead was uncovered and likewise was detached before its presence was noted, but this example later disappeared and cannot be figured here. Accounts, however, suggest that the position which it occupied was possibly in the thorax, but it is not so recorded. The removal of the last block resulted in the finding of a portion of a third arrowhead (Fig. 1, No. 2), immediately beneath the left femur, in circumstances identical with the first; that is, in removing the matrix from the under side of the block.

Independent of the lost arrowhead, which is described as very similar to the first, two artifacts were taken from *beneath* an articulated and fossilized skeleton of an extinct bison. That Mr. Boyes seems not to have recognized the full importance and significance of these finds is suggested in his permitting the loss of the second example — whether through theft or otherwise—and the fact that he did not make an immediate report of them. The first intimation the writer had of their discovery came through a visitor to the Museum, who had been present when the first arrowhead was uncovered. Replies to inquiries and later verbal details by Mr. Boyes verified and enlarged upon this account in all particulars.

Deeming it of greatest importance that the age of this deposit be determined, the writer requested Mr. Harold J. Cook to make a detailed investigation, particularly in relation to the geology and association of other fossil species. Mr. Cook's report appears in this issue of NATURAL HISTORY.

As critical studies of the artifacts found associated with the bison remains near Colorado, Texas, must be left to the archæologist, but brief detailed mention of them will be made here. There are two or three private collections of arrowheads that were picked up on the surface in the vicinity of Lone Wolf Creek, all of which have been examined by Mr. Cook and Mr. Boyes. None contained examples approaching in similarity, either in form or workmanship, those found with the bison skeleton. The latter are of grayish flint, quite thin, as shown in Fig. 1, and are devoid of evidence of notching, which is distinctly opposed to the forms found on the surface in that locality. Equally distinctive is their superiority of workmanship which, I am told, also applied to the example that was lost. While there seems to be no doubt that these artifacts represent a cultural stage quite distinct, as compared with that revealed in the arrowheads found on the surface, it is not the writer's intention to discuss such questions, and he will refer to the similarity of this find to that made by Mr. H. T. Martin at Russell Springs, Logan County, Kansas.

Readers who have been interested in the subject of man's antiquity in America, are, no doubt, familiar with this discovery, which was made by Mr. Martin in 1895, and while the writer has not examined this artifact, Mr. Martin kindly sent a photograph for reproduction here; this for comparative purposes. (Fig. 2.) Dr. F. A. Lucas applied the specific name *occidentalis* to the race of bison with which this artifact was associated.

During the summer of 1925, Messrs. Fred J. Howarth and Carl Schwachheim of Raton, New Mexico, informed the writer of a quantity of bones exposed in the bank of the Cimarron River, near the town of Folsom, Union County, New Mexico. Later, those gentlemen forwarded examples for examination, which proved them to be parts of an extinct bison and a large deerlike member of the *Cervidæ*. Accompanied by Messrs. Howarth and Schwachheim, Mr. Cook and the writer visited the locality in April, 1926, and after a study of the deposit, made arrangements with Mr. Schwachheim for the removal of the overlying formation, consisting of some six to eight feet of very tough, hard clays. In June the writer sent Mr. Frank M. Figgins to supervise the removal of the bones, in which work he was aided by Mr. Schwachheim.

Fig. 2.—Artifact associated with fossil bison. Collected by Mr. H. T. Martin, at Russell Springs, Logan County, Kansas. Natural size

Not the least of the writer's interest in this deposit was the possibility that additional evidence of man's antiquity in America might be uncovered, and with that prospect in view, he gave explicit instruction that constant attention be paid to such discoveries—not with as much expectation of success, as in the belief that opportunities of that nature should not be neglected. It was therefore, something in the nature of an anticipated surprise when such a find was made. In this case, it was of the greater portion of an arrowhead, similar in its general form to those found at Colorado, Texas, but decidedly more tapering at the point, and of quite superior workmanship. Unfortunately, this artifact had also been dislodged from the matrix before it was discovered—something the writer was anxious to avoid. However, it was directly associated with the remains of an extinct bison, and greater caution was urged in the work of excavating. Not until nearly the close of the season was additional evidence uncovered, this proving to be a second arrowhead almost identical with th first in form, and like the first, having the proximal end missing. The material from which it was fashioned is distinctive, being a very pale gray ground, through which run narrow, diagonal streaks of red. This artifact, too, had been dislodged before its presence was suspected, but at the spot from which it came, the tool struck a hard substance, which, upon being exposed, proved to be a wedge-shaped fragment of flint, approximately one-quarter of an inch in width by three-quarters of

FIG. 3.—ARTIFACTS FOUND ASSOCIATED WITH EXTINCT BISON, NEAR FOLSOM, UNION COUNTY, NEW MEXICO. NATURAL SIZE

FIG. 4.—PORTIONS OF ARTIFACTS ASSOCIATED WITH EXTINCT BISON. NATURAL SIZE

No. 1.—Larger portion of artifact in contact with fragment in situ

No. 2.—Larger portion of artifact slightly separated from fragment in situ an inch in length, lying in a fixed position, adjacent to a bison rib. This was removed without being disturbed, in the form of a small block, and in addition to the flint and rib in close contact, there are also in the block two toe bones and an atlas. Upon its arrival at the laboratory, immediate attention was given to cleaning the fragment of flint, which proved to be of the same material as that of the larger portion of arrowhead, and suggested that it might be part of the missing proximal end. When a test was made, a perfect contact resulted. (See Fig. 4). The perfection of this contact, together with the peculiar markings and color of the material from which the artifact was fashioned, prohibits any conclusion other than that they are parts of one and the same artifact. Fig. 3 illustrates the Folsom artifacts. No. 1 is a very thin flint of a dark reddish-brown color, and representing a quality of workmanship the writer has rarely seen equalled. No. 2 is also very thin and while it is not quite equal in fineness of chipping, as displayed in No. 1, this may be, and probably is, due to a difference in the material from which they are fashioned.

Compared with the artifacts from Colorado, Texas, the Folsom examples are distinctly more pointed, but whether this difference in form and superiority in workmanship is traceable to individual preference and skill, the writer does not venture an opinion. He does, however, make comparisons with flints found on the surface, in the region about Folsom and Raton, New Mexico, and in this connection it is of interest to note that the latter are unlike such surface artifacts from the vicinity of Colorado, Texas,—being usually very small and evidencing far greater skill in their manufacture. The writer has examined a large part of the Carl Schwachheim collection of flints, from northern New Mexico, and Mr. Schwachheim verifies his conclusions that it contains nothing resembling the flints found associated with the bison remains near Folsom.

Until the studies now in progress are completed, the geological age of the Folsom bison will not be known.[1] That it is of an extinct race there is no question.

We have, then, in the Folsom arrowheads, the third instance of a very similar type of artifact being found immediately associated with extinct bison, in circumstances which lead geologists and palæontologists to conclude that they belong to the Pleistocene age.

Having read an article dealing with the question of man's antiquity in America by Mr. Harold J. Cook, which appeared in the November, 1926, number of the *Scientific American*, Dr. F. G. Priestly of Frederick, Tillman County, Oklahoma, wrote Mr. A. G. Ingalls, editor of that publication, briefly describing the finding of artifacts associated with fossil mammal remains in that vicinity. After some correspondence, and with Doctor Priestly's consent, Mr. Ingalls forwarded this letter to Mr. Cook. Doctor Priestly's account of these discoveries was of such a convincing nature that it could not be doubted that the Oklahoma material was of great importance. With the view of making studies of both the material and the physical character of the deposits from which it was taken, Mr. Cook and

[1]Dr. O. P. Hay has kindly consented to study all of the bison material that was obtained in Texas and New Mexico, and expresses the belief that it contains three undescribed races.

the present writer joined Doctor Priestly at Frederick in January.

It was at once apparent that while Doctor Priestly recognized and understood the importance of the finds he described in his letter to Mr. Ingalls, it was equally obvious he had followed a very conservative course and the writer was not prepared for the discovery that in addition to the artifact mentioned, several others had been unearthed and no less than five of them preserved.

In his account of these finds, Doctor Priestly stated all had been personally made by Mr. A. H. Holloman, who owns and operates a sand and gravel pit about one mile north of the city of Frederick. To Mr. Holloman, therefore, the writer is indebted for a history of the discoveries, their stratigraphic position, and other items having a bearing on them.

As Mr. Cook's account will cover the geological history of these deposits, and the immediate vicinity, here it is necessary merely to say the sand and gravel pit consists of an open cut on the east face of a ridge approximately half a mile in width and running for some miles in a generally north and south direction. Sand and gravel from an area of about two acres have been worked out near the crest of this ridge, which, with the overlying stratum of clay, silt, etc., varied from ten feet to twenty-five feet in thickness. At the time of our visit, a nearly vertical cut of not less than 150 yards in length and varying from fifteen feet to twenty-four feet in height was exposed, in which every phase of the several strata was clearly defined.

Independent of the opportunities thus offered for studies of the exposed formations, it also made it easily possible for Mr. Holloman to point out the horizons at which artifacts and the several varieties of fossils had been found.

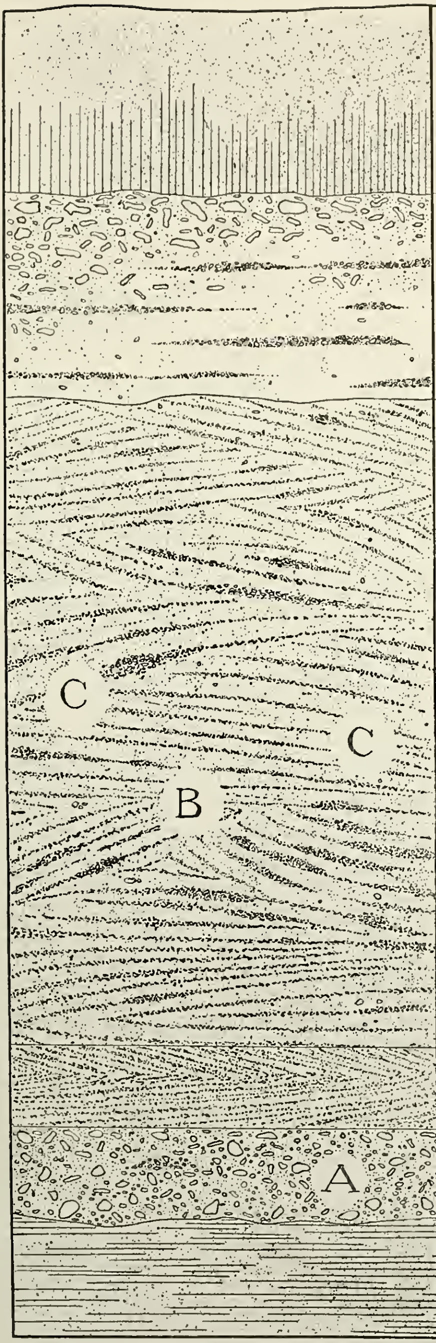
That a great deal of fossil material has been uncovered since the opening of the pit, there can be no doubt, but not until during the past year was an effort made to preserve any part of it. Accounts are unanimous in showing that quantities of such material have gone into the refuse heap, now comprising thousands of tons; into the surfacing of roads; the cement mixer, etc. Seven known artifacts are buried somewhere in this refuse pile or carried away: a metate and six pestles or manos, but these cannot be considered here.[1]

Although fossils are found throughout the entire stratum of sand and gravel deposits, a superficial study of all the evidence suggests the possibility that two faunal and cultural stages are represented. This, however, is for others to determine, and the writer will confine himself to the circumstances connected with the finding of the artifacts and to brief references to the deposits from which they were taken.

Figure 5 illustrates a typical section of the deposit, and is drawn to the scale of ¼ inch to 1 foot for the average thickness of the several strata. It also indicates the horizons at which the several artifacts were exposed.

The base member, composed of clean river gravels, pebbles, and occasional bowlders up to five inches in diameter, is solidly cemented with semi-translucent lime, and lies uncomformably upon red beds of Permian age. This stratum contains numerous fossils of several varieties, such as *Mylodon* cf.

[2]The Colorado Museum of Natural History has arranged to keep a representative constantly on the ground to search for and preserve all artifacts and fossils hereafter uncovered.



DARK, CHOCOLATE-RED CLAYS WITH VERTICAL COLUMNAR CLEAVAGE TOWARD BASE.

BRICK-COLORED CLAY AND SANDS, WITH LENSES OF GRAVEL AND PEBBLES. UPPER HALF OF STRATUM HEAVILY CHARGED WITH CALCAREOUS MATTER.

CROSS-BEDDED SANDS, GRAVELS, AND PEBBLES, LARGELY UNCEMENTED. COARSE MATERIAL—UP TO 2 INCHES IN DIAMETER—CONFINED TO LOWER HALF OF STRATUM.

EXTENSIVE AREAS OF CROSS-BEDDED SANDSTONE.

HARD CONGLOMERATE OF CLEAN PEBBLES, GRAVEL, AND BOWLDERS. UP TO 5 INCHES IN DIAMETER.

RED BEDS OF PERMIAN AGE.

Fig. 5. Holloman Gravel Pit, Frederick, Oklahoma. Scale, ¼ inch to 1 foot

harlani, three species of *Equus*, *Trilophodon*, sp., and a primitive *Elephas*, etc. Associated with them and at the point marked "A," the artifact illustrated in Fig. 6, No. 1, was found by Mr. Holloman. It is a light-gray flint, and while the flaking exhibits considerable skill, perhaps, as a whole, the workmanship is poor, with the chipping confined to the reverse sides of the edges (see cross-section, Fig. 6, No. 2). Whether or not other flints have been uncovered at this level, there is no means of determining, this single example having been picked up by Mr. Holloman as it was broken out of the hard matrix by workmen. Two stones taken at the same level and described by Mr. Holloman, can scarcely be regarded as other than pestles or grinding instruments, but subsequently these disappeared and cannot be otherwise recorded here.

Lying immediately on this hard conglomerate is a partially cross-bedded layer of coarse, lenticular sandstone, one and one-half to two feet in thickness. This appears to be, principally, at least, nonfossiliferous; but the following member, consisting of heavily cross-bedded and but partially cemented coarse sands, gravels, and pebbles, contains numerous fossils throughout its varying thickness of from nine feet to fifteen feet. (See Fig. 5.) Seven feet below its upper margin, or at the point marked "B," the arrowhead illustrated in Fig. 6, No. 3 was found in position by Mr. Holloman. It is a pale grayish and reddish flint, mottled and slightly streaked, and of good workmanship. With the exception of an appearance of slight damage at the point, due, perhaps, to its having come in contact with some hard substance, it is quite complete.

On a general average level of a foot

FIG. 6.—ARTIFACTS FOUND ASSOCIATED WITH FOSSIL MAMMAL REMAINS NEAR FREDERICK, TILLMAN COUNTY, OKLAHOMA. ALL NATURAL SIZE

No. 1.—From basal stratum. See "A" in diagram, Fig. 5.

No. 2.—Cross- section of artifact No. 1.

No. 3.—From horizon marked "B" in diagram, Fig. 5.

Fig. 7.—Cross-bedded sandstone resting upon basal conglomerate from which artifact No. 1, Fig. 6, was taken. (See "A" in diagram, Fig. 5), Holloman Gravel Pit, Frederick, Oklahoma

or two above the horizon at which this arrowhead was found, not less than five unquestionable metates have been uncovered in Mr. Holloman's presence —three of these being illustrated herewith. They are composed of a hard, close-grained, limy and silicious sandstone, the ovate depression in the largest example having a maximum depth of three-quarters of an inch. The edges of these artifacts are distinctly rounded and smooth, as is the reverse side. As it cannot be doubted that these stones show evidence of human workmanship, that they are identical in general form to metates found in other localities, and owing to the fact that no other stones of a similar nature have been found in the thousands of cubic yards of material that have been removed, there can be no question about their original purpose and use.

When first exposed, two of these artifacts stood in an upright position, which suggested to Mr. Holloman that they might be grave markers. Careful search, however, failed to reveal the slightest evidence of human remains. Their position in river sands, gravels, and pebbles, would seem to strengthen the evidence of their antiquity, without a history of the subsequent events that buried them from nine to twelve feet below the present surface and lowered the adjacent valleys one hundred feet below the present ridge in which they were found.

Perhaps no very great importance would be necessarily attached to these artifacts were it not for the fact that they were imbedded in ancient river channel material and that Mammoth remains, including numerous teeth, are found at various levels, to a point eight feet above them. Further, no remains of this type of Mammoth, *columbi*, have been found at, or below, the horizon at which the metates were exposed.

Reference has been made to pestles, or grinding stones. Five stones were found by Mr. Holloman at various levels from the base of the deposit to the horizon of the metates, but unfortunately these have been lost and are not of record here.

In connection with these finds, the writer desires especially to express his appreciation of the generosity extended by Doctor Priestly and Mr. Holloman, for not only did they lend every possible assistance, but donated to the Colorado Museum of Natural History all of the artifacts and fossils they had preserved. In addition to this, they aided in locating fossils in the possession of others. Mr. Holloman has also volunteered every facility for the Museum to engage actively in work in the quarry. Science owes Doctor Priestly and Mr. Holloman its appreciation.

Fig. 8.—Metates from Holloman Gravel Pit, Frederick, Oklahoma. See "C" in diagram Fig. 5

New Geological and Palaeontological Evidence Bearing on the Antiquity of Mankind in America

By HAROLD J. COOK
Honorary Curator of Palæontology, Colorado Museum of Natural History

THE Colorado Museum of Natural History, at Denver, Colorado, through its staff and friends, has been unusually fortunate during the past two years in bringing to light new and striking evidence that primitive men have lived in America vastly longer than has been generally conceded or believed by most investigators.

Three distinct and separate discoveries have been made during this period, all of which are of great importance, and only one of which has been published and reported to date. Each of these offers special evidences of its own; and, fortunately, each represents a somewhat different period of past time, so the three appear to illustrate a fair cross-section of most of the Pleistocene. The latest of these discoveries, just investigated the last of January, 1927, near Frederick, Tillman Co., Oklahoma, is the oldest. Next comes the already reported finds from Colorado, Mitchell Co., Texas. The youngest of these is a discovery made last summer, near Folsom, Union Co., New Mexico. Each will be considered in the order of its discovery.

As Director J. D. Figgins is simultaneously writing of the human artifacts found in these localities, no detailed mention of them will be made herein; but after going over the situations and localities and the specimens, with the men who found them, the writer is convinced of their authenticity.

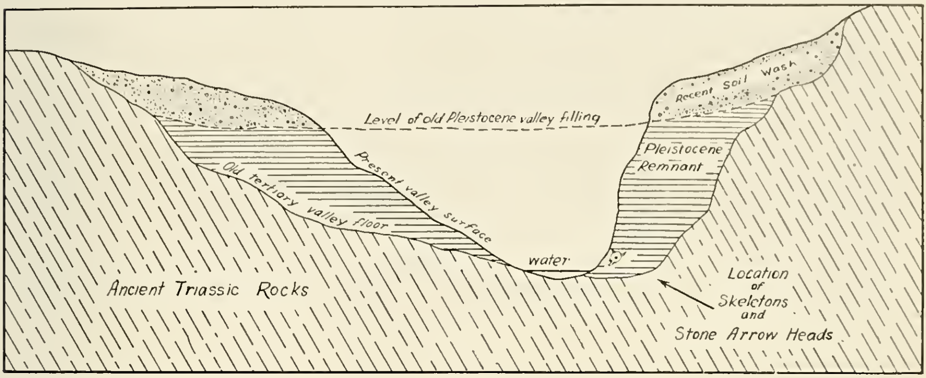
A brief general outline of these discoveries, and the geological and palæontological evidence with them, as far as worked out to date, follows. The writer is aware that a great deal of important and valuable evidence is still to be worked out, and is confident that when this has been done, much confirmatory evidence of a highly significant nature will be available.

Complying with a request of the director of the Colorado Museum of Natural History, the writer went to Colorado, Texas, early in May, 1925, to study the geology of the region for the purpose of determining the age of the deposits in which artifacts had been found associated with the fossil remains of an extinct species of bison.

Heavy rains, immediately prior to my arrival, had cleared out many old exposures, enlarged others, and made new ones along the stream beds and arroyos. These proved to be extremely useful in identifying the surface formations, and brought to light additional fossil material.

From the town of Colorado investigations were extended north and west for distances in excess of one hundred miles; smaller areas were studied to the east and south. Special attention was paid to the numerous exposures of streams and their dry tributaries along the southern margin of the "Staked Plains."

The results of this reconnaissance are:—(1) the Fredericksburg group of the Cretaceous has been deposited unconformably on the Docum beds of the Triassic in this area; (2) erosion subsequent to the Cretaceous has deeply eroded the region in part, completely removing the Cretaceous beds, and cutting into the Triassic; (3) widespread, general, but rather shallow Pleistocene beds consist of consolidated coarse sands and gravels, mostly of Cretaceous origin—with lenticular and irregular occurrence of clays. The cementing material is principally calcium carbonate. Pleistocene fossils



Diagrammatic cross-section of the valley of Lone Wolf Creek, near Colorado, Texas, showing the relations of the geologic formations, and the situation under which the evidence was found. (By permission of *Scientific American*)

deposition took place during part of the Pleistocene, partially refilling most, if not all, of the then existing valleys; (4) post-Pleistocene erosion has recut many of these valleys, exposing in part old valley floors and sides, in part leaving small areas of varying magnitude of the Pleistocene in position.

On Lone Wolf Creek, near the town of Colorado, at the spot where the Bison Quarry and artifacts were found, a considerable remnant of the Pleistocene is still preserved, and the present tiny stream has cut clear through them and into the Triassic floor, from which all Cretaceous had been removed before the Pleistocene deposition. In this locality, the Pleistocene varies greatly in thickness, due to subsequent erosive phases, but in general, it may be said to be from six to twelve feet thick, overlaid by secondary depositions of varying character, from clay to gravel, unconsolidated. As a whole, the were found in position at numerous points, but in nearly all cases they were scattered and fragmentary, as is to be expected in stream deposits of sufficient force to transport such coarse material.

When visited by the writer, recent flood-waters had exposed additional bison remains in situ, at the spot where the articulated bison skeleton and arrow (or spear) points were found associated, and in the lower layers of the undisturbed calcareously cemented Pleistocene. Examination of the fresh exposures resulted in the finding of teeth of two species of *Equus*, of *Elephas*, and of a large camel, probably *Camelops*. Fragmentary evidence of other types are present, but too incomplete for accurate identification.

The fossils and artifacts were removed from near the base of the deposits, as illustrated in the accompanying diagram. That they were con-

General view at the Bison Quarry, near Folsom, New Mexico. The Bison Quarry is in the little arroyo just over the top of the automobile. In the background is a group of extinct volcanic cones, including Capulin, a national monument. Photograph by H. J. Cook

Near view of the deep little arroyo which cut down through a deposit of ancient extinct bison bones, near Folsom, New Mexico. The X marks the layer in which the bones and arrowpoints were found. Photograph by H. J. Cook

temporaneous in deposition cannot be questioned. Identical conditions of deposition were traced more than a mile up Lone Wolf Creek valley, from the Bison Quarry where the artifacts occurred.

Other creek valleys, or arroyos, dry most of the year, are less denuded, and there the Pleistocene is more extensive. As a whole, the deposits seldom exceed twenty feet in thickness, and vary from that to nothing, depending on the local situation and its relations to original bedding and subsequent erosive influences.

The writer collected numerous fossils both in the Pleistocene and in the older formations. The Triassic vertebrate remains were checked by Dr. C. W. Gilmore, and the invertebrates by Dr. J. B. Reeside. Dr. T. W. Stanton made identifications of the Cretaceous criteria, and personally visited the locality to investigate the stratigraphy and fossils.

The Pleistocene vertebrate fossils have been but partially studied and must await final identifications from studies now in progress. It may be said at this point, however, that the evidence is too conclusive to admit of doubt or question. The artifacts were

Part of Bison Quarry, near Folsom, New Mexico showing bone bed in the left foreground, with blocks containing the fossils bones partly worked out. Mr. Carl Schwachheim, who with Fred J. Howarth, discovered this deposit, is standing on the floor at the base of the bone layer. Photograph by Frank M. Figgins

found *beneath* a nearly complete and articulated skeleton of a Pleistocene bison. The associated fauna is typical, and the geologic evidence clear. The bison is unique among types found in America, with characters strongly suggestive of Asiatic relatives, and indicative of Asiatic origin.

The second discovery, near Folsom, New Mexico, was made by Messrs. Fred Howarth and Carl Schwachheim, of Raton, New Mexico, who reported the matter to Director Figgins. Subsequent investigation indicated an important discovery, and in April, 1926, Director Figgins and the writer went to Raton, and were taken to the new location and shown every possible courtesy by Mr. Howarth. A preliminary examination of the deposit revealed important possibilities and arrangements were made with Mr. Schwachheim to start work in the field. The writer visited the quarry twice in the early summer, and helped make the

The arroyo at the Folsom Bison Quarry, after the work of excavating and stripping was under way, showing extent of operations undertaken. Photograph by Frank M. Figgins

preliminary excavations and collections. Later, Mr. Frank Figgins, from the Colorado Museum of Natural History, joined the camp and had charge until the close of the season.

The situation is a rather unusual one in which to find fossil bones. Situated at an altitude of about 7000 feet, the location is essentially a mountain valley, cut deeply into Cretaceous rocks, and the higher levels are capped by lava. This valley had been partially eroded, when a later lava flow filled in and apparently cut off part of the upper end of the valley. Later, the valley cut through the lava dam, and again began cutting deeper upstream. The exact relations here have not yet been worked out for lack of time, but it is apparent that swampy, marshy conditions existed for some time in a considerable area in the valley bottom above the latest lava flow, and muds and silts were deposited to at least eighteen feet in depth. Later, the next cycle of erosion started recutting, and a narrow arroyo or gully worked its way back up the valley, and in places down to the original valley floor. It is near the head of this arroyo, and down at a depth of from about eight to twelve feet that the fossil bison skeletons were discovered, in both banks of the gully.

The bison is closely related to *B. occidentalis*, and is considerably larger than our modern form. A number of individuals are represented, and fine, practically complete skeletons have been secured. Associated with this were found, during the course of excavating, the two beautifully worked arrow points or spear points described by Director Figgins.

The matrix is a dense, exceedingly tough clay silt, and small, irregular areas in it are distinctly cemented by lime. Shells of characteristic freshwater invertebrates occur, but have not been studied. The bones in many cases show plainly the evidence of having been trampled on by other animals, while lying buried in the mud. One scapula, uncovered by the writer, had a plain footmark stamped out of it and driven down into the matrix below, where another bison had stepped on it while it lay in the mud.

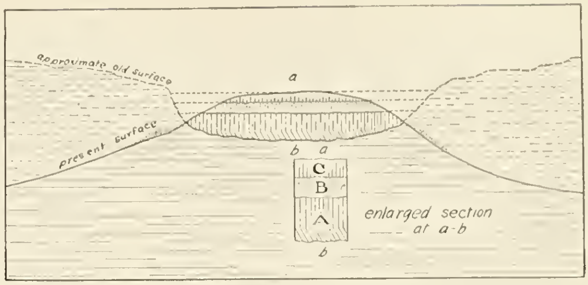
Fragments of other animals have been uncovered herein, but are too scrappy, as far as found to date, for accurate determination. It is planned to continue excavations the coming season, and it is quite probable that other important evidence will be brought to light.

Observations and studies made to date plainly indicate considerable antiquity, certainly thousands of years, for this deposit. The fact that an extinct race of bison is represented is further contributory evidence. While it is premature to express an opinion as to the exact age of these beds on present evidence, in the light of observed data the writer is of the opinion that this will prove to be a late Pleistocene deposit. Again, the association of artifacts with extinct bison, — as at Colorado, Texas,—is certain. The writer hopes to complete certain studies on the geology of the area this year, which should throw more definite light on its age.

In December, 1926, the writer received a letter from Mr. Albert G. Ingalls, associate editor of the *Scientific American*, enclosing a letter written to him by Dr. F. G. Priestly, of Frederick, Oklahoma, telling of the finding of Mammoth and other fossil bones associated with an arrow point, deep in a gravel pit, and under a bed of solid stone. The writer got in touch with Doctor Priestly, and also took the matter up immediately with Director Figgins, who instantly appreciated its probable importance and significance. Arrangements were completed, and late in January, 1927, the writer and Mr. Figgins drove to Frederick, Oklahoma, to examine the evidence at first hand.

We were received with the greatest cordiality by Doctor Priestly, who did all in his power to aid us in every way, as did also Mr. A. H. Holloman, owner of the pits where the fossils were found. These sand and gravel pits are operated on an extensive scale commercially by Mr. Holloman, and he has most courteously offered every aid and facility. Also, both of these gentlemen have generously donated to the Colorado Museum of Natural History all of the important fossils and artifacts which they had saved during the operations conducted to date. Not only this, they put us in touch with others who had fossils from these pits, and through this connection, we received two fossil *Equus* jaws from Doctor Ball, dentist of Frederick, and from Doctor Hartwick of the same town we secured the loan of an interesting *Mylodon* caudal vertebra.

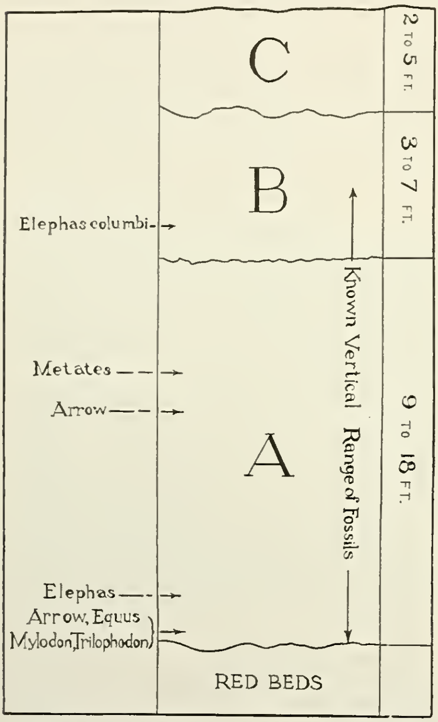
The sand and gravel pits in question are situated on the top of the highest hill in that locality, about one mile north of Frederick. This hill is more properly part of a long ridge, running nearly north from Frederick toward the Wichita Mountains, some twenty-five or thirty miles



Diagrammatic cross-section of the ridge at the Frederick sand and gravel pits, showing the position of the ancient stream channel, and illustrating how the old valley became inverted into a hill, through erosion. The present valleys adjoining are about 100 feet lower than the old river floor

A section of the west face of pit at Frederick, Oklahoma, where fossils and artifacts were found. A. H. Holloman (left), owner of the pit, and Harold J. Cook. Mr. Holloman is standing on top of the lower sandstone and conglomerate member of Bed A. (See diagram)

Detail of a part of Bed A, Holloman Sand and Gravel Pits, near Frederick, showing typical cross-bedding which characterizes this deposit. Photographs by J. D. Figgins away. The sand and gravel which forms its top are old stream bed deposits, laid down when this ancient Red River tributary ran at that altitude. The top of this hill is about 100 feet above the immediately adjoining valleys, and about 280 feet above the



Diagrammatic section of the exposed deposits in the Frederick gravel pits, illustrating the relations of beds and the occurrence of fossils and artifacts

present water level of Red River, a few miles away in the same drainage basin.

The general surface of the whole region is composed of Red Beds of Permian age into which the Pleistocene river valley was cut. In this ancient valley, coarse granitic sands and gravels were washed, apparently from the Wichita Mountains, and were carried down and bedded in the valley bottom. The accumulated sands and gravels of this nature make up the lower beds, or Bed A, of the accompanying diagrammatic section. As sand and gravel are far more resistant to erosion than the relatively soft clays of the Red Beds, gradual general erosion on both sides of the valley wore the general surface levels down, while the valley floor held its own. Finally the stream found access to lower levels. At this time, when the old channel was first abandoned, a flood-plain period in the valley was instituted. The beds laid down during this stage are Bed B of the diagram. As denudation continued and the drainage followed lower levels, the flood plain deposits ceased, and the overlying clay-silt beds (Bed C of the diagram) with their columnar structure strongly suggest a period of æolian deposition.

As erosion proceeded and the encroaching new valleys undermined the sides of the old and higher valley floor, residual gravels from the old beds formed protecting mantels along the sides of the former Pleistocene channel, retarding erosion. Thus, by maintaining its position through resistance to erosion, the valley essentially became inverted.

Other channel remnants are left in the region besides the one under special study; and it is planned to examine these critically for additional geological and other evidence immediately.

The floor of the Pleistocene valley was at least half a mile wide at the point where the sand and gravel pits are now located. The middle and lower part of the channel was somewhat west of the present cut, and so the beds there are thicker than in the section given herewith. This is shown by the fact that the Red Bed floor of the stream dips west clear across the open cut in the quarries. Drag-line holes have been cut still farther west for about a quarter of a mile, down through the channel beds to the Red Beds, sampling the depth and quality of the sands and gravel. From these it is possible to get a very good cross-section of the channel, as far as the holes were cut, and nearly to the west side of the ridge.

The face of the present quarry, on its west side, is at least one hundred and fifty yards long, and has over a twenty-foot face.

A typical vertical section of the beds is given herewith; but, of course, in any stream beds of this character, the actual thickness will always show variation for every location measured.

In general, three main phases of deposition are noted, as mentioned above. The lower beds, to a depth of nine to eighteen feet at the quarry face, are characteristically cross-bedded, undisturbed river channel sands and gravels, with local lenses of reworked Red Bed materials, brought down from some point upstream at the time of the original deposition. The lower member of this bed, A, is coarse, generally cemented gravel, and carries some water. It is in this bed that fossils are most abundant, and in it one flint spear point was found imbedded. Above this is cross-bedded gravel and sands, and in some areas a well consolidated sandstone member is present, about three feet above the Red Bed floor. Under this, the primitive Mammoth jaws were discovered. Fossils occur all the way up through Bed A, Mr. Holloman informs us, but not abundantly. The more advanced type of Mammoth, *Elephas columbi*, is found repeatedly in the lower part of Bed B. The finding of *Trilophodon* and primitive Mammoth in the lower beds, and a more advanced type of Mammoth above, suggests that quite a long period of time had elapsed between the two deposits. More work and further observations will undoubtedly throw added light on this.

Three Edentates are present, the two big ground sloths *Megatherium* and *Mylodon*, and *Glyptodon*. Besides the three elephants previously named, we also have at least three species of horse present, all of the genus *Equus;* also, a small and a medium-sized species of camel, of genera undetermined; also turtles and fragmentary bones of other families too broken for accurate identification. As little attention has been paid until just now to the saving of smaller and fragile fossils in those quarries, undoubtedly much important evidence has been lost. However, with the array of species present, and those almost certain to be recovered, it should be possible to place these beds quite accurately as to their proper position in the Pleistocene. Present studies indicate they are of early Pleistocene age, and the writer is convinced of their contemporaneous association, surprising as such a culture at that time may seem.

While other instances have been reported of the finding of evidence of mankind associated with extinct animals in America, nowhere has the evidence of antiquity been so clear-cut and conclusive as this. As compared with the find in Colorado, Texas,[1] the present occurrence appears to be distinctly older.

[1]Cook, Harold J. "The Antiquity of Man in America," *Scientific American*, Nov., 1926. "Definite Evidence of Human Artifacts in American Pleistocene," *Science*, N.S., Vol. LXII, No. 1612, Nov. 20, 1925

HAWKSEYE BRIDGE, SOUTHERN UTAH

The Fifth Bernheimer Expedition to the Southwest

By CHARLES L. BERNHEIMER

Foreword.—The writer of this article is the author of an interesting book, *Rainbow Bridge*, in which he vividly portrays some of his adventures while exploring for the American Museum in the rough, rocky, inaccessible country north of the Navaho Indian Reservation in Arizona. Mr. Bernheimer here gives us an additional note on his 1926 trip and his discovery of a new natural bridge in southern Utah.

Mr. Bernheimer has made five annual expeditions for the Museum, their object being to seek traces of prehistoric inhabitants by traversing the most difficult sections of the region, following courses probably not previously traveled by white men. It was on one of these expeditions that the wonderful archæological riches of Canon del Muerto were discovered, an account of which appears in the article by Doctor Kidder on pages 202-209. The Museum is happy to announce that Mr. Bernheimer is now on his sixth expedition.

OUR expedition, carried on during the early summer of 1926, through country as rough and rugged as any we had ever traversed in our earlier explorations, brought to light a new and interesting geologic phenomenon, a hugh monolith heretofore unknown to white man.

We had traveled long and hard northeast of Navaho Mountain and when about five miles west of Piute Cañon, due east of Desha Cañon, suddenly in the distance we beheld this strange structure. It appeared to be a tremendous and piercing hawkseye perched there to hold inviolate all that came within its protecting ægis. "How like the eye of a hawk" was the thought that ran through each and every mind, and promptly we named it "hawkseye." On coming closer, we found that its strange and fantastic appearance was due not only to its own formation, but also because immediately behind it and concentric with the bridge was a deep cave. The bridge and cave are separated by a slit in the rock of about fifty feet. A careful examination of the cave disclosed that the rotundity of the bridge is repeated in its recess by an arch which suggests a new bridge in embryo, and still farther on in the very bowels of the cave is to be found an oval depression completing the perfect concavity of this striking phenomenon. We estimated the height of the bridge to be about 170 feet and its span from abutment to abutment about the same, while the vertical thickness of the rock at the top of the arch is about 20 feet.

The cave and bridge originally were one. Through the action of the elements, a version of which will be found further on, about 50 feet of the opening arch of the cave became separated from its rear part by a break in the roof parallel with the mouth of the cave, thus creating the bridge.

The roof of the bridge and of the cave are on a level with the top of a small ridge. There is no water on this ridge or indeed anywhere within miles. The cave is equally dry, not even water seepage could be found there, nor was there vegetation of any kind in the cave as is the case when there is but the slightest presence of water.

Looking at this striking giant, we all felt that too little credit has heretofore been given to the great force which

Columbine caves

has contributed so much to the special impress of these desert wastes, making them look different from lands anywhere else—namely the mechanical forces of wind.

An old medicine man whom we encountered at the bottom of Piute Cañon at the foot of the lower crossing

Leaving the Hawkseye Bridge we traveled northeast and finally came across some caves which we called Columbine Caves because of the profusion of flowers we found growing in their depths. These caves also are located in a spot where it is absolutely impossible for water action to have had any but the most insignificant influence in their formation. They represent another monument to this great force.

From Columbine Caves our path led on through a rock-strewn country. Between Piute and Nokai cañons, on a plateau isolated from all else, we came upon a hugh domelike rock. In the flank of this rock mass is a miniature cave still in the formative stage, filled with sand and pebbles, the tools with which the master workman, the wind, does his grinding and chiseling.

In Purple Sage Cañon, a tributary of Desha Cañon, the ground was literally

Isolated, hugh, domelike rock with miniature cave in its flank

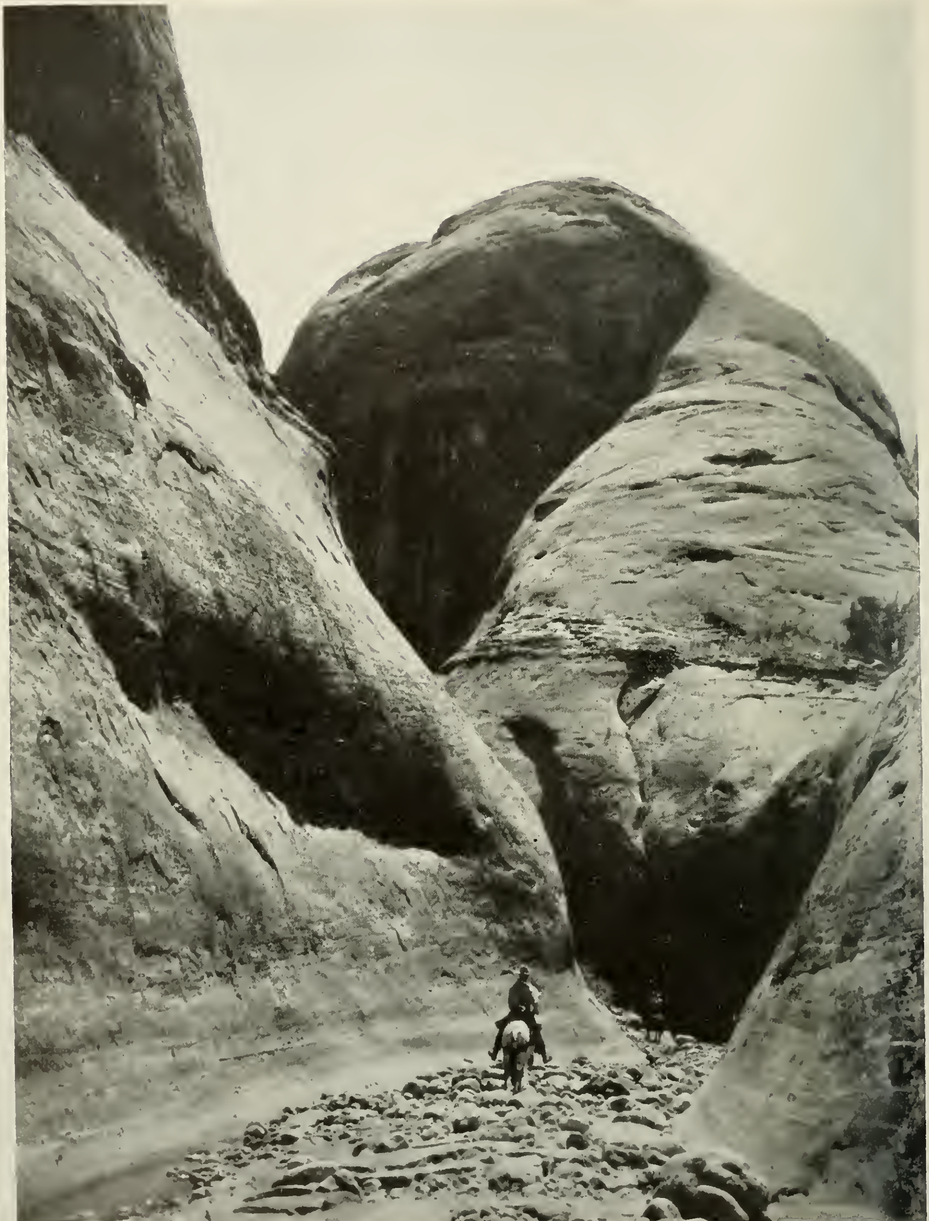
covered with purple sage—an effect beautiful and weird in this immense waste. We did some scouting and found ourselves on top of a rock island about a mile square, another strange example of the wind's handicraft, for this rock island was dotted with innumerable deep cylindrical cavities. The island is not mesa shaped. Its sides are slanting and it is detached from any other high point. Indeed, there are no high points within a radius of several miles. It is not in a position to receive water, other than rain or snow. We named it Pot Hole Ridge. Many of these pot holes were from 30

Pot Hole Ridge, picturing a section of one of the so-called "pot holes"

to 40 feet deep, and dry. Others contained water about 25 to 30 feet down, undoubtedly the remnants of rain and snow. A number of them were filled to the top with sand and earth and provided sustenance for many types of desert herbs, flowers and bushes. In some, cedars were growing, which, judging by their size, could not be less than four hundred years of age. Indeed, many of these pot holes reminded us of exquisite jardinières. Their mouths sloped but merged very promptly with their perpendicular

WILD ROSE CAVE.—Behind the man's head at the right is seen the top of the ladder described in the text, and at the left is the black jar of the corrugated type

sides, forming perfect cylinders. Because of the danger of sliding into their depths, from which there is no way of escape unless one is fortified with a rope,—and we were not, —we were unable to secure good photographs, though we did succeed in getting a view of the general landscape. The enigma of the birth of these pot holes is possibly explained by a tiny one which we chanced to pass. It was not larger than a tea cup. In its bottom lay



At the bottom of Nasja Cañon

sand ready to revolve, bevel, and polish with the next wind blast, and thus do its share towards contributing to the dramatic and weird setting of this precious desert land of ours.

From here we went on to Nokai Cañon, traveling at great length in its bed for we were determined to find whence it came. We discovered that three small cañons came together, as it were, in one, and formed the hugh Nokai. The most westerly one of these three parent cañons we named Wild Rose Cañon because of the tangle of wild rose bushes we encountered. This cañon headed into a large cave which we named Wild Rose Cave.

This cave affords inviting ground for scientific examination. Among numerous other ruins it contains a perfectly preserved house which, however, has no door. The only opening in its walls is a small space about 12 inches square, undoubtedly intended for ventilation. The cedar poles of a ladder protrude through its roof. This ladder, which we believe has not been used in five hundred years or more, is still in perfect condition. It is a beautiful specimen of the handwork of the aborigines. Narrow at the top and wide at the bottom, its five rungs are slipped through two courses of willow twigs lying parallel with and on the upper part of the cedar poles, and cross-tied with smaller willow twigs. It is my belief that no such perfect specimen is to be found in any museum today. In the vicinity of this cave, partly exposed, we saw a black jar, almost perfect, of the corrugated type, about fifteen inches in diameter. We removed nothing from this cave, believing that things should be left undisturbed for a more careful and systematic examination. The potsherds here were all of the Betatakin type.

This year we decided once more to attempt to go through Nasja Cañon. In 1922 we failed to travel from Surprise Valley down Nasja Cañon, and as we were still anxious to know into what it emptied, whether the San Juan or Colorado River, we thought the time opportune to make another endeavor. As in our previous expedition we were again prevented by the same narrowing down of the cañon. We also found that the hugh rock masses which in 1922 had given us much difficulty, some of them being twenty feet high and as much in diameter, had been crushed by the flood waters—not a trace of them was to be found. The

A typical resident of the Navaho region standing before his hogan in Sagi Cañon

contour of the cañon's bottom had changed materially. To attain our object it was necessary for us to climb the wall of the cañon. This climb was possibly seven hundred feet or more and was of the most trying sort, but on reaching the top we were fully rewarded for our efforts for we saw that Nasja Creek, which flows through the Nasja Cañon, empties into the San Juan River near a spot on the north shore of the stream which was known to one of my guides as Sunshine Pasture.

It is regrettable that the many tracks of prehistoric animals, probably one hundred or more, and no doubt of various sized dinosaurs, which we came across in Sagi Cañon photographed so poorly. We reached them late in the

Dinosaur tracks in Neskla-Nizadi Cañon, taken in 1924

afternoon. They are located near the head of the main easterly branch of Sagi Cañon called Doguo-tshe-boco. We are planning to visit this locality again during the coming summer, and hope that this next visit will result in satisfactory photographs. The tracks, though smaller, are not unlike those which we discovered in our trip of 1924. This photograph represents a spot in Neskla-Nizadi Cañon, a confluent of Navaho Cañon.

Indian Music from the Southwest

By HELEN ROBERTS
Research Assistant in Anthropology, Institute of Psychology, Yale University

FOREWORD.—The study of primitive music is now an important part of field work, and most anthropological expeditions go out equipped with a recording phonograph. After the record is made, the student of music must carefully record the song text in the original language, and then by listening to the phonograph, transcribe the tune in musical notation. The department of anthropology in this Museum has a large collection of such phonograph records from various Indian tribes.

Miss Helen H. Roberts, the author of this paper, who is an anthropologist and also a specialist in music in the Institute of Psychology, Yale University, has made field trips to the West Indies, to Hawaii, and elsewhere, and is well known through her publications on Hawaiian, Eskimo, Indian, and Negro music. In this article she gives a few examples of music of the Indians of our Southwest, transcribed by her and not previously published.

THE serious study of Indian music in the Southwest began shortly after Theodore Baker published in German in 1882 his doctor's thesis on the music of the North American wilds, based on a survey of some eastern tribes. As early as 1636, however, various books of travel casually mention Indian songs, and now and then, as in Sagard-Theodat's *Histoire du Canada*, notations of two or three tunes of eastern Indians appeared. Several other studies of Eastern and Plains Indian music followed Baker's before Dr. Jesse Walter Fewkes initiated the study of Pueblo music under the auspices of the Hemenway Southwestern Expedition. Yet it was Doctor Fewkes who first realized the working possibilities of the phonograph in securing records of the songs. He first put it to the test in Maine in 1889, and in 1890 in recording songs at the pueblo of Zuñi, New Mexico. The instrument used was worked by a treadle and fitted with a fly wheel to regulate the speed. Benjamin Ives Gilman collaborated with Doctor Fewkes in transcribing and thoroughly studying these records[1] and later wrote a large treatise[2] on Hopi melodies based upon records which Doctor Fewkes also obtained with the aid of a phonograph at the Hopi village of Walpi in 1891. The Hopi were much impressed by this new talking machine and in one of their celebrations the Hopi clowns later "took off" Doctor Fewkes and his outfit very cleverly, much to his amusement and that of the entire Indian audience[3].

About 1897 Washington Matthews collected phonograph records of some Navaho songs[4] which were transcribed by John Comfort Fillmore, but of all

[1]Zuni Melodies. *Jour. of American Archaeology and Ethnology*, Vol. 1, pp. 65–91, 1891.

[2]Hopi Songs. *Jour. of American Archaeology and Ethnology*, Vol. 5.

[3]Fewkes, J. Walter, "The Butterfly in Hopi Myth and Ritual" 591–592, (*American Anthropologist*, N. S., Vol. 12, pp. 576–594, 1910).

Doctor Fewkes writes about this as follows:—

". . . In 1891 the author was engaged in pioneer work with the phonograph in the preservation of Hopi melodies. The use of this instrument naturally made a strong impression on the Hopi, who were at first much astonished but later this feeling gave way to amusement when a graphophone was introduced by the late T. V. Keam.

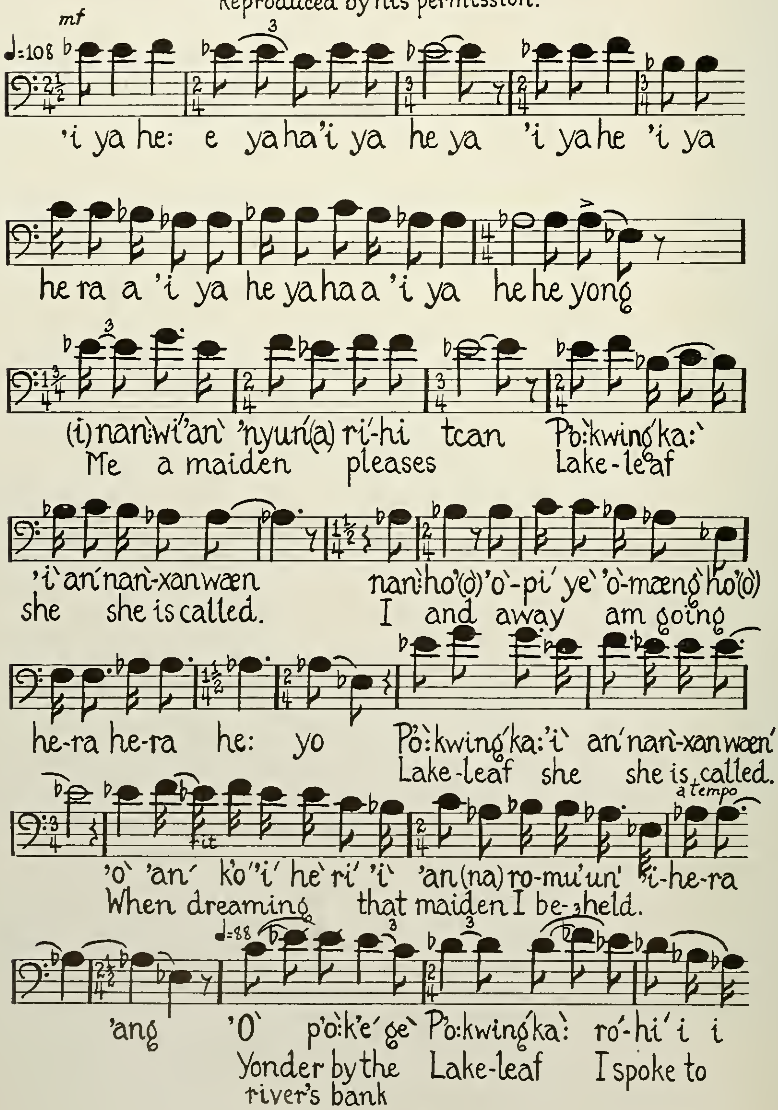
"The value of this instrument for amusement did not escape the clowns, who in one of their performances improvised a phonograph out of an old Sibley stove funnel. Their representation of it is shown in a photograph made by Major Williams in 1892. The bearded person represents the author while the man at the right is one of the clowns. Another clown, hidden under a blanket, responded in a quaking voice to a second performer who from time to time spoke or sang into the funnel, the record being taken down by the bearded Hopi dressed as a white man. The fun thus produced was highly appreciated by the people on the house tops."

[4]*Navaho Legends*, Houghton, Mifflin and Co., N. Y., 1897.

the chants for which Matthews at one time or another secured texts and voluminous descriptive material, only eleven songs appeared in notation. The Navaho chants are said to be extremely beautiful and it is a pity that more have not yet been recorded and transcribed in musical notation. In 1907 Natalie Curtis published *The Indians' Book*[1] which, in addition to many songs of other than southwestern tribes, contains a number of Apache melodies including Pima, Mohave, Yuma and Navaho, and songs from the pueblos of Zuñi, San Juan, Acoma,

[1]Harper, New York.

Tewa Love Song
Collected by J.P. Harrington
Reproduced by his permission.



Laguna, and Walpi. Miss Curtis did not attempt a critical study of the songs, merely aiming to give them exactly as heard, but their structure is easily revealed by her method of drafting them, while her careful and conscientious work indicates the trustworthiness of her notations. She probably collected many more songs than appeared in *The Indians' Book* but, except for scattered examples, I am not aware that she published them.

In 1914 Albert B. Reagan reproduced thirty-nine tunes from the Pueblos[1] in a volume not devoted to the study of their music, and therefore not so well known from this standpoint.

Dr. P. E. Goddard, of the Museum, recorded songs by phonograph from the San Carlos, White Mountain, and Mescalero Apache, in connection with his studies of language and ceremonials. They are not general samplings of songs, but whole ceremonial series such as those pertaining to girls' adolescence ceremonies and offer excellent comparative material for the tribes mentioned, since they belong to comparable categories. They were transcribed by the writer but so far remain unpublished.

J. P. Harrington, of the Bureau of American Ethnology, is another collector. A number of myth songs taken by him in the village of Picurís and transcribed by the writer, are now in press. In connection with her ethnological studies, Dr. Elsie Clews Parsons secured a number of records from Zuñi and Laguna and from the Navaho. Reid Stacey presented five tunes in "Some Zuñi Ceremonies and Melodies,"[2] and in 1913 E. G. Stricklen published eight tunes of the Papago[3] while here and there such men as Farwell, Lieurance, Burton, Loomis, Troyer, have published many Indian melodies from the Southwest, most of which have been harmonized and worked over for concert purposes.

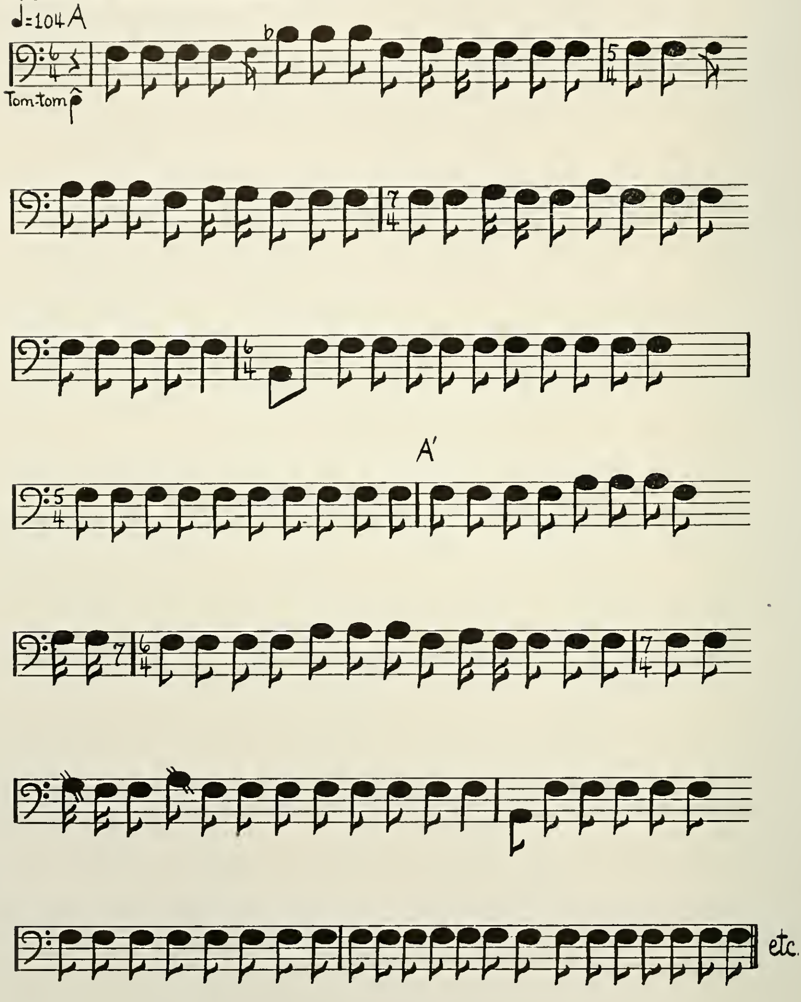
[1] *Don Diego; or, The Pueblo Uprising of* 1860. The Alice Harriman Co. New York. (cop. 1914.), 352 pp., 8 pl.

[2] Some Zuñi Ceremonies and Melodies. *The Music-lovers calendar.* Urbana, Ill. 1907, Vol. 2, pp. 54–61.

[3] Notes on Eight Papago Songs. University of Californio. Publications in American Archæology and Ethnology. Berkeley, Cal., 1923. V. 20; *Phoebe Apperson Hearst Memorial Volume*, pp. 361–366.

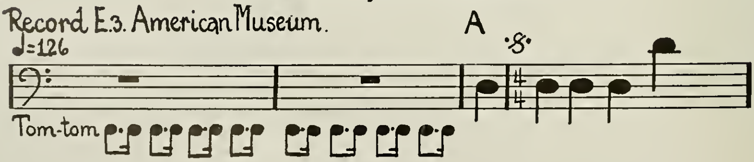
A Girls' Adolescence Ceremony Song
San Carlos Apache
Collected by P.E.Goddard.

Record E.4. American Museum



A Girls' Adolescence Ceremony Song
San Carlos Apache
Collected by P.E.Goddard.

Record E.3. American Museum.



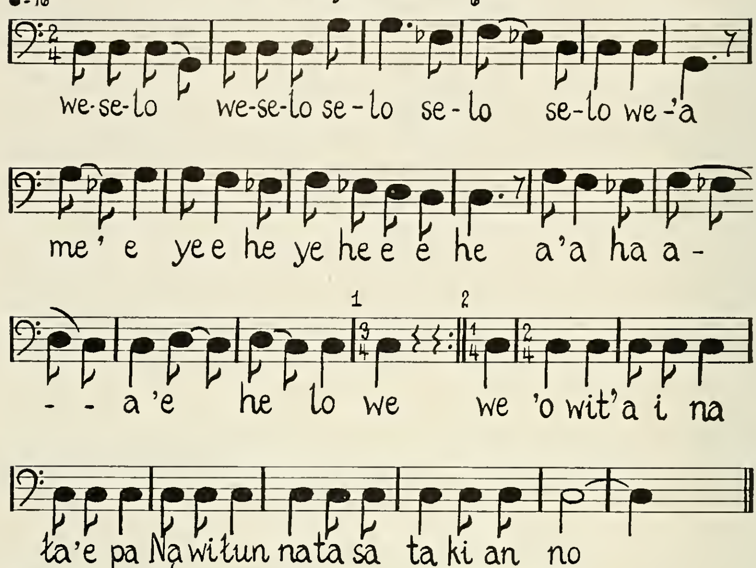
1 On the second repetition of the second score d (in parentheses) is substituted for the sixteenth note b, while in the fourth score f# is replaced by the dotted eighth and sixteenth notes, f# and a.

Song of the Elf in the Fire[1]

Old Giant Myth

Picuris Pueblo

Collected by J.P. Harrington.

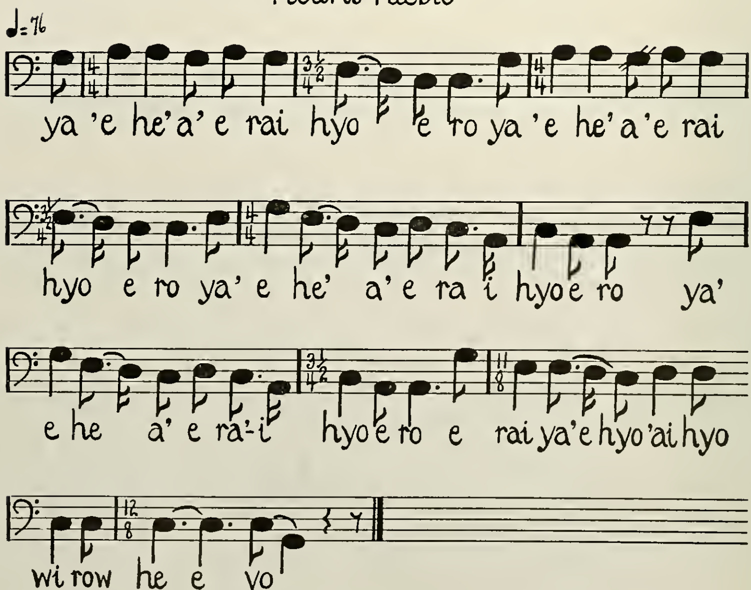


1 Reproduced by permission of the Bureau of American Ethnology.

Love Song of the Elf[1]

Magpie-Tail-Boy Myth

Picuris Pueblo



1 Reproduced by permission of the Bureau of American Ethnology.

However, except for the studies made by Doctor Fewkes and Doctor Gilman and the collections by Doctor Goddard, no systematic attempts have been made to study the songs of the Southwest. Doctor Fewkes's collections aim at revealing the character of Zuñi and Hopi music. Since songs composed for similar purposes, such as steps in ceremonial ritual, are apt to show similarities, specimens from different types of ceremonies would give a good general idea of the state of music of a particular tribe,

Lullaby

Zuñi Pueblo[1]

1 Reproduced by permission of Elsie Clews Parsons.

Zuñi Man's Grinding Song

Collected by Elsie Clews Parsons[1]

1 Reproduced by her permission.

while those belonging to any given ceremony would reveal stylistic similarities.

Doctor Gilman decided that Zuñi music[1] was subject to no restrictions of scale but that the songs were "the musical growths out of which scales are elaborated, and not compositions undertaken in conformity to norms of interval order already fixed in the consciousness of the singers. In this archaic stage of the art, scales are not formed, but forming." While Gilman critically analyzed the examples of Zuñi music from a structural as well as a melodic point of view, he seemed primarily interested in the scale possibilities, and did not go beyond indicating the divisions of the melodies. In Volume IV of the *Journal*, page 10, Fewkes, discussing the Hopi songs, says that many resemblances between Hopi and Zuñi music would be expected from the close relationships of the religious ceremonials of the two peoples.

[1]*Journal of American Archæology and Ethnology* Vol. 2, pt. II, p. 89.

Judging from the Apache ceremonial songs, the music of these people is exceedingly circumscribed, archaic, and generally monotonous, but such is apt to be the case with chant songs, and probably not all Apache music is so uninteresting. Certainly many pueblo melodies are strikingly beautiful despite their simple character. It is possible to give here only a few specimens of songs from our Southwest Indians, but these should make clear the desirability of collecting more of them before they are forgotten by the Indians themselves, for as Doctor Parsons says, this is one of the most important and neglected fields for the study of Indian music today.

Hopi Indians burlesquing Doctor Fewkes's work with the phonograph. The bearded individual is supposed to represent Doctor Fewkes. From *The American Anthropologist*, N. S. Vol. XII

Primitive Surgery

FIRST EVIDENCE OF TREPHINING IN THE SOUTHWEST

By H. L. SHAPIRO

Assistant Curator of Physical Anthropology, American Museum

ONE of the oldest of surgical operations is trephining or trepanning. Although Hippocrates, in the fourth century B.C., mentioned that trephining was of ancient origin, it was with considerable hesitation that scientists received the announcement by Pruniéres in 1872 of the discovery of Neolithic skulls with clear evidence of trephining. Shortly afterward Broca read a classic paper on "Prehistoric Trephining in Europe" which, by a masterly array of evidence, convinced anthropologists that Neolithic man, even with his crude, stone instruments, was already quite accustomed to trepan the skull. From then on an increasing amount of material was brought to light which conclusively showed that this practice was fairly common throughout all Europe during that remote time. Most of the cases, however, were confined to the Neolithic, and it seemed strange that this operation was rare during the succeeding epoch, the Bronze Age, when finer instruments were available. Pittard, however, has reported a skull from Sallanches dating from the Bronze Age, which has a healed opening made by trephining. Nevertheless, the number of Bronze Age trephined crania is still relatively few. This decline of Neolithic trephining may be significant in determining the motives involved during the Neolithic period.

In modern practice, trephining is performed in cases of trauma or injury to the bone. Great care must be exercised to prevent injury to the membranes surrounding the brain or to the brain itself. Even with the relatively skilled and aseptic procedure employed in the latter half of the nineteenth century, Bluhm reported a mortality rate of 50 per cent for 1000 cases of trephining. Where the operation was performed for epilepsy without antecedent traumatic conditions, the mortality was reduced to 20 per cent. From a study of trephining among the pre-historic Peruvians, Muniz and McGee were able to establish an approximate mortality of 50 per cent, which compares favorably with the high mortality found by Bluhm.

The modern technique consists in removing, with the aid of a circular saw called a trephine, a section from the skull. Various ingenious attempts have been made to determine the exact procedure used by the early Neolithic surgeons. From a careful study of the Neolithic trephinings themselves and the methods used by modern primitive people, it seems clear that there were three precedures employed. After folding back the skin and laying bare the skull, the desired section was marked out and removed by deep intersecting incisions. Another method, which appears to have been common in the Neolithic period, is by a process of scraping, which was a very much more laborious technique but one that may have been less liable to prove fatal as the result of too deep an incision. The operator, by scraping, would have constantly in view the exact stage of the operation. Finally, a third method, which seems to have some confirmation in the procedure used by the Kabyles of northern Africa, is one which consists of encircling the site to be removed with a series of drill holes which are joined together to free the circumscribed area from the surrounding tissue. In these methods the operation has been estimated to last approximately an hour. Frequently, the subject fainted from pain and loss of blood. The New Hebrideans are said to recover completely within two or three weeks after the operation.

In America the first case of prehistoric trephining was described in 1872 by Broca. The skull was discovered by Squier in a site not far from Cuzco in Peru. No sign of healing was evident and the marks of the instrument were very clear. Since then an innumerable amount of trephining has been reported from Peru, but only a few cases in the rest of America. In 1897 Hrdlicka published a paper on two trephined crania from Chihuahua, Mexico. Few unequivocal cases of trephining had been found, however, in America north of Mexico. Skulls from Michigan and Illinois have been reported with openings in the skull, but these have not exhibited the characteristic marks of trephining. In Ohio, Indian graves revealed trophy skulls with similar openings which were used for suspension. Smith, in 1924, reported two trephined skulls from the northwest coast.

As far as I am aware, the only evidence for prehistoric trephining in the Southwest of the United States is the two skulls described below. In 1923 two skulls of pre-Columbian age were discovered in New Mexico, on a Museum expedition, one by Earl H. Morris at Mitten Rock and the other by Louis R. Sullivan at Lamy. The Mitten Rock skull is shown in Fig. 1. The cranium shows extensive pathological lesions of long standing. Nodules and depressions cover the entire vault. The opening is roughly circular and includes most of the lower part of the right half of the frontal bone. The lower left-hand border of the opening has invaded the frontal sinus. Roughly, the opening is 50 mm. wide and about 40 mm. long, which is an unusually large one. There are no signs of repair and, considering the diseased nature of the skull, it seems plausible that the operation was performed to relieve a long established pathological condition. The right external angular process of the frontal bone shows what appear to be the marks of a former depression by its marked declination toward the trephining, indicating perhaps some preexisting abnormal condition which may well have been one of the causes for the operation. There are no marks of the instrument beyond the sharply defined edges of the opening itself. The bone appears to have been cut quite easily due to its diseased state. In an archæological site which is notable for the frequency of artificial flattening, it is of interest that this skull shows no indication of any deformation. This may possibly have arisen from the fact that special attention was given this individual whose pathological status appears to have been of very early origin. The site of operation is a dangerous one, and the invasion of the sinus indicates either inexperience or necessity, due to some condition situated in that area.

The second skull, Fig. 2, discovered by Sullivan at Lamy in New Mexico, is of great interest because of a number of factors. The skull itself is quite

TWO RECENTLY DISCOVERED EXAMPLES OF TREPHINING

Fig. 1.—A cranium found at Mitten Rock, New Mexico, by Earl H. Morris, during the course of excavations in 1923, showing trephining in frontal bone

Fig. 2.—A trephined skull discovered by Louis R. Sullivan in 1923 at Lamy, New Mexico. The borders of the opening are beveled and cicatrized

distinct from any of the others unearthed at this site. Its undeformed dolichocephaly is in pronounced contrast to the artificially deformed brachycephaly which characterizes this ruin, San Cristobal. The cranium was discovered at the bottom of the refuse heap in which most of the crania were found, and may point to an earlier inhabitant of this typical pueblo site. At any rate its general character is quite unlike the other San Cristobal crania. In this case the trephining is in the right parietal bone about 1cm. from the middle of the sagittal suture. The opening, roughly diamond-shaped, the long axis being directed posteriorly, is about 20 mm. The regularity of the opening and the beveled edges exhibit clearly the character of trephining. The borders of the opening show cicatrization, the cancellous tissue being entirely covered over by the growth of new and compact bone, and the inner table reveals under the glass several fine spicules of new bone growing into the opening. The seat of the opening is in the most frequently chosen site for primitive trephinings. No traces of a pathological condition were observable. Altogether this case is a clear document for pre-historic trephining in the Southwest with a recovery from the operation evidenced by the repair shown in the wound.

There have been many hypotheses proposed to account for the occurrence of this form of pre-historic surgery. Broca believed that the operation was performed to relieve epileptics from an evil genius or spirit, who escaped through the opening made in the skull. He attributed most of the trephinings to this superstition and dismissed fracture as a primary cause, since in most cases the trephining was performed on the parietal and not the frontal bone where most of the fractures would be likely to occur. In a monograph by Muniz and McGee the hypothesis is advanced that trephining had a thaumaturgic orgin and was not originally curative in function. At first the operation was post mortem to obtain amulets of superstitious value. Later the operation was performed for the same reason on living captives. Its curative powers, the authors assume, were observed by primitive surgeons who adopted the curative function as an additional reason for trephining.

Among modern people trephining has been reported among the Kabyles of northern Africa and in the South Seas. The Kabyles are said to be very adept at this operation, which they perform for traumatic lesions, vertigo, headaches, and other disorders. Crump found that in New Britain trephining was practised mainly as the result of injuries to the skull sustained during combats. In New Ireland he reported the operation to cure epilepsy and to relieve certain forms of insanity due to pressure on the brain. Ruffner says that trephining is also practised among the contemporary hill tribes of Daghestan, and among the Tahitians and Montenegrins.

The two skulls from the Southwest, referred to above, establish the fact that trephining was also known and practised in the United States during pre-historic times, thus increasing the distribution of this remarkable form of surgery.

Hydras as Enemies of Young Fishes

By E. W. GUDGER
Bibliographer and Associate in Ichthyology, American Museum

IN August, 1902, a sudden epidemic occurred among the black-spotted trout fry in the hatchery of the United States Fish Commission at Leadville, Colorado. Examination showed that the hatching troughs were divided into three compartments, and that the greatest mortality occurred in that division into which the water entered. It was somewhat less in the middle division, and practically negligible in the last. The water supply was seemingly pure, almost entirely devoid of sediment, and entirely normal in temperature. For some weeks the matter was quite a mystery. Then Prof. A. E. Beardsley of the department of biology of the Colorado State Normal School was called in to investigate the trouble.

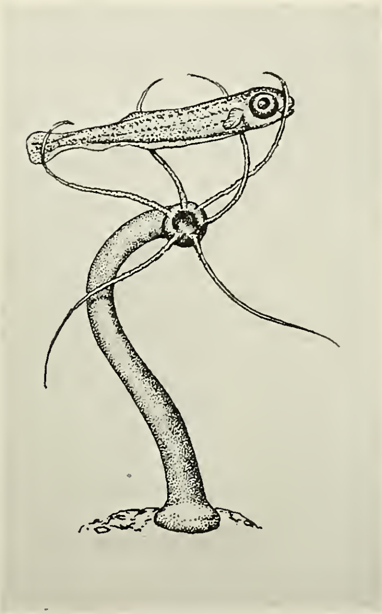


Fig. 1.—An enlarged figure showing a young fish caught in the tentacles of a hydra.

Figure drawn to illustrate the phenomenon described by Beardsley and Trembley

The interior of the hatchery was dimly lighted, but Beardsley, acting on a hint from one of the men who had seen something in a trough when a ray of sunlight fell on it, arranged a set of mirrors, with which he directed a beam of sunlight into one of the troughs. There he discovered the culprits—great numbers of very white and very transparent hydras were found covering the walls of the trough, hydras so colorless that in the somewhat twilighted interior of the hatchery they were entirely invisible. A careful count was made of various square inches of Division One of several troughs. This gave an average of 131 hydras per square inch, or 20 plus per square centimeter.

When I was a student assistant in the general biology course at Johns Hopkins University a good many years ago, there was a favorite pond in Druid Hill Park wherein I collected hydras. Here, on the wooden partitions which subdivided the pond into sections, they were found in great abundance, more thickly than anyone in the laboratory had ever seen them before —perhaps 6 or 8 to the square inch— but in nothing like the high concentration which Professor Beardsley found.

The Colorado hydras were 10 to 20 mm. in length, and 0.15 to 0.30 mm. in diameter—slender white organisms, fastened by the basal end to the walls or bottom of the trough, and having at the free end a mouthlike opening surrounded by 5 or 6 long, very slender, threadlike tentacles.

The whole body of a hydra is thickly set with peculiar stinging or poison cells called nematocysts (thread cells), and on the tentacles these are concen-

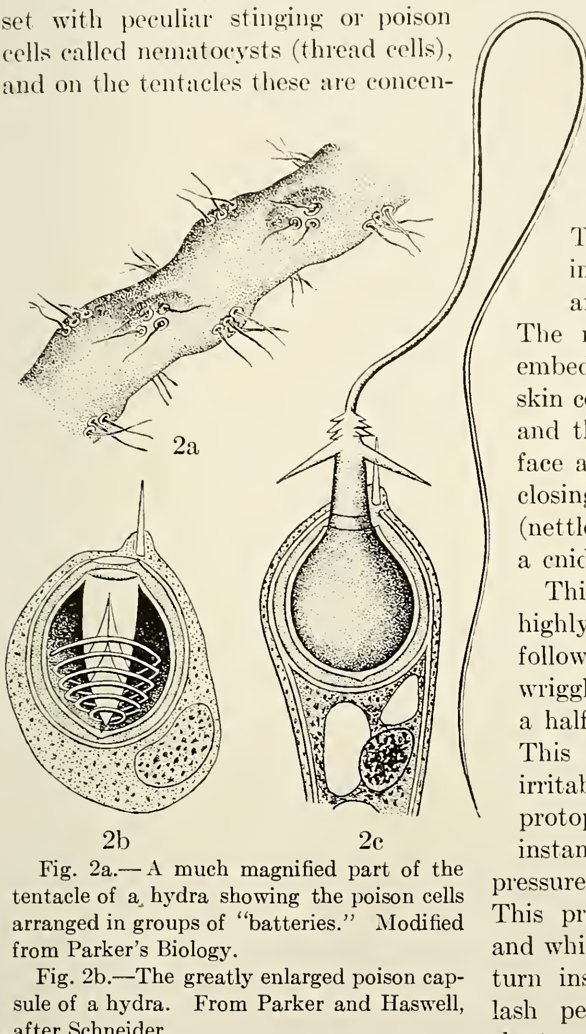


Fig. 2a.—A much magnified part of the tentacle of a hydra showing the poison cells arranged in groups of "batteries." Modified from Parker's Biology.

Fig. 2b.—The greatly enlarged poison capsule of a hydra. From Parker and Haswell, after Schneider.

Fig. 2c.—A much magnified poison capsule which has been thrown into action. From Parker and Haswell, after Schneider.

trated into regular batteries ready to be "touched off" by the first passing object which comes in contact with and irritates these cells. Figure 2a shows in enlarged form a part of a tentacle with some of these "batteries," the projecting hairs being the partly discharged nematocysts.

Fig. 2b shows a poison cell as it appears when normally at rest in the ectoderm or skin layer of cells in the body of the hydra. The thread cell or nematocyst consists of a hollow bag with a finger-like inpushing having spines at the base and terminating in an inverted, long, hollow, whiplash-like tube. The bag, the finger-like inpushing, and the hollow whiplash are filled with a virulent poison. The nematocyst or thread cell is embedded in a modified ectoderm or skin cell, which forms its "carriage," and this has projecting on the surface a hair or "trigger." The enclosing cell is called a cnidoblast (nettle bladder) and the "trigger" a cnidocil (nettle hair).

This somewhat complicated but highly efficient apparatus works as follows: The baby trout comes wriggling along and touches one or a half dozen of the trigger hairs. This calls into play the inherent irritability and contractility of the protoplasm of the cnidoblast and it instantly contracts sharply, putting pressure on the contained nematocyst. This practically explodes, the finger and whiplash part of the nematocyst turn inside out, and the tip of the lash penetrates the tender body of the troutlet and discharges the poison with which it is filled. Such an everted thread cell is portrayed in Fig. 2c. Moreover, not only do those cnidoblasts whose triggers are touched, contract, "go off" as it were, throwing out the thread cells, but the stimulation is communicated through the very rudimentary nervous system of the hydra to the neighboring cnidoblasts, and whole batteries explode at once, covering the baby fish with thread cells and paralyzing it completely. Figure 1 of this article shows such a baby fish paralyzed by the thread cells, grasped by the twining tentacles, and on its way to the mouth of the hydra.

To make absolutely sure that the hydras were the only cause of the high mortality of the baby fishes, Beardsley filled a number of glasses with water from the hatchery pipes. Into some he put troutlets by themselves, in others fishes and large numbers of hydras from the troughs. In the first glasses there was only the normal mortality usual in hatching fish, but in the others there was a heavy death rate due to the activities of the hydras. In fact Beardsley found that 25 per cent of the baby trouts were killed by the hydras in less than 30 minutes, 60 per cent in 45 minutes, 80 per cent in 60 minutes, and 100 per cent in 75 minutes. Examination with a lens showed hydras attached by their mouths to the surface of the fishes—in some cases as many as a dozen were so attached. Low mortality was shown among the fishes in the glasses filled with water from the trough without hydras, and the remaining fry in the clean hatching trough were in good health at the end of twenty-four hours.

No other cause for this wholesale mortality being discovered, Beardsley correctly concluded that the hydras were the culprits. Search was then made for the origin of these hydras in all the sources of water supply. All were found free of hydras save one small pond along whose shallow borders aquatic vegetation was thickly clustered. Innumerable hydras were attached to the submerged parts of these stems and leaves, as well as to the sticks and stones lying on the bottom of the pond.

Thinking that he had discovered a phenomenon not merely interesting but absolutely new, Beardsley wrote and published an article, "The Destruction of Trout Fry by Hydra," in the Bulletin of the United States Fish Commission for 1902, Washington, 1904, Vol. 22, pp. 157–160. That his discovery was extremely interesting is undoubted, but that it was not new will be seen later in this article.

In 1905, there appeared in *Allgemeine Fischerei Zeitung* a notice of Beardsley's article signed "Dr. Pl." This was seen by one A. Schuberg[1], who seems to have been a German trout grower. In a later issue of the same journal for 1905, Schuberg refers to Beardsley's article and recounts his own experiences which antedated Beardsley's studies. In a little pond well stocked with duckweed (*Lemna*), he was growing young trout 30 or 40 mm. long. A progressive destruction of these fish went on. He examined both fresh and preserved fish and found on their bodies, but especially on their fins, very many of the nematocysts or nettle threads described and figured above. Examination of the duckweed in the pond showed great numbers of the brown hydra (*Hydra fusca*). These were judged to be the authors of the mischief, and an attempt was made to clear the pond of both *Lemna* and hydras.

Just here an interesting bit of corroboratory evidence may be introduced from the neighboring and closely related class of animals, the Amphibia—the tadpoles of which are the fish stage of their evolutionary life history. In 1911 there appeared from the pen of William West a note, entitled "*Hydra vulgaris* and the tadpoles of *Rana temporaria*" (*Naturalist*, London, No.

[1]Schuberg, A. Süsswasserpolypen als Forellenfeinde. Allgemeine Fischerei Zeitung 1905, Vol. 30, pp. 31–32, 201–203.

655, p. 301), in which he writes as follows:

In our biological laboratory it is a common thing to watch Hydra catch species of *Daphnia*, *Cypris* and *Cyclops*. I have even seen them gorged with the large red larva of *Chironomus plumosus*, the *Hydra*, when distended, only having room for half of it! (I have a *Scyllium canicula* with the hinder part of a fish in its stomach and gullet, and the other half projecting from its mouth). This Spring I had a fine lot of *Hydra vulgaris* in several large aquaria, and as I had previously had some batches of frog's eggs developing, I placed some of them, when about a fortnight old, in the various aquaria, some being three or more weeks old in later experiments. On looking a few hours later, I was astonished to see several of the tadpoles held fast to the sides of the aquarium, they kept now and then struggling to escape, and if any succeeded in doing so, which was seldom the case, they invariably succumbed eventually. These experiments were eagerly repeated by a number of students. . . . The tadpoles were paralyzed, they were too large to be engulphed, and they finally sank to the bottom, and did not reappear. In all the other aquaria where *Hydra* was absent, the tadpoles lived.

However, long before either Schuberg or Beardsley, 160 years in fact, Abraham Trembley, the Father of "Hydraology" (the study of hydras), had in 1744 described their method of catching little fishes. He left little for us to learn about the behavior of hydras. His account, entombed in his great monograph on the hydras,[1] seems not to be known. It is well worthy of reproduction herein *literatim et verbatim*. He says:

Having taken in the month of June, 1743, a considerable number of little fishes about four lines long [about four twelfths of an inch or eight millimeters long], the first use that I made of them was to see if the polyps would eat them.

I placed several of them in vessels where I had some polyps. The experiment very soon apprised me of what I had surmised, that is that the vivacity and energy of these little fishes gave them power to offer a sharp resistance, but I ventured to flatter myself that the polyps would soon put an end to this by catching them. The Gardons [young roaches] (this is the species of fish to which I refer), the Gardons, in swimming about, soon encountered the tentacles of the polyps, and this then was the beginning of the combats which indeed were not all finished in the same fashion.

When the fish would encounter only one arm of the polyp, it ordinarily happened that it disengaged itself by a lively jerk; and it would sometimes even break off the tentacle which endeavored to hold it captive and would carry this part off with it. However, the combat would end less happily for the little fish when it would be caught by several arms at once. The efforts which it would then make to set itself free would for the most part be useless, and would often bring it about that it would become even more closely entangled in the tentacles of its enemy. It could be easily seen that the polyp was making great efforts to hold fast to the fish. The arms which enveloped it on all sides would become very much swollen [and shorter], but they came to the fish a few at a time and only when it made great efforts. Then they were vigorously wrapped around the fish—in a word that which Ovid says of the marine polyp [i.e., *poulpe*, Octopus?] would perfectly apply to the fresh water polyps under study here. One would think that it is the latter of which the poet speaks when he says, "And thus under the water the polyp with its tentacles outthrown from all sides holds its submerged prey."

When I saw a polyp which had arrested a fish and had brought it to its mouth, I wondered whether it would be entirely possible for it to swallow the fish which was four lines long and proportionally thick and which would not bend itself to fit itself comfortably in the body of the polyp. The polyp, which had undertaken to do the swallowing, having been obliged to contract itself because of the shocks which the fish had given it in its struggles, was now not longer than 2 or 3 lines. In spite of all this the greater number of polyps which had caught Gardons had put an end to the swallowing. When a long-armed polyp had

[1]Trembley, Abraham. Mêmoires pour Servir à l'Histoire d'un Genre de Polypes d'Eau Douce à Bras en Forme de Cornes. Leide, 1744. pp. 213-217, pl. VII, fig. 3. An English version (not seen and thought to be abbreviated) by George Adams was issued in London, 1746: a German translation by J. A. E. Goerze was published at Quedlinburg, 1775 and 1791.

swallowed a fish, that narrow part of its stomach which forms the tail end would be compelled to expand and receive a part of the prey. A polyp which had swallowed a fish was difficult to recognize. Let us suppose, for example, that it had swallowed it tail first, one would then see the contracted tentacles around the head of the fish. This is that which would appear the better. The skin of the polyp would be stretched so tightly and applied so closely to that of the Gardon that one could distinctly see the fish through it, so that if one had not known it to be there one would have thought that he only saw a fish which had at the anterior extremity barbels some lines in length.

This little fish would then occupy the entire length of the body [cavity] of the polyp whose skin was then very thin, wherein in the meantime it was undergoing digestion. It did not remain alive more than a quarter of an hour. After it had been subjected to the action of the digestive juice and had been returned by way of the mouth of the polyp, it was actually recognizable but nevertheless very much disfigured. This is what I have seen a considerable number of times.

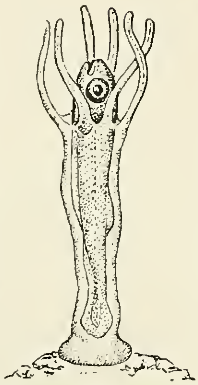


Fig. 3—The little fish has been swallowed tail first by the hydra. The body of the hydra has shortened greatly in order to expand sufficiently in width to engulf the small fish. Note how the tentacles have also shortened and thickened. Drawn (greatly magnified) from Trembley's description

Plate VII, Fig. 5, in Trembley's book is supposed to show this, but the figure is so small and so dark that I have not been able to make anything out of it—even with the use of a magnifying glass. The same is true of the figure in the German version (1791) which I have examined. However, the accompanying excellent figures by Mr. William E. Belanske have been made under the present writer's supervision to show, in Fig. 1, how the fishlet is caught, and in Fig. 3 how it has been swallowed tail first and is undergoing digestion. The purpose of the figures is to portray visibly what Trembley described 183 years ago. Furthermore, an effort has been made to keep the relative sizes of fish and hydra within the limits set by Beardsley and Trembley, though of course these and the other figures are much enlarged.

From the above accounts, particularly Trembley's, one may quote the author of Ecclesiastes that there is nothing new under the sun.

From the original painting by Ts. Holmboe, from which the 1925 Norwegian Government stamp issue was made to raise funds for the Expedition

North to 88 and the First Crossing of the Polar Sea[1]

By LINCOLN ELLSWORTH

"When one goes forth a-voyaging
He has a tale to tell."

HOW often one hears the remark "Now you can rest on your honors." But what a fallacy! For honors are and ever should be but an urge to greater effort. Perhaps it is better that we should never be content, for happiness, says an old lesson, lies rather in achievement than in possession or satiation. Without effort there can be no achievement, and without achievement life would not be worth while. Action is life, and what is life but a groping toward knowledge and consciousness and "more light?" Our struggles and our sufferings, our ambitions and our defeats, our yearnings to be better and stronger than we are, are but the voice of that vital urge from within which makes us grow, and which transforms this wandering planet on which we live into a theater of unending achievement.

In its desire to honor us I feel quite certain that the American Museum of Natural History is unaware of just how deeply I feel its debtor for what I myself have done, for here, in this very Museum, came my first urge to go into the Arctic. The vividly colored allegorical paintings in the Museum halls—scenes of life taken from those faraway people living on the shores of the Polar Sea—stirred my imagination. A gaunt land. A waste of cold, of storm, of drought. What was the attraction, wherein the fascination? Just why or how would be difficult to explain. One cannot always analyze a taste or a

[1]From an address made at a meeting held at the American Museum on January 2, 1927, commemorating the first crossing of the Polar Sea.

Into the unknown,—just before landing at Latitude 88°, 120 miles from the North Pole

passion, but I know these filled me with dreams that would not let me be.

There, too, were the sledges that had reached the North and the South poles. How it thrilled me to trace their journeys on the relief maps on the walls above them, stage by stage until the goal was reached—a goal that had acted as the motive-force for some of the most wonderful journeys in the face of terrible conditions, in the history of our race, and which, I thought, had cast more men in heroic mold than ever the glitter of the crown or the flash of the sword. The world needs heroes. They are the salt of youth. And out of the salt of youth comes the iron of mature manhood that tempers the will for the conquest of difficulties. But a boy's will is the wind's will, and the thoughts of youth are long, long thoughts. Beyond the "last frontier" —beyond even the outermost edge of discovery, toward that huge tract in the Polar Sea marked "Unexplored," lay my dreams! But how should I follow to that land of far horizons?

It is strange how often big ambitions of life find realization from very small happenings. A chance acquaintance, an item in a newspaper, may prove to have been turning-points in life if you take the trouble to trace things back to their beginnings. Take my own case. I am certain I never should have gone to the Arctic had I not seen a small news-item buried inside one of our dailies, telling of Captain Amundsen's arrival in America on a lecture tour. This was in October, 1924. I was all packed ready to start for south America, in fact, I had my ticket bought—but the result of a chance meeting changed my plans and instead of South America I went to the North Pole. How much I owe to Roald Amundsen! Through him the opportunity came to me, and the two years of our association and companionship together have been the happiest of my life.

It had always been Amundsen's wish to fly to the North Pole, and there if possible, abandon one plane in order to

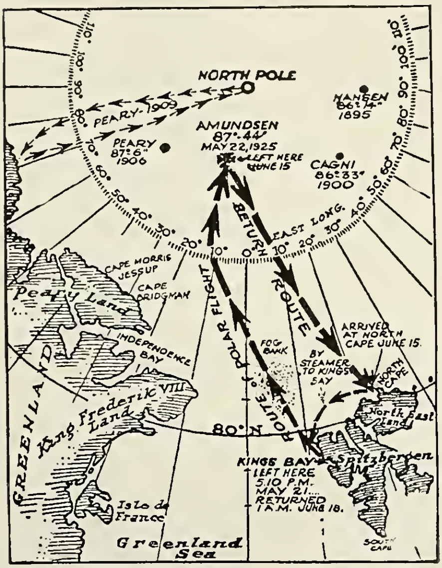
Top.—A forced landing 120 miles from the North Pole, where we lived 25 days.

Left center.—Semaphoring during the first five days of enforced separation of the two planes

Right center.—Our only implements,—3 wooden shovels, sheath knives tied to skii sticks, and a two-pound belt ax. From left to right, Ellsworth, Amundsen, Riise-Larson, and Feucht

Bottom.—"Where faith abides though hope be put to flight."

refuel the other from her, and with the remaining plane go on to Point Barrow, Alaska. Because the interest of us both lay, not in the attainment of the Pole—Peary having already been there—but the exploration of that great million



From the New York World

Amundsen-Ellsworth 1925 Polar flight

square miles of unknown Polar Basin beyond, we took this into consideration in planning our 1925 flight from Spitzbergen with two aëroplanes.

The story of the flight over the Polar Sea to within 120 nautical miles of the Pole has already been told. After a journey lasting eight hours, the time estimated to bring us to the Pole, we came down into the first open "lead" big enough for our planes to land in to take an observation as to our exact whereabouts, for we had been heavily drifted to the westward by a strong northeast wind, and our fuel was just half consumed. We found ourselves in latitude 87.44 N. and longitude 10.20 W. Thus, while we had flown 600 miles—the exact distance of the Pole from Spitzbergen—our drift of 50 miles off our course was responsible for our loss in latitude and the fuel necessary to carry us to the Pole.

Before we could get out the lead closed up, and it required twenty-five days of hard labor to free one of our imprisoned planes. The mournful sound of the wind blowing through its rigging made us quick to seek shelter in its interior after our long day's labor of clearing. Although our four-walled compartment was of metal and heavily coated with hoarfrost, it shut out the damp, fog-bound waste in which we were but mites, a colorless waste that seemed to reach into infinity. The scanty heat from the "Primus" together with that given out by our bodies, was sufficient to raise the temperature above freezing. The hoarfrost, melting, dripped down our necks and spattered into our mugs of chocolate, but nothing could dampen our spirits, not even the fact that Riiser-Larsen's stock of black chewing tobacco, which we were now smoking, was fast diminishing, for was not the thought of the warm sleeping-bag and the ration of malted-milk tablets to munch contentedly as we dozed off to sleep and forgetfulness, that of Heaven itself? I never knew the real feelings of my companions, for whatever conversation there was as we sat over our chocolate, was mostly in Norwegian, but I learned to accept with abiding faith what each day offered. Spitsbergen was but eight hours away; maybe tomorrow we would be on the way! Thus passed twenty-four days, but on the twenty-fifth,—the day we had actually set two weeks previously, to start on foot for the Greenland coast, 400 miles away, but which we knew we couldn't reach,—our efforts were rewarded, and one plane, with six men in it, rose, and left that hell forever.

Returning to meet the King at Oslo, July 5, 1925

Return of Expedition to King's Bay, June 19, 1925, 1:30 A. M. Left to right—Riiser-Larsen, Undal, Dietrichsen, Amundsen, Ellsworth, Feucht

Saying good-bye May 11, 1926, 8:55 A. M.

The Norge rising out of her hangar at 8:55 A. M., May 11, 1926

This, in short, is the history of the flight itself. The scientific results, from an expedition that cost $150,000, consisted in the exploration of 120,000 square miles of hitherto unknown region and the taking of two soundings which showed the depth of the Polar Basin at that latitude to be 12,000

The Norge on her way. Photograph taken from Byrd's plane by Russell D. Owen

feet, thus precluding the likelihood of any land on the European side of the North Pole. But we had had our compensations; we had blazed a trail; for the flight had shown that the meteorological conditions prevailing over the Polar Basin offered no hindrance to its successful exploration by means of the proper kind of aircraft. Thus, while the pioneer may not share in the world's wealth, to him comes a joy but dimly perceived by those who merely profit thereby.

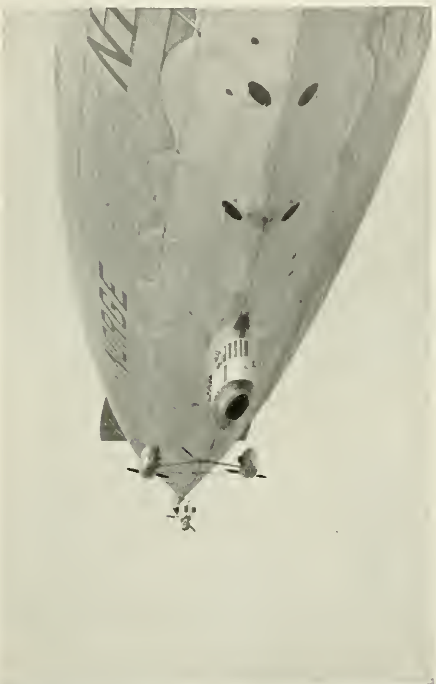
One would naturally think after such an experience that we had had enough. But no, our work was not yet finished. Beyond—to the northward—still stretched the unknown. Between the Pole and Alaska lay what? Mystery—a mystery as luminous, and yet as impenetrable as its own mirage, enveloped an area twice that of Alaska.

After our experience with airplanes we decided to buy an airship, and we went to Italy because Mussolini had one that appeared to fit both our needs and the size of our purse.

The N.1, built to the designs of Col. Umberto Nobile in the Italian State Airship Factory, and christened by us the "Norge," was of semi-rigid construction, 349 feet long and of 20 tons displacement. Her fuel capacity of 7 tons, with which to run her three 250 horse-power Myback motors, gave her a range of 3500 miles, or about 70 hours, at a speed of 50 miles per hour. Her gas capacity of 660,000 cubic feet was about ⅓ that of R.33.

The "Norge" was equipped with a Marconi wireless direction finder, the tuning-circuit for which was designed to cover a wide band of wave lengths; those used ranged from 900 to 1400 meters. The energy for the specially constructed valve transmitter was delivered from a windmill-driven generator supplying 3000 volts.

There was a delay of several days after the long flight from Italy to Spitzbergen, before the "Norge" was able to proceed on her journey across the Polar Sea. Favorable weather conditions were essential. We needed a clear sky with good visibility, and a favorable wind; also a high barometric pressure and a low temperature. These last two elements influenced greatly the lifting capacity of the dirigible. For each degree Fahrenheit that the temperature went down, the airship gained 80 pounds in lifting capacity, which was increased by 140 pounds for each tenth of an inch added to the barometric pressure.



The keel of the "Norge" looked like a flying store-house when all was ready for the start at 8.55 o'clock on the morning of May 11, 1926. The equipment included tents, sleeping-bags, skiis, snow-shoes for those who couldn't ski, rifles, shot-guns, ammunition, a hand-sledge—the finest piece of workmanship I ever saw—made by Oskar Wisting on the "Maud," and a b canvas boat. Two men among the personnel, Amundsen and Wisting, had the distinction of having been at the South Pole, and now both were en route for the North Pole.

Provisions consisted of pemmican, chocolate, oat biscuits, and dry milk, sufficient to last 16 men two months, with a daily ration of 500 grams for each man.

On the walls of the cabin hung the pictures of Norway's King and Queen,

Mystery, silence, desolation

presented to the "Fram" on the expedition to the South Pole in 1910; an image of the Madonna which the Italians had brought with them; and a four-leaf clover given to the ship by Major Scott, who piloted the British airship R. 34 across the Atlantic. In the keel hung the flags of Norway, the United States, and Italy, to be dropped on the North Pole.

To those who made the first crossing of the Polar Sea it will ever be "life's great adventure," for in all human experience never before has man traveled so fast and so far into the realm of the unknown. There is an indefinable something about such an experience, where illusion and reality are so hauntingly intermingled, that ever after it may well color one's whole sentiment of existence.

Two hours after leaving King's Bay we found ourselves over the "pack-ice." What weather! The sun shone brilliantly out of a sky of pure turquoise, and the whalelike shadow that our airship cast beneath us trailed monotonously across a glittering snow-field, unbroken, save where wind and tide had rift the icy surface into cracks and leads of open water. Three white whales darted under the protecting shelf of an ice-floe, and polar bear, frightened at the sight and noise of the weird monster that took to the air instead of the sea, dived into the sheltering leads, sending up columns of spray that reflected the bright sunshine.

As we approached latitude 83½ the snow-crowned peaks of Spitzbergen merged into the deepening blue of the southern sky, losing their identity, and all signs of life vanished. Intermittent fogs rolling beneath us like a great woolen ocean, hid the ice from our view. Approaching 88 we had to rise from 1800 feet to more than 3000 in order to get over it. Latitude 87.44,—what memories! The motors were slowed down in commemoration of our sojourn there the year previous, although we were passing the exact spot 50 miles to the eastward. In this latitude, during the summer months, it is difficult to separate days and nights, for the sun swings around the horizon at practically the same altitude during the entire twenty-four hours But our Greenwich chronometer told us we had been out 16½ hours, so the time was really 1.30 A.M. May 12. The fog had completely cleared away and there was no wind. The navigator who had been on his knees at one of the starboard windows since 1.10 with his sextant set on the height and declination the sun should have at the Pole, corresponding to the given date, suddenly announced, "Here we are!" as the sun's image started to cover his sextant bubble. We were over the North Pole! With motors throttled and heads uncovered we descended to within 300 feet of the ice and dropped three flags.

At 12.30 A.M., forty nautical miles before reaching the Pole—a radiogram was handed me, which read "Passing into your 46th birthday and another hemisphere, we send you our heartiest congratulations." It was signed "Your friends of Spitzbergen." My health was drunk in cold tea for which I used Amundsen's South Pole mug marked "Fram 11-12-1911." But as the time goes back one day in passing from one hemisphere to another, "it looked," as I remarked in my diary, "as though I might get another celebration to-morrow."

"There is no more evanescent quality in an accomplished fact," says Conrad, "than its wonderfulness." Solicited incessantly by the considerations affect-

FIRST MESSAGE EVER RECEIVED FROM THE NORTH POLE

By FREDRIK RAMM.

New York Times Correspondent Aboard the Norge.

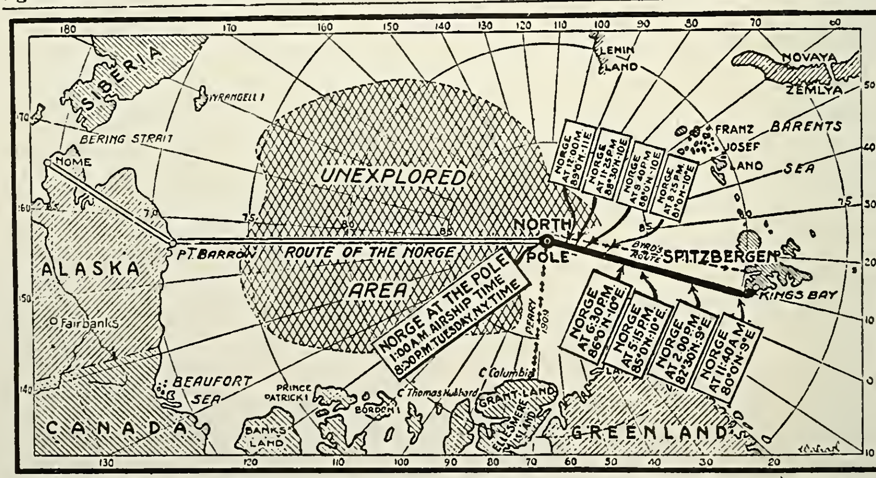
By Wireless to The New York Times.

NORTH POLE, Wednesday, May 12, 1 A. M. (on Board the Dirigible Airship Norge)--We reached the North Pole at 1 A. M. today, and lowered flags for Amundsen, Ellsworth, and Nobile.

LATER, 3.30 A. M.--Lowering the three flags, Norwegian, American and Italian, when the Norge was over the North Pole, was the greatest of all events of this flight. Riiser-Larsen's observations showed that we were over the Pole. The Norge descended and speed was reduced, when the flags were lowered over the wastes whose edges gleamed like gold in the pale sunlight, breaking through the fog which surrounded us.

Roald Amundsen first lowered the Norwegian flag. Then Ellsworth the Stars and Stripes; finally Nobile the Italian flag.

The airship's 1 A. M. time (Norwegian time), was 8 o'clock on Tuesday night, New York daylight time.



PROGRESS OF THE NORGE AND HER PROJECTED ROUTE ONWARD TO ALASKA

REPRODUCED FROM THE NEW YORK TIMES OF WEDNESDAY, MAY 12, 1926.

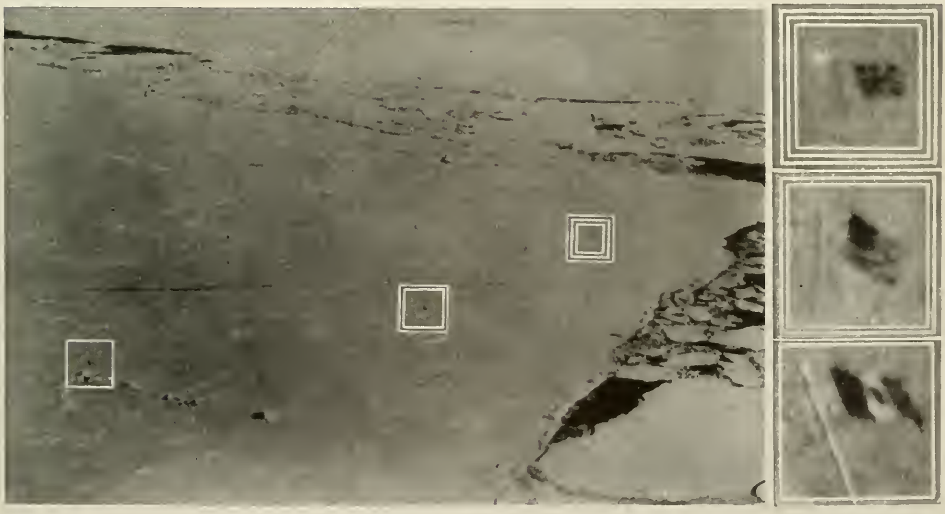
ing its fears and desires, the human mind turns naturally away from the marvelous side of events. And it was in the most natural way possible that, after crossing the Pole, we filled our mugs with meat-balls immersed in a liquid of hot grease, from a large thermos cask, and, squatting down anywhere out of the way of trampling feet, devoured the first and only hot meal of our entire voyage from Spitzbergen to Alaska.

With full speed ahead we settled down to the monotony of routine again, heading southward instead of north, with the sun-compass settled for Point Barrow, Alaska, 1500 miles away. Ahead lay the world's biggest unexplored area. What would it reveal, a lost continent, islands, or what? Would we cross safely to tell the world what we had seen? Although we were without sleep, these questions animated every man aboard to a state of constant watchfulness and expectancy. Hour after hour passed, but only the same glittering surface rift by wind and tide into cracks and leads of open water, was here as before crossing our route, in a west-east direction. We reached the "Ice-Pole" at 7 A.M., five and one-half hours later. This "Ice-Pole," so called because it is the center of the Arctic ice-mass and therefore the most nearly inaccessible spot in the Arctic regions, lies in latitude 86 N. and longitude 157 W. But its inaccessibility was now conquered, and the sixteen men looking down upon the chaos of broken ice-fields and pressure ridges of upturned ice-blocks that appeared as though giants had waged war with the Polar-ice, agreed as to its accessibility by means of air craft only.

We had covered one half the distance between King's Bay and Point Barrow. Of the seven tons of fuel the ship carried, only about two tons had been consumed. Here, strange to say, we picked up the first sign of life since leaving 83½ (almost 700 miles) one lone Polar bear track. What a challenge! What a mockery to our egotism! Yet there it was, plainly crossing a large ice-floe. Only a Polar bear, but something alive and like ourselves seeking—but what, away out here?

A typical view from the Norge—what we saw for 72 hours

Anyway, it was something tangible again. The sense of utter solitude—the illusion of disembodiment—that had taken possession of me, as I seemed



The North Pole!

The Fascination of the Unknown. Upper left—fringe of the "Polar Pack." Middle—the only big "lead" seen on the voyage. Lower left—vicinity of the North Pole

to float through the void like a lost soul, beyond the confines of a three-dimensional world, vanished, and in its place sprang eternal hope and the desire to achieve.

Just ahead, so it seemed, lay Alaska, the goal of our dreams. "A little more, yet how far it was; a little less, but what worlds away." But as we approached its coast, fears assailed us; for we ran into the only storm during our entire voyage—fog, wind, and sleet—and for thirty-one hours we battled. In flying, as in life, it is not what we see, but what we cannot see, that we fear. Each moment held not only something new, but something unforeseeable. Ice coated the aërial wire and froze the windmill driver of our generator, which supplied the electrical energy to operate the transmitter and charge the storage batteries, and all efforts to establish communication with Alaska were of no avail. The last report from Alaska, before the wireless ceased to work, showed a cyclone that seemed to be stationary over Bering Sea.

Ice-crust formed on the bow of the ship. This was alarming, not only because it loaded her down, but also because it spoiled her trimming. We tried to counteract the effect by moving the fuel from the bow tanks and sending the crew aft. Needless to say, our greatest danger lay in the ice that was torn loose from the sides of the ship by the whirling propellers and thrown against the gas bags. An ice-block of the most fantastic shape settled on the sun compass, stopping the clockwork and putting it out of action for the rest of the flight. It was a surprise, therefore, to find by observation at 4 A.M. on May 13, that we were in a nearly north-south position on a line striking the Alaskan coast and passing only twenty-one nautical miles west of Point Barrow, because it had been nearly twelve hours since the last longitude observation. At 6.45 A.M. land was sighted ahead on the port bow, and at 7.25 after a voyage lasting 48 hours, we reached the coast. Flat and snow-covered, it was the most desolate looking coast line imaginable, but it was land and that was enough.

In the rigging of the Norge. Showing flags and emergency rations

Taking observations for atmospheric electricity

As we passed over the coast line the fog became denser and denser, obliging us to go lower and lower in order to be

First land after 2000 miles—the coast of Alaska

able to see far enough ahead so that we would not run against obstacles. At last, abreast of Cape Beaufort, it became impossible to see any longer, and we rose through fog and cloud into bright sunshine. Heavy layers of fog drifted beneath us, and only now and then through openings in it could we glimpse the barren peaks of the Endicott range, over which we were passing —far too little to enable us to make out our whereabouts.

Her work finished—the Norge deflated at Teller

When we believed ourselves as far south as we could go, we tried to get down underneath the fog and do our best to find the way. We had to nose down to an elevation of only three hundred feet before we could see what lay beneath. We were over drift-ice again. Where were we? Unreal as it may seem, our wireless picked up a strong signal at this moment, which we thought might be Nome but we could not tell for certain, because it was a communication with another station and we couldn't get the signature. But it gave us a position north of Diomede Island and enabled us to set a course for Cape Prince of Wales.

Very soon we were over open water which aroused our suspicions, for we might just as well be on the outside of Bering Strait and, with our course, heading straight for the Aleutian Islands. Getting into sunshine again we were obliged to take our observation from the top of the ship, as the sun at this latitude was so high that it was hidden by the envelope in whichever direction the ship pointed. The observation gave our latitude as 67.30. We then went down through the clouds and found ourselves over land, having passed over the whole of Kotzebue Bay, driven by a northerly gale of more than 70 miles per hour. Heading west to get to the sea again, we heard the Nome wireless, which together with the identification of the coast line, gave us our exact position. At 3.30 on the morning of May 14, we rounded Cape Prince of Wales, and, tired but happy, brought our airship, coated with a ton of ice, safely to rest at the little trading post of Teller, 91 miles northwest of Nome, after a journey of 3393 miles, lasting seventy-two hours, across the Polar Sea from Europe to America.

I have told the story of the flight itself, but there are no words with which to describe the lure of that far-flung, strangely beautiful world of glittering white, lying beyond the rim of the Polar Sea, over which we flew; that can reveal its mystery, its melancholy, and its charm. And so, the first Transpolar Flight passes into history, but the trail it blazed, approximating 120,000 square miles in area, through the world's largest unexplored region, will ever be remembered as a romantic epic of advancing knowledge in man's conquest of the "Unknown."

The answer to the mythical "continent" theory,—after four generations of Arctic exploration

CHARLES SPRAGUE SARGENT

From a photograph taken about 1890 when he was 49 years of age. Courtesy of Prof. Ernest H. Wilson, Arnold Arboretum

Charles Sprague Sargent

BORN APRIL 21, 1841; DIED MARCH 22, 1927

By FREDERIC A. LUCAS
Honorary Director, American Museum

THE recent death of Charles Sprague Sargent brings to a close a long and active career, a career marked by many notable achievements. His activities began in 1861 when, shortly after graduating from Harvard, he joined the U. S. Army, in which he served during the Civil War, rising to the rank of brevet-major.

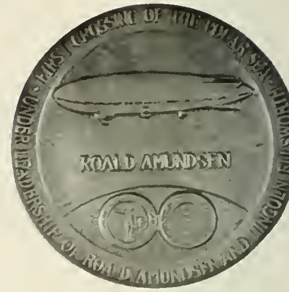
After devoting some years to study and travel, he was, in 1873, appointed director of the newly established Arnold Arboretum, a position he held until his death. He was also director of the Harvard Botanic Garden from 1872 to 1879, and from 1879 professor of arboriculture at Harvard. The Arnold Arboretum was made possible by the bequest of Mr. James Arnold, of New Bedford, who died in 1868, leaving the sum of $100,000 to be devoted to the advancement of agriculture or horticulture. Acting upon the advice of Mr. George B. Emerson, one of the trustees of the fund, this sum was turned over to the President and Fellows of Harvard University, who on their part set aside 120 acres of the land given by Benjamin Bussey on which to develop and maintain an arboretum. Subsequent additions doubled the size of the original tract and on the 240 acres have been gathered a large proportion of trees and shrubs, both native and foreign, that have been found able to support the climate of eastern Massachusetts.

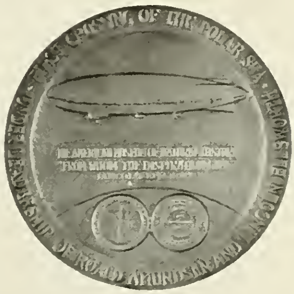
In 1879 he was appointed Special Agent of the Tenth Census, to gather statistics in regard to our forest resources, and the results of his studies were published in 1884 as Vol. IX of the Tenth Census Publications, *Report on the Forests of North America*. It was in connection with his work on the Tenth Census that he brought together the Jesup Collection of Trees of North America, which is not only a monument to Mr. Jesup, but a testimonial of the energy and thoroughness of Sargent As visitors know, this consists of sections of trees, the lower part being left in its natural state, with the bark and upper so cut as to show the grain of the wood. Many of them are of an age and size that could not now be duplicated. The sections of trees were supplemented by many water-color drawings of the leaves, flowers, and fruit of the respective kinds. These drawings were made by his wife, Mrs. Mary Robeson Sargent, who was an accomplished artist. Of late years the improvement in methods of reproducing flowers and foliage has made possible the introduction of many beautiful copies of flowering sprays and leaves.

Sargent's greatest literary work is the monumental *Silva of North America*, in which are described and figured practically all the then known trees north of Mexico. The first of the fourteen imperial quarto volumes appeared in 1891,—the last in 1902. That the work was completed in this time reflects great credit upon both author and publishers. Better known, because more generally used, is his *Manual of the Trees of North America*, in which are described 717 species, besides numerous varieties. He was also the author of many shorter papers, from 1888 to 1897 was editor of *Garden and Forest*, and, besides his work on American forests, was the author of *Forest Flora of Japan*.

In his will Sargent left to the Arnold Aboretum his fine library of botanical works, with provision for its continuance and increase. He also bequeathed to the President and Fellows of Harvard College $10,000 to which the interest should be added annually for a hundred years, the sum thus formed to be added to the endowment fund of the Arboretum. Thus he made provision that the work in which he stood preëminent and to which he devoted a lifetime should live after him.

Commemorating the First Crossing of the Polar Sea





CAPTAIN ROALD AMUNDSEN and LINCOLN ELLSWORTH were the guests of honor at the American Museum of Natural History on the night of January 21, 1927, when the American Scenic and Historic Preservation Society and the American Museum commemorated the First Trans-Polar Fight of May 11–13, 1926, by presenting medals to these two distinguished explorers. Dr. George Frederick Kunz, president of the American Scenic and Historic Preservation Society, was in charge of the presentation ceremonies. After formally opening the meeting, he said:

"The greatest problems for many centuries and the goals of all great explorers have been the North Pole, the South Pole, and the Northwest Passage. Peary discovered the North Pole, Byrd visited the North Pole, but no one except Roald Amundsen and Lincoln Ellsworth completed the crossing and investigation of the great unknown Polar Basin lying between the Pole and Alaska, after so many generations of effort to learn its secrets.

Only one man can make claim to three such great achievements as the Northwest Passage, the South Pole, and the North Pole and the crossing of the Polar Sea, and him we honor tonight. These were no dashes. To my knowledge it has taken him thirty-five years of the most careful research and study to accomplish these, and the achievement was worthy of the blood that impelled Lief Ericson to discover the American continent, and the many Norsemen who knew and loved the sea. The only element that Amundsen ever lacked was fear—he had no fear. If there were difficulties, he overcame them.

Peary reached the North Pole on foot, but he always advocated the air as the only means for the successful exploration of the Polar Basin; which brings to my mind that as early as 1885 Commander Cheyne of the British Navy interested me so that plans for a trip were almost completed by which we were to take two dirigibles to the Pole, storing one with gas and returning with the other. Lack of financial support prevented the fulfillment of his ambitions and my youthful hopes."

Turning to Captain Amundsen and addressing him as "one of the three living members of the 'Polar Legion'—Amundsen, Byrd, and Ellsworth," Doctor Kunz presented the medal and said:

"Captain Amundsen, the American Scenic and Historic Preservation Society and the American Museum of Natural History take great pleasure in honoring you tonight with their gold medal, for the golden qualities that you possess made this medal possible."

Doctor Kunz then continued:

"As a friend of many years I know that Lincoln Ellsworth possesses high personal qualities, and that he and his co-leader Amundsen have made the most careful study of Polar matters. Ellsworth has made a most important geological survey across the Andes of South America, and has spent years as a civil engineer on railroad surveys in our western mountains. His ambition had always been the exploration of the unknown Arctic. Finally he and the great genius Amundsen joined in the two historic flights which they carried out together in 1925 and 1926; the 1925 flight will always be remembered as the first successful penetration of the Arctic via the air,—falling short of the North Pole by a distance not much greater than the length of Long Island; and in 1926 they carried out their ambition to cross the Polar Sea. In honor of Mr. Ellsworth's sterling qualities and in recognition of his invaluable coöperation in polar exploration, the American Scenic and Historic Preservation Society and the American Museum of Natural History take pleasure in presenting him with this medal."

As Doctor Kunz handed the medals to the explorers there was enthusiastic applause.

The medals, which were alike, were of solid gold, three inches in diameter. On the obverse was engraved a representation of the dirigible "Norge" and the seals of the Society and the Museum, surrounded by the inscription "First Crossing of the Polar Sea Under Leadership of Roald Amundsen and Lincoln Ellsworth." On the reverse was a map of the northern hemisphere on which was traced the route of the Norge, surrounded by the following inscription: "Kings Bay, North Pole, Point Barrow, Teller. 11-13 May, 1926, 3393 Miles, 72 hours."

A third medal similar in design, and bearing the inscription

The American Museum of Natural History
'From whom the inspiration came'
Lincoln Ellsworth

was later presented to the American Museum by the American Scenic and Historic Preservation Society.

NOTES

CENTRAL ASIATIC EXPEDITIONS

The uncertain political conditions in China make it impossible for the Central Asiatic Expeditions to continue work in the field this summer. Consequently all the staff except Dr. Roy Chapman Andrews and McKenzie Young, in charge of motor transportation, and also Capt. W. P. T. Hill, topographer, have returned to America, and will devote themselves to the preparation of the scientific report of the expedition. Doctor Andrews and Mr. Young plan to remain in Peking where Doctor Andrews will be occupied with the preparation of the story of the expedition. Walter Granger, palæontologist of the expedition, returned to the Museum on June 19 and Mr. N. C. Nelson on June 28.

Messrs. Granger and Nelson spent the winter in the province of Yunnan on reconnoissance work. Much of the east province was explored from the Red River in the south to the Yangtze River in the north. While most of the area proved barren of fossil vertebrates and evidences of early man, an important deposit of early Pleistocene mammals and two sites of early pre-Chinese culture were discovered near the southernmost bend of the Yangtze. This site yielded stone implements of types similar to those found by Mr. Nelson last winter in the gorge region many hundreds of miles farther down the Yangtze. In addition to fossils and artifacts, collections were made of mammals, birds, reptiles, and fishes. Mr. Nelson excavated a small shellheap on the border of the great lake (Kunyang) adjoining Yunnanfu, in which he discovered both Chinese and pre-Chinese pottery but no traces of stone implements. He also obtained for his own department samples of clothing, implements, etc., of both the Chinese and tribes-people of Yunnan at the present time.

While field work is temporarily suspended, excellent progress is being made in the publication of the results already accomplished.

A handsome quarto volume entitled "The Geology of Mongolia" by Prof. Charles P. Berkey, chief geologist of the Central Asiatic Expedition, and Mr. Frederick K. Morris of the American Museum of Natural History, will appear shortly from the Knickerbocker Press of G. P. Putnam's Sons, New York. It is based on five thousand miles of reconnaissance exploration made by the authors in 1922 and 1923 as members of the Museum's Central Asiatic Expeditions, Dr. Roy Chapman Andrews, leader. The route traversed extends from Kalgan to Urga, to Tsetsenwan, to Sain Noin, to Gorida, to Uskuk, to Tsagan Nor, to the Baga Bogdo and Gurbun Saikan mountains, and back through Djadokhta, Sair Usu, Ardyn Obo and Shara Murun to Kalgan. Throughout the entire extent of this traverse, geologic cross-section profiles were constructed en route; detailed topographic and geologic maps were made where the motor party camped a week or more. The volume will contain nearly 600 printed pages of text matter, including 44 plates, 161 text figures, and 6 colored geologic maps in a pocket at the end. The present work will constitute Volume II of a final series of *de luxe* volumes, entitled *The Natural History of Central Asia*. Volume II is the first of the series to appear. It has been edited by Dr. Chester A. Reeds of the Museum's scientific staff, and as soon as the printing has been completed, an edition of 1500 copies will be placed on sale by G. P. Putnam's Sons.

Volume III, "Geology of Mongolia" (continued) by C. P. Berkey and F. K. Morris, and the "Geographical Surveys" by Major L. B. Roberts along the Kobdo-Kalgan trail will follow in due course of time.

Volume IV, "The Permian of Mongolia," by Dr. A. W. Grabau will deal with the invertebrate fossils collected by the Central Asiatic Expeditions in Mongolia.

Volumes V–XII (in preparation) will be devoted to Botany, Ichthyology, Archæology, Reptilia, Mammalogy. Geology and Palæontology.

Vol. I, by Dr. R. C. Andrews will present the narrative account of the Expedition.

ASTRONOMY

Collections for the proposed Astronomic Hall are increasing and the Museum is deeply gratified over a recent gift by Mr. and Mrs. Charles J. Liebman of several of Howard Russell Butler's paintings of the hydrogen prominences accompanying the eclipse of the sun. Mr. Butler also presented one of his paintings—"The Approaching Shadow of the Moon."

Amateur Astronomical Association Adopts Constitution.—The fourth meeting of the new astronomical society was held in the Museum auditorium on Thursday evening, June 23. A constitution and by-laws were adopted, and the following officers were elected: President, Clyde Fisher; First Vice-president, Stansbury Hagar; Second Vice-president, George A. Galliver; Third Vice-president, Fairfax Naulty; Fourth Vice-president, Oswald Schlockow; Secretary, M. Louise Rieker; Treasurer, Harry Lawton.

The evening's program included a talk on the Pons-Winnecke Comet by Harry Lawton, who was the first member of the Society to see this close celestial caller. An excellent lantern slide of the comet from a photograph made by Mr. William Henry was thrown on the screen. The new Zeiss Projection Planetarium was described by Clyde Fisher.

At this meeting 107 additional applications for membership were signed, bringing the total number of members to more than 600

There will be no regular meetings during July and August, the fall reunion being scheduled for Thursday evening, September 15.

BIRDS

The Chapin-Sage Expedition.—A report dated April 1, from Dr. James P. Chapin, who was then at Rutshuru, Kivu District, has just reached the Museum. After leaving Ruwenzori the Chapin-Sage Expedition was considerably delayed because of the difficulty in securing porters.

On March 14 the party met Messrs. Coolidge and Whitman of the Harvard Medical Expedition and stopped a day with them. They then moved on to Luofu. Doctor Chapin says: "Despite the delay in getting through the highlands west of Lake Edward, the time was not altogether lost, for it is a most interesting region where only one bird collector, Rudolf Grouer, an Austrian, had previously worked. The road climbs up and down between 6500 and 8000 feet, traversing patches of mountain forest and bamboos, where I was able to see a great many mountain birds and to collect as many as I could take care of each evening. We now have 2080 birds."

Central American Expedition.—Mr. and Mrs. Ludlow Griscom have returned from an exploring expedition to eastern Panama, whither they sailed on February 3 last, accompanied by Mr. Maunsell S. Crosby, one of the foremost amateur ornithologists in the United States. The expedition was financed jointly by Mr. Griscom and Mr. Crosby. After a brief visit to the famous Barro Colorado Island Research Station in the Canal Zone, the party chartered a yacht and proceeded to the Pearl Islands in the Bay of Panama, where special studies of the enormous sea-bird rookeries were made, and all the land birds peculiar to the archipelago were collected for the American Museum of Natural History. Mrs. Griscom took hundreds of photographs of the sea-bird colonies, and 1700 feet of motion-picture film. Undisturbed by man, the tameness of the birds was extraordinary, and as many as 100,000 pairs of birds were found in a single rookery. A new hummingbird was discovered here. Proceeding to the mainland of eastern Panama, the expedition visited the jungles on the upper reaches of the Sambú River, and spent some time at Cape Garachiné, exploring the bird life in the gigantic "cuipo" forests. Here several birds new to science were discovered and a number of other rarities were added to the collections of the American Museum. The main purpose of the expedition, however, was to study the ecology of the primeval forests of eastern Panama to be compared with similar studies made by Mr. Griscom in previous years in Yucatan, Nicaragua, and western Panama.

The Whitney South Sea Expedition.—For several months little has been heard from the members of the Whitney South Sea Expedition who make their peregrinating home on the schooner "France." It is believed, however, that since completing work among the New Hebrides, the party, under Mr. Rollo H. Beck, has undertaken collecting at a number of the more remote of the Solomon Islands, beginning with Santa Ana. From San Cristoval Island, of that group, Dr. Frederick P. Drowne wrote on March 20, 1927, that birds were comparatively easy to obtain, that most of the species proved to be new to the Whitney Expedition collections, and that, owing to the excellent anchorage, the visit would be prolonged until daily collecting showed evidence of having covered the whole range of the fauna. Much less favorable anchorages, he added, were to be expected at some of the other islands.

The Solomons are a rich field never before thoroughly worked by ornithologists. Neither is a good representation of their avifauna to be found in any American museum. The expected shipments will, it is hoped, endow this Museum with a collection rivalling the one recently received from the New Hebrides Islands. The next sphere of operations will probably be the New Caledonia group, the main island of which is larger than any yet visited, excepting New Zealand.

Whitney Expedition material continues to yield data of romantic as well as scientific interest. The rediscovery of long lost forms of bird life, for example, is often more exciting than the finding of species new to science. Discoveries of both these types are recorded in a current paper in the American Museum *Novitates* on certain small shearwaters related to *Puffinus assimilis*. During the second voyage of circumnavigation of Capt. James Cook, Sir Joseph Banks obtained in Lat. 48° 27′ S., Long. 93° W., a sea bird which he called *Procellaria munda*. His fellow naturalists, Solander and Parkinson, made, respectively, a Latin description and a pencil drawing of the bird, after which the specimen was presumably thrown away. The date of the incident was Feb. 15, 1769. From that day until the time of the Whitney Expedition, *Procellaria munda* was never seen again, and the very name had long since acquired a somewhat cryptic status. But on Feb. 16, 1926, or 157 years later, almost to a day, Mr. Beck collected six specimens of this bird on the same parallel of south latitude, but at a point approximately 815 nautical miles farther west. It has been described in the paper referred to above, and according to the modern reviewer, should bear the name *Puffinus assimilis munda*.

Mr. and Mrs. Jose G. Correia, who spent four productive years with the Whitney South Sea Expedition, have how transferred their activities to islands in the eastern Atlantic Ocean. Their places in the South Pacific are to be taken by Messrs. Guy Richards and Hannibal Hamlin, who will sail for Sydney, Australia, shortly after their graduation from Yale University this spring.

Rollo Beck Rediscovers Curlew-snipe. It is satisfactory to record that Dr. P. R. Lowe's exhaustive paper[1] on the characters of the curlew-snipe (*Æchmorhynchus cancellatus*) was based on specimens collected by the Whitney South Sea Expedition, under the command of Rollo H. Beck. Doctor Lowe writes that before the receipt of specimens from the American Museum the species was not represented in the British Museum, and states that prior to its rediscovery by Beck it had long been regarded as extinct. With an appropriate touch of humor he adds that its extinction, like Mark Twain's death, had evidently been exaggerated!

Barro Colorado Island.—Dr. Frank M. Chapman returned in April from a winter on Barro Colorado Island, in the Canal Zone, where his time was devoted chiefly to a study of the nesting habits of the colonial oriole or Oropendola (*Zarhynchus wagleri*). Heretofore Doctor Chapman's field work in the tropics has been faunal rather than biographiical in character; but it is believed that as our growing collections adequately repre-

[1] *Ibis*, 1927, pp. 114–132.

sent a bird's structure, variations, and distribution, we should supplement this knowledge by an intensive study of its habits. With this more rounded picture we shall be better equipped to attack the problems of its origin and its place in nature.

Birds of the Amazon.—Thorough collections of birds made by the Olallas on opposite banks of the upper Amazon reveal the surprising influence exerted by this river on the distribution of life. Species after species range from the Guianas to the north bank of the Amazon without change, but on the south bank of the river, these are replaced by an obviously representative but quite different form which ranges, without further change, to Bolivia.

When continued intensive collecting supplies the data that will permit both the longitudinal and latitudinal ranges of these birds being plotted, it is believed that significant facts will be revealed concerning their geographic origin and more recent evolution, and that the factors which determine the boundaries of the minor faunal areas of the Tropical Zone will be more clearly understood.

Notable Additions to the Collection of Birds are single specimens of the remarkable new wren from Cuba (*Ferminia cerverai* Barbour) and the rare Narcondam Island hornbill (*Rhytidoceros narcondami*), both received from the Museum of Comparative Zoology.

Needed—A Statue of Audubon.—The removal of the exhibits of the department of public health from the west corridor of the Museum, and the rearrangement and extension of the Audubon Gallery have left a space at the head of the stairway, overlooking the exhibits, that would be an admirable place for a statue of Audubon. While there is a bust of heroic size among the Pioneers of American Science, a life-size statue is greatly needed in connection with the Audubon Gallery, and offers a fine opportunity for some admirer of Audubon and his work to add to its attractions and interest.

LOWER INVERTEBRATES

Dr. Roy W. Miner is spending July and part of August at the Mt. Desert Island Biological Laboratory, Bar Harbor, Maine, where, in coöperation with research associate Frank J. Meyers, he expects to complete the feld operations necessary for the Rotifer Group now being installed in the Darwin Hall, and also expects to make a series of comparative studies of marine worms with special reference to adaptation of the structures of the head and paropodia. From these it is intended to construct additional models for the annulate alcove in the Darwin Hall. Doctor Miner will be assisted by Dr. George H. Childs as artist.

CONSERVATION

Cook Forest a State Park.—In Natural History for January, 1925, pages 90–93, is an account of the Cook Forest in western Pennsylvania and of the efforts of the Cook Forest Association, (331 Fourth Avenue, Pittsburgh, Pa.) to bring about its preservation as a state park. Through the appropriation of $450,000 by the state legislature, this hope seems about to be realized, although it will be necessary to raise $200,000 additional by private subscription before the tract can be purchased.

Of all the vast forests that once covered much of the northeastern United States, Cook Forest contains the last tract of primeval white pine forest of any considerable extent and its preservation is of æsthetic, scientific, and historical interest, not only to the citizens of Pennsylvania but of all the eastern states.

The proposed park will provide ample areas for buildings, camp grounds, parking space, picnic and recreation grounds outside the forest itself, so that there is no reason why the latter cannot be kept permanently in its present beautiful natural condition.

EDUCATION

Mr. George D. Pratt, a Trustee of the Museum and chairman of its Committee on Education, is planning to visit Norway and Sweden during the summer to secure still and motion pictures to be used in the school service work of the Museum.

Dr. G. Clyde Fisher left New York June 30 to join Ernest Thompson-Seton at Bismarck, South Dakota, and will devote the summer months to visiting different Indian reservations to secure still and motion pictures of Indian dancing and feasts. They will also visit the Grand Cañon and the Petrified Forest. H. A. Sievers of the department of public education accompanies the expedition.

Philip Pratt, a teacher of art in Pratt Institute, who for some years past, has utilized his summer vacations to secure still and motion pictures of the peoples of foreign lands, particularly France, for use in the educational work of the American Museum of Natural History, sailed June 25, on the "Corson," for

HEMLOCKS AND PINES ALONG THE SENECA POINT TRAIL, COOK FOREST, PENNSYLVANIA, WHICH WILL BE MADE A STATE PARK IF THE NECESSARY SUM CAN BE RAISED

SPRING FOLIAGE IN THE COOK FOREST. THE WOODS ARE NEVER SO BEAUTIFUL AS IN MAY WHEN THE YOUNG LEAVES OF THE HARDWOODS AND UNDERGROWTH ARE UNFOLDING

VALLEY OF THE CLARION RIVER, PENNSYLVANIA, SEEN THROUGH THE TREE TOPS OF THE COOK FOREST

PRIMEVAL WHITE PINES IN THE COOK FOREST. THESE TREES, WHICH ARE FROM 200 TO 300 YEARS OLD AND IN MANY CASES MORE THAN 160 FEET TALL, ARE ALMOST THE LAST OF THEIR KIND

Mediterranean ports. He is accompanied by John Foley.

In addition to their work in the principal Mediterranean ports, the party will visit the interior of Syria, Palestine, Germany, Hungary, Greece, Turkey, Roumania and Egypt.

This expedition, owing to the limitation of field funds at the Museum, has been made possible through the generous coöperation of the American Export Steamship Corporation, which is extending to Mr. Pratt every possible assistance for the execution of his work.

Outdoor Education.—The Trail-Side Museum and Nature Trails at Bear Mountain are under the direction of the resident naturalist, Mr. William R. Carr, while Dr. F. E. Lutz is continuing the Insect Station at Tuxedo.

HISTORY OF THE EARTH

Frick Palæontological Expeditions.—Through the generosity of Mr. Childs Frick, several expeditions have been planned to collect palæontological material in the west. Albert Thomson is again in search of Pliocene fossils in Western Nebraska; Carl Sorensen is working on the Miocene deposits of Western Nebraska in coöperation with the Colorado Museum. Barnum Brown is conducting a Cretaceous and Jurassic reconnaissance in Colorado, Wyoming and Montana. Joseph Rak in Santa Fé, New Mexico, and John C. Blick in Keams Cañyon, Arizona, are working on the Pliocene material of those states.

The Samos and Siwalik Collections of Fossil Mammals and Reptiles.—The Museum has received from Mrs. Henry Clay Frick a most generous and welcome gift of the entire collections made in the Siwalik Hills of India and Burma in the years 1921–23, and in the Island of Samos in the year 1924, by Curator Barnum Brown. The Siwalik Collection of 644 catalogued specimens constitutes a priceless addition to the great series of vertebrate fossils already in the Museum. This enumeration gives little idea of the extension of knowledge of the extinct fauna of the Miocene to Pleistocene times on the Great Plains of India, which is revealed in the many perfect specimens of the Frick-Brown Collection, including skulls of the great Proboscideans—Mastodon, Stegodon, Archidiskodon, and a superb example of the giant tortoise Colossochelys.

The Samos Collection contained in 56 large cases is even richer in individual specimens than the Indian Collection. It comprises a great variety of antelopes, gazelles, horses, cattle, *Samotheres*, Proboscidea, and carnivores giving a priceless addition to our knowledge of animal life surrounding the Mediterranean in Pliocene time. Of this collection 343 specimens have already been prepared and determined.

Mrs. Frick has added to her previous gifts the amount necessary to defray the entire cost of preparation. The Siwalik Collection will be entirely cleaned up this year, to be followed by the complete cleaning up of the Samos Collection. The Proboscidea in these two collections are being described in Curator Osborn's monograph on the *Mastodonts and Elephants*. The other quadrupeds and reptiles are being described under the direction of Curator Brown, with the coöperation of Dr. Guy E. Pilgrim on the antelopes of the Siwaliks.—H. F. O.

A Lost Nevada Meteorite.—One evening at twilight in the fall of the year, about 1882–83, a large meteor was observed by one of our correspondents to pass over Tuscarora, a silver mining camp in the northern part of the state of Nevada. The same observer estimates that the meteorite fell fourteen to sixteen miles from Tuscarora, and states that some parties, who claim to have dug down beside it, reported it to have fallen in a creek bottom, where the bed-rock formation was not very near the surface, and that the meteor went into the earth thirty-four feet and still remained raised above the surrounding landscape.

A second correspondent, a mining engineer who was in Tuscarora at the time, states: "I remember distinctly seeing what I presumed to be the cloud left by the passing of the meteor. I was in the open and looked up and saw what seemed to me a coil of smoke of a peculiar color, much like the fluorescent color of Willemite under the ultra violet ray, or the color of molten gold. It was not in a straight line, but seemed to have convolutions. I was very much astonished at the sight, and for a moment was unable to comprehend it or to assign any cause to the phenomenon. I did not see the meteor itself, nor did I see the place where it landed. I believe the cattlemen reported it to have fallen in the country west of Mt. Blitzen. It was seen by quite a number of people at the time, talked of, and forgotten."

Another correspondent reported recently that the meteorite fell on soft ground; that it penetrated the earth to an unknown depth; that a hole some six feet in diameter with raised rim was observed following the impact; that the greasewood and sage brush round about the hole was burned off for a distance of two hundred yards following the descent of the meteor, and that the soft ground about the hole was baked by the "fire ball" so that it resembled a porous coke, light in weight. As the location was definitely reported to be in a haystack yard in the upper end of the Jackson Valley, Jackson Mountains, Nevada, and as there was a strong possibility that the meteorite could be located, through the generosity of Mr. J. P. Morgan the Museum sent Dr. C. A. Reeds, curator of geology, to investigate. Doctor Reeds found that the location did not afford any of the features mentioned above, but instead these was an ancient flood plain deposit consisting primarily of water-worn pebbles and rounded bowlders set in a moderate amount of alluvial earth.

The distance between Tuscarora, where the meteor was observed in the sky, and the Jackson Mountains is one hundred and twenty miles. There are many desert valleys between these two points any one of which may harbor the final resting place of this large meteorite.

Physical Conceptions of Life and of the Age of the Earth.—While in Cambridge last summer, Professor Osborn discussed with Sir Ernest Rutherford, the distinguished president of the Royal Society, the much mooted question of the age of the earth. Sir Ernest is thoroughly convinced of the superiority of the measurement of geological time through calculation of the radium content in the older and younger rocks. On being pressed for his own estimate of the age of the earth beyond the recognized sedimentary estimates, he would extend the time over a period of one thousand million or one billion years. He dismisses other methods of time-measurement such as the sedimentary records employed by Walcott or the sodium content of the sea as used by Joly as much less reliable than the radium content on which he bases his estimate. This is provisionally ten times as great as that attained by Walcott or Joly. Professor Joly himself discusses with great fairness this very question of the life and age of the earth in his recent delightful volume *The Surface History of the Earth.*

MAMMALS

The Taylor Sudan Expedition which left New York last December returned to the Museum on June 14. Mr. Irving K. Taylor, who financed the expedition, and Mr. H. E. Anthony, who went as Museum representative, reported a very successful trip.

The expedition entered the Sudan by way of Egypt, landing at Alexandria and traveling by railroad and steamer to Khartoum, which became the center of operations. On January 15 the party left in two small native sailing boats or "nuggers" to collect along the White Nile for about 300 miles south of Khartoum. After a month of this work they returned to Khartoum to take up their charter on one of the Government shooting boats. With this large craft they ascended the White Nile as far as Lake No and worked up several of the tributaries, such as the Bahr el Ghazal, Bahr el Jebel, and Bahr el Zeraf. At a point south of Mongalla the steamer was headed north and the expedition returned to Khartoum. The work on the Nile was completed by the end of March.

The main energies of the expedition during this time were devoted to making collections of both the river birds and those found along the banks; to collecting large game mammals and the smaller species; to securing a representation of the many forms of fresh-water fish found in the Nile and its tributaries; and to collecting such reptiles and amphibians as could be found.

At the conclusion of the work on the river Mr. Taylor and Mr. Anthony left by train for Port Sudan on the Red Sea, and from that point made a safari by camel into the Red Sea Hills after ibex and gazelle. This section of the Sudan is very dry and arid and the conditions encountered there are very different from those which prevail along the Nile. About a month was spent in this district, and the collectors secured good series of the animals they set out to take. This trip brought them into contact with the Hadendoa, the native tribe which is known today, after Kipling, as the Fuzzy Wuzzy. The Fuzzy Wuzzy is a very unusual type and the expedition secured his services as guide and beater for the illusive ibex. The field work was brought to a close in the harbor of Port Sudan where a large collection of Red Sea fishes was secured for the Museum.

The collections brought back by the Taylor Sudan Expedition include more than 225 mammals, more than 500 birds, and many hundreds of fishes and of reptiles. The most imporant part of the mammal collection is the large series of big game, among which may be mentioned buffalo, Nile lechwe, white-eared kob, waterbuck, tiang, hartebeeste, ibex, Dorcas gazelle, Soemmerring's gazelle, bushbuck, reedbuck, warthog, etc. Not only were skins and skulls taken but many skeletons were preserved as well.

The party took about three thousand feet of motion pictures and several hundred still photographs, but found opportunities for photography greatly limited because of the unusual growth of high grass and river vegetation. In normal years this vegetation is burned when the river falls and the banks become dry, but 1927 was a season of high Nile and vegetation was too green to burn. This meant that game could be very abundant but so well hidden that the hunter had great difficulty in shooting animals, much less in photographing them.

It is expected that the photographs and notes of this expedition will serve as the basis for later, more extended accounts in NATURAL HISTORY.

LEE GARNETT DAY EXPEDITION.—GEO. H. H. TATE and T. DONALD CARTER, through funds provided by Lee Garnett Day, will leave in the early part of July for an expedition to the Roraima district of South America to secure a representative series of the mammals and birds of that region. This will be known as the Lee Garnett Day Expedition and will be in the field about six months.

THE PUTNAM BAFFIN ISLAND EXPEDITION sailed June 12 under the leadership of George Palmer Putnam and hopes to secure specimens of the bow-head whale for the Museum.

THE GREENLAND NARWHAL.—MR. H. C. RAVEN, associate curator of the department of comparative anatomy, who was the zoölogist of the Museum's expedition to Greenland, has been making a study of the foetal and adult narwhal specimens secured by the expedition. Mr. Raven is especially interested in the skeleton and digestive apparatus of these animals. Scientists from other institutions are also interested in this very valuable material. Prof. Ernst Huber, of Johns Hopkins University Medical School, is making a very careful study of the facial muscles of the narwhal. Mr. A. Brazier Howell, of the United States National Museum, will study the musculature as a whole. Dr. George B. Wislocki, of the department of embryology at Johns Hopkins University, has investigated the placentation and foetal membranes of the narwhal, and doctors Tilney and Riley, of Columbia University, College of Physicians and Surgeons, are studying the brain of the narwhal.

Mr. Raven hopes that the results of these investigations may all be published together.

MINERALS

THE MORGAN GEM COLLECTION of the American Museum of Natural History has recently been enriched by the gift of a number of valuable pieces through the generosity of Mr. J. P. Morgan, who has already given largely to this collection founded by his father.

The gift includes three cut gems remarkable in size and beauty. There is a blue zircon from Chantabun, Siam, weighing 30 carats; a spinel from Ceylon, of a rich purple color and weighing 46½ carats; and a magnificent deep-colored amethyst from Madagascar, which weighs 48½ carats.

The most unique and valuable object of the series is a chain and pendant carved from a single piece of light-green Burmese jade with spots of darker green. The 65 links which make up the 30 inches of length of the chain together with the pendant are carved without a break.

A large flat dish, roughly oval in shape, and measuring 11 by 6 inches, is carved from a seam of amethyst bordered by chalcedony in such a manner that the banded chalcedony forms the rim of the dish. Another dish of great beauty is an irregularly circular bowl carved from translucent pale-gray chalcedony. The material, which is cut very thin, shows circular radiations, caused by the stalactitic character of the chalcedony, which transmit the light with fine effect. This piece measures 5½ by 6 inches.

There are also four smaller dishes carved from English fluorite, aventurine from India, rich red-banded jasper, also from India, and Silesian chrysoprase. The last named is made from material mined more than a hundred years ago and no longer to be obtained in such large pieces.

A mass of Baltic amber weighing nearly 53 ounces completes the series.

These objects are at present displayed in the accession case in the Morgan Hall, and will be subsequently distributed in appropriate cases of the Tiffany-Morgan Gem Collection.

HONORS

Osborn Chair of Biology Established.—A gift of $200,000 has been announced by Princeton University fort he establishment of a Chair of Biology to be known as the Henry Fairfield Osborn Research Professorship of Biology, in honor of President Osborn who was a graduate of the class of 1877.

Henry Fairfield Osborn received the degree of Doctor of Science from New York University, in June.

The Honorary Degree of Doctor of Science was bestowed, June 20, upon Dr. Roy Waldo Miner by Williams College, of which Doctor Miner is a graduate.

New Dahlia Named after G. Clyde Fisher.—At the annual meeting of the New York Bird and Tree Club held at the home of Mrs. John Lewis Childs, Floral Park, Long Island, a new dahlia just developed by the John Lewis Childs Nurseries was formally named the Dr. Clyde Fisher Dahlia in honor of the president of the Club.

RESEARCH IN TROPICAL AMERICA

The American Museum has been represented on the Board of Trustees of the Institute for Research in Tropical America since its organization, and during the first year of the existence of the Institute's laboratory on Barro Colorado Island in the Canal Zone, it was a contributor to the laboratory fund. This annual contribution has now been renewed.

RECENT MUSEUM LITERATURE

The latest additions to periodical Museum literature are the *Bulletin* of the Carnegie Institute and the *Natural History Magazine* of the British Museum of Natural History. The former is to appear monthly, except during July and August, and deals with the activities of that complex, the Carnegie Institute comprising the Art Gallery, Museum of Natural History, Music Hall and Library School, and also of the Library and Institute of Technology. The *Natural History Magazine* of the British Museum, two numbers of which have appeared, like the periodical published by the Bloomsbury Branch, is a quarterly, of a popular nature and devoted entirely to the work of the Natural History Museum. The first number contains a brief introduction by Sir Sidney Harmer, who has recently retired from the directorship, and an account of the Museum Building by Assistant Secretary G. F. Herbert Smith. The other articles, many of them illustrated, are all by members of the staff, and cover a wide range of subjects from an account of "Rafflesia, the Largest Known Flower," to "Important Additions to the Collection of Beetles" which describes two species one-eighth of an inch long. The longest article is devoted to an account of the progress of the British Museum East African Expedition to Tendagurn for dinosaur remains. The locality had been worked by German expeditions for six years prior to the war, but the deposit of dinosaur bones covers so large an area that it may be profitably worked for many years to come.

Novitates.—Through the medium of *Novitates*, the American Museum gives to the world first reports of new discoveries of scientific value. The *Bulletin*, also published by the Museum, contains more extensive accounts of scientific studies. These papers are placed on sale by the Museum. *Novitates* may be secured for fifteen cents a copy, and the price of the *Bulletin* articles varies with the number of pages and size of plates. The following papers have been published during the period January 26–July 2, 1927.

Novitates

No. 244.—New Light on the Giant Fossil May-Flies of Mongolia. By T. D. A. Cockerell. 4 pp. Two text figures. January 26, 1927.

No. 245. New Neotropical and Oriental Diptera in The American Museum of Natural History. By C. H. Curran. 9 pp. One text figure. January 27, 1927.

No. 246. New Diptera from the Belgian Congo. By C. H. Curran. 18 pp. January 29, 1927.

No. 247. Synopsis of Males of the Genus *Platycheirus* St. Fargeau and Serville with Descriptions of New Syrphinæ (Diptera). By C. H. Curran. 13 pp. January 31, 1927.

No. 248. Undescribed Tachinidæ and Calliphoridæ from the Belgian Congo. By C. H. Curran. 7 pp. February 1, 1927.

No. 249. The Plethodontid Salamanders; Some Aspects of Their Evolution. By G. K. Noble. 26 pp.

Ten text figures. February 2, 1927.

No. 250. DESCRIPTIONS OF NEW BIRDS FROM NORTHWESTERN PERU AND WESTERN COLOMBIA. By Frank M. Chapman. 7 pp. February 19, 1927.

No. 251. DESCRIPTIONS OF NEW BACTERIA FOUND IN INSECTS. By F. MARTIN BROWN. 11 pp. February 21, 1927.

No. 252. NORTH AMERICAN BEES OF THE GENUS *Anthidium*. By Herbert F. Schwarz. 22 pp. February 28, 1927.

No. 253. ADDITIONAL NORTH AMERICAN BEES OF THE GENUS *Anthidium*. By Herbert F. Schwarz. 17 pp. March 1, 1927.

No. 254. A NEW AND REMARKABLE FLYCATCHER FROM GUATEMALA. By Jonathan Dwight and Ludlow Griscom. 2 pp. March 8, 1927.

No. 255. CHINESE ANTS COLLECTED BY PROFESSOR S. F. LIGHT AND PROFESSOR N. GIST GEE. By William Morton Wheeler. 12 pp. March 12, 1927.

No. 256. A NEW SHARK FROM THE CONTINENTAL SLOPE OFF FLORIDA. By J. T. Nichols. 2 pp. One text figure. March 12, 1927.

No. 257. A REVISION OF THE GEOGRAPHICAL RACES OF THE BLUE GROSBEAK (*Guiraca cærulea*). By Jonathan Dwight and Ludlow Griscom. 5 pp. March 14, 1927.

No. 258. NEW AFRICAN TACHINIDÆ. By C. H. Curran. 20 pp. March 17, 1927.

No. 259. A FEW ANTS FROM CHINA AND FORMOSA. By William Morton Wheeler. 4 pp. March 18, 1927.

No. 260. NEW WEST INDIAN TACHINIDÆ. By C. H. Curran. 15 pp. Five text figures. March 19, 1927.

No. 261. THE VARIATIONS AND DISTRIBUTION OF *Saltator aurantiirostris*. By Frank M. Chapman. 19 pp. Eight text figures. March 28, 1927.

No. 262. NEW DOLICHOPODIDÆ FROM THE WEST INDIES. By M. C. Van Duzee. 10 pp. March 29, 1927.

No. 263. A NEW BLIND CATFISH FROM BRAZIL. By N. A. Borodin. 5 pp. One text figure. March 31, 1927.

No. 264. THREE NEW MINNOWS OF THE GENUS *Barbus*, AND A NEW CHARACIN FROM THE VERNAY ANGOLA EXPEDITION. By J. T. Nichols and Rudyerd Boulton. 8 pp. Four text figures. April 5, 1927.

No. 265. *Puntius streeteri*, A NEW CYPRINOID FISH FROM BORNEO, AND *Cobitophis*, A NEW GENUS OF BORNEAN COBITIDÆ. By G. S. Meyers. 4 pp. One text figure. April 20, 1927.

No. 266. SOME NEW CATFISHES FROM BRAZIL. By N. A. Borodin. 7 pp. Four text figures. April 20, 1927.

No. 267. MAMMALIAN FAUNA OF THE HELL CREEK FORMATION OF MONTANA. By George Gaylord Simpson. 7 pp. Six text figures. April 30, 1927.

No. 268. MAMMALIAN FAUNA AND CORRELATION OF THE PASKAPOO FORMATION OF ALBERTA. By George Gaylord Simpson. 10 pp. Seven text figures. April 30, 1927.

No. 269. A FOSSIL PORPOISE FROM CALIFORNIA. By Wm. K. Gregory and Remington Kellogg. 7 pp. Three text figures. May 20, 1927.

No. 270. MURID RODENTS FROM THE ASIATIC EXPEDITIONS. By Glover M. Allen. 12 pp. May 31, 1927.

No. 271. *Pimelodus platicirris*, NEW SPECIES, AND OTHER NOTES ON BRAZILIAN CATFISHES. By N. A. Borodin. 4 pp. June 30, 1927.

No. 272. UNDESCRIBED ASILIDÆ FROM THE BELGIAN CONGO. By C. H. Curran. 18 pp. Six text figures. July 2, 1927.

Bulletin

Bulletin LIII, Art. II. "The Aquatic Mollusks of the Belgian Congo, With a Geographical and Ecological Account of Congo Malacology." By Henry A. Pilsbry and J. Bequaert. (With Field Notes by the Collectors, H. Lang and J. P. Chapin). 602 pp. Plates x to LXXVII, 15 maps, and 93 text figures.

WESTERLY SIDE OF THE NEW HALL OF REPTILES AND AMPHIBIANS

A unique feature of this hall is a series of effectively lighted habitat groups installed in a cloister, the entrance to which is seen at the left

REPTILES AND AMPHIBIANS

The New Hall of Reptiles and Amphibians.—"The youth of the city who are learning to look at all life and living things with intelligent appreciation, will find the new Hall of Reptiles and Amphibians (in the new southeast wing of the Museum) full of fascinating surprises," President Osborn remarked at the opening reception (June 14, 1927), "while their teachers will find it a rich source of clear illustrations of biological principles." The corridor of habitat groups shows a fine series of Nature's "animated gargoyles," all apparently busily engaged in the game of life, in the midst of many strange and beautiful scenes,—prickly-backed lizards in the splendor of sunset in an Arizona desert, giant tree frogs in the moonlight on a mountain-side in the West Indies, black sea-going lizards on the black volcanic rocks of a long white beach at noonday in the Galapagos Islands, etc.

In a series of cases running the length of the hall are exhibits illustrating biological principles,—"adaptation," "elimination of the unfit," "variation," "concealing coloration," "warning coloration," "mimicry," and the like. On the opposite side of the hall the exhibits illustrate how amphibians and reptiles breed, how they care for their young, how they secure their food and devour it, and so on.

Not the least interesting alcoves are those devoted to "snake stories" and to the economic importance of reptiles.

The colleagues and friends of Curator G. K. Noble are congratulating him and the members of his department as well as the department of preparation upon the completion of one of the most interesting halls in the whole Museum,—a hall of stimulating ideas as well as of strange and beautiful objects. Finally, all unite in grateful memories of the late Miss Mary Cynthia Dickerson, the first curator of the department, who laid the foundations for its present high standing in educational and scientific work.—W. K. G.

SCIENCE OF MAN

Valuable Indian Collection Acquired. The department of anthropology has received a particularly valuable collection from the Northern Cheyenne Indians of Montana. This collection was made about 1900 by Dr. George Bird Grinnell during his visits to that tribe. Not only are objects such as these now rare and unobtainable, but the information concerning each specimen adds very greatly to their value. Doctor Grinnell has a very intimate knowledge of the Blackfoot and Cheyenne, acquired during many years of close acquaintance with them. The results of these years of study have been published in several volumes of which *Blackfoot Lodge Tales*, New York, 1893, *The Fighting Cheyenne*, New York, 1915, and *The Cheyenne Indians* (in two volumes), New Haven, 1923, are the most important.

The collection just given has been in the Museum on loan since 1904, and several of the more interesting specimens have been on exhibition in the Plains Indians Hall. One of the choicest specimens is a Cheyenne shield. There is some evidence that the shield was made in 1780 and is therefore 147 years old.

Dr. Leslie Spier, formerly an assistant in the department of anthropology, but for several years professor of anthropology in the University of Washington, Seattle, has been appointed professor of anthropology in the University of Oklahoma. While connected with the American Museum, Doctor Spier carried on excavations at Trenton and afterward took part in the archæological survey of New Jersey. Later, he carried on archæological explorations in Arizona and finally made a special ethnographic study of the Havasupai Indians.

Textiles from Cliff Dwellings.—Finely woven cloth was found by Earl H. Morris in some of the dry recesses of cliff dwellings in ca ons del Muerto and de Chelly (Ogden Mills Expedition). These unusual textiles are now the object of investigation in the laboratories of the department of anthropology. Though little more than fragments were secured, many of these are large enough to show not only the weave, but the design. For the most part the materials are cotton. After cleaning, many of the fragments prove to be well-preserved and often retain their colors in relative values. Mr. .S. Ichikawa, assistant in the department, has the work in hand, and is now engaged in analyzing the weaves used in these textiles. So far, almost every known variety of weaving technique has been observed, ranging from the simple lace coil, still found among the Indians of California, to tapestry weaves with oblique contrast lines, similar to prehistoric cloths in our Peruvian collection. Among the unique techniques is a weave in which certain weft threads are so manipulated as to produce open meshes, either square, or oblong, according to the movement of the weft. This form has been reported from the southern part of Arizona, so it had a wide distribution. Many specimens are still to be analyzed, some obviously presenting complicated processes, all of which go to show that long ago, well back in pre-Columbian time, the spinning of thread from cotton and the weaving of cloth reached a high level of excellence among the otherwise primitive cliff dwellers of our Southwest.

Among recent Visitors in the department of anthropology has been Dr. Fay Cooper Cole, senior professor of anthropology in the University of Chicago, who is conducting a field archæological station in Illinois for the training of students in archæological technique.

Dr. Robert H. Lowie, formerly associate curator in the department of anthropology, and now professor of anthropology in the University of Caifornia, will conduct courses in anthropology in the Columbia University summer school.

Leidy on the Central Asiatic Origin of Man.—In a recent article by Professor Osborn entitled "Why Central Asia," various theories as to the homeland of man were set forth and credit given to the various writers. It now appears that the veteran palæontologist, Joseph Leidy, was overlooked, because Dr. Joseph Leidy, Jr., calls attention to the following passage published in the year 1857 in a work now little known, *Indigenous Races of the Earth,* by Nott and Gliddon. In this quotation, Leidy remarks:

> It is not at all improbable that man (strictly the genus Homo) may have first originated in Central Asia. . . Various races of man, in different geographical positions, may have acquired their peculiar characteristics (their specific origin) at successive periods long distant from each other.

Investigations in Physical Anthropology in America.—One of the most significant investigations in physical anthropology in America within recent years is *Old Americans,* by Dr. Ales Hrdlicka, curator in the U. S. National Museum and one of America's most distinguished anthropologists. Doctor Hrdlicka carried on extensive studies on a representative population of Old Americans whose ancestry on all branches showed a continuous residence in the United States for at least three generations. In many cases the antiquity of the family line in this country was considerably longer. This population was found to be dominantly of British origin and while still preserving their racial affiliations with the parent stock have nevertheless produced a sub-type which is distinct from the ancestral one in several respects.

ACKNOWLEDGMENT

Acknowledgment is due to Julian P. Scott, who made the photograph of Carl Akeley entitled "Thinking about the Gorilla" which appeared on the cover of the Akeley Memorial Number of Natural History, and again on page 130 of the same issue. Mr. Scott also made the photograph of Ralph Winfred Tower that was published on page 214 of Natural History, Vol. XXVI. The negatives are the property of Science Service, Washington, D. C.

NATURAL HISTORY
APPEAL FOR BACK NUMBERS

The Library of the American Museum receives frequent requests for complete files of Natural History which it is no longer able to furnish. Should any subscriber care to donate copies of earlier issues, particularly Vols. I–XIV, the gift will be very much appreciated, and postage will be refunded to the donor. Address the Librarian, American Museum of Natural History.

NEW MEMBERS

At a meeting of the Board of Trustees of the American Museum of Natural History held May 2, Mr. Lincoln Ellsworth was proposed by the nominating committee to fill a vacancy in the Board, of the class of 1927. This nomination was approved, and Mr. Ellsworth was unanimously elected a Trustee of the Museum.

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 9653.

Associate Benefactor

Mr Irving K. Taylor.

Corresponding Members

Prof. Max Weber.

Messrs. Jean Delacour, Charles Tate Regan.

Life Members

Mrs. Constance R. Cutting.
Dr. Reginald Burbank.

Messrs. Hunt T. Dickinson, Alfred L. Loomis, Irwin R. Kirkwood, William R Timken.

Sustaining Members

Mesdames: E. V. Gabriel, George B. Hopkins, L. D. Ricketts.

Messrs. Charles F. Fuller, Edward C. Lord, Frank Melville, Jr., Benjamin Mordecai, John Caldwell Myers.

Annual Members

Mesdames: William J. Demorest, Dudley D. Doernberg, S. W. Fairchild, Charles F. Fuller, Langdon Geer, George A. Graham, Robert Hoe, Jr., Ramsey Hoguet, Arthur C. Holden, B. H. Homan, Henry Homes, Richard F. Hoyt, Walter Jennings, Benj. H. Kaufman, Paul M. Mazur, John R. McGinley, Coleman B. McGovern, Cord Meyer, Jr., Victor Morawetz, Henry Necarsulmer. Harold E. B. Pardee, Clara L. Poillon, Robert H. Pretzfeld, R. Bartow Read, W. S. Rodie, J. G. Schurman, Jr., Frank R. Smith, Walker E. Swift, Eugene Untermyer, Randolph S. Warner, W. A. White.

Misses M. Winifred Hall, Edna K. Phillips.

Rev. Henry Darlington, D.D.

Doctors: William C. Geer, M. Chas. Gottschaldt, Hans E. Kudlich, Perry J. Manheims, A. V. Moschcowitz.

Hon. George de Ghika.

Major William Kennelly.

Messrs. Geo. A. Bates, G. Albert Baumann, Bruno Benziger, Joseph G. Butler, 3d., H. Towner Deane, Murray W. Dodge, Henry G. Eilshemius, Louis M. Eilshemius, John Farr, Jr., L. J. Fischer, J. Goebel, Jr., William T. Grant, Alfred Gregory, John L. Handy, James M. Hartshorne, Arthur M. Hess, Stephen G. Hess, Carl T. Heye, Charles R. Hickox, Irving B. Hirshfeld, Ernest P. Hoes, J. W. Hornor, Benjamin A. Javits, Frank B. Jewett, Frank H. Keen, Walter S. Klee, Charles A. Kollstede, Leon H. Kronthal, James B. Lackey, Richard M. Lederer, William C. Lester, Leo Levy, Robert E. Liebmann, Benj. W. Loeb, Andrew W. Loebl, Frederick W. Longfellow, Homer L. Loomis, J. S. Lovering, Ranald H. MacDonald, Wm. P. Malburn, Lee McCanliss, W. G. McCullough, George A. McIlroy, George Merzbach, Arthur G. Meyer, John H. Miller, George Murname, Sol Mutterperl, Julian S. Myrick, Alfred H. Newburger, Charles D. Nicoll, L. J. Nolan, Winthrop G. Noyes, Joseph J. O'Donohue, Jr., Lee E. Olwell, Edward C. Patterson, Paul G. Pennoyer, Lawrence Phillips, Wray Physioc, Roy Pier, Andrew J. Post, S. C. Powell, E. Allan Reinhardt, Fleming H. Revell, Alfred Rheinstein, Herman Robson, Otto Roethlisberger, A. B. Roosevelt, Reuben J. Ross, William H. Scheel, C. Alison Scully, Nathaniel Stevens Seeley, Jacob Seibert, Jr., Wm. P. Shannon, Mesier R. Snyder, Morton F. Stern, Walther Albert Stiefel, Lawrence C. Stix, Ralph Stoddard, Leon E. Stropp, Rutherford Towner, Wolcott Tuckerman, Kenneth H. Turnbull, Samuel Ungerleider, Ernest Urchs, Edgar Wachenheim, Frank L. Weil, Louis M. Weiller, William Y. Wemple, Samuel L. Whitestone, George L. Wrenn, Roy T. Yates.

Master Hustace H. Poor.

Associate Members

Prof. Ellen Hayes.

Doctor Caroline A. Osborne.

Mesdames: John Wendell Brooks, Lucy Stock Chapin, Albert S. Clark, Magdalena R. Dexter, W. H. Edwards, W. H. Etz, Isaac W. Jeanes, Sophie H. Marshall, Frank V. Miller, Charles Scheuber, Florence Stocker Stimson, Mabel Loomis Todd.

Misses: Pearl M. Andrews, Elizabeth Brewster, Elizabeth F. Genung, Winifred Goldring, Mary J. Guthrie, Genivera E. Loft, Christine Miller, Delia S. Ovitz, Mary Louise Stark.

Rev. Dr. Henry B. Hemmeter, and Dr. D. Marsh

Albert O'Brien, Theodore C. Petersen, Luis Rodez.

Prof. Dr. W. H. Hoffmann.

Professors: C. L. Baker, Teiso Esaki, R. D. George, E. Duncan Grizzell, T. L. Haecker, Alfonzo L. Herrera, Maynard M. Metcalf, Walter R. Miles, Harry Justin Roddy, Henry Norris Russell, Peter Sandiford.

Doctors: W. H. Bergtold, Harold C. Bingham, Severance Burrage, A. B. Cannon, Frank A. Delabarre, Howard E. Enders, Robert D. Fletcher, James M. Flynn, H. M. Fooder, Jonathan Forman, W. D. Funkhouser, Henry Watson Furniss, John Y. Graham, Charles R. Grandy, Caswell Grave, William Avery Groat, Vernon R. Haber, Frank Wilson Hachtel, Henry Rudolf Henze, Frank Hinman, G. A. Hinnen, Henry B. Hitz, A. J. Hodgson, Frank F. Hoffmann, Davenport Hooker, James W. Hunter, Jr., George Ives, Victor C. Jacobsen, Albert Ernest Jenks, W. R. Jillson, Edward W. Jones, Carl F. Klaus, Harry H. Knight, Heinrich Krause, Harvey D. Lamb, T. I. Lerche, A. Liliencrantz, S. E. Longwell, Wm. H. Luedde, George W. Mackenzie, Edward F. Malone, James W. Mavor, W. R. McNair, Hugh C. McPhee, C. F. Menninger, R. E. Mercer, Wm. H. Mercur, Austin R. Middleton, George Richards Minot, E. Leigh Mudge, J. X. Newman, Frank Parsons Norbury, S. T. Orton, A. L. Peckham, Alfred O. Peterson, Chas. S. Potts, John B. Reeside, Jr., Frederick Hollister Safford, A. G. Sandblad, Ara Nathaniel Sargent, Harry B. Schmidt, Walter Merritt Seward, Milton G. Sturgis, Chas. R Sumner, Elihu Thomson.

Judge Ambrose Feely.

Messrs: Lyle Abbott, H. B. Allen, Benjamin Baker, E. J. Baker, Jr., Jno. W. Baker, Gershom Bradford, Jos. H. Bush, F. D. Chase, Wallace W. Coleman, Roy P. Curtis, Gilbert W. L. Darwin, James P. B. Duffy, Edwin G. Foster, Bertram I. Gerry, Walter M. Giffard, J. D. Grant, Frank C. Greene, T. W. Gregory, Theo Grieff, Herman A. Gudger, D. Marshall Haas, Robert Hall, Gustavus Harkness, C. Holland Harper, Alfred Hart, E. N. Hart, W. O. Hellwig, Jean Heysel, Chas. C. Hill, Frank H. Hill, Wm. O. Howell, Southgote Y. Hoyt, H. A. Huebotter, Charles F. Hutchison, Judson Dunbar Ives, Joseph Jessop, R. L. Jones, William E. Keily, E. T. Keim, Harry D. Kirkover, Leopold H. Korecki, Daniel E. Koshland, Wencel J. Kostir, John A. LeBlond, J. Artemus Lewis, John A. Manning, Kirtley F. Mather, Dean B. McLaughlin, Charles E. Mead, C. E. Kenneth Mees, James Mills, Roger P. Minahan, E. B. Morris, Francis J. A. Morris, Fremont Morse, James H. Moyle, John Murphy, John T. Myers, C. R. Neiswander, C. H. Ocumpaugh, Tinius Olsen, Bernhard Palm, Ernest J. Palmer, David N. Panabaker, J. E. Pearce, C. B. Pollock, Ed. Prather, Louis Quarles, George S. Raymer, John T. Reid, Edwin S. Reider, S. Lynn Rhorer, James Henry Rice, Jr., Louis Roark, H. B. Rumrill, J. C. Scanlon, G. A. Shook, Lewis H. Thornton, James Madison Todd, L. M. Todd, Edwin V. Van Amringe, Augustus L. Wallon, Edward I. Weiss, F. A. Whiting, Frederick M. Whitney, J. B. Winstanley, Percy W. Witherell, C. C. Yang, Laurence D. Yont.

THE EDUCATION NUMBER

JULY-AUGUST

The July–August Number of **Natural History** will be devoted to the service which the Museum renders to the schools and to education in general, and will be edited by Clyde Fisher, Curator of Visual Instruction, and In Charge of Astronomy.

Professor Henry Fairfield Osborn will contribute an article on "Creative Education."

Other articles will be included as follows: "The Story of the Museum's Service to the Schools," by George H. Sherwood, curator-inchief of the department of education and health and director of the American Museum of Natural History. "Nature on the Lower East Side" by Margaret Knox, principal of Public School 15, Manhattan. "The Museum as an Educational Interpreter" by Paul B. Mann, head of the department of biology in Evander Childs High School, New York City, and associate in education in the American Museum of Natural History. "The New Projection Planetarium" by Dr. W. J. Luyten, of the Harvard College Observatory. "The Still-open Road" by Dr. Frank E. Lutz, curator of insect life and research associate in outdoor education in the American Museum of Natural History. "Heredity, Environment and Response" by James E. Peabody, head of the department of biology, Morris High School, New York City. "Organic Education or the Fairhope Idea" by Marietta Johnson, director of the School of Organic Education, Fairhope, Alabama. "The Museum in the Life of the Child" by Rita Berman, author of "A Mother's Letters to a Schoolmaster."

THE AMERICAN MUSEUM OF NATURAL HISTORY
FOUNDED IN 1869

MEMBERSHIP MORE THAN NINE THOUSAND FIVE HUNDRED

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 9500 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

Natural History, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through Natural History they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843 in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herpetological survey of the Central Asiatic Expedition by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthrop collection of mammals, in **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the incomparable work of Carl E. Akeley on the Eastman-Pomeroy Expedition in Kenya and Tanganyika; in **Polynesia**, the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies**, Douglas Burden's collection of giant dragon lizards; in **North America**, the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America**, collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. a total of 2,057 reels of motion pictures were lent oaned to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES**, some exclusively for members and their children, others for the schools, colleges, and 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.

Vol. XXVII JULY-AUGUST, 1927 No. 4

NATURAL HISTORY

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY
EXPLORATION·RESEARCH·EDUCATION

EDUCATION NUMBER

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1927

Henry Fairfield Osborn, LL.D., President
George H. Sherwood, A.M., Director and Executive Secretary
Frederic A. Lucas, Sc.D., Honorary Director
Wayne M. Faunce, Sc.B., Assistant to the Director and Assistant Secretary
James L. Clark, Assistant Director, Preparation

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

Curator-in-Chief, vacant

Astronomy

G. Clyde Fisher, Ph.D., LL.D., In Charge

Minerals and Gems

Herbert P. Whitlock, C.E., Curator
George F. Kunz, Ph.D., Research Associate in Gems
Lea McIlvaine Luquer, Ph.D., Research Associate in Optical Mineralogy

History of the Earth

Curator-in-Chief, vacant

Fossil Vertebrates

Henry Fairfield Osborn, LL.D., D.Sc., Honorary Curator
Walter Granger, Curator of Fossil Mammals
Barnum Brown, A.B., Curator of Fossil Reptiles
Charles C. Mook, Ph.D., Associate in Palæontology
William K. Gregory, Ph.D., Research Associate in Palæontology
Childs Frick, B.S., Research Associate in Palæontology

Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

Frank Michler Chapman, Sc.D., N.A.S., Curator-in-Chief

Marine Life

Roy Waldo Miner, Ph.D., Sc.D., Curator
Willard G. Van Name, Ph.D., Associate Curator
Frank J. Myers, B.A., Research Associate in Rotifera
Horace W. Stunkard, Ph.D., Research Associate in Parasitology
A. L. Treadwell, Ph.D., Research Associate in Annulata

Insect Life

Frank E. Lutz, Ph.D., Curator
A. J. Mutchler, Associate Curator of Coleoptera
Frank E. Watson, B.S., Assistant in Lepidoptera
William M. Wheeler, Ph.D., Research Associate in Social Insects
Charles W. Leng, B.S., Research Associate in Coleoptera
Herbert F. Schwarz, A.M., Research Associate in Hymenoptera

Fishes

William K. Gregory, Ph.D., Curator
Bashford Dean, Ph.D., Honorary Curator
John T. Nichols, A.B., Associate Curator of Recent Fishes
E. W. Gudger, Ph. D., Bibliographer and Associate
Charles H. Townsend, Sc.D., Research Associate
C. M. Breder, Jr., Research Associate
Van Campen Heilner, F.R.G.S., Field Representative

Amphibians and Reptiles

G. Kingsley Noble, Ph. D., Curator
Clifford H. Pope, B.A., Assistant [Central Asiatic Expeditions]
Bertram G. Smith, Ph.D., Research Associate
A. B. Dawson, Ph.D., Research Associate

Birds

Frank M. Chapman, Sc.D., Curator-in-Chief
Robert Cushman Murphy, D.Sc., Curator of Oceanic Birds
W. DeW. Miller, Associate Curator
James P. Chapin, Ph.D., Associate Curator of Birds of the Eastern Hemisphere

Birds (continued)

Ludlow Griscom, A.M., Assistant Curator
Jonathan Dwight, M.D., Research Associate in North American Ornithology
Elsie M. B. Naumberg, Research Associate

Mammals of the World

H. E. Anthony, M.A., Curator
George G. Goodwin, Assistant
Frederic A. Lucas, Sc.D., Research Associate

Comparative and Human Anatomy

William K. Gregory, Ph.D., Curator
S. H. Chubb, Associate Curator
H. C. Raven, Associate Curator
J. Howard McGregor, Ph.D., Research Associate in Human Anatomy
Dudley J. Morton, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

Clark Wissler, Ph.D., Curator-in-Chief

Science of Man

Clark Wissler, Ph.D., Curator-in-Chief
Pliny E. Goddard, Ph.D., Curator of Ethnology
N. C. Nelson, M.L., Associate Curator of Archæology
Charles W. Mead, Honorary Curator of Peruvian Archæology
Harry L. Shapiro, Ph.D., Assistant Curator of Physical Anthropology
Margaret Mead, Ph.D., Assistant Curator of Ethnology
George C, Vaillant, Ph.D., Assistant Curator of Mexican Archæology
William K. Gregory, Ph.D., Associate in Physical Anthropology
Clarence L. Hay, A.M., Research Associate in Mexican and Central American Archæology
Milo Hellman, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

Roy C. Andrews, D.Sc., Curator-in-Chief
Walter Granger, Curator in Palæontology
Charles P. Berkey, Ph.D. [Columbia University], Research Associate in Geology
Frederick K. Morris, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
Amadeus W. Grabau, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

George H. Sherwood, A.M., Curator-in-Chief

Library and Publications

Ida Richardson Hood, A.B., Acting Curator
Hazel Gay, Assistant Librarian
Jannette May Lucas, B.S., Assistant Librarian—Osborn Library

Education and Public Health

George H. Sherwood, A.M., Curator-in-Chief
G. Clyde Fisher, Ph.D., LL.D., Curator of Visual Instruction
Grace Fisher Ramsey, Associate Curator
William H. Carr, Assistant Curator
Nancy True, A.B., Assistant
Paul B. Mann, A.M., Associate in Education
Frank E. Lutz, Ph.D., Research Associate in Outdoor Education

---

Charles-Edward Amory Winslow, D.P.H., Honorary Curator of Public Health
Mary Greig, A.B., Assistant Curator of Public Health

Public Information

George N. Pindar, Chairman
George H. Sherwood, A.M.
William K. Gregory, Ph.D.
Wayne M. Faunce, Sc.B.
Clark Wissler, Ph.D.

Natural History Magazine and Advisory Committee

George H. Sherwood, A.M., Chairman
Departmental Editors
A. Katherine Berger, Assistant Editor
Clark Wissler, Ph.D.
George N. Pindar
Frank M. Chapman, Sc.D.
Frank E. Lutz, Ph.D.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION THROUGH THE MUSEUM

EDUCATION NUMBER

CLYDE FISHER, EDITOR

JULY-AUGUST, 1927

[Published October, 1927]

VOLUME XXVII, NUMBER 4

NATURAL HISTORY

VOLUME XXVII CONTENTS FOR JULY-AUGUST NUMBER 4

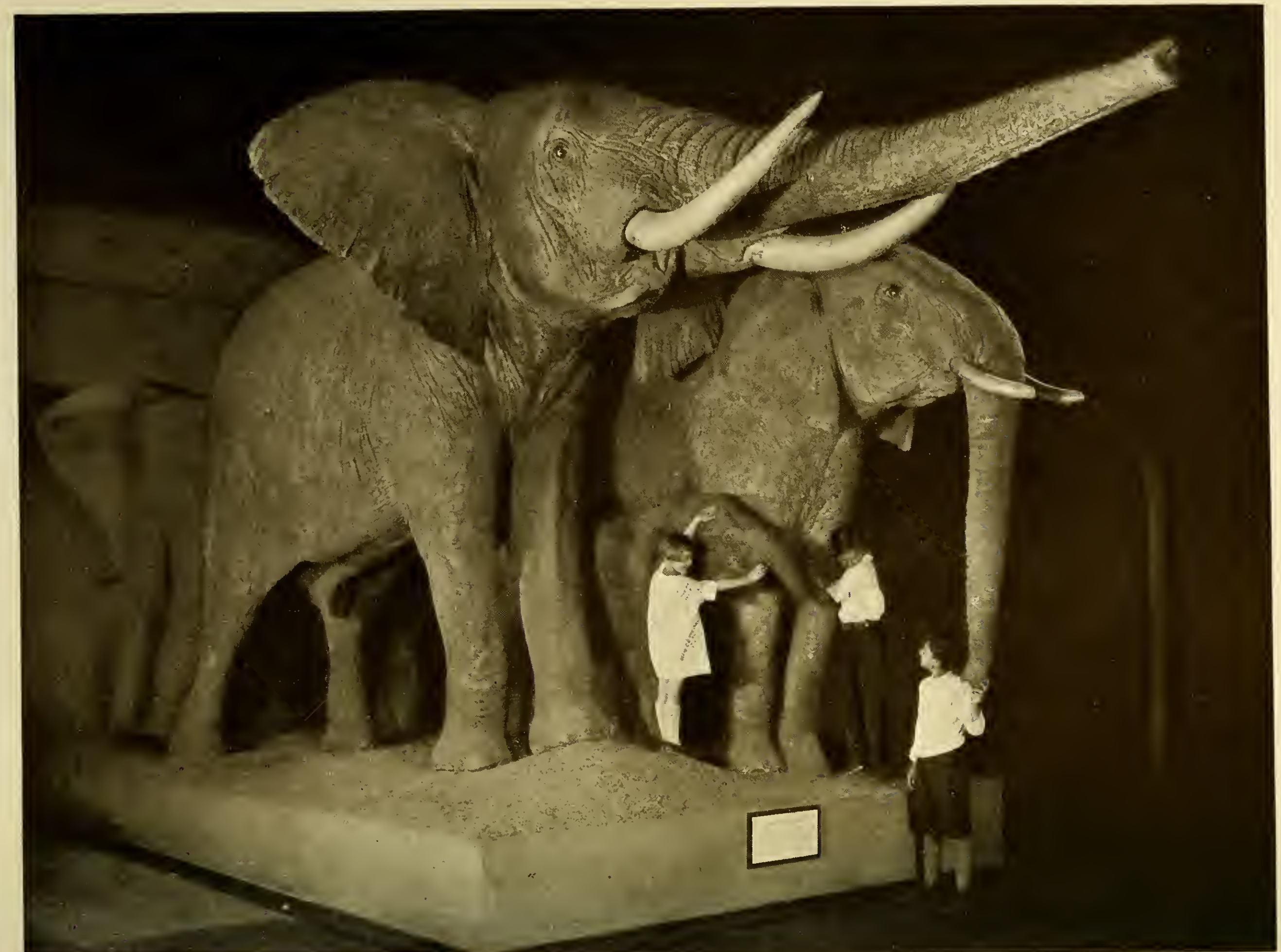
Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th Street and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.



ORIGINAL OBSERVATION IS A FORCE IN CREATIVE EDUCATION
Photograph taken in the American Museum

NATURAL HISTORY

VOLUME XXVII JULY–AUGUST, 1927 NUMBER 4

"Creative Education"[1]

BY HENRY FAIRFIELD OSBORN

President of the American Museum of Natural History

FIFTY years as a teacher have afforded an original retrospect and prospect of the art of education, an art which has an unchanging element in the quality of the human mind and an ever-changing element in the vicissitudes of our environment which we call civilization. Throughout this long half-century period I have been consistent with my oft-repeated advice to my students, namely, to think a subject out for oneself and then to read what others have thought about it. I have myself given an immense amount of personal thought to the methods of intellectual education, and I am free to confess that I have depended very little on reading even of the works of the great masters and innovators to whom I refer from time to time in this volume. My rule with myself and with my students has been, first, to try to master a subject or to thoroughly understand it; second, to try to add something of my own to this subject—that is, to produce or create something new. I have followed this productive principle successively in psychology, in neurology, in comparative anatomy, in palæontology, in biology, and, finally, in the philosophy of life. In each of these great subjects I have undertaken original research and publication and have attempted to impress upon myself and upon the talented students who sought my advice the spirit of thoroughness and then of creation or production.

REAL BASIS OF CREATIVE EDUCATION

Beginning in the autumn of 1881 as a very young and inexperienced assistant professor of comparative anatomy in the College of New Jersey (the larger title of Princeton University was not assumed until 1896), I opened my courses very much along the lines I had myself followed two years before in the laboratories of Francis Maitland Balfour at Cambridge and of Thomas Henry Huxley in London. While the technique and outline of the courses followed the general method introduced by Huxley into biological teaching, my attitude toward the students was rather that of Balfour in his splendid course in comparative anatomy, namely, a personal and more or less intimate attitude which is possible in classes of fifteen to twenty-five but impossible with the very large classes of the present college and university period. With my college students, I depended from the outset neither upon discipline nor upon the marking system, but upon the *inherent interest of the subject.* Once captivated by the interest of the subject, a student needs to be held back rather than pushed forward! I felt instinctively that original observation and original thinking by the students were far more im-

[1]NATURAL HISTORY is privileged to publish advance excerpts from Henry Fairfield Osborn's book, *Creative Education.* (Charles Scribner's Sons, New York.)

portant than any instruction or body of learning I could give them, and I began to practise creative methods of education long before I had formulated any theory or principle of education.

One of the most brain-stirring periods of my life was in my study in the American Museum of Natural History when Baca-Flor, the Peruvian portrait painter, narrated to me his search for the lost art of the ancients, as he termed the masters of painting of the fifteenth and sixteenth centuries. For fifteen years he had read all that was written and had listened to all the lectures offered in Paris, but no one told him the secret of the ancients. Finally he concluded that their art was lost and must be rediscovered. Similarly, and on my own account, in 1903[1] I came to the conclusion that something had been lost in the art of education. I looked into some of the pedagogic literature of the day; it left me entirely unsatisfied; I felt that some principle must be rediscovered. Then I began to delve into my own experience and to wonder how I got my own education. I tried to get down to the very bottom of things and settle upon solid bases, cutting out of vision all the temporal and contemporary supports. One essay which may have helped me was Ruskin's "Seven Lamps of Architecture," but it was a mere coincidence that I came to the conclusion that the solid bases of education lay not at all in what modern pedagogues, such as President McCosh of Princeton and President Eliot of Harvard, were debating, that their controversy was matter which had temporarily assumed the aspect of solidity and of real importance, and that the real basis of education was the balanced or reasonable or well-adjusted working of seven principles, or factors, or forces, or influences as intimately related as seven harmonious and beautiful sisters, so that none could be complete without the others; that every well-educated man from the very beginning had unconsciously worked out these seven principles in his own self-education and that the measure of his success and influence was the measure in which he employed them all or worked toward all, some flowing into him and some flowing out of him.[2]

What are these principles or factors which are essential to the creative and productive mind, and what educational theory is most apt to develop them?

So far as intellectual progress is concerned—and I am not now discussing religious, moral, or physical progress—the first and most fundamental of these forces are in the nature of canons, or standards: they lie in the distinction of TRUTH from error, in the appreciation of BEAUTY and fitness, and in the application of these standards to thought. Together with our standards come our sources of knowledge, and there arises, as the first, that of LEARNING from the stores of tradition, from books, and the experience of man in our own and previous generations; there follows close, as the distinctively nineteenth-century source of knowledge, that of direct OBSERVATION of men and of nature. Then, for the testing of our knowledge, there is the triumphant crucible of human REASON. Next, our standards, our knowledge, and our reason seek EXPRESSION in spoken and written language. Finally, as the supreme human, most closely approaching the

[1]Osborn: *The Mediæval and the True Modern Spirit in Education.*

[2]This seemed far more fundamental than the *elective* vs. *required* system, than *modern* vs. *classic* languages, than *literary* vs. *scientific* subjects of training—questions which have been debated *ad nauseam* since McCosh and Eliot crossed their sword in the '80s.

super-human, power, the six preceding forces lead to the PRODUCTION of new ideas and to all the forms of original activity. This is the epitome at once of the 'universal,' both in intellect and in education.

TRUTH, BEAUTY, LEARNING, OBSERVATION, REASON, EXPRESSION, and PRODUCTION, in their most comprehensive forms, are the seven forces of progress, and the *factors of education* are the processes of storage of these forces by coöperation of teacher and student, the former with his constantly diminishing, the latter with his constantly increasing, responsibility. The batteries become ready to discharge, the potential intellectual energies ready to be liberated; and the cunning business or art of the teacher consists in patience and alertness in ways, means, and methods, in repairing or supplying deficiencies, and in discovering powers which are never actually to be idle.

This centrifugal versus centripetal idea, however, was a mere working hypothesis, tested perhaps, or sought to be tested, in my own long search; how about other men? Looking then into the lives of others, of scientists, of artists, of men of letters, I found corroboration. The principle of the seven cardinal elements of education is my own; if it were not I should be false to my profession of origination. It is the product of fifty years of experiment and observation as a teacher, not of reading what other people have written about education. In working it out I had undoubtedly observed and profited by the merits and failures of the work of McCosh, Guyot, Brackett, Balfour, Huxley, and others of my great teachers, but it was not until after I had worked it out that I began to scan Spencer, Rousseau, Froebel, Pestalozzi, Montessori, etc. If I had reversed this order and started by reading what others had to say about education, I fear it would have atrophied my creative powers, such as they are.

CREATIVE EDUCATION OF THE CHILD

The intellectual development of the child, as well as of the school boy and girl, fascinated me in the American Museum, where I discovered that the most surprising intellectual predispositions and tastes may manifest themselves at a very youthful age.

I recently listened to a discussion of this subject by J. Howard Whitehouse, warden of Bembridge School, Isle of Wight, and William Wyamar Vaughan, headmaster of Rugby, in which the positive and negative sides were taken, and the advantages and disadvantages, the gains and losses were briefly summarized. Warden Whitehouse, who has recently made a representative collection of actual creative school work in England as a gift to the department of education of New York University, took the side which I am supporting in the present volume, and to show his point of view I may quote from one of his recent works:[1]

> All creative interests which come into the lives of boys are good and may prove of transcendent importance. It is not that we want a boy to cut woodblocks in order to get his living when a man as a wood-engraver, any more than we desire a boy who loves flowers and creates a beautiful garden to become a professional gardener. Such boys in following these and other creative activities are unconsciously forging keys unlocking for themselves the entrance to courts of beauty and of joy—the beauty of all true work, the joy of service and self-realisation expressed in all true work, and to these courts they come with standards of taste and judgement achieved through personal effort and experience, not docilely received from others.

[1] J. Howard Whitehouse: *Woodcuts*, page xi.

So far as I observed in the English school work exhibition at Oxford, the creative movement in certain schools in England has advanced much further than in America; the actual work of the students themselves, in wood-engraving, for example, attains a very much higher level than any of our schools show. On the other hand, in the Lincoln School of New York City the creative school work in literature has already produced a surprising variety of composition in prose and verse.

CREATIVE INTELLIGENCE

The one great force of life is its renewing and creating power, which throughout all Nature marks the impassable line between the life-world and the matter-world. True education takes its keynote from the life-world; it must instill in young and old its renewing and creating power.

Education is such a vastly comprehensive term that it includes every power and function of man as a whole and of every cell of which man's body is composed. You cannot detach the education of the cells of the frontal lobes which distinguish the high order of human brain from the education of the cells of the liver which supply the frontal lobes with chemical reactions necessary to pure rather than to atrabilious thought. We need all the physical and all the psychical powers, and not the least the moral; we need to develop the will, the determination, the energy, no less than the imagination, the individuality.

It is part of my creed that spiritual, moral, and physical forces are absolutely essential as the environment of the intellectual forces, but in this volume I am writing only of the intellectual aspects of creative work. The genius of creative talent relies on the brother geniuses of hard work, of self-control, and of persistent determination. The art of the teacher, whether in school, college, university, or museum, is to discover this creative talent in his students and to encourage it by giving it proper nurture and environment. The creative mind is born, not made; it is an intellectual urge which may manifest itself in one of many thousand lines of activity of the human mind. Whether in industry, science, art, or literature, the impelling motive of creative talent is to add something new or true or beautiful to our civilization. The creative mind may be born quite alone or as one of a group of kindred and productive predispositions, as in a rare genius like Leonardo da Vinci.

The bearing of these reflections on the modern practice of education is obvious. Originative and creative power in the germ is the very oldest of the distinctively human faculties, and the cultivation and development of this power should be the chief end of education, to which all other forces should contribute. Man differs more, perhaps, with respect to this originative faculty than any other animal; there is a pretty sharp division between the sulphidic or productive and original mind and the bromidic or parrot mind. But in educating youth we should always proceed upon the theory that there is some sulphide if we can only discover it; if it is not there we should seek to engender it. With some exceptions our general tendency in education is to encourage the bromidic habit of mind; at least, our systems of premiums and awards and honors and standing are largely designed for exceptional memory rather than for exceptional originality and creative power.

THE JOY OF CREATIVE WORK

Since my regretful retirement in 1908 from active teaching as head of the Department of Zoölogy of Columbia,[1] I have solaced myself as an educator by endeavoring to adapt education to the new problems of civilization and the prospects of the future. From the standpoint of the lofty creative aim of education, the present prospects in America are far from bright, because the imitative element in our civilization is so dominant. More or less servile imitation of the creative achievements of the past lead on to fame and fortune and to other rewards of modern life. Imitation in speech, in manner, in dress, is becoming world-wide, especially through the press and its methods of photographic reproduction. In almost every country beauty and originality of design are giving way to uniform and tiresome mediocrity. Even more lethal or deadly is the mediocre and stereotyped environment of our thought.

Let us, therefore, stoop to simple and primitive methods in order to conquer; let us show our youth that creative work is far more attractive than sport, than any of the modern forms of amusement, than newspaper or magazine reading, than any form of social dissipation, and, above all, that it has far higher rewards than any form of imitative work, however lofty the motive. Let us conclude this prospect with the inimitable apostrophe of Bergson.[2]

Philosophers who have speculated on the significance of life and the destiny of man have not sufficiently remarked that Nature has taken pains to give us notice every time this destiny is accomplished; she has set up a sign which apprises us every time our activity is in full expansion; this sign is joy. I say joy; I do not say pleasure. Pleasure, in point of fact, is no more than an instrument contrived by Nature to obtain from the individual the preservation and the propagation of life; it gives us no information concerning the direction in which life is flung forward. True joy, on the contrary, is always an emphatic signal of the triumph of life. Now, if we follow this new line of facts, we find that wherever joy is, creation has been, and the richer the creation the deeper the joy. The mother looking upon her child is joyous because she has the consciousness of having created it, physically and morally. A man who succeeds in his enterprise—for example, a captain of industry whose business is prospering—is he joyous solely on account of the money he is winning and the notoriety he has acquired? Doubtless these elements count for much in the satisfaction he feels; but they bring him pleasures rather than joy, and whatever true joy he tastes belongs essentially to the consciousness he has of having established an enterprise which marches on, of having created something that goes ahead. Consider exceptional joys like those of the great artist who has produced a masterpiece, of the scientific man who has made a discovery or invention. We sometimes say they have worked for glory and derive their greatest satisfaction from the applause of mankind. Profound mistake! We care for praise in the exact measure in which we feel not sure of having succeeded; it is because we want to be reassured as to our own value and as to the value of what we have done that we seek praise and prize glory. But he who is certain, absolutely certain, that he has brought a living work to the birth, cares no more for praise and feels himself beyond glory, because there is no greater joy than that of feeling oneself a creator. If, then, in every province, the triumph of life is expressed by creation, ought we not to think that the ultimate reason of human life is a creation which, in distinction from that of the artist or man of science, can be pursued at every moment and by all men alike; I mean the creation of self by self, the continual enrichment of personality by elements which it does not draw from outside, but causes to spring forth from itself?

[1]On the presentation of a complete plan for biological teaching in Columbia University, the author was elected DaCosta Professor of Biology (Zoölogy) in 1890. On retiring from the active chair to become President of the American Museum of Natural History in 1908, the author was given the title of Research Professor of Zoölogy in Columbia, in reference to his future dedication to research and writing.

[2]Henry Bergson, Huxley Lecture. Delivered at University of Birmingham, May 29, 1911: reprinted as "Life and Consciousness" in the *Hibbert Journal*, Vol. X, No. 1, October, 1911, pp. 24-44.

THE GOAL OF CREATIVE EDUCATION

There is little doubt in my mind that potential abilities, for the most part, remain undiscovered, for it is often only a happy accident which brings an inspiring object or inspiring idea within the range of the intellectual taste or predisposition. Sometimes this concurrence of predisposition and inspiring object comes early in life, but quite often it happens late in life and after a long career in some pursuit to which one is not fitted by natural endowment. I have in mind two marked cases of this kind of late entrance into a highly successful and productive career; for personal reasons only one may be cited: James Terry, a man of business, while visiting the country house of a friend, was descending a stairway in the dark and groping his way by passing his hand along the wall. Suddenly his hand slipped into an alcove or recess, at the bottom of which he touched a large stone axe or 'celt.' Grasping the celt and hastening to the library, he inquired of his friend where it had been found and if others might be found in the same locality. On the following day he visited the locality, secured other celts and stone implements, and thereupon became infatuated with the subject of American archæology. He abandoned business and devoted the remainder of his life to archæological exploration and collection, thus accumulating the extensive James Terry Collection of the American Museum of Natural History, one of the finest of its kind.

A closely similar experience was that of a merchant of Ipswich, England, J. Reid Moir, who entered upon a career in prehistoric archæology through the casual handling of a single flint implement.

The unhappy people of the world include two classes: those who have no creative talents, and those who possess talents and never discover them. Our goal of creative education, therefore, is to discover the potential abilities in science, art, and literature which undoubtedly exist in the minds and spirits of the youth drawn from the many races which in the past two thousand years have created the science, art, and literature of Europe. Such abilities are often like beautiful, tender, and sensitive plants which soon perish in an unkindly, unsympathetic environment, but which, if fostered and encouraged, will blossom and bear fruit in our material and mechanical civilization, which is inwardly yearning for the True, the Beautiful, and the Good.

The Story of the Museum's Service to the Schools

METHODS AND EXPERIENCES OF THE AMERICAN MUSEUM OF NATURAL HISTORY

By GEORGE H. SHERWOOD
Director of the American Museum and Curator-in-Chief of its Department of Public Education

A DUSTY, musty place where curious and unfamiliar animals are stored and seldom seen, is the average person's idea of a museum of natural history. This popular conception is perhaps well expressed by the little boy who, after spending an afternoon at a museum with his teacher, rushed home and breathlessly exclaimed to his mother, "Oh, Mamma, I have had a wonderful time this afternoon!"

"Where have you been?" asked his mother, and the boy replied:

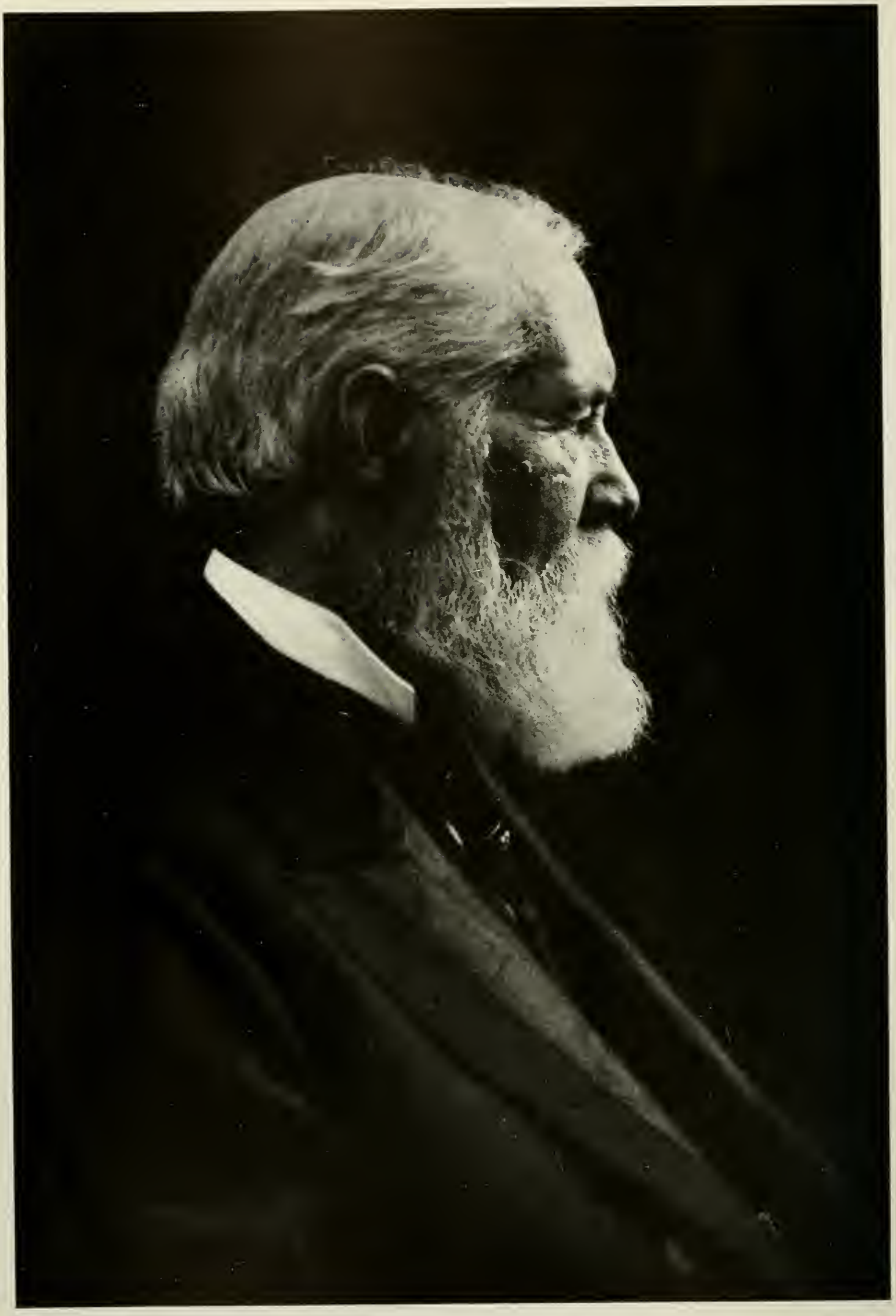
"Oh, teacher took me to the dead circus!"

The modern up-to-date museum is far from being a "dead circus." If it is performing its proper function, it is very much alive. It becomes a part of the life of the people. It is not enough for it to be a safe-deposit for valuable records, for strange and beautiful specimens, and to accumulate a vast store of information. It must be prepared to make that information available for the people. Museums stand as the great exponents of objective teaching and the modern museum has become an aggressive force in education. This is particularly true of natural history museums.

Through improvements in the technique of preparation, through attractive and readable labels, through the development of the habitat group—which shows the inter-relation and interdependence of life, the exhibition halls of the up-to-date natural history museums have become veritable magnets which draw both young and old. The attractiveness of the exhibition hall presentations reflects the arduous efforts of the explorers and field workers, who have penetrated to remote corners of the earth to assemble facts; and the careful and painstaking study of the curator who has coördinated these facts and drawn from them the proper deductions. It is, however, through direct contact with the school system that museums have become entitled to consideration as important factors in education.

The American Museum of Natural History claims to belong to the modern museum group and the purpose of this article is to set forth the various phases of the service which it is rendering to schools, colleges, and universities.

The group of public-spirited citizens who organized and founded the American Museum of Natural History in 1869 realized the possibility of service to the schools on the part of the Museum. The general educational value of its collections and exhibits was widely accepted, but as the institution grew, it became more and more evident that if the Museum was to fulfill its function it must establish closer relations with the public schools and the educational system. The desirability of museum extension was thus early recognized and the first steps in accomplishing this were taken in 1880, when the Trustees authorized Albert S. Bickmore—the superintendent of the Museum—to prepare for the public school teachers a special course of



ALBERT SMITH BICKMORE
1839–1914

Professor Bickmore originated the plan of the American Museum in 1868, and from 1880 to 1904 was the first curator of its department of public education lectures on natural history to be given at the Museum and to be illustrated with Museum collections. Thus began the system of visual instruction so closely identified with Professor Bickmore's name. Professor Bickmore was a pioneer in education by the visual method. When he took hold of the work, the technique of making lantern slides was in its infancy and simple projection machines had not been developed. He applied himself to this new field in education with the same enthusiasm and persistence which had enabled him to create the American Museum of Natural History; for it was he, more than anyone else, who brought together the Founders of the Museum and fostered it in its early days.

Professor Bickmore ransacked the corners of the earth for the best materials. There was not a traveler of note who came to New York, whom he did not seek out and ask for negatives. He journeyed to remote lands himself to obtain first-hand information, and in later years often sent out special photographers in order to obtain the best results possible. One of the greatest contributions which the American Museum has made to education is this work of Professor Bickmore. Even today, notwithstanding the great advance in photography, the excellence of a "Bickmore slide" is seldom, if ever, surpassed. Professor Bickmore directed this educational work until 1904, when ill health compelled him to retire from active service.

The keynote of this first period of the Museum's educational activities (1869 to 1904) was instruction for teachers. That of the second period (1904 to 1927) is instruction for pupils. During the first period, the scope of the work included the schools of the entire state. In the second, attention was focussed primarily on the schools of New York City, because after 1904, the State withdrew its financial support, while the City gradually increased its appropriations for maintenance. It was proper therefore, that the Museum should give its attention, first to the needs of the City schools, rather than to those of the State. Moreover, the introduction of nature study into the curriculum, the development of modern pedagogical methods, the growth of libraries, the perfecting of projection apparatus—which made material for illustrated lectures more practicable—and the continued increase in the wealth of the Museum's educational materials naturally all contributed to direct the workinto new fields. The means of instruction which have been developed by the American Museum during the last twenty-three years, are designed to meet the conditions of the New York City school system. They are, however, based on such fundamental pedagogical principles that they may easily be modified to apply to any school system.

The Museum's program of school service has the hearty endorsement of the Board of Education, superintendents, and other school officials, but the conduct of the work is left entirely to the department of public education of the Museum, which is responsible for the relation with the schools. This action on the part of the school authorities has been an important factor in the success of the work, because it has simplified service and because it brings the Museum's staff into direct contact with the principals and teachers, thus leading to a better understanding of their needs.

The members of the Board of Estimate and Apportionment too, have

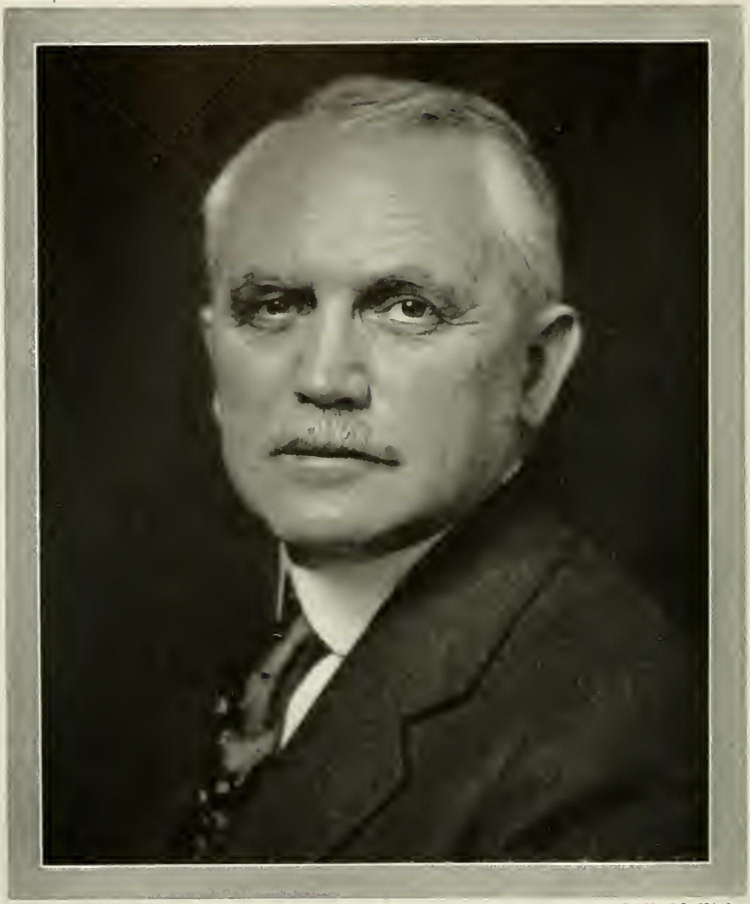
For school delivery service.—Throughout the school year this fleet of cars is kept busy distributing and collecting motion-picture films, lantern slides, and natural history specimens lent by the Museum to the public schools

Large groups of children often are conveyed to the Musuem in buses which are arranged for by interested and enthusiastic teachers. Each child contributes his own fare, which is purely nominal

Photograph by Fowler

HENRY FAIRFIELD OSBORN, LL.D., D.SC.
President of the American Museum of Natural History

Educator, author, administrator,—always a student with his students,—Professor Osborn early in his career independently formulated the theory of creative education and applied it throughout his fifty years as a teacher. During his administration as president of the American Museum there has been a notable advance in the teaching value of the Museum exhibits through attractive grouping and posing, and his presentation of the collections has become a standard for other institutions. His work in public education was acknowledged in 1923 by the Roosevelt Memorial Association in the award of the Roosevelt Medal of Honor



Photograph by J. H. McKinley

GEORGE H. SHERWOOD, A.M.

Director of the American Museum of Natural History and Curator-in-Chief of its Department of Public Education

Mr. Sherwood came to the American Museum from Brown University, and for twenty-three years has been head of the Museum's department of education. It is under his supervision that the present methods of the Museum's extensive coöperation with the schools of New York City have been developed. Mr. Sherwood is a practical teacher who believes that the training of children is the most important vocation in the world

Photograph by Underwood & Underwood

CLYDE FISHER, PH.D., LL.D.

Curator of Visual Instruction, American Museum of Natural History

Doctor Fisher's practical experience in the schools of Ohio and Florida, his training at Johns Hopkins University where he received his doctorate in botany, together with his enthusiasm as a teacher, have developed to a high degree his natural, rare talent of stimulating interest, and imparting knowledge to young people. He has been a member of the education department for fourteen years, and has rendered exceptional service in promoting the growth of the Museum's methods of visual instruction

Photograph by Julius Kirschner

GRACE FISHER RAMSEY

Associate Curator, Department of Education, American Museum of Natural History

Through her training in the Buffalo State Normal School, of which she is a graduate, and her twelve years' experience as a teacher of science in the high schools of New York State, and as director of Nature Study and School Gardening, Mrs. Ramsey has gained a clear conception of the needs and requirements of teachers. During the eight years she has been connected with the department of education in the American Museum, she has had the responsibility of developing its extensive lantern slide service, and has recently been placed in charge of the motion-picture loans to the schools of the city expressed their belief in the value of the Museum's service to the schools by providing for the construction and equipment of a special building—the School Service Building—to house these activities. This splendid new equipment will enable the Museum to increase its usefulness to teachers. The School Service Building will be described later in this article. The Museum service is not local, for the Museum messengers penetrate all boroughs of the city and deliver our visual instruction material free to any school anywhere in the Greater City.

While the department of public education is the agent of the Museum in its contact with the schools, the department is in large measure dependent upon the other scientific departments for the wealth of nature material which it can offer to the schools. The Museum explorations bring together rare and valuable collections; the researches based on this material and the published results represent the work of the respective scientific departments. It is the function of the department of public education to digest this material and to present such portions of it as will be useful to teachers and pupils.

The various branches of the Museum educational work fall under two main headings, namely: (a) Extra-mural activities—Museum service in the schools, and (b) Intra-mural activities—School service at the Museum. Under the first group are the circulating nature study collections, the distribution of lantern slides and motion picture films, lectures in the schools and in special lecture centers, and the circulating collections loaned to the branch libraries. The intra-mural activities include lecture courses at the Museum—instruction for the blind and sight conservation classes; exhition-hall instruction and guidance for visiting classes; coöperation with the training schools for teachers, the high schools, and colleges, and coöperation with nature organizations such as Boy Scouts, Girl Scouts, and similar groups.

The extent of this service is indicated by the following statistics showing the scope of the work in 1926:

Pupils using nature study collections	765,790
Pupils and teachers attending lectures	171,769
Attendance at library loan exhibits	32,592
Pupils viewing motion picture films	530,955
Pupils viewing lantern slides	4,358,423
Total number of school children reached by educational activities	5,859,529

The oldest feature of the Museum's School Service is the distributing of nature study collections. This work was begun in 1904, at about the time when nature study was introduced as a subject in the curriculum of the New York Public Schools. Its purpose was to place in the hands of the teacher, so far as practicable, the actual specimens required in her work. The collections are of small size, each being contained in a wooden carrying case about the size of a large suit case. The material comprises representative specimens of mammals, birds, insects, lower invertebrates, minerals, woods, and public health charts and exhibits.

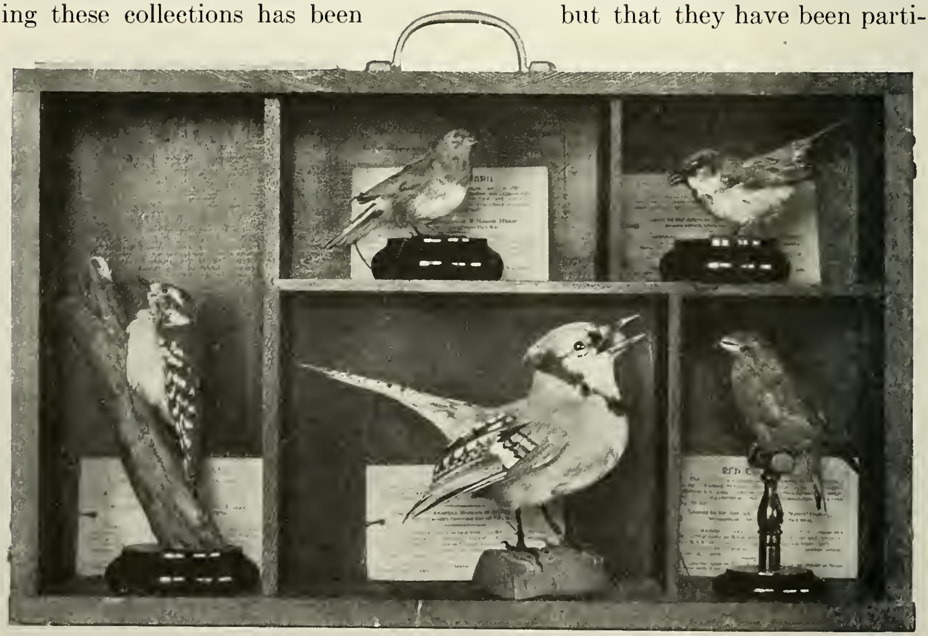
Recently we have added to our circulating collections a series of the habitat group type which is intended to give more of the environment of a species than is possible with a hand specimen. For example: the set labeled "Birds That Are Our Friends" has a painted background showing rolling fields with trees in the distance, while perched on a tree in the foreground is a screech-owl with a mouse in his beak;

on the ground a pair of quail or bob-white are eating seeds; a cuckoo (an insect eater) is resting on a trunk, and near by is a goldfinch. These birds are useful to man in saving his crops from insects, weeds, or vermin.

One of the most important factors in the growth and development of the circulating nature study collections is the fact that these are loans and not gifts to the schools. A former teacher once said "If you wish a friend really to read a book, lend it, do not give it to him." Following this principle has maintained a personal contact between the staff members of the Museum's educational department and the teachers, which has vitalized the work.

Realizing that a teacher's time is fully occupied, the method of obtaining these collections has been made as simple as possible. The Museum furnishes blanks upon which the principals make application for the collections, and indicate the sequence desired. Delivery is then made by the Museum messengers, who call again at the end of the loan period—that is, in three or four weeks—and replace the first exhibit with another.

To the question, "Is this method of visual instruction worth while?" the following statistics are in themselves a sufficient answer. In 1926, from a total of 600 schools 443 were regularly supplied, and 970 collections were in circulation, while the total number of pupils studying the collections was 765,790. Certainly, if these nature-study collections were not practical, we would not have so many busy teachers beseeching us for this material. We learn from the teachers that not only have the collections proved their value in teaching facts about nature, but that they have been particularly useful in language work, especially with foreign-born children.



The blue jay set.—These specimens may be easily removed from the case and handled by the pupils

Perhaps their greater service, however, is giving these city children a glimpse of the great out-of-doors. The country dweller has very little conception of the limited horizon of thousands of these children in the congested parts of the city. Many of them never get more than a few blocks

Birds that are our friends.—One of the small habitat-group cases of birds with explanatory labels, circulated among the city schools

from the place where they were born. The school building is the limit of their travels. The dog, the cat, and perhaps the horse are the only animals they have ever seen. The vegetable market window and the push-cart represent their knowledge of flowers. No wonder, then, that the little nature-study exhibits from the Museum stimulate their imagination and broaden their outlook!

The following observation gives some idea of this restricted environment. A teacher brought her class to the Museum to hear one of the illustrated lectures. Many of these pupils had never been on an elevated train before, although they had seen the trains go thundering by daily. Several of the girls were car-sick.

Through the Alice R. Northrup Memorial, pupils of the city schools who have done efficient work in the nature rooms of the School Nature League are taken for two weeks to a farm in the Berkshires. The first morning after arrival one little girl from the lower part of the city saw a horse grazing in the yard. She burst into sudden laughter and exclaimed:

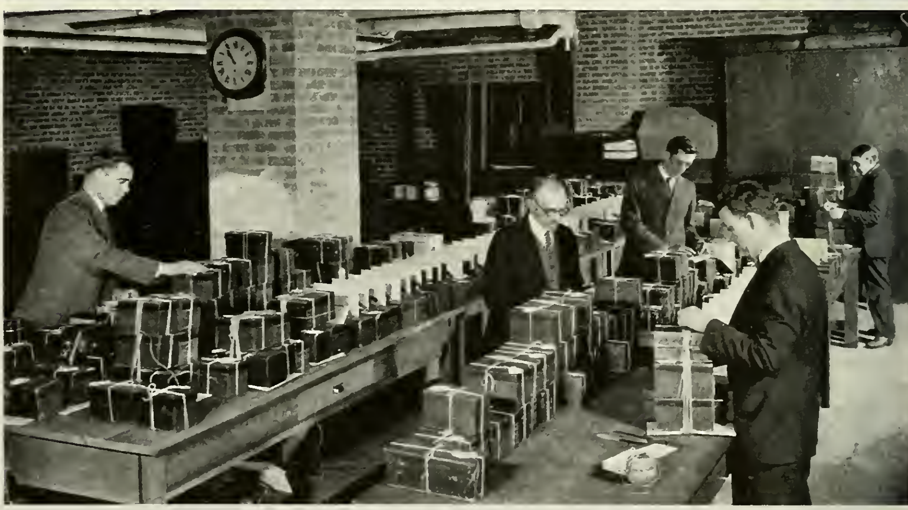
"What a funny way for it to eat!"

"How should it eat?" she was asked, and she replied in digusted tones,

"Out of a nosebag, of course."

The phase of our school service which has had the most remarkable development and which probably serves the greatest number of teachers, is the lantern slide circulation. The Museum has unrivaled opportunities to secure material for the making of slides for school use. A photographic outfit forms part of the equipment of every expedition sent into the field. As our expeditions reach all parts of the earth, the photographic results have enriched our library of photographs until we now have more than 125,000 negatives upon which we can draw for illustrations. Our library of lantern slides, of which Professor Bickmore's superb collection of slides formed the nucleus, number more than 70,000 and cover not only natural history topics but also geography, history, industries, and in fact, nearly every phase of human endeavor—past and present.

In 1914 the Museum offered to make these slides available to the teachers of the city on a loan system by which the slides would be delivered to any school in the city by Museum messengers—as is done in the case of the nature study collections. The Board of Education approved this



Above.—Lantern slide room in the School Service Building.—From here more than 800,000 lantern slides were circulated without charge to New York City schools in 1926

Below.—The shipping room in the School Service Building.—Here are some of the orders of lantern slides packed for the day's delivery to public schools proposition and until the present year made a small appropriation, which in 1926 amounted to $3750, for its support. This appropriation, however, covered only a fraction of the actual cost which in 1926 totaled approximately $22,000. At the present time the *entire* cost of the slide distribution, as well as of the other branches of our educational activities is borne by the Trustees either from their own funds or from appropriations for maintenance by the City.

The growth of the slide service has been phenomenal and its extent can be seen at a glance from the following statistics:

	1917	1920	1923	1926
Number of P. S. borrowing	84	154	240	320
Total number loans	1,131	2,435	9,677	18,470
Total Slides	63,111	138,133	440,315	808,789

The value of this visual instruction material to teachers is obvious. The slides cover a wide range of subjects which are taught in the classroom. The use of the slide in classroom and assembly simplifies the teacher's task and enables the pupil to absorb information more quickly and permanently.

Teachers may make their own selection of slides from our library. Realizing, however, the many demands upon a teacher's time, we have anticipated their needs by preparing a series of lectures illustrated with from thirty to eighty slides and accompanied by a suitable manuscript which enables the teacher to give a lecture with a minimum of effort. There are now some seventy of these sets in service. The slide librarian has also selected about 200 small groups of slides illustrating topics of grade work, without manuscripts. Catalogues of the lecture sets and groups, as well as of the general slide collection, are sent to teachers who can then make their selection of material according to classroom needs. The great desideratum of the slide service is duplicate slides. Unfortunately the great majority of our slides are not duplicated and this is true of many of the prepared lecture sets. The demand for this material is so great that some of the lecture sets are reserved eighteen months in advance. A fund of from $10,000 to $15,000 or any part of it would assist in relieving the situation. Here is a concrete instance where a friend of the Museum could confer a great boon on teachers and enrich the lives of thousands of children by providing the means for duplicating slides—the value of which has been proved.

Experience has shown that both the lantern slide and the motion picture are important aids in visual instruction, and one supplements the other. To supplement its slide distribution the Museum has also established a film service which is growing rapidly. The Museum messengers deliver the films to any school in Greater New York that desires them and there is no charge. In 1926, 91 schools were supplied and more than 2000 reels were loaned, while the number of children that saw them was more than 500,000.

In building up our film library we have had two objects in view, first, the preservation of important natural history records, and second the acquisition of material for service to the public schools, and the Museum has been most fortunate in securing such an excellent series of motion pictures. Our pictures have been secured by

Indians of the Eastern Woodlands.—One of the many special exhibits lent to public libraries of the city

gifts from friends of the Museum, by members of the Museum staff on expeditions, and by purchase. Our library includes "How Life Begins," by George E. Stone; "Nanook of the North," by Robert J. Flaherty; "Merin the Nomad," and other Mongolian pictures, by Roy Chapman Andrews and James B. Shackleford; "Trailing Wild Animals in Africa," by Martin Johnson; "The True North" by Captain Jack Robertson; three sets of the Yale Chronicles of America Photo Plays; "Everyday Life of the People in France," by Mr. and Mrs. Philip H. Pratt; "Adventures of a Gray Squirrel," and others pictures of mammals, birds, and wild flowers, by Clyde Fisher; and in addition, many reels presented by Mr. George D. Pratt and other friends.

Recently the United States Bureau of Mines has selected the American Museum of Natural History as a depository and distributing center for its films. These are mainly on industrial subjects. Already 69 reels have been added to our loan series.

Twelve reels of Canadian subjects have been deposited with the Museum from the Canadian Government Motion Pictures Bureau, Department of Trade and Commerce, and 4 reels by the Consolidated Gas Company of New York.

The Museum's film library is also augmented by the renting of suitable films from non-theatrical or theatrical distributors. Many of the school lectures by members of the Museum staff are illustrated with such films.

It is not enough that the Museum supply specimens, lantern slides, and films to the schools. There is an ever-growing call for lectures in the schools. These requests have been met so far as our limited staff could be made available. As a branch of its lecture service, the Museum has been giving a series of illustrated talks for children in certain centrally located schools, with the object of giving the pupils the benefit of our lectures without the expenditure of carfare to the Museum—a very serious matter in many families.

For several years the lending of nature-study material for schoolroom use has been well supplemented by the special exhibits lent to public libraries of the city. In the Museum's study collections are clothing, pottery, baskets, industrial models, dolls, implements of war, birds, animals, and many other types of specimens that can be used with success to illustrate books on travel, geography, nature-study, history, art, and current events. From these through the coöperation of the department curators, circulating loan exhibits are selected. By arrangement with the librarians such exhibits are installed for varying periods in the children's rooms in the libraries.

The primary purpose of these exhibits is to stimulate the children to read good books. More often the collections form the basis of definite coöperation between the schools and the libraries. Children who are studying Mexico in the classroom are taken by their teachers to the library, where they examine the Mexican material loaned by the Museum and read books describing that country; children who are studying "The Song of Hiawatha" visit the library to see Indian collections, and boys and girls who are learn-

Art students copying Indian designs. Ancient Peruvian fabrics give inspiration for modern patterns ing the principles of design go with their notebooks to copy the decorations on Indian baskets and pottery.

This coöperation with the libraries takes the Museum to the neighborhood. Oftentimes, moreover, these exhibits awaken the spirit of research, bring both the child and his parents to see the extensive collections at the Museum, and then send them back to the library for further reading.

Important as are the museum aids in the classroom, of equal or even greater value is the assistance which the Museum can give when teacher and pupils come to the Museum. First among these intra-mural activities are the lecture courses, if numbers are taken as the criterion. Annually more than 170,000 school children attend these lectures.

A public school lecture in the Museum auditorium.—Annually more than 170,000 school children attend these lectures

As in the case of the circulating nature study collections, the underlying purpose of all these lectures is to *supplement* the classroom work of the teacher—not to *replace* it.

The subjects are chosen with special reference to the prescribed courses of study, and deal particularly with topics in geography, history, and natural science. All are illustrated with colored lantern slides and also, for some years past, with motion pictures.

Whenever practicable, the subject matter of the lectures is correlated with the exhibits in the Museum. For instance, if the lecture is on the "Early History of New York City," reference is made to the Indians of the Eastern Woodlands Hall, where the life of the Indians of Manhattan is depicted; if the subject is "Physiography of the

United States," reference is made to the halls of geology and to the halls of the great vertebrate fossils, where early earth history has been visualized. A lecture on "Hiawatha's People" will be correlated with the mammal and bird exhibits, as well as with the Indian halls.

Most of these lectures are adapted to the needs of elementary classes. Recently in evaluating our work with the schools, we questioned the value of certain motion pictures shown in these courses, particularly "Treasure Island," "Robin Hood," and "Huckleberry Finn," thinking that after the children had seen the picture they would not think it worth while to read the book on which the film was based. Our doubts were removed when we learned from a teacher that not only did the showing of these films stimulate the children to read these classics, but led the parents, especially the foreign-born, to come to the school to find out where they could buy these books. The children talk about the picture until parents become interested and want to know more about the story.

Recently one teacher asked for our unused lecture program announcements. These she gave to her pupils, who took them home. One mother came to the school to express her gratitude to the teacher for taking her children to the Museum, and said that while formerly her husband spent a great deal of time away from home, now they all gathered around the table at home to read the story books based on the Museum lectures. Thus, our lectures may indirectly aid in bringing the family groups closer together and in establishing better standards in the minds of children and parents.

In addition to these regular courses of lectures for school children, members of the Museum staff lecture at the training schools for teachers, with the purpose of presenting to the pupil-teachers certain background topics on which they are especially well qualified to speak. The result of this relation to the training schools is far-reaching.

Many special lectures are given to visiting classes, especially from the high schools. Twice a year during Regents' Week, the examination period, the biology classes from several of the high schools are brought to the Museum, given a lecture on some biological topic in the auditorium, and then sent into the exhibition halls with a questionnaire for further study. Thus for these classes, as well as for groups of Boy Scouts, Girl Scouts, Woodcrafters, etc., the Museum exhibition halls serve for great indoor field trips.

A specialized branch of the Museum's educational work is the instruction for the blind which has been developed through a special endowment, the Jonathan Thorne Memorial Fund. The blind children in New York City are taught in the same public schools as normal children. They are grouped in sight conservation classes and taught by trained teachers under the guidance of a special supervisor. In the Museum's program of visual education special provision is made for these children. In consultation with the Supervisor for the Blind, informal talks which can be illustrated with actual specimens or with apparatus are prepared by the Museum staff under such titles as "Birds of Our Parks," "Indians of the Plains," "Animals That Give Us Clothing," "Sea People and Their Castles," "The Change of Seasons."

The results from this work are gratifying. Often they are read in the children's happy faces. Again, they are

Why seasons change.—The use of the Uranisphere in a Museum classroom makes it easy for children to visualize the causes of the change of seasons

seen in the direct expression of these boys and girls in essays based on the lesson.

Another important branch of our intra-mural activities is the exhibition hall instruction and guidance. The well-labeled exhibition hall, with its habitat groups, its carefully selected specimens, and its well thought out arrangement, stands as the great silent teacher, a true exponent of visual education. What a vast store of information is contained in these halls, and what an aid they are to teachers in giving to their pupils accurate knowledge of nature!

Experience has shown, however, that a well-labeled hall is not sufficient, and in order that a group of children may obtain greater profit from their visit to the Museum it is necessary to have specially trained instructors who understand the child's point of view and can interpret the exhibits for the children. The inadequacy of even a good label, because of lack of knowledge or carelessness of the teacher, is illustrated by the following incident, which occurred in one of the halls recently.

A teacher with a class of a dozen children stopped before the case containing an African lion, part of an exhibit intended to show the difference between past and present methods of taxidermy. The label on the case reads

TAXIDERMY
PAST AND PRESENT
AFRICAN LION, MOUNTED AT THE MAISON
VERREAUX, PARIS, ABOUT 1867

The following conversation was overheard:

"Now, children, look at this animal! See how ferocious he is! See his bushy mane! This, children, is a taxidermy. Now, children, what kind of an animal have we here?"

And the twelve little voices piped up proudly, "This is a taxidermy."

The exhibition hall instruction by

our staff members has not been systematized and fully developed because, until the School Service Building was erected, we did not have suitable facilities for correlating this instruction with classroom work. For years the teachers have been bringing groups for study and examination of the principal exhibits, and the department of education has been supplying instructors for them, so far as practicable. This instruction has been adapted especially to children. The exhibits of the halls are so comprehensive and so accurately executed that these tours of the Museum are equivalent to field trips, and there is great opportunity to enliven the classroom work in geography and history by correlation with such trips. How much more significant to the pupils is the history of Manhattan Island if they have had an opportunity to visit the Hall of the Indians of the Woodlands and see for themselves what the Manhattan Indians were really like, what kind of houses they built, how they were dressed, how they obtained their food, and how they played. Similarly, a class which is taking up physical geography can better understand valley formation and mountain erosion by a visit to the Hall of Geology than by many days spent on text books.

During the current year a definite plan was initiated to have classes from the neighboring schools visit the Museum for definite instruction by the Museum docents. The pupils were assembled in one of the sample class rooms, where specimens had been placed which could be handled by the children. Under the guidance of the Museum instructor, they were made familiar with the objects and learned their significance. After a half hour in the classroom, the groups were taken into the exhibition hall, where the larger collections were seen. The development of this phase of the Museum work is one of the most important features of our future growth. The instructor, or guide, plays an important rôle in interpreting the exhibits to the school children and to the public. The keenness of the children, their enthusiasm, and their desire to know the why and wherefore of things, make this work most interesting. The personal observations of the children and of adults, while at times amusing, give food for thought. Three small colored boys, all eyes, were standing in front of the snake-bird group, looking at a mother bird feeding her young by regurgitation. In this process the young pushes his beak far down the mother's throat for the food.

One of the little chaps announced with pride, "My mother told me she was feeding them."

The other two chorused violent protestations.

A heated argument followed, and with finality one said, "Aw, say, can't you see? She's eating them."

The discussion was finally closed by the boys' appealing to a Museum instructor, who chanced to be passing through the hall, and the first boy's pride was restored when the instructor told them that the mother bird was feeding the young and explained the process.

In the Habitat Bird Group Hall is shown a group of man-o-war birds, in which the male birds have a large, inflated, red air-sack on their throats during the breeding season. Two little Italian boys, about ten and eleven years of age, were standing wide-eyed before this group.

"Oh see!" said the ten-year-old to his companion, pointing to the air-sack

THE BEAR MOUNTAIN NATURE MUSEUM

This museum was provided through the interest of the American Association of Museums, and at the invitation of the Interstate Palisades Park Commissioner the American Museum has undertaken to operate it

A TADPOLE STORY

A portion of the Bear Mountain Nature Trail and Trailside Museum, operated by the American Museum. Photographs by Leroy Davies of the male bird "See that bird's Adam's apple!"

As a further step in making the exhibits more significant to the children, trails are being laid out in several of the halls, so that children may follow them and in this way gain a greater knowledge of the subjects. Questionnaires have been prepared, more particularly for the use of classes from the high schools and colleges. Nature games have been introduced and are greatly enjoyed by the children to their profit. This phase of the Museum work is only in its infancy, but is now to be developed since adequate facilities are available.

Our educational department has also participated in the maintenance of the Nature Trails originated by Dr. Frank E. Lutz at the station for the study of insects near Tuxedo, New York. This pioneer work of Doctor Lutz has given great emphasis to the outdoor nature movement and has been adopted in many of the camps for boys and girls. On the invitation of the Interstate Palisades Park Commissioner, the Museum has undertaken the operation of the Nature Trails and Trailside Museum at Bear Mountain which was initiated and provided for by the American Association of Museums. This is frankly an experiment, but the numbers who are daily visiting the trails indicate their practical usefulness.

The most important recent event in the Museum's educational program is the construction and equipment of the School Service Building by the city of New York. This, for the first time, gives the Museum adequate facilities for caring for the teachers and classes coming to the Museum, and better facilities for those activities where the Museum goes out to the schools. The Board of Estimate provided for the building in 1922, and the construction was completed in 1926. The equipment is nearly installed, and it is planned to open the building formally in the fall. The School Service building is a basement and four-story structure, 160 feet long by 90 feet wide on the first floor, and 55 feet wide on the upper floors. It is thoroughly fireproof in its construction, and has been most carefully planned to take care of the Museum's needs in its School Service work.

The four floors are assigned as follows:

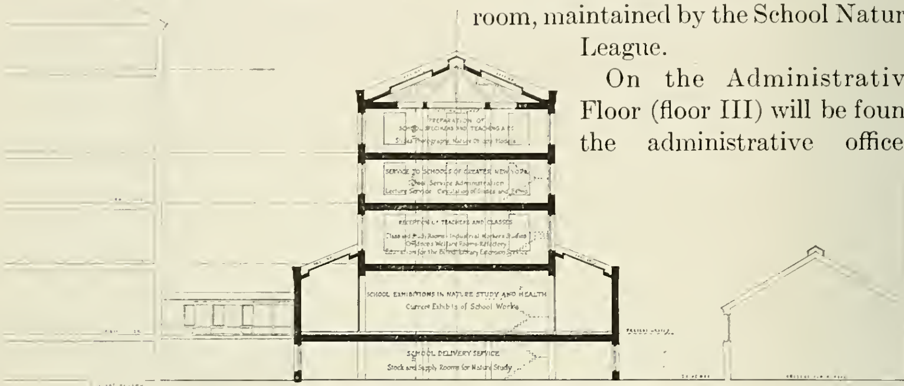
First floor: Education Hall, reserved for temporary exhibits.

Second floor: Reception floor to provide for classes visiting the Museum.

Third floor: Administrative offices, study rooms. library, and activities connected with the extra-mural work of the Museum.

Fourth floor: the production floor, where photographs and negatives are cared for and the photographic studios are located.

Education Hall, on the first floor, will be entered through the Bickmore corridor, designed as a memorial to the late Prof. Albert S. Bickmore, the originator of the American Museum of Natural History. Here will be placed Professor Bickmore's bust, and a marble tablet commemorating the great educators of history from Socrates to Agassiz. There will also be a tablet to the benefactors of the Museum's educational work, and the memorial tablet to Jonathan Thorne, in whose memory was given the endowment for the education of the blind. Education Hall, itself, is a beautiful room, 160 ×90 feet, and is one of the finest exhibition halls in the Museum. At the westerly end of the hall is placed a statue of William H. Maxwell, first Superintendent of Schools of New York City, presented to the Museum by the Maxwell Memorial Association. On the north side of the hall will be installed permanent exhibits on public health, presenting such aspects as nutrition and public sanitation. It is intended also that this hall shall serve as a reserve auditorium. Consequently, a platform is being erected at the westerly end of the hall, and seating provision may be made for approximately 1000 people. It is equipped with both stereopticon and motion-picture projection apparatus. The primary purpose of this hall, however, is to reserve it for temporary exhibitions of current interest. For instance, if it is desired to show the people of New York City what is being accomplished by the vocational schools, here is the place for it. In fact, it would be available for a demonstration of any school activities that the Board of Education might wish to take up.



Transverse Section of the School Service Building

The principal feature of the Reception Floor (floor II) is the classrooms of various sizes to accommodate small and large groups of pupils or teachers. Special provision is made for the instruction of the sight conservation classes on this floor, and there is a duplex assembly room which has a maximum seating capacity of approximately 400. A rolling partition quickly converts this into two assembly rooms. Each of these is thoroughly equipped with modern slide and motion-picture projection apparatus.

Here, also, is the model school nature room, maintained by the School Nature League.

On the Administrative Floor (floor III) will be found the administrative offices, comprising a suite of three rooms, the library of lantern slides with offices, shipping room, and laboratory. A unique feature of this division is the teachers' consulting room, which is equipped with illuminated tables for the easy examination and study of slides. Teachers may examine slides in this room, arrange their lectures, and practise them in a sample projection room adjoining. On this floor is also a college classroom, equipped with tablet armchairs, the teachers' reference library, which will be supplied with the best nature books and with current periodicals pertaining to their work. Here, also, is the office and laboratory of the division of public health.

The Production Floor (floor IV) comprises the library of photographs and negatives, four dark rooms for the production of photographs and slides, the slide colorist's room, the film-cutting room for the editing and care of the motion-picture films, and a sample

Last year's fall flower show in Education Hall

Duplex assembly room in the School Service Building

projection room for examination of slides and films.

With this splendid structure available and its practical equipment, the Museum is in a position not only to extend its service to the schools, but to render it more effective.

The department of public education does not limit its works to schools only. It has encouraged all movements designed to stimulate public interest in outdoor nature education, and has actively participated in several of them. For years the Museum has been

These especially designed illuminated tables in the teachers' consultation room prove most valuable to teachers in the preparation of lantern-slide talks

coöperating with the School Nature League which is doing such splendid work in taking nature into the schools. The League slogan is "A Nature Room in Every School," and the value of these rooms in the life of the child can hardly be overestimated. Recently an even closer coöperation with the League has been instituted by giving the League headquarters in the new School Service Building where a model nature room is being maintained.

The Boy Scouts, Girls Scouts, Woodcraft League, Campfire Girls and similar organizations are making extensive use of the Museum collections and exhibits, and in some instances the tests for merit badges are given by our staff members.

In the foregoing article we have presented the principal features of the methods of visual education employed by the American Museum of Natural History. We make no claim that they are new to education. They have been modified to meet the conditions in New York City. The Museum's wealth of material in its exhibition and study collections, its miniature collections which are sent to the schools, and its extensive series of negatives and slides freely available for school use, give the New York child a rare opportunity to visualize his geography and history lessons—which, in a measure, is some compensation for his lack of contact with the outdoor world.

The Museum's Part in Nature Education

FROM PHOTOGRAPHS OF THE EXHIBITS IN THE AMERICAN MUSEUM

ON FAMILIAR TERMS WITH THE "KING OF THE NORTH"

A polar bear in his appropriate setting of snow and ice is rather beyond the range of experience of most children. But these youngsters from the New York City schools don't have to "just imagine" a polar bear. They know from close association with this one in the American Museum of Natural History just how big he is and how his white coat hides him in the Arctic landscape

CORRECTING A MEDIEVAL ERROR

Does a pelican feed her young with the blood from her breast? The heralds of old thought so, and many a coat of arms shows *a pelican in her piety* doing that very thing. It's a pretty legend but children nowadays demand facts. Here they see at close range exactly how the baby pelican gets its food, and it's every bit as interesting as the old story—with the added advantage of being true

WHAT BIRD IS THAT?

Brother may well ask the question and remember the answer, too, for it is the whooping crane, a rare species and almost extinct. They once ranged from Northern Mackenzie to Central Mexico. Before he and his sister grow up, these birds may have passsd with the great auk and passenger pigeon. But these specimens they are studying will be preserved for their children's children

THEY WANTED TO KNOW IF IT WAS REAL

It just didn't seem possible that any baby animal had a skin like that, but these doubting Thomases were convinced when they were invited to feel the bristly hairs on the rhinoceros' hide. And those tubular ears interested them, too. Can you think of any better way of teaching children the shape of a rhinoceros' ear than by letting them poke their fingers into it

IF THESE WERE YOUR CHILDREN—

Wouldn't it be a relief to you to know that they had even temporarily abandoned their ball playing and roller skating, amid the traffic hazards of city streets, to spend a bit of their playtime seeing how the beavers build their dams and construct their houses? Four of the five children in this picture are almost daily visitors to the Museum

FROM EARTH AND SKY AND SEA

In this model School Nature League Room, maintained by the School Nature League, are living things that crawl and creep and fly and swim, plants that grow, and animals that snuggle softly into warm hands. It is seashore, woods, and mountain-top all brought within four walls for city children who could otherwise know little of the wonders of God's great out-of-doors

SIGHTLESS EYES BUT SEEING FINGERS

The Museum offers opportunities for nature study even to those who can never see its exhibits. These blind children, only a few of the many similarly afflicted, who regularly attend Museum classes conducted for their benefit by members of the staff, gain their ideas of plant and animal life through the sense of touch supplemented by careful oral instruction

THE END OF A NATURE TRAIL

When you have followed the trail from case to case and noted the differences between the feet of the sandpipers and those of the woodpeckers, and the kind of bills that the flycatchers have and those of the seed-eating birds like the sparrows, it's nice to sit down with the leader and count up your score on the questionnaire

WHICH WILL STRIKE FIRST?

Will victory rest with fang or claw? Here are all the elements of drama—interest, fear, conflict—but the action is suspended. To complete the scenerio these youngsters will *want* to know more about bobcats and snakes

YOUTH AND AGE MEET

In the Dinosaur Hall the five-year-old can look back fifty million years, and marvel at the huge bones and empty skull of the Brontosaurus. These children already know more about this dinosaur than he ever knew about himself. Their education has begun——

BUT CHILDREN WILL GROW UP

As high-school and college students, the boys and girls who used to visit the Museum for Nature Study or just to look at the queer animals, return. It is advanced zoölogy they're studying now. They come to supplement the meager illustrative material of classroom and laboratory with the wealth of specimens and the specialized instruction that the Museum offers

WHERE FLYING WINGS ARREST THE GAZE

The first glimpse of this dome in the Hall of Birds of the World is almost certain to draw forth an involuntary gasp of wonder. Nor is the first impression dulled upon closer acquaintance. Prolonged and contemplative observation reveals with what scientific accuracy even obscure details have been portrayed. Like many another corner of the Museum, it suggests further study to all who realize that no one has yet lived long enough to complete his education

The Museum as an Educational Interpreter

By PAUL B. MANN

Head of Department of Biology, Evander Childs High School, New York City, and
Associate in Education in American Museum of Natural History

JUST off the lower Bowery is a triangular block comprising the heart of "Chinatown." Whatever the weather, there are always visitors, young and old, drawn by the lure of the exotic.

So much here is completely different: the baskets piled high with bamboo sprouts and tiny seedlings; the bottle-necked gourds and strange roots vying for room in the little shops with curious strings of dried foods,—fishes, mussels, squids, mushrooms, dark-brown ducks and geese, and occasionally a whole pig, also smoked and dried. If you buy an ancient blue jar (for its artistic quality, of course, rather than for the ginger you know it contains), and insist upon a receipt, you will see the almond-eyed proprietor use a little brush, held vertically, to produce the column of black, cabalistic figures, though he may bring you back to earth by reaching for a modern rubber stamp and a red stamp pad, as a more practical way of identifying his place of business. Each doorway and corner has its knot of jacketed orientals, eagerly discussing something vital to themselves, while black-haired and black-eyed children play the American games of ball and of marbles in the narrow streets. The flanking buildings so elbow these alleys that you feel more cramped than in some of Boston's or Nantucket's ancient lanes. The reddish signs, the Chinese bulletin boards, the yawning cellar openings and divergent stairways, all contribute to a realization that one is actually in foreign parts. The only drawback might be lack of a guide who could answer questions.

Just what is this spell of Chinatown? If you will analyze it, you will find that the attraction lies in the opportunity of actually seeing objects and people about whom you have read or heard. Curiosity and interest are two driving forces. When they can be linked up with constructive ideas and a program of education, you have gone far toward real achievement.

The museum idea is almost as old as civilization. Aristotle, according to Pliny, at one time had a thousand men collecting zoölogical and botanical specimens from Greece and Asia for his Lyceum, which was the first great zoölogical garden and museum the world had ever known. Would that modern patrons were as generous to museums as Alexander was to Aristotle, to whom he gave the present equivalent of $4,000,000 for physical and biological equipment and research! Ptolemy evidently was the first to use the word "museum," and this was in connection with the institution he founded at Alexandria.

Museums in general seem to have had their genesis in collections made by the rich for their own personal gratification and exhibitions. As science gradually developed, scholars and students began to bring together specimens and materials to aid their studies. Such private collections eventually grew into the public museums we know today.

The idea of educating the public, especially through close coöperation of museums with the public schools of their localities, is a comparatively recent development and has great possibilities. Not only are practical aids thus made possible for the teacher who has the difficult problem of making teaching objective in a huge metropolis like New York City, but a sympathetic and appreciative attitude toward the museum is early developed in the youth of the schools.

How best to link up a great institution like the American Museum of Natural History with the tremendous quantitative needs of a million school children and their families, together with the vast floating population, is a complex problem calling for much more than mere exhibition!

If Chinatown can interest the adolescent and his parents, a similar impulsion must be possible from the varied departments of a great museum. The panorama here is crystallized and static; no cross-section of real life is going to parade in front of a case. For many, a visit to Chinatown may not be possible. At best its attractions are peculiarly local in interest. In the case of this Museum, whose expeditions reach every land, there is an almost unending display of treasures from all quarters of the world. These treasures are bound to create interest. But is this interest motivated in the fullest sense? Is it always linked up with constructive ideas? Having procured representative specimens and arranged them significantly in well-lighted cases with attendants in charge, has the Museum accomplished its mission?

Let us see. Who is coming to see these exhibits? Is it possible that the kind of visitors might determine the Museum's procedure, even to the point of devising ways and means of educating its guests to appreciate the types and kinds of displays? Is it possible to think that a museum might even modify its general aims because of its daily visitors? The average visitors are not scientists. School children, at least those studying biological science, are likely to know more than the layman about some of the extensive animal exhibits, but their knowledge at best is meager. Naturally, exhibits labeled by scientists will meet the needs of other scientists. But more and more the museum must meet the educational needs of its average visitor and fall in line with the new movement for adult education. Labels couched mostly in scientific terms can have no appeal to any but the trained scientist. The layman or schoolboy will see the animal or exhibit but he will not see relationships, sequences, economic importance, zoölogical cause and effect. He will do little or no real thinking, nor, for that matter, make any real observation. Mere looking is like mere hearing, which is far from *listening*. Every curator of every department of every public museum is on the defensive when it comes to the interpretation of his exhibits, so that the public shall get all they are entitled to.

As an example of what I mean, let me refer to an incident, which occurred recently. While working in Darwin Hall, I overheard a trio of visitors as they were making the rounds of that room. They saw all the specimens in the synoptic groups of animals, but their conversation showed that *Amœba proteus* and *Tænia solium* were not, for them, names to conjure with, nor good pegs, alone, on which to hang interesting ideas. Here were specimens typical of each division of the entire animal kingdom, but apparently these visitors got nothing much out of these exhibits. When they came to the glass mosquitoes and exhibits showing struggle for existence, and even Mendel's Law worked out in plant and animal illustrations, they looked and looked, and discussed them eagerly. Would scientists lose any of the values which the synoptic series hold if more humanized labels were used to interpret these groups to the lay public? For instance, would not the public get a new appreciation of the federal efforts to safeguard meat through rigid inspection, if more phases of the life history of the tapeworm (*Tænia solium*) and trichina were exhibited and interpreted?

The next steps then are to evaluate thoroughly the impressions of the visitors; to study the curricular needs of the schools, and see to what extent the museum is supplying the right materials and help; to re-arrange exhibits wherever needed in order to show sequential, structural, and other relationships; to develop a new kind of guide or questionnaire which is informative and inspirational, and contains stimulating queries; to organize docentry service so that time may not be wasted and that pertinent knowledge may be acquired; in short to take the schools and the public into partnership.

It is only fair to the far-seeing director and other active officers of the American Museum to state that all the preceding program is being considered. Far from being an institution of mere exhibitions, the Museum is itself seeking to satisfy the growing needs of the schools as well as of a public becoming constantly more discerning.

Among the most recent aids for high schools are new lectures accompanied by lantern slides, which have been produced for the use of the teachers; a library of microscopic slides for elementary and advanced biology, assembled for distribution like lantern slides; live fruit-flies (*Drosophila*), furnished for breeding and Mendelian experiments; new insect habitat groups developed with elaborate keys and descriptive labels; bird guides and keys, rewritten and issued in the convenient nature study size; a traveling collection of fossils, built up to illustrate types of prehistoric animals and evolutionary development; mounted pictures of scientists and scientific institutions; and framed pictures, loaned for limited periods to schools for hanging in classrooms. In addition, the entire traveling collection of loan specimens, charts, and objects has been re-organized. As the result of suggestions from teachers, many special lantern slides have been made and added to stock. The last two items affect private institutions as well as public schools, both elementary and high, as does also the inspirational radiation from the new School Nature League room in the School Service Building at the Museum. No more than mention need be made here of the invaluable film library which is also free to the schools, and to which constant additions are being received. Teachers' organizations, such as the New York Association of Biology Teachers, have begun to utilize the superb facilities of the new rooms for evening meetings. With the opening of the new library, there will be additional reasons for enjoying the Museum.

The staff of the Museum's department of public education has been enlarged, particularly to meet the growing needs of teachers and pupils of New York City and vicinity. More expansion is already indicated.

One other new plan is of vital importance. A limited number of teachers from the Training Schools of the city are to have a period of instruction in museum technique and methodology either at the American Museum or at the Children's Museum of Brooklyn. This training course for teachers was put into operation in a tentative way last spring, with excellent results. Such a program is bound to increase in value to teachers with continued experience and experiment.

Field expeditions have been for many years a prominent aim of the administrators of the American Museum. New lustre has thus been added to scientific research and the Museum itself enormously enriched. Many patrons have been interested in sponsoring these activities. The worth and productive value of such Museum expeditions have been fully demonstrated, and the Museum now asks for strong support and heartiest endorsement of its pioneer work as educational interpreter.

The Monarch Butterfly Group.—One of a series of small habitat groups showing the life history of different insects, for circulation in the public schools of New York City. These groups have been found especially useful in teaching biology

The Child Discovers His World

By RITA SCHERMAN
(Mrs. R. M. Berman)
Author of *A Mother's Letters to a Schoolmaster*

CHILDHOOD is a period of discovery. The young child's whole being, "like a large eye," is open to the impressions of the world about him and "wholly given up to them."[1]

Knowledge of things and doings—news of his surroundings—is being garnered by this discoverer, rapidly, constantly: forms, sounds, colors, identities, processes, activities, meanings, relationships of space, time, number, bulk, kind, relationships of people, with all the words which designate and represent all these things. The whole of Nature and of Art and Artifice await his discovery: Nature, the power, law, process, and substance of all being; Art and Artifice the ever-developing superstructure we know as civilization. What an immensity to take hold of and make his own!

As discoverer in this great world of unlearned happenings, a universe of innumerable visible actions and invisible relationships, the child needs a compass, and it is the attitudes and values of the grown persons about him that he takes as compass. These attitudes and values are reflected in schools, museums, curricula—institutions and systems that grown persons provide to educate the child, to lead him forth into life and knowledge.

How logically do these present life to the child and free him for ever larger discovery? Are the academic categories of knowledge, laid down centuries ago by scholasticism, fit pathways of education for the children of this era of world democracy? Can the discoverers find reliable guides to life in the catalogued subjects of school curricula and the stereotyped classifications of formal museum exhibits? Is there needed a more viable arrangement of the facts of human knowledge so that the discoverer, as he learns of the ways of nature and of human kind, may find his way intelligently and unconfused amongst all the concepts he garners? Does he not himself indicate through his own natural interests what the pathways of that new classification should be?

It is along the byways of aroused curiosity that the interests of childhood lie, along the little roadways of *needs*, in his day-by-day contacts with life, that the interests of the discoverer play. A child's inquisitiveness about the world lies primarily along the paths of the activities he observes about him, whether in the realm of human doings or in the mechanisms of objects he sees or handles; whether in the ways of beasts, birds, and insects, plants, sun, stars, and the weather, or in the intangible forces which do man's bidding in the wonders of modern invention. What things are for, what things are made of, what makes things go, and WHY—these are the pivots around which the learning of children naturally takes place.

To examine the discoverer's store of concepts gleaned in the first free years before "shades of the prison house" begin to close about the growing boy and girl, is to find that they cluster around the essential activities and experiences of life—Shelter or Home-Making, Food-Getting, Clothing and Adornment, Communication, Trans-

[1]Friedrich Froebel, *Education of Man*, p. 24

portation, Barter, Government or the Rules of Living, Play and the great Arts that have sprung therefrom. These are what make up living, no less for us than for our children. Around these is built up the pattern of all human activity. To maintain these—the elements of our human economy—we utilize the visible resources and the unseen forces of nature. These, throughout the ages, have been the natural needs which instinct has guided to development. They were the same when man's first concepts of his world and first articulations began to build up the body of primitive knowledge, and the complex knowledges of today's civilization are still woven inevitably around them.

Would it not appear needful, then, at this stage of progress in human development, and in the interests of a scientific and logical approach to learning, that education make a restatement of knowledge in terms of *needs*, in terms of the basic activities and everyday experiences of humankind? It is obvious that man's comprehension of his environment and of the interrelationships of life-processes will proceed more readily when the approaches to learning are made thus logical and scientific—brought into accord with the psychology of learning itself. The academic subjects which have served for generations to introduce man to knowledge are doors which do not *lead forth*—this being the true sense of the word education—but which *lead away* from natural interest, from the identification of the self, "in desire, effort and thought," with "objective subject-matter."[1]

Knowledge, whether in schools or museums, should be presented to the child in a dynamic unfoldment, as news growing out of the thing his thought is engaged with at the moment, as a pageant of development which he may follow back or trace forward, from the tool he holds in his hand, the engine he fascinatedly watches, the coin he carries in his pocket, to the dawn of pre-history, if he will, or to the far reaches of the unseen and infinite where often, if we let them be, the thoughts of little children steal back from whence they come, "not in entire forgetfulness, . . . but trailing clouds of glory . . . from God which is their home."

The ideal school, the ideal museum, the ideal curriculum will present to the child means by which he may orientate himself in the complex civilization of which he is inheritor. That which we present to him should be an exposition of knowledge and achievement, a survey of experience, an index to his world, and this cannot be done in terms of the school subjects, but needs elucidation in terms of familiar everyday doings made fascinating by the drama of growth. Each activity becomes thus a pageant marching down the ages,—the pageant of Home-Making; of Clothing and Adornment; of Sustenance or the drama of Food-Getting; of Transportation—the evolution of Means of Travel; of Communication—how men exchange their thoughts and record their experiences; of Barter—how men exchange the products of their skill; of Government—how men agree to live and behave in orderly fashion. And so on.

A concept of education as individual discovery offers, in all avenues of activity and information for the child—in schools, museums, motion-pictures, and books—fascinating possibilities for illuminating the pathway of the discoverer. Within the past

[1]John Dewey, *Interest and Effort in Education*, p. 90

decade, in many parts of the world, schools have sprung into being which have challenged the lockstep in education, and their demands will doubtless eventuate in the appearance of books, motion-pictures, maps, and charts which will more and more humanize knowledge, take it out of the pigeon holes of the formal subjects and redistribute it along lines that hew closer to the realities of everyday life.

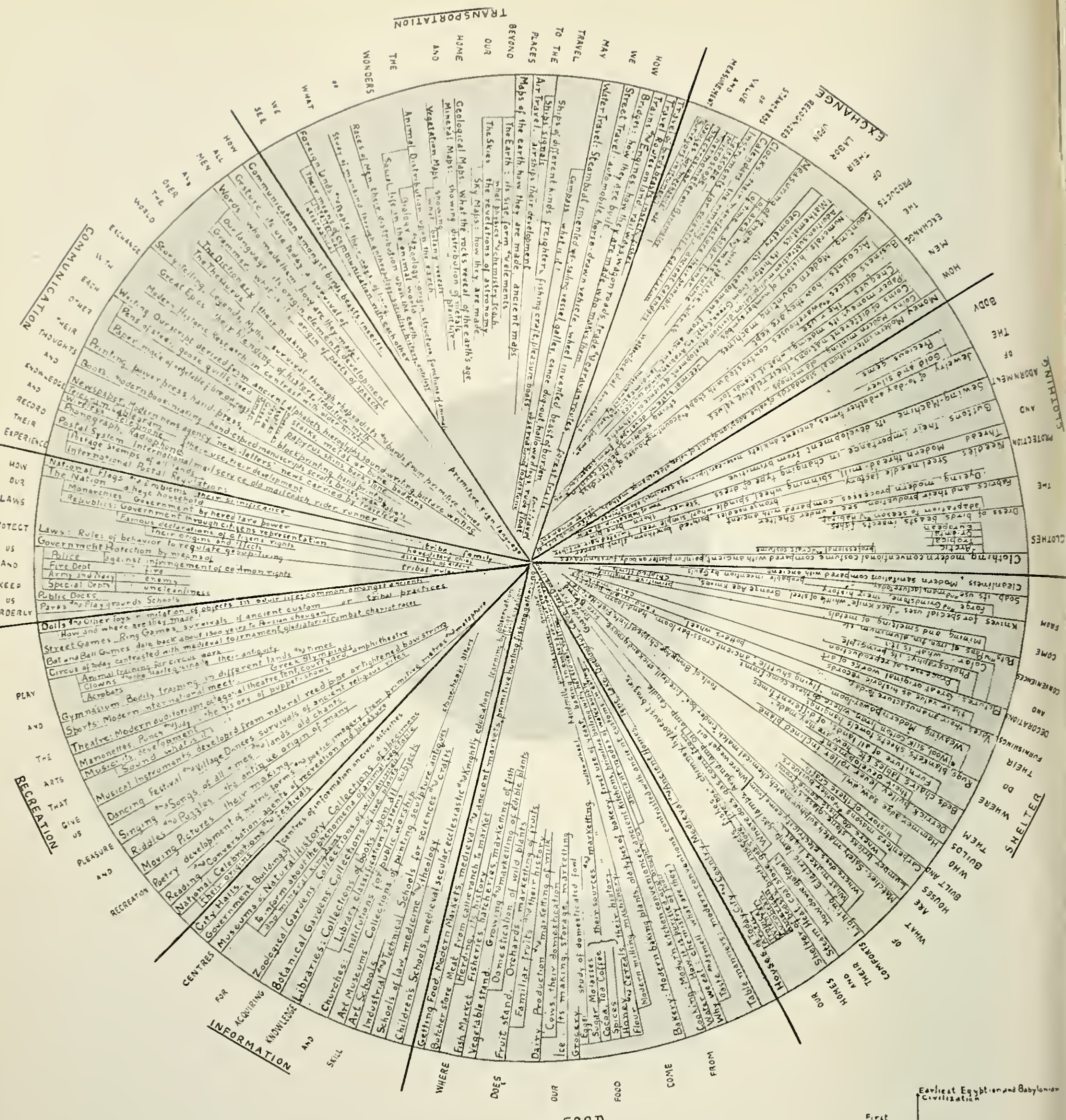
Museums must meet this challenge too, and they are beginning to do so. In many places developmental exhibits have been installed, the interest in which, amongst adults as well as children, indicates the value of a much more extended re-arrangement of specimens, relics, and models. The great need is a correlation of exhibits such as will not alone make clear the relation of the past experience and products of the race to familiar aspects of present-day life, but will also demonstrate the interdependence of plant-, insect-, bird- and human life.

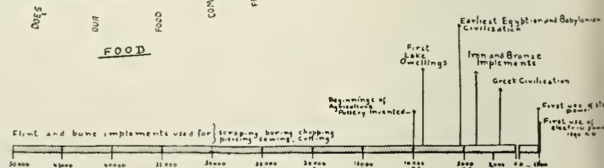
What man finds on the earth, and *what man does with what he fiinds*—these two lines of inquiry present a basis for the correlation of museum exhibits in terms of familiar needs. Illuminating facts from amongst all the pigeon holes, particularly those labeled natural history, anthropology and sociology, should be called upon to build up these exhibits. The child, discoverer of today's world, finds the bulk of what man, the discoverer of a half million years ago, found then. Wonder of day and night, sun and moon, stars and seasons, fruit and flowers,—things whose appearance is directed by powers unseen; ways of beast, bird, fish, insect, man, all manifesting common peculiarities; power of communication, each with its kind; kindred needs of food and shelter; definite forms of group or social organization, more or less marked until they reach the degree of co-operative activity of the bird-family, the bee, the ant, the human being.

The fundamental life-experiences of mankind are plainly paralleled, as has been suggested here and there on the accompanying chart, in the life-histories of beast, bird, fish, and insect, and if we go back far enough into the history of human life we see how closely they were allied in method in the beginning. There is, however, this great dramatic contrast: ways of living amongst the lesser creatures have been unchanged, we suppose, from the beginning of time, but ways of living amongst men have varied and changed from primitive times and still continue to change. Man's ever-increasing command of earth's resources has given his achievements an evolutionary character.

The discovery of *what man finds on the earth* acquaints the child with the essential nature of things, and gradually, sooner or later, leads him to an apprehension of the Science of being. How soon or how late, depends upon the clarity with which his discoveries are interpreted to him. The discovery of *what man can do and does do with what he finds,* leads him into the realm of Art and Artifice, in which imagination and intellectual activity bring him creative joy.

The facts of Science, Art, and Artifice, seen in this perspective, indeed belittle the traditional subjects either as starting points of learning in the schools, or as bases of classification of museum relics and models. Grown-ups who see thus, and ponder what they see, know that they can let go of formal subjects, formal periods of instruction and formal exhibits, and follow the needs of the child as his interests reveal them.





A CHART OF CIVILIZATION
(ABRIDGED)

An Index to and Survey of Human Experience upon which to base a reclassification of knowledge, a rational curriculum for public education, as well as a library of educational motion pictures, a children's encyclopedia, and a children's museum (static or traveling).

The scale indicates the duration of time represented by the radiating lines on the chart. Of the 50,000 years of man's experience indicated, the innermost circle represents 45,000 years and more. The white circle represents about 5,000 and the shaded outermost circle represents the last 100 years.

The earliest rough stone implements discovered are estimated to be 500,000 years old. It would take a scale extended many feet to the left of the one shown here, to illustrate the remoteness of that period.

Note the amazing rate of man's material progress in the last 100 years, which span so small a portion of this time-line that they can be represented only by a mere stroke at the right-hand end.

This chart is reproduced from the one used by the author in her book *A Mother's Letters to a Schoolmaster.*

Long before the formal school age does the child begin to map out his own curriculum as he reaches out to the grown-ups about him for aids in his investigations of life and things. "Where to do the moon go"? asks my little boy. "Is the moon the daddy star"? And your little girl says: "Is it far to the end of the sky"? or "Why do not things fall up? . . . Where does the wind go? . . . Will the days that have gone come back again? . . . What is the last number there is? Where do colors come from"? Always thus something lifts itself up to the vision of the discoverer out of contemplative moods. A grown-up who is a reliable compass encourages the discoverer to ponder and investigate what lifts itself up, and to give each new concept a *place* in the order of wonders already revealed.

The degree to which this encouragement is given in the very early years of childhood determines to a large extent the receptivity and eagerness and freedom with which the older child acquires knowledge. Habits of contemplative thinking, and investigative and organizing tendencies can be encouraged or inhibited just as positively as habits of bodily skill or desirable behavior. Homes, schools, museums, the theater, and every avenue through which the child gains direction in his living, should organize the elements of that direction in ways to stimulate and encourage reflective thought. Such ways will lead far afield from the docketed knowledges that have up to now mapped out the pathway of learning for children young and old.

And besides revealing his world to the discoverer as a place of ever-recurring wonder, a place of constant growing and marvelous organization, a place of beautifully interrelated life-processes, schools and museums should show it to be a place of *sharing*, with development and survival dependent, indeed, on the very principle of sharing. Just as amongst the lower creatures survival and multiplication of such sharing beasts and fowl as the cow, sheep, and hen are undeniably assured, so the artifices of men survive and develop in proportion to their sharing qualities. The implements and devices of utility discovered or invented by primitive man have evolved to forms suited to modern needs, whilst instruments of torture and cruelty have disappeared and will continue to disappear until they are as extinct as the predacious animals which have vanished from the face of the earth.

From the point of view of the accompanying Chart of Civilization which pictures these ideas, Nature appears not as one isolated subject in the curriculum, not as a separate compartment of study, but practically as *the* curriculum. It is synonymous with Life, the wholeness of experience, and the ways and doings of human beings are part of that experience. Nature and natural history become thus names for the expression of an infinitely varied activity of intelligence, and the proud achievements of men—the vitaphone or Woolworth Building, for instance, —are seen as reflecting not a different intelligence from that which fashions the bird's nest or the beavers' dam, but as inevitable responses to more complex needs. As educative agencies become more and more conscious of that unfolding intelligence, they will confidently open pathways along which children may move forward to discover, let us hope, a fairer, freer, kindlier, and more peaceful world.

Photograph by Clyde Fisher

CAN HE SHOOT HIS QUILLS?

Photograph by Clyde Fisher

WHAT CAN TAKE THE PLACE OF NATURE IN EDUCATION?

Education as Natural Development

By MARIETTA JOHNSON

Director of the School of Organic Education, Fairhope, Alabama

TODAY, at Fairhope, Alabama, the School of Organic Education occupies nine school buildings and a campus of ten acres. The pupils vary from kindergarten to college age. Twenty years ago this school had its inception in a little cottage where six children were enrolled. During these years of growth and progress, it has succeeded in its original purpose of providing a school program which would minister to the health of the spirit, mind, and body of the growing child. Throughout these years it has been supported mainly by volunteer contributions largely solicited by the director. That the school might be of value for public education, no tuition is charged the children of the town. A boarding department has been developed through which the school may become partly self-supporting.

Believing that education is life and growth, the school concerns itself primarily with the child's spiritual or emotional life. The stimulus for growth is interest. There are aims and purposes in life itself. Persevering, enduring, and concentrating for objectives in which he has absorbing interest, are the finest disciplinary experiences for a child. Submerging the personal desire or caprice to conditions inherent in the situation is the highest form of discipline, and this is attained in all creative work. In order to furnish the best environment for the development of sincerity, joyousness, and un-self-consciousness, all formal work is postponed until children are eight, nine, or ten years of age, and creative hand-work is used in its stead. There are no desks to interfere with the freedom of movement; there are no intellectual tasks or assignments; no external goal to be reached, and all marks and grades are omitted. Music and dancing are provided in full measure; the story hour is made enjoyable.

As the children grow older, they begin to make use of books and figures. Still there is no assignment of tasks. The freshness of intellectual attack is preserved for the time when the child's mind is really awakened. It is insulting to ask the child a question to see if he can answer. He should never be questioned except to help him understand. In working out projects the child learns to wait for data before making decisions. He forms the habit of taking truth *for* authority instead of truth *on* authority. This is fundamental to intellectual integrity.

The children are grouped according to their chronological age, and the teacher provides each group with the things necessary for health and study. Special individual attention is given where it is needed, and cases of trifling or indifference become special problems for the teacher. The intellectual development of the child should be as un-self-conscious and un-striven-for as spiritual or physical growth. The prolonging of childhood is the hope of the race. No child should be accelerated. The gifted or precocious child simply should be given more work to do rather than be placed with older children. Placing twelve-and thirteen-year-old children with those of more mature years often results in real tragedy, for sex and social consciousness is forced when this is done. For true health and normal growth, co-education is absolutely necessary. A balanced attraction during the growing years is imperative.

After the children have learned to read, write, and use figures, they take up history, literature, geography, and arithmetic. The creative hand-work, music, and dancing continue.

At fourteen years of age the pupils enter the high schools, not because of any special preparation, but because they are now youth and require a different process. Here four years are spent on earnest, serious work in science, literature, history, mathematics, and language. More advanced creative hand-work in the shop and gardens, and cooking, sewing, music, and dancing supplement these studies. Even in the high school there are no tests or examinations. No child should know failure. No child should develop an inferiority complex. The growing edge must be kept keen through interest, and the order of the development of the nervous system must be respected. After four years of high school work, the pupil automatically graduates. Our graduates have entered many institutions of higher learning and have done well.

Society owes to the young, throughout the growing years, guidance, control, instruction, association, and inspiration. The fundamental condition of growth for the adolescent is social. Some day there will be a college in which the required studies will be music, dancing, dramatics, and arts and crafts. When an investigation is made of the extra curricula activities in our colleges, I venture to say that these will be found to have more educational value than much of the work of the classrooms. The fundamental, all-inclusive art is the art of human relations. Every opportunity and assistance should be given the young to grow in it.

The question all along the way is "What is needed to produce a sound, accomplished, beautiful body, an intelligent, sympathetic mind, and a sweet, sincere spirit"? In the measure that the school provides conditons which produce these, is it educational.

Photograph by Clyde Fisher

HAPPY JACK'S FAVORITE FOOD

Photograph by Clyde Fisher

OOH! ISN'T HE WARM?
(A Florida gopher)

Photograph by Clyde Fisher

WHO'S AFRAID OF A 'POSSUM?

Photograph by Clyde Fisher

CATCHING SAND FLEAS ON THE BEACH
How they can hop!

Step into the little gardens and you will find busy groups of children learning about soils and seeds and slips

Nature Study on the Lower East Side

By MARGARET KNOX
Principal of Public School 15, Manhattan

NOT long ago there were gathered in the dining room of one of New York's big hotels nearly 800 men and women, most of whom were teachers in our city schools. They had come in this social way to dine together and to talk about Nature Study and the School Gardens of our Public Schools.

This gathering was under the auspices of the School Garden Association of New York City which has for its motto, "A Garden for Every Child," and in the program prepared for that day there were items interesting enough to set the whole world a-thinking.

One page of the program is devoted to the activities of the School Garden Association which has a membership of about 8,000 men and women. Here are some of its activities itemized: A Nature Garden Center which exhibits a nature library, a class museum, and window garden demonstration for teachers; publication of the Nature Garden Guide, a small four-page leaflet issued for the instruction of members of the School Garden Association in all matters relating to nature work in the schoolroom, or in the school and home gardens; exhibitions in public schools of bulb raising, seed planting and growing, flower shows, and nature teaching.

Then we come to a page in this nature program headed "Some Nature-Garden High Spots" and we read such interesting items as these:

Classroom gardens in schools	16,256
Bulbs purchased in public schools in 1926	230,270
Narcissus shows in schools, December, 1926	270
Nature rooms in schools	81
Classroom nature projects carried on	99
Pupils voting for a school tree	333,205

These are a few of the statistics that make us stop, look, and listen for the signal that is to direct us along the right road in our educational journey with our children.

The figures in themselves are cold. They tell nothing of the warm, pulsating love of nature that was throbbing in the hearts of hundreds of teachers and thousands of children while these figures were piling up. They cannot take you into the dark old school buildings where these projects have been worked out by an enthusiastic teacher who loves to lead her class out from the harsh, unattractive materialism of the environment in which the children live, to bask in the warmth and sunshine of Nature and God's out-of-doors.

Will you come with me on a Nature Trail more fascinating than any you may have taken in solitude or with one or two friends as you opened up and marked out your way through quiet beautiful woods, over hill and dale, and by the banks of rushing streams?

Down on the lower East Side of our great city of New York, surrounded by tall, dingy tenement houses, bounded by streets swarming with pushcarts and vendors of all kinds of things from second-hand kitchen utensils to fur coats, from vegetables and fruit to live fish and chickens, stands an old gray building, Public School 15, Manhattan. It has stood there for nearly one hundred years, ever since this East Side Ghetto was one of the fine residential sections of Old New York. When I say that most of the 2200 boys and girls now attending this school live within a radius of two square blocks, and that of their 4400 parents fewer than 100 were born in America, you can easily judge of the congested condition down here and of the great foreign population that is to be welded into America's strength.

We enter the playground of the schoolhouse. Bright pictures adorn the walls. Ferns are on the window sills. The door at the rear is opened and a flash of color meets the eye. Draw nearer. In a little garden, not much bigger than a handkerchief, banked by a five-story tenement on one side and our own dingy school on the other, are blooming daffodils, hyacinths, crocuses, tulips. They are carefully guarded by monitors from the industrial classes. These are the children who do not succeed in getting high ratings in academic lessons but who are ever ready to dig and plant and water the garden. Here stands a foreign mother, tears streaming down her cheeks, looking lovingly and longingly at the flowers. She has come in to meet her little girl just entered into the kindergarten. Thoughts of her little country home in Hungary flood her mind, and she feels a pang of homesickness as she points out to her child the flowers that she knew in the old country.

Let me describe "Bulb Day" in this school. On a bright day in October in a corner of this little garden you will find a beehive of busy children working. They have put up a table on trestles, and on it they have baskets of bulbs, of soil and sand, of fertilizer and of pebbles. The children of the industrial classes have prepared this garden spot so that they may sell to hundreds of children bulbs and proper soil to set them in. It has been fun to do all this preparatory work of mixing and sifting and selecting the proper ingredients for bulb raising, under the direction of their teacher, and when the sale begins these boys and girls act like veteran gardeners giving advice to their young patrons.

From all parts of this dingy old building come the classes in orderly lines, each child bringing with him his flower pot, or old bowl, or pipkin thrown out by mother because it was cracked, but just the right thing for the planting of a healthy bulb, and in his tiny hand a few pennies to pay for bulb and soil. The line of children passes in front of the table, and behind the table the trowels are busy filling the receptacles with soil and dispensing the bulbs.

Then back to the classroom go forty children all intent on planting each his own bulb, and placing it in the darkness of the coat closet, there to stay until teacher decides that they are to be brought out into the light.

And so these lessons in nature, real live nature, go on from day to day, until at length the climax,—in January when our great day comes, Graduation Day, and there in our assembly hall are placed dozens of lovely blooms of the narcissus bulbs. These, raised by the children themselves, are the most beautiful of all our decorations that happy day.

In the spring season the hearts of the children are made glad by the procession of early spring flowers raised from bulbs of their own planting: snowdrops, crocuses, daffodils, jonquils, hyacinths, and tulips follow one another in rapid succession, filling the air with their spring fragrance and delighting the eye with their beauty.

What a difference this sort of nature study makes in the lives of these little ones who, when asked some years ago by the teacher, "What are the signs of spring?" answered without a moment's hesitation, "Putting the swing doors on the beer saloons," or, "The cat lies out on the back fence trying to get the sun to shine on her."

Here are some of the answers given in a nature English composition lesson, when the subject assigned was "The Signs of Spring."

> Spring is here! Spring is here!
> Let us give a great big cheer!
> Daffodils dancing on the window-sills,
> In the yellow sun!
> Mother Nature greets us here,
> Spring is here! Spring is here!
> Come, come, let us sing,
> Let us tell the birds it's spring!

And this one by a little 6B girl:

> Awake! Awake! the voice of Spring
> Says to the birds, "Awake and sing,"
> And all the flowers beneath the earth
> Are full of mirth! Are full of mirth!
> See! how the flowers peep up from their beds,
> Up from the earth come their tiny heads,
> Throughout the world the voices ring,
> The voice of Spring! The voice of Spring!

The School Garden Association and the School Nature League founded by teachers who loved nature themselves and who wanted all children, even those condemned to live away from woods and fields and gardens, to get a chance to know the flowers, the trees, and the birds, have been pioneers in teaching us how to teach our course of study in nature, and in making real to the children this whole beautiful subject. These organizations mean bringing to thousands of children who have no opportunity to go out into the woods and fields and along the open road, by the side of streams and ponds, a knowledge of God's nature children: the birds and butterflies, the flowers and trees. They mean awakening in the minds and hearts of thousands of children a love of nature and a great interest in the study of nature things.

Look into the school buildings all over the city today. You will find window gardens in all the rooms, with eager children watching and nurturing the bulbs or seedlings that they themselves have planted. Step into the little gardens and you will find busy

NURTURING THE BULBS AND SEEDLINGS

Narcissus, hyacinth, crocus, and daffodil blossoms poke their heads above the soil and speak to the children with their fragrance and beauty groups of children learning about soils and seeds and slips. By and by you will see the window gardens blossoming, not only in the school but in the homes too, as the narcissus, the hyacinth, the crocus, and daffodil blossoms poke their heads above the soil and speak to the children with their fragrance and beauty. And you must not forget to visit one of the most interesting places in this big school of mine. It is the Nature Room. This is the place where the child gets an opportunity to ask the questions that will lead him out into the open. Every school should have a fully equipped Nature Room where children can browse awhile every day and get near to nature's heart. It is just as necessary for the complete instruction of our children as is the Geography Room with its maps and globes and atlases, or the Sewing Room with its machines and needles and thimbles, or the Shop with its benches and tools.

Let me quote here a composition written by a seventh year child:

Our Nature Room

My! It certainly does seem as if Mother Nature loves Public School 15, for she has come to stay and is living in our Nature Room. It would take a year and a day to explain everything in it, but I shall try in the best way. We have two rooms, a larger one and a smaller one, which open into each other. The larger one contains nests of birds, a live canary, a guinea pig, a rabbit, alligator, goldfish. There are also the stuffed owl, who looks very wise indeed, a porcupine, a wild-cat, a fox, a squirrel, and stuffed birds. The smaller room contains specimens of lichen, weeds, shells, minerals, skins of alligators, pictures of birds, animals, minerals, and a cotton field. To make a long story short, I think Public School 15's Nature Room is one of the most interesting rooms in the district, and as I have said before, I certainly do think Mother Nature loves our school, don't you?

Nature study needs objective illustration more than any other subject in our curriculum. Without it, reading and literature become dull and meaningless. The Nature Room should make real O. W. Holmes's "Chambered Nautilus," Maltbie Babcock's "Surprise," Swinburne's "White Butterflies," Frances Hodgson Burnett's "Secret Garden," Wordsworth's "Daffodils," Bryant's "Fringed Gentian," Grahame's "Wind in the Willows."

Making connections with rural schools that have enthusiastic, interested teachers, is another very important part of the nature work in our schools.

Some years ago our school got into communication with a country school in Dutchess County quite out of the way in a small village. We asked them to send us flowers and twigs and branches and nests—anything in the line of nature material that city children living in a crowded tenement district would not be likely to see, and in a short time boxes and barrels began to come cityward filled with all sorts of nature treasures: birds' nests, hornets' nests, wasps' nests, evergreen branches,—spruce and hemlock—pine cones, and all the flowers in their season.

The excitement of our children at the opening of these nature boxes was quite thrilling, and the knowledge that both teachers and children gained from the study of their contents was surprising.

Then came the next important step in this interesting correspondence. The city children were kept busy sending letters of thanks to the country children—a fine way to teach letter writing. They wrote compositions descriptive of the material they had received or they asked questions about the different things, all of which exercises gave them experience in writing upon interesting topics and gaining definite knowledge of nature facts.

In the drawing department the teachers made use of the nature specimens for lessons in drawing, painting, and designing, with very good results.

Samples of all the work of the city children were sent to the rural school and very soon the teacher of the country school sent us word of the fine effect this had upon the work of the country children. They became very much interested in all the work of the city children and tried to excel in all the branches.

Let me quote one of the compositions written by a third year boy, nine years old:

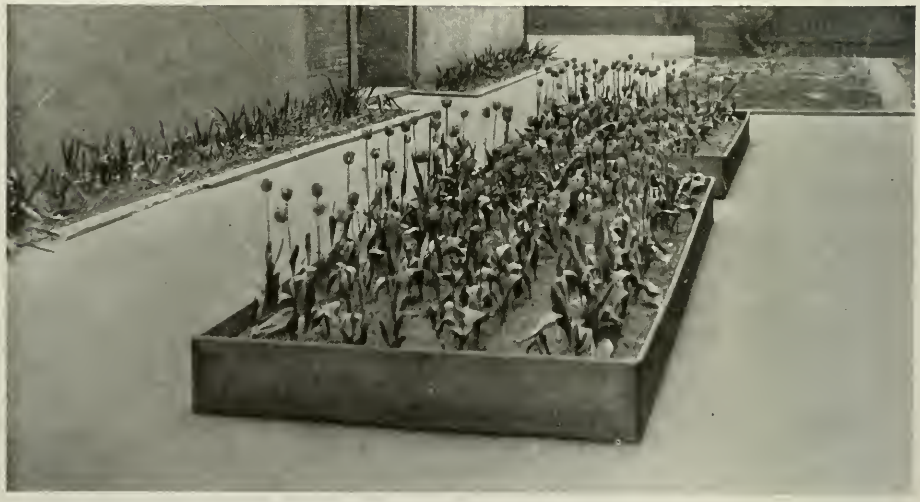
There is a caterpillar in the woods. It will soon become a butterfly on account of the magic change period. God is the magician. He always changes ugly things into something lovely. So he will change the little brown caterpillar into a marvelous butterfly. The butterfly will have two handsome brownish red wings to spread in the summer air. It will flit around and sip every flower's honey. It will be happy all summer until winter comes and then it dies. Wasn't that a wonderful change?

I have taken you along a Nature Trail blazed for the children of the crowded neighborhoods of a great city, and I have tried to show you that we place the study of nature very high in the curriculum. We want to train our children today to love the sciences that lead them out into the open places of this great, beautiful, wonderful world, and that influence each child to seek his life far from the "busy haunts of men."

We need farmers, foresters, gardeners, horticulturists, ornithologists, and astronomers. Why not find them among the children who have spent their early days far from the woods and fields, and lakes and streams?

Nature study in the schoolroom leads the child in spirit into the open, to live in the fields under the stars, in the woods, and by the sea, and to read the mysteries of Creation in God's great book of nature.

We need this sort of training for all the children of America.



School garden, Public School 15, Manhattan. The hearts of the children are made glad by the procession of early spring flowers raised from bulbs of their own planting

The Still-open Road

By FRANK E. LUTZ

Curator of Insect Life and Research Associate in Outdoor Education, American Museum of Natural History

IN a recent number of *Harper's* Charles Merz sang "a song of the once-open road" and its "one hundred and ninety thousand cars, forever flitting from one filling station to another, with half a million people on their backs."

I, too, have been in that "vast company of motors" and have had "impressions of a never-ending road, a thousand farms, no-parking signs, successive towns passed through at twenty miles an hour, back-axles of no end of cars." But, the road is "closed" only in the minds of those whose eyes see nothing but their speedometers, and because our various governmental bodies have not yet fully caught a vision of the real usefulness of public parks.

"Twilight in September," Mr. Merz truly sketches a part of the picture. "Over the hills winds the caravan: lunches gone, lights twinkling, tonneaus full of goldenrod. America revisited."

Let me give you a different picture. Twilight in September. A car parked beside the winding caravan or left in a garage; on a hill stands a motorist "afoot and light-hearted"; lunch forgotten; twinkling flash-light playing on a goldenrod where a long-horned grasshopper fiddles a merry tune with its wings; mind and soul full of the joy of out-of-doors. America not only visited but made his own.

Like so many good things, the automobile is a curse or a blessing depending on the way we use it. Fate having been kind to me, I had occasionally gone by train to our West. How often did I wish that I could stop the train so that I might for even a few minutes listen to a bird which I had glimpsed through the car-window, or smell the fragrance of a clump of flowers, or take a short stroll along the brook-side! Then Fate was still more kind, for I motored to Colorado and those joys were mine. All summer that automobile of plebeian make was my home and my helper, not my master. A cañon twenty miles away,—in an hour I was there, and at the end of a perfect day my house was by the side of the road or, if I pleased, it was my helper to take me elsewhere for the night. No. The road is still open.

But not in the East, do you say? If not, that is the East's fault. Would that the East had more automobile tourist camps so that it would not be necessary "to hurry half the day for the apparent purpose of arriving at a point far enough away to make it necessary to turn at once and hurry home" because near that point there is no place in which a nature-lover can spend the night out of doors as he would like to do! It is not far from true that, quoting Merz again, "a family of six will drive two hundred miles to bring home three balls of glass with imitation butterflies inside," but it should be on the conscience of some of us that no one of this family appreciates the beauty of a live butterfly flitting from flower to flower.

It is highly desirable and is rapidly becoming essential that there be near every city of at least moderate size a tract of public land that is kept in as nearly natural condition as possible.

[1]The accompanying photographs of Yellowstone National Park's very swccessful Nature Trail were taken by Mr. Ansell Hall of the U. S. National Park Service.

ENTRANCE TO OLD FAITHFUL NATURE TRAIL, YELLOWSTONE NATIONAL PARK

The sign at the left gives an introduction to the Nature Trail similar to Doctor Lutz's "The Spirit of the Nature Trail." On the back of this sign, where it can be seen by persons leaving the Nature Trail, is information telling visitors of the other two important trails in this region. In the enclosure just beyond the log bridge is a very rare moon-wort fern (*Botrychium*)

EIGHT KINDS OF LICHENS ARE FOUND ON THIS SHADED ROCK ON OLD FAITHFUL NATURE TRAIL, YELLOWSTONE NATIONAL PARK

SMALL RUSTIC SIGNS ASKING VISITORS TO HELP PROTECT THE FLOWERS ARE HUNG OVER YELLOWSTONE TRAILS

We find it is much more effective to enlist the coöperation of visitors than to attempt to prohibit the picking of flowers

Large National Parks are fine but we need more State Parks and we need, badly need, County Parks—not merely country clubs for the public where those who wish may play golf or tennis or may swim or may eat a picnic lunch, although each of these things is or may be good, but real samples of God's out-of-doors that you and I and our butcher and baker may learn to appreciate and love and, because we do appreciate and love them, to protect.

There is one of the difficulties, not insurmountable but real. Who is to teach and how is it to be done?

Recently I was one of those attending the President's National Conference on Out-door Recreation who were amused by the wit of a representative of the Department of Commerce and Labor. He expressed approval of refuges for blue jays but pleaded for parks where "blue jeans" might rest. The point is well taken but we should do more. The finest radio set in the world would be no more than a parlor ornament if we did not know how to use it; and, to those who know, an open space is not merely a chance to breathe fresh air and to stretch out on the grass. It is Nature, even though it be but a vacant lot; it is much more of Nature if it be a bit of natural woods and fields; and Nature becomes a part of and fills out our lives if some friend introduces us to her and we become really acquainted.

A few years ago the slogan of our National Parks was "Our National Playgrounds" and that was good, for play is important. Now the policy of our National Parks has become in part educational, with Yosemite and Yellowstone apparently taking the lead, and that is fine. No grander, no more inspiring, no more instructive exhibits can be imagined than those in the great out-door museums, our National Parks. The exhibits merely need labels telling about them in language that everyone can understand.

But, if National Parks, why not State Parks; and, so that all of us, even the "blue jeans," may go at any time, why not County Parks? The hills in a County Park may not be mountains but, still, they were fashioned by the same forces; the trees may not be so large and so numerous but their stories are just as fascinating; the birds are just as beautiful and sing as sweetly; and, once you learn to know him, a chipmunk is as interesting as an elk and much more approachable.

Whitman sang of "the open road" because he knew something of these things; Merz gave us "a song of the once-open road" because many of the people on it do not know, but it is not their fault. It is not their fault partly because there are so few places where they can come into real contact with nature without violating trespass laws and partly because it is not easy for those who catch but glimpses of nature in their busy lives to learn the really interesting features of the great, complex out-of-doors.

Teachers about nature have a great responsibility and, if plenty of the right kind of public parks are provided, these teachers will have great opportunities. There will be places for both "blue jays" and "blue jeans" and the two will enjoy themselves and each other. Conservation will not need so much preaching, because more will practise it, knowing what it is all about. Far from being destroyers of nature or even ignorers, automobilists as a class will be protectors of nature because they are not ignorant. After all, they are human beings even though they do not ride in our car; and, if they are

A SNOW MAT OF APLINE FIR ON OLD FAITHFUL NATURE TRAIL, YELLOWSTONE NATIONAL PARK

THE BOTANY POST ON OLD FAITHFUL NATURE TRAIL, YELLOWSTONE NATIONAL PARK

Strings lead from the names on the post alongside the Trail to flowers in bloom ignorant of nature and of how to treat it, that is because no one has taught them and there are few chances for them to teach themselves.

We can still sing the song of the open road if our eyes are open and if there are places where we can use our eyes; but trespass notices, however inconvenient, should be respected. Let us, the public, have many conveniently located bits of nature that belong to us. Let us, nature-lovers, see to it that there is an abundance of out-door museums in which the exhibits are natural because they are nature and in which these exhibits are so labeled that the public, of which we are really a part, may understand and be interested.

The American Museum's Station for the Study of Insects tried an experiment along this line three summers ago and the success of the experiment far exceeded even our expectations. We told people about nature when these people were out-of-doors where they could see living specimens in natural environments. I do not mean personally conducted field trips. On them, one who knows can benefit, at most, only fifteen or twenty people at one time. We label our museum exhibition halls so that visitors do not need a guide. Why not follow the same method where Nature provides the exhibits? The newspapers described our "Nature Trails" in the Harriman State Park, near Tuxedo, New York, as an "insect zoo" and that was a rather fitting name for one section of the trails. On the other hand, it told only a part of the truth, for we believe that, to understand and thoroughly appreciate the lives that insects live, you must not only see live insects but you must know about their environment, about the plants upon which they feed, and about the animals that feed upon them; you must sense the light, the shade, the moisture, and the temperature that go to make up the habitat of the insect. So, at the Station for the Study of Insects, where we made our first Nature Trails, we told our visitors about the plants, for example, and, if the visitor was interested in plants, we had something for him even though he was not interested in insects.

We told about these things partly by word-of-mouth but largely by labels, and we tried to make these labels as human as every-day conversation.

There were two Nature Trails, each about half a mile long and roughly circular. One was called the "Training Trail" and the other the "Testing Trail." Information was given on the Training Trail, but on the Testing Trail there were fifty numbered questions about the plants and the insects along its sides. If a visitor wished to "test" himself he could write his answers to these questions, bring them to us, and we would tell him his score, or he could score himself by use of the list of answers posted at the end of the "Testing Trail." Also, we had competitions both between individuals and between teams.

Instead of risking confusion by attempting to tell something about everything that grew along the Training Trail (and, for the most part, we included only those things that naturally grew there) we picked out just a few of the easy and most interesting things, especially things concerning which there is popular misinformation. Also, we largely avoided technicalities. For example, it is a technical matter to distinguish the various oaks of the black-oak group and even the specialists do not agree. So we merely said that members of the black-oak group can be recognized as belonging to that group by their having a tiny bristle at the end of each principal lobe of a leaf, while members of the white-oak group have no such bristles. We told that the acorns of the black-oak group are not palatable, while those of the white-oak group are more or less so; that many insects recognize the difference between these groups and feed only on the leaves of one or the other; and so on.

We tried to teach some underlying principles of conservation by showing that, if a flower is picked, the plant's children (its seeds) are killed; that, given a chance, a small tree would grow to become a large one; and that plants, the chestnut for example, suffer from diseases just as we do. (American chestnuts have been killed by a fungous disease and not by insects.) We asked people to benefit themselves and others by not needlessly stepping on or breaking a living plant. This they did in a mighty fine way and, as a result, although thousands tramped our Training Trail, it is at no place where it really was a trail (and not a road) more than eighteen inches wide. Only a few not-yet-knowing people—possibly hopelessly ignorant or selfish—picked the flowers that others wished to see or dropped paper where it would mar the beauty of God's out-of-doors, which it is our right to enjoy unspoiled.

The underlying idea of our labels, the "spirit of the Training Trail," was that "a friend is taking a walk with you and pointing out interesting things." This friend, the label we put there, when showing the winding tunnel inside a leaf where a tiny caterpillar spent its life feeding and growing, quoted Lowell:

> There's never a blade nor leaf too mean
> To be some happy creature's palace.

and, as the visitor walked by the side of the babbling Wild Cat Brook, one of these friendly labels reminded of Stevenson's

> There's no music like a little river's. It plays the same tune (and that's the favourite) over and over again, and yet does not weary of it like men fiddlers. It takes the mind out of doors; and, though we should be grateful for good houses, there is, after all, no house like God's out-of-doors. And lastly, sir, it quiets a man down like saying his prayers.

We put these Trails where we did so that they might be convenient of access to the automobiling public, but especially that they would be relatively near the many organization (scouting, charity, and industrial) camps in the Interstate Park. Do you realize that thousands of children from cities and towns are camped there, each for a week or more, every summer? It is not enough to lecture about nature to these children during the winter when they are seated as though in school and with nothing to look at but pictures. A fine city museum, no matter how realistically its exhibits imitate nature, does not fully meet their needs. We cannot help them much by writing magazine articles and books. The children are in the Park every summer with nature all about them. It is the time and the place to tell them what they are keen to know.

The better of these camps have "nature councillors" and exceedingly useful camp museums, the latter preferably made by the children themselves. The Nature Trail is an additional help. Some have called it an "outdoor museum" but it is not that, for a museum is a place to which specimens are brought and in which they are stored. The nature-trail idea is to leave things where they are but to label them with interesting facts. If interesting facts are given first, less interesting ones will then be more readily grasped. Is that not true in your own case? After you have learned that a toad catches insects for food, that its young are tadpoles living in water, and that, though warty itself, it does not give warts to people who touch it, you will probably care to know that the scientific name of toads is *Bufo*, that the species you are looking at is *Bufo americana* and that it differs from another native toad, *Bufo fowleri*, in such and such characters. At any rate, on our Training Trail the labeling was not a catalogue of species but a personal conversation.

If there is but one Nature Trail in a large region, something is gained, since it is possible for people to come from a distance to see it; but that is not "taking nature lore to the public"; it is asking people to come to nature lore. So, it was extremely gratifying to see with what enthusiasm various camps took up the idea and made Nature Trails of their own. The children, in doing this work, learned more than they could possibly do by merely studying a trail that some one else had made. Furthermore, they had a sense of proprietorship; that trail was theirs; they had become part owners of nature and their fathers and mothers and all their relatives and all their other friends were welcome to come and share in the joy of knowing about out-of-doors. Thus our half-mile of Training Trail grew in a season to more than ten miles and this fact, even more than the kind verbal comments of our visitors, made us think that our work was worth while. Now there are hundreds of such Trails and on three continents.

Why not? Why should there not be written or printed "friends" in every city, county, state, and national park telling people something concerning the things there—not just the names of them but something that appeals? Why should not the camping grounds of automobile tourists be made more than mere overnight stopping places? If a commercial concern thinks it is worth while to put its slogan where you cannot help but see it while you eat your wayside lunch, why is it not the duty of those who know about nature to meet you there and by neat, chatty labels tell you something worth while? That would be taking nature lore to you and to others of that vast company of people we call "the public," and it would be well worth while.

The New Projection Planetarium

By W. J. LUYTEN
of the Harvard College Observatory

WITH its plans for installing one of the Zeiss projection planetariums in its proposed Astronomical Hall, the American Museum of Natural History has again taken the lead in bringing before the American public one of the most amazing triumphs of science and engineering, and in offering them something of great educational value. This "Miracle of Jena," as Professor Strömgren, director of the Copenhagen Observatory, aptly called the planetarium, at once a school, a theater, and a moving picture, presents to the interested public not only the whole great field of astronomy, but the whole conception of the universe as revealed by many centuries of painstaking labor and study of the astronomers, and it does this in simple, comprehensive form, in the silent language of the stars themselves.

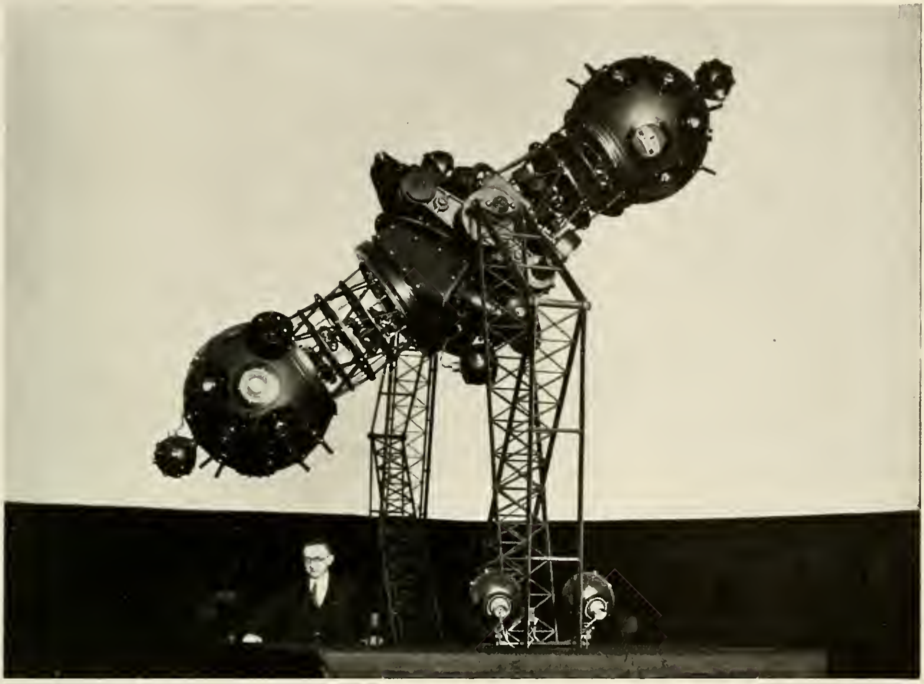
A planetarium is, by its name, an instrument which shows the motion of the planets and their satellites around the sun, and portrays the mechanism of the solar system. Ever since the time of Copernicus, or rather, since the acquiescence of the authority of the Church (which first burned Giordano Bruno at the stake and made Galileo recant his heresy) planetariums have been constructed to show how the planets revolve around the sun, and the moons around their respective planets, thus explaining the phases of the moon, and of Venus and Mercury. Huygens, in Holland, was known to have made one of the first relatively accurate machines. Charles Boyle, nephew of the famous physicist, the fourth Earl of Orrery, had a very complicated planetarium constructed for him, which has since been named for him, thus giving rise to the word "orrery," now often used to describe a planetarium. One of the most celebrated planetariums of recent times is that of Eyse Eyzinga, in Franeker, Holland. But undoubtedly the most elaborate and most successful of them all is the great Zeiss planetarium at Munich, which is in a room with black walls in which are many very small holes, indicating the stars. Although this instrument was the best in existence, it was universally agreed that it was not satisfactory, because it portrayed the solar system as an observer on the outside would see it. So the Carl Zeiss Corporation set to work to design an apparatus which would show the universe as we really see it, from the *inside,* avoiding the difficulty of having to imagine ourselves on the outside of the universe. And this was no easy task, as you can well imagine. It took Dr. Ing. W. Bauersfeld, the inventor of the present planetarium, twelve years of calculation and experimentation, and five years of construction before he could produce the first projection planetarium.

Let us consider what such an instrument must do: It must show the sky in exactly the same flattened form as we actually see it; it must give this sky the same dark-blue color, and above all it must convey to us the impression that it is infinitely far off. The several thousand stars which the human eye

The Zeiss Planetarium in Prinzessinnen Garten in the old university town of Jena

can see must be depicted with truthful accuracy; they must be shown to rise and set in the same manner as we observe them to do. The sun, moon, and planets must be shown moving along the celestial sphere in their appointed places; they must show the same phases and the same changes in brightness as they do in the sky. But when the new instrument was ready for action, it *did* fulfill all these requirements, in fact, it far surpassed expectations, even those of the inventor,—its success was immediate and great. The original instrument, made for the National Museum in Munich had a hemispherical dome about thirty feet in diameter, but subsequent domes were quickly increased in size, until at present they are built seventy-five feet or more in diameter. The one in Düsseldorf has a diameter of ninety feet.

In the center of this enormous dome stands the projection apparatus, containing in embryo the whole visible universe. It consists of a large glass cylinder carrying a large knob at each end. These knobs contain a replica of the actual sky, the stars, planets, Milky Way and other objects of interest. The glass cylinder represents the power behind the throne, it is the brain of the universe, it directs the destiny of the firmament, and decides whether we shall see the sky as it is now or as it was in the remote past or as it will be in the distant future. Each of these knobs has several lenses on its surface, 39 in all; behind these are lantern slides carrying the stars on them. By lighting a powerful electric lamp in the center of each spherical arrangement of projectors, behind these lantern slides, the stars, tiny little holes in the black film of the lantern slides, seem to emit light, and by means of the lenses images of them are projected on the dome. The new projection apparatus contains about 5400 such stars, and the greatest care has been taken that no slight defects in the lantern slides should give rise to "new" stars,—spurious objects which do not actually exist in the sky. The size of the star images on the original



The Zeiss Projection Planetarium, the great invention which is installed in the center of the dome at Jena

slides is such that the artificial sky shows the stars in the exact proportion of their brightness. For this reason Sirius, the Dog Star, has been given a special projector, in order that it may, as in reality, appear as the brightest star in the firmament. In addition to the projectors for the stars there are seventeen lenses which are made to show the well-known star clusters and nebulæ, such as the Pleiades, the Beehive cluster, and the great nebula in Orion. Two projectors, one on each knob produce the Milky Way in the sky, giving an almost exact replica of this faint, hazy, band which extends all across the sky. Thirty-two other projectors can, if so desired, be lit, in order to show the names of the constellations. In the glass cylinders between the knobs are housed the projection apparatus which produce the sun, the moon with all its phases, Mercury, Venus, Mars, Jupiter, and Saturn, while at various places, not used otherwise, minor refinements are located.

Such are the complicated technical details of the Zeiss projection planetarium; but when the machine is in operation these details become lost, and the spectators see only the realistic and thrilling spectacle of the infinite and eternally moving universe. When first the visitors to the planetarium enter the dome and take their seats as near the center as possible, they see

STUDENTS READY FOR A DEMONSTRATION AT THE ZEISS PLANETARIUM IN JENA nothing but a brightly illuminated white surface, the inside of the dome. Gradually the lights are dimmed, and, as the eyes become more and more accustomed to darkness, the now perfectly dark sky seems to take on that peculiar dark-blue hue which our eyes see in the real night sky. Then suddenly, the artificial sky is lit, and the whole audience whether trained astronomers who know what to expect, or school children eagerly awaiting the unexpected, cannot suppress an involuntary exclamation of delight, and for a few moments they sit spellbound, fascinated by the twinkling multitudes of stars. They feel as though they had been transplanted to a high mountaintop, and, gazing at the lucid beauty of a clear night unspoiled by disturbing moonlight, suddenly realize their insignificance in the infinity of surrounding space. Then the machinery is set in motion, and the firmament begins to turn, stars rise and set, and the spectators cannot help but feel the silent music of the spheres. The Milky Way appears in all its splendor, and some sensitive eyes already see some of the larger spiral nebulæ, and other far distant objects. Again the picture changes at a command of the operator of the projection apparatus, who, for the time being has become the Directing Power of the Universe. The sun, moon, and planets appear, the rotation of the earth carries them across the sky,—and a day passes in four and a half minutes. By a change of gear even this can be speeded up, and a day be made to pass in less than one minute, a year in five minutes, a century in a few hours. But again the universe is tampered with,—the clock is put back several thousand years, and the sky is shown as it was seen by the early Chinese observers, by Ptolemy, by Copernicus, and by Galileo. It is even possible to produce the conjunction of bright planets which formed the star of Bethlehem, and it is shown how, in the course of 26,000 years, the North Pole of the heavens changes place among the stars, deserting our present Pole Star, approaching Vega in 12,000 years, and returning again to its point of departure in a "great year," 26,000 ordinary years. By means of special devices, a comet may be made to appear, and eclipses of the sun and moon be made to occur.

In short, so great is the spell which a demonstration of the planetarium casts over the spectator, that he cannot help feeling the lure of astronomy, he cannot help realizing that he has for a moment, at least, peered into the mysteries of the infinite. It is this lure of astronomy, inherent in all human beings, which has made possible the erection through private endowment of so many first-class observatories in this country, and which in turn is satisfied by opening the principal observatories to the public as often as work permits. But, as all astronomers know, only too often do interested people have to be turned way, simply because the sky will not oblige. With a cloudy sky, an observatory can do nothing. The planetarium does not mind such a little thing as a cloudy sky. It can be operated at any time, under any weather conditions and it will never disappoint its visitors. Furthermore it will never be necessary to resort to such desperate means as cutting an image of Saturn with its rings out of cardboard, affixing it to a distant wall, and turning the telescope on it in order that a royal visitor may not be disappointed by cloudy weather, as once happened in an English observatory.

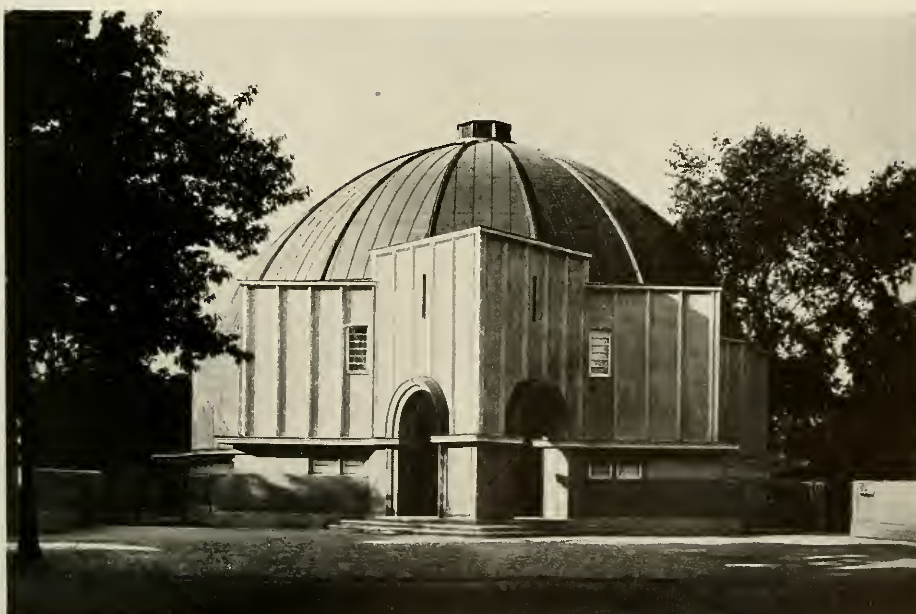
For educational purposes, as well, a

In Düsseldorf,—the largest planetarium dome yet constructed

In the capital city,—Berlin

VARIOUS TYPES OF DOMES
FOR THE ZEISS

In the great railroad center,—Leipzig



In the art center,—Dresden

IN USE IN GERMANY
PLANETARIUM

projection planetarium is invaluable. In a few hours more can be shown with it and more attained in the way of explaining difficulties, than could be done by several months of lecturing. It is not surprising, therefore, to hear that more than a score of cities in Europe have already obtained one or ordered one. Munich, in Bavaria, was the first, but Jena, Düsseldorf, Berlin, Hamburg, Dresden, and many other cities in Germany soon followed. And the great success may be measured by the fact that, in less than two years, the planetarium in Munich attracted more than 80,000 visitors.

In this country the American Museum of Natural History took the lead very early when Dr. Clyde Fisher, director of the astronomical department of the Museum, went to Germany to study the construction of the planetarium with the express view of having it adopted by the American Museum. Doctor Fisher, in announcing the campaign for financing the new astronomy building, said that he expected the new planetarium would probably attract more people to the Museum than all other features combined. The new Astronomical Hall which has been planned for the Museum, and which is to cost $3,000,000, will be a five-story building with the dome for the planetarium as the crown of the building. The plans have been fully drawn, but construction has been postponed pending the completion of the endowment drive.

Other American cities seem to have been more successful in their plans for the erection of a planetarium. In Chicago the project has definitely been started with the offer of Julius Rosenwald to finance it, in Seattle Louis C. Frye, millionaire packer, has already opened negotiations with the Zeiss company. And of course the rivals of the Pacific Coast—San Francisco and Los Angeles—are both looking forward to a speedy erection of a planetarium.

An Opportunity

THE interest in astronomy is surely increasing, and a hopeful sign it is. A generation or two ago the subject was included in the curriculum of many secondary schools as well as of colleges and universities, but it was gradually dropped, without much doubt, on account of the feeling that even an elementary knowledge of the subject involved too much difficult mathematics. In the last few years, however, either in spite of the mathematical bugbear or because some of the technical part has been eliminated from astronomy as a cultural subject, the pendulum seems to be swinging the other way. One of the outstanding bits of evidence that there is a genuine and widespread interest in the subject is shown in the organization this spring of a popular astronomical society in New York City. Several of the leading newspapers gave favorable editorial notice of the organization meeting, and the movement was encouraged and helped by the scientific magazines. As a result Prof. Henry Fairfield Osborn welcomed 500 people to the first meeting which was held at the American Museum, and within six weeks the new society could boast of more than 600 members, — probably already the largest astronomical society in the world. Its official name is

"The Amateur Astronomers Association," and the American Museum of Natural History is its headquarters.

The members of this new society, as well as thousands of people throughout the country, are intensely interested in the plans of the American Museum of Natural History to build an astronomical hall,—this structure to be the central part of the series of buildings of that institution as outlined in the Astronomical Number (July–August, 1926) of NATURAL HISTORY. It is most fitting and proper that the astronomical department, which shall set forth the most ancient, the fundamental science, should occupy the hub of this great natural history museum.

A Museum of Astronomy equipped with exhibits, with interesting and lucid labels, and with apparatus that will work before the visitors' eyes, the climax of the latter being a Zeiss Projection Planetarium, will have an irresistible appeal to the public. Every one loves the beauty of and is interested in the movements of the heavenly bodies, and desires to know about the origin of our planet and of our solar system.

What field of science offers so great an opportunity to enjoy majestic beauty? What subject helps us more in our natural struggle to comprehend the infinite? What science does most to lift one out of the petty things of everyday life, thus allowing the soul to expand?

Consequently, what greater educational project can be conceived than building and installing the proposed astronomical hall at the American Museum of Natural History? At present, the greatest thing of the kind is in Munich. What an opportunity for some great philanthropist to establish in our metropolis an institution whose educational and inspirational effect upon the people of America would be immeasurable!

—CLYDE FISHER.

NOTES

SCHOOL SERVICE

EDUCATIONAL FILMS FROM LAPLAND.—Mr. George D. Pratt, a Trustee of the American Museum and chairman of its committee on education, visited Sweden and Norway this summer where he took both still and motion pictures of the country and its people. These are to be used in the Museum's work with public schools. Mr. Pratt also procured from the Swedish Film Industry a copy of the film "In the Country of the Mountain People." This film, which tells the story of summer and winter life in Lapland, was especially taken for the schools of Sweden.

COPPER MINING IN MOTION PICTURES.—Through the interest of Mr. George D. Pratt, the motion picture library of the school service department has been enriched by the gift from the Kennecott Copper Corporation, 120 Broadway, New York City, of ten reels of motion pictures on "The Story of Copper." This film shows different methods of mining copper in the United States and Alaska, as well as the processes of milling, smelting, and refining. These pictures are for the use of the public schools of New York City, and will be shown in the Museum auditorium.

THE CONSOLIDATED GAS COMPANY OF NEW YORK has deposited at the American Museum four reels of motion-picture film showing the history and manufacture of illuminating gas and the uses of gas in modern industry and in the home. These films are for free distribution to the public schools of New York City.

THE DEPARTMENT OF PLANT AND STRUCTURES has also deposited with the Museum a three-reel film which shows the work of various city departments from the Board of Alderman in session to street cleaning. These films are especially adaptable for civics classes and will be lent free of charge to any public schools in New York City.

MR. ERNEST THOMPSON SETON conducted

an expedition through several of the western states for the purpose of studying sign-language, dances, and other customs among the Indians. Other members of the party were Dr. and Mrs. Clyde Fisher and Mr. Herman A Sievers of the American Museum; Mr. George M. Will, archæologist, and Mr. Clell Gannon, artist, of Bismarck; Mr. Russell Reid, naturalist of the North Dakota State Museum; Mr. Carol Stryker, curator of the Staten Island Museum; Mrs. Julia M. Buttree, secretary of the expedition; and Miss Helen E. Saunders, biologist, Girl's Commercial High School, Brooklyn, New York.

Doctor Fisher, with his Akeley camera, secured some excellent motion pictures of sign-talking, with translation, among the Sioux on the Standing Rock Reservation at Fort Yates, North Dakota, and of a number of dances at Taos, Santa Clara, Tesuque, and other pueblos in New Mexico. He also made several hundred still photographs of various places of interest in the west, including some of the Petrified Forests, the Painted Desert, and the Grand Cañon in Arizona.

Canada in Motion Pictures.—Following a visit to the Candian Government Motion Picture Bureau, Mrs. Grace Fisher Ramsey secured twelve films portraying the industries and scenic features of Canada. These are for distribution to schools, churches, or civic organizations in New York City and vicinity.

Motion Films of Life in Mediterranean Ports.—Mr. Philip Pratt, who with Mr. John Foley visited Mediterranean ports this summer to obtain motion pictures for the Museum, has recently returned. He reports that as a result of three months' study of the countries bordering the eastern end of the Mediterranean Sea, he was able to secure a series of pictures in Syria, Palestine, and the delta of the Nile. These three new films of scenes from the every-day activities of the people add new interest to the growing collection of travel pictures at the American Museum.

In Egypt Mr. Pratt concentrated on the delta country and included many scenes of rural and town life, as well as the life of Cairo and the port of Alexandria. In Palestine the towns of Jaffa, Haifa, Jerusalem, Bethlehem, Nablis, and Nazareth, as well as others less known, were visited, and a pictorial record of the mode of life in that country was made. Another phase of eastern life was studied in Damascus and Beyrouth, and other Syrian towns. Special attention was given to child-life in these countries, and many of the pictures show them at work and play. In addition to the motion pictures, Mr. Pratt took several thousand still photographs.

Mr. Pratt received every possible assistance for the execution of his work through the generous coöperation of the American Export Steamship Company.

A FEW NOTABLE BOOKS ON NATURE EDUCATION AND THE MUSEUM

Through Field and Woodland. By Alice Rich Northrop. Edited by Oliver Perry Medsger. G. P. Putnam's Sons, 1925. As indicated by the title, this book is a companion for nature students, and it covers nearly all phases of natural history. Written by the founder of the School Nature League, it was left unfinished at her untimely death. To finish the work, and to arrange the material, no better person could have been engaged than Mr. Medsger, the thoroughgoing and dependable all-round naturalist and teacher of experience. The editor is head of the natural science department in Lincoln High School, Jersey City, N. J. Containing more than 500 pages and 200 illustrations, a goodly number of the latter being plates in color, the book is all it purports to be,—a veritable *vade mecum* for students of nature.

First Lessons in Nature Study. By Edith M. Patch. Macmillan, 1926. Not many technical scientists preserve the point of view of childhood and youth, but the author of this book is an outstanding exception for whom we are grateful. Miss Patch is the only woman who holds the position of State Entomologist in America, and she is also a member of the teaching staff of the University of Maine. Her earlier books, *Dame Bug and Her Babies*, *Hexapod Stories*, and others have shown that she can write interesting untechnical stories that are accurate as natural history. This work is dedicated to the dean of nature study teachers in America, Anna Botsford Comstock, and is worthy of such inscription. It is a book of nearly 300 pages, divided into 15 chapters, and will be found most helpful to both pupils and teachers.

Nature Guiding. By William Gould Vinal. Comstock Publishing Co., 1926. Doctor Vinal was formerly professor of nature study in the Rhode Island College of Education; he is now a member of the staff of New York State College of Forestry. This book of about 700 pages was prepared for that great American institution, the Camp. The author is finely equipped both by experience and training for the undertaking, and he has brought together a wealth of material of great value to the camper and to the nature counsellor.

Nature-Study, Part 1. By Charles Lincoln Edwards. Hesperian Press, Los Angeles, 1924. Doctor Edwards has been director of nature-study of the Los Angeles City Schools for more than a dozen years. Previous to his present work, he was a university professor for twenty years. He believes that any one who desires knowledge of nature should have all that the university offers, but stripped of the technical terms which so often conceal, rather than reveal, the truth. Here is a book of more than 200 pages, containing chapters on "Spirit of Nature-Study," "Sense Education," "Plants and Animals of the Home Neighborhood," "Mammals of the Circus," "Seaside Life," etc., which is especially adapted to the Pacific coast and our western country.

Manual for Small Museums. By Laurence Vail Coleman. G. P. Putnam's Sons, 1927. This book was written for those who contemplate founding a museum, or for those who wish to stimulate the growth of small museums already in existence. The author says that he was prompted to write it by his "observation of the rapid growth of interest in museum-making and the hindrance or defeat of many efforts through lack of information."

Much of the material was gathered by the author in the course of travels over 15,000 miles from the northern to the southern border of the country and from coast to coast, since he has been Executive Secretary of the American Association of Museums. Without doubt Mr. Coleman has visited more American museums than any one before. That he has really investigated them and interpreted their work is abundantly shown by the content of the chapters.

The book contains 400 pages and is illustrated with 32 plates. Every phase of museum activity and every branch of museum administration are treated. In the introduction the museum field and the purpose of museums are discussed. The first part of the main book is devoted to organization, the second to administration, the third to curatorial work, the fourth to educational work, the fifth to research, the sixth to building, and the conclusion to the outlook, and then follow a number of important appendices.

No one is so well equipped to write a book of this nature, and we believe it will be found indispensable to those for whom it was prepared.—C. F.

ASTRONOMY

The unusual group of large sunspots visible most plainly September 15 to 17 was the principal subject of discussion before the large audience that convened at the American Museum of Natural History on the occasion of the first autumn meeting of the Amateur Astronomers Association. Mr. Harry Lawton, one of the members, showed a lantern slide of a superb photograph, made on the day of the meeting, by Mr. William Henry, of a tremendous group of spots, the three largest of which averaged 28,000 miles in diameter. The whole group covered an area of about 160,000 miles long by 85,000 miles wide. Mr. Lawton discussed the correlation of sunspots with auroral displays and their possible relation with the meteorology of the earth.

Dr. Clyde Fisher, president, invited the members to visit the Museum on Friday, September 16, and Saturday, September 17, to view these spots through the Brashear telescope. Many persons responded to the invitation. The sky was free of clouds on both days, and the spots showed with startling clearness.

Astronomy for Girl Scout Leaders.—Dr. Clyde Fisher gave an astronomy lecture in the Girl Scouts National Training course for leaders at Camp Macy, near Briarcliff Manor, New York, on September 22. Two hundred and sixty-four Girl Scout leaders from all parts of the United States were present. Doctor Fisher's lecture was on the subject of the evening sky, and was prefaced by a description of the Zeiss Projection Planetarium and the Astronomical plans of the American Museum.

TESTIMONIAL OF ESTEEM TO HENRY FAIRFIELD OSBORN

In celebration of the seventieth birthday of Henry Fairfield Osborn, August 8, 1927, his many friends and coworkers from all parts of the world united in a testimonial of affection and esteem by presenting to him a unique and

QUEEN ANNE SILVER-GILT CUP AND COVER

Made by Thomas Folkenham in 1711

This cup was presented to Prof. Henry Fairfield Osborn by his friends as a token of affection and esteem, on the occasion of his seventieth birthday, August 8, 1927. The cup is mounted on an ebony plinth with silver-gilt inscription plate by Freeman of London beautiful cup and a set of engrossed resolutions. The cup, of Queen Anne silver, was made by Thomas Folkenham in 1711. The resolutions bore more than 500 signatures inscribed on individual cards of vellum, which were assembled and mounted with the greeting in an illuminated gift book, designed and executed by William E. Belanske.

Because of Professor Osborn's proposed trip to the west and absence from the city on August 8, the presentation was made at his home in Garrison on July 28 by a subcommittee. At the same time Professor and Mrs. Osborn were invited to be the guests of honor at a reception to be held September 29, when the surplus of the funds raised by Professor Osborn's friends—amounting to more than $7,000—will be presented to Professor Osborn for his research work. All arrangements for this celebration are in the hands of a committee of which Dr. Frank M. Chapman is chairman and Dr. William K. Gregory is secretary.

The birthday resolution follows:

TO HENRY FAIRFIELD OSBORN
August 8, 1927

On your seventieth birthday your colleagues and friends join to salute you, to congratulate you and to express their delight in finding you radiant in health and spirit, joyously carrying on your life work.

We desire to thank you most heartily for your leadership in many fields. Drawing around you in the American Museum of Natural History a staff of explorers and coworkers who are animated by your spirit and who gladly enroll under your banner, you have penetrated to the uttermost parts of the earth and have brought its natural history treasures to the Museum. To your unceasing labors, as Curator of Palæontology and as President, we owe the series of unique exhibition halls at the Museum, where countless visitors pass before an impressive panorama of extinct life. Thanks to your sympathetic understanding, the school-children of New York and their teachers enjoy all the educational and emancipative opportunities of the Museum's School Service. And in the near future the Museum will also display still other imposing evidences of your constructive genius when the Roosevelt Memorial Hall and the Akeley African Hall take their places in the assemblage of buildings devoted to science and education.

We desire also to express our admiration of the creative, tireless spirit which, during a life crowded with administrative work, has produced a series of publications, covering many hundreds of titles and ranging from brief articles in NATURAL HISTORY to the great monographs on the titanotheres and the proboscideans, now in press.

We congratulate you upon the many distinguished honors that the highest scientific tribunals of the world have awarded to you in recognition of your services to science. We join the great company of your readers in acknowledging our indebtedness for such classic works as "From the Greeks to Darwin," "The Origin and Evolution of Life," "The Age of Mammals," and "Men of the Old Stone Age."

Princeton University will not forget your services when in 1877 as co-leader with your life-long friend Professor W. B. Scott, you led the first Princeton expedition to the fossil fields of Wyoming; or when, after your return from your graduate studies at Cambridge University, you brought the Huxleyan gospel of comparative anatomy to your pupils.

Columbia University has reason to remember the great part you played in planning and guiding the Department of Zoology in its formative period; nor will your old students, either of Princeton or of Columbia, ever forget what new worlds you opened to them and showed them how to enter.

The New York Zoological Society owes to you thirty-one years of brilliant service as Chairman of the Executive Committee and later as its President.

From many parts of the world therefore your friends unite to testify their appreciation of your services as a leader in biological science, in education, and in the highest ideals of citizenship.

We congratulate you again upon this unique record of service. We delight in the admirable spirit of fairness, generosity, friendliness, and comradeship which you have shown, not only to your colleagues but to the least of your assistants. And we rejoice with your devoted wife and your sons, daughters and many grandchildren, that this seventieth birthday finds you with forces unimpaired, still planning, still building, under the inspiration of a dauntless optimism.

CENTRAL ASIATIC EXPEDITIONS

At the second "Asia Lecture" of the Royal Geographical Society, November 8, 1926, Dr. Roy Chapman Andrews presented a most comprehensive story of the five years' work done in Mongolia by the Central Asiatic Expeditions. He spoke upon the organization, methods of work, and the most important results achieved in the several branches of science represented. His lecture was illustrated with an excellent series of colored photographs which were secured on these expeditions. After summing up the work of the expedition, Doctor Andrews said,

The three season's field work already completed have been confined to Outer Mongolia, north of the Altai Mountains. We feel that *for the purposes of the expedition*, this region is now sufficiently well known to warrant directing our attention elsewhere. A surveyed line more than 1000 miles long has been run north-west through the heart of the desert, thus giving accurate starting-points for any future topographic work.

We hope in the seasons of 1927, 1928, and 1929 to carry on similar investigations in Inner Mongolia. We are particularly anxious to complete another westward surveyed route south of the Altai which will connect with the excellent work done by Carruthers, Stein, and other explorers in Chinese Turkestan. To carry out such a survey will be one of the main objects of the expedition in 1927. We have reason to believe that rich sedimentary fossil-bearing basins lie in the Western Gobi, and that special attention to prehistoric archæology will be eminently worth while.

Doctor Andrews' talk was prefaced by a short address by Dr. D. G. Hogarth, president of the Society, in which he said,

Doctor Andrews is going to tell us to-night about a great deal more than dinosaur eggs: about the organization of almost a new form of exploration—the realization of what I ventured in my presidential address a few months ago to hope would be the work in the future of this Society—that is, intensive study of a particular area. . . . The great journeys of exploration are probably done in almost all the world, the great pioneer lines have been thrown across the continents. What we have to do now is to fill up great gaps between those single lines. Dr. Roy Chapman Andrews is going to show you how this has been done in a most interesting region, Mongolia.

A discussion, opened by Sir Francis Younghusband, followed Doctor Andrews' report. Sir Francis, speaking of the slides said,

We are too accustomed in this Society to have placed on the screen dreadful dull grey photographs, but Dr. Andrews has brought us colored pictures which have given us a most delightful impression of the desert.

He further remarked:

I should like to add that an expedition such as that described cannot be carried out unless the leader has great organizing capacity. He has, first of all, to spend a year or two in organizing the whole expedition. That in itself is an enormous undertaking: getting the men and money together, as well as the whole of the supplies. And then one can realize what it must have been in the field to coordinate motor cars and camels. When I crossed the desert motor cars had not been thought of. To get Americans, British, Mongols, Chinese, and Heaven knows who else to work together requires in the leader magnificent capacity for organization. And what the lecturer said is perfectly true. Every leader feels that he cannot carry out what he has to do without the men working under him—that he is indebted to them for a great part of the success of the expedition. But success is not due to them entirely. In the main, the success of the expedition must depend upon the leader himself. We can gather from what the lecturer has said and from the way in which he spoke of his men that he is an ideal leader of an expedition.

Prof. D. M. S. Watson, professor of zoölogy, University College, expressed the opinion that

The expedition Doctor Andrews has designed and conducted is without parallel in the history of palæontological science. In the course of three or four years he has brought our knowledge of the history of life in Mongolia from literally and absolutely nothing, except one rhinoceros tooth, to a stage which in the United States of America, which is parallel in size and complexity, was reached only after thirty or forty years of investigation, not by a single authority but by many museums and by the Survey. I do not think anywhere there is any other piece of geological work carried out on the scale of a whole continent, as it were, which has given us at once the history of a large area throughout the whole of Jurassic, Cretaceous, and Tertiary times. Not only have we now this geological knowledge, but we have also revealed to us new and most important types of animals, particularly those little mammals recently described by Drs. Gregory and Simpson, which came from the same beds as the dinosaur eggs, which will, I am sure, prove to be of the utmost importance.

Apart from such finds of interesting creatures, we have the fact that there has been verification of many—not of all—of the conclusions which President Osborn drew from his studies of the distribution of mammals of the world. We have verification of the idea that Mongolia was one of the great centres, if not the greatest of all centres, of the evolution of mammals, and that gives great satisfaction to those actually working on palæontological material. To have one's convictions verified is the test of the value of one's type of scientific work. For that we have to thank Dr. Andrews. We have also to thank him for providing us with a perfect model of the way in which such palæontological expeditions should be worked. We have had investigations carried out in the field by those men who will work out the results in the laboratory, and this for all the sciences which are capable of throwing light on the problems to whose solution the expedition has been directed.

Sir Sidney F. Harmer, director of the British Natural History Museum, congratulated Doctor Andrews warmly on the work he has accomplished. Among other things he said,

Dr. Andrews has already explained that in going to Mongolia he was actuated by the desire to find out what is true and not to prove any theory. That is the real spirit which actuates science in general, at any rate any which is worthy of the name. We have followed with the greatest admiration the work that Dr. Andrews has done. You will agree, from what he has told you, that he has thoroughly deserved success. . . . I should like on behalf of all representatives, as far as I am entitled to speak for them, of geological and allied sciences in this country, to express our cordial congratulations to Dr. Andrews for the great work that he has done and to emphasize the fact that the work really is great. The American expedition has discovered an enormous amount which we did not know before.

Hazards of Expedition Work in Mongolia.—One of the achievements to which the leader of the Central Asiatic Expeditions may point with pride is the fact that during the first six years of the exploration not a single member of the party met with a serious accident. This party has included, besides the many Chinese and Mongol servants and assistants, a total of twenty foreigners, and the exploration accomplished covered three full seasons in Mongolia with six, eight, and fourteen foreign members on successive years, also many trips to remote parts of China by smaller parties, and all this in regions where opportunity for trouble is not wanting. This freedom from injury or harm has been due partly to the ability of the experienced field men to take care of themselves under various conditions, and partly to the splendid organization and direction of the expedition by Doctor Andrews.

It was not to be expected, however, that this immunity could continue indefinitely, and this spring the first serious accident happened to Mr. J. MacK. Young, chief of motor transport, who is just now recovering from the effects of severe frost bite.

In March, of this year, when Mongolia was still in its vicious wintry mood, Mr. Young, who at that time had charge of the expedition affairs in Peking, found it important to visit the expedition camel herd which was wintering on the plateau near the motor station of Chap Ser about one hundred miles out from Kalgan. The climate of Mongolia is delightful for two or three months in the summer, and is tolerable in the late spring and early autumn, but for the remaining months of the year it is downright bad, bitterly cold, windy and altogether inhospitable and dangerous. Mr. Young, however, with characteristic devotion to duty and contempt for physical discomfort, started out from Kalgan in a motor car in company with one Chinese assistant. The weather was moderate for the season and he reached the little group of mud huts called Chap Ser without incident. Here he was told by the local Mongols that the camel herd had been recently moved a considerable distance to the northward to new feeding grounds; they also informed him that a snow storm was brewing and that after such storms motor cars were usually unable to travel for several days because of snow drifts. So he reluctantly abandoned the idea of seeing the caravan leader and on the following morning started on the return journey to Kalgan.

A few hours after leaving Chap Ser the predicted storm broke, with blinding snow and a great drop in temperature. The men were warmly clad after the fashion of winter travelers across the Gobi, and no great discomfort was experienced, but upon arrival at the nearest station, some thirty-five miles from Kalgan and still on the plateau, Mr. Young discovered that several fingers of both hands had been frozen, presumably because of pressure on the driving wheel. But it was not until he reached Kalgan the next afternoon, following an all-day fight through snow drifts down the pass, that he realized the seriousness of the situation. He then took the first train for Peking and placed himself under the care of Dr. Harold Loucks, of the Rockefeller School and former Expedition Surgeon. The third, fourth, and fifth digits of each hand were found to be badly affected and it was advised by some to make immediate amputation because of the dread of gangrene, but skillful treatment given by Dr. Loucks over a period of three months has left Mr. Young with all but the tips of three fingers. Recent letters, both in longhand and typewritten, received at the Museum indicate that "Mack" is getting back toward normal again, and both his colleagues on the expedition and his host of friends in Peking and elsewhere are glad to know that the accident has been so much less serious than feared at first.

BIRDS

THE WHITNEY SOUTH SEA EXPEDITION.—A large shipment of material from the Whitney South Sea Expedition has been received at the Museum. It proves to be one of the most important that has ever come from the Pacific. The collection is chiefly from the Solomon Islands, but has a small proportion from the New Hebrides. It comprises several thousand bird skins, many nests and eggs, bird skeletons, and birds preserved in formalin, a small series of mammals and reptiles, twelve Melanesian skulls and other human skeletal material, two hundred Lepidoptera (chiefly butterflies) and a considerable collection of insects of other orders, spiders, myriapods, mollusks, and other marine invertebrates, a box of photographic negatives not yet counted but evidently numbering several hundred, about four hundred feet of motion-picture film, together with field notes and journals which carry the record of the expedition up to date.

The birds number so many rarities that it would be impracticable to list them here. Previously, however, the Museum possessed only a few scattered specimens from the Solomon group, whereas now perhaps ninety per cent of the avifauna is well represented in the collection. Notable among the sea birds is a series of the petrel *Pterodroma brevipes*, not previously in the Museum collection. The land birds likewise include many peculiar and interesting forms which are quite new to the Museum. For the first time there are examples of families which show the affinity of the region with New Guinea and the neighboring large islands. These include hornbills, giant cuckoos, crested pigeons, cockatoos, a variety of parrots and lories, megapodes, and many others. The expedition is now working in an extraordinarily rich region, and altogether this collection of birds is the most diversified that has yet been received.

The Whitney Expedition material continues to add indirectly as well as directly to our natural history collections. Through exchange of Polynesian specimens obtained during the early years of the expedition, the museum has accumulated many species of rare birds from other parts of the world, and has greatly reduced the number of genera lacking in the world series.

CONSERVATION

California to Have a States Park Program.—Good news comes from California to the effect that a bill has been passed by the Legislature and approved by Governor Young, making possible a real States Park Program for California. A central State Park Commission, a State Park Survey, and submission to California voters in 1928 of a $6,000,000 bond issue—to be matched with an equal amount from private gifts—are among the accomplishments which the League has been endeavoring to bring about. Senate Bill 439 unifies the administration of all parks, sites of historical interest, etc., owned by the state of California. A Division of Parks is created under the new Department of Natural Resources. The chief of this division will have the guidance of an unsalaried State Park Commission appointed by the Governor, with an appropriation of $25,000. Senate Bill 440 provides for a comprehensive survey of the state as the basis for developing a well balanced State Park System, with an appropriation of $15,000. Senate Bill 441 provides for submission to the voters in November, 1928, of a $6,000,000 bond issue, the proceeds of which are to be used to pay one-half the cost of park lands recommended by the State Park Commission, the balance of the cost to be contributed from other sources.

HISTORY OF THE EARTH

The Department of Vertebrate Palæontology has suffered an irreparable loss in the resignation of its head, Dr. W. D. Matthew, who left in June to take up the post of professor of palæontology in the University of California at Berkeley. Doctor Matthew first came to the American Museum on July 1, 1895, as an assistant in the department of vertebrate palæontology. Later he occupied the positions of assistant and associate curator, and was made full curator in 1911. In recent years he has been curator-in-chief of Division I, which includes, besides Vertebrate Palæontology, the sciences of Mineralogy, Geology, Geography, Astronomy, and Invertebrate Palæontology.

Doctor Matthew's connection with the department, thirty-two years, covers almost the entire period of growth and development of the department, which was established by the Trustees, under the curatorship of Prof. H. F. Osborn, late in 1890. During this time the collection of vertebrate fossils has grown under Professor Osborn's direction to the greatest in existence.

In the accumulation of this collection, in its preparation, in its public exhibition, and in the scientific and popular reports upon it, Doctor Matthew's share of the work has been monumental. Doctor Matthew's long and intimate association with this collection, and the opportunity he has had of studying other collections in many parts of the world, coupled with thorough training and a natural ability, have resulted in a knowledge on his part of the fossil vertebrate faunas of the world which is probably unequalled. His leaving is therefore not only a distinct loss to his own department and to the Museum in general, but to the whole scientific community of New York. Fortunately, it has been arranged that Doctor Matthew return to the Museum for two months each summer in order to complete the several important studies which he has had in hand for some time, and it is hoped that departmental volumes will bear his name for many years to come.

HONORS

Carl Akeley Honored.—At a General Assembly of the Société pour la Protection de Nature held at Brussels July 9, 1927, Dr. Jean Derschied, who had just returned from the Kivu, gave an interesting account of his voyage to central Africa in company with Carl Akeley. After Doctor Derschied's address, Mr. Edmond Leplae, president of the Society, spoke of the life and achievements of Mr. Akeley, and expressed the sentiments of universal regret aroused by his untimely loss. Upon a motion made by Mr. Leplae, Mr. Akeley was unanimously elected, posthumously, Membre d'Honneur of the Society as a mark of appreciation of his eminent and distinguished services to science and to the work of conservation.

MAMMALS

Frick Expedition to Quebec.—Through the generosity of Mr. Childs Frick it was possible for Mr. George Goodwin to spend two months this summer, in the southern part of Quebec, collecting mammals for study groups in the American Museum of Natural History. The trip, which extended up the Cascapedia River as far as Berry Mountain, was made by automobile, team, and canoe. Of the 350 mammals collected, the most noteworthy specimens were a series of ten Gaspé shrew, *Sorex gaspensis*, and nine specimens of Rock vole, *Microtus chrotorrhinus*.

The Lee Garnett Day Roraima Expedition.—Recent communications from the Lee Garnett Day Roraima Expedition in the field report favorable progress. A week-end cable from Manaos, Brazil, to Mr. Day stated that the party was sailing on August 24 up the Rio Branco with Boa Vista as its destination. Boa Vista is in communication with Manaos by wireless, but after the expedition leaves Boa Vista it will be out of touch with the outer world, and the Museum is not likely to have any word from it until the party emerges from the Roraima district, some months later. A small collection of birds and mammals from Para has already been received at the Museum.

Hunting Alaska Brown Bears.—Mr. Van Campen Heilner plans to hunt the Alaskan brown bear at Pavlof Bay, which is the type locality for *Ursus gyas*. Any specimens of this bear obtained will be carefully prepared, with full measurements and skeletons, in the hope that they may serve as the basis for a future group of Alaskan brown bears. Mr. Heilner, although field representative in the department of fishes, has very broad interests in various branches of science, and has actively participated in other expeditions, one of which was to Ecuador for birds, with Dr. Robert C. Murphy.

Mr. Francis B. Shields of the department of mammals is spending his vacation along the north shore of the St. Lawrence, where he expects to make a collection of mammals for the Museum. Incidentally, Mr. Shields, who is a student of archery, will attempt to collect the large mammals with bow and arrow.

MARINE LIFE

Dr. Roy Waldo Miner has returned from a trip to Mount Desert Island, Maine, where, through the coöperation of the Mount Desert Island Biological Laboratory, he obtained final observations for the new Rotifer Group and a number of careful studies of marine annulates to be utilized in constructing a series of models for the Darwin Hall. Doctor Miner was accompanied by Mr. Frank J. Myers, research associate in Rotifera, who coöperated in the work for the Rotifer Group and also continued his researches on the Rotifera of North America. Dr. George H. Childs assisted Doctor Miner in marine work and executed a fine series of drawings in color for the annulate models.

Doctor Miner also gave a lecture in the laboratory course on "Studying a Coral Reef from the Bottom of the Sea."

REPTILES AND AMPHIBIANS

Doctor Noble spent the summer months at the Marine Biological Laboratory, Woods Hole, in the capacity of Investigator. There he continued his studies on the anatomy and evolution of the Amphibia. He has recently been appointed National Counselor in Reptile Study of the Boy Scouts of America.

A pamphlet on the Reptiles and Amphibians of the New York City Region written by Doctor Noble, has just been published in the Guide Leaflet series of the Museum. The pamphlet, gives a list of the species found in the local region together with a summary of their distribution. Many New Jersey reptiles and amphibians are not found on Long Island, and others are absent from Westchester County. The list was prepared to call attention to these differences and to indicate the gaps in our knowledge of the ranges. It should be of special value to the local naturalist.

In the new laboratories of the department of herpetology facilities are available for the study of living specimens. Reptiles and amphibians may easily be shipped alive, for they do not require food en route. During the past three months, a collection of living frogs has been received from Australia, some living geckos and lacertid lizards from Spain, and several shipments of reptiles from Central America. Of special interest is a pair of basilisks—lizards that run over the surface of water—from Honduras. Shortly after arriving in the Museum, the female laid a number of eggs which are developing well in a nest of damp wood pulp.

Mr. Clifford Pope during June and July visited the mountains of western North Carolina and eastern Kentucky to complete his studies of the salamanders of that region. This was Mr. Pope's second expedition, and the fourth sent by the American Museum, to investigate the amphibian and reptilian faunas of these mountains.

Mr. Pope directed his efforts to solving three problems; first, the tracing of the life history of the rare arboreal salamander, *Aneides aeneus;* second, determining the course of evolution among the terrestrial salamanders of the genus *Plethodon;* third, investigating the status of a rare yellow-cheeked species of *Desmognathus.* It was found that these plethodons, though restricted to narrow ranges, were very abundant within certain limited areas. The coral-cheeked *Plethodon jordanii* is confined to the topmost ridges of the Great Smoky Mountains, by far the highest range in the East. *Plethodon shermani,* still more narrowly confined, has been found only on the top of Wayah Bald, a mountain in the short Nantahala Range. It is characterized by the coral color of its legs which contrasts sharply with the uniformly black body and head. Study of the yellow-cheeked *Desmognathus* showed that its position as a distinct species is not convincing. Because of their dependence upon the cool, moist atmosphere of the higher mountains, these salamanders cannot cross the deeper valleys, and are therefore unable to extend their narrow ranges They have evolved "on the spot." *Aneides aeneus* was found, in eastern Kentucky, to live under the loose, decaying bark of dead trees, both fallen and standing. A cluster of eggs was discovered, the first on record.

In addition tò solving these definite problems, Mr. Pope secured several hundred living specimens, many of which will serve as material for experimental research through the coming winter. Among the species secured alive are *Plethodon shermani, P. jordani,* and *P. metcalfi; Desmognathus phoca, D. quadramaculatus,* and *D. fuscus fuscus; Leurognathus marmorata* and *Aneides æneus.*

Through the kindness and interest of Mrs. Ethel De Long Zande and her colleagues of the Pine Mountain Settlement School, Harlan County, Kentucky, living quarters were provided for Mr. Pope during his research work in these mountains.

SCIENCE OF MAN

The Bernheimer Expedition.—Early in the summer Mr. Charles L. Bernheimer organized and led the Sixth Bernheimer Expedition to the Navajo Mountain district in southern Utah. Mr. Bernheimer reports the achievement of the objectives laid down for this season's work which were, in the main, to gather information on and locate sites of archæological interest, to search for traces of animals of the Jurassic period, and to find a natural bridge of which reports had been heard. The expedition was eminently successful in every respect. Hundreds of prehistoric dwelling sites were seen and noted for possible future examination, though in every case preliminary search was made for potsherds and burial sites (Sansoni Mesa). At Hogoha Labyrinth, inaccessible cliff-house sites were seen and also a burial cist. The fall of a huge bowlder which narrowly missed one of the guides and covered up the burial cist, prevented careful examination. Here also was discovered the most interesting ruin seen this summer, a cave containing mud- and grass-walled but roofless houses built in pairs. These showed no signs of habitation, but the ground in front of the cave was strewn with potsherds of many types.

During the expedition of 1926 there were noted numerous dinosaur tracks. These were re-visited for further study. Casts were taken of some of these tracks for future study in the Museum.

Through his volume on *Rainbow Bridge* Mr. Bernheimer's lively interest in natural phenomena of this kind is well known, and this latest expedition led to the discovery in Monument Valley of another arch of the Rainbow Bridge type. This bridge was named Clara Natural Bridge. It forms the head of a box cañon and is wedged about 200 feet above its base; it is 100 feet high, 175 feet from base to base, 25 feet thick, and 25 feet wide on top.

Ethnological Collection from Dutch Guiana.—Through the generosity of Dr. Morton C. Kahn, of the Cornell University Medical School, who has recently returned from an expedition to Dutch Guiana, the department of anthropology has received an ethnological collection from the Djukas or Bush Negroes living on the Saramacca and Surinam rivers. The Djukas are descendants of African Negro slaves imported to northern South America during the period when the slave trade with the west coast of Africa flourished. Despite the passage of time and their contacts with the Indians of the region, these Bush Negroes still retain, both in physical type and in general culture, many of their African characteristics. The collection donated by Doctor Kahn consists of ceremonial objects, amulets, rattles, clothing, etc., and of implements of every day use, such as carved gourds, and seats, food paddles, pot stirrers, spoons, combs, food and clothing pounders, all carved out of wood. It is in these carved wooden objects that the resemblance to African techniques, both in form and ornamentation, is very marked.

Dr. Margaret Mead spent two months this summer visiting German museums. The object of her trip was two-fold: to familiarize herself with innovations in the exhibition of Oceanic ethnological specimens, and to make a detailed study of the Melanesian and Micronesian collections in Germany. The American Museum has a large and rather heterogeneous collection of Oceanic specimens, many of which were collected by whalers and came into the Museum without accurate localization. No American museum possesses Melanesian collections equal to the German collections made during the extensive German colonization in the Pacific. The present careful exhibition in German museums of this bulk of material provides the best background for the localization of specimens in other collections.

Doctor Mead visited the museums in Bremen, Hamburg, Berlin, Dresden, Cologne, Frankfort a M., Stuttgart, Nuremberg, and Munich.

This trip will serve as a basis for the further classification of our Oceanic material and the ultimate rearrangement of the South Seas Hall.

The distinguished Japanese archæologist, Dr. K. Hamada of the Imperial University of Kyoto, Japan, visited the Museum recently to study archæological material from America. Doctor Hamada spent part of the summer with Dr. A. V. Kidder, observing field methods in the archæology of the Southwest. Later he visited the Ohio Mound area where he was the guest of the State Archæological Society. The early archæology of Japan is now an object of special interest, and Doctor Hamada expects to begin systematic field exploration upon his return.

Mr. J. Reid Moir Presents Flint Implements to the American Museum.—Through the efforts of President Henry Fairfield Osborn, the Museum recently acquired from Mr. J. Reid Moir of Ipswich, England, a series of thirty casts representing the finest of the supposed flint implements found mostly by himself in the Pliocene and Middle Glacial deposits of East Anglia. The specimens have been placed on exhibit in the Tertiary Mammal Hall. With the exhibit of the ancient material has also been placed a series of modern flint pieces demonstrating Mr. Moir's theory of the development of the most characteristic tool, namely, the rostro-carinate or eagle-beak.

NEW BOOKS

Our Face from Fish to Man, a book dealing with the comparative anatomy and early history of the human face, was completed by Doctor Gregory during the summer; also a chapter on "The Lineage of Man" for *Creation by Evolution*, a work including articles by leading authorities edited by Frances Mason.

The Marine Fishes of New York and Southern New England, by J. T. Nichols of the American Museum's department of ichthyology, and C. M. Breder, Jr., of the New York Aquarium, has recently been published by the New York Zoological Society. It is on sale at the Museum as well as at the Aquarium. Herein each of the 261 species known to have occurred in local waters is illustrated by an outline drawing, which should be of service in distinguishing them. There are also paragraphs on distribution, seasonal occurrence, life histories, and habits.

The Bingham Oceanographic Expeditions.—The first paper contributed from the Bingham Oceanographic Collection has just reached the Museum. This deals with the Ceratioidea or deep-water frog-fishes, and is by Mr. Albert E. Parr. Several new species are described and figured, showing how rich are the collections which Mr. Harry Payne Bingham has recently been obtaining in his yacht "Pawnee" for his private oceanographic museum. This paper is the first of a series of scientific reports on the oceanographic expeditions directed by Mr. Bingham. We are told that two others are already on press and are about to appear.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 9753.

Patrons:

Messrs. Lee Garnett Day, W. F. Kenny, Gustavus D. Pope, John Alexander Pope.

Fellows

Mrs. Keith Spalding.
Mr. Henry Rogers Benjamin.

Life Members

Mesdames: Wm. E. S. Griswold, M. Taylor Pyne, Jr.

Messrs: Orris G. Lawson, Herbert Pulitzer, D. K. Worcester.

Master Herman Armour Nichols, Jr.

Sustaining Members

Mr. Bernard A. Rosenberg.

Annual Members

Mesdames: Robert J. Alexander, Winifred M. Burgesser, Gilbert Darlington, Winifred S. Harris, M. M. Seabeck, Walter Sichel, Ethel Iriwn Smalley, H. A. Van Dorn, Norman Wallace, James P. Warburg, Percy Shelton Weeks, Turnbull Wood, Clarence H. Young.

Mother Ryan

Misses: Amy Hope Ballard, Clementine Plimpton Gennert, Florence Halsey, Eleanor Hodges, Virginia M. Pennoyer, Dorothy Weir.

Doctors: Edward L. Partridge, Wm. A. Wilson.

Messrs: Reginald Auchincloss, A. F. Beringer, Arthur Bloch, W. C. Bowden, Jr., Charles U. Caesar, William E. Dawson, F. H. Deknatel, L. McGregor Demarest, Elmer G. Diefenbach, Bernhard A. Duis, Joel Ellis Fisher, Frederic M. Halsey, Saul S. Hauben, Henry R. Hayes, Charles Hecht, Geo. Miller Jones, Montifiore G. Kahn, Edward G. Kent, Walter Kidde, Samuel Knox, Henry C. Martin, Z. P. Metcalf, Julius Paul Meyer, C. O. G. Miller, Arthur Mincer, John P. Morrissey, Edwin C. Mulligan, Arthur Pforzheimer, Timothy A. Quackenbush, William Roberts, Edmund Seymour, Alburn E. Skinner, Stuart M. Stanley, Moses Tanenbaum, Charles Triller, Harold A. Weismann, Charles C. West, Wm. H. Winterrowd, Robt. Witbeck, Myron Wolff.

Associate Members

Princess Alfred Hohenlohe.

Doctor Minerva Blair Pontius.

Mesdames: K. H. Beij, J. H. Ten Eyck Burr, Irene Hirschi, George Leviston, Caroline Mermo Lewis Frances Mason, W. Wallace McKaig, Zelia Nuttall.

Misses: L. E. Babcock, Frances J. Kodadek, Hazel Marie Losh, Adelia McCrea, Lilian Putnam, Lula May Schulze, Flora Murray Scott, Frances E. Watkins, Anna Mc.Zentmyer.

Professors: Charles Lincoln Edwards, Charles Walter Howard, A. DaCosta Lima, Edward Loth.

Doctors: O. O. Fisher, Hilary S. Jurica, Allen K. Krause, K. F. Meyer, Octavio Montoro, Fernando Ocaranza, Eugene L. Opie, Charles H. Reckefus, Jr., H. J. Ropshaw, C. E. Seashore, Merrill A. Stainbrook, Lewis G. Westgate.

Messrs. Chas. Anda, Wyllys W. Baird, La Place Bostwick, C. R. Bulley, R. G. Chandra, Wm. L. Clay, B. M. Comerford, Edmund P. Edwards, John L. Emerson, H. H. Evans, H. D. Flautt, Asa Bird Gardiner, Joe H. Green, Stansbury Haydon, J. P. Henderson, M. C. Hine, Albert L. Hoorn, E. J. Howe, George T. Huther, J. T. Illick, Davis L. James, Eugene Janssens, George D. Kirkham, D. Koelbloed, Edwin V. Komarek, Frank D. Mann, F. O. Martin, James C. Miller, F. L. Patton, S. H. Prater, Walter I. Pratt, Alexander Read, Arnold K. Reese, W. H. W. Skerrett, Jr., Gilbert M. Stark, F. W. Stout, Gray H. Twombly, W. O. Watson, Howell York, Alvin D. Zachary.

THE NATURE NUMBER

SEPTEMBER-OCTOBER

The September–October number of **Natural History** will deal with nature's many phases, from recently discovered fossils of past ages to the latest studies of animal life at home and abroad.

Among the articles will be "Creatures of Perpetual Night" by G. Kingsley Noble, "The Peruvian Guano Islands of Seventy Years Ago" by Robert Cushman Murphy, "The Truant Tides of Tahiti" by H. A. Marmer, "Light and Darkness in a Tropical Forest" by H. C. Raven, "The Coral Seas of Michigan" by E. C. Case, "Frog Hunting in Fukien, China" by Clifford H. Pope, "Desert Landscapes of Northwestern Nevada," by Chester A. Reeds, and a discussion of "Recently Discovered American Pleistocene Artifacts" by Harold Cook, Henry Fairfield Osborn, Albert Thomson, W. D. Matthew, W. K. Gregory, N. C. Nelson, and Barnum Brown.

THE AMERICAN MUSEUM OF NATURAL HISTORY
FOUNDED IN 1869

MEMBERSHIP MORE THAN NINE THOUSAND FIVE HUNDRED

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 9500 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843 in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herpetological survey of the Central Asiatic Expedition by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthrop collection of mammals, in **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the incomparable work of Carl E. Akeley on the Eastman-Pomeroy Expedition in Kenya and Tanganyika; in **Polynesia**, the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies**, Douglas Burden's collection of giant dragon lizards; in **North America**, the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America**, collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. a total of 2,057 reels of motion pictures were lent oaned to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES**, some exclusively for members and their children, others for the schools, colleges, and the general public, are delivered both in the Museum and at outside educational institutions.

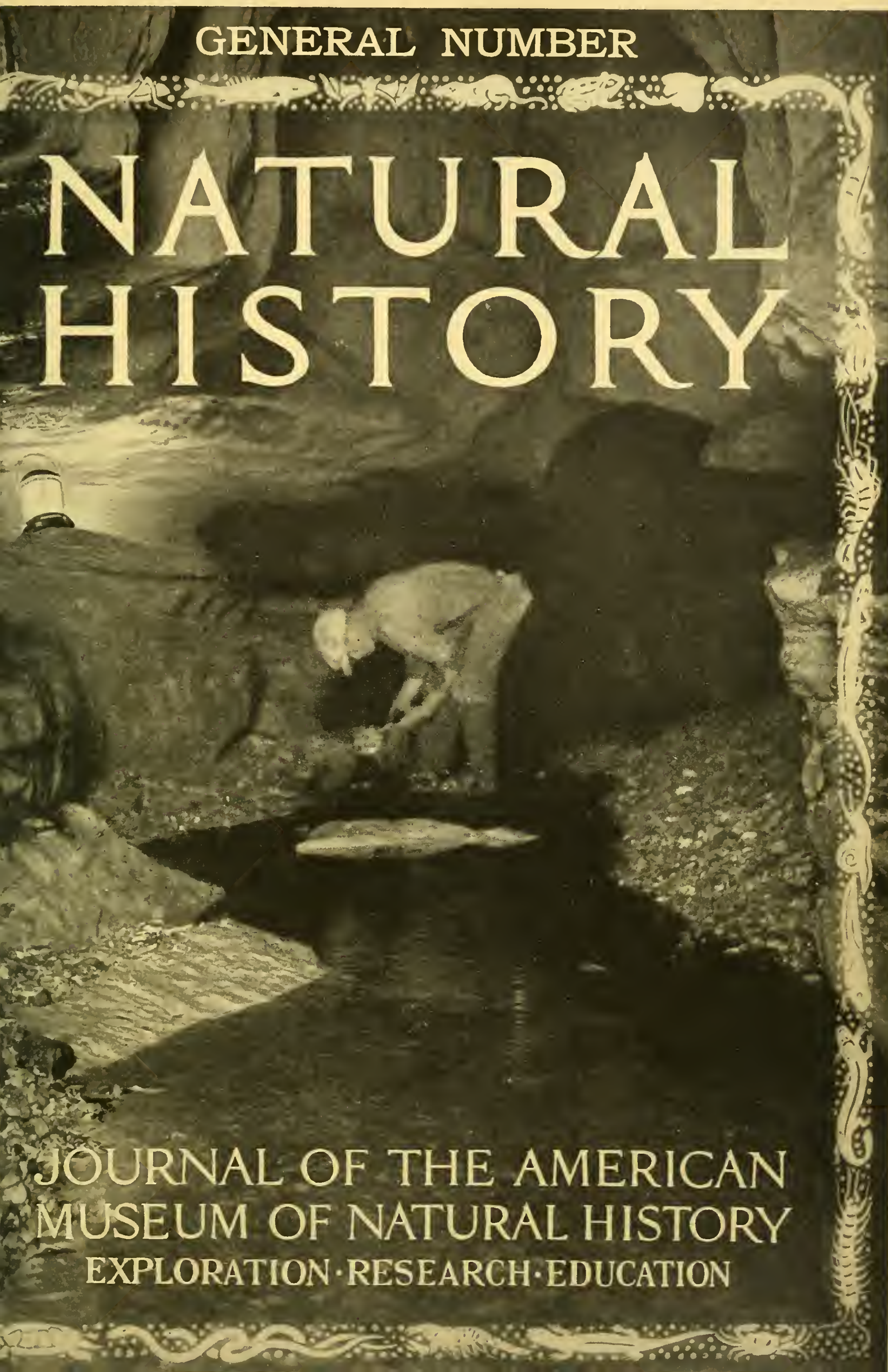
The **LIBRARY**, comprising 100,000 volumes, is at the service of scientific workers and others interested in natural history, and an attractive reading room is provided for their accommodation.

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.

For a detailed list of popular and scientific publications with prices apply to:
THE LIBRARIAN, AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK CITY

XXVII SEPTEMBER-OCTOBER, 1927 No. 5



GENERAL NUMBER

NATURAL HISTORY

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION · RESEARCH · EDUCATION

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1927

Henry Fairfield Osborn, LL.D., President
George H. Sherwood, A.M., Director and Executive Secretary
Frederic A. Lucas, Sc.D., Honorary Director
Wayne M. Faunce, Sc.B., Assistant to the Director and Assistant Secretary
James L. Clark, Assistant Director, Preparation

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

Henry Fairfield Osborn, LLD., D.Sc., Curator-in-Chief

Astronomy

G. Clyde Fisher, Ph.D., LL.D., In Charge

Minerals and Gems

Herbert P. Whitlock, C.E., Curator
George F. Kunz, Ph.D., Research Associate in Gems
Lea McIlvaine Luquer, Ph.D., Research Associate in Optical Mineralogy

History of the Earth

Henry Fairfield Osborn, LLD., D.Sc., Curator-in-Chief

Fossil Vertebrates

Henry Fairfield Osborn, LL.D., D.Sc., Honorary Curator
Walter Granger, Curator of Fossil Mammals
Barnum Brown, A.B., Curator of Fossil Reptiles
Charles C. Mook, Ph.D., Associate in Palæontology
William K. Gregory, Ph.D., Research Associate in Palæontology
Childs Frick, B.S., Research Associate in Palæontology

Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

Frank Michler Chapman, Sc.D., N.A.S., Curator-in-Chief

Marine Life

Roy Waldo Miner, Ph.D., Sc.D., Curator
Willard G. Van Name, Ph.D., Associate Curator
Frank J. Myers, B.A., Research Associate in Rotifera
Horace W. Stunkard, Ph.D., Research Associate in Parasitology
A. L. Treadwell, Ph.D., Research Associate in Annulata

Insect Life

Frank E. Lutz, Ph.D., Curator
A. J. Mutchler, Associate Curator of Coleoptera
Frank E. Watson, B.S., Assistant in Lepidoptera
William M. Wheeler, Ph.D., Research Associate in Social Insects
Charles W. Leng, B.S., Research Associate in Coleoptera
Herbert F. Schwarz, A.M., Research Associate in Hymenoptera

Fishes

William K. Gregory, Ph.D., Curator
Bashford Dean, Ph.D., Honorary Curator
John T. Nichols, A.B., Associate Curator of Recent Fishes
E. W. Gudger, Ph. D., Bibliographer and Associate
Charles H. Townsend, Sc.D., Research Associate
C. M. Breder, Jr., Research Associate
Van Campen Heilner, F.R.G.S., Field Representative

Amphibians and Reptiles

G. Kingsley Noble, Ph. D., Curator
Clifford H. Pope, B.A., Assistant [Central Asiatic Expeditions]
Bertram G. Smith, Ph.D., Research Associate
A. B. Dawson, Ph.D., Research Associate

Birds

Frank M. Chapman, Sc.D., Curator-in-Chief
Robert Cushman Murphy, D.Sc., Curator of Oceanic Birds
W. DeW. Miller, Associate Curator
James P. Chapin, Ph.D., Associate Curator of Birds of the Eastern Hemisphere

Birds (continued)

Ludlow Griscom, A.M., Assistant Curator
Jonathan Dwight, M.D., Research Associate in North American Ornithology
Elsie M. B. Naumberg, Research Associate

Mammals of the World

H. E. Anthony, M.A., Curator
George G. Goodwin, Assistant
Frederic A. Lucas, Sc.D., Research Associate
William J. Morden, Field Associate

Comparative and Human Anatomy

William K. Gregory, Ph.D., Curator
S. H. Chubb, Associate Curator
H. C. Raven, Associate Curator
J. Howard McGregor, Ph.D., Research Associate in Human Anatomy
Dudley J. Morton, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

Clark Wissler, Ph.D., Curator-in-Chief

Science of Man

Clark Wissler, Ph.D., Curator-in-Chief
Pliny E. Goddard, Ph.D., Curator of Ethnology
N. C. Nelson, M.L., Associate Curator of Archæology
Charles W. Mead, Honorary Curator of Peruvian Archæology
Harry L. Shapiro, Ph.D., Assistant Curator of Physical Anthropology
Margaret Mead, Ph.D., Assistant Curator of Ethnology
George C. Vaillant, Ph.D., Assistant Curator of Mexican Archæology
William K. Gregory, Ph.D., Associate in Physical Anthropology
Clarence L. Hay, A.M., Research Associate in Mexican and Central American Archæology
Milo Hellman, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

Roy C. Andrews, D.Sc., Curator-in-Chief
Walter Granger, Curator in Palæontology
Charles P. Berkey, Ph.D. [Columbia University], Research Associate in Geology
Frederick K. Morris, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
Amadeus W. Grabau, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

George H. Sherwood, A.M., Curator-in-Chief

Library and Publications

Ida Richardson Hood, A.B., Acting Curator
Hazel Gay, Assistant Librarian
Jannette May Lucas, B.S., Assistant Librarian—Osborn Library

Education and Public Health

George H. Sherwood, A.M., Curator-in-Chief
G. Clyde Fisher, Ph.D., LL.D., Curator of Visual Instruction
Grace Fisher Ramsey, Associate Curator
William H. Carr, Assistant Curator
Nancy True, A.B., Assistant
Paul B. Mann, A.M., Associate in Education
Frank E. Lutz, Ph.D., Research Associate in Outdoor Education

---

Charles-Edward Amory Winslow, D.P.H., Honorary Curator of Public Health
Mary Greig, A.B., Assistant Curator of Public Health

Public Information

George N. Pindar, Chairman
George H. Sherwood, A.M.
William K. Gregory, Ph.D.
Wayne M. Faunce, Sc.B.
Clark Wissler, Ph.D.

Natural History Magazine and Advisory Committee

George H. Sherwood, A.M., Chairman
Departmental Editors
A. Katherine Berger, Assistant Editor
Clark Wissler, Ph.D.
George N. Pindar
Frank M. Chapman, Sc.D.
Frank E. Lutz, Ph.D.

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY
EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION
THROUGH THE MUSEUM

GENERAL NUMBER

A. KATHERINE BERGER, EDITOR

SEPTEMBER-OCTOBER, 1927

[Published November, 1927]

VOLUME XXVII, NUMBER 5

NATURAL HISTORY

VOLUME XXVII   CONTENTS FOR SEPTEMBER-OCTOBER   NUMBER 5

Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to George F. Baker, Jr., Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

THE BLIND SALAMANDER

The subterranean passageways of the Ozark Mountains form the habitat of *Typhlotriton spelaeus*. An expedition was sent last September by the American Museum to study this creature in its native haunts. The field work is being supplemented by laboratory experiments to determine the causes of retrogressive evolution in cave animals and particularly in the blind salamander

NATURAL HISTORY

VOLUME XXVII SEPTEMBER-OCTOBER, 1927 NUMBER 5

Creatures of Perpetual Night

AN ACCOUNT OF THE AMERICAN MUSEUM'S EXPEDITION TO THE CAVES OF THE OZARKS IN SEARCH OF THE BLIND SALAMANDER

By G. KINGSLEY NOBLE

Curator, Amphibians and Reptiles, American Museum

FROM the Appalachians to the Rockies the vast plains of the continental interior extend some 1200 miles, the thick layers of sediment nearly as even and unwrinkled as when first laid down. From Carboniferous time when the beds of the Mississippi Valley were finally raised above the level of the shallow inland sea until today the great basin which forms so large a part of the United States has remained a lowland, now rising, now sinking, but never oscillating far in either direction. Only in the Ozark region have orogenic forces pushed up the beds of Palæozoic limestone into steep, rocky hills. Limestone is poor material with which to build great mountains. The rains soon smooth off all prominent features, and the water, acidified by the decaying vegetation of the slopes, seeps through the porous rock to carve for itself innumerable channels and chambers within the heart of the hills. The Ozarks, seamed and wrinkled, remain throughout most of the year a series of dry shells within which the subterranean waters flow for miles before bursting forth at the base of the hills to join the larger rivers of the lowlands.

The devious passageways and water channels which honeycomb the Ozarks have always held a strange fascination for the hardy peoples who settled in southern Missouri and northern Arkansas. The more accessible caves, especially those rich in stalactites and stalagmites, were soon explored but there remained dozens of other more extensive caves which seemed to defy the entrance of man. Yet into these crooked, winding passageways adventurers finally penetrated, and we now know that the heart of the Ozarks is not formed merely of cold, stony, dripping chambers. An abundance of life is present and this life is adapted, we may say finds greatest satisfaction, in the inky blackness and perpetual coldness of this subterranean world.

One may well ask why any animal should prefer to live so far removed from the outer world. Naturalists for a century have asked this very question. And some of the most distinguished among them, such as E. D. Cope, have visited the Ozarks to gain a better acquaintance with the cave fauna. Most cave animals are blind, their bodies white and ghostly translucent in the light of a torch. Many are equipped with a rich growth of sense papillæ, or bristles, with which they feel instead of see approaching enemies and prey. What have been the causes of these changes? Use and disuse, the older naturalists replied, but such an explanation does not receive any support from the vast amount of experimental data provided by modern biology. Hence, it seemed advisable to penetrate once more into the Ozark caves to determine more accurately the

View east of Marvel Cave. The Ozark Mountains are a series of hollow shells within which flow most of of the streams of the region

Most cave entrances in the Ozarks are small and hidden. Wild Cat Cave in Barry County is no exception

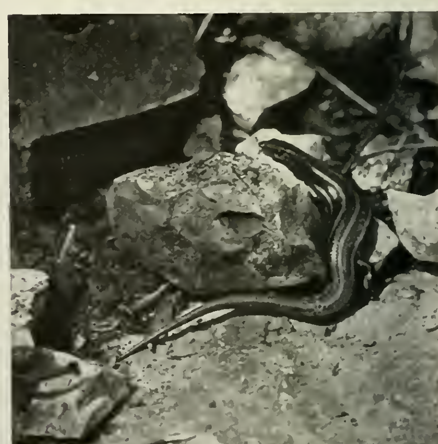
The Ozarks are formed almost entirely of limestone. Cave entrances are found usually at the foot of the hills

The beginning of a cave. Water flowing over the soft limestone soon cuts a channel for itself and sinks out of sight environmental factors and further to secure living material in sufficient quantity for an experimental analysis.

The work was carried on in three counties in southwestern Missouri. Toward the end of the trip the latter part of September of this year, our efforts were concentrated on the caves of Stone County, for here, principally in Marvel Cave, Cope, Eigenmann, and Hurter had found the cave salamander, *Typhlotriton spelaeus*, in some numbers.

Most of the cave entrances in this country are far off the main highway, usually at the foot of some hill. As the roads generally follow the ridges, there was ample opportunity to get acquainted with the fauna of the outer world. The hills on closer acquaintance proved to be steep piles of small limestone chips among which there struggled a thick growth of deciduous woods. Descending a slope was like walking down a coal pile, the chips giving way at every step. In such a terrain devoid of anything that can be called soil, moisture can remain but a short time, and as September had been a very dry month, the loose stones noisily announced our approach with a metallic clatter. The first to be frightened by the intruders was a blue-tailed skink which scurried away in the brush. Turning over adjacent logs we captured two others. This lizard and its close relative, the coal skink, we met very frequently in the hills. The slim-bodied skink, *Leiolopisma*, was found in the same situations and on the more exposed slopes we caught the collared lizard *Crotaphytus collaris*. Our first descent into the lowlands revealed that snakes were far more abundant than in any other place I have visited. The most conspicuous was the mountain black snake, *Elaphe obsoleta*, but the individuals we met were not like our New Jersey friends; they were flecked above with white and blotched below with black. Here was an incipient species not yet sufficiently demarcated from its eastern relatives to be called a distinct race. On these arid slopes a dark coloration would seem entirely out of place, but all the racers, *Coluber flagellum*, we saw, were handsomely clothed in satiny black. Copperheads, we soon discovered, were very common, and after we had captured our first, a few feet from the trail, the almost perfect concealing coloration of this serpent assumed for us a new interest.

Only a very small part of the Ozark fauna seemed concealingly colored and a few creatures were obviously the reverse. One that thrust itself upon us from the first was that of the noisy "news bee," a fly which is colored exactly like a queen yellow jacket and has the form, color, and sound of the same unpleasant acquaintance. Here was an instance of mimicry, the fly supposedly gaining protection by this mummery. Natural selection working



A frightened blue-tailed skink dashed away among the chips of limestone on a host of color varieties in an ancestral fly picked out this noisy yellow and black fellow, recognizing by this very act that bluff and noise will sometimes carry one a long way toward success.

The entrance to Marvel Cave, called Marble Cave until recently, is through one of two openings in the roof of an enormous subterranean chamber nearly 200 feet high, 400 feet long, and 225 feet wide. A pile of stone débris forms a hill about 125 feet high under the openings and the descent to its summit is managed by a wooden stairway. The latter is maintained by Miss Genevieve Lynch, the owner of the cave, who for some years has opened the cave to visitors. The few tourists who come to this little-known region follow a guide to the far end of the chamber where a tortuous passageway twists back and forth digging deep into the ground until it reaches the water course made by Lost River. The lowest point of the journey is reached at the foot of the waterfall which has been determined as 480 feet below the surface of the ground. Throughout the long route followed by tourists, blind salamanders have never in recent years, been seen. It was our plan to begin where the tourist turns back, namely, at the foot of the waterfall. A hole half way up a bank of soft red clay indicates the opening of the passageway to Blondie's Throne.

Previous experience had taught us that cave exploration is very wet, sticky work. One crawls or wallows forward in adhesive mud far more often than one ever stands. Our party consisted of Byron C. Marshall, a herpetologist of Arkansas, Clark Gallaher, head guide of Marvel Cave, and myself. The bank proved as soft as it looked, and we were all smeared with mud before we reached the entrance and began the long crawl. Marshall and I were armed with electric torches and collecting tins, while Gallaher managed a gasoline lantern, the first, no doubt, ever carried in this narrow passage.

Blondie's Throne is probably not more than four hundred feet from the waterfall, but as much of the distance is covered flat on one's stomach, the trip required over an hour. The passageway probably averages two feet high and four broad. The mud of the water-

Copperheads are abundant in the Ozarks

fall room soon gives way to sheets of limestone and dripstone of varying colors from black to yellow. The floor of the passage is made anything but comfortable by a series of more or less connected pools containing water of 58° F. We dragged ourselves slowly

Our work began where tourists turn back. The first "crawl" in Rockhouse Cave

through the water and found that Hurter, who many years before made this crawl, must have been mistaken as to the scarcity of life. A black gnat which we had seen in other caves was here in abundance, some black beetles were seen walking over the rocks, while the pools contained a colorless amphipod crustacean in numbers.

We came upon our first *Typhlotriton* shortly after beginning the crawl. It was walking rapidly over the loose stones in an effort to escape. In the light of the gasoline lantern its pale tones gave it a most unreal appearance. The beast looked more like some creature fashioned out of dough than a living organism. Its dark eyeballs shone through the translucent lids and gave it a peculiar expression. But once the creature was in the collecting tin it appeared more animate. Close scrutiny revealed that its skin was not devoid of pigment. The net of capillaries underlying the epidermis was covered with melanophores, but these pigment cells were fully contracted. The creature reminded me of the salamanders whose pituitaries I had removed in the laboratory, and I could not help but wonder if the pituitary body was functioning normally in this creature.

We reached Blondie's Throne without encountering any other salamanders. But the bats which dashed past us as we crawled frequently misjudged the distances and rudely brushed us with their wings. Blondie's proved to be a great vault of gray dripstone. A crawl of ten feet up a bank of slippery clay brought us to the main entrance to the room. The ceiling some forty feet overhead seemed to swirl about in the bright gleam of our spot lights. The squeaking and the continuous rain of excrement disclosed that the ceiling was in fact in motion. Myriads of bats circled about overhead, the beating of their wings sounding like the rythmic puffing of a distant locomotive. The room is partly filled by a tremendous stalagmite or throne above which a canopy of stalactites gracefully droops. But the festoons of black drapery on either side of the throne soon began to flutter, and I realized that they were great masses of bats holding tightly to one another's backs. A closer inspection showed that thick rugs at the foot of the throne were sheets of reeking bat guano in which one sank half way to the knee. The odor was stifling, the noise bewildering, and yet the grandeur and

In the Underground Home of the Blind Salamander

GLIMPSES OF THE PASSAGEWAYS WHICH HONEYCOMB THE OZARK MOUNTAINS AND SOME PORTRAITS OF THE CREATURES WHICH DWELL IN THE SUBTERRANEAN WORLD

By G. KINGSLEY NOBLE
Curator, Amphibians and Reptiles, American Museum

CAPTURED BUT STILL DEFIANT

The great-eared bat *Corynorhinus rafinesquii* is the rarest of the four species which inhabit the Ozark caves. This fellow tried to dash by us in a narrow passageway but misjudged the distance. The figure is about twice natural size

ENTRANCE TO MARVEL CAVE

The descent into the best known cave inhabited by the blind salamander is made through the roof of an enormous underground chamber nearly 200 feet in height and 400 feet in length. Directly under the two small openings in the roof is a hill of stone débris more than 100 feet high. Reaching down to the top of this hill, a ladder and stairway have been built. These served as the starting point for many trips to the several underground passageways which ramify from the chamber

CATCHING A "GRAY GHOST"

The blind salamander, dubbed by earlier explorers the "gray ghost," frequents the edges of small underground streams or pools. The species seemed to have a variety of tastes, for the expedition surprised one on the clay banks of Chimney Cave, shown above, and caught others along the rocky passage of Mystic River in Marvel Cave. Unlike blind salamanders in other parts of the world, the "gray ghost" is primarily terrestrial when full grown

THE WORK OF WATER

Underground water channels penetrate the Ozarks in every direction. Exploring these tunnels is full of uncertainty because of the erratic course taken by the streams. One loses all sense of distance when crawling underground, and we reckoned our travels in hours from daylight

A REST BETWEEN CRAWLS

Most of the passageways are very narrow and the only way of going from one pool to another is by crawling. The passageways are frequently covered with stalactite formations of which the most disconcerting are the hollow spikes of stone hanging from the ceilings of the more difficult "squeezes"

CHAINS OF STONE

The walls of the large underground chamber of Mead's Cave are covered with great sheets of stalactites, some of most unusual form. It is here only that the expedition found a veritable chain of stone hanging from the top of one of the larger "thrones."

Mead's Cave, like many of the other enchanting subterranean chambers of Missouri is unknown to the tourist

THE "ANGEL"

Stalactites are usually terra cotta in color. Only rarely do they appear without a coat of wet, reddish mud. Then these draperies of stone may appear almost any color, especially the softer tones of yellow and red. In Fairy Cave an exquisite stalactite of sparkling white hovers gracefully over an equally beautiful stalagmite. The formation resembles an angel with outspread wings descending a marble throne. Many travelers come each year to see the "Angel" of Fairy Cave

STARING WITH SIGHTLESS EYES

The blind crayfish *Cambarus setosus* is the color of bleached bone. Its eyes are rudimentary, but like all other subterranean animals its sense of touch is greatly refined. Many a young blind salamander has had its tail snipped off by the strong pincers of these crayfishes. The long hairs on the claws are sensory organs and are not found in the species which live in the outer world, for the latter have functional eyes to use in detecting their prey

Entrance to Smallin's Cave. On leaving the outer world one experiences a drop of temperature of from 20° to 40° F.

Netting blind crayfish. In Smallin's Cave more blind crayfish were found than in any other locality

"THE GULF OF DOOM"

Underground passageways sometimes lead to the brink of stupendous chasms. The exploration of these great black spaces is attended only with extreme difficulty because of the crumbling character of the rocks. One of the passageways in Marvel Cave follows the edge of the "Gulf of Doom"

LOST RIVER

Lost River in Marvel Cave flows from under a ledge of rock, fills a hundred stony basins with icy water, and then leaps into the obscurity of the "waterfall room" below. It is said that its water feeds some springs several miles from the cave magnitude of the throne room with its walls ornamented with dripstone held us spellbound. It was half an hour before we began our perilous descent to the stream bed.

Beyond Blondie's Throne the passageway grows even more difficult as the pools become more frequent and deeper. But here collecting began in earnest. We soon caught one blind salamander under a stone in the water, two together under a stone beside a pool, and another that tried to slide past us in the narrow passage. But most surprising was still another which, when we disturbed it at the edge of a pool, made straight up a sloping bank toward a hole under the roof of the passage. Thus, these creatures with their sightless eyes must have well defined routes of travel and escape. By frequently touching their snouts to the ground they are able to make considerable speed between the loose pieces of lime and dripstone which floor their passageways.

Later we made other trips to Blondie's and to near-by caves, which presented equally difficult crawls. None of these was as successful as our first. The crawl farther up Mystic River almost ended in disaster. Just as our party were attempting one of the worst squeezes, a swarm of several thousand bats started through the same opening. The squeaking, fluttering hords almost stifled John, our guide, who was in the lead. They crawled up his trouser legs, down the open neck of his shirt. When they began to pile up as a solid, squirming wall directly across the crevice, the thought of whether there was enough oxygen for all struck the members of the party at the same time, and without

Thousands of bats spend the winter in the passageways of Marvel Cave and the murmuring sound of many wings always follows the explorer

The Georgian bat, *Pipistrellus subflavus*, is the smallest in the United States, but the squeaking of the hordes when roused from hibernation is deafening

waiting for further demonstration, a retreat was at once begun.

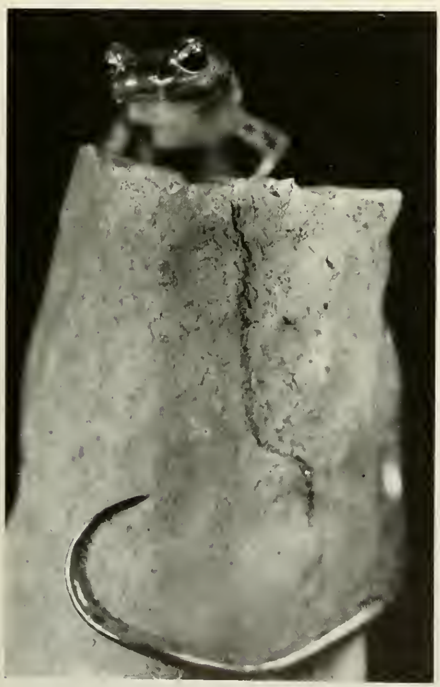
After a day below ground struggling in the mud and drip of the passageways we were always glad to spend the following day in pursuing some task which would keep us in the sunshine. Our attention turned first to the amphibian faunas that lived on the surface of the ground. These we found were very accessible because they were concentrated in the only places where any surface waters occurred.

There was a spotted frog very similar to our eastern leopard frog, but with a white mark in the middle of the tympanum. In this and certain other characters it seemed to grade into the southern *R. sphenocephala*. The leopard frog is one of the earliest frogs to breed in the spring, and it was a great surprise to find in middle September a mass of eggs that this frog had laid in one of the warm pools. By far the most abundant amphibian along these wet seeps was the cricket frog, a diminutive tree frog which has given up life in the trees to frequent the edges of stony pools. Nevertheless, it has retained the structural characters of a tree frog including the adhesive disks on the ends of the digits.

That part of the amphibian fauna which especially claimed our attention was the salamanders. The question which we had always before us was, how did the blind and colorless cave salamander, *Typhlotriton*, come into existence? Many salamanders enter caves of their own volition seeking the coolness and moisture they require. The large reddish species *Eurycea lucifuga* is so frequently found in caves that it is sometimes said to be adapting itself to cave life, although it shows no adaptive change either in eyes or coloration. Under the wet rocks of the trickles, sometimes at a great distance from any cave, we found *E. lucifuga*, although not as frequently as the more abundant species, *Plethodon glutinosus* and *Eurycea melanopleura*. In the

Our wet clothes thrown off upon our emergence from the cave were quickly covered with butterflies seeking moisture in the dry outer world

East the first of these two species is abundant, but never found in stream beds and rarely in caves, for the woods are sufficiently damp to supply all the moisture requirements of the species. But in the Ozarks nature is severe and all moist-skinned salamanders, in order to survive, crowd together about these seeps, or springs. After a hot climb over the barren hills, we could well understand why all of these species were found in such limited regions. The same creatures were later found abundantly in caves, sometimes far from the entrance in regions of perpetual blackness. They were not in the act of adapting themselves to cave life; they were merely existing in one of the few places that moist skins could survive.



A cave salamander that has lost neither eyes nor pigmentation, *Eurycea lucifuga*, startled by the intruders

Among the fishes, detailed field studies of Eigenmann, Hubbs, and others have shown that the caves have not been peopled by the accidental entrance of epigean species. The first step in the origin of blind fish has been the acquisition of light-avoiding and cranny-seeking habits together with an increase in the importance of tactile and olfactory organs in the securing of food. In other words, fishes sought the caves through choice after they had developed habits which necessitated their entering cave or semi-cave conditions. Further, fishes in the process of becoming blind cave species, have been described in several families, showing beyond any doubt that this has been the *course* of evolution in this group. Such an explanation reveals nothing about the *causes* of cave fish evolution; it merely opens another approach to the problem. Change of instinctive habits seems, from the work of Coghill on amphibian larvæ, to be a phenomenon of growth. Neurones grow and extend their processes until they make connections with new nerve-muscle segments. The cave-seeking habits of the fish are forced upon them by growth or by physiological changes in their nervous mechanisms, and the failure of the eyes to develop has followed as a secondary phenomenon.

Returning to the salamanders, for blind fish do not occur in the hilly parts of Stone County, conditions are found to be different from those usually described by evolutionists. All plethodontid salamanders having an inherited abhorrence for light, or to express it more exactly, being negatively heliotropic, would normally enter caves. Further, in the arid Ozarks all species retreat to caves and some may penetrate deep into the ground. Why, then, has only one species become blind when experiment has shown that blinded salamanders can feed successfully? Our attack on this problem began as soon as we reached the springs, for here we discovered to our surprise that the larvæ of *Typhlotriton* were abundant. Unlike their parents they were densely pigmented and had well developed eyes. Those we captured with our wire scoops exhibited such a range of size that it was apparent that the older ones had passed several years as spring-living creatures.

In the outer world the amphibian fauna was congregated about the spring "seeps." The leopard frog and cricket frog (right) were the most abundant species

A study of a great many springs in Stone and adjacent counties revealed that the larvæ were far more abundant in springs outside of caves than within the region of darkness. This is true even though the larvæ are negatively heliotropic—individuals kept in a tank retreating under the débris during the day and appearing again during the night. In the springs with *Typhlotriton* we found the larvæ of the rare *Eurycea multiplicata*. These also varied


In Wood's Spring (left) hundreds of young blind salamanders were found. The spring water which trickles from beneath the hills soon sinks into the ground to rejoin the underground streams

greatly in size and must have a prolonged larval life. A few metamorphosing *E. melanopleura* were found in some springs, but as these were of small size, it was clear that they, as do all plethodontids of the Ozarks, save *Typhlotriton* and *E. multiplicata*, metamorphose the first year.

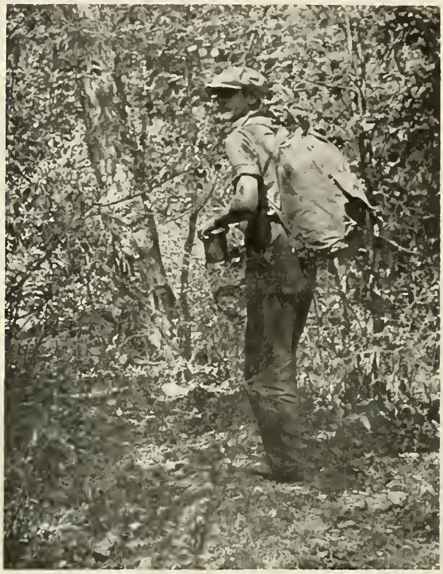
A detailed examination of the springs and caves revealed that the adult *multiplicata* was thoroughly aquatic, reminding one greatly of the eastern *Leurognathus marmorata.* On two occasions the adults were found half a mile in from the entrance of a narrow, winding cave. Such regions are, of course, perpetually dark, but the *multiplicata* had well developed eyes and pigmentation. The larvæ, on the other hand, showed a distinct preference for warmer spring waters. In springs where the temperature ranged below 65° F. *Typhlotriton* was the dominant larva. Where it rose above this level *multiplicata* became much more abundant. Springs flowing for a distance under the surface rock and warmed to 70° usually contained only *multiplicata* larvæ, although among the great number of records obtained exceptions have been found. In brief, of all the Ozark salamanders obtained, only two have an extended larval life in the water, and these two species usually avoid competition by selecting waters of different temperatures. The species which frequents warm water metamorphoses without losing either its eyesight or pigmentation, but the one that lives in cold waters undergoes a remarkable change at metamorphosis, its pigmentation is reduced, and the eyelids which form never open more than a small slit. The retina behind the partly closed lids undergoes certain degenerate changes.

Both species during their larval life are highly thigmotactic, that is, are more comfortable when in contact with several surfaces, and spend much of the day between rocks among which water flows rapidly. In the pile of loose stones at the mouth of Wood's Cave, an area only 22 ft. 6 in. by 5 ft. 10 in.

in extent, more than three hundred larvæ were captured. We found one adult but no larvæ, in the many yards of pool gravel within the cave. If metamorphosis brought with it an urge to climb away from the rushing spring water to the quiet cave pools beyond, these larvæ, which even before metamorphosis readily climbed out of my milk cans and other containers, would most surely make their way into the caves, for the only other direction not flanked by scorching blocks of limestone led to the warmer pools which we knew by both observation and experiment were not favorable to the species.

The problem of blindness and depigmentation in these salamanders appeared as a problem of metamorphosis and not one of progressive adaptation. Laboratory experiments of recent years have thrown much light on the nature and mechanism of metamorphosis. The rôle of the thyroid hormone in producing metamorphic changes is well known, but the importance of external factors in altering the end result is not so clear. Thus, it is possible that *Typhlotriton* raised in waters of different constitution or temperature might show a greater or less degree of these metamorphic changes. The immediate problem of the importance of external vs. internal factors in producing the ghostly creature found in the caves is removed from the domain of field observation to that of laboratory work. The adult *Typhlotriton* have never been found outside of the caves, and yet each generation of larvæ spends two or more years outside of the caves as well formed and pigmented salamanders. The destructive changes of metamorphosis necessitate a retreat to adjacent caves, where a combination of external and internal factors results in the animal adapted to cave life. Generations of cave life have not affected the form of the larva and, without laboratory analysis, who can say that it has permanently affected any feature of the animal's heredity, even its metamorphosis?

In transporting and handling our salamanders many problems presented themselves. In order to bring larvæ from the surrounding springs to our



Returning to camp with a load of living blind salamanders safely packed on ice

base camp at Marvel Cave we found it necessary to carry the containers on ice. Further, the larvæ shipped better in wet leaves than in water. All these facts were learned only with the sacrifice of life. By constant vigilance and care we have managed to bring several hundred larvæ alive back to New York, where they are now available for laboratory studies which we believe will throw further light on the importance of environmental vs. hereditary factors in the origin of blindness and depigmentation in the cave salamander, *Typhlotriton*.

The Coral Seas of Michigan

By E. C. CASE
Director, Geological Museum, University of Michigan

THERE is on my desk a small piece of limestone, weighing perhaps a couple of pounds—just a small fragment of the enormous mass of very pure limestone that daily is being torn from the ground in northern Michigan by hundreds of tons and is being shipped to the iron smelters, the cement mills, and the manufactories of chemicals. This small bit of limestone is in a way a key to the origin of one of the greatest resources of the state, for it is a fragment of one of the innumerable coral reefs which form so large a part of the rock foundation of Michigan.

Last summer I was one of a party engaged in making a survey of the northern part of the southern peninsula of Michigan to determine the position and thickness of the limestone beds, in order that the quarryman might more surely locate the pure stone and more profitably exploit it. Armed with hammer and compass and notebook we invaded many a quarry that was being worked and many that had been abandoned. We tested the rock and robbed the different layers of fossils which would tell the age of the beds and, by comparison with fossils from other beds, the extent of the deposits. Very soon we began to realize that in a great arc reaching from one side of the state to the other, from Charlevoix to Alpena, we were dealing with the deposits of an ocean where reef after reef had grown to the surface and felt the force of battering waves now stilled for millions of years.

The more evenly bedded layers of limestone and shale formed from the mud of the ocean bottom are interrupted again and again by irregular masses of rock composed almost entirely of the calcareous skeletons of corals, bryozoans, and the innumerable forms of life which frequent coral reefs. Among the fossil corals lay the shells of the cephalopods—the shelled ancestors of the modern squid and cuttle-fish, of brachiopods—the "lamp shells" and "butterfly stones" of the quarryman, of crinoids—the "stone lilies," and of trilobites whose kind disappeared from the earth when the development of life was little more than half accomplished. All these lay as they had lived in the holes between the corals, or where they had been cast by the surge and reflux of the waves.

We came to know these reefs most intimately for they were the subject of our daily study for several weeks, but I wondered what the hard-headed business men who had sent us upon the survey and who were dependent upon the results of our work for their profit would have thought if they had known what I was really doing much of the time. Clad in khaki and stout boots, armed with hammer and rule and chisel, I was apparently clambering about steep quarry faces, measuring the thickness of the layers, testing the quality of the stone, knocking off samples for analysis or chipping out fossils for comparison, so that I might make a report in so many tons of limestone to feed so many blast furnaces, or mills, or factories. In reality I was often a diver sinking slowly beneath the waters of an ocean so old that the stars of the constellations were in other combinations, and would shift and regroup themselves many times before they came to stand as we see them now.

Slipping down the quarry face between the steam shovel and the drilling rig—really holding my breath as the green water closed over me, pausing at a layer crowded with fossils—really feeling the soft mud of the ocean floor rise about my feet as I bent to peer between the waving, interlacing branches of living colonies of animals, stopping to crack out a brachiopod—or the test of a trilobite—really stooping to gather an iridescent shell or snatch at a living trilobite as it scuttled to safety beneath a bushy coral, or breaking the stem of a fragile "stone lily," I was an explorer in regions where man's foot had never trod, a hunter of animals whose kind had passed from the world more than sixty milleniums ago.

In such a mood, I dropped over the edge of the great quarry at Alpena, sinking down, down, down, through 125 feet of imagined water until I came to rest on the ocean floor at the bottom of the pit where I found my little piece of limestone. The floor of the quarry was a grayish, shaly limestone, the hardened mud of the quiet ocean bottom filled with the débris of corals and shells all broken and powdered by the constant movement of the waves. Before me was the reef on which the waves had broken. The face of the stone, shattered by the rending dynamite of the quarryman, was a section of the reef a hundred feet long by twenty feet thick, with how much more hidden under the stone no man can know. The corals lay there as they had lived, and built up the reef. Colony after colony of the kind called *Acervularia*[1] had started, each from a minute bud, and had grown by the addition of individual after individual to the central mass. The colonies, or "heads," were packed and crowded, piled one upon the other just as they

Specimen of a cup coral standing upright as it grew upon a head of *Acervularia* more than sixty million years ago. From the quarry of the Michigan Alkali Works at Alpena, Michigan. Note the mat of bryozoans or moss-animals at the foot of the cup and near the top

[1]Except for the upright cup coral the pictures are taken from Rominger's Fossil Corals of Michigan, Volume III of the Report of the State Geologist of Michigan, 1873–1876.

had lain in the time of their lusty lives until some change in the temperature or the salinity of the water, or some lack of food supply killed them all, and the reef passed into the initial stages of ruin.

Such a reef contains many kinds of corals. In some the individuals crowd close together, each adding its portion to the common mass, similar species always forming similar patterns, but there is seemingly an endless variety of patterns for the different species. Other corals are solitary in their growth, each individual building unto itself the hard calcareous skeleton which takes the form of a cup or cornucopia. During life these fragile cups stood upright upon the smaller end, but after death they were almost invariably broken from their slight support by the moving water and left lying upon their sides, or broken into fragments.

In the reef I was looking at there was a single cup coral which had taken its start upon one of the heads of *Acervularia* and had grown as fragile and upright as a Venetian wine glass. In life the cup was filled by the body of the living animal, perhaps as vivid in color as ruddy wine, its cluster of tentacles waving in the water to catch its food or shrinking from the touch of a passing fish. By some happy chance several heads of *Acervularia* had grown around this single cup coral, of all the thousands of its kind, and warded off the common fate. So I came upon it—after it had lived and died, after the beauty of its flesh had melted from the skeleton, after the skeleton had been transformed into stone, after more than sixty million years of burial. The chalice stood even as it had stood when brimming with life, unharmed, almost unchanged.

The cup coral (*Heliophyllum*). Note the radiate appearance of the septa in the cup, suggesting the name

Most carefully I cleaned away the surrounding rock, most carefully I loosened the fragile thing that had escaped the possible accidents of æons of time and the final shattering blast that had resurrected it, most carefully I wrapped it in fold on fold of the softest tissue. Now up, up, through the waters of the old Devonian ocean, up through age on age of geological time until I emerged at the surface into the bustle and roar of the rock crusher that was devouring the world I had left.

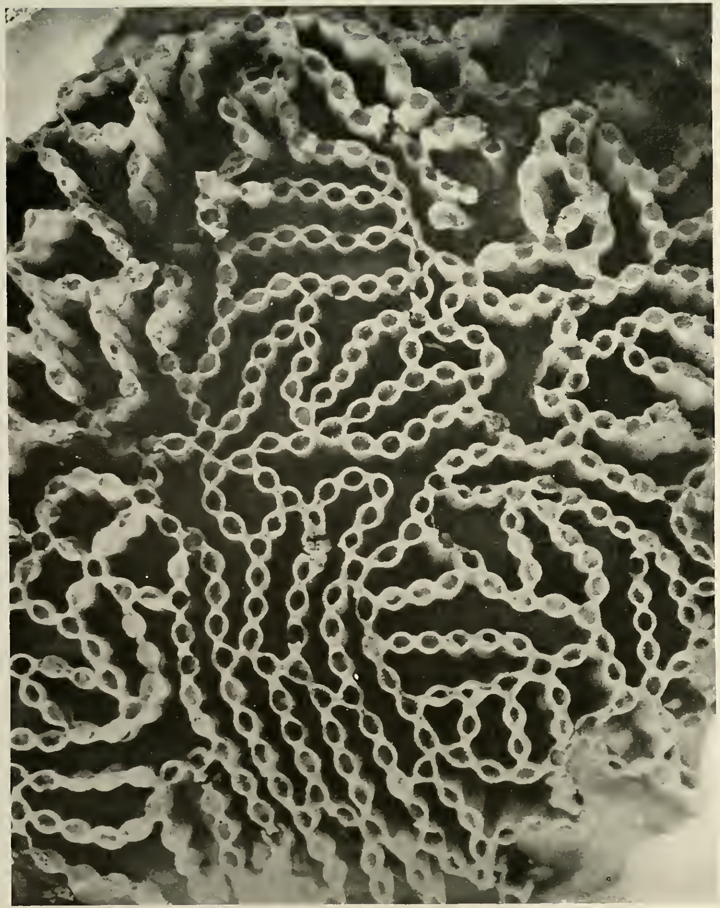
In the laboratory my little fragment of limestone had still more of its history to reveal. The waves had ground to blue mud the skeletons of thousands of less fortunately placed corals and the mud had settled down into every crack and crevice of the reef, finally hardening into the limestone which masked even as it protected the specimen I had recovered. Patiently and by slow degrees, the limestone was cleared away until I could see the whole, and then it was revealed how crowded and strenuous had been the life upon the reef. As soon as the polyps which built up the head of *Acervularia* had died and the decay of its soft parts had laid bare the skeleton, the hard surface was seized upon by other forms of life as a support. Soft, living mats formed by colonies of bryozoans crept over the surface, each minute individual adding its tiny part to the intricate, lacelike skeleton of the colony. Not one, but several such mats are present on the specimen, covering parts of the large head of *Acervularia*, covering each other and creeping up on the sides of the cup coral. The skeletons of the colonies of bryozoans are so small in structure that they must be examined under a magnifying glass, so accurate in the placing of each part that the same species may be recognized among a thousand specimens, so beautiful in their tracery that even the curiosity of the scientist prying into the ultimate secrets of form and relationship is diverted into wonder and admiration. It is a far cry from the collection of ancient Belgian lace in the museum at Bruges to the bottom of a limestone quarry in the New World, but, in the bottom of a muddy pit, I have bent over a fragment of shale or limestone carrying a bit of the skeleton of a bryozoan, with much the same feelings as when I pored over the cases of priceless lace in that historic building.

The bryozoans were not the only forms that seized upon the support afforded by the dead coral. Wormlike "serpulids" fastened themselves there and left their tiny coiled shells scarce two pin-heads in size; certain of the brachiopods abandoned their free life and fastened themselves to the same support, self condemned to cease from their active endeavor and henceforth take what might come. Their shells still cling to the support, mute witnesses of their surrender. So one diving trip ended in the recovery of my little piece of limestone with its history.

Beebe has told us how from his diving helmet his vision can penetrate but a short distance through the clear water and how he was tantalized by dim visions of shapes wavering in the obscuring haze. In the same way the dreaming geologist is tantalized by dim visions of weird forms of life only half revealed, but to him the obscuring haze is one of time and of only partial preservation of the remains. A scale, a tooth, a fragment of a plate gives but a half revealing glimpse of some fish that once haunted the reef. In those early days it was the fashion to wear the skeleton on the outside of the body,—scale armor and plate armor are infinitely older than the mediæval knight who consciously or unconsciously copied the fashions of his remote predecessors. When these oldest of the armor bearers died, their bony plates, scales, and loosely fastened teeth soon fell apart and were dispersed on the reef or the ocean bottom. The palæontologist finds a tooth, sharp as a lance head, and knows that where he stands there once drifted the body of a sharklike creature whose approach was the terror of all the smaller forms. Smaller

Head of a honeycomb coral (*Favosites alpenensis*) which grows in long heads and stalks

Polished surface of a head of fossil coral (*Acervularia*) showing the structure of the separate corallites



Halysites, the chain coral, showing the chainlike appearance of the joined openings of the individual corallites

A bit of a head of fossil coral, *Diphyphyllum*, similar in appearance to *Syringopora*, except that the individual corallites are larger in diameter teeth with sharp chisel edges and a grinding surface are all that is left of fish which browsed among the corals, nipping off the buds of the living polyps and grinding the fragments to powder, or wrenching from the holes and crannies of the reef such forms as had sought protection by hiding there. Occasionally the palæontologist finds fragments of great plates, or by good luck whole plates, of the giant *Dinichthys*, a rapacious form from 20 to 30 feet long, with great shearing jaws that were longer than the span of a man's arms. I have found such plates, and in my explorer's mood may well be forgiven the shudder of apprehension that comes to the diver as he sees the dim outline of a great shark bulk waveringly through the haze of the waters above him.

Perhaps I have led the reader into a strange, and for the most part unknown world, but if he will have the patience to bear with a few details, the way of the palæontologist will no longer seem that of a mere "thanatologist," a dealer with the dead and relics of the dead, but rather a "palæobiologist," a student of the life that is past, the life that struggled forward to the things that we see about us now.

The term "coral reef" may be taken in a somewhat general sense to include the great assemblages of life which build up the barrier and fringing reefs of the islands and continents of the tropical seas. Such reefs are formed in large part by colonies of corals, bryozoans, hydrocorallines and similar forms which secrete calcareous matter from the sea water and build it into the hard parts of their bodies. When the animals die, the indestructible calcareous skeletons build the stony mass of the reef. Associated with the colonies of animals are many forms of plant life, "sea weeds," which contribute as much or more of the calcareous hard material as do the animals. The reefs grow to the surface of the water where the force of the waves breaks off bits of the stony matter and grinds them into fine mud which is distributed in even layers on the near-by portions of the ocean floor. These form the layers of shales and limestones, but through the even layers project the irregular masses of the reef which was the source of all the material around them.

The majority of living corals can not endure a temperature below 69° Farenheit, nor a depth much greater than one hundred fathoms; they are all marine in habit and as they live with their mouths generally upward and open to all that comes, they may not survive in muddy water where the sinking sediment would choke out their lives. So far as we may determine, the habit of the ancient corals was not greatly different from that of the living forms, and so, when we find a bit of coral in the limestone or shale, we may be certain that at some time in the past the place where we now stand was covered by a warm, shallow sea.

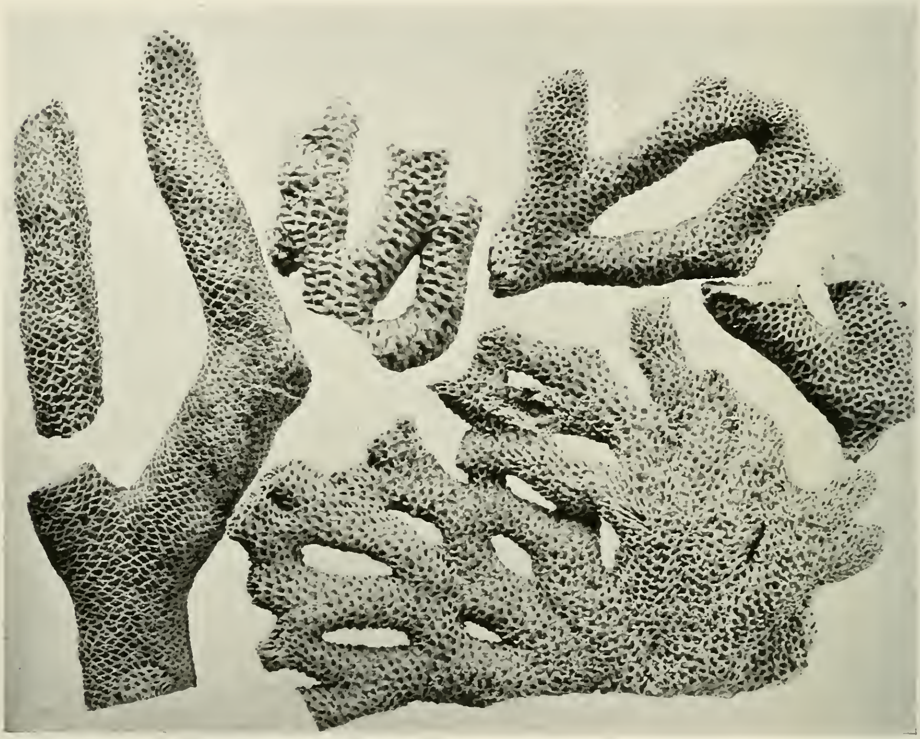
The estimates of the extent of geological time are so various and so discordant that it is impossible to decide between the many hundreds of millions of years demanded by the students of radium and the few hundreds of millions of years which are sufficient for the students in other branches of science. Figures so vast mean but little for they are all beyond the grasp of the human brain. Professor Schuchert of Yale University has suggested that the extent of time since life appeared on the earth is, perhaps, in the neighborhood of 300,000,000 years, and that the time since the rocks first received remains of life that could be preserved as fossils is something like 250,000,000 years. These figures will at least serve to give some idea of the order of the numbers with which we must deal.

The 250,000,000 years is divided by geologists into three great eras, the Paleozoic, the Mesozoic and the Cenozoic. The first of these is divided into several epochs, the Cambrian (the oldest), Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian. It is altogether probable that with the increase of knowledge the number of these divisions will be increased.

In a broad way, the state of Michigan can be thought of as a pile of saucers, each geological formation a single saucer resting upon the one beneath and the rims of the various saucers appearing on the edge of the pile. The youngest of the formations is the Pennsylvanian appearing in the center of the State. The successively older formations appear as the concentric rims around the center. Toward the north, the oldest of the formations, the Cambrian, forms the southern shore of Lake Superior. South of this, the next younger rocks, the Ordovician, extend from Bay de Noc on the west through the center of the northern peninsula and are continued on the northern shore of Drummond's Island. South of this, the next younger, the Silurian, forms and parallels the southern shore of the northern peninsula and forms the southern side of Drummond's Island. Next come the rocks of the Devonian which sweep in a great arc, first northeast from Charlevoix and Petoskey, on the west, and then southeast to Alpena, on the east.

Along each of these arcs the harder limestone of the coral reefs thrusts itself through the soil which covers the areas where the softer rock has been removed by erosion. Most of the rocks of the Ordovician arc are hidden by swamp and forest, but on the northern side of Drummond's Island the waves have swept the rock clean. Here I have stood upon the shore and looked down through three feet of the clear waters of Lake Huron upon the surface of a coral reef as beautiful in form as any reef of the southern seas. Perfect heads of the compound coral *Columnaria*, so called because of the rigidly straight skeletons of the individual corallites, lie crowded together with every detail of the structure etched into perfect relief by the solvent action of the water. Between and on the heads lie the cornucopia-like skeletons of the solitary corals and in every depression lie the shells of brachiopods, trilobites, cephalopods, and crinoids. In every detail it resembles a living reef except that all has been stilled into imperishable stone. The waving sea weed, the scuttling crab, the frondescent colonies of bryozoans are quiet, but how easy in imagination to make the whole quicken into action and to see the gorgeous colors creep over the gray stone, tinting them as the coming of morning tints the gray eastern sky.

A short distance north of this reef, on the shores of little Sulphur Island there is a bit of ancient history clearly graven in the stone. In the most remote days of the earth's history, long before living things had learned to build the hard parts that might remain as fossils, a mass of sand was gathered together by wind, or wave, or river. Later this was cemented together into a hard sandstone and then the whole was buried beneath the accumulations of later time. How deeply it was buried and for how long a time we may not know, for that part of the record has disappeared forever. In some disturbance of the earth's crust the sandstone was heated and squeezed until it became a very hard, compact quartzite and then was raised again to the surface. Just when it was raised and when it became again a part of the ocean shore we do not know, but certainly it was facing the waves of the ocean in Ordovician time. We do know that the sea of Ordovician time beat against the quartzite, carving it into cliffs and tearing down masses that were ground to bowlders on the beach, for after this had gone on for some time the shore began to sink again and the waters crept over the rocks, depositing the gray mud of the ocean floor upon and between the bowlders and finally covering and burying the whole cliff. In the mud and on its surface lived thousands of the animals of Ordovician time and their fossil remains now lie encased in the limestone between the bowlders, and in the cracks of the rock of the cliff. The whole region was buried for an unknown length of time and then raised again to feel anew the beat of storm waves. Today the waves of Lake Huron are tearing away the Ordovician mud and beating upon exactly the same surface, exactly the same grains of the quartzite



Cladopora, a form of branching coral very common in Michigan. It is easily distinguished by the oblique position of the openings that were beaten by the waves of the old Paleozoic sea, at least eighty millions of years ago.

On the south shore of Drummond's Island, at the little village of Raber near Detour, and at Engadine and Gould City along the line of the Minneapolis and Sault Ste. Marie Railroad, the reefs of the Silurian seas are especially prominent. Here the searcher must watch the stone fences and the piles of rock culled from the ploughed fields, or crash his way through the thick second-growth timber and brush to some burned off spot where the soil has been washed away and the rock revealed. I once started with a friend across a ploughed field near Gould City. In five minutes our arms were filled with fossil corals so beautiful that they simply could not be left behind, but fossils are heavy and soon our burden was deposited in a fence corner. The walk was resumed, but only to repeat the process again and again. The next day we chartered a wagon to bring our treasure trove to the railway station. On one small piece, not more than one foot by two feet, which I pulled from a farmer's fence, I identified thirteen different varieties of corals and bryozoans.

In these reefs are found the heads of *Favosites*, the "wasp nest" or "honey comb" coral, occuring in a dozen different habits of growth, from masses several feet across to colonies no larger than a golf ball, in broad, wavy sheets, in irregular cylinders, in branching and digitating masses. Here is found *Halysites*, the "chain coral," with long, slender corallites attached edge to edge in thin walls that cross and intersect; the mouths of the corallites appear as a succession of small, oval openings like the links of a chain. Here is the *Syringopora*, the "organ-pipe coral," a series of semi-detached tubes which the author of the genus likened to the pipes of a syrinx. Here, too, an amazing number of the cup corals lie scattered along the reef, large and small, slender and stout, some flat as a button, some like small horns of plenty.

By a happy chance, the substance of the corals found in this region has been changed into silica, which is much more resistant to the action of all the weathering agents than the limestone in which they were enclosed. I have frequently stumbled upon a piece of white silica sticking out of the black soil and with a little care, have recovered a perfect skeleton of one of the corals.

South of the Silurian reefs lies the land of the Devonian, described above in the account of the little piece of limestone. To most people who go to northern Michigan it is a land of lakes and summer resorts. Beyond the hotel and the lake there is only glacial soil and much unproductive sand. To them it is a land of swamps and thick brush where the pine and the other forest trees have been cut away, where unsightly skeletons and blackened stumps tell where the fire has swept again and again through the forest. If the visitor will don something of the outfit of the geologist, his hob-nailed boots and khaki, arm himself with a hammer and chisel, and then let himself sink beneath the waters that have built up the substance of some of the great quarries, he will find Michigan is a land where the waves once broke on the coral sands, a region of romance where beauty can still be rescued from the jaws of the dragon steam shovel, a land—

> Where the sea-egg flames on the coral,
> And the long-backed breakers croon
> Their endless ocean legends
> To the lazy, locked lagoon.

TIDE HOUSE AT TAHITI

The Truant Tides of Tahiti

By H. A. MARMER

Of the U. S. Coast and Geodetic Survey

A THOUSAND miles below the equator and very nearly midway between South America and Australia, the island of Tahiti rises from the depths of the South Pacific Ocean. Only a few miles from its palm-fringed beaches, the ocean is more than ten thousand feet deep, while a few miles inland the crest of Orohena towers more than seven thousand feet above the surf.

It was in a generous mood that nature fashioned Tahiti. Bestowing on it the gift of perpetual summer coupled with a pleasant, healthful climate, a fertile soil, riotous vegetation and waters matching the productiveness of the land with a wealth of fish of all kinds, it added the further gift of varied and enchanting scenery: within the compass of a few miles, coral strand and mountain peak; waterfalls leaping hundreds of feet down precipitous cliffs; streams of entrancing beauty, their courses bowered with tropic verdure; lovely river-threaded valleys abounding in fruit and flowers.

For the past hundred and fifty years, since it first became known to the civilized world, the charms of Tahiti have been sung by all who touched its shores. The spell of its indulgent climate, its people of splendid physique, and more especially the charm and grace of its friendly feminine population, have combined to make of Tahiti a name that conjures up pictures of romance and adventure, a place that invites to truancy from labor and from the compulsions of civilization.

Not only have visitor and native alike responded to the spell of Tahiti, but the sea itself appears to have succumbed to the spirit of truancy. Over the vast expanse of the seven seas it is the moon that is mistress of the tide, compelling its rise and fall to keep step with her own movements; but at Tahiti, while the tide acknowledges the sovereignty of the moon, it also plays truant and pays very nearly as great homage to the sun, so that here sun and moon play approximately equal tidal rôles.

SUN, MOON, AND TIDE

To understand the full significance of the strange behavior of the tides at Tahiti, it will be of advantage to consider for a moment the normal relations of sun, moon, and tide. That the moon and the rhythmic rise and fall of the sea, which we call the tide, were in some way intimately connected, must have been discovered early in the life of mankind; for, not only does the tide vary in the amount of its rise and fall with the moon's changing phases, but like the moon it also comes later every day by about fifty minutes. That the sun, too, is concerned in the rise and fall of the tide is evident from the fact that at times of full and new moon, when sun, moon, and earth are in line with one another, the tides have their greatest rise and fall; while when the moon is in her first and third quarters, that is, when sun, moon, and earth are at the vertices of a triangle, the rise and fall of the tide is at a minimum.

Before the beginning of the Christian era, the Greeks and the Romans had recognized the fact that the tide was brought about by sun and moon, and they recognized, too, that the moon played the leading rôle. But the agency by means of which sun and moon produced the tide remained a mystery for many centuries. Indeed, it was not until the genius of Newton in the latter decades of the seventeenth century discovered and formulated the law of gravitation that the connection between moon and tide received a rational explanation.

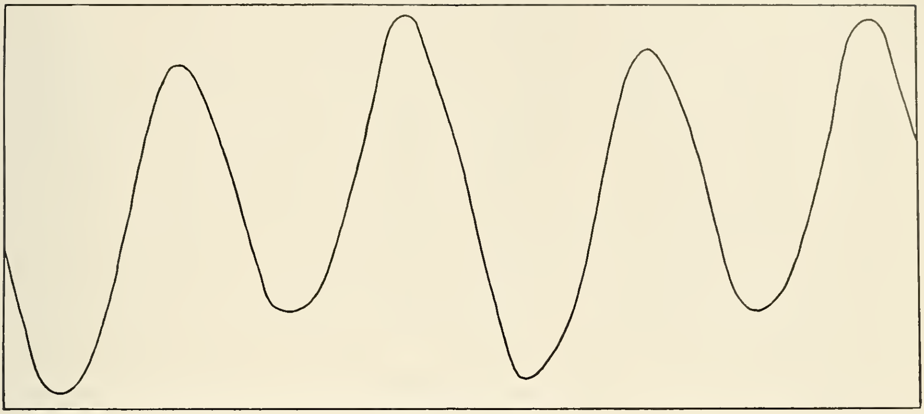
At first thought it is something of a paradox that in controlling the tidal movement of the sea the sun must yield supremacy to the moon, for the sun is the source of energy and master of life on land and sea. It holds both earth and moon in subjection, compelling them to attend as satellites. In size, too, the moon compared to the sun is altogether insignificant; the sun can furnish material to make twenty-six million moons and still have enough left for something like ten thousand planets the size of our earth. Why is it then that the moon plays the leading rôle in the production of the tides, making the length of the tidal day the same as the lunar day and compelling the tide to keep step with her own movement? What explains this seeming paradox?

The explanation is found in the laws of celestial mechanics. When, on the basis of universal gravitation the mathematician works out the law that governs the tide-producing power of a heavenly body, he finds that there are two parts to it. First, the power of a heavenly body to produce tides varies exactly as the amount of matter in the body, the greater the body the greater the tidal force. Second, the further away the body, the less the tidal force, but in such manner that when the distance is doubled the tide-producing force is reduced eightfold; or as the mathematician expresses it, the tide-producing power of a heavenly body varies directly as its mass and inversely as the cube of its distance.

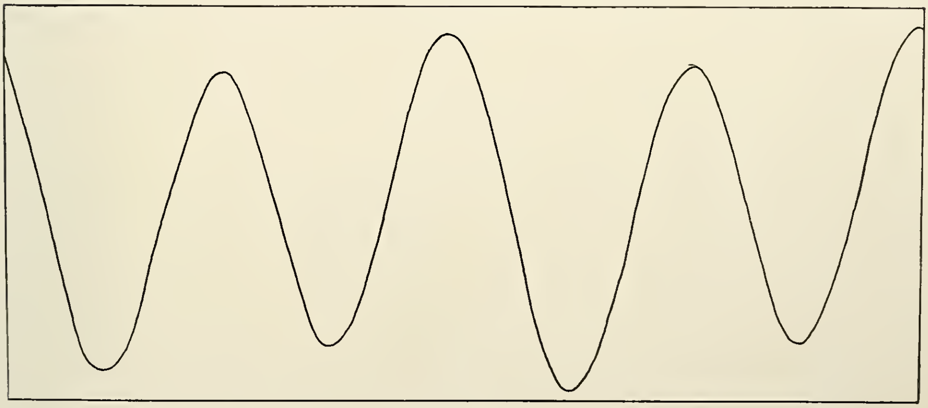
Applying these laws of the tides to the sun and moon, it would appear at first glance that because of its enormous mass, the sun's tide-producing power should be much greater than that of the moon. Indeed, if moon and sun were equally distant from the earth, the sun's tide-producing power would be 26,000,000 times that of the moon. But the moon is 389 times nearer than the sun. According to the second part of the law of tides, therefore, the moon's advantage over the sun because of its nearness is found by cubing 389 which gives, in round numbers, 59,000,000. The moon therefore because of its nearness overcomes the advantage of the sun's greater mass in the proportion of 59,000,000 to 26,000,000; that is, the moon's power to produce tides on the earth is something like 2¼ times as great as that of the sun, and hence the tides the world over, with scarcely an exception, follow the moon.

THE IMPRESS OF LOCALITY

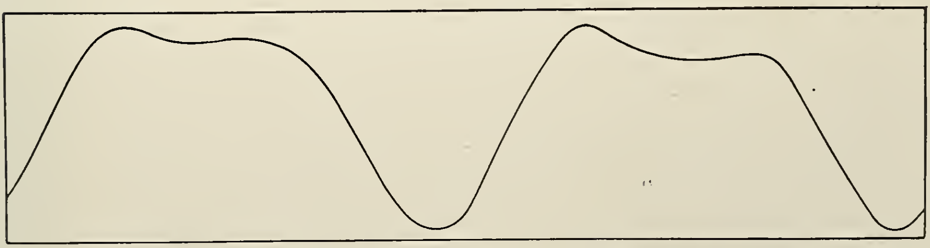
Since the tide-producing forces arise outside the earth in the sun and moon, it might be supposed that over the whole earth the tide would exhibit the same characteristics. And to the casual glance the tide appears to be cosmopolitan in character and to possess no local distinguishing traits to vary the monotony of its ceaseless rise and fall. On closer examination, however, this appearance of uniformity



Rise and fall of tide at foot of of the Statue of Liberty, New York Harbor. July 1–2, 1920. Height scale $\frac{1}{30}$ of nature



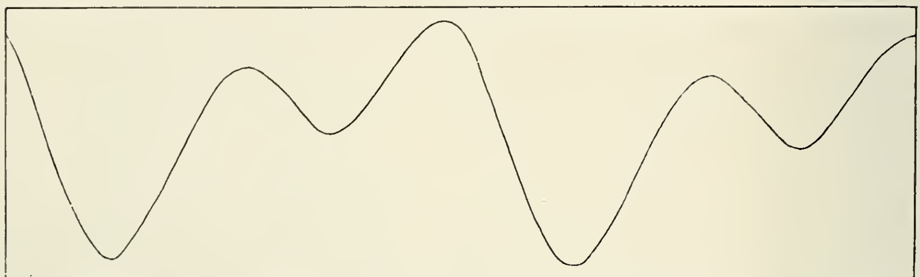
Rise and fall of tide, Portland Harbor, Maine. July 1–2, 1920. Height scale $\frac{1}{60}$ of nature



Rise and fall of tide, Galveston, Texas, July 1–2, 1920. Height scale $\frac{1}{15}$ of nature is found to be deceptive. Not only do differences in the extent of rise and fall come to light—at some places it is less than a foot while at others it is more than forty feet—but each locality reveals distinctive features in the rising and falling of the tide that are typical for that locality.

By means of the self-registering or automatic tide gauge, the tide at any place can be made to write the story of its rise and fall graphically, furnishing a visualization of its history for as long a period as desired. Looking at such a tide curve representing the rise and fall of the tide in New York Harbor for the first two days in July, 1920, we see that despite its reputation for frivolity and the vagaries along its "gay white way" the tides that wash the shores of New York City are very regular in habits. High water and low water follow each other in a uniform manner at intervals of a little more than six hours, rising and falling approximately four and one-half feet. And regularly do these tides follow the moon, low water coming two hours after the moon has passed the meridian and high water eight hours after the meridian passage.

Now compare the tide curve at Portland, Maine, for the same days. Not one whit more correct is this New England tide in its behavior than the tide at New York. Here, too, the tide follows the moon regularly, and while both places exhibit the characteristic features of the Atlantic Coast tides, the impress of locality is seen in the differences in time and range of tide. At Portland the tide is about three and one-half hours later than at New York and the range is twice as great, being almost exactly nine feet.



Rise and fall of tide, Golden Gate, San Francisco Harbor. July 1–2, 1920. Height scale $\frac{1}{60}$ of nature

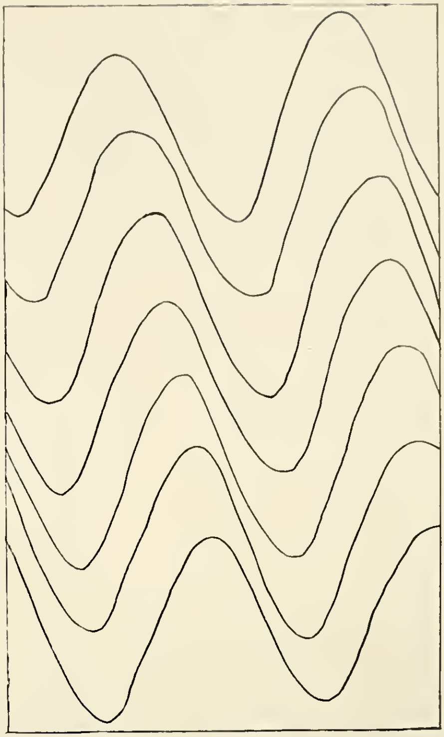
Going farther away the differences in tidal characteristics become more striking. Glance at the tide curve representing the rise and fall of the tide at Galveston, Texas, for the same two days in July. Here the range of the tide averages but one foot, as compared with four and one-half at New York and nine at Portland. But what is even more striking is the character of the rise and fall. On the Atlantic coast the two high waters and also the two low waters of a day are approximately the same, the morning and afternoon tides resembling each other closely in all respects. In the Gulf of Mexico, however, the two high waters do not differ much but morning and afternoon low waters are so strikingly different that frequently the higher of the two low waters merges with one of the high waters and at such times there is but one high water and one low water each day.

On the Pacific coast the rise and fall of the tide is different from that on the Atlantic and Gulf coasts. The characteristic features of the tide that sweeps past the Golden Gate is exhibited by the tide curve for July 1–2, 1920. With an average rise and fall of four feet both the high and low waters of each day exhibit characteristic differences. And wherever tides have been observed, distinctive features in time, range, and characteristics of rise and fall are found that betoken the impress of locality.

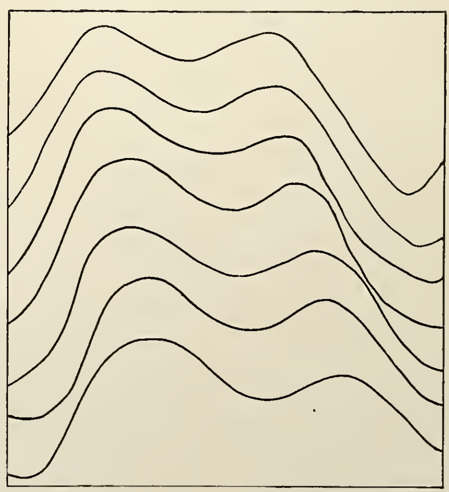
SOVEREIGNTY OF THE MOON

Notwithstanding the very decided differences shown by the tides in various regions, one feature they have in common almost without a single exception the world over, namely, acknowledgement of the sovereignty of the moon. Day after day the tide at any given place follows the moon's meridian passage by a very nearly constant interval. As the Venerable Bede expressed it twelve hundred years ago, "in every country the moon keeps ever the rule of alliance with the sea which it once for all has agreed upon."

Every day the moon crosses the meridian of any given place, on the average, fifty minutes later than the day before; and the tide at any point, with the striking exception of the region around Tahiti, follows the movement of the moon and likewise, on the average, comes later each day by fifty minutes. Heavy winds may disturb this regular succession somewhat, but only temporarily, the tides following the storm coming in their appointed time as if nothing had occurred to disturb the serenity of their way.

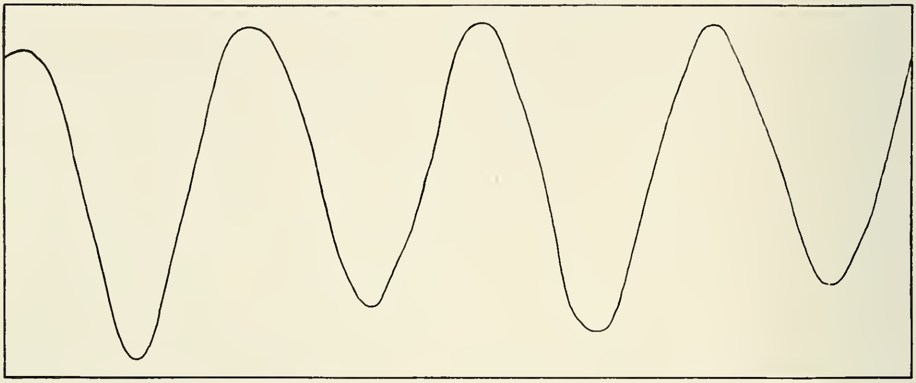


Tide curves, New York Harbor, June 4–10, 1921. Height scale $\frac{1}{65}$ of nature



Tide curves, Petropavlovsk, Siberia, June 11–17, 1828. Height scale of $\frac{1}{70}$ of nature

This retardation in the time of tide stands out clearly if we arrange the tide curves for any place, day by day, in serried ranks like an army on the march. Whether in New York Harbor or on the coast of Siberia, in the polar regions or under the equator the retardation in time stands out in the curves as a shift to the right from top to bottom, which averages fifty minutes per day. This means in other words that in a week, each phase of the tide will have become later by almost exactly five hours.



Rise and fall of tide, Tahiti, September 1–2, 1924. Height scale $\frac{1}{9}$ of nature

BEHAVIOR OF TAHITI TIDES

At first glance the behavior of the tide at Tahiti seems to be altogether unexceptionable, the rise and fall appearing to exhibit no unusual features. Examining a typical tide curve for this island—exemplified by the tide curve for the first two days in September, 1924—we find it much like the tide curve at numerous other places. The range of the tide, to be sure, is small, being on the average less than a foot; but the general appearance of the curve is that of a regular tide curve.

If, however, we examine the succession in the time of tide at Tahiti from day to day, the fact will soon come to light that here the tide does not come later each day by the interval of fifty minutes which characterizes the tide at other places. Instead, there will be periods of a week or more when each phase of the tide comes about the same time on successive days. Here the tide curves for a week, arranged in serried ranks, do not show the distinct shift to the right found at other places; on the contrary, there is a pronounced tendency for the various phases of the tide, from day to day, to fall almost vertically under each other as exemplified by the tide curves for a week in September, 1924, as shown in the diagram on the following page.

Within the period of a week the tide at other places in the world would have kept time with the moon's motion so that at the end of the week each phase of the tide would be five hours later than at the beginning of the week. At Tahiti, however, as the week of tide curves shows, there is a barely perceptible shift to the right from top to bottom—instead of five hours it is somewhat less than two hours—and every day high water comes about twelve o'clock, morning and night, while low water comes about six o'clock in the morning and six in the evening.

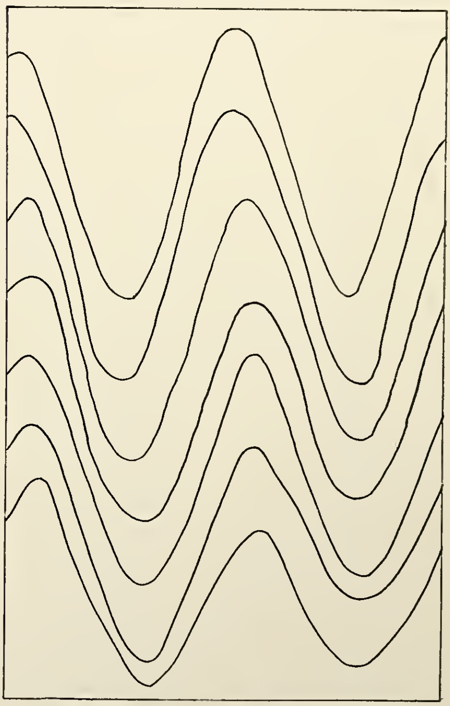
It is in this feature that the tide at Tahiti is exceptional. Instead of becoming later each day by very nearly an hour, the tide here tends to come about the same time every day. Indeed, as a general rule it is not incorrect to say that at Tahiti the tide is high about twelve o'clock morning and night, and low about six o'clock morning and evening. Colloquially, therefore, the tide at Tahiti may be summarized as "highwater, noon and midnight; low water, breakfast and supper." The local term, *tooerar-po* is used alike to express high water and midnight. And it is altogether likely that the tides served the easy-going Tahitians as a sufficiently satisfactory timepiece. When life is pleasant and unhurried what difference, really, does an hour or two make?

JOINT SOVEREIGNTY OF SUN AND MOON AT TAHITI

In the fact of the tide at Tahiti tending to come about the same time every day, the sun manifests its joint and equal sovereignty with the moon. But a regard for accuracy makes it necessary to emphasize the point that it is not *exactly* the same time but only *about* the same time that the tide comes. This emphasis is called for since in describing Tahiti the statement is frequently made that the tides here ebb and flow with unvarying regularity, never changing in time from one year's end to another. Indeed, a recent book quotes a mariner as saying that from the verandah of his club at Papeete he could tell the time of day within a quarter of an hour by looking seawards and seeing where the water stood!

We now have accurate information with regard to the tide at Tahiti for it has recently been carefully studied. At the instance of the U. S. Hydrographic Office, Mr. Harrison W. Smith of the Massachusetts Institute of Technology, sojourning in Tahiti, secured accurate tide observations for several years. These tide observations have been analyzed by the tidal mathematicians of the Coast and Geodetic Survey, and it was found that here the sun has approximately the same tidal effect as the moon.

At Tahiti therefore, the moon shares with the sun her sovereignty over the tide. And it is this fact that accounts



Tide curves, Tahiti, September 13–19, 1924. Height scale $\frac{1}{9}$ of nature

for the truancy of the tide. Compelled at the same time to pay equal homage to both sun and moon, the tide tries now to keep step with the moon, which tends to make it come later each day by fifty minutes, and now to follow the sun which labors to make it come at the same time day after day. It thus wavers in its allegiance from one day to the next and ends by coming to high water about noon and midnight, and to low water about six o'clock both morning and evening.

CAUSE OF TIDE'S TRUANCY

In tracing the peculiar behavior of the tide at Tahiti to the joint and equal sovereignty of moon and sun, we have gone but one step towards the explanation of the truancy of the tide here. The question at once comes up, why this exceptional state of affairs in the tidal effects of sun and moon at Tahiti? The answer is found in a study of the wave movement with which the sea responds to the tide-producing forces of sun and moon.

It is a matter of every day experience that a body of water which is disturbed from its condition of rest tends to set up waves. A pebble dropped into the pond, the wind sweeping the surface of the lake, the boat propelled through the water—all these give rise to waves. And in the same way the tide-producing forces of moon and sun, acting upon the waters of the sea, bring about the slow but mighty wave which stirs the sea to its very depths and which we call, for short, the tide.

A body of water is capable, however, of sustaining two different kinds of waves. Suppose we take an oblong tank, say twenty feet long filled with water to a depth of about half a foot. By agitating the water at one end with a paddle we may start a wave which will advance or progress from one end of the tank to the other, the outline of this wave being the sinuous curve which we generally associate with wave movement.

But we may also set up in our tank of water a wave movement of an entirely different kind by raising and then immediately lowering one end of the tank. The water will then swash or oscillate alternately from one end of the tank to the other about an axis situated in the middle of the tank. And if we examine this type of wave movement carefully we will note that the rise and fall is practically nil at the axis and increases regularly toward the ends of the tank.

The more recent studies of the tide show that the tide wave of the open sea is of the oscillatory kind, the oscillation taking place about axes where the rise and fall of the tide obviously is small. Moreover it follows that the axes of the oscillation due to the moon's tide-producing forces do not coincide with those of the sun's tide-producing forces.

Here then we find the explanation of the truancy of the tide at Tahiti, for this island lies close to one of the axes of the oscillation due to the moon's tide-producing forces. The tidal effect of the moon is therefore small here—so small in fact, that the moon loses its predominant position of mistress of the tide, sun and moon playing equal rôles.

The Peruvian Guano Islands Seventy Years Ago

By ROBERT CUSHMAN MURPHY
Curator of Oceanic Birds, American Museum

NOW and again it happens that some perishable treasure of a bygone day is not only saved from oblivion but is dropped into the lap of the individual who, above all others, may comprehend and prize it. Once, at least, this has been my lot. If a connoisseur of Americana were invited to carry away from a dismantled house an unlisted, unrecognized copy of Denton's *New York* (1670), he could hardly feel a greater thrill of exultation than did I when a visitor entered my laboratory in the Museum and casually spread out the photographs reproduced on the following pages.

It would be rash to assume that no similar records of the climax in Peruvian guano traffic are in existence. For decades the fleet of square-riggers crowded about the Chinchas and other treasure islands, bringing crews from the United States and from nearly every seafaring country in Europe. Many a sailor of those years painted crude impressions of cliffs and huddled ships on bits of planking, a few of which have found their way into maritime museums. Photography was in its infancy, yet some of the wide-awake skippers who made repeated voyages to these rock-bound heaps of fertilizer must have sought means to secure objective records of the stirring, well-nigh incredible scenes that met their eyes. Indeed, the present photographs may prove the point. But where are others? Possibly in metal-hasped albums lying forgotten in old homes of New England or British seaports; possibly among the musty archives of the *Biblioteca Nacional* at Lima; we have no means of knowing, but it is safe to say that most of them have vanished utterly—no more to be sought than the priceless manuscripts of Alexandria which were burned by order of Omar in the year 641.

These photographs from the Chinchas, which were presented to the Museum by Mr. Walter R. Merryman, of Haverhill, Massachusetts, are prints of about seven by nine inches from negatives prepared by the old wet-plate process. The method came into vogue a few years after 1850, and, since it was necessary to sensitize the glass sheets immediately before their exposure and to develop them immediately afterward, a high degree of skill was required, as well as the transportation of such a quantity of impedimenta as would appall a modern film-pack enthusiast.

The pictures came into the possession of Mr. Merryman through two collateral forbears, one of whom, Captain Charles Spence Merriman, of Brunswick, Maine, died about 1872. Captain Merriman commanded the ship "Marcia Greenleaf," in which he is reported to have made several runs to the Chincha Islands. From the character of the prints, the residue of guano depicted on North Chincha, and the appearance and rig of the clustered vessels, it is possible to fix the date of the photographs as approximately 1860.

The wild story of the guano years, which Peruvian historians refer to as a "saturnalia," is not likely to be familiar to many American readers of

South Island of the Chinchas, October, 1919. The dark patches on top of the island are a great colony of cormorants. The topographic changes wrought by the removal of the guano beds may be seen by comparison with the old photograph on page 443. In the background twelve miles distant, is San Gallan Island

today. A sketch of the period, however, is to be found in *Bird Islands of Peru*,[1] in which the particularly vivid reminiscences of "The Chincha Islands Fifty Years Ago," by Dr. Frederic A. Lucas, honorary director of the American Museum, go far to reconstruct the Guano Age during the earlier years of its decadence. The death of the whole trade, and its phoenix-like rebirth under a newer and better régime, belong to another tale. For the moment our thoughts are turned back to a time when guano-fever burned as fiercely as ever did gold-fever, and when the Chinchas were a focus of greed and corruption, a forgotten center of dust-gagged misery and slavery as well as of important business ventures, eminently respectable, of course, and represented by calculating skippers and by ships with towering spars.

Aside from the evidence these photographs yield as to the amount of ancient guano that yet reposed upon the islands nearly seventy years ago, they are of exceptional interest as a record of contemporary shipping. Doctor Lucas and I have pored long over the fleets of more than thirty vessels revealed in the panoramas of North and Middle islands. The majority are American craft. Here and there lies a hull with painted ports that may be a degenerated British packet. The brig in the right foreground of the Middle Island view seems also to be an Englishman. The cumbersome deck-houses of two or three full-rigged ships stamp them as St. Johnsmen, from New Brunswick, and a small white bark, bearing an elaborate figurehead, may be French or Norwegian. But nine out of ten, perhaps, are Yankees—new or old, as indicated by their lines, the loftiness and rake of their masts, or the number of their topsail-yards. A few are close to the clipper type, while

[1]*Bird Islands of Peru*, by Robert Cushman Murphy. Putnam, N. Y. and London, 1925. Reviewed in NATURAL HISTORY, Vol. XXV, No. 2, pp. 199–201.

others may have been launched before Old Ironsides left the ways.

What a picture these venerable windjammers make! Some are light, awaiting their turn, but others, such as the bluff-bowed ship moored to a shore-ring in the North Island view, are already well laden, with lighters alongside. Fast by bower and kedge, the staunch vessels rest in the North Strait, with awnings and wind-sails set for comfort. Careful skippers, with the prospect of a long delay, have unbent their canvas and, in some instances, have sent down their upper yards. What a galaxy of proud ship-masters within hail of each other! What courtesies and amenities exchanged each quiet tropical evening! For guano fetched ninety dollars a ton in Liverpool or Charleston, and, to skippers and crews life was a jolly song. It was not strictly necessary to heed the accompaniment to this song, rendered on the plateaus of the islands by coolies who sweated out their lives under the lashes of black drivers, or dashed themselves over the precipices into Lethe.

Sailor's trinket from the Lobos Islands, Peru. The bottled design, save for two ships drawn on paper, is made up wholly of guano and polychrome rock powder

Perhaps a few of the readers who scan these photographs may recall country stores in New England bearing the sign "West India Goods and Groceries." West India Goods were euphemistic words for rum and molasses, and the "groceries" always included small bags of Peruvian guano, stencilled with an unreal sea-fowl. Behold now the source of this magical, strong-smelling powder, and the wooden bottoms in which it was carried from the despoiled Chinchas to the ends of the earth.

GUANO CUTTINGS ON MIDDLE CHINCHA ISLAND

The thickness of these amazing beds, as estimated from the stature of the toiling coolies, is not less than sixty-five feet. The original insular deposits, which may be likened to glacial caps, were in some places more than a hundred feet deep, representing the accumulated droppings of myriad sea fowl throughout thousands of years

South Chincha Island, as seen across the strait from Middle Island. Excavation is here in a younger stage and the cut bank of the great mound of guano shows distinctly. Noteworthy among all these pictures is the apparent absence of the sea birds that were the sole producers of the treasure. Compare with the recent photograph on page 440.

Residual stacks of guano on Middle Chincha, showing stratified layers perhaps one hundred and twenty-five feet in height from bed-rock to the former level of the deposit. A Peruvian survey of 1853 computed the quantity of guano then lying on the three Chincha Islands to be 13,376,100 tons

A GUANO TOWN OF YORE

A corner of the "city" on North Chincha Island, of which not a trace now remains. Wooden chutes carried the fertilizer to box cars at lower levels from where, in turn, it was transported to cliffs above the anchorages

FILLING THE LIGHTERS

At the terminus of the railways the guano was dumped into enclosures, and subsequently shot through huge canvas hose to small craft beneath. Sometimes even the ships would be warped against the rocks to be loaded directly, and, it is said, within a space of three or four days

GUANO CARRIERS AT THEIR MOORINGS IN THE NORTH STRAIT, AS SEEN

THE SAME FLEET AS VIEWED FROM THE BRINK OF THE CLIFF OF MIDDLE

FROM NORTH ISLAND, WITH MIDDLE CHINCHA ISLAND IN THE BACKGROUND

ISLAND, WITH THE TOWN AND REMNANTS OF THE GUANO HEAPS ON NORTH ISLAND

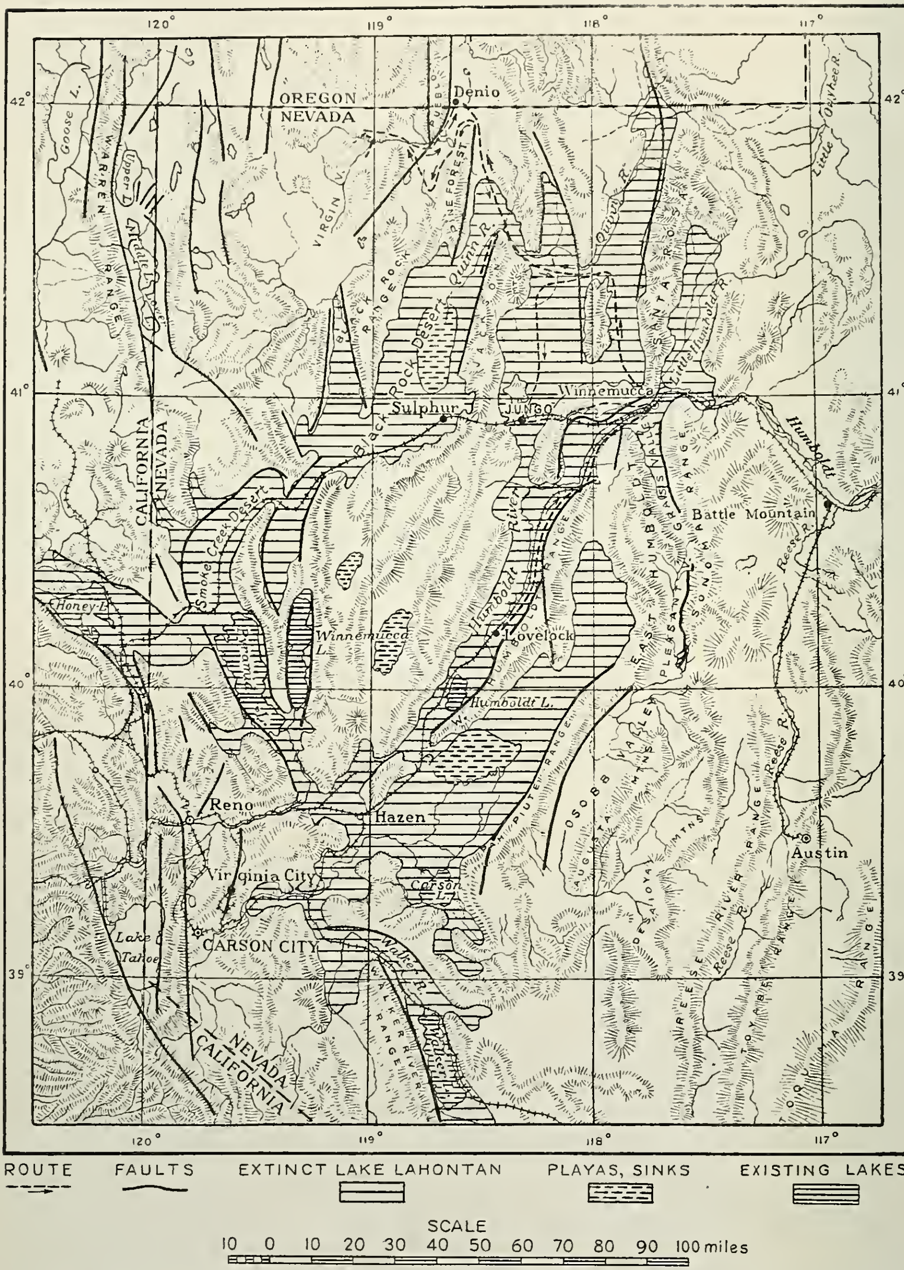


Fig. 1. Sketch map of northwestern Nevada showing the relative position of the uplifted mountains and depressed valleys, the pronounced fault lines, the former extent of Lake Lahontan and the existing lakes, playas and sinks, also the route taken by Dr. Chester A. Reeds and his party in May, 1927

Desert Landscapes of Northwestern Nevada

By CHESTER A. REEDS
Curator of Invertebrate Palæontology, American Museum

THE most striking feature of northwestern Nevada is its desert landscapes. These landscapes are not great barren wastes of drifting sand with only a dune to relieve the monotony of the horizon, as a person unacquainted with American deserts might suspect, but a region consisting of many mountain ranges, high plateaus, mesas, and extensive valleys, Fig. 1. In the clear air of the desert these features seem to be of much smaller dimensions than they really are. Many of the valleys have no outlet, since the lowest passes, from one to another, are oftentimes several hundred feet above the valley floor. If it were not for the minimum rainfall, scarcity of water vapor in the the atmosphere, and diminished amount of water on the surface of the ground and underground, the region would be a fertile country. Rivers and flowing streams are rare, springs few and far between, and water a commodity for which men search, often with life at stake. The desert climate is consequently of an exaggerated continental type.

The atmosphere of this immense region is dry, remarkably clear in winter, but filled in summer and during the period of equinoctial storms with minute particles of dust which produce extraordinary color effects. Radiation is intense and the temperature is subject to extremes, the annual range being about 124°. The daily variation is also great. The mean temperature for the winter months, December, January, and February is 26°, with extremes reported of 73° and −42°; the mean temperature for the summer, June. July, and August, is 69°, with extremes of 108° and 20°. The low humidity of summer prevents the heat from being oppressive and cases of sunstroke are unknown.

The rainfall is exceedingly light. It nowhere exceeds twelve inches, while the average annual rainfall varies from seven to eight inches. Some sections have no rain for several successive years. During the winter months, the precipitation is usually in the form of snow on the mountains, Fig. 5. Oftentimes a considerable fall of snow covers the mountain tops in May. The melting of the mountain snows in the spring causes severe freshets, which in turn are followed by long seasons of drought at a time when water is most needed for agricultural purposes. Fogs and hail are rare, but cloud-bursts are not uncommon.

Two railroads, the Southern Pacific and Western Pacific, have been built across northwestern Nevada, and except for the towns along these routes and the various mining camps, the region is sparsely settled; in fact, ranch houses have been built only where mountain streams debouch upon the desert plains, and then only where the supply of water is sufficient to afford two separate waterings of the land under irrigation, Fig. 2. Except for an occasional garden, attention is given almost exclusively to the raising of wild grass or alfalfa with which to feed live stock, chiefly cattle and sheep, during the winter months. Graded state and national highways

Fig. 2. View looking northwest across the Black Rock Desert; in the foreground an ex-cowboy may be seen irrigating an alfalfa field on the Steele ranch. Water for this purpose is taken from Jackson Creek, a snow-fed mountain stream, which debouches on the valley plain a half mile east of the spot shown

Fig. 3. A portion of the western face of the Jackson Mountains. View looking southeast from the edge of the Black Rock Desert in the vicinity of Jackson Creek and the Steele ranch. A bowlder-strewn alluvial fan appears in the foreground and mid-distance, also some rabbit-brush; in the back ground may be seen the dissected mountains with short stream valleys normal to the front, and a fault scarp with two prominently exposed faces, which runs parallel to the edge of the mountains

have been built across this section of the State to accommodate the ever increasing automobile traffic, but these routes are few, and the outlying districts are still served by dirt roads and trails, which during the spring months are frequently too soft, too crooked, too steep, or too much washed out to afford pleasure in driving a car over them.

In May, 1927, while traveling from Lovelock, Nevada, to Jackson Creek in the Jackson Mountains and northward to the Virgin and Thousand Creek valleys, which appear southwest of Denio, Oregon, Fig. 1, the writer had an opportunity to observe closely the variable features of this remarkable desert. This exploring trip was made possible through the courtesy of Mr. J. P. Morgan of New York. In the field the writer was accompanied by Mr. Carter L. Loth of Staunton, Virginia, and Mr. John T. Reid and

Fig. 4. The rock-strewn delta and depressed narrow channel of Jackson Creek, western margin of the Jackson Mountains, Nevada. View looking northeast from the Black Rock Desert

Fig. 5. The upper course of Jackson Creek; a broad flat mountain valley containing a few stunted trees and many thousands of desert shrubs

Captain A. H. Scott of Lovelock, Nevada.

The region is of intense interest to the geologist, since it is formed of innumerable faulted crust blocks, the elevated ones constituting the north and south mountain ranges, and the depressed ones the valleys that lie between. The treeless ranges have bases from five to twenty miles wide, while the intermontane valleys are of about the same width. The elevation of the valleys above the sea is approximately 4000 feet, while that of the mountains is from 1000 to 6000 feet higher.

The uplifted and tilted earth blocks have many pronounced characters in

Fig. 6. Fault scarp along the western margin of the Sonoma Range, the development of which produced the Pleasant Valley earthquake of October 2, 1915. Photographed by P. Blanchard of Kennedy, Nevada.

Fig 7. Near view of the recent fault scarp at the base of the Sonoma Range, and a mountain stream tumbling down over it. Photographed by P. Blanchard of Kennedy, Nevada, following the Pleasant Valley earthquake of October 2, 1915

common. They show no outlying foothills, no mountain spurs or lobes passing out into the valley plains, Fig. 3, and no flat baylike valleys extending into the ranges, all of which indicates that they are not residual mountains, resulting from protracted erosion. The steeper slopes of the ranges, Fig. 3, aside from alluvial cones and sediment aprons, Figs. 3 and 4, are limited by a sinuous base line at the margin of the valley plain. Furthermore, the short mountain streams leave the ranges practically normal to the mountain front, and not longitudinally along the structure of the bed-rock as in adjusted streams. Those that leave on the steeper side of the mountain ranges often show a more youthful condition in their lower course, Fig. 4, than in their upper portions, Fig. 5. This suggests a progressive series of uplift movements along the marginal fault line in recent time. Fault scarps of recent date, Figs. 3 and 6, with vertical displacements varying from 10 to 50 or more feet can be traced along a considerable length of many of the mountain ranges as noted by the heavy black lines on the sketch map, Fig. 1.

The most recent displacement along a fault, which was also the *locii* of a severe earthquake, occurred on October 2, 1915, along the eastern margin of Pleasant Valley, Nevada, Fig. 1. Two fore-shocks and a large number of after shocks accompanied this disturbance: The first fore-shock of about 10 seconds' duration came at 3:41 P.M., the second fore-shock which lasted half a minute began at 5:49 P.M., while the principal shock occurred at 10:54 P.M., and lasted for about a minute. These shocks produced the slipping along the fault scarp noted in Figs. 6 and 7, which were taken by Mr. P. Blanchard of Kennedy, Nevada, a short time after the quake occurred. These views were forwarded to the writer by Mr. John T. Reid of Lovelock, Nevada. The sinuous fault line, which is still evident, extends for twenty-one miles along the western margin of the Sonoma range, as noted in Fig. 1. Of the twenty-five or thirty people that inhabited the region at the time no one was injured; however, several stone ranch houses and barns near the line of the fault were completely demolished. The shocks were felt within a radius of seven hundred miles of the fault.

It is reported that, following the earthquake, streams of water came into existence where there was no water before, and at other places where there were springs the water ceased to flow. Near the fault and in numerous places within a hundred miles of the disturbance a great increase of water was observed, Fig. 7. In some instances the flow has returned to normal, while in other places the larger flow still continues.

Excellent records of this severe earthquake were obtained at many of the seismograph stations in the United States and Canada. The record of the north-south component of the seismograph at the American Museum is reproduced as Fig. 8. It is interesting to note that the fore-shocks as well as the main shock are recorded. Since there is more than three hours difference in time between New York and Nevada this fact should be considered in comparing the record with the field data.

In Pleasant Valley it is reported that the principal shock lasted one minute; on the seismograph record, Fig. 8, it may be noted that the recording of the quake took slightly more than an hour. This is due to the fact that the waves set up in the earth by the disturbance are of various kinds and have different speeds and routes. The fastest waves, which take the shorter route through the earth, are recorded first. The slower waves that follow the surface of the earth are recorded later.

This earthquake along the western margin of the Sonoma range is typical of the disturbances that have arisen in comparatively recent geological time, along the numerous faults noted on Fig. 1, which occur on one side or the other of the block mountain ranges of northwestern Nevada. The pronounced fault scarps on the westerly side of the Jackson

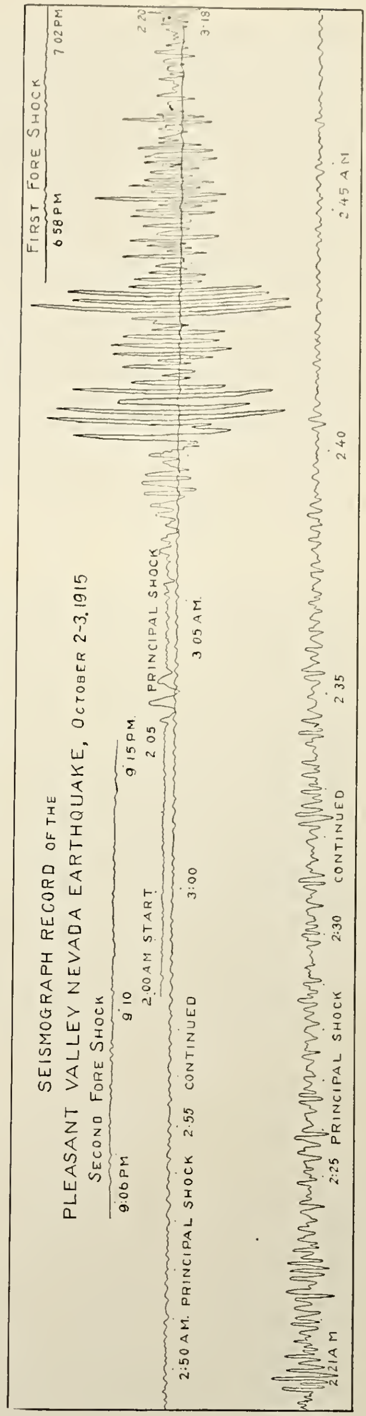


Fig. 8. Instrumental record of the Pleasant Valley, Nevada. earthquake of October 2, 1915, made by the seismograph at the American Museum of Natural History, New York

Fig. 9. A shallow mud lake, the terminus of the Thousand Creek valley of northwestern Nevada. View taken nine miles southwest of Denio, Oregon. In the foreground may be seen some desert shrubs and a huge block of lava, which has broken loose from the Pueblo Mountain escarpment, shown in Fig. 19. The northern end of the Pine Forest range appears across the lake with two low volcanic cones near the center of the picture

Fig. 10. A dried mud lake surrounding Jungo, Nevada. The sun-cracked level surface is conspicuous in the foreground; in the mid-distance a mirage, represented by the dark line in the photograph, gives a vivid impression of the vanished water; in the background the Donna Schee mountains on the left with an elevation of 5200 feet, and the Slumbering Hills on the right, with altitudes of 6400 feet, add variety to the landscape. View looking northeast from Jungo, Nevada, May 14, 1927

Mountains, Fig. 3, led the writer to enter this fault line on the map, Fig. 1.

The great valleys of northwestern Nevada are generally level-floored and most of them represent the bed of a great inland lake of Pleistocene age known as Lake Lahontan, which has disappeared for the most part. The maximum extent of this lake as traced by Russell in 1885 has been entered on the sketch map, Fig. 1. Some of the deepest depressions of such a body of water are yet marked by Walker, Humboldt, Carson, Pyramid, and Winnemucca lakes, Fig. 1, which are fed by rivers and are perennial; others, which are intermittent, are represented by sinks, mud lakes, and playas, Figs. 9 and 10. These lakes are for the most part salty or brackish and the latter group evaporate when the supply of water fails.

The largest of the mud lakes occurs in the Black Rock Desert on the western side of the Jackson Mountain Range. At times it is several hundred

Fig. 11. A near view of the white "alkali flats" of the Black Rock Desert. In May the ground was still soft and wet from the snow-fed waters of Jackson Creek and Quinn River. In the distance the Black Rock Range, some twenty miles away, is faintly outlined

Fig. 12. A. H. Scott, C. L. Loth and J. T. Reid, eating luncheon at a roadside spring on the desert eleven miles northwest of the Quinn River crossing. The waters of this spring, which are hot, with a temperature of 130°, contain a small amount of sulphur and other minerals. Chalcedony, the hard rock that appears near by, is deposited by the spring waters. In bygone days the Indians oftentimes camped for months in the vicinity of the spring for they found that the waters possessed medicinal values

miles in length and only a few inches deep. It is fed for the most part by Quinn River and its tributaries. In the spring the ground is soft and marshy; in the summer time when the waters evaporate they leave a clay bed which dries hard and, over large areas, is encrusted with saline matter of such whiteness that it dazzles the eyes of the traveler, Fig. 11. These white beds are known as "alkali flats." Sun cracks and mirages are not uncommon on the surface of these dry lake beds, Fig. 10.

On the margins and sometimes on the floor of these desert basins occur large springs, some cold and some hot, many of which are surrounded with deposits or incrustations of mineral matter, frequently chalcedony, Fig. 12.

Fig. 13. A view of Lone Mountain near Lovelock, Nevada, from the tufa deposits a mile to the northwest. Several shore line terraces developed by the receding water of former Lake Lahontan appear on the slopes of this mountain. The floor of the old lake with its sand, gravel and tufa deposits and desert vegetation appear in the foreground

Fig. 14. Numerous stacks of calcareous tufa deposited in old Lake Lahontan occupy the top of a gravelly ridge three miles northwest of Lovelock, Nevada. Algæ and bacteria secreted this material from the saline lake waters and deposited it locally as tufa

One of the various localities where the ancient shore lines of Lake Lahontan appear well preserved is on the face of Lone Mountain two miles to the west of Lovelock, Fig. 13. This mountain has an elevation of 4650 feet above the sea and 650 feet above the alluvial plain of the Humboldt River. It has a base consisting of granite and hornfels and is overlaid in turn by volcanic tuffs and rhyolite. The tuff and lava caps dip to the northeast beneath the valley floor. At an elevation of 300 feet above the surrounding plain the east face and north end of the mountain are notched with a deep wave-cut terrace and bold cliff etched by the former waters of Lake Lahontan. Due to the northeastward inclination of the volcanic rocks, the wave-cut terrace rests in part upon the granite, at the south, and in part upon the tuff and rhyolite, at the north.

A mile to the northeast of Lone Mountain numerous stacks of calcareous tufa extending northeast-southwest, stand upon a gravelly ridge, Fig. 14. As noted by the hand-level, they have approximately the same elevation as one of the wave-cut terraces on the face of Lone Mountain. One of the stacks has an eagle's nest on top of it, Fig. 15. In 1885, Russell[1] recognized three types of calcareous tufa in the Lahontan Basin: namely, the lithoid, stony and compact; the dendritic, porous and coralline; and the thinolite, crystallized and a pseudomorph after an unknown mineral. He reports that these tufa deposits appear in succession above the present level of Pyramid Lake with the lithoid at the base, succeeded by the thinolite, and the dendritic covering the two.

Recently, J. C. Jones[2] observed that the tufa deposits forming at present in the Salton Sea were being deposited locally through the activities of plant life, that is, blue-green algæ and the bacteria associated with them. He concluded that, since the Salton Sea waters, which are depositing dendritic tufa, contain ten times more calcium carbonate than Lake Pyramid waters, which contain only one-twentieth of the amount of calcium possible and are depositing only lithoid tufa, the calcium content of the lake waters is a determining factor in the type of tufa formed. He also concluded from various experiments with Pyramid Lake waters, that the thinolite was deposited as aragonite at a time when the waters of Lahontan were saturated with calcium carbonate. A fine specimen of the tufa with thinolite growths in the center, which was presented to the writer for the American Museum by Mr. Reid, appears as Fig. 16.

Fig. 15. Near view of a calcareous tufa stack with an eagle's nest on top, three miles northwest of Lovelock, Nevada. C. H. Jones, C. L. Loth, and J. T. Reid are making an inspection

Fig. 16. Top view of a globular cup-shaped mass of calcareous tufa from three miles northwest of Lovelock, Nevada. Three varieties of the tufa are shown: The lithoid on the margin, the dendritic and thinolitic within the cup. This specimen which is 15 inches in diameter was presented to the writer for the Museum collections by Mr. John T. Reid of Lovelock, Nevada

The flora of northwest Nevada is of a peculiar type, Fig. 17. With the exception of the alkali flats, no portion of the desert is devoid of vegetation. Scattered trees, such as the piñon and the juniper, appear along the mountain streams at an altitude between 5000 and 7000 feet, but they rarely reach a height of 15

[1]Russell, I. C., 1885. Monograph No. 11, U. S. Geological Survey.

[2]Jones, J. C., 1914. Publ. 193, Carnegie Inst. pp. 79–83.

Fig. 17. A desert landscape in the Jackson Mountains, Nevada. In the right foreground may be seen the more luxuriant growths of rabbit-brush on the banks of Jackson Creek; in the left foreground a hay stack of bunch grass; in the background sage brush and other kindred plants cover the slopes of the mountains and the tributary valley

feet, Fig. 5. Several varieties of poplar, alder, and willow are also found in the cañons, but these trees as a rule are of slow growth, knotty, and ill-adapted for timber. On the foothills are found phlox and lupine, and in the mountain valleys bunch grass which is valuable for grazing purposes.

The great valleys are treeless, but they are covered with desert shrubs. Greasewood (*Sarcobatus vermiculatus*), creosote bushes (*Larrea tridentata*), sage brush (*Artemesia tridentata*), rabbit-brush (*Chrysothamnus nauseosus*), shad-scale and "Humboldt tea" are the more common species.

The most striking of the various desert landscapes that were seen in northwestern Nevada were those to the southwest of Denio, Oregon, in the vicinity of the Thousand Creek valley and Virgin valley. In some places, successive flows of lava appear one above the other with such regularity that they resemble inclined stratified marine beds as in the Pueblo range, Fig. 18. In other places they form great table-lands, Fig. 19, or cap mesas, Fig. 20. The Thousand Creek valley, Fig. 19, is a depressed crust block whose southern margin is bounded by an Eocene rhyolitic lava that stands some 700 feet higher than the floor of the valley. This escarpment of Fig. 19 as well as the cliff face of the Pueblo range, Fig. 18, represent great fault scarps. The northern margin of the Thousand Creek valley is quite unlike the southern margin in that it is irregularly indented and the various lava flows appear at different elevations, the oldest at the top with the younger flows occupying old erosion channels at successively lower levels. The most striking instance of this kind is "railroad ridge" some seven miles long, which rests on a stream bed deposit about 200 feet above the present floor of the valley. Fossil bones of horses, camels, lions, and mastodons have been found in the Thousand Creek valley sediments, which according to

Fig. 18. View showing the eastwardly facing fault scarp of the Pueblo Range. The successive flows of rhyolitic lava, ash beds and tuff appear so regular that they resemble marine stratified beds. View looking west from the floor of a mud lake nine miles southwest of Denio, Oregon

Fig. 19. View looking east across the Thousand Creek valley. On the right appears an old flow of rhyolitic lava of probable Eocene age which is separated from the valley floor by a fault scarp some 700 feet in height. The tip of "railroad ridge" a more recent flow of lava appears in the left margin, while the Pine Forest range may be seen in the distance

Fig. 20. View looking south across the valleys of Beard Creek and Virgin Creek, Nevada, 28 miles southwest of Denio, Oregon. In the foreground appear the ranch house and barns of Mr. Thomas Dufurrena; in the middistance the weathered slopes of the soft Virgin Valley beds, and in the background the lava-capped mesas, which are a conspicuous feature of this volcanic region

Fig. 21. Near view of some of the opal mines in the Virgin Valley beds. The hills are barren of even the more common desert plants

Fig. 22. A large silicified tree trunk of Miocene in the Virgin Valley beds near Beard Creek, northwestern Nevada. The trunk is five feet in diameter and exposed for forty-two feet. The annual rings, which are well preserved, resemble those of the living Sequoia trees of California. From left to right Messrs. C. L. Loth, J. Lubbinga, A. H. Scott, and J. T. Reid

Dr. J. C. Merriam,[1] suggest a desert fauna of Miocene age.

Virgin Creek and Beard Creek, which form the headwaters of Thousand Creek, and lie to the south and west of the old flow of rhyolite shown in Fig. 19, have eroded deep valleys in the soft synclinally folded strata consisting of volcanic mud flows, carbonaceous sediments and volcanic ash deposits, known as the Virgin valley beds, Figs. 20 and 21. These beds contain fossil bones of horses, camels, rhinoceros, and many trunks of fossil trees, some of great size, Fig. 22. The Virgin valley beds are overlaid by extensive and horizontally disposed sheets of lava except where the streams have removed them. The yellowish volcanic muds, which buried

[1]Merriam, J. C., 1911. Bull. Dept. Geology, University of California, Vol. VI.

the great trees and animal life of this region in late Miocene time, contain many fiery opals. Some of the fossil trees contain opal, and it is due to this fact that many of the fine specimens of this petrified forest have been shattered by the prospector's sledge. Since opals crack readily with sudden changes of temperature, the better specimens, which occur as globules oftentimes as large as a man's fist, are obtained by mining below the frost line, Fig. 21.

Various portions of the Humboldt River valley, particularly to the northwest of Lovelock, Nevada, also contain fossil trees. A fine specimen which resembles a *Sequoia* was presented to the writer for the American Museum collection by Mr. George Stoker of Lovelock, Nevada.

The landscapes in the vicinity of these fossil trees of large size are barren desert wastes now, but the specimens indicate that the region has not always been so arid. The presence and great extent of Lake Lahontan, which is believed by some to have been contemporaneous with the various glacial stages of the Pleistocene epoch, suggest that the climate was formerly more humid. The extensive deposits of tufa and saline beds, are interpreted as representing periods of dessication. The variable character of the sediments, which cover the floors of the intermontane valleys and consist of alternating beds of lacustrine and fluviatile material, suggests recurrent waves of humidity and aridity. The numerous fault scarps on the margin of the mountain ranges, some of recent age, indicate that the region is being slowly uplifted. The geologic history of the Colorado River and its great cañon in southeastern Nevada, also confirm the general uplift of the Great Basin. As the region is elevated to greater heights, particularly the Sierra Nevada Mountains, which now intercept the moisture-laden clouds from the Pacific Ocean, a more extreme condition of aridity will arise. The present vegetation will then slowly disappear and the desert landscapes of northwestern Nevada will assume even a more desolate character, unless peradventure, for reasons yet unknown, a moister climate should return.

A HAZARDOUS TRAIL

Although much work has been put on these trails in time past, at present they are in bad condition, and only a Chinese load bearer would have the patience or endurance to carry heavy loads over them

Frog Hunting in Fukien, China

By CLIFFORD H. POPE
Herpetologist, Central Asiatic Expeditions

FOREWORD. Contrary to popular belief, the efforts of the Central Asiatic Expeditions are not confined to collecting fossils, but include work on recent as well as fossilized vertebrates, not from Mongolia alone but from all parts of China. Early in January, 1925, Clifford Pope returned to China to continue his work with the Expedition as assistant in zoölogy. He collected recent reptiles, amphibians, fishes, and mammals. During the latter months of 1925 and nearly all of 1926, he remained in Fukien Province, making his headquarters at Foochow.

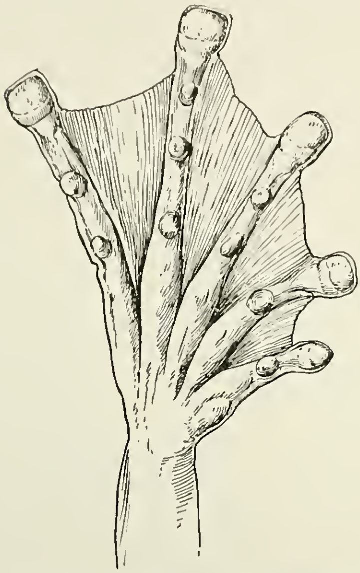
In the following article Mr. Pope tells many interesting things about the habits of Chinese frogs, and relates amusing encounters with the country people who so willingly helped him at every turn

Mr. Pope wishes to express a debt of gratitude to Mrs. Lydia A. Wilkinson of Foochow, who not only made him feel so much at ease in her home, but generously offered her spacious back yard as a place to sun and repack hundreds of smelly specimens. To Dr. and Mrs. C. G. Trimble of Yenping he also wishes to express his appreciation for all they did to facilitate his work in the Yenping district.

TWENTY varieties of Chinese frogs "pickled" and stored away in museum jars make a tragic and hopelessly homogeneous assortment. These same twenty frogs alive in the wild forests and giant bamboo groves of South China assume a most fascinating aspect.

Take for example their voices. The giant green tree frog, *Polypedates dennysi*, which measures a good ten inches with outstretched legs, has a clear, liquid flute note beautiful in quality and volume, while its smaller brown cousin, *Polypedates leucomystax*, merely clucks like a hen. The green-backed frog, *Rana graminea*, denizen of the foaming mountain torrent, sends forth a variety of notes suggestive of a lot of young birds just learning to sing. A third tree frog, an unidentified *Rana*, has a long, trilled whistle, the last few notes of which, in contrast to the jazzy beginning, are so mournful that they make one feel despondent. Why this sorrowful ending to so lively a beginning? The pygmy of the lot, a typical *Microhyla*, scarcely an inch in length, from its retreat in the high grass bordering the rice fields, produces a sound like that of a whirling rattle in the hands of an energetic child. Then there is the mystery frog, the one we failed to hear but of which we were told so much. According to the Chinese, it calls only in the tenth moon of the lunar calendar and its call is so deep and full that, at first hearing it, one is startled. Stranger still, it is said that back of each eye it has a horn. We were not fortunate enough to secure an adult individual of this species.

It is not in voice alone that these amphibians show their individuality, for each kind occupies its own particular niche in the general mountain environment. The musical notes of the great green tree frog generally come from a clump of bushes or a low tree. The little brown one has adapted itself to a condition brought about through the Chinese fondness for rice. To grow rice it is necessary to flood fields, and in order to flood mountain fields, terraces must be constructed. These terraces would not hold were they not provided with rock-work faces. In this rock-work there are countless cavities and, in the evening, issuing from these cavities, incessant clucking may be heard. Each frog selects a likely cavity and



The "sole" of the giant tree frog's webbed foot. There is often a striking likeness between the feet of semi-aquatic and aboreal frogs as both of them must cling to smooth surfaces. The diagram shows clearly not only the large cushions, one on the end of each toe, but also the smaller ones ranged along the toes. The terminal pads, or cushions, secrete a substance that keeps them from drying and thus enables them to retain a surface hardly to be called "sticky" but much like the face of a non-skid rubber friction cap

there it lives, retreating to great depths in the day, but coming to the mouth after dark. It is in the spring that the fields are flooded for the setting out of rice and it is in the spring that these frogs lay their eggs. They have only to deposit them anywhere in the grass and weeds growing on the faces of the terraces and, when the tadpoles develop sufficiently, they have but to drop into the water provided so generously below. Before the Chinese arrived on the scene with their rice culture where did these frogs live and how did they breed?

Late one cloudy afternoon, after a disappointing day, I was climbing over some great bowlders under which a rushing stream made its way down the steep, forested mountain-side. Suddenly the silence was broken by a deep, resonant sound, hard to describe but known to me as the call of the giant *Rana spinosa* so common in these shaded cascades. I was thrilled, for it had come from under the very rock on which I stood. Dropping to my knees, in an instant I had thrust my arm and hand into the cavity under the bowlder. My excitement soon reached a far higher pitch for, instead of a frog, I felt a velvety mass covering completely the bottom of the rock. It did not take long to dislodge a section of this mass. There in my hand lay three objects, each one a perfectly transparent ball the size of a marble with an object as large as a BB shot, dark at one end and light at the other, apparently floating in its center. Like three masses of jelly they rolled about, changing their shape as they moved. It was quite impossible to pick them up. The frog had literally called me to its home, thus revealing to me its life secrets, secrets never before known to science. Further examination showed that there were not only hundreds of the transparent balls hanging from the submerged surface of the bowlder, but that they were held in place by strings of elastic mucous so that the swiftest flood was powerless to wash them away. Each egg was protected by two sacks, one close-fitting, little larger than the egg itself, the other many times larger and filled with a clear fluid. How could this frog, itself but little bigger than a man's fist, be responsible for this great mass of eggs? The explanation lies in the nature of the clear protective substance, which not only has the power of adhering tenaciously to the smooth surface of wet rock and of stretching and resisting water like the best rubber, but also of swelling to enormous size upon absorbing and retaining quantities of water. The egg so delicate and fragile and yet so full of that marvelous potential energy that causes it to grow from a tiny mass of comparatively homogeneous matter into a highly complex organism, is thus protected. At certain early stages the slightest jar or pressure would destroy it, and yet the parent frog and nature work together to place it where the raging of storms, the rushing of foaming floods, heat from a tropical sun, or days of cold drizzle cannot interfere with its development.

Quickly gathering a few of the eggs, I climbed down the stream bed, soon reaching the place where it emerged from the forests of the steep mountainside to continue its course through the open, cultivated valley, now an unbroken expanse of flooded rice fields. Thus was I brought back to the realization that I was in China.

It did not take long to reach camp, which in this case happened to be a temple astonishingly perched on the steep side of our forested cañon. It would be useless to attempt to describe the scene that I looked out upon from this temple camp. I often envied the grim idols that had only to repose there, gaze out upon the forested cliffs and white waterfalls plunging into the depths of the cañon on every side, and accept food offered at regular intervals by worshippers weary from days of toiling up mountain trails. The cañon was one of the deepest I had ever seen; its

Each individual egg seen fastened to this upturned stone is enclosed in a mucous sack which adheres tenaciously to the surface of the rock, thus enabling the eggs to resist the pull of the current

Yu Fa, my star collector, hunted half a day before he turned up this stone with the eggs on it and subsequently received the reward of a fifty-cent dollar

In strong contrast to the eggs shown on page 465, these, also embedded in mucous, are attached in a mass instead of singly, illustrating another amphibian adaptation to breeding in swift water

Da da, shooter of more than a dozen tigers, is seated on the rock behind. To the left stands Young Tang, reptile and amphibian preparer. Fu Tuan, the cook, is in front at the right, while Old Tang, the taxidermist, sits next to him. Trapper Ah May squats like a Buddha

sides were almost perpendicular, their upper parts being sheer walls of rock. Lower down were forested cliffs frequented by serow, deer, leopards, and many other wild animals.

I had traveled all the way from the American Museum to China to collect animals and study their habits. A trip of five weeks' duration, beginning in luxury on the extra-fare train out of New York and ending in a tramp along a narrow stone trail leading up the cañon to this temple, had put us in the heart of a country with a fauna of great variety and special biological interest.

This interest lies in the geographical location of Fukien Province which we had picked out as our field, and which is known to the West chiefly as the home of the best Chinese teas. Situated midway between Canton and Shanghai, this region refutes the popular conception of China Proper as a flat country densely populated, for here, less than two hundred miles from the coast, is a wild mountainous district very sparsely settled. Moreover, Fukien occupies an area intermediate between tropical and temperate zones, and its fauna, therefore, contains many elements from both climes. Abundant mountains and forests help to augment this profusion of wild life and materially increase the naturalist's interest.

With an appreciation of the wonder and beauty of nature peculiar to this race of nature-worshippers, the Chinese had built this temple in a place appropriate in more than one way, for in China a wild, secluded mountain retreat is generally picked out as a suitable locality for a place of worship. This temple therefore was an ideal camping site for a collector.

Experience had taught me that one could secure large quantities of all the common reptiles and amphibians by enlisting the services of the country

Frog-catching equipment.—At one end of the rod is a little iron basket upon which pine knots are piled and lighted when the hunter is out frogging. The basket of "fat pine" is on his back. Note frog in left hand

This man was "boss" of a gang of tea pickers but he used to do collecting on the side. He is standing on a platform used for drying tea

people, who are only too glad to earn a little extra money catching snakes, lizards, and frogs everywhere so abundant. After stopping in a new locality it was only necessary to advertise for specimens. I had sent out notice and some were already being brought in. By using this method I was able to conserve my own time for special observation on the life histories of the more striking forms. Nearly every country lad has a business eye, and is not to be trifled with. A small boy, after hearing that we also wanted frog eggs, led me to a flooded field in which were many dozens. Unfortunately they turned out to be a kind already collected so I had to refuse them. After walking a few steps from the field I missed the boy and looked back to see him carefully treading the eggs in the mud one at a time! He was not going to allow himself to be fooled by any foreigner.

The temple keeper, a picturesque and decrepit old soul, seemed glad to have us as his guests even if we did use his cooking utensils as aquariums and fill his rice bowls with snakes. We learned at the time of our departure, when he followed us ten miles to ask for a larger gratuity, that his feebleness was more apparent than real. However, he did everything in his power to make us comfortable, even to repairing the bamboo water system that consisted of a trough supported so as to conduct water from a spring stream right into the temple kitchen. One day a worshipper left an enormous red candle to be burned before the largest image, and this provided light abundantly.

A few days later, I was on my knees investigating a dark cavity formed in the stream by several bowlders, when I noticed a tiny object, black save for sparse mottlings of gold. It was resting on a stone in the bottom of the shallow water. After I had laboriously drained the pool, the creature was finally coaxed into a small bottle. It turned out to be a tadpole, *Staurois ricketti,* with its abdomen strongly suggestive of the bottom of a certain type of handy bed-room lamp made to adhere by a soft-rubber sucking disc to any polished surface. This tadpole's belly was little more than a perfect miniature sucker (see sucking-disc figures page 470). It is thus enabled to stick to the rocks and resist the pull of the swiftest current. But alas! in the bottle it had a miserable time trying to apply its cup-shaped sucker to the concave surface of the glass. In a short time it was dead from exhaustion. At first there was no way of telling just what sort of a frog this tadpole would have turned into, but careful and prolonged observation finally cleared up the question. The parent frog proved to be no less well adapted to a life in the swiftest cascades than its larva, for it was not only colored and mottled like the bed-rock of the streams in which it lived, but was provided as well with large adherent discs on the ends of its fully webbed fingers and toes. Its body and head were flat, offering little resistance to the rushing water. It could insert itself in the narrowest crevice with ease. One hot day, with perspiration streaming from every pore, I gazed longingly at several of these frogs enjoying the spray of a foaming waterfall while reposing in a dark cavity of the bed rock. At the first alarm they dived into the boiling current, swam through it, and landed in safety on the opposite side. How even their powerful legs and webbed feet can carry them through such a

Looking across Kuatun Valley. There is a delicate beauty in the high groves of bamboo that the camera fails to reproduce

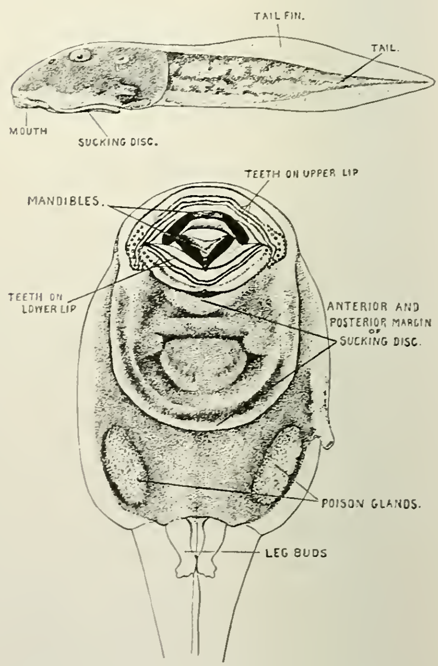
A close look will disclose a man standing among these giant bamboos and give an idea of their great girth and height

From the high, cool "lab" I looked out across a wide valley to a range of forested, grass-capped mountains. This porch is thirty feet above the very steep mountain-side below

current is a problem still to be solved.

Later in the season when these same gold-mottled, black tadpoles had become numerous in the streams, I was sitting beside a pool watching them slide about over the rocks. It was hard to see how they moved, as they are legless, but it was evident that they were either feeding on the microscopic growth and slime on the face of the rocks or simply sporting about in the clear water. I was beginning to think what a charmed life they were leading there in that peaceful, cool water, when I noticed a salamander gradually appear, sneaking out from under a rock. Though only eight inches long, it was, compared to the tiny tadpoles, a veritable monster. Slowly it advanced toward the nearest polliwog which fed on, unconscious of approaching danger. In one gulp the salamander most unceremoniously swallowed the innocent tad and deliberately directed its course toward the next.

It was in August that the frog with the mournful ending to its whistle became evident. At first its note was heard only here and there in the forest, but, after a few nights, the frequency had greatly increased. I went out with a bamboo torch to investigate and found the small creatures climbing around among the dwarf bamboos growing along the stream. Only the males were calling. At each sound a little pouch of translucent skin projected from either side of the caller's throat. Even my approach with the light did not frighten them so badly but that they would, after a short pause, begin to call again right before me. They were not to be distracted from this major business of singing their best love songs by the approach of a mere mortal. Strangely



Above.—Side view of *Staurois ricketti.*
Below.—Ventral view of same showing the sucker which enables it to stick to smooth, wet rocks, and resist the pull of the strongest currents. With the rasplike "teeth" it scrapes food from the surface of rocks

Dozens of new species of birds, mammals, reptiles, etc. have been described from Kuatun Mountain. The cross shows where our camp was located

enough, previous frequent hunts in this same place had failed to reveal a single one, but here they were at last and in great numbers. By the third night the valley fairly rang with their incessant calling. Obviously they were gathering along the banks of the stream for their mating season; they had come to deposit their eggs in the swift stream. At this point observation was interrupted for two days; and on the third night, when I went out to continue work on them, not a whistle could I hear, nor could I find a trace of the myriads that had, only two nights before, filled the valley with their notes. They had disappeared more mysteriously and suddenly than they had come. Where had they gone? Up to the time of their breeding not a single one had been seen by us or brought in by the country people, and afterward quite as diligent searching failed to reveal one. The stream undoubtedly contained countless thousands of eggs but they were even more securely hidden than their depositors.

The old temple keeper proved himself to be something of a naturalist even though we could not accept all his theories and explanations. A small deer was brought in one day and he explained to us how that special variety sometimes gave birth at one time to no less than three different animals,—serow, goral, and muntjac. This belief might be styled the mutation theory par excellence. How rapid would the progress of evolution be if this were true! On another occasion he ran in to tell of an encounter he had just had with a tiger. The beast, evidently not a man-eater and more probably a leopard, upon seeing him wave his hands and hearing him shout, had sneaked off into the jungle and spared our naturalist to tell the tale.

It was on the day of our arrival that he had established his reputation as a true naturalist among us. Balls of

My headquarters for four months, thanks to the hospitality of its owners. The windows of the "lab" may be seen just under the eaves on the extreme left

"Salamander Mountain" seen across the roof of one of my temporary "labs." Note weights that keep the bark roof from being blown away

The trusses of this bridge are built upon a plan which is universal in Chinese architecture. Highly specialized cascade frogs abound in the stream beneath

Rare high-altitude frogs bred in this terraced rice field just baek of our headquarters. The primitive yoke and plough shown is in common use in Fukien

white were hanging from a bush over the temple spring. They looked like Christmas decorations but close examination showed them to be composed of a light, frothy substance of the consistency of well-beaten white of egg, the froth containing in its turn hundreds of tiny white spheres. Each ball was pear-shaped and as large as two fists. Our naturalist confidently proclaimed them to be frog spawn, and before long, thanks to the incessant rain, we had ample opportunity to test the truthfulness of his contention.

One day at dusk a giant tree frog, one of our first specimens, began to call from a bucket in which we had confined it. Soon it was answered from the depths of the rain-soaked bamboo forest. More calls and more answers followed until the drenched mountain-side seemed to be taking on a new form of life. The answers not only increased in number but in volume as well, so we knew that our captive frog was starting a general gathering. We peeped out from the concealment of the temple doors and waited silently for many minutes. As the darkness fell our eyes became accustomed to the fading light and now and then we could just make out forms approaching by great leaps from every direction. These giants of the

The giant green tree frog (*Polypedates dennysi*) of Fukien lays its eggs in a rubbery, sticky mass of froth which it hangs from bushes over water. Such masses are shown just above the central line of this picture

frog world can advance several yards at a bound and now they were obviously gathering around the spring. It was a rare concert that we were hearing. Soon we cautiously stepped from the temple and slowly approached the small tree growing over the bush. Flashes from our light revealed a mass of frogs climbing over one another while clinging to a branch of the bush already bent down low over the spring by their weight. This plainly enough was their spring mating rendezvous, but there was one question that puzzled us: how could one frog lay such a large mass of frothy material as our informant maintained they did? Careful use of the flashlight there in the pouring rain,—how these slimy creatures revelled in the abundance of this element that made us complain so violently— answered the question, for it was seen that the female, while laying the eggs and clinging to the leaves with her forelimbs, used her hind feet to beat into a froth the egg-containing mucus as it came from her body. On the following morning the additional decorations hanging from this bush improved its appearance considerably.

We carefully studied the development of the eggs and also put numbers of them from one batch into fixing solution at regular intervals. At the end of the first week the tiny eggs had changed in form and assumed the form of polliwogs. The froth gradually liquefied and allowed the immature larvæ to wriggle their way downward until they finally dropped into the spring below.

THE SPIRIT OF THE TROPICS

The sudden squall with fickle winds and drenching rain has passed, the beach and the forest are quiet; soon the rushing muddy water in the foreground will have been lost in the sea; then in its place will be a quiet brook, and the coming night will find all serene and clear

Light and Darkness in a Tropical Forest[1]

By H. C. RAVEN
Associate Curator, Comparative and Human Anatomy, American Museum

THE forest of Borneo suddenly resounds to a series of clear, shrill notes, "wat-wat-wat-wat." The watwats (the Malay name for gibbons) are calling, for they have detected the approaching dawn, and when the light spreads across the sky, they begin feeding on fruit and buds as they leap and squat and walk like man in the billowy tops of the largest trees. Meanwhile another high-pitched voice can be heard, certainly for more than a mile, calling "a-r-u-w-a-y"—"a-r-u-w-a-y." This is the aruway as the Malays call the argus pheasant. No one can see as yet his marvellous wings with their thousand eyes but, like his barnyard cousins, he heralds the coming of the dawn and then starts to seek his food on the damp leaves of the forest floor.

As if aroused by these restless ones, gaudy colored fruit pigeons, doves, and raucous-voiced hornbills take to the air. A variety of sounds, mostly the voices of birds, follows closely the spread of light from the eastern sky. Monkeys sway the otherwise motionless leaves as they follow one another, leaping from tree to tree. Giant squirrels three feet long calling "pert-pert-pert" with a whistling tone might easily be mistaken for birds, and pigmy squirrels with bodies not as large as my thumb creep like tiny parasites upon the liana-girdled boles of forest giants. Too numerous to mention are the myriads of peeping, whistling, booming, buzzing animals that are to be heard during the two hours following sunrise, and, besides, there are those quiet ones, such as the great white butterflies which float so silently beneath the leafy canopy, seeming to flutter only when struck by an occasional sunbeam.

The heat of the sun soon has its effect upon the life of the jungle, the animals become more quiet. They appear to have expended the surplus energy gained through a night of rest. For a time the forest, except for the buzzing of a few insects, is limp and still; then as the sun climbs higher, air drifts in from the coast. Frequently the breeze is hardly perceptible at first, for it has scarce force enough to warp long strands of spiders' webs hanging from the forest roof. It gradually increases, causing leaves to swing back and forth and the rattans to shimmer in the sunlight.

Through the later morning hours, midday, and early afternoon, when the sea breezes are gently drifting through the forest and the rays of the sun suck moisture from the great green sponge, the animals remain quiet except for sudden shrieks following the crash and boom of some great tree that for no apparent reason topples over.

When the sun begins to sink, the birds and other day-loving animals of the jungle again become active, as if they realized there would be but a short time in which to search for food before dark, although their afternoon activities are not quite so pronounced as those of the morning.

Sunset finds beautiful pittas whistling softly from the glens of deepest shadow, nutmeg pigeons with bulging

[1]The observations and photographs contained in this article were made during six years spent by Mr. Raven collecting in the East Indies for the United States National Museum.

crops leaving fruit trees to seek roosting places with others of their kind, and huge black and white hornbills flapping and soaring on humming[1] wings back

The watwat (gibbon) of Borneo is found in most localities where the virgin forest is undisturbed, and its clear shrill notes resound with freshness and vigor during the early morning hours and at dusk. The young watwat, like the young of the other anthropoid apes, makes a quiet, lovable, and intelligent pet

to the trees of their choice. Monkeys of many kinds in groups are gathering along the river banks to spend the night in the tops of trees overhanging the water. The calls of the aruway and the watwat compete with the almost deafening hum of countless cicadas.

Twenty minutes after sunset the light of day has gone, and the stars give barely light enough to detect the shadowy forms of huge fruit-bats, whose wing spread measures five feet or more, as they fly across the river level with the tops of the trees, or the smaller insectivorous bats that dip and dodge within a few feet of the water. The buzzing and humming of insects sounds like the beating of the surf on a distant shore. Above the noise of the insects may be heard the plaintive notes of the night hawk and the lonely call of a little owl. Occasionally the whirr of the wings of "Rajah-wali," that rare nocturnal hawk which catches bats on the wing, may be heard over the river as it plunges downward in pursuit of its prey.

It was perhaps two hours after dark that we heard a shrill "pow," the sound made by the sambur deer when alarmed. A few minutes later, equipped for jacking, Tambielawang and I stepped from the prahu to the canoe and then ashore. We walked silently along the beach toward the mangroves, keeping close up under the trees for the tide was high. I continually played the light about trying to see what there was. We were quite close to the scattered mangroves when I saw the reflection from two pairs of deer's eyes, which were easily recognized by their pale yellow color, like the flame of an oil lamp.

The reflection of the eyes of nearly all nocturnal animals can easily be seen with the light, and the different kinds show considerable variation. The eyes of insects, such as moths and butterflies, reflect a pink or reddish light, as do those of spiders, crawfishes, and fishes. Besides deer, the muntjacs and little mouse-deer (*Tragulus*) also reflect an even yellow light. The wild pigs reflect a pinkish light that is rather weak and always looks small. The banteng, water-buffalo, and many

[1]The vibrations of the wing feathers make a peculiar noise when the bird is in flight, both when soaring and when flapping the wings.

A small wild cat of Borneo, *Felis bengalensis*, with colors like those of the Bengal tiger but a color pattern peculiar to itself, is about the size of a house cat but of slightly different proportions

kinds of antelopes give a bright reflection, very pale yellowish or greenish in color, sometimes almost white.

Both deer were in water a foot or more deep. Keeping the light directed at them, I walked close to the mangroves where the sandy beach ended. We saw tracks in the sand where the samburs, both does, had come out of the forest. They looked toward the light for a few moments and then turned and walked along through the salt water, lowering their heads occasionally as though they were drinking. On several occasions I found sambur deer either in salt water or walking along the beaches near it, and I was interested to see if they drank the sea water. In attempting to follow these deer I accidentally made a noise when pulling my foot out of the mud; that frightened them, and they bounded away in the darkness.

We tried to get between and over the arched mangrove roots and through the mud, but this was slow, so we went inland through the forest, hoping to find more sandy beach beyond the mangroves, along which it would be easy to walk. When we reached the forest, we found lots of rattans and other vegetation blocking our way. For a few yards I pushed my way along, under vines and over logs, as I

One of the commonest poisonous snakes of Borneo and Celebes is the green pit viper (*Trimeresurus*). It is a handsome animal with the general form of a rattlesnake, bright green in color intermixed with a pattern of chalky-white and yellow, and with a brown tail

THE APPROACHING NIGHT

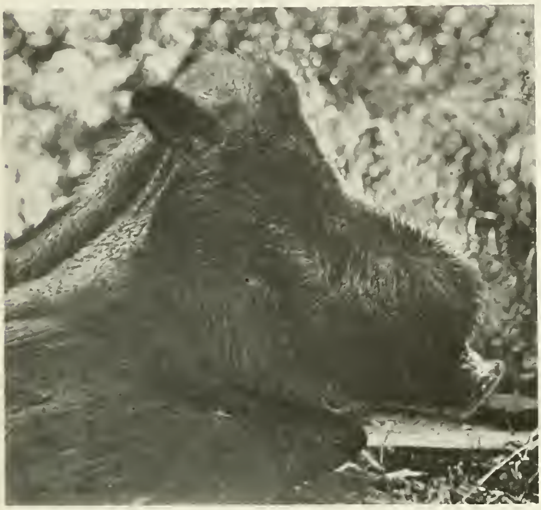
In the East Indies it is characteristic of the monkeys to spend the nights perched in the upper branches of trees overhanging the river banks. In the center of this picture is a group of three silky black langurs or "lutong," as they are called by the Malays did not wish to risk making a noise by cutting with my machette. Finally, however, I stopped to get out the machette and pull a few thorns out of my arm. As I stood holding the light about waist high, Tambielawang suddenly exclaimed: "Djaga tuan! Ular tadung!" (Look out, Mister—a poisonous snake!) and, sure enough, right there, not more than two feet from me was a small green pit-viper, repeatedly and viciously striking at the light, its brown tail tightly coiled around the stem of a rattan. After watching the snake for a few moments I knocked it down on the ground, tied a little stick along its neck, so that it could not strike, and then Tambielawang carried it dangling from a piece of string.

We did not find a way through to any more sandy beach, but on the bank of a little brook that emptied into the mangrove swamp we saw a beautiful cat, *Felis bengalensis*, about the size of a house cat. Its tail was slightly shorter than that of a house cat and its fur was the same color as that of the tiger from which it gets its name, orange-yellow and black above and whitish below and on the sides of the face. It sat on its haunches on the bank of the stream as we approached, looking just as quiet and peaceful as any domestic animal on a farm.

Nearly three hours after leaving the prahu we returned, deposited our specimens, and crossed to the beach on the other side of the river. When we neared the nipa palms I saw the reflection of an eye that glowed red like an ember and near it, but a little higher, a couple of eyes that looked pale pink. We walked very cautiously, frequently stopping and turning the light aside; for some animals, though apparently not alarmed by the light seem to dislike it, and if it is constantly directed at them, they turn their heads away and cannot be seen. When we were within fifteen or twenty yards, I could see the outlines of the animals. The eye with the red reflection was that of a crocodile just at the water's edge. Its lower jaw rested on the mud and its huge mouth was wide open, its body partly submerged in the water. Not more than fifteen feet from the crocodile's mouth were two wild pigs, one an old boar with a heavy bristly beard on his face and jowls; the other less hairy one was a female. Here was a thrilling scene. It was very evident that the crocodile was simply waiting for the pigs to come within reach, when it would grab one of them and try to pull it into the water, where it could be drowned. We stopped walking and watched as the pigs continued to root about in the mud beside the nipa palms. Occasionally, as one of them raised its snout from the mud, it gave a slight grunt or an audible sniff, but made no loud noises. They moved about, sometimes being thirty feet from the crocodile, and once or twice they seemed not more than eight or ten feet from the gaping jaws, and it looked as if they might back right into the waiting trap. We expected to see the crocodile spring forward but it remained absolutely motionless.

We had been watching for perhaps fifteen minutes when the pigs suddenly turned in our direction and sniffed. Then for a few seconds they were perfectly still, except for the end of the snout. Finally their tails and the bristles on the boar's back stood up and we knew they had scented us. With a prolonged "um-um-um-um" they trotted back into the forest. In my collection I had several boars so I used this opportunity to add this large female. As we turned our attention again to the crocodile, it closed its mouth, turned, and started to swim away when disturbed by our voices. The noise of the gun, in this case, did not appear to have frightened it.

followed as quietly as possible, playing the light in all directions. Fortunately we were able to catch sight of the porcupine again and add it to our collection. It was a large specimen, some of its black and white quills being



The wild boars of Borneo are long-faced swine with warty growths on each side of the face. The warts are covered with long, very coarse bristles. The photographs show front and side views of the head of a large specimen

For some time we walked through the forest without hearing anything but the melancholy call of a little owl and the swish of leaves as a branch sprung upward, released by some fruit-bat starting its flight by simply falling into the air. We followed the trails made by deer and pigs, for I learned that this was the quietest way, and that many other animals besides deer and pigs used these runways. We halted upon hearing a slight noise, then continued more cautiously than ever. I caught the reflection of the eye of a mouse-deer which I presently secured. The report of the gun startled a big porcupine that was apparently feeding near by. The porcupine rustled its bristles and thumped on the ground with its hind foot as it ran away. We

about eighteen inches long and nearly as large around as an ordinary pencil. Tambielawang carried the mouse-deer and the porcupine, while I carried the light and the gun.

It was not more than two hours from the time we left the beach where I had killed the pig until we returned. As we approached the place where the carcass lay, we heard some animal running away. Upon reaching the carcass, I was surprised and disgusted to find that a pig, perhaps the boar we had seen earlier in the evening, had been there and had partly eaten the body of the female. Usually we found it safe to leave the carcass of an animal in the forest until early morning, but as a rule we covered it with boughs.

Night had more than half gone and

the tide was dead low when we stepped back on the prahu. I awakened the Malays and asked them what had become of the little green viper which we had left on the floor. No one knew. It was alive, and had squirmed free of the stick I had tied to its neck. We did not like the idea of its being loose somewhere in the boat, so we spent some time in taking up the floor boards, moving things about, and finally locating it, way forward, under a pile of firewood.

Just as I boarded the prahu I thought I saw the eye of a crocodile about fifty yards up stream from where we were anchored. Now standing on the cabin top, I took a good look and saw the tiny red glow. I told Tambielawang and Boega what I saw, and also told them we would go upstream after crocodiles in the canoe and that Tambielawang could harpoon while I held the light and Boega paddled the canoe.

The crocodile we had seen from the boat disappeared, so we continued quietly upstream. Boega squatted in the stern, Tambielawang sat close behind me in the bow; he paddled too. In many places the trees arched together high above the river. Everywhere the banks were sloping, slimy, muddy, blackish. The narrow dugout moved as silently as the river flowed, and the paddles were seldom lifted out of the water, so there was not often even the slight sound of dripping water. I saw the eyes of several crocodiles; most of them were small and all drew down backward under water when we approached within four or five feet of them. The river wound back and forth through flat terrain and just as we rounded a bend I saw the eye of a crocodile which was out of water.

When the eye is nearly on the level of the water, the reflection at a distance appears double or elliptical, for the reflection in the water is also seen, but when the eye is six inches above water, the reflection and the eye will appear to be a foot apart.

I directed the light at the eye while holding the lamp with my left hand and with my right pointed at the animal in an attempt to make Tambielawang see it. Meanwhile the canoe continued forward slowly and I could make out a small mud flat extending out from the slimy bank. I was within fifty feet of the eye when I realized that what I had taken to be a log on the mud flat was in reality the body of the crocodile, a much larger one than I had anticipated. Tambielawang stood up behind me with the harpoon and was arranging the line, but Boega who of course could not as yet see the animal, continued to send the canoe forward. It was but a few moments from the time I could see the body of the crocodile until we were uncomfortably close to it. Tambielawang did not throw the harpoon, so I whispered to Boega "Mundur" (back up). At the sound of my voice the big crocodile turned its head toward the water and raised one of its fore feet to take a

The mouse-deer (*Tragulus*) is a tiny deer-like animal without antlers, but the males are provided with sharp recurved canines. During my nightly wanderings in the great forests of Borneo, I frequently found them lying down, chewing their cud after having fed upon fallen fruit and the tender leaves growing close to the ground

Above.—My prahu, the "Bintang Kumala," built by Moros on one of the little islands off the east coast of Borneo, served to transport me and my Malay companions for hundreds of miles along the coast and up the rivers. At sea we used a large oblong sail on bamboo spars while on the rivers we rowed and poled.

Below.—The dugout canoe of the Malays and Dyaks of Borneo is a craft ideally suited to streams and rivers of that low lying forested country. It was a canoe of this type that we used in our frequent excursions along the rivers at night

step. By this time I had raised my shotgun to my shoulder and fired at the animal's neck and shoulder. Almost simultaneously with the discharge of the gun Tambielawang threw the harpoon. The crocodile thrashed about on the mud for a moment and then lay still.

When the animal began to thrash about, we quickly got the canoe out of

A human habitation where the the jungle has been replaced by fruit trees. Bread-fruit in the foreground, bananas to the left, dense mangoes behind two slender coconut palms, and to the right of them, two sugar palms

the way, close to the bank on the other side of the river. After it quieted down we paddled over and picked up the harpoon pole. The head of the harpoon was firmly fastened in the thick skin of the animal's neck. After waiting a few minutes more while the crocodile remained perfectly still, Tambielawang pulled on the harpoon line; the animal did not move, it was apparently dead. We grew bolder and ran the canoe up on the mud flat within a few feet of it. I was still squatting cross-legged in the bow of the canoe, holding the light in one hand and the gun in the other. We had a couple of two-tined fish spears with us, so I told Tambielawang to prod it, but though he prodded hard enough to shake the great body it showed no sign of life. I then told him to step out on the mud, take the animal by the tail and pull it around so that we could slide it into the water. He answered "Saia takut tuan, barangkali dia bulum mati" (I am afraid, Mister, perhaps it is not yet dead). I then took the fish spear and prodded it saying. "Tentu sudah mati" (Certainly, it's dead), but he simply repeated "Saia takut." With that I handed him the light and stepped off into the slimy black mud.

The mud came half way to my knees and I nearly lost my balance at each step, but about half a dozen steps brought me to the side of the animal. A few more steps and I could reach the tail. To steady myself I touched the animal's back with my hand—it was as if I had received an electric shock—it moved, its jaws sprang open and it flung its great head toward me and snapped the jaws shut just behind me. Its tail also curved round toward me. Then, for a moment that seemed an age, the light was turned away and I was left in utter darkness. Tambielawang and Boega had shoved the canoe off and were already near the far bank. I called to them and told them to keep the light directed my way, and eventually I got them to come nearer.

The crocodile made just the one quick move and then lay still, but I expected to be grabbed at any moment. Some branches that almost reached the water at high tide hung out over the mud flat. By walking a few feet I managed to reach up and catch these branches and pull myself up the bank to safety. We all worked up stream a few yards beyond the mud, and there they passed my gun up to me. There was but one cartridge left, but with it I failed to kill the crocodile. It seemed to be paralyzed so that it could not go forward but thrashed about in a most terrifying way.

Tambielawang speared it with the fish spears but it only thrashed about, breaking the bamboo shafts, and becoming entirely tangled in the harpoon line. Finally we cut long saplings with which we succeeded in pushing the animal into the water, where we could tow it behind the canoe with the harpoon line. Twice while going down stream it thrashed for a few moments, then again acted as if it were dead.

When we reached the prahu, the boy on board had a rope ready with a noose. We guided the crocodile right into this noose and drew it tight about its neck. Then all hands took hold and we pulled our specimen out on the sandy beach.

The air was damp and cool, all the vegetation round about was laden with dew, and there was a slight mist as we stood on the little beach. The light of the lamp was growing dim, the oil was nearly finished. One of the Malays yawned; the rest of us yawned; then we all climbed back on the prahu and, just as I lay down on my rattan mat, we heard the watwats call—it was "dini-hari" (the dawn of day).

A view of the Segah River in the interior of Dutch Borneo. To reach this spot required paddling and poling the prahu for fourteen days beyond the last Malay hut

How the Cassowary (*Casuarius bennettii*) Goes A-fishing

By E. W. GUDGER
Bibliographer and Associate in Ichthyology, American Museum

When one recalls that the cassowary is a huge bird belonging to the family Struthionidae—birds with rudimentary wings—of which the best known member is the ostrich, one instinctively recalls that the ostrich inhabits the desert regions of the Sudan, the Sahara, and the Kalahari. Hence the generalization is apt to be made that the cassowary also is a desert dweller. This is fairly true of the Australian cassowary which inhabits the Cape York section of the island-continent. However, the other members of the genus dwell in Papua or New Guinea, and the islands to the east of it, and in the easterly islands of the East Indies—the Moluccas. These islands all have a fairly heavy rainfall, and here in their large forests or in the grassy plains between them live the cassowaries, alone or in couples, but as a general rule not in flocks.

Now the most interesting things to be learned by the average person about any animal are its habits; how it gets its food, how it avoids being converted into food by other animals, and how it perpetuates its kind. And these things are particularly interesting about animals from far away countries, such as the bird under consideration, which we ordinarily know from books only or, at best, from mounted specimens in museums.

As to the food of the cassowary, it is to be feared that the knowledge of most persons, like that of the present writer before he began to collect notes on this bird, is confined to the famous rhyme (with which I have taken some liberties):

> 'Twas a bold bad cassowary,
> On the plains of Timbuctoo,
> Sinfully ate a missionary,
> Body, boots, and hymn book too.

As a matter of fact, the cassowary, like the ostrich and the Struthiones generally, is omnivorous (but not to the extent indicated above). In the wild state it feeds chiefly on fruits and nuts, but, according to the authorities, it likewise greedily devours animal food and will feed on mice, lizards, frogs, fishes, crustaceans, insects, etc. Tame cassowaries have been known also to swallow bones, whetstones, corks, nails, fruit stones, and raw potatoes, all of which were passed through the digestive tract unchanged. In fact, the excrements of the wild birds are so copious and heterogeneous that they have often been mistaken for those of some large mammal. In captivity these birds are ordinarily fed on soaked bread, cooked potatoes, scraps of meat, fruit, etc.

But most of us are so obsessed with the idea that all struthious birds are dry (very dry) land dwellers that we find it hard to believe they would go into the water, much less get their food out of it. Yet Salvadori[1] tells us that cassowaries frequent parts close to streams and that they even enter the water to bathe. More specifically Ramsay[2] writes of the Australian cassowary, that:

[1]Salvadori, Tomasso, Monografia dell gen. *Casuarius*, Briss. *Memorie Reale Accademia Scienze Torino*, 1883, 2. ser. tomo 34, pp. 175 and 191.

[2]Ramsay, E. P., On the Habits of the Australian Cassowary, *Casuarius australis*. *Proceedings Zoölogical Society of London*, 1876, p. 121.

At all times I have noticed that they are very fond of bathing. The semi-adult bird . . . was remarkable in this respect and might frequently be seen waiting at the pump in the yard until some one came for water, when he would sit quietly under a copious shower, stretching out his neck and ruffling up his feathers to allow the water to reach the skin.

George Bennett[3] kept as pets four specimens of the mooruk (*Casuarius bennettii*) from the island of New Britain. Of their habits and behavior he has given most interesting accounts which are well worth looking up *in extenso* by the interested reader. These mooruks came from a particular section in New Britain. Herein is reproduced Bennett's drawing of the island group of which he says.

The mooruk (*Casuarius bennettii*) of New Britain, Western Pacific. After Bennett

The chart will show the position of the island [of New Britain] and the small figure of the bird marks the place from whence it was procured.

He was informed by the captain of the trading schooner from whom he got the birds that they had been sold to him by the natives, who declared that they are captured soon after they are hatched and are reared by hand. The words "mooruk" and "morroop" are the native names of Bennett's cassowary and are supposed to be a reproduction of the sounds made by the birds, but Bennett never heard his pets give utterance to such sounds, or any remotely approaching them.

In 1858 Bennett got two young specimens of *C. bennettii* from the sea captain referred to, who had had them on board his trading schooner for eight months. They were very tame and became very amusing if sometimes obstreperous pets. With regard to their habits leading to the matter under consideration, Bennett states that they were fond of ruffling out all their feathers and spreading their diminutive wings; that their skins were white and their feathers always clean and smooth. While they ordinarily sought shelter from rain, on hot days in December they liked to have buckets of water thrown on them and to roll about in pools of water. On occasion they would go out in a shower and evidently enjoyed it, but when they left the water they would shake their feathers as a dog does his fur, and would always keep their plumage clean and shining.

Furthermore, the cassowaries can and will swim, and swim well—a most surprising thing when one examines

[3]Bennett, George, Notes on the "Mooruk" (*Casuarius bennettii*). *Proceedings Zoölogical Society of London*, 1859. pp. 32–34.—Gatherings of a Naturalist in Australia. London, 1860. Chapter XI. The Mooruk or Cassowary of New Britain, South Pacific Ocean. pp. 243–264, colored plate, text-fig. on p. 248.

their feet, organs plainly intended for scratching and for running. Beccari[1] speaking apparently of the cassowary of Ceram (*C. galeatus*), of which he carried several specimens about with him on his journeys, says:

> Cassowaries like water very much, and, during the time mine were on board, they often dove of their own accord into the sea during the hot part of the day, but they did not go far from the schooner.

This must be taken to mean that they swam around the vessel. Ramsay (1876), writing of *C. australis*, says, "I found the cassowaries to be excellent swimmers," and he quotes an inspector of police in north Queensland that he had found one swimming across a river of considerable width.

But the reader is asking, "What evidence is there that the cassowary catches the fishes which it is alleged to eat?" My answer is to produce two witnesses and let them speak for themselves. The first is the well known traveler and collector, O. Beccari, who has already been quoted and who writes:

> Hunters have told me that the cassowary of Ceram [*C. galeatus*] often goes into the ocean and squats down in places where the water is not very deep, among corals where there are many small fishes, crustaceans, etc. When it returns to the shore, it shakes its feathers and all the small marine animals that have stuck to and among these then become its prey.

"But," says the reader, "this is merely hearsay evidence, and has no scientific value." True, but it is of corroboratory value when taken in connection with the next citation which is the first-hand observation

[1]Beccari, O., Lettera Ornitologica Intorno agli Uccelli Osservati Durante un Recente Viaggio alla Nuova Guinea. *Annali Museo Civico Storia Naturale*, Genova, 1875, vol. 7, pp. 718–719.

Chart of New Britain. The small sketch of the bird shows where it was taken. After Bennett of a scientific man, Wilfred Powell.[1] He had been told that the morroop was very fond of fish but no statement was made as to how the bird caught the fishes. However, one day he saw with his own eyes the whole performance, and here is his description of it.

> I was one day some little distance up a river in New Britain, sitting in my little dingey fishing (the boat and myself being partly hidden by bushes); I saw a Morroop (Cassowary) come down to the water's edge and stand for some minutes apparently watching the water carefully; it then stepped into the river where the water was about three feet deep, and, partially squatting down, spread its wings out, submerging them, the feathers being spread and ruffled. The bird remained perfectly motionless; I also noticed that the eyes were closed as if asleep. It remained in this position for fully a quarter of an hour, when suddenly closing its wings and straightening its feathers, it stepped out on to the bank, where, shaking itself several times a number of small fishes fell from under its wings and from amidst the feathers, which were immediately picked up and swallowed. The fishes had evidently mistaken the feathers for a description of weed that grows in the water along the banks of the rivers in this island, and very much resembles the feathers of the Cassowary, and in which the smaller fish hide to avoid the larger ones that prey on them.

The same account is found *verbatim* in Mr. Powell's book, *Wanderings in a Wild Country.* Mr. Powell was a Fellow of the Royal Geographical Society; he spent three years among the people of whom he writes, and his account of the morroop was published by the Zoological Society of London. I have read his book and find that it tallies in general data about the animals with what one finds in other works dealing with the islands of this region. The explanation as to why the fishes take refuge under the wings and amid the feathers of the cassowary is one which will appeal to all who know anything of the habits of fishes. These habits of hiding are so well known to the native inhabitants of various parts of the western Pacific, that they suspend in the water bunches of grass and leaves and then presently surround these with their nets, confident of making catches of the fishes which will seek shelter under them. As for myself, I see no reason to doubt Powell's account and I give it my full credence.

[1]Powell, Wilfred. Field Notes on the Morroop (*Casuarius bennettii*) of New Britain. *Proceedings Zoölogical Society of London*, 1880, pp. 493–495.—Wanderings in a Wild Country, or Three Years amongst the Cannibals of New Britain. London, 1883. Appendix, pp. 270–274.

Drawn by W. E. Belanske under the supervision of Doctor Gudger, to show their conception of how the cassowary does his fishing

Merin's boy playing his fiddle at Tsagan Nor. Photograph reproduced by courtesy of the Central Asiatic Expedition

Two Mongolian Folk Songs[1]

By L. B. ROBERTS

Topographer of the Central Asiatic Expeditions

THE Mongols were singing again tonight, in a minor cadence, with constant repetition.

I asked Buckshot and Dalai Badajapoff to go with me to Merin's tent; for I felt that with these two as interpreters, I could arrive at a reasonable understanding of their songs. I recognized the tunes as the ones they have sung ever since they joined us at Shabarakh Usu. Sometimes they sing these for two or three hours steadily.

Merin's tent is larger than the average, about fourteen feet long, blue in color with good-luck symbols in clever scrolls worked into the sides with white cloth. Ten Mongol camel drivers call it home, as they eat and sleep there; they use no cots but spread their layer of felt on the ground, put their sheepskins at the edge of the tent for a wind break, and manage very well.

Merin, as chief of the caravan, had his usual seat of honor in the group, on

[1]An extract from the note book kept by Mr. Roberts while in the Gobi Desert during 1925.

WAR SONG

LOVE SONG

There was a wanderer,
Who wandered here and wandered there;
His helmet it was on his head,
It was upon his head. And

From the mountain he could see,
His native land, his native land,
And as he left his native land,
Each cheek it had a tear. And

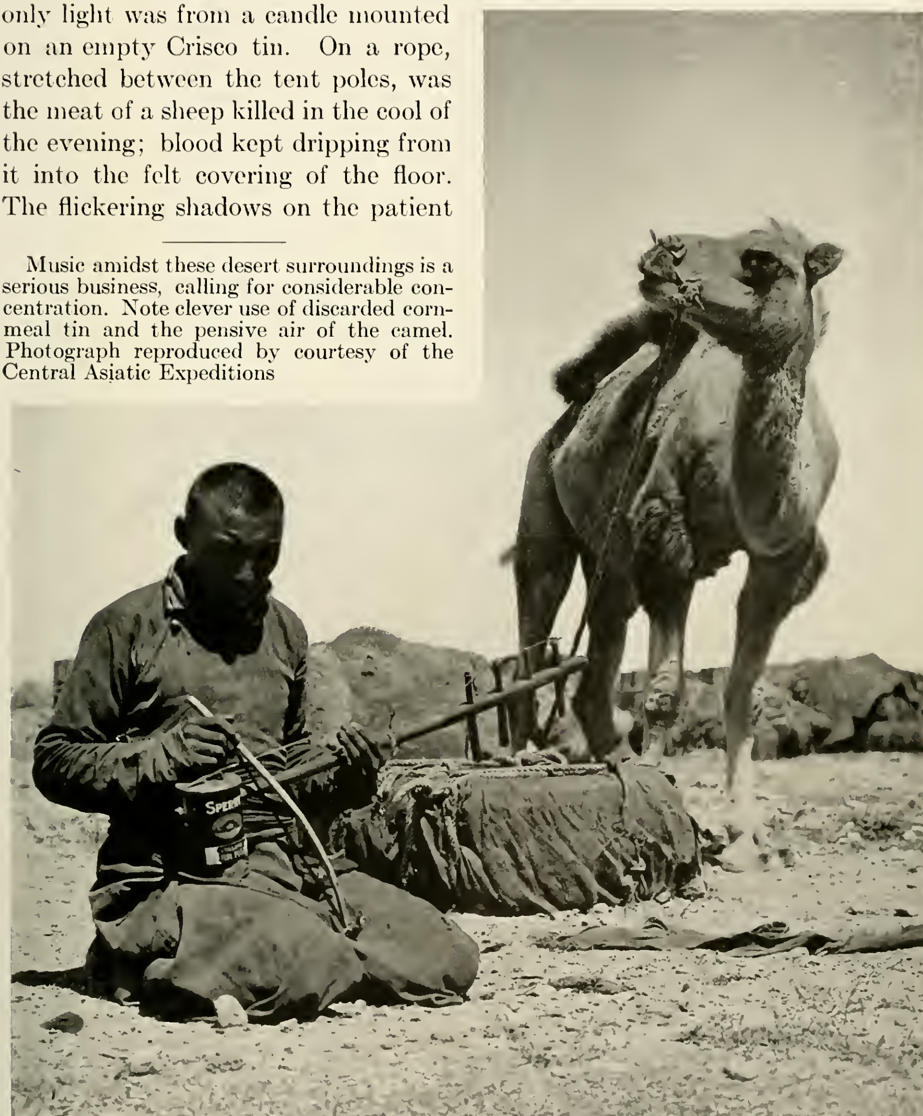
As he looked from the mountain,
He saw a foreign land, saw a foreign land
And as he went into this land,
His sleeves were wet with tears. But

Always on his wanderings,
As he wandered here and wandered there,
He thought of wife and native land,
Of wife and native land.

a prayer rug which came from Tibet. With rare and quiet courtesy he asked me to sit in his place. The food, a terrible mixture, was being boiled in a big, open kettle at the entrance. The smoke, acrid and hard on the eyes, from the argol fire, filled the tent with weaving eddies; the interior was black and plenty dirty.

The wind was blowing hard outside, blowing sand against the tent; our only light was from a candle mounted on an empty Crisco tin. On a rope, stretched between the tent poles, was the meat of a sheep killed in the cool of the evening; blood kept dripping from it into the felt covering of the floor. The flickering shadows on the patient faces of the Mongols gave me a decided impression of primitive strength which seemed to harmonize with our surroundings. It is remarkable how these men resemble our Indians at home; I've seen some in Oklahoma and Arizona who might be blood brothers to them.

Merin is getting along in years; he must be at least sixty, I'm told, and his



Music amidst these desert surroundings is a serious business, calling for considerable concentration. Note clever use of discarded cornmeal tin and the pensive air of the camel. Photograph reproduced by courtesy of the Central Asiatic Expeditions face is lined and seamed from dealing, for so long a time, with weather and with men. As a rule he is very sober-minded, but he entered into the spirit of the occasion, and he, too, sang for me. All of these men have passed through bloody times.

Two of them played the instruments —one had a fiddle, the other a sort of guitar. They were rare instruments, and it seemed to me that it was a most remarkable thing that any tune whatever could be obtained from them. The guitar was held together with wire and string and yet it stood the strain quite well. The belly of the fiddle was a large corn meal tin; it had four strings and the method of producing different tones was peculiar, for the bow was slipped between the strings and the scale run by pressing the bow first against one string by a downward movement for one note and by an outward pressure against one of the other strings for the next note. The faces of the players showed absolutely no emotion—they played the monotonous strains over and over without a change of facial expression.

The complete stock of songs amounted to two distinct melodies—Dalai said at once that they were very, very old; were sung by the men who followed Ghengiz Khan. One appeared to be a war song and my efforts to get any translation met with complete failure. As I finally understood the matter, a foreigner broke into the yurt of a peaceable Mongol, stole his wife and sheep, so all good men should unite in driving out the foreign people. The melody, however, I was able to get on paper in a reasonably correct manner. The words evidently are made up and sung as they come to mind, the same methods used by the bards of ancient time.

I fared a bit better with the other melody, a love song; they sang it over and over again until I really had it; simple melodies both of them, but unforgettable.

Professor Arrhenius in his garden. Photograph by Clyde Fisher, June 21, 1924

Svante Arrhenius
1859-1927

By CLYDE FISHER
Curator of Visual Instruction and In Charge of Astronomy, American Museum

WITH the passing of Prof. Svante Arrhenius on October 2, 1927, the world lost one of its greatest scientists. Although only sixty-eight years old at the time of his death he had accomplished epoch-making results in at least four fields of science.

His first interest in research was in physical chemistry, and in his dissertation for the Doctorate in Philosophy at the University of Upsala, he set forth the theory of Electrolytic Dissociation. It is not often that theses for the Doctorate are ever heard of again after being accepted, but here was one by a young Swedish student that contained an absolutely new idea which was destined to become the basis of possibly the most ingenious and productive theory in the field of chemistry. Presented in 1883, the Electrolytic Dissociation Theory is, after nearly half a century, still the basis of modern chemistry.

This contribution to science would alone have been sufficient to have placed Arrhenius among the world's greatest investigators, but he did not stop here.

After a thoroughgoing and fruitful study of liquid solutions, he began to extend his dissociation idea also to gases. This at once opened up an entirely new and vast field, namely that of cosmic physics. He investigated the influence of the moon upon lightning, the northern lights, the effect of atmospheric carbonic acid gas upon the temperature of the earth's surface, etc. As the culmination of these researches he wrote his *Textbook of Cosmic Physics.*

Since there are no hard and fast lines in nature, and since every science is related to every other science, Arrhenius was soon carrying on research in astronomy. One of the interesting theories he advanced in the field of cosmic physics was that rays of light exert a very feeble pressure, and on the basis of this assumption he was able to explain many otherwise incomprehensible phenomena. The great astronomer, Schwarzschild, further developed Arrhenius' theory on the nature of comets and their tails.

Like Huxley in the biological field, Arrhenius has presented his views of the universe in popular form, and these contributions have endeared him to the lay readers. Among these books we have *Worlds in the Making, The Destinies of the Stars, Life of the Universe as Conceived by Man, and Earth and the Universe,* most of which have been translated into nearly all languages.

And Arrhenius' activity did not end here, for this most versatile man did great service in the field of medicine. His researches here were chiefly in the study of the chemistry of toxins and anti-toxins, and he brought together his results in a fundamental work entitled *Immunochemie* (*The Chemistry of Immunity*).

Arrhenius received his Ph.D. degree in 1884 from the University of Upsala. Later he received many honorary degrees from the leading universities of the world. Among his many degrees were four different kinds of doctorates, namely Ph.D., M.D., D.Sc., and LL.D. He won the Nobel Prize in Chemistry in 1903, and since 1905 had been director of the Physico-Chemical Department of the Nobel Institute at Stockholm. He won the Davy Medal in 1902 and the Faraday Medal in 1914. Heidelberg and Groningen made him a Doctor of Medicine, *honoris causa;* Oxford and Cambridge bestowed the honorary degree of Doctor of Science. He was also an honorary Doctor of Philosophy at Leipzig and a Doctor of Laws at Birmingham. Many scientific societies throughout the world paid him the tribute of honorary membership. Among his books there should be mentioned, besides those cited above, *Electro-chemistry* and *Chemistry in Modern Life.*

Arrhenius was twice married, in 1894 to Sophia Rudbeck; in 1905 to Maria Johanson. He left two sons and two daughters.

During the latter years of his life, Arrhenius was president of the Sverige-Amerika Stiftelsen, and helped select the students who came to America on an exchange basis organized and conducted by the American-Scandinavian Foundation.

Now it must not be supposed that the head of this man was turned by the many honors that were bestowed upon him for his various achievements, for it was not. While a student at Johns Hopkins under the regime of Remsen, the great American chemist, it was my good fortune to hear Arrhenius discuss his researches on one of his lecture trips to this country. Then in 1924 and again in 1925 it was my privilege to visit Arrhenius in his home at the Nobel Institute in Stockholm. I found him a modest, approachable, lovable man. To be a great human man is one thing; to be one of the world's greatest scientists is another; but to be both in one, as Arrhenius undoubtedly was, calls forth our admiration and our affection.

NOTES

APPOINTMENTS

Prof. Henry Fairfield Osborn was appointed Curator-in-chief of the Division of Mineralogy, Geology, Geography, and Astronomy at the October meeting of the American Museum Executive Committee. At this meeting the following resolution was unanimously adopted by the Committee:

Resolved, That in accordance with the recommendation of the Director and the Ad Interim Committee, the Executive Committee hereby appoint Professor Henry Fairfield Osborn Curator-in Chief of the Division of Mineralogy, Geology, Geography, and Astronomy, and Curator-in-Chief of the Department of Geology and Palæontology for the year 1927, and desire to express to Professor Osborn their appreciation of his willingness to undertake this service for the Museum.

The Directorship of the Museum of Comparative Zoölogy.—Dr. Thomas Barbour, a distinguished naturalist, well known to all students of vertebrate zoölogy, has just been appointed to the directorship of the Museum of Comparative Zoology, Harvard University. He succeeds Mr. Samuel Henshaw, who has been director since 1912 of one of America's largest and most complete collections of zoölogical material. Doctor Barbour brings to this office a broad knowledge gained through many years of field work in the East and West Indies, in southern Asia, South America, and particularly in Central America. As one of the organizers and directors of the Barro-Colorado Zoölogical Station in Panama, as one of the leading spirits in the development of the Harvard Institute for Tropical Biology and Medicine, and as a very active curator at the Museum of Comparative Zoology, Doctor Barbour has done perhaps more than any other American biologist to open up the animal life of the American tropics to investigation and close study.

Doctor Barbour's recognized ability as an administrator is attested by the great number of offices he holds in scientific institutions and societies. He is a member of the faculties of Harvard University and of the Harvard School of Tropical Medicine, a member of the Library Counsel, and one of the curators of Harvard College Library. Although Doctor Barbour has published papers in many fields of vertebrate zoölogy, his chief interest centers in the distribution and systematics of reptiles and amphibians.

ASTRONOMY

The Amateur Astronomers Association meets at 8:15 o'clock, every first and third Thursday evening at the American Museum.

The Program Committee is arranging an inspiring course of lectures by prominent speakers for the indoor meetings. Dr. Harlow Shapley, director of the Harvard Observatory, has promised to address the Association on December 15 on "Current Astronomical Researches at the Harvard Observatory."

Three Telescopes Loaned.—A fine spirit of coöperation is being shown by the members of the Amateur Astronomers Association in the loan of three equatorially mounted telescopes, one of which is a 6-inch Alvin Clark. These, together with the one now in use, will enable a larger number of persons to view the heavenly bodies at night from the lawns of the American Museum. As the membership in the society is rapidly increasing, the loan of telescopes is much appreciated.

Advisory Council.—The new astronomical society, the Amateur Astronomers Association, is fortunate in that the following persons have kindly agreed to serve on its advisory council:

Prof. Henry Fairfield Osborn, President, American Museum of Natural History.
Dr. Frederick Slocum, Director, Wesleyan University Observatory.
Dr. Caroline E. Furness, Prof. of Astronomy, Vassar College.
Dr. Anne S. Young, Director, Mount Holyoke Observatory.
Dr. S. A. Mitchell, Director, University of Virginia Observatory.
Dr. Asaph Hall, U. S. Naval Observatory.
Dr. Frank Schlesinger, Director, Yale University Observatory.
Dr. Henry Norris Russell, Director, Princeton University Observatory.
Dr. Harlow Shapley, Director, Harvard College Observatory.
Dr. Edwin B. Frost, Director, Yerkes Observatory.
Dr. Heber D. Curtis, Director, Alleghany Observatory, Univ. of Pittsburgh.
Dr. John A. Miller, Director, Swarthmore College Observatory.
Dr. C. H. Abbott, Smithsonian Institution.
Mr. Howard Russell Butler, N. A., formerly of Princeton University.
Mr. Worcester Reed Warner, of Warner & Swasey Co.
Mr. David Pickering, President of the American Association of Variable Star Observers.

BIRDS

The Ruwenzori-Kivu Expedition.—Dr. James P. Chapin and Mr. DeWitt L. Sage returned from their African trip on September 25. This expedition was made possible through the generosity of Mr. H. W. Sage, and a further contribution was added by Mr. Childs Frick. Eighteen months were spent between Mombasa and Cape Town, of which one year was devoted to work in the eastern Belgian Congo. Mr. Frank P. Mathews, their companion in the early part of the expedition, returned to this country in the autumn of 1926 to resume his studies at Harvard University.

After an investigation of the Ruwenzori Range and Semliki Valley, Doctor Chapin and Mr. Sage traveled southward through the mountains west of Lake Edward and stayed for three months in the country about the Kivu volcanoes. With the generous authorization of the Belgian Ministry of Colonies, they paid particular attention to the birds of the Parc National Albert, a wild-life sanctuary occupying one of the most beautiful spots in Africa and consecrated by the grave of Carl Akeley.

Mount Hood, Oregon. Photograph through the courtesy of the U. S. Forest Service

The homeward journey continued by way of lakes Kivu and Tanganyika, the Katanga district, and South Africa. The results of the expedition include about 2600 birds for the Museum's collections, several hundred small mammals, reptiles, amphibians, and fishes, as well as a series of photographs and several thousand feet of motion-picture film. The motion pictures are the special contribution of Mr. Sage.

Blue Geese.—For three consecutive years Mr. R. L. Lambert of the National Zoological Park in Washington has been experimenting with the hatching and rearing of young blue geese from eggs obtained from a captive pair in the National Zoo. He achieved such success in this hitherto unaccomplished feat that the Société Nationale d'Acclimatation awarded its silver medal to the National Zoological Park. The medal was accepted from the Society by Ambassador Herrick and transmitted through the State Department to Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution.

The society awarding the medal was founded in 1854 by Isidore Geoffroy Saint Hilaire to stimulate acclimatization of plants and animals to regions in which they are not native.

COMPARATIVE ANATOMY

The department of comparative anatomy is engaged in the production of a series of twenty-five exhibits for a general Introduction to the Study of Man, in conjunction with the department of anthropology. The manuscript and illustrations for a general guide to the comparative anatomy of the human face have been completed.

Associate Curator Raven is spending the months of October and November at Johns Hopkins University in study with Professor Huber on human and comparative anatomy and anatomical technique.

CONSERVATION

Mount Hood To Be Preserved from Commerical Development.—Col. William B. Greeley, Chief Forester, U. S. Department of Agriculture, recently denied an application from a commercial company for permission to construct an incline cableway to the summit of Mount Hood, with rest rooms at the top and midway stations. He declared that in his opinion material gains in tourist traffic would fail to compensate for the loss in the esthetic and sentimental value of a mountain peak having the grandeur of Mount Hood, were it subjected to commercial development.

The Rainy Lake Watershed.—One of the most beautiful of the few remaining wild regions in the United States lies along the northeastern boundary of Minnesota, which is largely formed by a series of lakes having their outlet in the Rainy River, a tributary of the Lake of the Woods, whose waters eventually discharge into Hudson Bay. The destruction of the beauty and natural condition of this region is now threatened by the plans of Mr. E. H. Backus, capitalist and paper manufacturer of Minneapolis, who is seeking authority to build a series of dams to change the water level throughout an area of about 1400 square miles of lake and forest country, killing the timber along the lake shores, irreparably disfiguring the scenery and leaving the water level under control of a private corporation, to draw it off as it pleases for power or for floating out pulp wood. The region is the annual resort of thousands of tourists and vacationists and many summer camps and cottages are situated on the shores of the lakes whose beauty will be seriously damaged. As these waters form the international boundary for at least a couple of hundred miles, the matter has been referred by governments of the United States and Canada to the International Joint Commission, the permanent commission of the two countries for dealing with boundary questions, which will probably consider it at a meeting to be held in Washington next April (1928). Protests from those interested in fighting these plans for the destruction and exploitation of the Rainy River region may be made through their Senators or Congressmen or addressed directly to the "International Joint Commission, Washington, D. C."

EDUCATION

New Motion Picture Catalogue.—The value of motion picture films in helping children visualize many school subjects is recognized by educational authorities, but without close correlation between the film and the classroom topic under discussion, there is the danger that film showings may be considered more in the form of entertainment than a true educational aid. Desiring to help teachers in securing this correlation, the department of public education in the American Museum of Natural History has prepared a new form of catalogue for its films.

The first section of the catalogue contains a list of the films classified according to subject. Each film is accompanied by a short description of the topics covered. The second section contains elementary and high school divisions which list the films according to both grade and subject.

At present the Museum has about 500,000 feet of film in active circulation in the New York City public schools. The Museum lends these films free of charge to any public school in Greater New York having a standard motion picture machine and a licensed operator. Deliveries of the films to and from the schools are made by the Museum messengers.

Japanese Exhibit.—The Japanese Educational Exhibit which had been displayed in the Palace of Education and Social Economy at the Sesquicentennial Exposition in Philadelphia was presented by the Minister of Education of the Japanese Government to the International Institute, Teachers College, Columbia University. Through the instrumentality of Prof. Milton C. Del Manzo of that institution, the exhibit has been presented to the department of education of the American Museum of Natural History, and it has been temporarily installed on the third floor of the School Service Building.

FOSSIL VERTEBRATES

Professor Osborn employed his six months' leave of absence from presidential duties, May 10 to November 14, granted by the Trustees, in completing six volumes which have been under way for many years. Of these, the monograph on the Titanotheres for the United States Geological Survey, which was begun before he succeeded Mr. Jesup as President of the Museum in the year 1908, is now passing from galley to page proof in the Government printing office, under the able direction of Bernard H. Lane, present editor of the Survey Publications.

This colossal work, by far the most extensive monograph ever published in the realm of vertebrate palæontology, gives for the first time the complete history of a single family of mammals from the time when the ancestors were less than knee high to the culminative period of animal grandeur which entitled them to the name *titanotheres*, originally given by Dr. Joseph Leidy, signifying *titan* beasts. For many years, Dr. William K. Gregory labored in the preparaton of this monograph with Professor Osborn, and thereby won his spurs as a vertebrate palæontologist, entitling him to the distinction he now enjoys as professor of vertebrate palæontology in Columbia University.

The monograph covers every aspect of titanothere life during the enormously long geologic period of transformation from Lower Eocene to Lower Oligocene time, so the work is a text and reference book of geology, of comparative anatomy, of paleo-geography, and of biology as well. It is here for the first time that Professor Osborn discovered how species actually originate. This is the last volume but one in the great series of the palæontologic monographs projected by the famous Professor Marsh of Yale University more than sixty years ago. In appreciation of his life-long work on this volume, the Geological Survey has recently promoted Professor Osborn to the rank of Senior Geologist.

The second volume which has greatly advanced during the past six months is that on the evolution of the Proboscidea, also a work of colossal size on which Professor Osborn has been engaged more or less steadily since the year 1908, when President Jesup sent him on an expedition, accompanied by Mr. Walter Granger, to the Fayum Desert in Northern Egypt, the ancient home of the elephant and mastodon family. This expedition was very successful in securing splendid specimens of these Lilliputian ancestral proboscideans which furnished the starting point not only of the proboscidean order but of the present monograph. The subject fascinated Professor Osborn so completely that he gradually extended the sphere of his research to the elephants and mastodonts of the entire world excepting the continent of Australia which was never reached by these hardy and adventurous explorers.

Proboscidean history is second only to human history in its romantic and historic episodes. The elephant, like man, has penetrated to every part of the globe and adapted himself to every climate and every form of feeding from the forests of the dry and humid tropics to the frozen Arctic tundras of the North. Nearly five hundred specific forms of these remarkable animals have been described, and extremely numerous and often fantastic generic names have been assigned to them. One of the most difficult problems in the preparation of this colossal work has been the unraveling of these names with justice to their various authors because they reach back into the primordial period of palæontology before the naming system of Carl Linnæus was adopted. Some of the greatest palæontologists, like Cuvier, were the greatest sinners and violators of modern rules of nomenclature. Another difficulty has been to get hold of the rare and out-of-the-way literature of many different languages in which these early descriptions and figures occur. In this matter the Librarian of the Museum has greatly assisted the amanuensis and editor of the text of this volume, Miss Percy; while the printing office has already produced nearly five hundred pages of the estimated number of one thousand pages which will make up the entire volume.

Owing to the extreme rarity o' some of the literature and inaccessibility of the original illustrations, every original figure is being reproduced by the half-tone or direct process and all the original descriptions of species or genera are being reproduced either in full or in abbreviated form. Preparation of this part of the volume has been rendered possible only through the munificent gifts of research funds to the Museum by President Jesup and Vice-President J. Pierpont Morgan. To the latter the volume will be dedicated.

In the next number of Natural History will appear an account of two other volumes by Professor Osborn, which have recently been completed, namely, *Creative Education in School, College, University and Museum* and *Man Rises to Parnassus*.

In this connection it is interesting to acknowledge the generosity and liberal-mindedness of the Trustees in permanently setting aside five rooms in the southeast corner of the fifth floor of the Museum as the Osborn Research Rooms, including the Library Room, the Tower Research Room, the editorial anteroom, and two smaller secretarial rooms. In this relatively secluded and quiet part of the Museum, it has been possible to push forward the technical preparation of these six volumes, but for the actual dictation and writing of the text, retreat to a quiet log house, known as 'Woodsome Lodge,' in the Highlands on the Hudson, was essential. In this mountain log house has not only a large part of the text of the present volumes been prepared, but 'Woodsome Lodge' is memorable as well as a place where John Muir finished his delightful biographic volume, *Boyhood and Youth*, also his more mature volume on *The Yosemite*.

For the present and future encouragement of research by junior members of the American Museum Staff, the seventieth birthday gift of $5000 to Professor Osborn is most welcome and opportune. Not desiring to use it for himself, on November 14 he presented it to the Endowment Fund of the Museum to be invested as the Osborn Palæontologic Research Fund. The interest of this Fund, which will amount to about $300 annually, will be used in the form of special grants, to be awarded on the completion of certain pieces of palæontologic research, especially to the younger workers in the field of vertebrate palæontology.

Mr. Barnum Brown conducted reconnaissance work in the Rocky Mountain region during August and September. He visited two of the Department's collecting parties in Nebraska and examined dinosaur prospects in Colorado, Utah, Wyoming and Montana. While in Montana Mr. Brown collected fossils in a coal mine in the Fort Union formation near Red Lodge and secured several small mammal jaws and teeth, some of which are new to science. They will be described shortly by Dr. G. G. Simpson. This interesting new vertebrate field was reported by Dr. J. C. F. Siegfriedt who has also secured a valuable collection. The Department anticipates working in this field the coming year.

Mr. Brown discovered one dinosaur skeleton in Montana and several localities sufficiently promising to warrant investigation by a collecting party, and it is probable that next season will see a renewal of the Department's work in the North American dinosaur fields which has been discontinued since the last season in Montana — 1916. Two new Eocene mammal fields were located in Wyoming.

While in Utah Mr. Brown received a telegram from Mr. J. D. Figgins, director of the Colorado Museum of Natural History, that another arrowpoint had been located in association with fossil bison remains near Folsom, New Mexico. He proceeded immediately to the quarry with Director Figgins and completed the excavation of the artifact which had been left *in situ*. This is one of several occurrences of this sort in Oklahoma, Texas, and New Mexico, which were described by Director Figgins and Mr. Harold Cook in the May–June number of Natural History. Mr. Brown has brought back from the Denver Museum the various stone weapons and implements so found and he is now engaged in making comparisons with materials in the Eastern archæological collections.

Mr. Albert Thomson returned to the Museum in October from Western Nebraska where he has been carrying on for the seventh season excavations in the Snake Creek Pliocene beds. He brought back a fair-sized collection which includes several choice horse and camel skulls and more fragmentary remains of new or rare forms; altogether a worthy addition to this interesting fauna.

Miocene Mammals from Ainsworth, Neb.—The Department has received recently a portion of a collection of Miocene Mammals made at Ainsworth, Nebraska, the past summer by two youthful local collectors—Messrs. Skinner and Quinn. In coöperation with Director Figgins of the Colorado Museum the entire collection made by these boys was purchased. The Colorado Museum took as its portion a mountable skeleton of one of the long-jawed mastodonts. The balance of the material, which has come to the Museum, includes a skull and jaws of a somewhat smaller individual of the long-jawed mastodont, five skulls with much of the skeletons of the short-legged rhinoceros *Aphelops*, and some important horse, camel, and carnivore material.

Mr. Carl Sorenson, of the departmental laboratory staff, represented the American Museum this summer on a joint expedition between the Colorado Museum and this institution. The party worked in various localities of late Tertiary deposit in Nebraska and finished the season at Ainsworth where they completed the excavation of the *Aphelops* skeleton and attended to the packing and shipping of the entire collection.

Field Work, directly under the supervision of Mr. Frick, has been carried on at Barstow, California, with Mr. Rak directing; at Santa Fe, New Mexico, with Mr. C. Falkenbach directing, and at Keams Cañon, Arizona, with Mr. Blick in charge. Each of these parties was successful in its search for late Tertiary mammals, but the one outstanding specimen of all this work is a complete and beautifully preserved skull of a gigantic camel from the Keams Cañon.

HISTORY OF THE EARTH

Field Excursion of State Geologists in Northwestern Illinois.—On the invitation of Dr. M. M. Leighton, state geologist of Illinois, representatives of fourteen state geological surveys, the Federal Survey, and a number of universities and other educational organizations, and the director of the Russian Geological Survey assembled at Urbana on October 19 to attend a four-day field excursion in northwestern Illinois. The states represented were: Alabama, Illinois, Indiana, Iowa, Kansas, Kentucky, Nebraska, New Jersey, North Carolina, Mississippi, Oklahoma, Tennessee, and Wisconsin. The American Museum of Natural History sent Dr. Chester A. Reeds.

On Farm Creek, near Peoria, Illinois, the party visited the type locality of Pleistocene deposits representing the Illinoian and Wisconsin glacial drifts, and the Sangamon and Peorian interglacial deposits. A similar section, with the addition of a gumbotil on top of the Sangamon beds, was examined on the west bank of East Bureau Creek. Coal bed No. 5, and Mazon Creek, the famous locality for fossil leaves and insects, the St. Peter's sandstone and numerous limestone beds affording invertebrate fossils of Palæozoic age, were also visited.—C. A. Reeds.

INSECTS

The Station for the Study of Insects, 1927.— This was the third season for the department of entomology's field station in the Harriman State Park near Tuxedo, N. Y., in charge of Curator Frank E. Lutz. As in previous years, a Nature Trail was maintained in addition to the entomological work. It was in immediate charge of Albert Redmond. who was one of the younger guests at the Station in 1925 and 1926. Owing to the establishment by the Museum of a large Nature Trail in the Bear Mountain section of the Palisades Interstate Park, the Station's Trail was conducted primarily for trying out new ideas and as a demonstration of a Trail suitable for summer camps and small local organizations.

The principal adult guests this season were Dr. F. W. Brown, a chemist who studied the problem of how insects find their food; Mr. F. M. Brown, a teacher working chiefly on the bacteria and enzymes of insects; and Mr. James Kendall, a graduate student of entomology. In addition, there were three "junior guests."

Doctor Lutz was, in turn, a guest at the Alfred L. Loomis Laboratory in Tuxedo Park from time to time. There he investigated the possibilities of various biophysical problems involving the use of an unusually well-equipped laboratory such as Mr. Loomis has. This coöperation between the Loomis Laboratory and the Station for the Study of Insects was very helpful. Although Doctor Lutz's time was too much interrupted to permit of carrying any one line of work to completion, interesting results were obtained, particularly in proving that many insects—perhaps the majority of them—can survive sudden and extreme fluctuations of barometric pressure, including even "ion-less" vacuum, a much more complete vacuum than is ordinarily considered to be "high." If air-pressure were the only factor to be considered, it would seem that insects might pass from one planet to another.

Museum Study Collections.—In addition to the pleasingly large number of students who come for irregular and short times to study the Museum's collections, Mr. Geo. B. McReynolds is devoting considerable time to the study of our scorpions, and Mr. Ezekiel Rivney is doing a part of his graduate work by a study of our beetles. Miss Carol Cady is taking training here in entomological drawing and several boys come at stated times to work under direction on insects.

Curator Lutz made a short trip to Washington in order to study the National Museum's excellent collection of West Indian bees. This is in connection with the Museum's part in the New York Academy's survey of Porto Rico.

THE LIBRARY

Mr. William K. Vanderbilt has presented to the Museum a copy of his beautiful book *To Galápagos on the "Ara,"* 1926. The narrative is supplemented by valuable natural history data and is illustrated by thirty colored plates as well as by numerous pictures in black and white.

Other recent accessions of interest include:

Journal of the Society for the Preservation of the Fauna of the Empire, 1904–1927.

The first series of this file is out of print and the Society had difficulty in assembling the entire run for presentation to our Library. The only other file of this publication noted in the United List of Serials is in Washington.

Jahresbericht der Commission zur Wissenschaftlichen Untersuchung der Deutschen Meere in Kiel, Volumes 1–21, 1873–1891.

This completes our file which is the only perfect one in New York City.

Bollettino Della Societa Sismologia Italiana, Volumes 1–26, 1815–1926.

Zeitschrift für Konstitutionslehre, Volumes 1–12, 1914–1926. (Forms Abteilung II of Zeitschrift für die Gesamte Anatomie).

LIFE AND THE UNIVERSE

J. H. Jeans, secretary of the Royal Society, and eminent mathematical-physicist, closes a recent discourse on the development of cosmical physics with the following paragraphs:

A general survey of the results obtained by cosmical physics has suggested that terrestrial laboratory physics is a mere tail-end of the general science of physics. The primary physical process of the universe is the conversion of matter into radiation, a process which did not come within our terrestrial purview at all until 1904. The primary matter of the universe consists of highly dissociated atoms, a state of matter which, again, was not contemplated before 1917. The primary radiation of the universe is not visible light, but short-wave radiation of a hardness which would have seemed incredible at the beginning of the present century. Indeed, our whole knowledge of the really fundamental physical conditions of the universe in which we live is a growth of the last quarter of a century.

The simple explanation of this situation is to be found in the fact that life, naturally enough, begins its exploration of Nature by studying the conditions which immediately surround it; the study of the general conditions of the universe as a whole is a far more difficult task which life on this planet is only now approaching. Now the physical conditions under which life is possible form only a tiny fraction of the range of physical conditions which prevail in the universe as a whole. The very concept of life implies duration in time; there can be no life where the atoms change their make-up millions of times a second and no pair of atoms can ever become joined together. It also implies a certain mobility in space, and these two implications restrict life to the small range of physical conditions in which the liquid state is possible. Our survey of the universe has shown how small this range is in comparison with the range of the whole universe. Primeval matter must go on transforming itself into radiation for millions of millions of years to produce an infinitesimal amount of the inert on which life can exist. Even then, this residue of ash must not be too hot or too cold, or life will be impossible. It is difficult to imagine life of any high order except on planets warmed by a sun, and even after a star has lived its life of millions of millions of years, the chance, so far as we can calculate it, is still about a hundred thousand to one against its being a sun surrounded by planets. In every respect —space, time, physical conditions—life is limited to an almost inconceivably small corner of the universe.

What, then, is life? Is it the final climax towards which the whole creation moves, for which the millions of millions of years of transformation of matter in uninhabited stars and nebulæ, and of waste radiation into desert space, have been only an incredibly extravagant preparation? Or is it a mere accidental and possibly quite unimportant by-product of natural processes, which have some other and more stupendous end in view? Or, to glance at a still more modest line of thought, is it of the nature of a disease which affects matter in its old age, when it has lost the high temperature and capacity for generating high-frequency radiation with which younger and more vigorous matter would at once destroy life? Or, throwing humility aside, is it the only reality, which creates, instead of being created by, the colossal masses of the stars and nebulæ and the almost inconceivably long vistas of astronomical time? There are too many ways even to enumerate of interpreting the conclusions we have reached; I do not, however, think there is any one way of evading them.

MAMMALS

The Whitehouse Collection.—Recently a very fine collection of 105 mounted heads and horns was presented to the American Museum by Norman De R. Whitehouse.

The trophies are from animals shot by his father, the late J. Henry Whitehouse, and assembled at the Whitehouse residence at Irvington-on-the-Hudson, and include buffalo, bison, sheep, and many species of antelope, takin, deer, moose, tiger, bear, zebra, and other animals.

Colonel Whitehouse, distantly related to W. Whitehouse, the African explorer, was a keen sportsman and hunter of big game. These relics of the chase represent many successful trips into almost all parts of the world, Africa, India, Russia, Tibet, North America, and some of the lesser known big game fields.

Many of the heads are rare and unusually large specimens. An Indian buffalo, listed by Rowland Ward in 1922 is the second largest on record. Thirty-two of the largest specimens were donated by the Museum to the

National Collection of Heads and Horns, Bronx Park.

Lee Garnett Day Roraima Expedition.—Word has been received from the Lee Garnett Day Roraima Expedition both by cable and letter. The party has had difficulty in reaching Roraima principally because of lack of porters. The work on this Brazilian frontier by General Rondon and the Brazilian Boundary Commission makes great demands upon the transport facilities, which are very limited at the best. Mr. Tate found it necessary to return from the back country to Sao Marcos in order to meet General Rondon and secure the benefit of his advice. At the same time a small shipment of specimens was sent to the Museum. The delay in reaching Roraima is not lost time because collections are being made en route, and contain much valuable material. A letter from Mr. Carter tells of his killing a jaguar which had carried off a colt from one of the ranches, and also of securing several specimens of the giant anteater.

The following cablegram was received just as Natural History went to press:—

"Base Roraima October 25. Most of forest destroyed by fire. Well supplied stores for work. Expect to stay two months. Everybody well.—Tate."

Vernay-Faunthorpe Expedition.—Mr. Arthur S. Vernay sails from New York on November 24 to join Col. J. C. Faunthorpe in Bombay. Mr. Vernay and Colonel Faunthorpe are planning to carry on their work of collecting representative and rare specimens of Indian mammals for the American Museum by securing the Sondaicus rhinoceros, which will complete the group of Asiatic rhinoceroses. The Sondaicus, which is a small, one-horned species, is almost extinct, and it is therefore imperative that museum specimens be obtained without delay. The penalty for shooting one of these animals is six months imprisonment, but through the kindness of Sir Harcourt Butler, the governor of Burma, permission to obtain two specimens was given the Vernay-Faunthorpe expedition. Mr. H. C. Smith, game warden of Burma, was delegated to accompany the expedition.

Mr. Albert E. Butler and Mr. Clarence S. Rosenkranz of the American Museum staff are accompanying the expedition for the purpose of obtaining accessory material and background studies for the Indian Hall groups.

OTHER MUSEUMS

The Setting to the Hispanic Museum at Broadway between 155th and 156th streets, New York City, has been greatly beautified by a magnificent bronze equestrian statue representing El Cid, the favorite hero of Spain. The sculptress is Anna Hyatt Huntington, noted for her statue of Joan of Arc on Riverside Drive, and other excellent pieces.

REPTILES AND AMPHIBIANS

The summer of 1927 yields two record size leather-back turtles.—The leatherback turtle *Dermochelys coriacea* (*Linné*) normally inhabits the warmer parts of the Atlantic Ocean, while the only other species, *D. schlegelii* (Garman) is found similarly in the Pacific. Occasionally individuals of the former species wander northward with the Gulf Stream, sometimes being found as far north as Maine. Hardly a summer passes without reports coming to the American Museum of specimens caught off the New York coast. Usually these reports describe huge individuals which, upon investigation, shrink considerably. However, these turtles do grow larger than any other present form.

In July of this year information was received at the Museum of an especially large specimen which had been found in the pound nets off Beach Haven, New Jersey, and which had been purchased by Mr. S. Walling of Keyport, New Jersey. Upon going down to measure the then still living reptile, I found it to be a truly gigantic beast, and so far as available records show, the largest individual ever measured. The total length over the curve of the back was seven feet four inches, while the width over the back, from tip to tip of the pectoral flippers, was eight feet ten inches. The carapace measured, along the curve, five feet seven inches. The turtle was not weighed by itself, but with the truck on which it was loaded, and in this way it was estimated at 1130 lbs.

To have a second turtle nearly as large as the first caught within three weeks thereafter was indeed a surprise. It was harpooned in Fire Island Inlet on the s uthern shore of Long Island by Mr. O. C. Grinnell of Bay Shore, New York, who kindly presented it to the Museum. It is now being prepared as a mounted skeleton. This turtle when received was measured and found to be seven feet one inch in length over the back, and eight feet nine inches across the flippers. The carapace over the curve was five feet three inches. When weighed on the scales at the Museum, however, it came to only 775 lbs.

Dr. C. H. Townsend, of the New York Aquarium, says in the *Zoological Society Bulletin* for November–December of 1926, that the carapace of a leather-back at the Aquarium measured, over the curve, five feet one inch. It weighed at death 840 lbs., which was after it had been without food for some time. "This," he says, "was thought to be the largest turtle actually weighed in the flesh, until recently the California Academy of Sciences received one that was five feet three inches over the carapace and weighing 1286 lbs." This specimen is the same length as the one being mounted at the American Museum.

Thus, through the courtesy of Mr. Grinnell, the American Museum will be able to display a skeleton of a leather-back turtle which of all those recorded is exceeded in length by only one other specimen, the one found at Beach Harbor, which Mr. Walling kept.—W. G. Hassler.

SCIENCE OF MAN

Field Work under the Ogden Mills Survey.—The object of the field work this summer in the Southwest under the Ogden Mills Survey was to obtain material which might enable us to be in a position to attack the racial problem in the archæology of the Southwest. Physically one of the least known of the cultural strata in the Southwest is the Post Basket Maker period (Basket Maker III). Consequently our primary efforts were directed toward this culture. The actual field work began the first of August with excavation of a large Post Basket Maker refuse mound, about 600 feet long and 300 wide. This site is located at Mitten Rock, west of Ship Rock, in the Navajo Reservation in New Mexico. Although the skeletal material was frequently fragmentary, we obtained a representative collection of crania and skeletons. The pottery was typically Post Basket Maker ware of the gray variety, usually without decoration. The decorated pieces showed crude black designs. Our next site was at Tocito, some 25 miles to the south. Here the culture stratum was Pueblo and we obtained a number of well-preserved skeletons and some excellent black-on-white ware characteristic of this period. The latter half of September was spent at La Plata in the southwestern corner of Colorado, where the Post Basket Maker culture achieved a well-developed stage. We dug in small scattered sites without clearly marked refuse mounds. But fortunately we secured an excellent collection of skeletons and a number of extremely fine vessels showing the developed character of the ware of this area.

Also at La Plata we made an unusual discovery in a small cave. Resting directly on an old fire we found a large corrugated pot of the Pueblo period in which there were the skeletal remains of at least two individuals, including the skull of one. The stratum was undisturbed, and the finding of scattered fragments of human bone leads one to believe that here were the actual remains of some cannibalistic rite.—H. L. Shapiro.

Quetzalcoatl Serpent Head.—Through the generosity of the Famous Players-Lasky Corporation the Museum has recently acquired a large serpent head of stone from the temple of Quetzalcoatl, ruins of San Juan de Teotihuacan, Mexico. This temple is one of the best known and most intersting of the discovered buildings belonging to the Toltec civilization. Thus a carved element of the original façade is a distinct addition through its historic and artistic importance to our Mexican collections. The serpent head was presented by the Mexican Government to the Famous Players-Lasky Corporation and through the courtesy of Mr. O. R. Geyer it was transmitted by that organization to the Museum.

Javanese Drama Collection.—Through the generosity of Mr. George D. Pratt a valuable Javanese collection has been secured. This collection contains forty-two painted wooden masks, with a wide range of individual variation from the placid, highly stylized female masks to the grotesque, tusked masks of monsters and demons. The eighty-seven marionettes represent all the forms used in the traditional Javanese theater,—the delicate silhouettes of buffalo hide rich with gold paint and elaborate filigree work, the flat wooden puppets which represent characters in a less remote period of Javanese history, and a few wooden puppets which are carved in the round. Students of marionettes will be interested in the wide variety of expression and posture which can be obtained in such a highly conventionalized medium, while art students will enjoy seeing such a rich selection of the originals of a favorite design element in Javanese art.

NEW PUBLICATIONS

CENTRAL ASIATIC EXPEDITIONS.—Since September 1 seven *Bulletin* and *Novitates* articles on Asiatic fishes, amphibians and reptiles, mammals, and fossil plants have appeared under the authorships of J. T. Nichols, Clifford Pope, R. W. Chaney, Glover M. Allen, and Karl P. Schmidt. These are in the series of Preliminary Reports of the Asiatic Expeditions which now number seventy-eight. Numbers one to sixty-three have been bound together as Volume I of these Preliminary Reports and there is already an accumulation of about half enough separata for a second volume.

The Geology of Mongolia, by Charles P. Berkey and Frederick K. Morris, has just been printed by the Knickerbocker Press of G. P. Putnam's Sons, New York. As Volume II of the *Natural History of Central Asia*, it is the first of a series of twelve *de luxe* volumes to appear on the work of the Central Asiatic Expeditions of the American Museum of Natural History. The book is a well-balanced and meritorious contribution to knowledge of the geology of a large portion of the Republic of Mongolia. It is of small memoir size, consisting of 475 printed pages and 205 illustrations, ten of them in colors.

Professor Berkey, the senior author, is head of the department of geology of Columbia University, New York; Mr. Morris, the junior author, is at present associated with the department of geology of the Massachusetts Institute of Technology, Cambridge, Massachusetts.

The field studies, which constitute the basis of this contribution, were made during the summers of 1922 and 1923, as part of the program of the Third Asiatic Expedition of the American Museum of Natural History, which Roy Chapman Andrews organized and led. The expedition traversed in motor cars many of the camel trails of inner and outer Mongolia, that is, the trade routes along which caravans have been directed for untold centuries. It is a historic region, for under their famous leader, Ghengis Kahn, 1162 to 1227 A.D., the Mongols ruled two-thirds of Eurasia. Although it is a region of great antiquity, it is a vast desert basin encompassed by high mountains—a wonderful field for the geologist with the rocks well exposed.

In 1922, it was a new land to the scientific world; explorers of various nationalities, particularly the Russians, had crossed various parts of it, but the characteristics of its bed rock and economic potentialities were still unknown. In addition to making a geological reconnaissance of the extensive route traversed, the geologists mapped special areas where the expedition camped a week or more. Maps in color, of six of these special areas appear in the pocket at the end of the volume.

—C. A. REEDS.

Across Asia's Snows and Deserts by William J. Morden, published by G. P. Putnam's Sons (October, 1927), is an account of the journey of the Morden-Clark Asiatic Expedition of the American Museum. The expedition, which was led by Mr. Morden, and included James L. Clark, assistant director of the Museum, went in search of *Ovis poli* and ibex. It was Mr. Morden's theory that *Ovis poli* existed in greater numbers than reports suggested, and the expedition proved that this theory was correct. More than a thousand rams and more than six hundred does were counted, and the expedition obtained a very complete series for the Museum's collection.

After completing the *Ovis poli* hunt in the Russian Pamirs, the expedition continued across Chinese Turkestan to the Thian Shau, and there collected a series of ibex.

It was the purpose of the expedition to continue to Mongolia, there to meet Dr. Roy Chapman Andrews, in order to return with him to Peking. A message received in the heart of Asia, however, announced that Andrews, because of the Chinese revolution, had been unable to carry out his plans. Despite this news, Morden and Clark determined to cross Mongolia, and as winter was approaching, left Kuchengtze, in Turkestan, with a camel caravan. They were captured by the Mongols at the tiny military post of Ji-ji-ho, and during the first forty-eight hours of their captivity were tortured by the soldiers, who had no understanding of their purposes in entering the country, and did not know who or what Americans were.

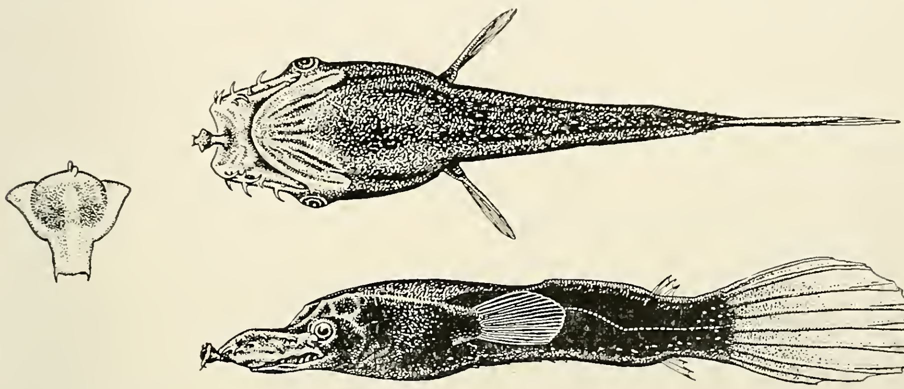
Ultimately, after being held under armed guard for three weeks, during which time they were taken across hundreds of miles of frozen, snow-covered desert, they were released at the town of Kobdo, and were permitted to make their way for six hundred more miles to a branch of the Trans-Siberian Railroad, by which they made their way to Peking.

The book is handsomely illustrated with sixty-three photographs and three maps, and contains a very complete account of this extraordinary journey. Mr. Morden has proved himself to be not only an explorer of ability, but an observer whose description of Central Asia will become an important record of that difficult and little known land.

The Natural Bridge of Virginia and its Environs is the title of a new booklet by Dr. Chester A. Reeds, curator of invertebrate palæontology in the American Museum.

The booklet, which bears the copyright of the author, contains sixty-four pages and eighty-five illustrations. It has the same format as the well-known *National Geographic* magazine. The booklet was printed in August, 1927, by the Momad Publishing Company Incorporated, of 150 Lafayette Street, New York, and 5000 copies have been placed on sale at the Natural Bridge Hotel, Natural Bridge, Virginia.

In addition to being a guide to Natural Bridge, and the gorge of Cedar Creek, the booklet contains a description and discussion of the origin and development of these striking geographic features. It is interesting to note that although this limestone bridge is the most pronounced curiosity of its kind in America, and has been known since Thomas Jefferson purchased it from King George III, in 1774, no publication on the Natural Bridge has appeared heretofore, which may be compared with this one. Doctor Reeds's able presentation of the subject and wealth of illustrations make it an outstanding booklet. It was written as a companion piece to the one on "The Endless Caverns of the Shenandoah Valley" which appeared in 1925.



One of the fishes of the Bingham Oceanographic Collection.—In *Thaumatichthys binghami*, perhaps the most peculiar of the new species of frog-fishes, the upper jaws are attached to the margins of a broad membrane so that they fold around the edges of the lower jaw to close the mouth. The luminous bulb is not, as is usual among these fishes, placed on top of the head, but projects straight forward from the roof of the mouth, a most convenient place for a bait, if that is the nature of the peculiar organ. The eyes are also found in a very unusual position at the angles of the mouth. Only one related species has formerly been known to science

Bingham Oceanographic Collection.—The first Bulletin of the Bingham Oceanographic Collection to be issued was noted in the last number of Natural History. We now have before us a full report on the fishes obtained during the 1925 cruise of Mr. Bingham's yacht, "The Pawnee," about the Bahamas and in the Caribbean. Some twenty forms are described as new. Of particular interest are a peculiar finned eel (*Anguillichthys*, new genus), *Hepatus pawnee*, and a small aberrant surgeonfish very like one obtained by "The Albatross" in the Pacific some years ago. This bulletin is one of the most important recent contributions to our knowledge of the seemingly inexhaustible variety of fish life in the "Spanish Main."[1]

We understand that another bulletin describing rare and new forms of deep-sea crustaceans by Miss Lee Boone is in page proof as this issue of Natural History goes to press.

Dragon Lizards of Komodo, the story of the expedition led by William Douglas Burden to one of the Lesser Sunda Islands in Malaysia, in search of *Varanus komodoensis*, has just appeared from the press.

Reptile Study, a handbook for the study of American reptiles, has been prepared by William G. Hassler of the department of

[1]"Fishes of the Spanish Main," Natural History, Vol. XX, pp. 449–451.

reptiles in the American Museum at the request of Headquarters of the Boy Scouts of America. The handbook is intended to meet the immediate needs of scouts who, in order to win a Merit Badge in this study, must pass certain examinations therein. The book, however, should prove of general interest to any student of reptile life.

THE FOLLOWING PAPERS have been published in *Novitates* and the *Bulletin* during the period from September 6 to November 9, 1927.

Novitates

No. 273.—REMARKS ON THE CLASSIFICATION OF THE PTEROCLIDIDÆ. By W. Wedgwood Bowen. 12 pp. Two text figures. September 6, 1927.

No. 274.—SOME BEES PRINCIPALLY FROM FORMOSA AND CHINA. By T. D. A. Cockerell. 16 pp. September 7, 1927.

No. 275.—FOUR NEW AMERICAN DIPTERA. By C. H. Curran. 4 pp. Three text figures. September 8, 1927.

No. 276.—ON CERTAIN FORMS OF *Puffinus assimilis* AND ITS ALLIES. By Robert Cushman Murphy. 15 pp. September 8, 1927.

No. 277. NOTES ON SOME ANTHIDIINE BEES OF MONTANA AND CALIFORNIA. By Herbert F. Schwarz. 8 pp. September 9, 1927.

No. 278.—A NEW *Ramphocorixa* FROM HAITI. (Hemiptera-Corixidæ). By H. B. Hungerford. 2 pp. Six text figures. September 9, 1927.

No. 279.—A NEW TREE-FROG FROM PORTO RICO. By Karl Patterson Schmidt. 3 pp. September 10, 1927.

No. 280.—UNDESCRIBED OR LITTLE-KNOWN BIRDS FROM PANAMA. By Ludlow Griscom. 19 pp. September 10, 1927.

No. 281.—A NEW BLENNY FROM THE HAWAIIAN ISLANDS. By N. A. Borodin. 2 pp. One text figures. September 12, 1927.

No. 282.—AN ORNITHOLOGICAL RECONNAISSANCE IN EASTERN PANAMA IN 1927. By Ludlow Griscom. 10 pp. September 12, 1927.

No. 283.—HACKBERRY SEEDS FROM THE PLEISTOCENE LOESS OF NORTHERN CHINA. Ry Ralph W. Chaney. 2 pp. Two text figures. September 13, 1927.

No. 284.—LAGOMORPHS COLLECTED BY THE ASIATIC EXPEDITIONS. By Glover M. Allen. 11 pp. September 13, 1927.

No. 285.—A NEW SPECIES OF THE FAMILY TABANIDÆ FROM THE BELGIAN CONGO, WITH NOTES ON THE GENERIC POSITION OF RELATED SPECIES. By James S. Hine. 4 pp. September 28, 1927.

No. 286.—RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO. I.—NOTES ON *Varanus komodoensis* By Emmett Reid Dunn. 10 pp. September 30, 1927.

No. 287.—RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO. II.—SNAKES FROM THE EAST INDIES. By Emmett Reid Dunn. 7 pp. September 30, 1927.

No. 288.—RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO. III.—LIZARDS FROM THE EAST INDIES. By Emmett Reid Dunn. 13 pp. September 30, 1927.

No. 289.—THE SKULL CHARACTERS OF *Crocodilus megarhinus* ANDREWS. By Charles C. Mook. 8 pp. Two text figures. October 10, 1927.

No. 290.—PORCUPINES FROM CHINA. By Glover M. Allen. 4 pp. October 24, 1927.

Bulletin

Bulletin LIV, Art. 1. "The Orthoptera of the West Indies. No. 1. Blattidæ." By James A. G. Rehn and Morgan Hebard. 320 pp. Plates I–XXV. September 9, 1927.

Bulletin LIV, Art. 2. "The Fishes of Hainan.' By John T. Nichols and Clifford H. Pope. 74 pp. Plate XXVI, 51 text figures. September 12, 1927.

Bulletin LVI, Art. 3. "The Reptiles of Hainan." By Karl Patterson Schmidt. (With abstracts from the field notes of Cilfford H. Pope.) 71 pp. Plate XXVII, 17 text figures. October 6, 1927.

Bulletin LVI, Art. 4. "Notes on Chinese Reptiles." By Karl Patterson Schmidt. (With extracts from the field notes of Clifford H. Pope.) 86 pp. Plates XXVIII to XXX, 22 text figures. October 11, 1927.

Bulletin LVI, Art. 5. "Notes on Chinese Amphibians." By Karl Patterson Schmidt. 24 pp. Plates XXXI and XXXII. October 14, 1927.

Bulletin LVII. Art. 1. "On the Anatomy and Classification of the Weaver-Birds." By Peter P. Sushkin. 32 pp. Eighteen text figures. October 24, 1927.

Bulletin LVII. Art. 2. "Diptera of the American Museum Congo Expedition." By C. H. Curran. 57 pp. Two text figures. November 9, 1927.

HONORS

Dr. Frederick A. Lucas was elected to honorary membership in the Museums Association of Great Britain, at their recent meeting. This is the first time this distinction has been conferred on anyone outside of Great Britain. Among the Honorary Members are Sir Frederick Kenyon, Sir Sidney Harmer, and Sir Cecil Smith, respectively former directors of the British Museum, British Museum of Natural History, and Victoria and Albert Museum, who were retired when they reached the age limit prescribed by law.

SEVENTIETH ANNIVERSARY CELEBRATION FOR PROFESSOR OSBORN

The beautiful bird hall on the second floor of the American Museum was the setting for the reception tendered Prof. and Mrs. Henry Fairfield Osborn on the evening of September 29, 1927. The occasion was the seventieth anniversary celebration in honor of Professor Osborn's birthday, which was arranged as an expression of esteem and affection by his many friends and colleagues. Addresses were made by Dr. Frank M. Chapman, who presided, Prof. Wm. B. Scott of Princeton, life-long friend of Professor Osborn, and by Professor Osborn, who paid high tribute to the unfailing inspiration and encouragement from Mrs. Osborn during the forty-six years of their married life.

The silver-gilt Queen Anne cup and the engrossed resolutions containing greetings from hundreds of Professor Osborn's friends from all over the world were on view during the reception.

After the addresses, the distinguished guests had an opportunity to greet and extend their felicitations personally to Professor and Mrs. Osborn.

MEETINGS OF SOCIETIES

Bicentenary of the Death of Newton.—Meetings and exhibitions commemorating the Bicentenary of the death of Sir Isaac Newton (1642–1727) will be held in Education Hall, in the School Service Building of the American Museum on November 25 and 26, 1927, at 10 a.m. and 2 p.m. under the auspices of the History of Science Society, in collaboration with the American Astronomical Society, The American Mathematical Society, the American Physical Society, and various other organizations.

Addresses will be given by distinguished scientists and philosophers of the United States and Canada, relating to Newton's interests in the fields of astronomy, mathematics, physics, chemistry, religion, and to his work at the mint.

The exhibition of Newtoniana, including portraits, medals, autograph letters, early editions, and association copies, and of material relating to Newton's predecessors and contemporaries in his fields of major interests, and to his translators, editors, and biographers, will be open daily from November 25 to December 17.

Fuertes Memorialist.—Dr. Frank M. Chapman has been appointed by the president of the Ornithologists Union to act as memorialist for Louis Agassiz Fuertes. An article will appear in *The Auk* and will be presented at the annual meeting of the Union November 15.

The International Congress of Americanists is to hold its twenty-third session at the American Museum of Natural History beginning the middle of next September. The Congress meets biennially with alternate sessions in the Old and the New World. The subjects discussed relate to native peoples of America and the historical, geographical, and geological problems related to them. It is expected that many prominent scholars and scientists from Europe, Mexico, and South America will attend. The thirteenth session was also held at the American Museum in 1902.

The New York Bird and Tree Club held its annual meeting in the Members' Room of the American Museum on Thursday, October 27. The following persons were elected to office for the current year: Honorary President, Dr. George F. Kunz; President, Dr. Clyde Fisher; Vice-Presidents, Mrs. Thomas A. Edison, Miss Henriette Ord Jones, Mrs. James R. McKee, Mrs. John Lewis Childs; Recording Secretary, Mrs. T. Carlyle Jones; Corresponding Secretary, Miss M. Louise Rieker; Treasurer, Mrs. Mansfield Merriman.

The Horticultural Society of New York held an exhibition of plants and flowers in the American Museum November 10–13. For the second time the large exhibition hall on the first floor of the Scool Service Building staged the display, which ranked well with the high standard established during the past score of years. The giant chrysanthemums were exceptionally beautiful, as were the roses. Exhibits deserving special mention were collections of greenhouse foliage plants, and an unusually large and fine display of orchids. Most of the plants came from florists and horticulturists within one hundred miles of New York City, but one exhibit that attracted much attention was a large collection of carnations which had been sent from Denver, Colorado, by aëroplane, and which arrived in excellent condition.

Roosevelt Day.—In celebration of Roosevelt Day, October 28, which was officially set apart by Governor Smith, there was placed in the foyer of the American Museum the following exhibit where it could not fail to attract the attention of all visitors who entered the building: a case of books by Roosevelt including all that could be classed as natural history, a snowy owl which had been collected and mounted by Roosevelt in his teens, a bust of Roosevelt by James Earle Fraser, a photographic portrait of Roosevelt, and the architect's model of the proposed Roosevelt memorial. In connection with this celebration, six showings of motion picture films illustrating the life of Roosevelt were held. Two showings were given the day before the birthday for school children, and four on the birthday for the general public. The motion picture films were lent to the Museum for this purpose by the Roosevelt Memorial Association.

AMERICAN MEN OF SCIENCE

Dr. J. McKeen Cattell in a recent number of *Science* has presented an analysis of the origin and distribution of the leaders of science appearing in the Fourth Edition of "American Men of Science." The leaders are selected by a vote of their colleagues and the honor which is thus given them is indicated in the directory. It is gratifying that the scientific staff of the American Museum includes a large percentage of the leaders in American science. To quote directly from Doctor Cattell's article, "The past twenty-six years have witnessed the development of endowed research institutions and the Carnegie Institution of Washington now stands next to Harvard and Chicago in the number of its scientific men of distinction. The Rockefeller Institute, limited to medical research, has also attained a high position. In this period the Carnegie Institution has grown from 7 to 47; the Rockefeller Institute from 3 to 19. The Boyce Thompson Institute, the Wistar Institute and the Mayo Clinic also show gains. The American Museum of Natural History and the New York Botanical Garden, with respectively 13 and 8 of the scientific men, rank before most universities and show a gain since 1906. It is of interest that these institutions can flourish under support and control partly private and partly public."

Mr. B. T. B. Hyde, more familiarly known to many as "Uncle Benny," has gone to Arizona to regain his health. For five years Mr. Hyde maintained a Nature Corner in the Entomological Hall of the American Museum. Here live snakes, insects, turtles, and creatures representing other branches of Nature Study were to be found. "Uncle Benny" was usually present to welcome visitors, who, wandering through the halls, were attracted by the open railed area where someone was working and where questions were invited.

Much of the work that was formerly carried on there will, in the future, go forward in the School Service Building.

NEW MEMBERS

Since the last issue of Natural History, the following persons have been elected members of the American Museum, making the total membership 9880.

Associate Founder

Mr. Arthur S. Vernay.

Patrons

Messrs. Maunsell S. Crosby, S. A. Goldschmidt.

Life Members

Mesdames: William I. Barry, Louis D. Conley, John L. Given.

Miss: Maria Babcock.

Messrs: Charles E. Bedaux, Hiram Blauvelt, Geo. L. Bourne, Barron Collier, Robert Crabb, William T. Dewart, Joseph H. Emery, Edward R . H. Grueneweald, James H. Lockhart, Andre Mertzanoff, Wm. Nesbit, Morton J. Newburger, Reuben D. Silliman.

Sustaining Members

Mesdames: Charles E. Bedaux, C. K. G. Billings, H. Casimir de Rham.

Miss: Nina Rhoades.

Doctor: Albert A. Berg.

Messrs: Sidney J. Baumann, Paul Block, Edward I. Farmer, Frank I. Liveright, Allan McCulloh.

Annual Members

Mesdames: Ellice M. Alger, Charles T. Barney, Joseph Black, T. Whitney Blake, L. W. Bonney, Samuel Brill, William Edward Cassell, L. W. Cole, H. A. Cushing, Robert C. Ferguson, Gertrude K. Finch, Robert M. Frank, A. R. Geissler, Malcolm Gifford, Henry M. Hewitt, L. Emmett Holt, Frederick Morgan Johnson, Mary Alice Barney Kean, John Henry Livingston, Max Mayer, Donald McGraw, W. Bard McVickar, J. Blackburn Miller, Charles E. Milmine, Paul Morton, Sarah Neely Murphy, James O'Neill, Grace V. C. Schley, Albert B. Schultz, Marguerite E. Schwarzmann, Kenneth A. Stier.

Sister: M. Adrian.

Misses: Ina Clayton Atwood, Jennie Mae Clark, Gladys M. Craig, Louise Eltinge, Helen Frank, May Hardart, Nina D. Herzog, Esther S. Hotchkiss, Helena A. Hulskamp, Lucile Renèe Koch, Margaret Bispham Levey, Helen M. Metzner, Susanne Meyer, Elizabeth Purcell, Alice R. Wilson.

Doctors: Raymonde A. Albray, Thaddeus Hoyt Ames, Cameron Vernon Bailey, Edgar M. Bick, Theodor Blum, Charles W. Burr, H. C. Fleming, Melvin Randolph Gilmore, Geo. C. McBride, A. L. Melander, M. Oshima, Sidney N. Parkinson, Arnold Peskind, Hervey C. Williamson.

Messrs: Theodore Badman, Wm. T. Baird, Louis G. Banker, William R. Beal, Lucius H. Biglow, Homer S. Black, Frederick W. Bohlmeyer, Frank Bohn, Edward Bose, Alfred Lockwood Brown, Edmund Brown, Jr., R. R. Brown, F. A. Burghardt, C. Alexander Capron, R. P. Clayberger, Paul L. Depland, Wilson D. I. Domer, Charles S. Doran, Louis Dreifuss, Arthur F. Elliott, Reginald S. Evans, W. T. Farley, W. Edward Foster, I. C. Gary, Simone N. Gazan, Lafayette A. Goldstone, Abner Graff, Arthur Butler Graham, William Graupner, Abraham L. Gutman, Harry Peale Haldt, Louis Hammer, Bernard J. Harrison, Isaac Harter, Rowland Hazard, John A. Hird, Lester Hofheimer, Frederick T. Holmes, Charles W. Holton, Harley D. Hutchins, Percy R. Iseman, Emanuel Jacob, Julius M. Johnson, Robcliff V. Jones, H. Thorn King, Jr., Joseph Klaw, Alfred-Kohlberg, W. S. Lambie, Antonio Lazo, Max J. Levy, Walter L. Lipman, John W. Little, M. H. Lynch, Harry Mack, Paul Maddaus, Albert Mayer, Lawrence S. Mayers, Walter M. McGee, Philip Gurdon Mumford, Royden L. Nathan, Robert T. Neely, S. Van B. Nichols, Fayette S. Olmsted, Lester Osborne, Frederick W. Patterson, C. Pelican, John O. Prescott, Joseph M. Price, Peter Rinelli, Thos. F. Russell, Jr., J. B. Salterini, Robert Schey, Gerald Sparks, Charles B. Straus, Malcolm Toch, Henry H. Tryon, Charles N. Waterman, Frederick Weber, Henry Nicoll Wightman, Charles Axford Wood.

Associate Members

Mesdames: G. Bump, Howard Constable, Vincent W. Lanfear, George McDonald, J. Arthur Pilkington, Julian S. Stein.

Misses: Ellen Bullard, Genevieve Burdick, Frances Ernst, Dorothy A. Johnson, Margaret Reinherr, Irma Schmincke, Sarah Lois Staples, Mary Tucker.

Reverend: Geo. H. Richardson.

Professors: John M. Berdan, Frank Wilson Blackmar, R. Borcea, Edward Channing, George C. Engerrand.

Doctors: G. Mason Astley, Joseph C. Aub, H. W. Brinkmann, H. Morton Cameron, Henry Herbert Goddard, C. Hartshorne, A. Pringle Jameson, S. R. Light, Henry D. Lloyd, W. L. Moss, James Morris Page, Edwin B. Powers, D. W. Rife, Denman W. Ross, Frederick A. Saunders, Taylor Starck, Glanville Terrell.

Lieutenant Commander C. H. Dench.

Messrs: Lewis F. Acker, R. P. Boas, Jr., Arthur Cole, Jr., Charles J. Dunn, Robert L. Eastman, Luis F. Estrada, F. L. Ford, Walter Godchaux, Jr., G. H. Heineman, Robert E. S. Heinemann, Arthur W. Henn, Geo. A. Herzog, Francis Welles Hunnewell, Clifton H. Kroll, William C. Lane, J. Eugene Law, J. B. Levison, Oscar M. Longnecker, Jr., Edward John McCarthy, H. W. Mossman, Raymond E. Murphy, Ben Olson, E. D. Patterson, Roland Case Ross, William B. Sharp, L. M. Stubner, C. Newbold Taylor, Richard W. Thatcher, Frank Webber, A. I. V. Wilson.

AFRICAN NUMBER

NOVEMBER-DECEMBER

Carl Akeley's keen desire to preserve for all time a record of the wonderful wild life of Africa crystallized itself into the vision of the African Hall. A glimpse of the magnitude of this vision will be given the reader of the African Number of **Natural History**. The beauty of Africa's flora, the mystery of its jungles, the variety and abundance of its animals, the grandeur of its scenery, the customs of its natives,—all this is described in the following articles:

"The Vanishing Wild Life of Africa" by Henry Fairfield Osborn, "In the Land of His Dreams" by Mary L Jobe Akeley, "A Safari in Africa" by George Eastman, "Picturing Africa" by Martin Johnson, "Home on Safari" by Osa Johnson, "Adventure Land" by Philip Percival, "Painting the Backgrounds for the Akeley African Hall Groups" by W. R. Leigh, "Natives of East Africa" by A. A. Jansson, "Collecting Large Mammals for Museum Exhibition" by R. H. Rockwell, "Angola as a Game Country" by Arthur S. Vernay, "With the Fuzzies After Ibex" by H. E. Anthony, and "Ruwenzori from the West" by James P. Chapin.

BACK NUMBERS OF "NATURAL HISTORY"

Early issues of **Natural History** are greatly desired by the Library. The gift of such issues will be greatly appreciated, and postage will be refunded to the donor. Address, LIBRARIAN, AMERICAN MUSEUM OF NATURAL HISTORY

TO READERS OF "NATURAL HISTORY"

Since NATURAL HISTORY is mailed as second-class matter, it will not be reforwarded by your postmaster. To avoid delay and the payment of additional postage, please notify us in advance, on the form below, of any change in your address.

The American Museum of Natural History
77th Street and Central Park West
New York, New York

CHANGE OF ADDRESS

..........................192

Name..

Former Address..

....

Present Address..

....

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

MEMBERSHIP MORE THAN NINE THOUSAND FIVE HUNDRED

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 9500 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843 in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herpetological survey of the Central Asiatic Expedition by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthorpe collection of mammals, in **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the incomparable work of Carl E. Akeley on the Eastman-Pomeroy Expedition in Kenya and Tanganyika; in **Polynesia**, the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies**, Douglas Burden's collection of giant dragon lizards; in **North America**, the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America**, collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. a total of 2,057 reels of motion pictures were lent oaned to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES**, some exclusively for members and their children, others for the schools, colleges, and 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.

NATURAL HISTORY

NOV.-DEC.
1927

AFRICAN
NUMBER

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

NEW YORK, N. Y.

PRICE FIFTY CENTS

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1928

Henry Fairfield Osborn, LL.D., President
George H. Sherwood, A.M., Director and Executive Secretary
Frederic A. Lucas, Sc.D., Honorary Director
Wayne M. Faunce, Sc.B., Assistant to the Director and Assistant Secretary
James L. Clark, Assistant Director, Preparation

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

Henry Fairfield Osborn, LL.D., D.Sc., Curator-in-Chief

Astronomy

G. Clyde Fisher, Ph.D., LL.D., In Charge

Minerals and Gems

Herbert P. Whitlock, C.E., Curator
George F. Kunz, Ph.D., Research Associate in Gems
Lea McIlvaine Luquer, Ph.D., Research Associate in Optical Mineralogy

History of the Earth

Henry Fairfield Osborn, LL.D., D.Sc., Honorary Curator-in-Chief

Fossil Vertebrates

Walter Granger, Curator of Fossil Mammals
Barnum Brown, A.B., Curator of Fossil Reptiles
Charles C. Mook, Ph.D., Associate Curator of Fossil Reptiles
George G. Simpson, Ph.D., Assistant Curator of Vertebrate Palæontology
William K. Gregory, Ph.D., Research Associate in Palæontology
Childs Frick, B.S., Research Associate in Palæontology

Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

Frank Michler Chapman, Sc.D., N.A.S., Curator-in-Chief

Marine Life

Roy Waldo Miner, Ph.D., Sc.D., Curator
Willard G. Van Name, Ph.D., Associate Curator
Frank J. Myers, B.A., Research Associate in Rotifera
Horace W. Stunkard, Ph.D., Research Associate in Parasitology
A. L. Treadwell, Ph.D., Research Associate in Annulata

Insect Life

Frank E. Lutz, Ph.D., Curator
A. J. Mutchler, Associate Curator of Coleoptera
Frank E. Watson, B.S., Assistant in Lepidoptera
William M. Wheeler, Ph.D., Research Associate in Social Insects
Charles W. Leng, B.S., Research Associate in Coleoptera
Herbert F. Schwarz, A.M., Research Associate in Hymenoptera

Fishes

William K. Gregory, Ph.D., Curator
Bashford Dean, Ph.D., Honorary Curator
John T. Nichols, A.B., Curator of Recent Fishes
E. W. Gudger, Ph. D., Bibliographer and Associate
Charles H. Townsend, Sc.D., Research Associate
C. M. Breder, Jr., Research Associate
Van Campen Heilner, M.Sc., Field Representative

Amphibians and Reptiles

G. Kingsley Noble, Ph. D., Curator
Clifford H. Pope, B.A., Assistant Curator
Bertram G. Smith, Ph.D., Research Associate
A. B. Dawson, Ph.D., Research Associate

Birds

Frank M. Chapman, Sc.D., Curator-in-Chief
Robert Cushman Murphy, D.Sc., Curator of Oceanic Birds
W. DeW. Miller, Associate Curator
James P. Chapin, Ph.D., Associate Curator of Birds of the Eastern Hemisphere
Jonathan Dwight, M.D., Research Associate in North American Ornithology
Elsie M. B. Naumberg, Research Associate

Mammals of the World

H. E. Anthony, M.A., Curator
Robert T. Hatt, A.M., Assistant Curator
George G. Goodwin, Assistant
Frederic A. Lucas, Sc.D., Research Associate
William J. Morden, Field Associate

Comparative and Human Anatomy

William K. Gregory, Ph.D., Curator
S. H. Chubb, Associate Curator
H. C. Raven, Associate Curator
J. Howard McGregor, Ph.D., Research Associate in Human Anatomy
Dudley J. Morton, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

Clark Wissler, Ph.D., Curator-in-Chief

Science of Man

Clark Wissler, Ph.D., Curator-in-Chief
Pliny E. Goddard, Ph.D., Curator of Ethnology
N. C. Nelson, M.L., Associate Curator of Archæology
Charles W. Mead, Honorary Curator of Peruvian Archæology
Harry L. Shapiro, Ph.D., Assistant Curator of Physical Anthropology
Margaret Mead, Ph.D., Assistant Curator of Ethnology
George C. Vaillant, Ph.D., Assistant Curator of Mexican Archæology
Erich Schmidt, Ph.D., Assistant Curator of Archæology
William K. Gregory, Ph.D., Associate in Physical Anthropology
Clarence L. Hay, A.M., Research Associate in Mexican and Central American Archæology
Milo Hellman, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

Roy C. Andrews, D.Sc., Curator-in-Chief
Walter Granger, Curator in Palæontology
Charles P. Berkey, Ph.D. [Columbia University], Research Associate in Geology
Frederick K. Morris, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
Amadeus W. Grabau, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

George H. Sherwood, A.M., Curator-in-Chief

Library and Publications

Ida Richardson Hood, A.B., Acting Curator
Hazel Gay, Assistant Librarian
Jannette May Lucas, B.S., Assistant Librarian—Osborn Library

Education and Public Health

George H. Sherwood, A.M., Curator-in-Chief
G. Clyde Fisher, Ph.D., LL.D., Curator of Visual Instruction
Grace Fisher Ramsey, Associate Curator
William H. Carr, Assistant Curator
Nancy True, A.B., Assistant
Paul B. Mann, A.M., Associate in Education
Frank E. Lutz, Ph.D., Research Associate in Outdoor Education

---

Charles-Edward Amory Winslow, D.P.H., Honorary Curator of Public Health
Mary Greig, A.B., Assistant Curator of Public Health

Printing and Publishing

Hawthorne Daniel, Curator, and Editor of *Natural History*
A. Katherine Berger, Associate Editor of *Natural History*

Public Information

George N. Pindar, Chairman
George H. Sherwood, A.M.
William K. Gregory, Ph.D.
Wayne M. Faunce, Sc.B.
Clark Wissler, Ph.D.
Hawthorne Daniel

Advisory Committee on Natural History Magazine

Hawthorne Daniel, Chairman
Henry Fairfield Osborn, LL.D., D.Sc.
Clark Wissler, Ph.D.
George N. Pindar
Frank M. Chapman, Sc.D.
Frank E. Lutz, Ph.D.
George H. Sherwood, A.M., *ex-officio*
A. Katherine Berger

NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

DEVOTED TO NATURAL HISTORY
EXPLORATION, AND THE DEVELOPMENT OF PUBLIC EDUCATION
THROUGH THE MUSEUM

AFRICAN NUMBER

DANIEL E. POMEROY, EDITOR

NOVEMBER-DECEMBER, 1927

[Published February, 1928]

VOLUME XXVII, NUMBER 6

NATURAL HISTORY

VOLUME XXVII CONTENTS FOR NOVEMBER-DECEMBER NUMBER 6

Published bimonthly, by the American Museum of Natural History, New York, N. Y. Subscription price $3 00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

THE PEAK OF MT. MIKENO AT SUNSET

Painted by W. R. Leigh while on the Eastman-Pomeroy-Akeley East African Expedition of 1926-27

NATURAL HISTORY

VOLUME XXVII NOVEMBER-DECEMBER, 1927 NUMBER 6

The Vanishing Wild Life of Africa

BY HENRY FAIRFIELD OSBORN

President of the American Museum of Natural History

As clearly explained in previous numbers of NATURAL HISTORY and more fully in the present number, the dominant motive in the African Hall is the lifelike and artistic presentation and preservation for all time of the manifold forms of animal and plant life now sorely threatened with reduction or actual extinction. The ideals of this great Hall seem now destined of fulfillment and, when carried into execution as we hope within the next decade, will through the creation of a new and nobler sentiment tend to check the present wanton destruction of African life.

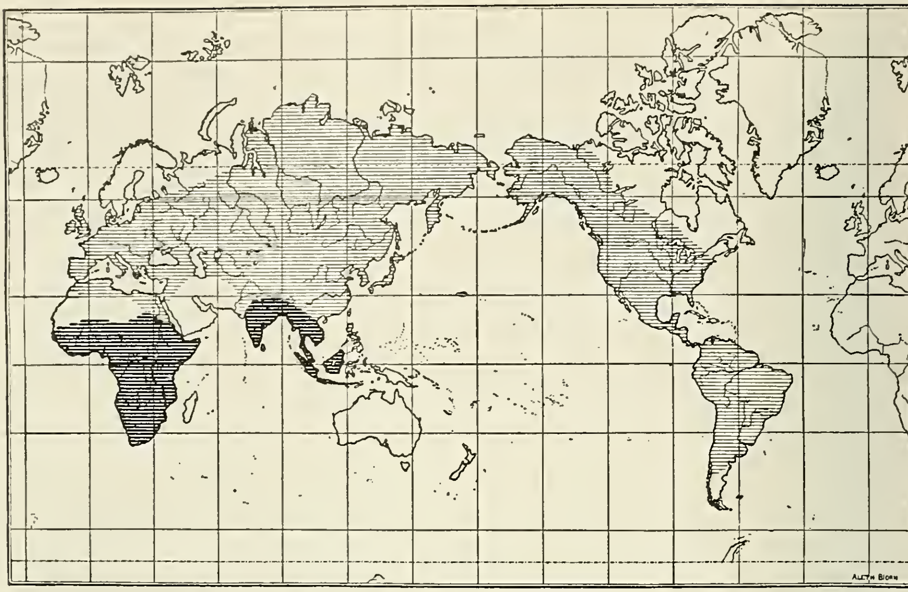
THE biography of a great continent cannot be fully written in the words of a naturalist or depicted by the brush of an artist even as gifted as Millais, the author of *A Breath from the Veldt*. It is fortunate that hundreds of explorers, sportsmen, and naturalists have recorded the tremendous impression made by the wondrous life of Africa as it was before man, the great destroyer, entered this earthly paradise. It is fortunate that through early travelers and explorers, we know of the myriads of superb animals, many, like the quagga, now extinct, which roamed the arid plains of South Africa. A few quadrupeds surviving in the South African preserves and the vast surrounding wastes, wholly swept clear of life, give us a pathetic picture of the doom which is awaiting their noble fellow species of the North. Only a palæontologist like myself can measure the full extent of the coming calamity to science and to art when the entire wild life of Africa shall have vanished and the few remaining remnants shall survive securely in the state and national preserves established by England and Belgium.

Also a palæontologist alone can realize to the full that a million years ago the entire world, including every continent, was filled with these glorious animals which it had taken millions of previous years to create. For example, when we first observe the tiny ancestral mastodon without tusks or proboscis, barely a yard in height, which browsed along the river-sides of northern Africa and gave birth to the entire order of Proboscidea, can we appreciate to the full the majesty and dignity of the existing African elephant, with its superb tusks, marvelously muscular trunk, and noble stature.

In Africa alone, of all the continents, there survive the chief offspring of 30,000,000 years of mammalian evolution.

It is fortunate that during the years 1895–96 Carl Akeley himself received the full and great impression of the wondrous life and surrounding scenes of Africa during the Field Museum Expedition, under the leadership of our Daniel Giraud Elliot,[1] for, even thirty years ago, it was not fully apparent with what rapidity the teeming life of a great continent can be destroyed by modern firearms and other methods of elimination. Even so late as 1912, when Akeley returned to Africa to secure the great African elephant

[1]Originator of the American Museum Bird Collections; for a twelve-year period (1894–1906) Curator in the Field Museum.



Worldwide former distribution of the Proboscidea, elephants and mastodonts, indicated in light shaded lines. Present geographic distribution of the surviving proboscideans in heavy shading; the African elephant, *Loxodonta*, in Africa, the Indian elephant, *Elephas*, in Southern Asia. In past time the Proboscidea included 13 families, 60 genera, and 350 species. The order is now reduced to 2 genera, 2 species, divided into fairly numerous subspecies

group, the coming doom of the African game mammals was not fully apparent. The recent Report of the Eastman-Pomeroy-Akeley East African Expedition of 1926–1927 is full of observations of the destruction which has taken place during the last fifteen years, as the following excerpt shows.

> Mr. Akeley soon found exactly the location he had in mind for the Klipspringer Group—a kopje, which consisted of up-heaved rocks of remarkable contour and of vivid color decorated with moss, flowers, shrubs and rank-growing grass, the typical home of the tiny, rock-dwelling antelope, the klipspringer. Below, on all sides, extended the vast plains of Africa, where once the great game herds ranged in tens of thousands, but where today, tragically enough, they have practically vanished. On the far northern horizon when it was very clear and when, as rarely occurs, there was no atmospheric haze, we could see Mt. Kenya's sharp pinnacle and glacier. Almost the same distance away to the south, Kilimanjaro's snowy dome was visible. A profusion of multi-colored flowers and a great variety of tropical birds surrounded us. The two artists spent every available moment in making color records of everything from the shrubs and tiny flowers to be reproduced in the group, to the landscapes to be used as studies for the background.

This paragraph reveals the full *biographic* purpose of the African Hall. Millais in his delightful *A Breath from the Veldt* had described and depicted the marvelous leaps of the klipspringer (*Oreotragus oreotragus*), the supreme saltator or jumper of the animal world. But here, in the fulfillment of Akeley's dream, is the nature lover, the naturalist, the taxidermist, the botanist, the artist, in conspiracy to reproduce the entire beauty of perfect animal form, of light, of color, of atmosphere, even of the distant snowy dome of Kilimanjaro!

The beauty and romance of these animals are so enthralling that even the Museum collector is held back from the

Model for the Gorilla Group prepared under the direction of James L. Clark, assistant director. The gorillas were obtained by Carl Akeley on a special trip to Africa in 1921. On his return he personally prepared and mounted the animals. The background was painted from color studies by W. R. Leigh

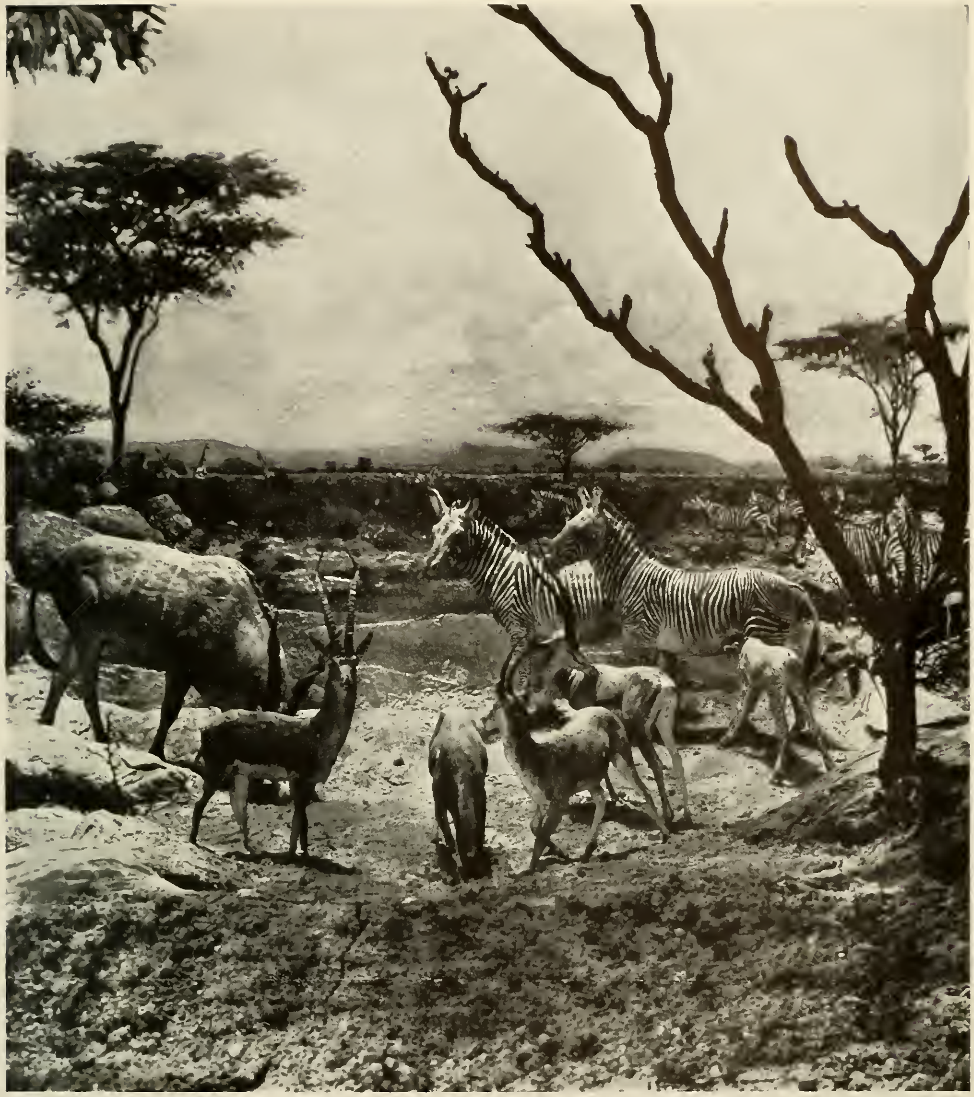
Model for the Buffalo Group, prepared by Robert H. Rockwell under the direction of James L. Clark, assistant director. Foreground and background from the color studies of W. R. Leigh

PANORAMIC VIEW OF THE MODEL

Prepared by Louis Jonas under the direction of of James L. Clark, assistant director. Foreground and background from color studies by A. A. Jansson

killing. It is told of Mr. Eastman that after watching a beautiful group of giraffes, he declared that he admired them so much he could not possibly shoot one. So was Akeley moved to compassion in the case of the klip-springer.

About this time I located a family of klip-springer on a rock pedestal thirty feet high and about twenty feet in diameter. Mr. Akeley built a blind and from it we secured excellent still photographs and motion pictures, the only ones, so far as he knew, that had ever been made of these dainty little antelope. As we walked around the base of this sheer rock pedestal, we could not imagine how these little, sure-footed animals could leap to the top. There was apparently no foothold whatsoever. Although our camp was near by and there was considerable noise



FOR THE WATER HOLE GROUP

The animals, which are shown gathered about the water holes, include Grant's gazelle Grant's zebra, Grevy's zebra, eland, giraffe, and oryx

from our black boys, as they shouted to each other, or from our cook, as he summoned us to meals with the beating of the frying pan, yet they were apparently wholly unconcerned in their secure fortress. The two klipspringer were apparently mother and son. Although a female was greatly needed for the group, Mr. Akeley was unwilling to take this little mother who had delighted us with her graceful poses. We left the little family unmolested.

Of the disappearance of the most graceful of all antelopes, the impalla (*Aepyceros melampus*), it is recorded:

A few rods below the family of klipspringer, a herd of impalla grazed peacefully or leaped over rocks and small trees in sheer ecstasy of living. On the outskirts of the herd were a few straggling kongoni, *Alcelaphus cokii kongoni*. Fifteen years before when Carl Akeley had camped here and when Theodore

A PANORAMIC VIEW OF THE

Prepared by Robert H. Rockwell under the direction of James L. Clark, assistant director. Foreground and background from color studies by W. R. Leigh

Roosevelt had hunted in this same locality, there were hundreds and thousands of antelope, but with the incoming of the settler and the increasingly great desire on the part of the white man to slaughter, the herds have vanished. In the whole region, we saw no more than half a dozen wildebeeste, and even in the Game Reserve south of the Kenya and Uganda Railway, the herds of game are small as compared to what they were fifteen years ago.

The difficulty experienced by the Eastman-Pomeroy-Akeley East African Expedition in securing the material for the Buffalo Group (*Syncerus caffer*), adds a new chapter to the history of extinction.

We hunted for several days, but the herd, having been shot into, had gone back into the swamp and was unwilling to appear. This country between the Theba and the Tana rivers, once alive with buffalo, now tells the same story of game extermination so apparent in other parts of Africa. The herd, numbering perhaps fifty or sixty, rarely comes out of the swamp except late in the night. They return to the swamp at dawn. An occasional native now came into camp to report that a large buffalo had been seen at a distance from the swamp, but on following up the clue we found the reports without foundation. It proved a tedious and disheartening hunt.

Mr. Leigh found conditions for painting very poor. The day after we arrived, Kenya, the dominant feature of the Buffalo Group background, became enshrouded in a cloud

MODEL FOR THE PLAINS GROUP

Included in this group of animals of the plains are Thomson's gazelle, Robert's gazelle, kongoni, Grant's zebra, white-bearded gnu, topi, and dik dik

mass. While waiting for Kenya's pinnacle to clear, he worked at the foreground of swamp and at the middle background of Kenya's foot hills from which rose the smokes of a hundred Kikuyu fires. Rain, mist, haze and murky atmosphere were some of the trials of our daily life. In camp on the edge of the swamp, the mosquitoes were bad past belief or the previous experience of any of us.

We overtook Mr. Eastman at Embu, where his party had hunted without success, and then we all moved on to Kagio and the Theba River. Messrs. Eastman and Pomeroy made their camp near by. The hunt was short. Mr. Eastman obtained a good cow buffalo for the group. Here the animals are so wild and the country is so impossibly rough for motor transport that specimens are difficult to obtain.

During a two-day trip down the Tana River, which in 1912 was swarming with game, Akeley found it a complete waste. Returning without success because he had secured no specimens whatever, the full realization of the fast vanishing wild life of Africa came over him and he wrote to Director Sherwood,

> I have not appreciated the absolute necessity of carrying on the African Hall, if it is ever to be done, as I now do after this painful revelation. *The old conditions, the story of which we want to tell, are now gone and in another decade the men who knew them will all be gone.*

The above citations, chiefly from the Report of the Eastman-Pomeroy-

Year	Collector	Locality	Popular Name	Scientific Name	Specimens
1909	Carl E. Akeley Theodore Roosevelt	Kenya Colony	**African Elephant**	*Loxodonta africana peeli*	Two males, cow, calf
1911	Lang-Chapin	Belgian Congo	**White Rhinoceros**	*Ceratotherium cottoni*	Male, cow, calf
1921	Carl E. Akeley	Belgian Congo	**Gorilla**	*Gorilla beringei milensis*	Two males, two females, young
1926	Eastman-Pomeroy-Akeley East African Expedition	Tanganyika Territory	**Lesser Koodoo**	*Strepsiceros imberbis australis*	Three males, two females, young
1926	Eastman-Pomeroy-Akeley East African Expedition	Tanganyika Territory	**Greater Koodoo**	*Strepsiceros strepsiceros bea*	Two males, two females, young
1925	Arthur S. Vernay	Portuguese West Africa	**Sable Antelope**	*Egocerus niger variana*	Two males, two females, young
1926	Eastman-Pomeroy-Akeley East African Expedition	Kenya Colony	**Klipspringer Group**	*Oreotragus oreotragus schillingsi*	Four Klipspringer Six Reedbuck (*Redunca fulvorufula chanleri*) Five Baboons (*Papio furax*) Five Hyrax (*Heterohyrax brucei borana*)
1926	Eastman-Pomeroy-Akeley East African Expedition	East African specimens for Museum collections	**Lion**	*Felis leo massaica*	Two males, two females, three young
1926	Eastman-Pomeroy-Akeley East African Expedition	Tanganyika Territory	**Wild Dog**	*Lycaon pictus lupinus*	Nine specimens
1926	Eastman-Pomeroy-Akeley East African Expedition	" "	**Plains Group**		One Zebra (*Equus quagga granti*) Six Gnu (*Connochaetes albojubatus*) Two Hartebeests (*Alcelaphus cokii*) Three Robert's Gazelle (*Gazella granti robertsi*) Four Thomson Gazelle (*Gazella thomsonii*) Two Topi (*Damaliscus jimela*) One Dik dik (*Rhynchotragus kirkii*)
1926	Eastman-Pomeroy-Akeley East African Expedition	Kenya Colony	**Water Hole Group**		Three Giraffe (*Giraffe camelopardalis reticulata*) Four Grevy's zebra (*Equus grevyi*) Three Oryx (*Oryx beisa annectans*) Three Grant's Gazelle (*Gazelle granti*)
1926	Eastman-Pomeroy-Akeley East African Expedition	" "	**Buffalo Group**	*Syncerus caffer radcliffei*	Two males, female, young

COLLECTORS AND DONORS OF AFRICAN HALL GROUPS

Akeley East African Expedition, supplemented by personal letters and records of individual members of the Expedition, reveal what an Herculean effort Akeley was making in this final achievement of his life. Akeley, like Moses, passed away when the promised land was within his sight, and the sadness of his final hours was doubtless alleviated by the certainty that surrounding him were those who would surely carry out his great purpose. In those dramatic and tragic days it fell upon other members of the Expedition, and especially on Mr. Daniel E. Pomeroy and Mrs. Akeley, to help overcome one difficulty after another and carry the Eastman-Pomeroy-Akeley East African Expedition through to its triumphant close.

Of the thirty-six groups destined to fill the main floor and the gallery of the Akeley African Hall, nine were donated and financed between the years 1909 to 1927, through the energy and generosity of the men who led the various expeditions concerned in the assemblage of these nine groups.

THE NATURALIST AND THE ARTIST IN AFRICA

The wonderful moving and still pictures of African wild life by Martin Johnson are also absolutely essential to the realistic design and completion of the African Hall. The only artist who has even approached the work of Martin Johnson in the past is John Guille Millais to whose wonderful volume, *A Breath from the Veldt*, I have already referred. Through marvelous powers of observation and of rapid note taking, he depicted the unbelievable attitudes of the springbuck and of the koodoo, of the impalla, of the reedbuck, and of the sable antelope. Little did he imagine during his tour of South Africa that in the brief space of thirty years his volume would become one of the priceless records of the past animal glory of that region. Fortunately for us, he avoided the ways of the sportsman and of the naturalist and chose the even more truthful way of the artist, as expressed in the following lines of his preface:

> Let me say then at once that though they are occupied in the main with dissertations on, and adventures in pursuit of big game, I have endeavoured as far as possible to avoid trespassing on the domain of the standard authorities on this subject. My object has been rather to supplement from personal observation what is already known of such animals as I came across during a recent tour in South Africa; to present to the best of my ability a true picture of life in that country, whether of man, beast, or bird; and to give to the sportsman of the period what help I can as a guide to the hunting grounds, and how to work them to advantage.

Of the earlier and more old-fashioned works, we have Andrew Smith's *Illustrations of the Zoology of South Africa*, which carries us way back to his expedition into the interior of South Africa in the years 1834, 1835, and 1836, sixty years prior to the artistic journey of Millais. At that time the now extinct quagga was still living, but the artist accompanying Smith's expedition did not figure it. In the Vernay-Angola Expedition, especially outfitted by Mr. Vernay for the sable antelope, this formerly abundant animal was found to be excessively rare, and only by the greatest good fortune at the last moment did Mr. Vernay come across a splendid sable antelope bull for the group which he is presenting to the African Hall.

Whereas South Africa was early opened to the explorer, the agriculturist, the sportsman, and the naturalist through the healthful entrance by the Cape of Good Hope, the last great Central African refuge of the mammalian life of the world was protected by the deadly climate of the African coasts and tropical interior and by the impenetrable deserts of the north. It is fortunate that the artistic side of this wondrous life region has been preserved through the new art of photography and through the early achievements of C. G. Schillings in flashlight photography, of Dugmore and Clark in instantaneous photography, succeeded by the photographic work of the expeditions of Paul Rainey, of James Barnes, of Theodore Roosevelt, and crowned by the five years' work of Martin Johnson.

These and other priceless photographic records gave all except color to the African picture. That color is no less important than form in conveying the beauty and grandeur of African life. From the first, Akeley planned for the services of colorists, and when the final moment came and his ideal was financed, he was fortunate in securing two extremely talented painters, W. R. Leigh and A. A. Jansson, who have brought back the color scheme of all those parts of Africa from which the great animal groups are chiefly drafted. Thus through the union of generosity and artistic genius, the African Hall becomes the Valhalla of the vanishing wild life of the Ethiopian region.

Would that Theodore Roosevelt, ardent friend of Akeley and author of *African Game Trails*, published in the year 1910, and co-author of *Life Histories of African Game Animals*, published in 1914, could have lived to see the Roosevelt Memorial Hall and have passed through its portals into the Akeley African Hall, there to meet Carl Akeley and witness his joy in the realization of the great dream of his life.

BIBLIOGRAPHY

Akeley, Mrs. Carl E: 'Report of the Akeley-Eastman-Pomeroy African Hall Expedition of the American Museum of Natural History, 1926–1927.'

Millais, John Guille: 'A Breath from the Veldt,' London, 1895.

Smith, Andrew: 'Zoology of South Africa,' Mammalia, London, 1849.

Roosevelt, Theodore: 'African Game Trails,' New York, 1910.

Roosevelt, Theodore, and Heller, Edmund: 'Life-Histories of African Game Animals,' 2 vols., New York, 1914.

Carl Akeley often described this as the most beautiful spot in all the world, and chose it as the background for the Gorilla Group. The volcanoes Chaninagongo and Namlagira smoulder in the distance. Photograph by Mary L. Jobe Akeley

In the Land of His Dreams

THE LAST CHAPTER OF CARL AKELEY'S 1926 AFRICAN EXPEDITION

By MARY L. JOBE AKELEY

AFTER months of strenuous preparation and planning Carl Akeley and I sailed for Africa in January, 1926, to begin the work of the Eastman-Pomeroy-Akeley East African Expedition.

A fund to finance the collection and construction of six important groups for the African Hall of the American Museum of Natural History, of which Mr. Akeley had so long dreamed, had been contributed by Messrs. George Eastman, Daniel E. Pomeroy, and the late Colonel Daniel B. Wentz. Happy in the realization that these groups would actually begin his great work, and keenly appreciative of the generosity which had made the undertaking financially possible, Mr. Akeley planned in a single trip to Africa to secure specimens, scientific data, accessory materials, and background studies for all six of these exhibits. For the first time he was to be accompanied into the field by a staff of two artists, Messrs. William R. Leigh and A. A. Jansson. In addition, two Museum preparators, Messrs. R. H. Rockwell and R. C. Raddatz, were to join him in Africa, but even with their assistance the task he had set for himself was colossal.

Mr. Akeley considered the Kivu volcanoes of the Belgian Congo the most beautiful of all Africa's wonder spots. It was here in 1921 that he had secured gorillas to be mounted in one of the four corner groups for African Hall. At that time his enjoyment of the scenic splendor of these volcanoes was marred only by his regret that no artist accompanied him to paint a background for his group and he keenly anticipated his return. Meanwhile, the creation by Belgian Royal Decree of the Parc National Albert, with the Gorilla Sanctuary at its heart, to preserve for all time the flora and fauna of this region afforded him intense satisfaction.

Mr. Akeley's old friend, M. Edmond Leplae, Director General of Agriculture in the Belgian Ministry of Colonies, was deeply interested in Mr. Akeley's work in the Gorilla Sanctuary in the Belgian Congo and, as we were passing through Brussels, requested him to be prepared for an audience with King Albert. The next day we were summoned to the Palace and presented to the King and to Prince Leopold. Both were highly appreciative of my husband's plans for conservation of the gorilla, inquired concerning our forthcoming expedition, and expressed the desire to know the results of our work on our return. Subsequently, the Belgian Government formally commissioned Mr. Akeley to make a general survey of the Parc National Albert, to continue the study of the flora and fauna, especially of the gorilla, and to suggest proper locations and means for the erection of laboratories in a central station of the Parc. His intense interest in the fulfillment of this mission, as well as his eagerness to provide the correct setting for one of the four major groups of African Hall, made him regard the work in the Belgian Congo as necessary to the completion of the African Hall expedition.

Autumn of 1926 saw the conclusion of the major part of the expedition's program. In the Lukenia Hills, the historic home of the tiny rock-dwelling klipspringer, studies had been made for the background and plant accessories, and part of the specimens had been taken for the Klipspringer Group. As this region is no longer a game country, it was necessary to complete the group with specimens taken by Mr. Rockwell on a hunt in the Kedong. During four strenuous weeks on the Northern Uaso Nyiro in the Northern Frontier of Kenya Colony, Mr. Akeley and Mr. Rockwell had collected the bull, cow, and young giraffe, as well as zebra, oryx, and various small antelopes for the Water Hole Group, while the painters had reproduced for its background a scene which the pioneers of the country frequently refer to as "The Gateway of the Northern Frontier,"—a fine prospect of plain and mountain range. At the Tinga-Tinga, near Kagio, between the Theba and the Tana, we had joined Mr. Eastman and Mr. Pomeroy in a short but arduous hunt for buffalo. While the artists and Mr. Rockwell remained there to finish landscape studies and the collection of specimens, we joined Messrs. Eastman, Pomeroy, and Johnson in Western Tanganyika where remarkable motion-picture records of lions were made. During the interims of photography, Mr. Akeley seized the opportunity to collect specimens for an additional exhibit, the Plains Group, and furthermore, by a stroke of good fortune, collected an entire band of nine wild dogs, thus unexpectedly securing specimens for a group long desired. Backgrounds for these groups were also painted. Altogether, the expedition returned with materials for ten groups instead of the six originally planned. The story of these first seven and a half months of Carl Akeley's last expedition in Africa is to be told in a series of articles in *The World's Work*.

In the midst of his collecting in

Western Tanganyika and following the extreme exertion of these months in the field, Mr. Akeley had an attack of fever. It was a great disappointment to him that because of this illness he was prevented from accompanying Mr. Pomeroy to Eastern Tanganyika to obtain greater koodoo specimens, a trip long planned and keenly anticipated. His last words to Mr. Pomeroy at Nairobi were, "Well, Dan, you will never know how sorry I am not to go on the koodoo hunt with you." After two weeks in the Kenya Nursing Home in Nairobi, where the physician pronounced his case one of complete exhaustion, and not of tropical disease, he was able to come to our base house in Nairobi, where he spent the next fortnight recuperating somewhat, but for the most part preparing for the trip to the Congo which he was so eager to begin.

In Brussels Mr. Akeley had suggested to the American Ambassador, Mr. William Phillips, that it would be of value to scientific investigation both in Belgium and in America if Dr. J. M. Derscheid of the Congo Museum at Tervueren, who was then at work upon a topographical map of the Kivu, should join us for our expedition to the Parc National Albert. The Ambassador cordially endorsed this plan and ultimately brought about its consummation with the King of the Belgians. Doctor Derscheid joined us in Nairobi late in September.

On October 14, 1926, we started for the Belgian Congo with three motor lorries and one small car. In addition to Doctor Derscheid, our party included Messrs. Leigh and Raddatz, and Mr. Akeley's faithful Kikuyu gunboy, Bill. A week later at Kampala it was necessary to do the usual overhauling of cars, secure information about the roads of Western Uganda, and the possibility of obtaining porters at Kabale, at the end of the motor road. West of Kampala we found some badly washed roads and broken bridges which had to be repaired. Although Mr. Akeley had by no means

The gorilla nest which was brought to New York as one of the accessories for the Gorilla Group. Photograph by Mary L. Jobe Akeley recovered his strength, he worked with his usual old-time vigor on all this heavy labor. One of the worst jobs was getting up the hill east of Kabale. This ascent was accomplished by having several score of natives push us and by attaching a cable to each lorry and using the small car to pull each in turn.

At Kabale, the District Commissioner, Captain Tufnell, and the Assistant District Commissioner, Mr. Vaughan Jenkins, welcomed us cordially and gave us every assistance in their power to bestow.

On Thursday, October 28, we were packed and ready for our two hundred porters, whom we found prompt, quick, and strong. We moved our outfit from Kabale across Lake Bunyoni to Bufundi. Four long days on foot over the mountains of Western Uganda followed. On Monday, November 1, we reached the Congo border where the splendidly kept roads of Uganda, all of which are traveled and frequently tree-shaded, gave place to muddy, overgrown trails.

Our marches, accomplished without bicycle or chair, had averaged about fifteen miles a day and we were all extremely tired. On November 1 there were many hills to climb, the heat and humidity were almost unbearable, and Mr. Akeley became faint and ill and too weak to walk. He was carried in an improvised hammock about four miles. In a thunder storm, Bill and I, with two or three boys, made him a little camp three miles east of Rutshuru. The remainder of the safari with Messrs. Leigh and Raddatz had outdistanced us and had gone into Rutshuru. Fortunately, Bill was able to recover one tent and sufficient food for the night from the rear ranks of the porters. The next day Mr. Akeley felt better and walked into Rutshuru.

Inability to secure porters delayed us there until Saturday, November 6. The Catholic church was being dedicated and all the natives were celebrating. These were strenuous days for Mr. Akeley in Rutshuru. He had trouble to get Congo currency. He had to obtain permits for entrance into the Congo, pay taxes on all our possessions including our guns, and go through the usual long and detailed formalities. At the time of the dedication of the Rutshuru church, he spent one entire morning in photographing the church ceremonies and afterward in photographing the native dances of the Batwa, the semi-pygmies of the Congo.

The Congo porters are not big and upstanding like the natives of Uganda. Many were lame and in bad physical condition. As they can carry only thirty or forty pounds we had to repack all our loads for them—a big task in itself. The second day after leaving Rutshuru, we reached the White Friars' Mission at Lulenga. Here Mr. Akeley and Raddatz spent three strenuous hours repairing the Fathers' motor cycle. We departed in a cold, heavy drizzle, which continued until we reached camp at Burunga at twilight. It was here that Mr. Akeley in 1921 had secured his gorilla guide and porters to take him up into the volcanoes, but the old Chief Burunga, who aided him at that time, had since been banished from the section, because of the commission of petty crimes. However, several of Mr. Akeley's former native boys came into our service, and later on his old gorilla guide, M'Guru, hearing that Mr. Akeley had returned to the country, joined us in our camp at Rueru, at the upper edge of the bamboos at an altitude of 9500 feet.

On our way up to the Rueru camp

we encountered cold and persistent rain. We often waded in mud above our boot-tops. The trail was so steep and slippery that progress was indeed difficult. November 9 was cold and wet, as were almost all of the succeeding days while we were in the Kivu. It rained so hard on the ninth, tenth, and eleventh that it was inadvisable to move out of the Rueru camp. Our guides, however, used the time to cut a trail through the dense undergrowth up to Mr. Akeley's old camp on the saddle between Mikeno and Karissimbi. On Friday, November 12, Raddatz, in charge of the porters, moved the main part of our provisions to the high camp and Doctor Derscheid followed on November 13. That Friday Mr. Akeley felt very weak and on the thirteenth spent the day quietly in bed, reading and sleeping. On the fourteenth he felt better and we moved the remainder of the camp up to the saddle. He walked from our camp across the cañon and up the first steep grade; he was then carried part of the way, but, as he said he felt very cold, he walked the last three miles into camp. A cold rain fell during the whole trip.

When we reached the camp, he was very much exhausted; nevertheless he related to Doctor Derscheid and me several of his experiences with gorillas in 1921. The atmospheric temperature stood slightly above freezing; there was a heavy mist and the wind blew violently down from the mountain top. We pitched our camp and got our little charcoal stoves going. He was unable to leave the tent thereafter.

It will be evident to even the casual reader of this article, as well as to our friends who knew what this expedition meant to my husband and to me, that it is well nigh impossible for me to chronicle the remaining events of the Congo expedition; to tell of the two and a half days of exhaustion which my husband suffered, following our arrival at the Mikeno camp, and of the sudden end on November 17; of how we laid his mortal body away in a tomb of solid volcanic rock in the midst of the country he loved, the "most beautiful spot in all the world"; of how we both had felt, on the entire expedition, that life for us was only at the beginning; and of how to me, life now seemed to have come to an abrupt ending; of how, ultimately, I found strength to go on alone, to complete to the best of my ability his unfinished work; and of how, in all the succeeding months of work, his spirit urged me on beyond any doubt or denial.

I can only add here an extract from a letter which I wrote on November 24, 1926, from our Mikeno camp to our close friends, Mr. D. E. Pomeroy and Mr. George H. Sherwood:

> He seemed always eager to push on to his goal—the *Gorilla Sanctuary*—remarking at almost each camp, "This is a beautiful spot and one I would like to spend a day in, were it not that every day in the Kivu is *so precious*, and there the beauties of forest and mountain surpass all this ten-fold. I sometimes felt he was torn between the physical desire to rest and the great urge of reaching the Kivu goal. None of us had a chair and he often remarked that he had never yet been carried on safari, as seems to be customary.
>
> The day we came up to this camp, he enjoyed every bit of the forest and as I walked beside him, he would say, 'Mary, this is the Kivu at last. Here the fairies play!' or, 'Isn't this forest the most beautiful, the most ancient in all the world?'
>
> Raddatz helped me wonderfully at the end—as he has on the whole trip. We were able to make a vault eight feet deep, in the lava gravel and rock. We made him a coffin of solid, native mahogany, metal lined. We lined the vault with closely set wooden beams, and tomorrow we are making a roof of thick

mahogany planks over it all, to shed the water. The plot itself is high, with natural drainage on every side. The tomb will finally be covered by a pyramid of lava rock and we hope to find a slab on which we can engrave his name. (Raddatz subsequently covered the grave with a slab of cement ten by twelve feet and five inches in thickness. We obtained the cement from Captain Tufnell in Kabale, but it was necessary to send our porters a second time, as nearly all of the first supply was spilled or more probably thrown away en route by the natives who carried it. Later my porters brought from Captain Tufnell in Kabale sixteen loads of Bermuda grass to be planted on the outside of the stockade to prevent the encroachments of the jungle. The cement slab bears the name CARL AKELEY, and the date, NOVEMBER 17, 1926). The whole plot will be surrounded by a close stockade of eight-inch trees, and over this we shall plant a vine which grows quickly and is as strong almost as steel. This will be a strong fortress against the herds of buffalo and elephant which aer numerous here. Doctor Derscheid, Raddatz, and I have worked every hour of daylight to give him the best home we could build, and he was buried as I think he would have liked with a simple reading service and a prayer.

A giant parasite collected by R. C. Raddatz as an accessory for the Gorilla Group. Photograph by Mary L. Jobe Akeley

He often said he wished to "die in the harness," and "to be buried in Africa." Whether he had any awareness of the end before the hemorrhages came, I cannot tell. To me he seemed far less ill than in Tanganyika, but he was always weaker and often expressed the wish "just to sleep." He often said he "was doing more in the nine months of this expedition than he had previously done on a two years' expedition.

All of the work of the Congo expedition was now before us. There seemed to be only one solution, to remain and complete the work so far as we all were able. We located the scene from which Mr. Akeley had wished the gorilla background painted, the photograph of which he had often shown me, and which he considered the most impressively beautiful scene in all Africa. On the morning of the twenty-first Mr. Leigh's camp was moved there and he began his work. During the succeeding days, Doctor Derscheid accompanied by Bill and twenty porters, guides, and askaris, made a ten-day survey trip around Mikeno. With Bill's help he succeeded in getting within two hundred feet of the top of Mikeno, a hitherto unaccomplished feat and one fraught with danger owing to the steepness of the slippery, moss-grown rocks. Later he climbed Karissimbi in heavy storm, reaching the summit alone.

Thereafter the weather continued cold; the clouds enveloped us; frequently light rains fell. My fifty porters were practically naked and their provisions so short that it was with great difficulty I kept them on the job. My cook, who knew a little of the Congo language, stood by me and was of the greatest assistance in Bill's absence. Each day the black boys had to cut a large supply of wood for our fires and for their own fires in their little huts, which they constructed of sticks and the green undergrowth. The water supply in the near-by swamp proved insufficient, just as it had in 1921 when Mr. Akeley camped there; consequently, the porters had to carry our water from a pool in the cañon near the Rueru camp. Each day it was necessary for us to send Mr. Leigh's meals and water up to his camp.

The problem of our porters' food was serious. The average Congo porter eats beans, but the headmen, the askaris, and our own East African boys demanded rice. I, therefore, had to have a group of porters almost constantly in transit to and from Kisenyi, the Lulenga Mission or Rutshuru in order to obtain any available food. The small chief at Burunga visited us occasionally and considerately sent a few potatoes, two sheep, and one small ox. The chief at Kigezi finally sent a fair supply of food, but there were times when I felt thoroughly ashamed to ration out such small supplies to our porters as I was compelled to do and to receive in turn their disappointed looks and often their spoken complaints. One day when there was no food whatsoever in camp for them, I gave them sixty pounds of our own white flour. They seemed to appreciate it and to sense that I would not willingly see them go hungry.

All the porters were asking to go back to their homes but I held them by promising them relief in a week or ten days. I then sent an urgent request to the authorities at Rutshuru and to the chief at Kigezi for more porters. Although relief did not come in the appointed time, the porters stayed with me. In fact, their manifestations of loyalty and readiness to help in my extremity amazed me. Only one deserted. I planned their work so that fifteen worked for a period of two hours while the others remained in their little huts by the fires. Then another shift came on and so on throughout the day.

We kept ourselves warm by wearing our heaviest clothing and by having little charcoal stoves going when we were in our tents. Fortunately, the natives made good charcoal.

During the same time of year while in the Kivu in 1921, Mr. Akeley had had much fair weather even in the midst of the rainy season. In contrast we had very little sunshine during a period of seven weeks, but that little, when we had it, was utilized to the best possible advantage. Mr. Leigh completed his paintings and made color studies of the foreground accessories of vegetation for the Gorilla Group. Doctor Derscheid continued his survey work in or near the camp or on the plains below. Raddatz worked faithfully and effectively. He made more than two hundred plaster casts for the reproduction of the vegetation, drying them with difficulty. Raddatz and I went frequently into the field near Mr. Leigh's camp for the plant accessory specimens. Here also I obtained a complete set of photographs of these accessories and of the forest and mountain landscape.

In addition to the plaster casts, Raddatz prepared formalin specimens of twenty-three plants. Bill made a collection of birds and I obtained a gorilla nest and a large quantity of moss and bark for the gorilla foreground.

We removed the upper part of the old tree, at the base of which the big gorilla fell in 1921, and collected sections of other small trees, to be used as accessories for the Gorilla Group.

In the bamboos below our camp we saw many signs of elephant, while buffalo came into our swamp to drink. Leopards were numerous. Frequently at night I heard one walking around my tent. His tracks were visible within two or three feet of my doorway each morning. We planned to set a trap for him, but it seemed that we were all too busy or too tired at night to do it.

We found many gorilla nests and fresh tracks of gorillas within two miles of our camp. Once, Doctor Derscheid and Bill were in the midst of a large band within good photographic range. They reported them as gentle and only mildly curious even when followed for more than an hour. Subsequently, Doctor Derscheid surprised at very close range a large band. One old male resented the intrusion, charged, and it was necessary for Derscheid to stop him with his gun. The gorilla, although barely scratched on the shoulder, turned aside quickly and the whole band disappeared.

When our porters arrived a day late, they proved insufficient to carry our collection and our outfit out of the Kivu, and we had to move it in relays, down the mountain-side. Finally, when we reached Rutshuru, I persuaded the local king to give me a few more porters to send back for the extra loads.

At this lower altitude the heat was intense, in great contrast to the cold rains of Mikeno.

It remained for us to transport our outfit to Lake Hannington in the Great Rift Valley, Kenya, to obtain the background and accessory studies for the greater koodoo group. The story of this part of the expedition will be told in a later issue of this magazine. It was the sixth of February, 1927, when we returned to Nairobi to conclude expedition affairs and prepare for our homeward journey.

In April when Mr. Akeley and I had been at Government House, he had promised the Governor, His Excellency, Sir Edward Grigg, that he would exhibit all the paintings of the expedition before our departure for America. Accordingly, on February 18, 1927, at the Legislative Hall in Nairobi, the exhibition was held under the auspices of the Kenya Arts and Crafts Society. As the Governor was on leave in England, it was formally opened by the acting governor, Sir Edward D. Denham, who in his speech paid high tribute to Mr. Akeley's genius and devotion to his work. Judging by the attendance and appreciation of the press, the exhibition was a revelation to the residents of Kenya of the beauties of Africa, and was well worth the effort involved. Many requests for photographic copies of these paintings have since come to me.

En route to America, I again visited Brussels at the request of His Majesty, Albert, King of the Belgians. Here, in accordance with Mr. Akeley's wish, I presented to His Majesty, on the occasion of his birthday, one of Mr. Leigh's paintings of the Parc National Albert, and at his request gave him a verbal report of the expedition in the Belgian Congo.

At a General Assembly of the Société pour la protection de Nature held at Brussels, on July 9, 1927, Mr. Akeley was unanimously elected, posthumously, Membre d'Honneur of the Society "as a mark of appreciation of his eminent and distinguished services to science and to the work of conservation."

The personnel of the Eastman-Pomeroy-Akeley East African Expedition

A Safari in Africa

BY GEORGE EASTMAN

IN COLLABORATION WITH DR. AUDLEY D. STEWART

FOR a week after our arrival in Africa the rains held us in Nairobi, making the trip over the four hundred odd miles of trail to Lake Paradise almost an impossibility. The roads for twenty-five miles around Nairobi were next to impassable, and Martin Johnson's headquarters, almost half a thousand miles away, seemed very far indeed. Yet we were most desirous of getting into the field, and when Philip Percival, our white hunter, suggested that we go down to the Rift Valley, sixty miles or so from Nairobi, we seized upon his suggestion with delight and made ready to depart. Being in Africa, we were keen to be in the field. Nairobi was interesting, certainly, but despite the comfortable cottage that Carl Akeley had rented and which served as our permanent headquarters, despite the generous efforts of innumerable people to make our stay in the little city entertaining, we felt balked by the rains, and were doubly anxious to get away. The Rift Valley trip would give us an opportunity to test out our camp outfit for a week or two, and would make it possible for us to start our "bags" with a few specimens of the common plains animals.

Percival and Martin Johnson went out on a scouting trip and reported when they returned that game was plentiful, so we were keener than ever to be on our way. But a wire came from Percival when he started out ahead of us with a motor truck, telling us to put our automobiles on a flat car and follow him that way as far as we could. Thus it was that our departure from Nairobi was less romantic than we might have hoped, for we started on our way riding on boxes in the "brake van" of a freight train. It was only for twenty-five miles or so, however, that we traveled in this fashion, and at the station of Limuru we detrained, unloaded our automobiles, ate our lunch, and started over the hills toward Bailey Camp in the Kedong—a part of the beautiful Rift Valley.

There were thirty-seven—whites and natives—in our party. Phil Percival, as capable and experienced a hunter as one could hope to find, and Mr. and Mrs. Martin Johnson were really responsible for the success of the venture. Daniel E. Pomeroy, Audley Stewart, and I, together with a Boer chauffeur, made up the rest of the white contingent, while gun-bearers, tent boys, porters, syces, a cook, and a head-man who had lost an eye in a rough-and-tumble fight with a leopard while he was with Stewart Edward White a year or two ago, added that dash of local color—and smell—that served to keep constantly before us the fact that we were in the game lands of Akeley's *Brightest Africa*.

It was toward Bailey Camp, in the Kedong Valley, that we headed, and having reached it we found not only that a comfortable camp was set up and ready for our occupancy, but also that we were, in reality, in the very home of big game. Only two weeks before our arrival a rhino, just a little way from that very camp, had charged and seriously injured Mrs. Bailey, who had been camped there with her husband, and as we began our hunt we knew that she lay between life and death at the Nairobi hospital. That she later recovered and resumed her hunting with her husband was most fortunate, but when we arrived at the spot from which she had been carried only a few days earlier, we had no assurance of so gratifying an outcome of the affair. Furthermore, the head of the particular rhino that had been responsible was still in camp when we appeared, and bore the gruesome traces of the encounter on his once dangerous horn.

The site of the camp was delightful. I was reminded more than once of my own camp in Peaceful Valley, Wyoming, save for the fact that the mountains were not so high and the valley was much larger. Back of the camp to the south the ground rose to an old volcanic crater, and about us was a beautiful grove of spreading mimosa trees, some of the trunks fully two feet in diameter. To the north the valley lay, three or four miles across, stretching east and west far beyond our range of vision. The floor of the valley was level, and was quite smooth enough to make it possible for us to run our cars almost anywhere.

We were on the edge of the Masai country—a reserve so far as white settlements are concerned, but not a game reserve—and we were on the road to Tanganyika Territory, a land we planned to visit.

The valley was filled with game. There were kongoni, zebra, Grant's gazelle, "tommies" (Thompson's gazelle), ostrich, giraffe, steinbuck, dik dik, eland, wart hog, and others. There was a herd of about a hundred and fifty kongoni immediately in front of camp when we arrived, and of course hyenas were about, while jackals, too, made their timid way across the valley. Merely to sit in camp and gaze out across that magnificent valley, dotted as it was with game, was thrilling, but hardly more than four or five days had passed when I experienced a thrill that far surpassed any other it has been my pleasure to experience.

Stewart, Percival, and I started out early one morning to see whether or not we could locate a Grant's gazelle that had fallen off the back of the car as it was being brought to camp the evening before. We searched unsuccessfully for an hour or so, and then gave it up in order to start across the veldt to see what we could see. We had not gone far, winding in and out among the scattered thorn trees, when Percival, with far less excitement apparent in his voice than I suspect would have been in mine, pointed and said simply, "Look at the lions."

About three hundred yards on our left were a lioness, two cubs, and a male. They had just left a zebra kill and were making their way toward some bush to lie up for the day. We approached to within 125 yards of the lions when the male stopped. There is no doubt of the majesty of a lion in the open. I felt it there, even at that distance, but we had come for lions, and I gave him a soft-nose Mannlicher bullet in the groin. He started to run, but changed his mind and faced us once more. Obviously he was making up his mind what to do, so we advanced, slowly, and at about one-hundred yards I gave him another bullet—this time in the chest. He collapsed where he stood, and leaving one of the gun-bearers to guard him, we started after the lioness, but she had disappeared with the cubs.

We found, when we returned to the lion, that he was a big one (8 feet 8 inches) in the prime of life and in perfect condition, except that his skin was much scarred. We had some difficulty, because of his weight, in getting him back to camp, and there the natives insisted on gathering around and shaking hands. In the evening they gave a dance in celebration, and as part of the affair, Stewart and I were carried about on their shoulders. All this might have been more flattering had it not been for the fact that custom has made it necessary for the successful lion hunter to give *bakshish* to the natives of his safari at such a celebration, and one did not need be so very suspicious to get the impression that the desire for gain at least as much as the joy experienced upon the death of so powerful an enemy had been the real reason behind this display of native delight.

Only two days after getting our first lion, we returned to Nairobi, in order to make ready for the long trip to Lake Paradise.

The major reasons for the Eastman-Pomeroy-Akeley Expedition, were, of course, the collection of material to go into the preparation of the groups that ultimately will appear in the Akeley African Hall at the American Museum. It is my pleasure and good fortune to be connected with that immensely valuable project, but being inexperienced as a museum collector, my own field work was devoted to the collection of only one group—the buffaloes—while the rest of my time was spent in getting acquainted with the people and the animals of the marvelously beautiful land that the Hall will represent.

It was Carl Akeley who, in the field, had the major responsibilities of planning and superintending the execution of the numerous phases of the work, and as a result, we were often separated from the camp of that indefatigable worker.

When we returned from the Kedong Valley, Akeley was busily engaged in looking after the work his artists and taxidermists were doing in the field. It was thus that our trip to Paradise Lake, the wilderness home of the Johnson's, was made without Mr. and Mrs. Akeley.

The trip to Lake Paradise was made by motor, and with the exception of one heavy rain during which our trucks mired down in the soft road, it was thoroughly delightful. The lake itself is situated in an old volcanic crater, and above it, on a ridge to the west, are located the houses that the Johnsons have built. The various houses, which are made of wattles, plastered with mud and thatched with straw, except the one in which Stewart and I were quartered, are on various levels following the undulations of the ridge. They consist of a living and dining room with a fireplace and a mud floor, a kitchen, a sleeping house for the Johnsons, a guest house, a bath house, a work shop in which an electric generator is installed, the photographic laboratory, and a storehouse. From these houses the ground slopes away from the lake to the "shamba" or garden, and below that is the native village of huts where the "boys" employed about the place are quartered. The place is almost exclusively a masculine paradise, for aside from Osa Johnson and two native women, the residents are entirely men.

The Johnsons had erected a log house for Stewart and me, while Dan Pomeroy was assigned to the guest house, and the white hunters erected their tents. The rooms are heated by fireplaces, and the hard wood grown in the vicinity burns very much as coal might burn, except that there is little smoke and no soot.

On the way to Paradise Lake we had some very good hunting, during which both Stewart and I got lions. Furthermore, coming across a rhino while we were after something else, I decided to get a motion picture of him with a Ciné-Kodak. With Phil Percival and Martin Johnson as my guard, I approached to within about twenty yards of him before he saw us, but he had no sooner made us out than he cha'ged. I started my camera, while Phil and Martin stood by. They let him get to within ten yards, and then Phil fired. Martin followed his example, while I was still busy with the camera. The old fellow kept coming, but he began to crumple, and finally fell just five and a half paces from where I stood. The affair could not have been more perfect if it had been staged, and I felt that it was the opportunity of a lifetime. The picture, too, came out well, and I consider it one of the outstanding "trophies" of my trip.

On another occasion, while we were camped at the "Wells" on the way north, a lion entered camp at night, and tried to take one of our mules. It all happened directly between our tents and where the "boys" were sleeping, which may explain why the mule got away. The lion got both claws into the mule's jaws—from behind—but for some reason did not hang on. It may be that he began to realize about then what a large camp he had gotten into. The mule was cut up a bit but made a good recovery. A leopard visited the camp the next night but did no harm, and Martin Johnson got a flashlight picture of him feeding on a zebra the night following.

A month, almost to the day, from the time we left Nairobi for Lake Paradise, we started on our trip back. We made an unsuccessful side trip after elephants, but though we located some, they were not sufficiently large to warrant our shooting them. After several days we abandoned the elephant hunt and returned to our base camp, and then went on to the "Wells," where we found the Akeleys with their corps of artists and taxidermists. Leaving them there, we continued toward the Tana River, where we hoped to get rhino and buffalo.

Gangway! The most cantankerous of African big game resents intrusion in his territory. From the moving-picture film "Simba"

Our first buffalo hunt was unsuccessful because of the thick bush. We spent one afternoon after them, but Percival decided that the work was too difficult under such conditions, so we moved camp, stoppping at Akeley's camp on the way. We learned, there, that he had had a painful automobile accident. While he was driving his car through the grass, a front wheel had struck a hidden bowlder, and he was thrown so forcibly against the wheel that he tore some cartilages loose from his breastbone. Stewart strapped him up and we continued toward a swamp eight or ten miles away, where a herd of buffaloes was known to be.

To hunt the creatures in the swamp was impossible, for the papyrus grew there eight or ten feet high, hiding the animals. We were fortunate, however, in finding a herd of about sixty a mile or so on the farther side of the swamp. Stewart, Percival, and I, with our gun bearers, succeeded in stalking them to within a hundred yards, and I shot first at a big bull, Percival and Stewart following. I could not tell whether I had hit my mark, and though we followed the herd as they departed, we lost them at dusk. In the *melée* a cow charged and was killed, and was immediately very carefully skinned for the Museum group. Trouble might have resulted over her, for my gun jammed after I had hit her with one bullet, and Percival had to come to my assistance by bringing her down.

We spent several more days without

success after the buffalo, and then, due to having broken a spring of our car when it dropped a wheel into a wart-hog hole, we were forced to make our way toward Nairobi.

Following our return to Nairobi, we made ready for the trip to Tanganyika Territory, but there is little space here for a detailed account of our experiences on the long trip to the 'Ngourmetti River and return. We were fortunate amost beyond our expectations, for we collected a series of excellent buffaloes on a hunt during which the tall grass seemed almost to boil with the stampeding animals. The prize of the lot was an old bull with a horn spread of forty-two and a half inches. Furthermore, while we were discussing the hunt upon our return to camp, a native boy came running in with word that a lion had mauled a couple of other natives who were building a blind for us. We learned, when we hurried to the blind, that only one boy had been injured, and though his scratches and the one bite the lion had managed to inflict seemed serious to me, the fellow, under Stewart's care, made a wonderful recovery and was about within three days. Shortly after this near-tragedy, I killed the largest lion I obtained on the trip. He measured nine feet four inches, and had a magnificent yellow mane.

It was on this trip, too, that we were fortunate in obtaining a remarkable series of motion pictures of Lumbwa natives spearing lions. After several hunts during which the natives speared a buffalo and had several other experiences in bushes too thick to make it possible for Johnson to photograph them at their dangerous work, they moved a few miles to a section where the bushes were less thick, and there the cameras recorded one of the most extraordinary stories of native African hunting that it is possible to imagine.

The amazing ability and bravery of these naked warriors when facing a lion in the open is beyond praise. With nothing to protect them save their leather shields—with nothing more effective in the way of weapons than their spears, they do not hesitate to close in on a lion, and despite the apparent barbarity of their method of hunting, it is, in reality, a merciful and exceedingly rapid procedure. With extraordinary accuracy, the spears fly to their marks, and in less time than it takes to tell, the lion has been pinned to the ground.

I have been able to tell of only a few of the happenings of the expedition of which I was a part. Nor have I done justice to Carl Akeley, that extraordinary character whose remains lie forever in the heart of the continent he loved, or of Osa and Martin Johnson whose photographic records of that land are so important an addition to the study of African wild life. Neither have I more than mentioned the others who made up our party, yet this has not been an oversight. Elsewhere I have prepared a somewhat more extended record, but even there I have done scant justice to these delightful and able individuals. The work in which each one of us was interested—the studies that are ultimately to be presented to the public by the Museum in which we all have so great and abiding interest—will be the monument that will stand permanently as a record of the achievements of those with whom I was associated, and little indeed can I add to the reputations of those who have already created for themselves an unrivaled place in the wide field of their own successful labors.

Picturing Africa

By MARTIN JOHNSON

I DOUBT very much whether any one who has not tried it has any conception of the difficulties connected with making wild-animal pictures. The screen pictures of the veldt, showing all kinds of wild game roving about, seemingly unaware of the presence of the camera and the camera man, often delude the audience into thinking that after all it is rather easy to photograph them. Herein art and skill defeat themselves. The better an animal picture is made, the less exciting it appears to be. The easiest thing to do is to shoot an animal with a high-power rifle at a comfortable and safe distance, or to run it down with a motor car, picturing the process and its excitements. The hardest thing is to picture that same animal in a calm, undisturbed state of nature. But that is the most important thing that the camera can attain.

I can well remember our first trip to Africa. It was during the driest part of the dry season. All along the railway line from Mombasa to Nairobi Mrs. Johnson and I saw thousands upon thousands of head of wild game—wildebeeste, zebra, Tommies, Grants, ostriches, giraffes, wart-hogs, kongoni, and eland. Spellbound we looked out of the window of our compartment. It was the most wonderful sight that we had ever seen, and we could hardly wait to get off the train to start photographing. It looked so easy that we thought we might have our picture done in a few weeks—and have the world's greatest animal picture at that, easily.

Two weeks after we had equipped our safari in Nairobi we were out on the Athia plains in our first camp. Then came disillusion. Game was everywhere, but the stubbornly suspicious animals would not let us get within camera range. For the first three weeks we got nothing but extremely long range scenes, and, when I developed tests, I found that the heat waves that dance in the distances had distorted and practically ruined the pictures. Then we tried building blinds, and we spent endless hours in them waiting for the game to come down to the water holes within camera range. But there were too many water holes and the whimsical, suspicious animals chose to drink elsewhere. They would not come near our blinds. After five weeks we gave up and went back to Nairobi. It was not going to be so easy as we thought.

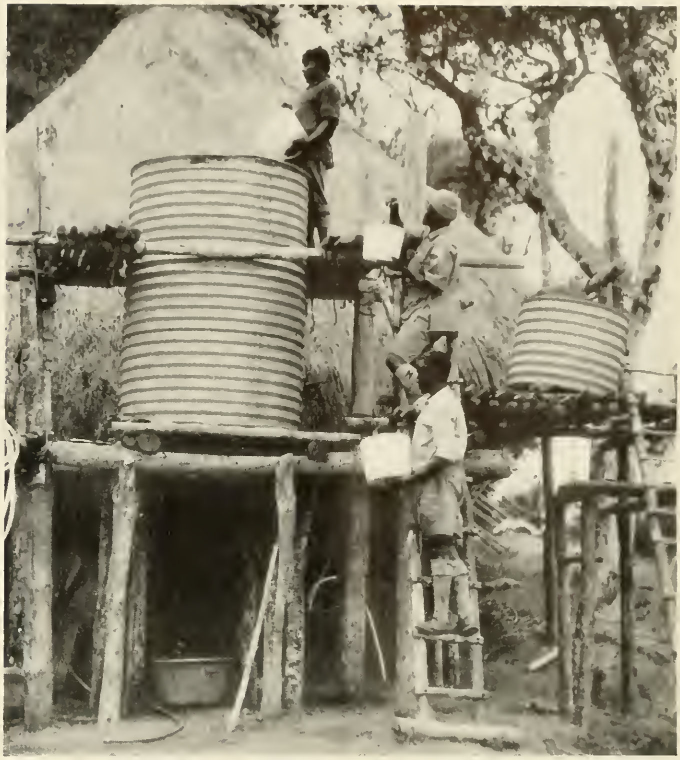
Osa and I talked it over and decided on new strategy. We planned to make a long safari of nearly four hundred miles to the arid districts in the north of British East where there were few water holes. There the game would be forced by thirst to come into the range of the cameras.

This safari cost us much time and a great deal of money. When we at last arrived we found a new set of hampering conditions. The nomadic natives with their herds were using the water holes for their stock by day and the game came down to drink at night. We safaried from one water hole to another until at last we came to one that was unmolested by the natives. Again we spent weeks in the blinds which we had to rebuild again and again, the while we learned a bit at a time about how and where they should be made. It was more than four months after we landed in Africa before we had a single scene worth putting on the screen.

The problems encountered in picture-making are many and complex. The camera makes certain demands. There must be fair light. The shadows must fall right, else the picture will be flat and uninteresting. The angles of view must be selected so as to avoid bald skies and awkward compositions. The footing must be stable and steady lest vibrations mar the picture. And that is only the beginning. The blind must be built to windward of the water hole so that the human, or inhuman, scent of the camera man does not reach the animals on some wafting breeze. If possible the blind should be slightly higher than the spot to be pictured, because the scent, carried by the rising heat of the body tends to go upward. Also the blind must be as perfect a bit of camouflage as possible. The animals have a critical eye. They do not admire a conspicuous blind. It offends their taste in landscape and challenges their sense of discretion. They do not enjoy having their Africa tinkered with. They do not like the click of a camera either. They never consciously get confidential with a photographer. African animals have only two lines of action with reference to the camera. They either run from it or at it. Neither treatment is entirely satisfactory to the man behind the camera.

Most of the members of the numerous antelope family and the other grazing animals like the giraffe and zebra can be photographed from blinds. Also now and then one gets a chance at the lions and leopards and other beasts of prey which follow the herbivorous animals to the water holes. But there are animals in Africa which seldom or never drink—the gerenuk for instance. It is but by the merest chance that such animals stray within the range of a water hole blind. They must be stalked afoot by the camera man. It is always a stern chase, which is notoriously a long chase—with usually nothing more to reward the effort than a handsome rear view of a vanishing animal with his tail waving good-bye as he goes over the hill.

Then there is the elephant which presents a special set of problems to the camera hunter. The elephant sleeps through the day and eats in the cool of the evening and night. We spent weary weeks following various small herds before we could catch them under light conditions which would permit the making of satisfactory pictures, and even then we did not know enough of their habits to be able to get close to them. We tried to solve our elephant problems by employing an expert, Boculy, probably the greatest of all the black elephant trackers in Africa. But then we often got too close and so we probably spent more time getting out of their way than we did making pictures.



Water supply installed at the back of Martin Johnson's laboratory at Lake Paradise

We had been out on safaris for a little more than a year when Osa and I took stock of our results. We had spent a large share of the money appropriated for our expedition and we felt we did not have enough animal pictures to make a satisfactory production. We decided we would simply have to take more chances and get closer to the animals, else the whole project would be a disastrous failure. So we threw caution to the winds and with our hearts in our mouths went back at it. The fun started. We got pictures all right, but every picture was a chance with death. I am half afraid now that a good many of our elephant pictures are too good. They make the elephant look hardly more dangerous than a slightly discontented cow. To get these pictures of the elephant in his own private home life meant the invasion of places where we were never supposed to be, in terms of any common sense. Often we had to run for our lives, and once we had to shoot our way out of a very bad mix-up. I suppose we had fifty close calls before we were satisfied with the pictorial results.

A great deal of the elephant work was in the forest where pictorial problems are the most difficult. The wind tends to blow from everywhere, boxing the compass every few hours and carrying the scent of the hunter to all the nervous animals. The light is constantly changing with every change of position, and under the trees there is very little light at all. The trees and grass absorb a great deal of the light and one has to give about twice as much exposure as on the open plains, because there is no reflection from the dark trunks and leaves. From about ten o'clock in the morning until three in the afternoon, just when the light is the strongest, is not a satisfactory time for making pictures because, with the sun nearly straight overhead, the shadows obscure details in the animal and at the same time make the general scene flat. Further, this is the worst period of the day for the shimmering heat waves which are the bane of African photography.

Besides all these smaller handicaps there are only about seven months of the year when one may expect good pictorial conditions. These are through the dry seasons, in the months following the two rainy periods. During the rains, with water abundant everywhere, the game scatters so widely that it is hard to find, and traveling is difficult. There is a slight advantage in camera-hunting the elephant during the rainy season, because at that time he leaves the forest for the plains. However, this is helpful only if one can be on hand at the time, for it is almost impossible to follow them for considerable distances.

Of course photography from blinds is practicable in the dry season only, where there are water holes to lure the thirsty animals into range. The blinds demand patience. They must be built and then left for a week or ten days before any attempt is made to use them so that the game will become accustomed to considering them a natural and harmless part of the landscape. One must expect, too, that a great deal of the effort made in blind work will be wasted. Often I

Mr. Johnson's open-air dark room while on safari. Daylight developing tanks were used and the water was cooled in canvas water bottles

The stage set for the making of a flashlight picture. The photographer enters the blind at night and, when a lion, a leopard, or a hyena comes to the "kill," presses a button that sets off the flash

have built a series of blinds commanding a water hole and then at the very time I started to use them the wind would shift inconsistently, against all calculations, and blow the scent toward the water.

I have one word of cheer to add to the lore of blind photography, however. After some years of research I find that the taboo against smoking in the blinds is all a mistake. The animals seem to pay no attention to tobacco. I am not sure why. Perhaps it is because they are familiar with fires on the bush and veldt and the acrid smell of smoke. But I am reluctant to libel the makers of my favorite cigars with any inference that their aroma resembles a jungle on fire. Anyway, it is perfectly safe to take comfort in a smoke while awaiting the coming of the animals.

The blind work on our last safari was the most difficult that we have ever experienced. This time, on top of all the natural difficulties, politics came to complicate affairs. A former head of the King's African Rifles on the Northern Frontier of British East decided he would solve all the problems of the territory by remarking the map. He moved the tribes about like checkers on a board, putting each tribal unit into a new and unfamiliar locality, with new neighbors. The result was that none of the natives knew the regions that they were compelled to call home. This made them unhappy and restive. It also ruined water-hole photography in the district. The natives, being unsettled, scattered about all the water holes, and built manyettas everywhere, driving the game away and making it wilder than ever.

On this last safari I managed to pay several natives to move their manyettas to other watering places with their cattle and sheep and camels, leaving me three good water holes for photography. But it was weeks before the game came back. Then, when I built my blinds, I encountered several weeks of murky weather. After the clouds cleared away, the country became so dry that every movement filled the air with alkali dust, and then came prairie fires to add smoke to the trouble. I was five months on two safaris before I got pictures. It is about the last word in camera troubles when one has to buy a water hole to give a zebra a drink,—and then gets burned out.

Another photographic problem in Africa is the preservation of sensitized materials and chemicals. Photo emulsions are made of a highly sensitive gelatine impregnated with delicately balanced silver salt solutions. Conditions of humidity and temperature affect the film which must be continually safeguarded. This means the use of carefully sealed tins, special drying compounds, and a continuous supply of fresh stock. I kept a steady flow of shipments arriving every few months from the Eastman Kodak plant in Rochester. But delivery out in the blue is something more of a problem than it is in civilization.

It must be realized, too, that a camera safari is a much more pretentious and exacting undertaking than a mere hunt where one is concerned only with food and ammunition. The photo equipment alone runs to considerable weight and it must be carried in dupilcate to guard against losses and accidents. On one safari, when Daniel Pomeroy was with us, we left Nairobi with six motor cars and about forty porters. We traveled three days to the north and spent ten days trying to get rhino pictures. We saw thirty-nine rhinos in the ten days and got close to many of them—for a moment. But always they grazed with fiendish persistence in places where photography was impossible—or else the light failed us. We had to leave after that difficult and costly trip without a picture. A few months later we returned to this region and made a wonderful series of rhino pictures in only three days, photographing the animals often as close to the camera as fifty feet. When the rhino is that close he may charge to kill at any moment. There really is such a thing as luck—in Africa.

The long safaris take up a great deal of time in going through gameless regions. Often we have made safaris from Lake Paradise requiring five weeks' time to do one week's work, and once we made a long camel safari into the Ndoto Mountains when we did not picture one animal. They had all migrated to the Horr Valley where we did not dare to follow because the wild Habash raiders were in there to poach ivory. The Habash do not like to be disturbed at their poaching, and there are some chances we will not take—even for a picture.

A whimsical thought comes to me. Now that the safaris are over and I am back in New York, I have boiled my pictures down to about two hours and fifteen minutes of screen time—what is left out of about 200,000 gross feet of film. That means that the essence of what I got actually occupied the camera for just one hundred and thirty-five minutes. This article may help to explain what I did the rest of the four years.

A Lumbwa Warrior

The Land *of* Glorious Adventure

A series of sixteen photographs by Martin Johnson taken during the four years he spent in Africa making his motion picture record of African wild life and African natives

A MARABOU STORK KEEPING AN EYE ON THE PLAINS FOR A CHOICE MORSEL OF FOOD

LOOKING OVER THE KAISOOT DESERT FROM THE LAKE PARADISE FORESTS. ALL THESE HILLS ARE EXTINCT VOLCANO CRATERS

WILDEBEESTE ON THE PLAINS OF SERENGETI IN TANGANYIKA

The animals migrate with the season, following the grass and water. Sometimes as many as 20,000 are congregated at one point, and for Martin Johnson to see 100,000 in one day was not unusual

ORYX AT A DESERT WATER HOLE

The water here is very alkaline and muddy and there is little of it. Only half a mile farther there is good water coming up through reed beds, but the game, fearful of lions and leopards, will not go near it

ELAND, ORYX, AND ZEBRA AT A NORTHERN FRONTIER WATER HOLE
The eland (the fine specimen in the center of the picture) came every day, always alone. Note the ostriches in the background

ONE OF THE GREATEST LION PICTURES EVER MADE

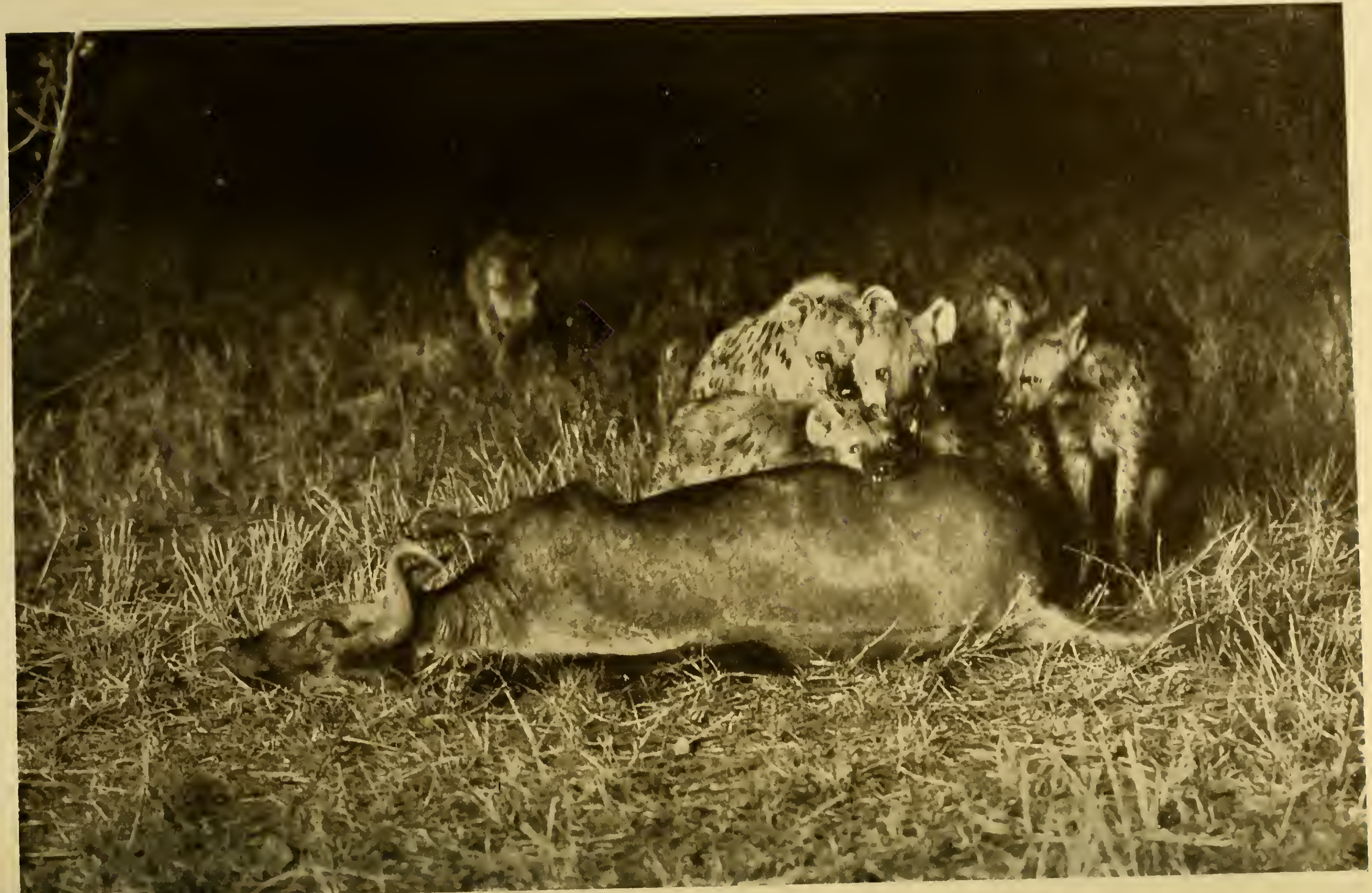
Well-fed, content, and never having been molested by man, the lions in the Tanganyika valley were easy subjects for the photographers. More than one hundred pictures were made, showing the animals playing, feeding, rolling on the grass, yawning, and even roaring

ON THE PLAINS OUTSIDE THE LAKE PARADISE FORESTS

After a rain the flowers spring up in profusion and are beautiful for a week or two. Then they wither and are blown away, and the plains once more become deserts

ELEPHANTS ON THE EDGE OF THE KAISOOT DESERT AFTER THE RAINS

Note the baby elephant just visible above the grass; it was probably born the night before, and the herd is moving slowly, stopping every minute in order not to tire it out



HYENAS ON A WILDEBEESTE KILL

A LEOPARD INVESTIGATES A GREVY ZEBRA KILL

The leopard's cubs could be heard whining in the distance while Martin Johnson was taking this picture. Although he waited an hour, hoping the mother would call her youngsters to the feast, she did not, and in fact, she was so nervous that she did little eating herself

IN SEARCH OF JUSTICE

An old Boran awaiting his turn to tell his troubles to the District Commissioner at Marsabit. These people have great faith in the judgment of the British and accept their decisions without question

NDOROBO HUNTERS

The Ndorobo hunters were so shy that it took Martin Johnson two and a half years to get within talking distance of them. Once their reserve was broken, they became very friendly, and would often tell the Johnsons of game in the vicinity

HEADED FOR THE SWEET POTATO PATCH

Elephants like sweet potatoes, and the Johnsons conceived the idea of planting a sweet potato patch to lure the animals within flashlight range of the camera at night. This cow elephant visited the patch every night during the dry season and often would bring her mates along for dinner

RETURNING FROM THE FEAST

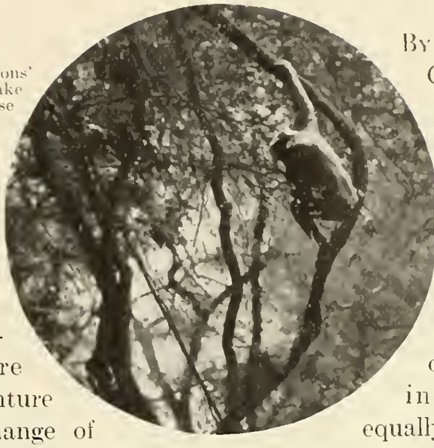
The Johnsons made many flashlight pictures of "Lady Sweet Potatoes," as they called their nightly visitor, but she never seemed to mind. Perhaps she mistook the flash for lightning. When the wet season arrived, she disappeared for three or four months, but she always returned

ABYSSINIAN BUSHBUCK

After drinking at Lake Paradise, these little animals started up the trail and photographed themselves by touching a wire. They are so shy that the Johnsons did not see more than four individuals during the three years they were at Lake Paradise

"At Home" in Africa

By
OSA
JOHNSON


The Johnsons' pet at Lake Paradise

SAFARI life in Africa is something like what I imagine war would be with the fighting left out. There is glamor and adventure and a constant change of scene. One moves with a little army, outfitted and organized and commanded just like an expeditionary force. And there is always movement, on and on and on. There is always an objective ahead and once it is attained there is always another farther on.

I am reminded of the homely wisdom of an old lady who lived out on the plains of Kansas, who often commented on this world of strife and work by observing "the cows with the long horns are always ahead." It is so in Africa on picture safaris. The elephant with the big tusks, the lion with the big mane, the rhino with the record horn—they always seem to be just ahead. So one goes on and on.

And so it happens that Martin and I have lived our lives together mostly on safari, always going somewhere, nomads of adventure.

In spite of this we have also always managed to have a home. Our home is where we happen to be. Martin's special business and concern is the camera work; mine is the home-making on the way. Of course it works out so that both of us have our share of everything, from the planning and organization to the adventures and the excitements, but a wife is a wife and a home-maker, even on safari. My time in Africa is about equally divided between standing guard over Martin and his camera with a double-barrelled elephant rifle and seeing that the safari cook keeps the home fires burning at dinner time.

The magazines for home-making women in the land of civilization are filled with systematizing plans, budget charts, and things like that. If system is necessary in the stationary, permanent home surrounded with all of the conveniences and services of the city, with a telephone handy to take care of any immediate household emergency, then system is about ten times as necessary on safari, where one has to carry along everything for living, including all the civilization that is necessary to comfort.

Sometimes our friends who see our pictures are surprised at the extensive equipment we carry, the large number of porters, or camels, or cars and wagons trekking across the veldt. That is because we really do have to take home along with us. The American sportsman and the American sportswoman, too, go hunting or exploring now and then, as a relief and an escape and diversion from the pressure of civilization and its complications. But we live on safari practically all of the time. We have been camera-adventuring out on the edge of things and "in the blue" for about seventeen years. Naturally we have not the same zest for "roughing it." We must get the maximum of comfort if the work is to be well done and if we are to have a life of our own at all.

Our last expedition to Africa, taking nearly four years, is typical. To get our records and screen stories of undisturbed and unspoiled animal and native life meant that we had to push way out beyond the white man's influence. And that meant some peril and considerable hardship and all the organization and "home-making" skill we could muster to make the living and the work endurable. The first step was the long safari of nearly five hundred miles from Nairobi, in British East Africa, up to a remote region not far from the border of Abysinnia, where our own Lake Paradise nestles down in the bottom of the crater cup of an old volcano, surrounded by jungles and a rim of forest, and outside that for hundreds of miles a desert country infrequently dotted with water holes and oases and bits of bush and forest. Lake Paradise was in a sort of way "home," with houses built of mud and sticks and thatch, and between seasons we did spend months there. But after all, it was really a place to go away from while we followed the wild life out across the veldt and into the jungles.

With runners and with cars we could keep up a kind of communication with Nairobi and its source of supplies, but we had to plan to take with us to Lake Paradise all of the equipment we were going to need and enough supplies for at least a year. A great many housewives get into a fret trying to decide what they are going to serve for dinner tomorrow. In Africa the problem was what to have for dinner for maybe about three hundred tomorrows. To help the systematic administration of

The cook's box designed and made by Mr. Eastman for Mrs. Johnson affairs along we built a "store" at a part of our Lake Paradise establishment. It was our store, and we were the only customers. In this building stocks of foods, canned goods, flour, sugar, coffee, and everything of that sort, were stacked around on shelves.

This enabled us to keep track of the rate of consumption so we could replenish when necessary. It helped to keep down waste, too. African native servants have no very provident notions and they never heard of economy. They learn the white man's ways and requirements so they can serve in an automatic sort of way, but you cannot trust them ever really to understand why things are done. That is not to be expected. We have been centuries working out our civilization and our notions about things. We must not expect the black man to get it all in a few years.

Building the laboratory at Lake Paradise

Take for a detailed example the matter of soap. The African black boy can do an excellent job of washing clothes. He does it surprisingly well in view of the fact that he himself wears practically no clothes and he only washes himself under the pressure of management. But he can never understand the magic of soap. If I gave a black boy one of Martin's shirts to wash and one bar of soap, the whole cake was used on the one shirt. The black boy likes to see the bubbles and the suds. He has no idea of the cleansing properties of soap, except as it might be some kind of magic stone. He thinks it is necessary to rub every inch of the garment with the soap in order to get the dirt out. My laundry boys were thrown into despair when I introduced flaked soaps and washing powders. The only safe solution of the problem was to issue the soap in bits, just enough for the job in hand.

It is curious that all the domestic work has to be done by the black boys—I may explain that any black man is a "boy" in the language of East Africa, no matter if the "boy" happens to be fifty years old. I found boys that could do neat sewing and mending. They could darn stockings and sew on buttons as deftly as any French seamstress. But the native women were utterly hopeless about such work. They had no feeling for it and not enough initiative ever to learn.

We took along garden seeds and tools and a few coops of chickens on our trek to Lake Paradise to be prepared to do a tiny bit of "homesteading" up there. So I had a garden with the vegetables that we needed to make it seem like home, and many of the garden flowers that we have back here in the United States, even roses. Also Martin insisted on big patches of sweet potatoes because he discovered that the elephants liked them. I supervised the gardening and I expect I am the first to raise a garden for an elephant pasture. There is a standard joke about the small boy who works his way into the circus by carrying water to the elephant, but Martin worked his way into a lot of very fine elephant pictures by having his wife run a sweet potato ranch. There were many elephants in the Lake Paradise forest and at the desert water holes in the surrounding region. Our place got highly popular with them, and the big bulls, their cows, and young, would come crashing around in the dark of the night to dig the sweet potatoes. Martin set flashlight cameras at night to get the elephants, and in the daytime I had to have a force of boys setting sweet potato plants. I mention this as one of the little details of gardening and home-making in Africa.

My little flock of seventeen chickens flourished up at the lake and multiplied rapidly. I soon had two hundred chickens. Then one night a prowling leopard got into the chicken yard and the next morning I had only one hundred chickens. I might have spared a half dozen to a leopard, but somehow I think a hundred broilers at a time are really too many for any cat. I should have liked very much to have had that particular leopard made into a nice fur coat. But we had no shooting whatever at the lake. That was part of our code of life and work. We were in Africa to photograph animals, not to kill them, so we got along with them as best we could and kept out of trouble with them as much as possible. We wanted pictures, not pelts and mounted heads.

So that we could avoid shooting even for fresh meat, we kept herds of cattle and sheep, bought from the Boran natives of the desert country. The African cow gives little milk, perhaps only about a quart or two a day, but it is very rich, almost all cream. We had plenty of cows and every third day we had freshly churned butter. Also we had a little portable ice machine, operated by hand power, so that on special occasions we could even indulge in ice cream. There is a great thrill in a mere dish of ice cream when it happens to be served out in the desert, half way around the world from New York.

We contrived to get a good deal of home atmosphere into the Lake Paradise place. Because of the nature of the available materials and the native methods of construction, each room that we wanted was made a little house by itself. My boudoir was a thatched-roof house with mud and stick walls. It sounds crude enough but really the interior was as feminine and civilized as any woman could wish. I had it floored with boards taken from cases of tinned goods. The walls were smoothed and tinted with a wash of pink clay that gave a wonderfully soft chalky color quite as handsome as any interior decorator could contrive. And I had cretonnes and soft skin rugs, and chairs also made from packing boxes, with trig little cretonne covers on them. My black maid kept it as neat as could be, after a long course of lectures on the subject. I could come off of safari and get out of corduroys and khaki clothes and boots and slip into fluffy feminine things in this room and forget all about the excitements of the chase in a moment. Once inside that room one could imagine it a boudoir in a Long Island bungalow or any country place.

When we went out on our many long safaris in pursuit of pictures of various animalst that could not be photographed in our immediate vicinity, a lot of planning had to be done about the supplies. When we first started these trips I simplified the problem by packing a case for each week of the trip. Each case was a "load," which means the unit of a one-man load, or what can be carried by one porter, about sixty pounds. This meant that if we were to be gone for two months there would be eight loads or chop boxes. Later, as I became more experienced in the planning, the requirements were worked out in quantity. For instance I knew that one load, or sixty pounds of flour, would be ample for a month of safari, and that one load of sugar would last for the same period.

Looking toward the fireplace in the dining room at Lake Paradise

While on safari we added variety to our diet with occasional game. Most of the members of the big family of antelopes are good to eat. Their meat is like ven:son. Also the African buffalo supplies perhaps the most delicious steaks and roasts in the world. Buffalo tongues are great delicacies. And ox-tail soup made from the buffalo is superior to any that we ever had from beef. Some of the meat was at times smoked and dried into what in Africa is called "biltong," which is the veldt equivalent of the "jerked" meat of the American plains in the days of the buffalo. Then we often had fish, too. Martin says that every time I saw more than a pint of water I had to go fishing. We caught many varieties of fish. The African waters offer catfish and fish like the American perch. In some regions, where the sporting influence of the British has extended, brown and rainbow trout have been planted and they have naturally extended their range until one comes on them in surprising places.

And speaking of that scattering of new species reminds me that our Lake Paradise gardens may some day complicate things for some exploring botanist in Africa. Tomatoes escaped from our gardens, and with seeds scattered by birds, are now growing wild for at least twenty miles out around the lake. Just imagine the excitement of some plant collector maybe a hundred years from now breaking into that old crater at Lake Paradise and finding a tangle of red damask roses and a bed of petunias!

Part of our problem of living was teaching the cooks to make American dishes. We got fairly well trained cooks, but their experience had all been with British hunters and their cookery was after the English manner. "Pishi," a black Mohammedan, was our star cook. He soon learned to make waffles and cakes after my favorite recipes. He did a fair job on pies, too. But there were times when I just had to take over the pie-making myself, to please Martin. We had tinned fruits for pies and sometimes wild fruits, too, that were exceptionally good. We also had wild mushrooms and a wild green that passed for spinach. I was thrilled when I found that after every rain we could gather wild asparagus out at the edge of the Lake Paradise forest.

Operating our safaris also entailed established routine to insure comfort. Each boy in the army of about fifty or a hundred porters had a prescribed and routine set of duties. Within twenty minutes after we had arrived at a camp site there would be hot water ready for baths and tea. And a meal would be under way before the unloading of the camels was done. Our tents would be ready in a jiffy, and less than an hour after arrival we would be completely "at home," in fresh clothes and ready to sit down to dinner. A similar swift routine of breakfast and packing and loading in the morning got us under way rapidly. Keeping to schedule is important, too, in the desert country. One must travel in the cooler hours and allow for long rests. Camels, in spite of all their reputation for endurance, can go only about two miles an hour and about two hours at a time.

But certainly my life in Africa was not all a matter of home-making on safari. I had my excitements, too, so many of them that they do not seem so important in memory as when they were happening.

I think it is pretty well known by this time that we are not big game hunters—in fact we shoot only when we have to in order to protect ourselves while making pictures—or as now and then happens, when we must have meat and can't buy cattle or sheep from the natives.

During the six years we had been photographing the wild animals, we had saved every head-skin, until we had about thirty, but we did not have the greater koodoo, neither did we have a very large buffalo, so Martin and I talked it over and it was agreed that we would get the two if the opportunity arose.

About a day's travel from Lake Paradise out where the desert is dotted with bush-grown gullies, I came upon a fine specimen of a bull buffalo with handsome horns. I stalked him a long way over rough country and then lost him in a thick tangle of bush. I went in after him, which was not such a very careful

Mr. Eastman and Mrs. Johnson baking bread while on safari

We were preparing to leave the Lake and return to America; Martin was busy doing last-minute developing in the laboratory, and, as I had nothing to do and time was hanging heavily on my hands, I decided to go after my buffalo, and I wanted the thrill of getting it alone. Martin was opposed to the notion because he holds that the buffalo is the most dangerous animal in Africa. But I managed to make him see my point, and so it was that I set out with only two black boys and a gun bearer to a point outside our forests where a very big buffalo had been reported.

thing to do. The buffalo is hard to see in the bush, and he is just about certain to come on a killing charge if one gets too close. I hunted through the bush and was about to give him up. Then I came on a little native village and got two spearmen to go beating through from the opposite side of the big thicket. I guessed that the buffalo would come out the same way he went in, since he had seen nothing on that side to alarm him. My guess proved correct. As the beaters came through the bush shouting, the buffalo came raging out. He saw me and headed for me at express-train speed. There was just a moment when I would have been glad to have been safe back at Lake Paradise, or most anywhere else. But the situation was not one for a great deal of debating. I got hold of myself and determined to be cool about it anyway. I drew aim and fired at the buffalo charging head down. He was less than thirty feet away when he fell, stone dead. My bullet went through the "boss" or heavy hard crown of his skull. It is said to be an almost impossible shot because of the extreme density of the bony structure. The performance made me decidedly proud of my rifle.

Anyway I had my trophy. By the time I got back to Lake Paradise with the buffalo head and hide I was able to be unexcited and casual about it—when I told Martin the story.

My hardest chase was another lone-handed hunt of six days on the trail of a greater koodoo. The koodoo is one of the rare antelopes of Africa, seldom taken by sportsmen. One day at the edge of the Lake Paradise forest I sighted a big male koodoo through my binoculars. He must have been nearly two miles away. I set out after him. The chase led me over the roughest kind of country, up and down ravines and into the mountains. There were places where I had to climb sheer walls of rock for at least a hundred and fifty feet, hanging on with toe hold and everything but my teeth. Fortunately I can climb well. I admit it. I studied the subject in an apple tree back home in Kansas when I was a little girl.

There were places on this koodoo chase where I had to pass my gun up and down cliffs with my black boys forming a chain like a bucket brigade. I literally wore out two pairs of hunting boots on that trip. I was determined to get that koodoo. But there is an end to every chase. I finally got within range of him, although it was a rather

Gathering the vegetables in the garden at Lake Paradise

Wild asparagus grows in great quantities near Lake Paradise. The Johnsons liked it better than the cultivated asparagus of civilization

long shot at that. I fired at three hundred yards and brought him down. Then with a quick second and third shot I finished him. I had the boys take the head and the whole body skin, and we started back to Lake Paradise. We traveled as fast as we could, back through that tangle of jungle and thickets and gullies and mountains. It was late in the night when we got back. I hate to think now of the scares I had as we passed shadowy places and clumps of bush which may have been hiding places for most anything in Africa.

The rhinoceros is one of the perils of travel, as much by night as by day. The rhino always charges when in doubt. He is made for charging and his big horns are terrible weapons. I think the rhino has inspired me to the breaking of all world's records in fast and lofty tree climbing.

The rhino often just voluntarily happens along to break up the monotony of a quiet evening in camp. I remember one occasion out of the Kaisoot desert when, late in the evening, we had a small fire over which we were boiling water in a five-gallon gasoline tin. The rhino took a dislike to the sight, and with a snort, shot through the camp, impaling the tin on his horn. The sudden bath of boiling water merely added to his speed. He went out into the darkness of the African night like a comet.

Often at night rhinos would charge through camp that way. One morning one of the boys came telling of the excitements of a rhino charge the evening before, after Martin and I were asleep. He was making fun of the fright of the other boys, including considerable mimicry.

"And where were you?" I asked him.

"I was very, very far up a tree, Memsab," he answered, "because you see I am my mamma's only boy."

Camel safari crossing the Kaisoot Desert

Adventure Land

By PHILIP PERCIVAL

Mr. Philip Percival is a famous "white hunter" living in Nairobi, British East Africa. "White hunter" is the designation evolved in that region for those agents of adventure who conduct safaris for sportsmen and explorers in the jungles and on the veldt of Africa. The white hunter is therefore an authority on the wild life and the natives of his territory. He is really an advance courier of civilization and the contact by which the civilized world learns of the great wild places. He must be first to seek out the unknown and unravel the mysteries of the far lands that we call "back of beyond" and out "in the blue." The white hunter in a very broad and constructive sense stands as the interpreter between the world of the wild, the primitive, and the savage, on one side, and the complex world of civilization on the other side as represented by his clients. Mr. Percival has had twenty-five years of safari experience in Africa, with many colorful adventures and contacts with the most famous sportsmen and scientists of both North America and Europe. His brother, Mr. Blaney Percival, was for many years the game warden of British East Africa.

—The Editors.

BRITISH East Africa is Adventure Land and Nairobi is its capital. It may be taken for granted that I think exceedingly well of the region and am likely to speak with considerable enthusiasm of its lures and charms because I have made it both my home and my profession. Also this Adventure Land must surely have a special interest for the readers of Natural History and to Americans in general. Probably most of what the great American public has learned of Africa has been communicated by the screen and by the reports and collections of museum expeditions. British East has contributed a most imposing proportion of the African trophies of both the screen and the museums. First came the screen records by Paul J. Rainey in his famous African Hunt pictures made chiefly at the Lasamis water hole. Since then your own Martin Johnson has spent some years in our country, sending back to the States nearly half a million feet of screen records of wild life. And this region, too, was a favorite collecting ground for the researches so ably conducted by the late Carl Akeley in his indefatigable efforts toward the projected African Hall of the American Museum. In addition, many famous American sportsmen have come our way, including more recently Daniel E. Pomeroy, of the Museum board, and George Eastman, to enjoy the thrills and wonders of British East.

Specimens of the amazing fauna of British East appear as important exhibits in most of the great museums of the world. So mayhap I have warrant for my assertion that Nairobi is really the capital of Adventure Land.

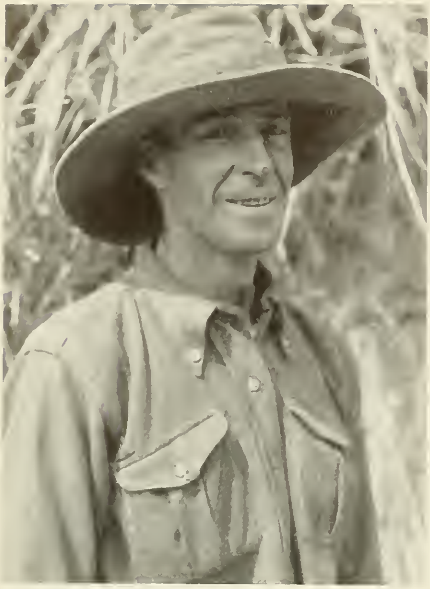
Our city of Nairobi—and it is truly a city, with a white population of nearly 4000 and some 8000 Asiatics—is itself a creation of adventure and chance. Back in 1899, as the laying of steel for the Kenya and Uganda railway was pushed through from Mombasa to Kisumu on Lake Victoria, it was adopted as a railway settlement. It was a convenient site because it was located at the inner edge of the grassy plains close to the beginning of the ascent to the upper highland country. Its delightful climate and central position led rather automatically to development.

The safaris for all of British East and most of those that penetrated into Tanganyika organize at Nairobi. It is the place to which you come to go anywhere "out in the blue." Depending on seasons and varying conditions, one may expect to find good sport and occasionally fine specimens within easy range, say from twenty to two hundred miles, from Nairobi. And there are an infinity of objectives for longer safaris out into the completely wild and unspoiled country.

Civilization is making its gradual encroachments in the regular pattern of development of every new country. First come the trader, the missionary, and the explorer, and after them come in time the prospectors, the settlers, and the farmers, each widening his circle of operation until the whole country is claimed for civilization, agriculture, and industry. Happily in the vastness of Africa there is ample room. For a great many years to come there will be an abundance of wild life. Meanwhile the development of the country means the building up of centers which give the sportsman and traveler assurance of bases of supplies and services and comforts which earlier were unobtainable.

Despite the comfortable facilities of Nairobi and its shops, hotels, and clubs, one must not hasten to the conclusion that British East is yet in any danger of being shorn of its thrills and color. From every train which comes up from Mombasa on the coast to Nairobi one can see vast herds of wild game, thou-

The Eastman-Pomeroy-Akeley East African Expedition breaking camp



Pat Ayre has the reputation of being one of the best white hunters in Africa

sands of head at a time, with now and then a glimpse of a lion.

The lion is amazingly persistent in British East despite unceasing pursuit by safaris and the war against him by settlers and natives alike. There is a large swamp within three hundred yards of the railway where it is estimated that not less than twelve or thirteen hundred lions have been killed since the road was built.

There is, I find, in the States a bit of an adage to the effect that "when Greek meets Greek they start a candy store." By some such law of racial predilection, wherever one goes on this globe and finds Englishmen, he is certain to find golf and also, if possible, trout fishing. So among our surprises for the visitor are some excellent trout streams, stocked in years past. The Kenya Angling Society brought in brown trout in 1912 which are thriving. Rainbow trout from South African waters have also been introduced with success. It is not unusual now to take a six-pound brown trout on the fly in our waters, and rainbows up to ten pounds in weight have been taken. It is amazing to record that fry planted in new waters seem to reach this size in only three years due to the wonderful amount of food in the rivers. The

Motor cars of the Eastman-Pomeroy-Akeley East African Expedition crossing the northern Guasho Nyero River

Philip Percival, known as the best white hunter in Africa, has to his credit 25 years of safari experience

local fish do not go up into the cold streams that have been stocked with trout, and the trout do not go down into the warmer water. Our best fishing is in the Aberdaire mountain region. Just as proof of the sporting quality of our country, let me boast that even the lowly barbel, or as you call him, catfish, will sometimes take the fly in British East Africa. The one bit of advice I would venture to the fisherman who intends to try African waters for trout is to bring short rods, the sort suitable for brushy streams and rough country.

Concerning safari equipment in general, it may be observed that there is no actual necessity for taking anything to Nairobi. Everything from guns to clothing may be obtained there, of the types and materials best suited to the requirements of the country. Many sportsmen have gone to vast trouble importing equipment to find on arrival that they could have done much better on the ground and at less expense, all costs considered. Of course it is to be expected that sportsmen are likely to want to bring favorite guns. In addition to the heavy bore rifles for big game, it is advisable to add a twelve- or sixteen-gauge shotgun for birds and perhaps a small .22 calibre rifle. One can have a lot of fun with

Canvas tarpaulins cut to the shape of the automobiles make camping possible wherever one happens to be at nightfall a .22 and it can be fired without disturbing the more important big game in the adjacent country.

Every competently organized safari includes expert native skinners and the proper supplies for preserving heads and skins for subsequent treatment by taxidermists.

It should be borne in mind that while wagon and motor-car transport is available for many journeys, the native porter is still the mainstay of transportation in many regions and for at least a part of the work of nearly every safari. This means that the equipment must be susceptible of division into loads of not more than sixty pounds each, a one-man load. Some of our sportsmen have their sixty-pound chop boxes packed at home and send them half way around the world in shape ready to go on the porter's shoulder. This expedites matters at the start and often is a safeguard against oversights and disappointments that could have been avoided by careful consideration in the planning in the leisure of home.

In Nairobi there are several highly competent tailors and the matter of special safari clothing can safely be left until arrival. The East Indian tailors are especially expert in making up khaki garments, and a London tailor at Nairobi can supply woolens, ducks, and suitable hosiery and boots.

The conditions of the climate are such that tents should be rot-proofed. Green duck is the most satisfactory. "A" tents with an ample fly and veranda awning and floor cloth are found the most satisfactory.

The choice of the season for safari is important, with many conditions to consider for the varying types of game. In the dry season the elephants are to be found chiefly in the forests, while in the wet season, when grass is abundant, they range out into the bush country and can even be found on the plains. The game movements are largely controlled by the food and water supply, and the lion will be found following the game upon which he preys. Another factor to be considered is the competition between the natives with their herds of cattle, sheep, and camels, and the wild life. The dry seasons are struggles for water out on the veldt and often the native herdsmen monopolize water holes and the game is driven away.

The wet season is not a matter of continuous rains such as one fancies prevails in the tropics, but each day in the season there is rain for a few hours, then sunshine. These conditions make traveling most difficult and expensive. Probably the best period for general game is from about May 1 to October 1. The second dry season runs from about December 1 to March 15. April is actually the only month really bad for hunting, the ground then being pretty well water-logged.

But, to be sure, I must admit as a good East African that every season is a good season, and that there is always good sport and prospect of high adventure. I have heard it said that Southern California has good weather. So it may be becoming to observe that our climate is in many regions closely similar. This I believe is just praise.

Painting the Backgrounds for the African Hall Groups

By W. R. LEIGH

"IT is just as important that the backgrounds be correct as that the animals themselves be so—just as vital as the Arizona settings in your Indian and horse pictures!"

It was Carl Akeley who spoke.

Seated on the opposite side of a luncheon table I felt with a glow of pleasure that my vis-a-vis was indeed the born artist of whom I had heard and read—an uncompromising idealist, a scientist and poet combined.

And time and closer association served only to deepen and broaden this impression. It was this intangible but most real fire radiating from the man that impelled all of us to contribute our best gladly—all of us who were fortunate in being aides in the first expedition sent out for the furtherance of the great African Hall project.

Not only must the backgrounds be as correct, but they must be as typical of the continent as were the beasts they accompanied; in fauna and flora, in geology and geography, we must give as comprehensive a sense of the essence of Africa as was possible within our limitations. We must produce complete pictures, faultless history, perfect science.

The background to a group of animals calls for the utmost measure of truth; there is in it no place for individuality as expressed in treatment, or style, for it aims to suggest paint as little as do the mounted animals; but in subtlety of tone, color, and line, the massing of light and shade, the catching of character in forms, the rendering of textures, the achievement of the illusion of realism and forgetfulness of paint, there exists a challenge; the mightiest wielders of the brush that walk may well take counsel with themselves ere taking up this dare, for Africa is diversified and vast and strenuous.

With a list of all the quadrupeds and a map of Africa, a selection was made of those creatures that could be accommodated in the Hall, and the landmarks which, coupled with them, would tell the biggest story—give the most vivid idea. These animals and landmarks are scattered over the whole continent and necessitate visits to some of the remotest parts.

Our first safari to the Lucania hills was during the rainy season; the Athi plains were green and meadow-like, and the brilliantly colored rock-lichens had dressed the kopjes in their most effective liveries. These rocks were a revelation to Mr. Jansson and myself, and we were lured into making a number of separate studies of them, besides our studies for the Klipspringer Group. Jansson especially, produced some remarkably handsome and artistic studies of the beautiful rock masses.

The play of cloud-shadows over the plains was another delight; infinitely delicate patterns of pearl and lilac with old-gold spaces of dewy light between, and the tree-fringed Athi zig-zagging away into the hazy immensity whence rose, as though pillowed on clouds, the lordly glacier-capped peaks of Kenya directly under the equator. It was a spot that might have been selected for the special observation of the endless pageantry of the skies; the inimitable storm effects with wild rags and tatters of torn clouds hurrying panic-stricken before black rolling masses that emitted quivering forks of flame, and direful groans, and long descending sheets and columns of rain, sometimes purple and green, sometimes illuminated, amber and iridescent-rose-pink; sometimes oblique straight lines, sometimes twisted and contorted. And the never-to-be forgotten grandeur of the sunsets, the supernal glory of the sunrises! Truly Lucania was a place to dream of.

Sometimes it is not possible to find all the elements necessary for the painting of a background in one place. The Buffalo Group was one of these. The right view of Mount Kenya and of the great swamp in which the beasts hide, as well as the lava-rock foreground, we found together, but the wall of vegetation necessary to give a true idea of the haunt of the buffalo had to be obtained from a different part of the morass; and even here the characteristic alleys and tunnels were lacking.

To gain adequate knowledge of these, I ventured one day, after considerable hesitation—for the buffalo is the most dangerous animal extant—into the beast's domain. With my gun bearer proceeding cautiously and silently for some distance, I came suddenly into a large amphitheater-like space where the rank vegetation had been completely trampled down, and in the center lay the skeleton of a cow buffalo, recently picked clean by the hyenas. All around, the high walls, pierced in two places by tunnels, formed entirely impossible barriers to the passage of men—save at a very slow pace—while underfoot the black gumbo gave way constantly, so that leaping from one precarious grass hummock to another alone kept one out of the turbid water. An occasional slip and splash was disconcerting to men who dared not breathe aloud, but when several wild fowls, without warning, started up with a whir of wings and wild cries, we halted. Dead silence reigned after the noise of the birds subsided, and I noted the things I had come for, with keen attention, but when my native touched my elbow and whispered that he believed he had heard the grunt of a buffalo, I decided to retrace my steps. Had there been buffalo near enough to have gotten our scent, it is easy to imagine what might have happened; yet without the hazard how could the information I needed have been obtained?

Sudden departures on long and arduous trips necessitated the construction of special boxes to protect studies from dust and careless handling; also against rain, and insects, and lizards that may crawl over them during the night, especially while the paint is wet. These boxes must be entrusted to carriers who will not fall down in the middle of rivers, or bump them violently against rocks and trees.

Making the Plains Group background was fun; a three-mile drive every morning and afternoon with an auto-truck, amid vast numbers of gnu, topi, zebra, Grant's and Thompson's gazelles, impala, kongoni, wart-hogs, and occasional bands of ostriches, oryx, and giraffe, with now and then a bunch of hyenas, a stray jackal or fox, even a lion or two—a drive to a pleasant hillside, where I sat in the truck overlooking the enormous game-dotted stretches, and in perfect weather painted Tanganyika. Wild dogs on the hills above me barked; secretary birds stalked by, and bustards paused and surveyed me curiously. I had time to paint storm effects, and moonrises, and

COLOR STUDY FOR THE WATER HOLE GROUP

Painted in the field by Arthur A. Jansson, while on the Eastman-Pomeroy-Akeley East African Expedition, 1926-27 intimate studies of grass-stretches and trees and kopjes; and there were no mosquitoes, no ticks; there was a nice, comfortable roaring of lions each night, an occasional stampede of game through camp that did no harm, and endless howling of hyenas, of course. It was a picnic.

In cases like the Gorilla Group, which necessitated a tramp of 125 miles—each way—and a climb to 12,500 feet altitude, the studies would all have been ruined but for extraordinary precautions. As it was, the dampness of the mountains made the canvases so loose and flabby that work on them was difficult.

The trail—we had to chop most of it out as we went—was through dense jungle the whole way up the mountains. The jungle was the natural habitat of elephants, buffaloes, leopards, and gorillas. We stampeded a herd of buffaloes on the way up, and saw many very fresh tracks of pachyderms, but though we would have been almost completely at the mercy of the beasts in case of a charge, nothing untoward occurred.

On this expedition our leader succumbed. The shock added to the natural difficulties of the place, staggered us all for a time. The responsibility of finding the point from which to paint became mine solely.

With the help of a native who, having been Mr. Akeley's former guide, knew the spot desired, I started out in bright sunshine to find the place, but we were soon enveloped in fog and floundered about in the dripping jungle all day, unable to tell whether we had found the place or not, hoping against hope, only to be driven back to camp by a deluge of rain and sleet.

On the following day we were more fortunate. Slipping and sliding up steep inclines, along buffalo trails, wading neck-high through dense masses of wild celery, stumbling over concealed logs, steaming with perspiration despite the cold, and gasping for breath, we found the exact spot, commanding a grand view of the two active volcanoes, Chaninagongo and Namlagira. We had been at the exact point the day before.

I established a camp on the following day, after leveling sufficient space by excavating back into the bank. It placed me five hundred feet above the base camp and necessitated a stay of more than three weeks, during which food and water had to be brought up to me daily. Work had to be done during such intervals as clouds and rain permitted. I painted from the open end of a big fly, which could not be prevented from flopping when the wind blew and jarring the canvas incessantly. I worked most of the time with a charcoal stove beside me, or between my feet, and clumsy with all the clothes I had heaped on me. The nights were made weird by the sullen glow of Namlagira's raging furnace, and by the unearthly cries of the tree hyrax, and the occasional rasping note of leopards. The tracks of the latter were found around camp every morning; also during the day family rows among the gorillas set the jungles echoing.

I determined not to miss the opportunity to get a study of the peak of Mount Mikeno—although it had nothing to do directly with the group; yet the red glow of the declining sun made a thing too marvelous to be resisted. It was a case of painting furiously upon those rare occasions when that phase of the peak could be seen. Often a sudden shower necessitated a hasty retreat to camp, for to get what I wanted I was obliged to go fifty yards off to one side.

It was also incumbent upon me to make a great number of studies of plants with their flowers and berries.

On our journeys back and forth from the Congo, we had to travel many miles through the bamboo belt. This is a strip approximately two miles wide on steep ascents, which is determined by altitude, above and below which no bamboo grows. The bamboo is a favorite haunt of the elephant.

The tract we traversed was composed of a wilderness of precipitous, winding and narrow-crested ridges, between which ancient lakes had become so filled with decayed vegetation that they were now reed-grown bogs, narrow, level, and stretching willow-green, like vast sleeping serpents, for miles between the darker green of the bamboo. The trail followed the line where the bamboo and the swamp met; an impenetrable jungle on one side, and an impassable swamp on the other. The jungle was smashed and battered in places, the morass criss-crossed by trails, and the path full of huge, deep tracks—the work of elephants. In case of a charge by a pachyderm there was no refuge, no escape save in the possession of good nerves and a heavy rifle.

During our return trip through this country, we were startled one day by a native staggering out of the bamboo into our midst. He was covered with dirt and blood. The man, with a companion, had been chopping bamboo a few moments before when an elephant had charged down on them. The companion was killed. On the same day reports reached us that two men had been killed that day on the trail which we would traverse the next day.

The following morning our two hundred porters got under way as soon as their loads were ready for them, as was their custom. I was in the lead of the rest of the party following them. I had proceeded some four miles when wild cries of terror ahead alarmed me. I hurried forward but, by the time I got around the bend that shut off my view, the elephants sighted had been frightened off by the uproar. Shortly afterward I passed what the cheetahs had left of the bodies of the luckless victims of the day before.

On our last safari to Lake Hannington difficulties equally great but of a largely different character were encountered. The region is a dreary desert tract, thinly scattered with native goat herders, and rarely visited by whites. It is composed of lava beds sparsely covered with stunted acacia and thorn bushes, and innocent of roads. At the time of our visit, it was also devoid of water, save the lake and its contiguous warm, hot, and boiling alkaline springs.

It was a fifteen-mile tramp from the end of the road, where the automobiles had to be abandoned, to the part of the lake for which we were bound, but through misinformation we walked twenty miles to the wrong end of the lake and were obliged to journey the same distance back along its shores to the right end. Though this consumed three days, it resulted in our seeing the vast aggregations of flamingoes that did not congregate in anything like such numbers at the end for which we were bound.

On arrival at our base camp it became my duty to ascend the eighteen-hundred-foot escarpment, and find a site from which to paint the background for the Greater Koodoo Group; as far as could be seen the escarpment was a pathless rampart, covered with a vast variety of bushes and cacti—everyone

Daniel Pomeroy, George Eastman, and Doctor Stewart inspecting paintings made by Mr. Leigh and Mr. Jansson for the water-hole groups

ingeniously armed with most vicious thorns—rocks, grass, and briars, and was exceedingly steep, where passable at all, while most of it consisted of sheer cliffs.

We had with us a native guide who professed to be familiar with the country. I inquired of him if there was a trail leading to the top; experience and common sense told me there must be,—I reasoned that the herds on the top would probably have to descend for water—but our guide said "No"; there was "no trail."

When all that was required for the establishment of a new camp was loaded on ten porters, this worthy undertook, the second noon, to pilot us up to the top. It looked a formidable task and for the porters proved an impossible one. Half way up the precipitous slopes, the treacherous footing and the thorns and rocks brought us to a standstill, with a band of baboons above us cursing and deriding us with furious ardor. The porters were strung out in a crooked line, clinging desperately with their feet to the precarious shelves, bleeding from scratches, panting, perspiring; the heat was frightful.

I scanned the slopes from the vantage point gained, and discovered a yellow streak half a mile distant, leading up a promising shoulder. I pointed it out to the guide. He laughed.

"It does not go the whole way up."

That didn't sound logical to me. I commanded a halt and rest, while I investigated. I satisfied myself that the trail did lead to the top and by sundown I had the whole party on a small level two-thirds of the way up. We made camp.

The following morning I took Tomasi, my best man, and started for the top. I carried the gun and he the canteen and lunch.

The top of the escarpment gained, a wide broken country spread out before us, in which the vegetation gave no hope of water within range of the eye.

Following the jagged edge of the cliff-system for two miles, over parched and pathless wastes of lava-strewn ravines and hog-backs—a wilderness of thorn and bramble amid which baboons and impala scampered from sight—I came about noon to the place where I decided my camp would be. It commanded a magnificent view of the lake and the two walls of the Rift Valley. Yet to make sure that I had really found the best point, I explored several miles farther, without changing my mind.

By the evening of the next day I was established in my new camp and had begun work. The wind proved a troublesome factor, keeping in a perpetual state of agitation the fly which protected me from the fierce rays of the sun. Water had to be brought up every second day—water that had alkali in it—and the heat made provisions spoil readily; an attack of fever put me in bad shape for a week.

Every night the wind rose and the dried leaves and thorny twigs of the tree above my tent scratched and scraped the heaving canvas, while hyenas wailed and laughed, and endless flocks of flamingoes honked overhead. As in the Congo, I had to do a large number of plant studies in addition to painting the view. The wind blew sand and litter over the wet paint and sawed the ropes of the fly in two against the rocks. Yet it was a fascinating camp—so deserted—so savage; the baboons came every day to denounce me; a big old male would perch upon a high rock, or in the crotch of a tree, and abuse me by the hour. Hyrax expostulated in no uncertain tones, and big crows balanced on snags to squawk intermittently. And the sunrises and sunsets! The great valley then lay in delicate lilac shadow, while the tops of the escarpment walls caught the first or the last rose-rays of the ascending or declining orb. And when the opal-tinted misty lake lay smooth in moonlight and down the starred expanse above a meteor plunged, there remained no doubt that it was a glorious camp.

Tomasi's feet got so full of thorns that I had to dress them with disinfectant and adhesive plaster and contribute a couple of pairs of socks and a pair of shoes. Tomasi never swore, never stole, yet he was an impregnable atheist.

In painting studies for backgrounds it is necessary to keep in mind that the ultimate picture will be painted on a half-circular canvas; also that a plastic foreground must be joined up with the picture. Some joinings are more convincing than others, and the sense of distance, aërial perspective, the impression of looking downhill, the management of shadows and lights, must all be thought of while selecting the motive.

The shipment of painted studies is a detail also not to be neglected. All rolling or bending is bad. Mr. Raddatz constructed a metal case with handles, into which all the larger studies, after removal from the stretchers, were packed with oiled paper between each two, so that lying flat and sealed against dampness, they traveled safely in the hands of the aforesaid gentleman across the ocean and into the Museum. In like manner the panel studies and sketch books were separately and specially packed by him, with the result that all have reached their destination in perfect condition.

Collecting Large Mammals for Museum Exhibition

By ROBERT H. ROCKWELL

The visitor standing before a museum group can have little conception of the enormous task which confronts the preparators when planning and constructing such an exhibit. The days of tracking on the field with unlimited patience, the knowledge of what to select, the long hours of arduous toil, often from early dawn till far into the night and under the most trying conditions, to preserve the specimens and make accurate measurements and color studies as a guide for the future work in the laboratory, and then the final assembling of all the parts into a harmonious whole,—all this is a story unknown to the world, but one without which the groups would not be possible.—The Editors

A RARE opportunity was in store for me when the late Carl Akeley proposed that I join his expedition in Africa and assist him in collecting specimens and data for a series of six animal groups for the African Hall. I was glad to avail myself of this offer, for Akeley was without doubt the greatest mammal taxidermist in America if not in the world. Many of his methods were distinctly original, and he knew Africa and its wild life as few people do. Besides this, he possessed that indefinable quality of character that endeared him to all those who came under his influence either in the field or in camp.

Akeley's plans called for a hundred specimens of mammal skins, not to be gathered in a haphazard way but to be selected carefully with reference to certain groups that were considered the most typical of Equatorial Africa. Prominent among these were the giraffe, buffalo, oryx, impala, zebra, hartebeest, and gazelle.

Few expeditions have entered Africa with the definite purpose of collecting material and accessories for habitat groups. The quest has usually been for a large series of study skins, specimens that seldom receive the care or handling to make perfect mounts or to meet the high quality of museum taxidermy. Akeley's methods of field work were painstaking and thorough, and aside from preserving a perfect skin, it included precise anatomical measurements and a great amount of two-handed work.

In the old days of "stuffing" skins, anyone with a hobby for collecting could go out into the wilds, secure a pile of skins, and then present them to a museum without measurements, bones, or other anatomical information. Indeed, the taxidermist was expected in many cases to resurrect beasts that he had never before laid eyes on. Fortunately this mode of procedure is passing, although even now a few of these terrible examples still stare accusingly at us from museum cases.

Collecting museum specimens is no light undertaking, especially when the animals are to be mounted. Merely recording a few measurements of a beast, flaying the carcass, and scattering some salt on the pelt is not going to insure fine results or well mounted specimens. From the time an animal is selected from a herd by the shot that brings him to earth, one must constantly bear in mind that his carcass should be regarded with due respect and every consideration given to "immortalize" that form by all the means that art and scientific skill can command.

Selecting the proper specimens for a group demands care and judgment. Only a small percentage of animals seen or stalked are fit subjects for mounting. Some of them present abnormal defects or are badly used up from fighting or old age. In such cases no amount of taxidermic skill will avail. The production of a flawless manikin, with every muscle and line a masterpiece of modeling cannot offset inherent defects in a skin and the results can be nothing but mediocre. An animal skin for mounting must be perfect at the start, cured properly, and kept perfect until it is placed on the manikin and put in a glass case. It was for such reasons that Akeley always objected to mounting anything that he had not seen or studied himself. His excellent animal groups in the Chicago Field Museum indicate that in this attitude he was thoroughly justified.

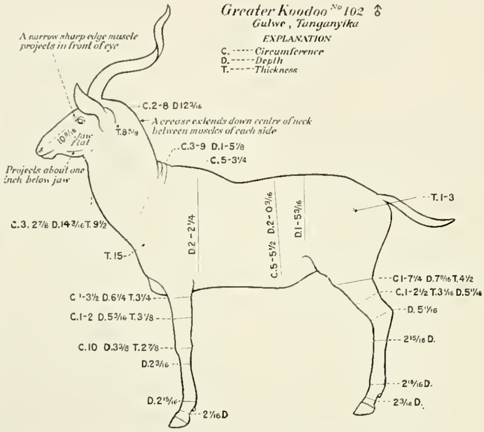


Chart for measuring large mammals. After Akeley

Our African collecting began at a place called Lucania, forty miles from Nairobi. The klipspringer was the first object of our efforts. As it was a thin-skinned animal, it was preserved by a different method than the larger and more massive beasts. No salt preservative or curing formula was used on these small pelts. The climate being dry and warm, the skins were turned inside out, exposing the entire fleshy surface to the air. They were protected by canvas from the hot rays of the sun, and within ten hours were quite dry. It was an excellent system but it required expert care and attention. The climate has to be such that the skins become dry before decay has a chance to set in. However, specimens preserved by this means are subject to the ravages of insect pests. To guard against this risk, the hides are taken when bone dry and placed in zinc-lined cases which are soldered up so as to be air-tight. Then, through a round hole in the cover (which is later capped with a screw-top plug) disulphide of carbon is poured in. This is a poison that destroys all injurious insect life but is not detrimental to the skins. It is a volatile gas, however, and the soldering must be done before the liquid is poured in, otherwise a dangerous explosion is liable to occur.

Of the larger animals that we collected, the buffalo and the giraffe presented more varied problems. They required much labor and a certain degree of skillful handling after they were brought down.

Selecting a typical specimen from a herd often demanded days of tracking and unlimited patience, especially with the buffaloes which are always keenly alert and suspicious. At times they are dangerous and one must always approach them with the utmost caution. When a herd becomes alarmed, the animals will mill together like a lot of wild cattle in a stampede, and it is then almost impossible to pick or choose a desirable specimen.

Two buffaloes had been secured by Mr. George Eastman for the group, but we still required several more specimens to complete our collection. A large herd was known to frequent a region thirty miles below Fort Hall, so, in the latter part of July, 1926, Akeley sent me down the Tana River to obtain the needed animals. This gave me an unusual opportunity to collect and study these interesting beasts in their natural environment. With a motor truck to carry my camping outfit and supplies, and sufficient provisions to last for two weeks, I headed overland through a trackless open country into the valley of the Tana, accompanied by five black assistants.

After hunting for five days we located the tracks of the herd. It was six o'clock in the morning when we found the trail at a series of water holes where the animals had evidently spent most of the night. We followed their well marked meandering trail over high hills and through open grassy country until noon. Then, in a thicket of dense bush, I saw a pair of flapping ears near the ground not more than ten yards in front of me. It was a buffalo lying down and watching us as we were working out the tracks. Presently there was a wild stampede, and buffalo just boiled out of the bushes, crashing down trees in their hasty retreat. There was too much confusion even to see what type of buffalo was dodging about, and they were gone out of sight in a moment. But we noted the general direction they took. At five o'clock that afternoon we caught up with them again and I secured a fine old cow and a calf which were very desirable specimens for the group.

After taking a few photographs in the fading light, I made about a hundred measurements of the two animals and a chart of accurate anatomical notes. We were now seven miles from camp, with darkness rapidly closing in on us, but it was absolutely necessary that the skins of these animals should be removed from the carcass at once so we decided to stay out for the night.

We had no lamps and there was no moonlight, but by gathering up what wood we could find we built a fire, and three natives held fagots over me while I did the skinning and dissecting. All the specimens were cased skins, and this made our work much harder. No opening cut was made on the legs except a six-inch slit from the dew claws to the hoofs. But a long incision was made along the belly and through this I had to grope in the darkness to cut the joints where the legs joined the body. The legs were then skinned out hollow and were peeled down much as one pulls off a stocking. It made a perfect job but it was heavy work at the end of a hard day's hunting, with no meals to speak of and a woeful lack of water. At midnight the work was far enough advanced so that I could rest a bit. I selected a tender piece of buffalo meat and broiled it on a stick over a red-hot charcoal fire, thus breaking an eighteen-hour fast.

There was no chance of sleep here, for it rained all night, and at the first faint signs of dawn I made haste to reach camp and secure the salt so vital to preserving the skins. If I could only get salt on those hides before the sun came up the situation would be saved; if I failed the skins would rot in a few hours and all my work would have been for naught. It was a long journey back to camp, and for the first four miles I ran for a good part of the

Drying the giraffe skin in the shade of a giant Acacia tree

way, but the lack of food and sleep began to tell, and the high matted grass seemed to trip me at every step. I had two porters with me, and as we crossed the slope of a low hill, I was so tired I gave one of the men my gun to carry. It was the first time I had ever allowed a native to carry my gun and it taught me a lesson. At that moment eight splendid buffaloes with enormous horns appeared, heading in our direction; we could just see their heads over the top of some tall grass. My first thought was of the possibility of a charge. Just then I saw that my porter had sized up the serious situation and was starting to bolt with the gun that was our only protection. There were no trees or rocks behind which we could dodge, for we were in comparatively open country, and the buffaloes came closer, spread out in company formation, and stood about forty yards away gazing at us in a menacing manner. At a command from me in no uncertain tones that native sneaked back with my rifle. I already had two buffalo skins not yet cared for, so I had to forego a splendid chance to secure a fine bull and I let the herd pass on without firing a shot.

On reaching camp I had a belated breakfast and with the motor truck worked my way among the hills where I had left my gun bearer guarding the two skins. By nine o'clock the two skins were thoroughly salted and saved. We took them back to camp with the complete skeletons of each. The flesh was all cut from the bone and the entire skeletons were preserved in ligamentary form as a guide in mounting later on. Then with the aid of two black helpers I shaved the hides down on the flesh side, taking off about a quarter of an inch of flesh and leather. It was a tedious operation requiring two days of steady work. The specimens were then suspended from a tree in the shade where they became perfectly dry within a few days.

The motor cars were invaluable to us in many ways, for we were enabled to carry with us a very complete outfit and a supply of salt that was most essential for our purposes. Indeed, it would have been well nigh impossible to accomplish the results that we obtained by using native carriers. Plaster of Paris was used to a great extent in making casts of the anatomy and death masks of the animals' faces. Some of the skeletons and skins were transported by motor truck for more than five hundred miles.

Collecting specimens of the giraffe was greatly facilitated by having everything we needed at hand in the car. Perhaps the most useful article was the large canvas tarpaulin that we raised over the beast after he was shot. While we worked it protected us from the burning heat of the tropical sun. If an animal is allowed to remain even three hours in the hot sun, decay is certain to set in and ruin the specimen. Dry salt was applied to the inside of the skin and a liquid salt solution to the hair side. Within ten hours the beast was entirely skinned, salted, and the skeleton cleaned, but it required three days to pare down the hard, fleshy hide. Skinning out the long legs without cutting them open was a most difficult operation. A three-foot piece of flat hoop iron with a sharp edge was shoved up and down under the skin of the legs, releasing the membrane that held the skin to the bone; then the legs slipped out easily. The advantage of this method lies in the fact that in the final mounting there will be no ugly stitching or seams showing on the mounted specimen.

As material for groups of mounted mammals, the collection represents perhaps the best and most carefully handled that was ever brought back from Africa for this purpose. The most vital part of the whole plan, however, was the good judgment of Carl Akeley when he decided to take with him the artists who were actually going to mount the animals, paint the backgrounds, and reproduce the natural setting for the groups. This personal contact with Africa and its wild life was in itself an inspiration that will survive. It will produce a more definite plan of artistic endeavor and strengthen our efforts to infuse into the African Hall an element of realism and truth.

Model of the Giant Sable Group for the American Museum, prepared by John W. Hope under the direction of James L. Clark, assistant director. Photographic studies for the foreground and background were made by Mr. Vernay

Angola as a Game Country[1]

By ARTHUR S. VERNAY

THE Portuguese colony of Angola on the West Coast of Africa is a game country, although it is known to the generality of sportsmen and collectors chiefly as the home of the giant sable antelope. One hears little of the variety and quality of Angolan wild life because British East Africa and Tanganyika, where game is so abundant, are much more accessible and the path of the hunter there is smoothed by numerous organizations that arrange for his comfort. Angola, where there is neither safariland nor professional hunter, has been penetrated by comparatively few sportsmen and consequently offers fascinating sport.

From a zoölogical standpoint, Angola is famous for the giant sable, although the area in which this species roams is astonishingly limited. But those sportsmen who have not visited Angola may be assured that the giant sable is by no means the sole interest that this country holds from the standpoint of game. Large herds of elephants range along the Cunene River—the most beautiful district of Angola; there are lions west of the Cunene; the hippopotamus lives in large herds by the great rivers, and there are many antelope, including the greater koodoo.

There are not found in Angola, of course, the large herds of game that one observes on the eastern side of Africa. And it is interesting to note that the elephant, although of the same size, carries smaller ivory. The heads of the various antelope, espe-

[1]The objective of the Vernay–Angola Expedition was to obtain a complete habitat group of the giant sable, comprising male, female, and young, for the American Museum. The expedition was surprised, however, on visiting various parts of the region, to see the abundance of game actually existent in Angola.

cially the greater koodoo, are invariably smaller than those in East Africa, with one exception: the giant sable carries a considerably larger head than the ordinary sable.

Specimens obtained included elephant, lion, Hartmann's and Chapman's zebras; roan, giant sable, klipspringer, stembok, springbuck, brindled gnu, eland, greater koodoo, water buck, reedbuck, duiker and blue duiker.

We saw hippopotamus, wart hog, oryx, leopard, hyena (which is somewhat rare in Angola) and bush buck, and found tracks of buffalo, but saw none. It is said that the gorilla also lives in this region but we did not find any, although we obtained a large number of lemurs and baboons.

Besides this game, our material for the American Museum of Natural History ranged from ants to elephants. I mention these extremes because we secured a large collection of the former and a splendid specimen of the latter. Our specimens of mammals, large and small, reptiles, birds, and fish, numbered approximately 8000, and then there were the insects, butterflies, and fossils of which we had gathered a large number. Among the reptiles was an important group of snakes and geckos, chameleons and other lizards.

The more interesting game, I should add, must be hunted very seriously, as it is not as plentiful in certain parts of Angola as it should be due to lax supervision of the game laws. Not only the natives, who have lain in wait at water holes with bow and arrow, but the Boers, who went to Angola forty years ago, trekking up from South Africa, have pretty well shot out the country. The Boer is invariably an expert tracker and a very fine shot, and, I am sorry to say, merciless in his quest, as he kills to obtain skins after

Transportation has its difficulties in the wilds of Angola his requirements for meat are filled. In certain sections of Angola colonized by the Boer, game is practically extinct.

There is, however, a district left around the Cunene River that offers great possibilities. From a place called Capalonga down to the mouth of the Cunene River, a distance of, roughly, 200 miles, one finds a virtually undisturbed country where game abounds. We had gone but one hundred kilometers from Capalonga when we came upon great herds of gnu that were almost tame. It was not until I had shot three for our collection that the great plain became entirely empty of these and other animals.

Those who have shot in Africa and realize the difficulty of getting in touch with the greater koodoo will appreciate the advantages of this region. Going along the banks of the Cunene one morning about eleven o'clock, I was amazed as we rounded a bend to come upon two greater koodoos basking in the sun. I am also told that a rare type of giraffe inhabits the savannah country near the mouth of the river. It is designated as the *Giraffa camelopardalis angolensis*, and is very much the same as the reticulated giraffe, except that the Angolan species has closer reticulations.

Birds are plentiful in this district. We saw a number of ostriches which were not so tame as those in East Africa and which never permitted us to come closer than 400 or 500 yards. There were also the greater and lesser bustards, several species of storks, marabou, and various cranes and many birds of prey. The sangras, or dwarf goose, a most interesting bird, was obtained along the Cunene.

So well worth while did we find this region along the Cunene that it is my intention to return and make the trip down the two hundred miles of game country between Capalonga and the savannah country.

From this summary of the game found on the expedition it may be seen that Angola holds attractions both for the sportsman and the scientist. With the completion, however, of the Benguela-Katanga Railroad, linking up Benguela with the great copper mines in Katanga and the Belgian Congo, game in this region will naturally become more and more scarce. This will be particularly true of the giant sable which even now has become so scarce that it is closed to shooting.

My interest in this species was aroused first by the fact that, prior to our expedition, I had seen only one mounted specimen of the giant sable—this being in the British Museum (South Kensington). Prof. Henry Fairfield Osborn was consulted and he urged the immediate acquisition of a complete group of the giant sable for the American Museum of Natural History. The result of our conference was that Herbert Lang, assistant curator of mammalogy in the Museum, joined the expedition, and Rudyerd Boulton of the Museum's bird department was appointed ornithologist. For this assistance I am forever grateful to Professor Osborn, as I have never been in the field with two more enthusiastic collectors and keen and interesting companions.

Many months were required to perfect our arrangements, the most important matter being to obtain the coöperation of the Portuguese government. This, after a few interchanges between Washington and Lisbon, was most readily given; consequently the governors of the different districts through which we passed did everything possible to facilitate our movements. Without this help the success which came to the expedition would never have been achieved. Mr. Lang, who is a veteran explorer, having spent six years in the Belgian Congo, did most of the work of preparation.

After a delightful stop in Lisbon we set out on a very comfortable boat of the German Oest Africa Line. The voyage of two weeks was broken by a visit at Teneriffe, followed by arrival at Loanda, capital of Angola. We then sailed for Lobito, which has one of the finest natural harbors in the world, protected by a long sand-spit extending far into the sea and making it possible for vessels to come quite close to the mainland in deep water.

On arriving at Lobito, I stayed for a few days with H. F. Varian, chief engineer of the Benguela-Katanga Railroad. From Mr. Varian, discoverer in 1913 of the giant sable which in his honor bears the designation *Hippotragus niger varianii*, I learned much that proved invaluable in obtaining the Museum specimens. Without his aid I am sure that the difficulties of our expedition would have been increased enormously. I would advise no one to undertake a hunting trip in Angola without first making the requisite arrangements with the Portuguese government and with some one resident in Angola.

It is an interesting experience to have to make one's own arrangements. In India they have an extraordinarily expressive term for this business; all the infinite preparations for an expedition, or for that matter any other arrangements, are called simply "bundabust." With no organizations nor professional hunters such as one finds in Nairobi, we had to make our own "bundabust." We assembled roughly four tons of supplies and equipment—much of which we had brought with us on the boat—and hired the native personnel. There were, besides the carriers, twenty-five camp boys, skinners, and men, who were soon taught to help in securing small creatures and properly preserving them.

Steinbuck, one of the smallest of the true antelopes

We were singularly fortunate in enlisting the services of Alan and Harry Chapman, who were born in Angola and consequently spoke not only Portuguese and Boer but also two or three of the many native tongues. The help of these men proved invaluable; they were able in the field and most agreeable companions in camp.

From Lobito we traveled by rail to Benguela, whence the railroad ascends to about 5000 feet, going due east to Huambo, a distance of about 250 miles. Here we established our base.

The best season for the giant sable is in September and October, particularly the latter six weeks, when the rainfall has begun and the new grass is coming up in the burnt stubble. As the grass had not yet been burned off, we turned southward toward Mossamedes for a series of springbuck.

Our route to Mossamedes lay through an arid country. All water had to be carried along in barrels, as the nearest supply was forty miles away. In this region we found only the springbuck, the desert fox, and, when nearer water, the oryx and Hartmann's zebra.

The first 275 miles of our journey to a place called Lubango was covered in Ford cars, which proved very useful. After a hundred miles we were in touch with game and saw roan, duiker, and various small antelope.

More interesting, however, were the tribes of natives encountered along the way, the Mondombos, Gambos and others, in the Province of Huilla. To obtain a photographic record of some of these was not easy. The hairdress of the women was most curious, being achieved by the use of red clay studded with shells, and their clever work in weaving sturdy baskets particularly attracted us.

After obtaining the springbuck series in Mossamedes we hurried back to Huambo in order to enter the sable country. Two or three days were spent in re-arranging the equipment. Then it was decided that Boulton should go to the hills for special birds, Lang to another district for small mammals and reptiles, and Alan Chapman and I should seek the giant sable.

We traveled three hundred miles eastward to the Cuanza River, which we crossed in long native dugouts, and were presently within three days' march of the sable country. This area extends only approximately a hundred miles north and south by forty miles east and west, being a part of the water shed of the Cuanza and Luando rivers. It is an inhospitable country, sparsely inhabited by a tribe known as the Luimbes, an inferior race physically and mentally. We hired a number of natives as carriers and found that they could pack only fifty pounds as contrasted with the sixty-pound load on the East Coast.

After three days' tramping through the bush we came upon a cluster of half a dozen native huts, and miserable hovels they were. The *sova*, or headman, told us their hunter—who is a mighty man among the natives—was away but would return soon. We decided to wait and rest.

Shortly we saw a fine-looking savage approaching. He was almost seven feet tall and, with his big bow and one large, carefully constructed and well balanced arrow, his native axe, and a sparse drapery of skins, he made a picturesque figure. Alan and I were duly impressed and decided to engage this mighty-looking savage whose name, we found, was Tarti.

Tarti said he had seen sable only a few days before and, from his account, their size exceeded one's dreams. We knew that Tarti was exaggerating, but nevertheless the next day we started on our quest. We hunted for three days but found no sign of sable and obtained only one fair specimen of roan. This was disappointing.

Tarti, we discovered, was unaccustomed to crawling through the burnt stubble in stalking and he usually spent hours in a tree or some concealed spot awaiting the approach of game. In this way he occasionally killed reed buck, duiker and, rarely, a roan or sable. He also had a pernicious habit, when stalking, of taking pungent snuff, so that we never knew when he might be seized by a fit of loud sneezing at the most inopportune time, frightening any game within earshot. After learning Tarti's shortcomings as a hunter we used him only as a guide, in which capacity he was valuable, for all the natives knew him.

On entering a village, Tarti always received a vociferous welcome. Natives sprang up from around their fires and cried "*Ohosie! Ohosie! Ohosie!*" To which he replied with gravity, "*Ondombo.*" Alan told me that the native greeting meant "The lion," a tribute to Tarti's ability as a hunter, while his salutation was simply a recognition of their compliment. He said "Great," much as one would say "Yes, I *am* the great lion."

Disappointed in Tarti's territory, we moved on to the Tetie River, which flows into the Chisonque and thence to the Luando, a district that Mr. Varian had recommended. The Tetie was little more than a stream at this season and the water was unpleasant in color and taste, but after boiling it twice we were able to drink it.

Within four days' hunting on the Tetie, where we camped, we luckily obtained two cows, a small bull, and a calf of the giant sable species. We had only a glimpse, however, of our principal quarry, the bull giant sable, which we saw once at daybreak, about three hundred yards away. The light was too poor for an accurate shot and the animal would undoubtedly have fled the region had we missed. He was followed for a short distance but his tracks were soon lost in the hard, dry ground.

Time passed and we became anxious, as only four days remained in which to obtain the old bull which would complete our group. Consequently I sent Alan northward while I turned to the south so that we could cover as wide a territory as possible in the limited time. We agreed that should either get the bull he would dispatch a runner to the other so that immediate preparations might be made to break camp.

I took with me a native of the Umbundu tribe, named Sakafuta, who had hunted with me for a considerable time. Sakafuta was keen and, although we could not speak to each other, he always seemed to understand what was required. We tried earnestly the next two days but had no sight of the bull giant sable.

It was necessary for us to leave camp on August 15 and on the evening of August 13 the group was still incomplete. No word had come from Alan. I returned to camp weary that evening, with Sakafuta on the point of giving out, as the burnt stubble had sorely tried his feet. It seemed as though we were to fail in obtaining the most wanted specimen for the Museum.

I informed the camp boys, through Mensa, our cook, an aged Sierra Leone negro who spoke English, that "tomorrow we pack up; no more hunting." Sakafuta was overjoyed, as his feet were bleeding, and the other boys began making preparations for the march.

After a hot bath, a good meal, and the wonderful quiet of the African evening, with time to think things over, aspects changed. "After all, the last day may be the best; the Museum's luck must hold." Mensa was called and told that I had changed my mind. Sakafuta and another must be ready at half past four next morning for a final attempt to get the old bull. I determined to make one more wide detour around the feeding ground where several days previously we had seen the bull sable.

Dawn was breaking as we set out at a quarter to five, at a brisk pace but with eyes and ears alert. It was about seven o'clock, the sun was well up, and we were moving noiselessly through grass to our waists; I was in the lead, the others following. Sakafuta and the other man, they afterward told Alan, were looking to the right when I saw on my left a black object moving in the grass.

A motion of the hand and the men slid silently into the grass and disappeared. Cautiously turning about, I saw a splendid bull giant sable antelope, with superb scimitar horns, boldly carried, walking parallel to us within a hundred and fifty yards, wholly unconscious of our presence. I shall never forget that sight.

He walked behind a huge fallen tree. Would he turn into the bush from behind the tree? If so, I must follow him, which would be a great risk, as with eyesight and hearing developed to an acute degree, he would have disappeared at the slightest sound. I could see his form dimly through the dead leaves. He kept straight on, reappeared, and the shot was taken. It was a little far back; he stumbled, and the next shot gave us the prize which completed the habitat group of giant sable.

We hastened over and carefully examined our trophy for the Museum. It was a fine old bull with horns measuring 54½ inches almost perfect in symmetry and with large base measurement. He was just what we wanted—a respresentative example of the bull sable in perfect condition.

I had not brought a camera with me, as all extra weight told heavily, so one man was sent back to camp to get it. Meanwhile, Sakafuta was beside himself with joy. He leapt up and down, beating his chest, patting the sable, slapping himself on the head, and continually mimicking the motions of the stalk. Apparently he was explaining to me how clever he and the other man were to have disappeared so quickly in the bush. Apart from his pride he knew that he had earned the reward of *escudos* that he had been promised in case we got the big bull, and which he certainly deserved.

Within four hours a small army of natives appeared, the sable was skinned and the skeleton carefully preserved. By eleven o'clock that night, our last before it was necessary to begin the return trip, the skin had been salted and packed and everything was in readiness for the move.

A runner was dispatched to Alan but could not find him, for he was hunting his territory thoroughly and moving camp day by day. Had I not been able to obtain the old bull, I had intended leaving Chapman in the field, as chances of success would have been better when the rains set in. However, he appeared next morning at nine o'clock, whereupon we immediately started back toward the Cuanza and home. Needless to say, we were delighted that the group was complete.

On the way back to our base at Huambo we met Lang, who had added a large number of specimens to the collection of small mammals and reptiles, and at Huambo we found Boulton who had had great luck with birds.

Natives of East Africa

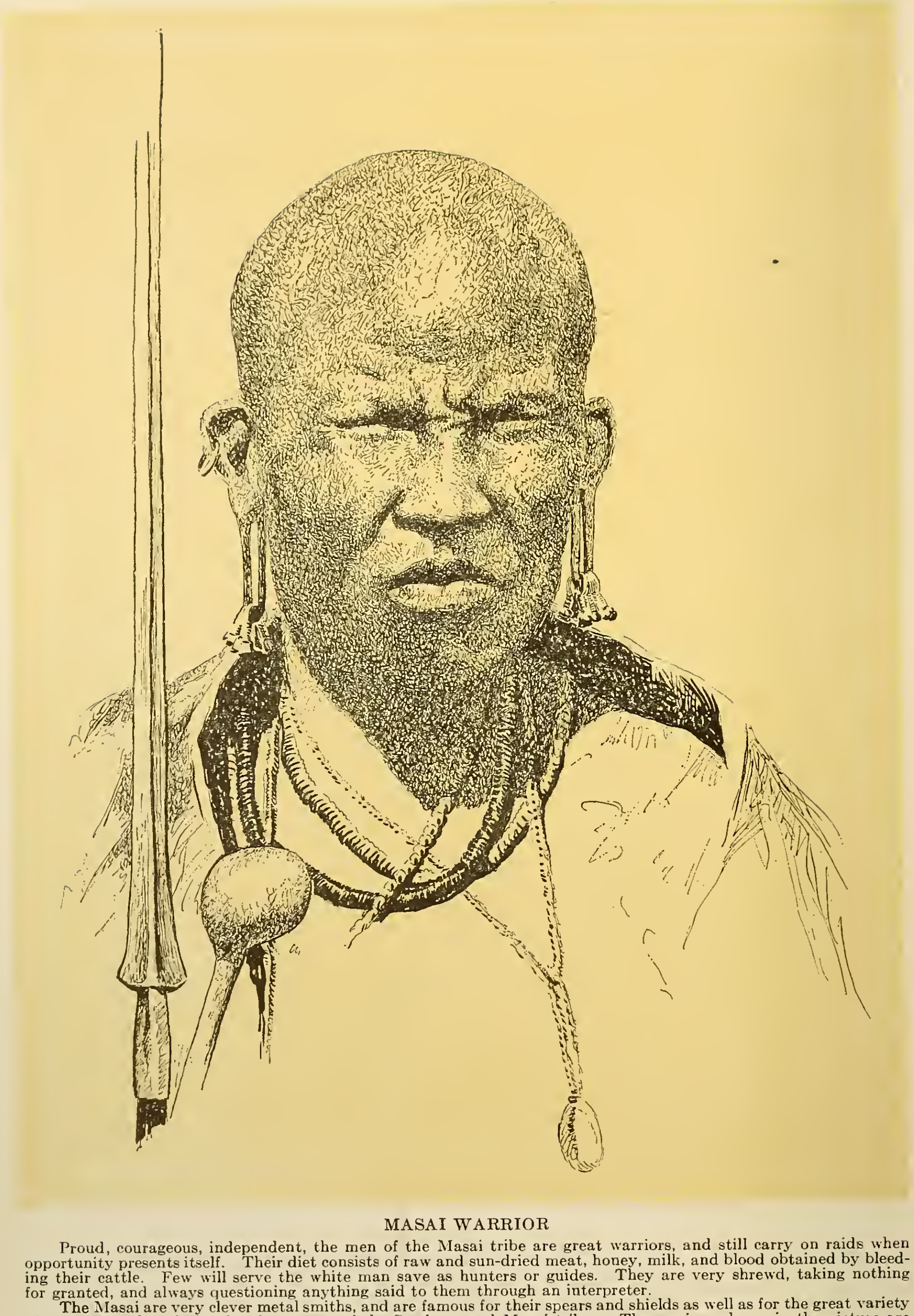
FROM PEN AND INK STUDIES MADE IN KENYA COLONY DURING THE EASTMAN-POMEROY-AKELEY EAST AFRICAN EXPEDITION OF 1926-1927

By A. A. JANSSON

KIKIYU HOUSEWIFE

The Kikiyu housewife or "bibi" does all the heavy work, and if she has children they must help her at a very early age. The burden carrier shown suspended from a band around her forehead is often laden with from 60 to 100 pounds of wood, sugar cane, bananas, or maize, and a baby may also ride on its mother's hip at the same time.

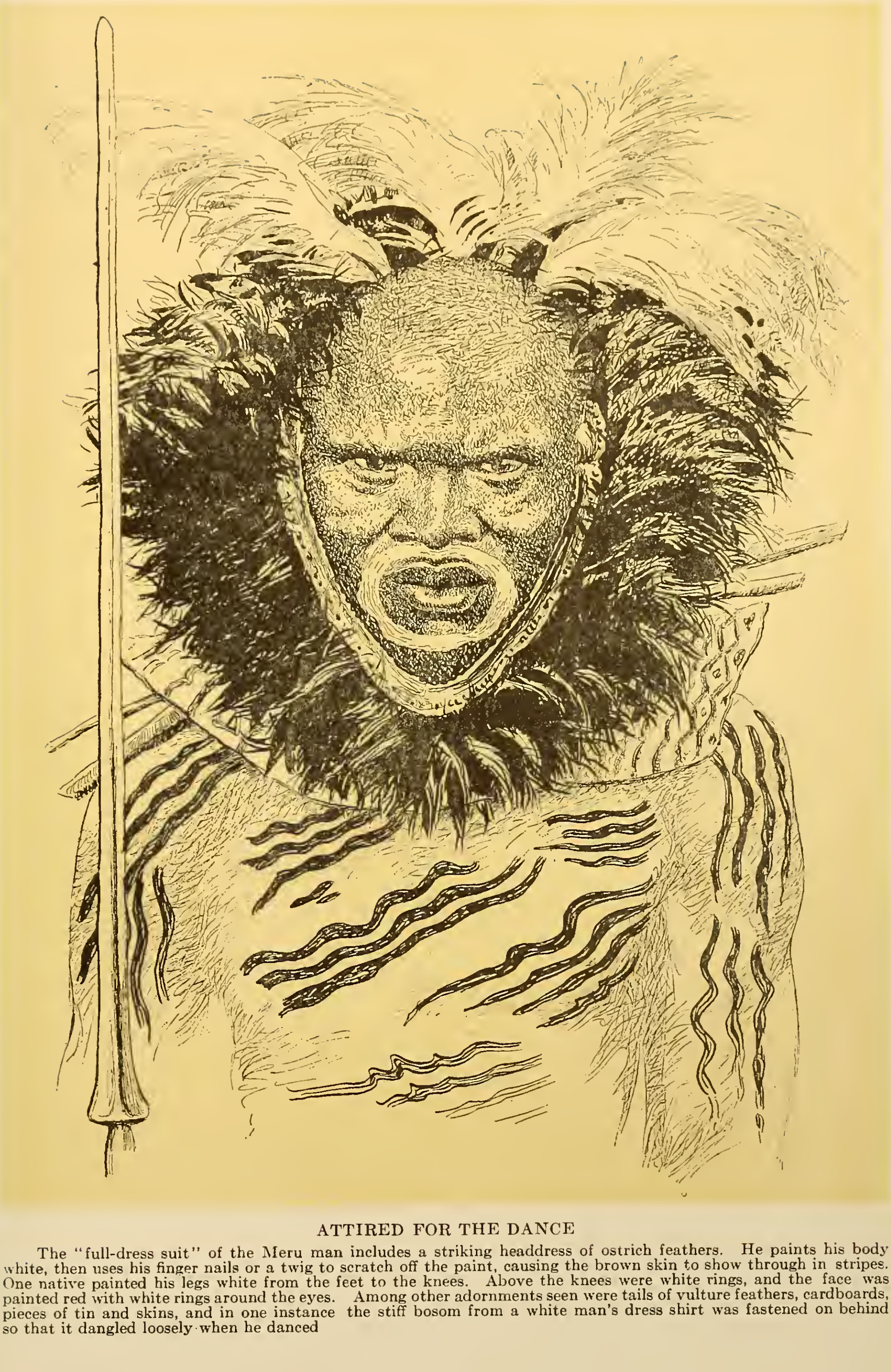
The Kikiyu woman's most conspicuous ornaments are ringlets of pink beads hung from her ears. The rings are about six inches in diameter, and twenty is not an unusual number for each ear



MASAI WARRIOR

Proud, courageous, independent, the men of the Masai tribe are great warriors, and still carry on raids when opportunity presents itself. Their diet consists of raw and sun-dried meat, honey, milk, and blood obtained by bleeding their cattle. Few will serve the white man save as hunters or guides. They are very shrewd, taking nothing for granted, and always questioning anything said to them through an interpreter.

The Masai are very clever metal smiths, and are famous for their spears and shields as well as for the great variety of ornaments they design for the women of the Samburu and Masai tribes. The earrings shown in the picture are made of iron and copper and are worn only by the men



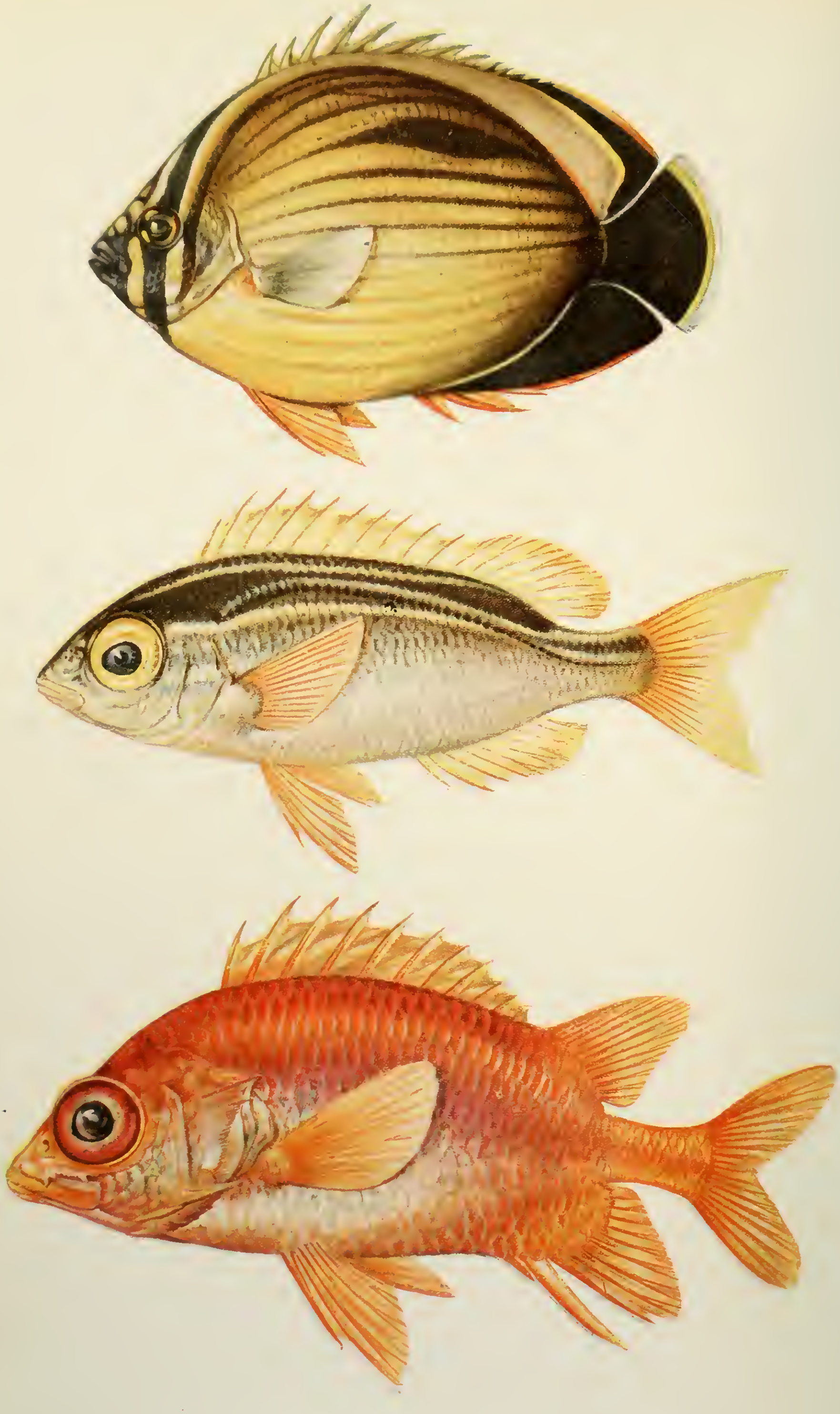
ATTIRED FOR THE DANCE

The "full-dress suit" of the Meru man includes a striking headdress of ostrich feathers. He paints his body white, then uses his finger nails or a twig to scratch off the paint, causing the brown skin to show through in stripes. One native painted his legs white from the feet to the knees. Above the knees were white rings, and the face was painted red with white rings around the eyes. Among other adornments seen were tails of vulture feathers, cardboards, pieces of tin and skins, and in one instance the stiff bosom from a white man's dress shirt was fastened on behind so that it dangled loosely when he danced

SAMBURU MOTHER

The "m'toto" straddles his mother's hip and nestles his head between her shoulder blades when he wants to sleep. He is held in place by his mother's garment, a simple strip of unbleached muslin, which is allowed enough slack to accommodate the m'toto, and is fastened at her side.

Shredded palm leaves, wood, fish vertebræ, rawhide, and brass and copper wire are all pressed into service for necklaces. Brass wire about one quarter of an inch thick is wound closely around the arms and legs. Brass wire earrings of the design shown are original with the Masai, but are also used by the Samburus, who are a closely related tribe. A pair are sold for one sheep or goat by the Masai natives who make them



FISH COLLECTED BY THE TAYLOR SUDAN EXPEDITION

Upon returning from the ibex hunt, and while awaiting the steamer for England, Mr. Taylor and Mr. Anthony made a large collection of the brilliant fish which teemed in the harbor of Port Sudan. The three shown here are, respectively; (top) *Chætodon vittatus* Bloch and Schneider; (center) *Scolopsis ghanam* (Forskal); (bottom) *Holocentrus ruber* (Forskal). See footnote, page 601

With the "Fuzzies" after Ibex[1]

By H. E. ANTHONY
Curator, Mammals of the World, American Museum

A BLAZING sun had slowly crossed a sky of brass, and shadows were lengthening behind the rocky, heat-shimmering ridges when our two guides came up to the tent where we sat cooling off after our four o'clock tea, brought their heels together and saluted in military fashion. Where they learned how was a mystery, but at any rate the practice served to introduce a little snap into customs that are, for the most part, very casual.

"Do you want to hunt ibex tomorrow?" was the English equivalent of their question which reached us, partly in Arabic, with the aid of a third native, Ali Abdullah, the skinner. Osman, our official interpreter, was lying on his back in the cook tent, his leg swollen from the bite of some venomous creature, a scorpion perhaps, or possibly a snake, but we hoped for his sake it was not the latter. The night before, he had stepped on some unknown thing in the dark and now was beginning a two weeks' period of helplessness.

We wanted to hunt ibex, of course, that was what we had come for, and we soon learned that our guides knew where we could expect to see some. Our auxiliary forces, the "Fuzzies," had scouted over the hills and reported favorably. We would get up at three o'clock in the morning, the guides said. This aroused no wild enthusiasm, but if it was part of the game we would do it. After a few questions the conference came to an end and the guides went back to the native section of camp.

It seemed as though three o'clock came as soon as we had fallen asleep, and if the ibex chose such an hour to be on the move we thought less of this animal than ever. Our first suspicions as to the mental status of the ibex had been aroused upon our arrival in the Red Sea Hills, for a more desolate, rock-strewn and worthless waste it is difficult to imagine. If the ibex, like our Rocky Mountain Goat, lives on rock and mountain scenery, as facetious westerners would have it, then indeed these hills should breed fat ibex.

About four o'clock we filed up the sandy floor of the Khor Mashail, the cañon where we were camped, and a mile or so above entered a tributary khor (stream-bed or ravine) and headed for the jebels (hills) above the Khor Shalalta. Up this ravine we moved silently, thankful that it was comparatively cool at this hour. However, the exertion of climbing soon made us wonder that we could have thought it was cool, and by the time we clambered up the rock-littered slope of the ridge where we were to take our posts, we were dripping wet. We took station with the two guides on a promontory which commanded a vast enclosed amphitheater and the sun had not yet appeared as we picked out places where we would be hidden against the rock.

There are two ways to hunt ibex in the Red Sea Hills, neither one of which is easy on the hunter. One is to climb the ridges and stalk the animal where you find it, the other, to climb up

[1]The Taylor-Sudan Expedition, which was made possible only through the generosity of Irving K. Taylor, has enriched the American Museum collections by several thousand feet of motion-picture films and negatives, as well as more than 250 specimens of mammals, 500 birds, a small collection of reptiles, and many hundred specimens of fish. The Expedition was unusually fortunate in being able to preserve the fishes so that they retained most of their original coloring, and the color plate accompanying this article shows the brilliant shades displayed by the specimens when the tanks were opened in New York.

Camps were made where an occasional small tree afforded a bit of shade. Packs could be left in the open, for it never rains in the dry season

where ibex are likely to pass and then send native beaters out to drive these wild goats past the point where the guns are stationed. While the latter method may sound like a tame procedure, this is by no means the case, for the ibex are wary and it is no small achievement to kill a "billy" even if it has been driven down from some more remote fastness.

For beaters we employed the native inhabitants of the hills, the Hadendoa or Beni Amer, the "Fuzzy Wuzzy" of Kipling's poem. The "Fuzzy" is a splendid, picturesque type of Hamitic stock, with a huge head of hair which he dresses with grease, so that he greets the nostrils at about the same range as a flock of his own sheep. He is a mountain climber par excellence and about the only human being that can dislodge and press after a stubborn ibex. We had nine "Fuzzies" to beat the sky-line ridges and eight camel drivers to take up posts on the lower divides and turn the quarry in toward the hunters. Several hours are required to surround an area and get the ibex started for a given post, and on the morning in question we saw and heard nothing until the sun was above the horizon.

Then a faint tinkle of sliding rock drew our attention to the slopes of the rocky hill to the northeast. Three gray-brown animals swept around the brow of the jebel and, after a short run, stopped and watched the eastern sky-line. With our glasses we could see that they were ibex, but they were so far off that we could not judge the size of their horns. Furthermore the light was still poor, for the sun was low, and there were great patches of dense shadow where the hollows lay under the peaks. Presently a "Fuzzy" topped the crest, following the track of the band, and then other "Fuzzies" bobbed up along the encircling ridges. The drive seemed well in hand.

Shouting to one another, the beaters pressed after the ibex which lost little time in seeking escape in the only direction left open to them. The animals tracked along in single file and with a marvelous sure-footedness, seeming literally to pour themselves across the steep slope into a shadow-filled ravine and at no time coming nearer than 500 or 600 yards from our stand. The beaters circled rapidly, cutting off escape on the far side of the rocks where the ibex had gone, and then tried to turn the animals in our direction. On the still air of dawn sounds carried far and the noise of small, dislodged stones was audible for half a mile, while one must needs have been deaf not to have heard the shouts of the "Fuzzies" and the avalanches of rock which they sent cannonading down the mountain-side to stampede the suspicious quarry. The ibex did not want to be driven and when they could not break through on the side they desired they became stubborn and refused to move at all. On a later occasion I watched an ibex (the animal being unaware of my presence) through my binoculars when it was not in the mood to drive, and saw it go into a hole under a large rock where it calmly remained, ignoring tumult and loose rock until the men themselves were almost up to it.

This particular morning the beaters shouted to one another and converged upon the Jebel Shalalta with all their forces. "Fuzzies" hurrying up from the rocky ridges to the west drove out two hyenas before them. These big doglike carnivores trotted silently down a ravine and lost themselves in the gloomy depths of the Khor Mashail. I was glad of this glimpse of them for on our first night in the khor we had heard the cavernous howl of a hyena reverberating up the valley, an ominous

In the Khor Sharag our tent was pitched on the open sandy floor of the ravine, a veritable bake-oven in the heat of the day

TYPES OF HADENDOA OR "FUZZIES"

This Fuzzy has a booming bass that rolled down the the rocky defiles

In Tokar the Fuzzy wears full dress and a serious air of dignity

In the hills the Fuzzy does not burden himself with needless garments

The Fuzzy is a fine physical type and spends most of his time with his flocks in the hills

Not all of the Hadendoa wear their hair unshorn. Many of them keep their abundant locks trimmed close

The Red Sea Hills are a jumble of steep, rugged ridges, often destitute of vegetation and barren beyond description

sound suggestive of great power, sonorous and sinister, my first contact with wild hyenas.

The "Fuzzies" shouted "Ao, Ao, Ao," their name for the ibex, and ran along the rugged crests in sure-footed abandon. One native in particular had a great full-throated bass and when he poised on some precipitous crag, peering into the long shadows below, his bushy hair giving him the appearance of some unnatural being, I thought to myself "What a setting for the Peer Gynt Suite." When his rollicking "Ho, ho, ho, ho, ho" rolled in great waves of sound through the rocky defiles then indeed he became a gnome in the "Hall of the Mountain King."

The three animals we had first seen soon returned across the talus opposite us the way they had come, but now we had little attention for them for we could see in the better light that they were females or young males, no good head in the lot. The natives were calling that a big "billy" was still lurking in the shadows and that we were to keep an eye open for his appearance. After thirty minutes of pandemonium, when shouts and crashing rocks aroused nothing more substantial than echoes, the "Fuzzies" walked into the deepest recesses and drove the ibex out into view. He was a splendid animal with great sweeping horns. Too far for a shot, he made a rather leisurely exit across the slope just below the crown of the jebel, stopping frequently to look back at the vociferous beaters and disregarding the rock dislodged from above in the hope of turning him down into the floor of the ravine. The ibex understood falling rock, and neither the demoralizing din of its fall nor the actual striking of missiles near him caused him to hurry. He went just where he wanted to go, broke through the cordon at the spot where ibex had first entered the picture, and left the Jebel Shalalta. Our morning's hunt had bagged for us only experience but that alone would be worth the effo t it cost, and the ibex had certainly deserved his escape by his refusal to be "rattled."

We soon learned that we could discount the native zeal for early rising. When Mohammed Ali (called Ali "Kebir," the "big Ali," to distinguish him from the many other Alis in camp), our head guide, said three o'clock, we said four and stuck to it. Upon one such morning the moon saw us mount our groaning camels and pad noiselessly down the khor for the Jebel Gadem, an hour or more to the west. Upon this occasion we took up separate posts and in due course of time a good male was started. The regular program followed, a noisy convergence upon the spot where the "billy" insisted upon hiding, the failure of crashing rock to demoralize the animal and the eventual rout of the ibex by a native who walked into the hiding place. This time I could see the final routing of the beast and the "Fuzzy" was only a short stone's throw from the ibex before the animal admitted defeat by running away.

The "billy" successfully avoided me, whom he had doubtless located early in the game, but tried to cross from one ridge to another and dropped down into the ravine between the two. This brought him past the post where Mr. Taylor waited.

In less time than it takes to tell, the ibex crossed the khor and appeared at the foot of the long climb on the other side. As the animal came up on a great rock and stood poised for an

A Nubian ibex is a prize that can be won only by the expenditure of great physical effort, but he is worth all he costs instant the ravine roared to the shock of Taylor's rifle and a white spurt of rock dust puffed up at the feet of the ibex. This did not alarm him any more than the rolling rock had done, and he began to climb deliberately for the sky. An ibex is not a large mark and at moderate ranges is missed surprisingly often. My rifle now took a part, but at such long range that it would have been more an accident than good marksmanship if a hit had been scored. Puffs of dust marked the path of the ibex until just as it was about to pass over the first low ridge and into safety, a bullet from Taylor's rifle found a mark and the hunt was over.

A young ibex makes an adorable pet

The ibex pitched clear of the rock where it stood and striking only two or three times fell almost sheer for a hundred yards. Strange to say this fall did not hurt the beautiful sweeping horns, although it did rub some hair off the body. The horns measured 21½ inches, and although not as large as those of males killed later, gave us the greatest thrill of the trip because they were the first.

The fortune of the chase favored Mr. Taylor and to his rifle fell the next ibex secured, the largest head we took, measuring 38 inches along the horns. This "billy" was secured as the culminating event of a very long drive. Before daybreak we had departed from camp at Adelaueb and taken up separate stands on the Jebel Shalalta. The drive sent ibex part way along the rugged shoulders of the peak but the animals turned back too soon and broke through the beaters before they could close up their widely extended line. The entire morning was spent in the effort to get the band, which contained two good males, back on to Shalalta but finally word was hallooed from the west that, as far as our stations were concerned, the hunt was finished. The ibex were headed for the Khor Mashail and if they attempted to cross that we might get a shot later. We returned to camp and had lunch, while at intervals faint shouts in the distance told us that the Fuzzies" were sticking like hounds to the scent and were still in touch with the ibex. Early in the afternoon the shouting took up the sustained reiteration of the short word the natives all used when the action became thick, and our guides hustled us out of the shade (thermometer over 100° there) and down the Khor Mashail. Soon we separated and climbed up to posts which commanded the two ravines where the ibex were coming.

The sun was pitiless and there was no shade. Slowly I fried on a big slab of rock and hoped that something would happen soon so we could get back to the tent and shelter from the sun. The drive pelted into the ravines and then I could tell that the commotion was all passing down the one where Mr. Taylor was posted. Three or four ibex, females, appeared against the sky on a little peak that limited

Here and there in the desolate khors are native burial grounds, cairns heaped over with white quartz

A spotted hyena stops in wonderment as the flash is fired

But a striped hyena strikes the trip-line in full canter

my northern horizon. They evidently were slipping away from the beaters and waited just behind the peak, looking back the way they had come. A burst of firing in the next cañon roused the echoes and then comparative quiet reigned. The shouting ceased and the ibex in my vision returned to the rocky slopes whence the drive had routed them. Mr. Taylor had secured a good "billy" and, incidentally, filled his license allotment.

Male ibex with good horns seemed to be so scarce about the Khor Mashail that we moved camp over to the Khor Sharag to permit me a better selection

Natives bring their camels to the Tokar agricultural show

The matting exhibit is a great attraction

The native constabulary stand at attention

A cotton-baling contest is the main feature

SCENES AT TOKAR, BASE OF OPERATIONS IN THE RED SEA HILLS


Suakin from the house-tops, a study in white walls


A gate at the end of a causeway leads into Suakin


The Turkish influence is shown by the shuttered windows


Crystal-clear sea water surrounds Suakin like a moat

SUAKIN, RAILROAD TERMINUS FOR THE RED SEA HILLS

From time immemorial the Fuzzy shepherd has tended flocks in the desert

for the remaining ibex I was allowed on my license. The Khor Sharag is marked on maps as being the bed of an intermittent stream, which comes to the surface here and there as a running brook. Everywhere we passed in the khor it was dry, and sun-baked sand and rock made up the landscape. The only water we encountered was in the shallow wells which the natives dug in the sand of the khor where they brought their flocks to water. We pitched our tents near these wells and watched the small bands of sheep, goats, and cattle as they scuffled by, kicking up what little dust there was and pressing forward eagerly for the long delayed drink.

Early the next morning I climbed the steep jebels above camp and found a station which gave me a broad outlook over a wild expanse of rough and broken country. The "Fuzzies" scattered to the four quarters of the compass and Mohammed Ali and I settled back to wait for the drive. The first rays of the sun were welcome for the wind was cool up there and I was content to bask a while in their warmth and to enjoy the beginning of the day.

The rocks were beginning to take on heat when movement along a distant skyline caught my eye. The binoculars disclosed a fine male ibex. This "billy" was taking no chances and remained high, a characteristic ibex trait—to seek the highest spot on the horizon and play hide-and-seek about it. He shortly dropped out of sight and another long wait followed. Then out of the northern sky, right where I had seen the ibex and where I knew my beaters were focussing their attention, a band of domestic goats dropped over a ridge and began to work down toward

Mr. Taylor rides his white camel as if to the manner born

the wells in the khor below. A "Fuzzy" shepherd drove the flock and marshalled them in good order by shouts and grunts. He and his goats were silhouetted on a crest half a mile away but I could hear the click of each hoof against the rocks and the peculiar goat-like snort that the "Fuzzy" made from time to time. These natives have the faculty of emitting a resounding snort which is unlike any human vocal effort I have ever heard, and apparently it means something in the goat vernacular for the beasts follow a snorting "Fuzzy" better than they would be driven by a shepherd dog.

In spite of this disturbance, the drive came to a successful conclusion. In due course of time, three ibex, all "billies," popped up against the horizon—what a picture a male ibex makes with his superb horns clear-cut against the sky—and ran down in the very tracks made by the domestic goats. The ibex circled and were headed by shouting beaters. The ring of excited "Fuzzies" drew tighter and tighter as the natives hurried up to the rallying call. A chant of "Ao, Ao, Ao" and "Ho, Ho, Ho, Ho," punctuated by the crashing din of falling rock brought us all to a fine pitch of excitement.

It was apparent that the beaters had the ibex about where they wanted them, but were having difficulty, as usual, in the final push to send the animals down our side. Ali and I peered around our little peak first on one side, then on the other, but we could see nothing. When we could stand the suspense no longer, the old guide indicated to me that we had best climb to the next peak, a few yards higher up, and look

Jebel Shalalta.—The highest peak and the most inaccessible ridge draw the ibex like a magnet

into the basin which it masked from us. We slipped out from our concealment and hurried up to the next spur. A few minutes of peek-a-boo about the rocks, and Ali grasped my arm excitedly to draw me still farther out from my shelter. Leaning out over the crag, I found myself eye to eye with a bearded patriarch of the flock, a scant one hundred yards away. The ibex had been slinking off among the rocks and making such good use of the terrain that they had almost escaped the trap. Almost but not quite.

The "billy" fell in his tracks, lodging in the rocks which kept him from a long fall. At the shot, another splendid male ibex leaped into view, calmly took in the situation, and bounded down hill. He was followed by a third male, equally large. I had my needed specimen and did not molest the others but watched with admiring eyes that swift sure flight over a slope so steep and precipitous that a man could descend it only by the use of hands, feet, and an abundance of time. To my mind, the only mountaineers that surpass the ibex are the birds.

Preliminary reports on the Taylor Sudan Expedition have appeared in the Notes of Natural History for several numbers. The final report, giving full itinerary and results, was published in the May-June number.—Editors

The snows of Mt. Stanley, seen at daybreak from Itereré

Ruwenzori from the West

By JAMES P. CHAPIN
Associate Curator of Birds of the Eastern Hemisphere, American Museum

A GLANCE at any map of Africa will impress one with the regular way in which the lakes along the western border of the Congo are aligned for a distance of 800 miles from the upper White Nile to the southern end of Tanganyika. They lie in the depressions of a giant trough, one of the two rift valleys which are striking geological features of the eastern half of Africa. The subsidence which formed these troughs has been accompanied by considerable volcanic activity, especially in East Africa. Mounts Kenya, Kilimanjaro, and Elgon are all extinct volcanoes, but the Ruwenzori Range, rising between Uganda and the Belgian Congo, is not a product of volcanism. There are some small craters near its eastern base, and eruptive rocks in a very few places on the eastern flank, but Ruwenzori is an exaggerated upheaval along the border of the Albertine Rift, here traversed by the Semliki River.

Our first visit to the Ruwenzori Range was from the northeast. Frank Mathews, of our party, was soon to return to America to enter medical school, so we made a quick trip from Kampala by motor, and found that from Fort Portal we could drive right to the foot of the steep, grassy slopes of the northern extension of the range. We climbed to the bamboos on the summit of Mt. Musandama (8000 ft.) and visited the Buamba Pass, but the snow peaks remained hidden in clouds except for one brief spell when De Witt Sage was lucky enough to be looking toward them.

The eastern slopes of Ruwenzori have been relatively well studied, and from that side the Duke of the Abruzzi in 1906 and Captain G. M. Humphreys in 1926 have led their parties to the loftiest peaks of the range. We planned to devote ourselves to studying the birds of the western slopes, and had no intention of scaling the snowy summits. Having said good-bye to Mathews at Jinja, Sage and I betook ourselves to Lake Albert, and thence through the Ituri District to the Belgian post of Beni. On a few days each year the snows of Ruwenzori reveal themselves to dwellers in Irumu, eighty miles away; but we were within two days of Beni before we beheld this impressive spectacle through the dark green foliage of a tropical forest. The post has been moved from old Beni, on the Semliki, where the blacks were fast perishing of sleeping sickness, to a higher and more healthful site known to natives as Bungulu. The panorama of Ruwenzori is finer from the old situation, but from near the new post Mounts Emin, Speke, and Stanley, each of them a group of snow-laden peaks, often stand out clearly. The rains were so heavy in October (1926) that we waited until November 5 before setting out for the mountains. Elephant-grass country stretched down to the Semliki River, but on its opposite bank we reëntered the forest. Two days more, and we came out into high grass and native farms, where the Butahu River[1] issues from the western base of the mountains. This district is the Karevia of Emin Pasha and Doctor Stuhlmann, where the latter in 1891 began his historic ascent to 13,326 feet. We were to follow almost the same trail.

The Wanande people of the vicinity were under the rule of old chief Bambumé, whose attitude was cordial and helpful. His predecessor, Kengeré, had held other views. About the time when the Duke of the Abruzzi, from the Uganda side, was scaling Margherita Peak in 1906, the British Museum Ruwenzori Expedition found its rear-guard being attacked in the Butahu valley, and was forced to abandon work.

On the southwest, the lower slopes of Ruwenzori are covered with a growth of canelike elephant grass, all but impenetrable. This is the case most of the way around the range, save for some ten miles in the middle of the west side, where they are forested. On all high mountains near the equator, as one climbs upward, varying belts of vegetation are traversed, until plant life finally disappears before eternal snow and ice. Parallel changes in the fauna are to be observed, especially noticeable in the case of birds. This altitudinal distribution of birds was the principal subject of our investigation.

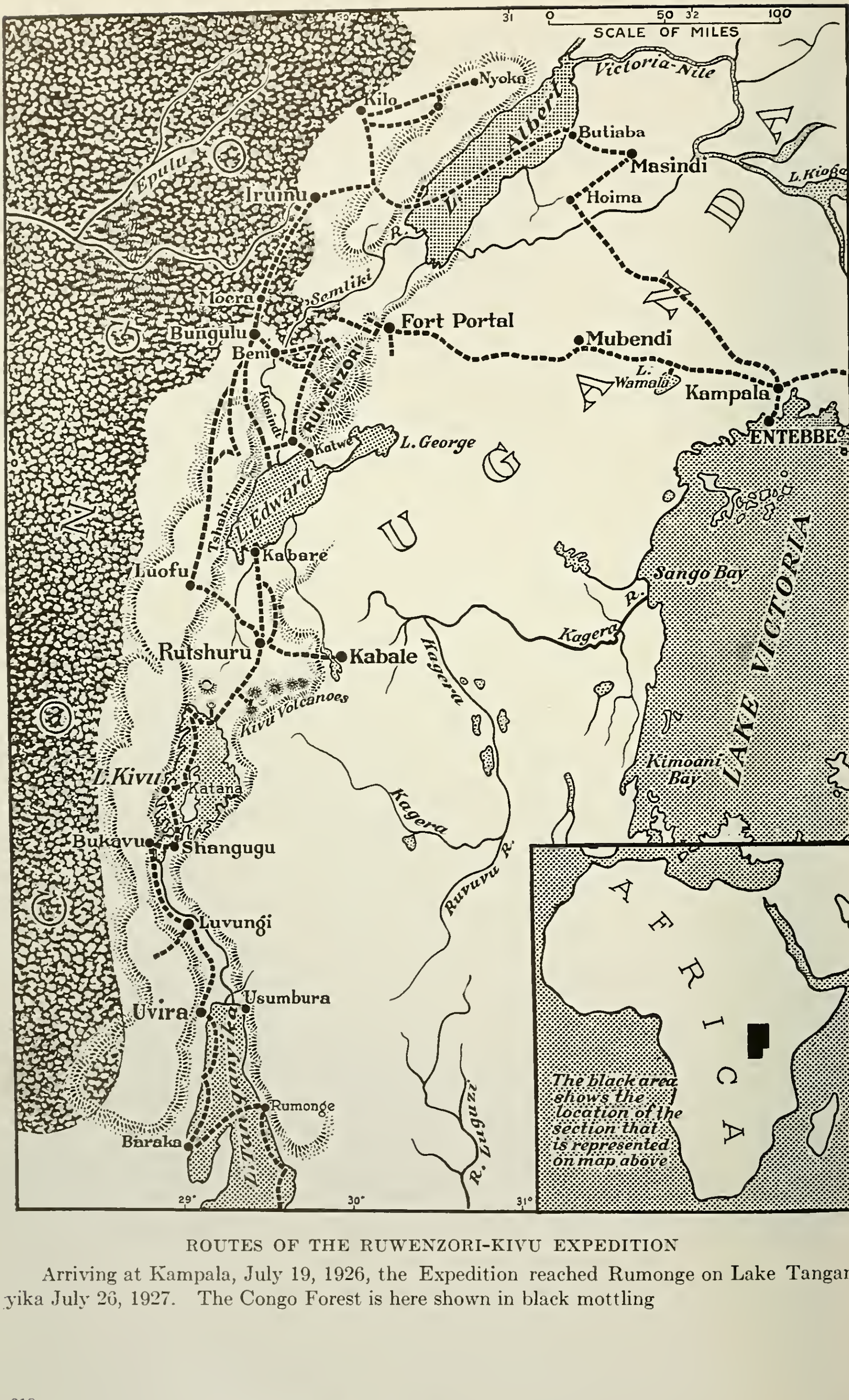
From Bambumé's we forded the swift, foaming Butahu River, and climbed through elephant grass up a steep slope to the village of Ra-u, where the aneroid read 6000 feet. One hundred and fifty feet higher we entered the mountain forest. An abundance of tree-ferns beautified this woodland, where we walked on in rain and fog. Following along the northern declivity of the Butagu valley, we stopped that night at a group of huts called Ibalé, close to 7000 feet.

The next day we climbed downward as much as upward, and ended our march at a place called Kalongi. The word Kalongi is derived from the bamboos; and here patches of bamboo come somewhat lower than usual, to about 7200 feet. About Kalongi the native huts are scattered widely on both sides of the Butahu gorge, but the two headmen, Muribati and old Molengikani, could furnish no more than seven porters. The population is scanty, and there is no village higher up.

The rains were by no means finished here. We pitched our tents in mud.

[1]Often written Butagu, but Stanley's spelling has both priority and accuracy in its favor.

ALEXANDRA PEAK, 16,749 FEET, FROM JUST ACROSS THE LAST VALLEY. GIANT ICICLES HANG FROM THE SNOW CORNICES



ROUTES OF THE RUWENZORI-KIVU EXPEDITION

Arriving at Kampala, July 19, 1926, the Expedition reached Rumonge on Lake Tanganyika July 26, 1927. The Congo Forest is here shown in black mottling

Almost every day it rained; fogs shrouded the mountains. This was to be our base camp, so we retained but twenty porters, to whom we gave blankets; our "boys" and guides receiving coats and sweaters as well.

As a guide for our mountain work we engaged a young and vigorous man, Vaonika by name, who had already accompanied Edmund Heller about a year previous. One or two of our other men amused us all by continually blowing shrill blasts on wooden whistles to drive off the rain clouds as they streamed up our valley, but this magic produced little result. It was November 21 before the weather permitted a fresh start.

The path toward the snows follows a long ridge, to avoid the bowlders and tangled vegetation in the gorges. So after crossing the Kanyamwamba brook at 6720 feet close to Kalongi, the next brook—and a very small one—is encountered at 12,800 feet just below a ridge called Itereré. First we traversed patches of scrubby mountain forest and old clearings with bracken and luxuriant herbaceous plants, then areas of large bamboos interspersed with trees, and at 8100 feet reached the first heath trees, where the natives are wont to go to propitiate the spirits of the mountain when rain is desired down in the valleys.

For months Sage and I had been asking ourselves whether it would be feasible to reach the permanent snows from the Butahu Valley. Since Stuhlmann's time most visitors had stopped on a mountain at 13,800 feet, where it became the custom to leave a record in a bottle. Beyond this, it seemed, a deep cañon barred the advance.

The first tree-heaths at 8100 feet were only a broken strip extending down the ridge. The bamboo, we found, continued on up to 9300 feet. Then the whole slope became clothed in lichen-draped heath trees, with the ground hidden under a thick green blanket of moss. Curiously enough, at the upper edge of the heath belt, the heath trees again extend *upward* in strips along rocky slopes and ridges, to 13,500 feet, whereas in the valleys they are replaced as low as 12,800 feet by open alpine vegetation, consisting of aborescent groundsels, giant lobelias, and a carpet of *Alchimilla*.

The heath and moss zone is the most disagreeable section on Ruwenzori. We had to camp in it, and even in the most favorable places it is so rough that there is scarcely a spot fit to serve for a tent. Old fallen trunks, hidden under the moss, conceal deep holes into which one falls most unexpectedly. It is always wet among the heaths. Frequent drizzles and fogs replenish the supply of moisture in the moss, which is so saturated that one dares not sit on it.

Our first camp in the heaths was at 12,050 feet, within three hours of Itereré (otherwise known as Kambi ya Tshupa, or "camp of bottles"). Following Heller's advice, Sage and I climbed on November 23 to Itereré, hoping for a good view of Mt. Stanley and its glaciers. We sent most of our porters down to wait at a camp in the bamboos, and took with us only a few of the mountain dwellers. Our hopes were not fulfilled, for we waited several hours in the fog, and had but one short view of the lower snow slopes. We read the paper left by Heller, but most of the earlier records were lost because of the water which in some mysterious manner always finds its way into the bottles.

As we stood on the crest of the ridge at this spot, we looked down into a

Left.— Heavy lowland forest at the western base of Ruwenzori (altitude 3300 feet) with a brook flowing from the mountains

Center.—Wild banana plant in the mountain forest at 6750 feet near Kalongi

Below.—A glade in the bamboos above Kalongi at 7600 feet. The largest bamboo stems were $3\frac{2}{5}$ inches in diameter

Right.—Camp in the heath zone (11,200 feet) where we spent the night of January 1-2

Center.—One of our carriers beside a flowering *Lobelia* plant.[1] In the left background are aborescent groundsels *Senecio*

Below.— Vaonika in the path through the deep moss of the heath zone. This is the most disagreeable section on Ruwenzori

deep gorge coming from the glaciers, now little more than two miles away, and directly beneath us lay a small lake, black as ink. The vegetation about us was composed of woody immortelle bushes, arborescent groundsels, a few giant lobelias, *Hypericum* trees with large orange-scarlet blossoms, and a carpet of *Alchimilla.* Here and there were large tussocks of sedge. The classic photograph of Mt. Stanley by Stuhlmann, as we afterward ascertained, was taken from this very same ridge, but a little lower down.

A chameleon from the mountain forest near Kalongi, bearing a spoonlike protuberance on the nose

The next day Sage climbed again to Itereré. He took with him a small tent, and spent a night alone hoping for better weather. He had the usual bad luck, speaking meteorologically. When I rejoined him in the afternoon, he had had but a few fleeting glimpses of the higher peaks. That evening I was to mount guard, Muribati and Vaonika keeping me company. Sage had not been gone a half hour when the air cleared, and almost until sunset I was busy with the camera, making a record of the perfect panorama of Mt. Stanley's summits. The next morning was likewise clear, with a more pleasing side light on the snows. Our porters down below had now practically exhausted their food supply of green plantains. They were to come up for me on November 26, so only half a day remained. It seemed a simple matter to continue on up the ridge, and I broached the subject to my guides. They objected that they had never gone higher and that there was no path between the tough immortelle bushes. In reality they feared to be led toward the mysterious white peaks. Pretending that I merely wished pictures from higher up, as well as plants for the herbarium, I urged them on, until finally they threatened to leave me to my foolishness. When I took their machette to cut my own way, my "guides" followed reluctantly fifty yards behind. After half-past nine fogs crept up the valleys and enveloped us, but I had prepared a sketch-map to avoid being lost and we made our way slowly upward. Our ridge appeared to culminate in a rocky summit almost in line with Alexandra Peak, the latter the second highest peak of the whole range, and from this angle concealing the highest of all, Margherita. About noon we finally reached the top of the mountain we had in view, and were rewarded by a sudden parting of the clouds revealing Alexandra Peak in all its dazzling glory, as well as a lake of olive-green color directly below us. Before us was a precipice and then a lovely alpine valley stretching over to the foot of the glaciers. Just below the finest of the glaciers gleamed another little pond of lighter green color. Our sharp mountain top continued as a ridge to the northward, and there seemed a possibility in that direction of crossing the head of the valley, and thus attaining the rocky slopes that bordered directly on the glaciers.

Nothing more could be done that day. Food for the men had given out, and we retreated to a camp in the bamboos at 8960 feet. Above the heath zone we had seen but few birds, yet they were well worth while. Most beautiful among them was a large sunbird, *Nectarinia johnstoni dartmouthi*, which found its food mainly on the tall flower-spikes of the lobelias, and was often active while the mountain was heavy with fog. In the bushes skulked a small brown-and-green flycatcher, *Cryptotopha umbrovirens alpina*, more of a warbler than a flycatcher in habits. Both these species dwell on other mountain tops in eastern and central Africa, but vary subspecifically in different places. We also noted a large starling (*Cinnamopterus tenuirostris*), huge white-breasted swifts, (*Micropus melba maximus*), ravens (*Corvultur albicollis*), a buzzard (*Buteo oreophilus*) resembling the young of our red-shouldered hawk, and a brown duck—presumably *Anas sparsa*.

Besides the rats which make their homes amid the grasses and *Alchimilla* of the alpine zone, there are hyraxes which screech and croak during the frosty nights, a small antelope (probably a duiker, though we saw only its tracks), and leopards, apparently quite numerous.

After the end of November a dry spell began in the upper Butahu valley, which greatly favored our work. The heath zone is exceedingly poor in birds. Day would break in almost deathly stillness, or at most the chirping or chuckling calls of a mountain turaco would reach us from the valleys. During a day's march through the heath woods one may see no more than three or four small birds, among them most likely a red-breasted sunbird (*Cinnyris afer stuhlmanni*). The thick blanket of moss, to my surprise, seemed practically void of runways or any other sign of rodents. As we went down the mountains, birds again became more numerous where the heaths

Our hut at Kalongi, built of bamboos and grass in two days, cost one dollar

Looking down 10,000 feet into the Semliki valley, from Itereré

gave place to bamboos and other trees. So for eight days I stayed on a ridge at 8960 feet, where some small purplish fruits attracted numbers of mountain turacos (*Ruwenzorornis johnstoni*). Here, too, there were large francolins (*Francolinus nobilis*) which could be trapped, although impossible to see in the undergrowth.

The bamboos themselves have little to offer in the way of food for birds; but on Ruwenzori they are mingled with many other kinds of trees, including the African yew (*Podocarpus*), and thus the bamboo zone harbors a varied bird fauna. In it, also, live many rodents and shrews, as well as a few golden moles, and monkeys and bush pigs. On this flank of Ruwenzori elephants and buffaloes climb no higher than 7000 or 8000 feet, and while chimpanzees are found in the lower mountain forests, it is certain that no gorillas dwell on the range. Across the upper Semliki valley in full view, rises the Tshabirimu range, northwest of Lake Edward, and there the gorilla is known to occur.

On December 5 I rejoined Sage at our base at Kalongi, and despite an abundance of work during the rest of the month, I was ever longing to stand amid snow. The two difficulties were porters and food to give them. True, our guides and porters insisted that no European had ever asked to go twice to Itereré, and that they would refuse. Several mishaps occurred. The old chief Bambumé was reported to be ailing, and on December 12 he died. There was a day or two of anxiety, as the natives were plainly annoyed at our staying on their mountains, and might easily connect our unwelcome presence with their tribal misfortune. Nothing happened.

At about the same time our cook and three of the best bird-skinners deserted. They were men from the Mangbetu country of the northern Congo. Yet we managed to celebrate Christmas with a dinner perhaps more copious and varied than well cooked. We had learned that rice could be bought of natives in the Butalinga country, some four days off in the Semliki valley, and men were dispatched to get five baskets of it. These arrived toward the end of December.

After days of argument and bargaining, Muribati and Vaonika had been won over to my plan. The porters demanded payment before setting out, but on the morning of New Year's Day, we were ready to start. We had thirteen men, but several would be carrying rice and water, so Sage elected to stay down, and see to transporting our base back to the Semliki valley. With my little party, four baskets of rice, and one iron barrel filled with water, I started up again through the bamboos. That night we slept in the heaths at 11,200 feet, and the second night we camped on top of Itereré. Life above the heaths would be more agreeable if the altitude did not affect one. The third day, as we regained the mountain top at 14,900 feet my pulse was racing at 120 per minute, but it was a happy moment.

We pitched a Whymper tent in a sheltered spot amid the rocks, filling the crevices beneath with immortelle bushes. All the men except my two guides returned to lodge at Itereré. We were to allow a full day for the trip to the glaciers. Then the porters would return for my tent and bedding. The afternoon was spent looking for a way down the cliffs ahead. I found a gully that took me part way, then a ledge across the face of the rocks, and finally a way to scramble off it on to a talus covered with senecios. Arriving there I concluded the rest was easy, and climbed back to our camp. Muribati and Vaonika, as expected, refused at first to go farther, and more argument and further promises of coats and blankets were necessary.

The next morning was clear, and permitted further photographs, while 150 or more giant swifts skimmed and sailed about over us. As we climbed down the cliff, my companions carrying my cameras and tripod, clouds began to obscure the peaks; but we

The more northern of the two glaciers visited was riven with crevasses. This photograph was taken near the highest point reached knew the way by heart, and were soon in the valley. Over the bowlders and the green moss, through groves of tree-senecios we walked, until on mounting a low ridge, we found ourselves within a few hundred yards of the green pond at the foot of the nearest glacier. The goal was within reach; and when my black comrades announced that they would stop here, and that I must go to the glacier alone if I liked, it mattered little. They were convinced they would die if they touched the mysterious white substance, and I knew their bare feet would not take them far on ice. So with kodak and boiling-point thermometer I set off.

At the pond, on which floated a thin skim of ice, I found its green color due not to the clear water, but to a soft gray-green mud which covered the bottom. Just above the pond lay the lowermost margin of the glacier, shelving down to a rather thin border, not an abrupt wall. Two small rills flowed toward the pond. The whole lower end of the glacier was free of snow, which plainly had not fallen there for weeks. The water in the hypsometer here boiled at 186.3°, and subsequent calculation gave the altitude as 14,627 feet. A short climb up the slippery rock at the side of the glacier brought me to the jagged bowlders of the lateral moraine, on the northwestern side. To my left rose a steep black mountain, without snow; to my right ran the smooth rounded border of the glacier, a stream gurgling underneath. It was easier to walk on the rocks than on the icy slope, though there were no crevasses. Most of the peaks above me were wrapped in fog, but at intervals this would clear in places.

Continuing upward, I found that the mountain beside me was connected with the base of Alexandra by a low ridge of rocks and earth. As soon as possible I scrambled to the summit of this, and found myself facing the southern edge of another glacier, much rougher than the one I had just left, and which turned toward the northwest as it continued downward. Following along the crest of the bare ridge between the two glaciers, I soon came to the very base of Alexandra, at an elevation (by aneroid) 800 feet above the foot of the more southerly glacier, or approximately 15,400 feet above sea level.

The summit of the Alexandra Peak, according to the Duke of the Abruzzi, is 16,749 feet, that of Margherita 16,814. These two highest peaks of Ruwenzori, forming the northern end of Mt. Stanley, towered directly above me, but even their slopes were now hidden in fog. Two ravens (*Corvultur albicollis*) flew back and forth overhead, but what they could find to eat there remains a mystery. All vegetation had vanished. The southerly glacier stretched away upward, apparently very smooth, toward the col between Moebius and Alexandra peaks. It looked like easy climbing, but without a companion or even an ice-axe, at this hour, it was idle to dream of going farther. The northerly glacier came tumbling down the precipitous sides of Alexandra.

It was about two o'clock in the afternoon when I started down the side of the glacier again. Beyond the pond I rejoined my two "guides" beside a fire of senecio wood. Vaonika had finally found courage to visit the pond in search of water, noted the floating ice and melted pieces of it in a tin can over the fire. Thus they were convinced of the nature of ice and snow.

The valley where we stood seemed never before to have been marred by a human footprint. It had been several years since I had read De Filippi's *Ruwenzori*, and like most people I had overlooked or forgotten the ascent of Dr. J. David in 1904. From the brief account of his ascent by Revelli,[1] it is evident that we took the same path he did, up to Itereré, which he wrote Itêre. From there his route is less easily recognized, but he speaks of reaching a ridge at 4300 m. (14,104 feet) from which he saw on his left the final amphitheater of the valley. On his right a green lake and beyond them the tongues of the glaciers. There is every reason to suppose that this was the point where we made our highest camp. He is silent about the crossing of the last valley, but I have little doubt that the glacier he climbed was the more southerly one of those I visited. He may therefore have reached the snow pass between Moebius and Alexandra Peaks. Only his "tooth" of gneiss rising 50 meters above the snows is difficult to locate, though a photograph taken by Sella[2] lower down to the west of this pass seems to show a smaller rocky projection. David gave the altitude of his snowy ridge at 5000 m. (=16,404 feet), and said the highest peak (Alexandra would have looked so) was to the N.N.E., some 400 m. (1312 feet) higher. As this would make Alexandra 17,716 feet high, there is clearly an error in his calculations. Possibly he stopped at almost the same spot as I.

In any event it may be stated that our ascent to the glaciers of Mt. Stanley from the west was the second. But a far more remarkable feat was performed by Capt. G. N. Humphreys and his companions early in 1926, when they descended from the pass between Mounts Emin and Gessi toward the northwest into the Semliki valley. And in July of the same year Captain Humphreys made the second successful ascents of Alexandra and Margherita.

My old friend, Dr. Joseph Bequaert, tells me that in 1914 he reached the crest of the ridge where we pitched our highest camp, just across the valley from the glaciers. He found it covered with light snow. We seem to have had exceptional good fortune with respect to the dryness of the weather in the first days of January, 1927. Very likely December and January are the best months for visits to Ruwenzori from the west.

The descent from the snows was rapid. In six days we had gone from the highest native farms to the glaciers and back, allowing sufficient time as well to stop for photographs, and to collect some birds and plants. On January 8 I rejoined Sage in the Semliki valley; and after a trip to the northern shores of Lake Edward, and a brief visit to the strip of lowland forest which extends from the west across the Semliki to the slopes of Ruwenzori and there fuses directly with the mountain forest, we returned to Bungulu.

As we mounted the hills again on the western side of the Semliki valley, we looked back at the gray mass of Ruwenzori crowned with unsullied snows. We recalled the weary days of panting effort as we climbed the tangled ridges or toiled still higher over the soft *Alchimilla* carpet, beneath the grotesque, over-developed groundsels. Then came back the triumphant hours amid the glaciers of Mt. Stanley, and silent thanks were rendered to the generous friends at home who had given us this unforgettable experience.

[1] *Boll. Soc. Geogr. Ital.*, 1906, VII (4th Series), pp. 354–365.
[2] De Filippi, *Ruwenzori*, 1908, p. 209.

From a pencil sketch by Stanislav Rembsky

Albert Operti
1852-1927

ON November 5, last, a modest, unassuming man finished a life of unselfish devotion to the highest of ideals, and quietly and unobtrusively as was his wont, passed away from the large and distinguished group of those who honored and loved him. Admiral Robert E. Peary, who was among those who knew him best, once wrote that he has "made History, aided Science, ornamented Art," and he added an even higher tribute to this when he said "Your integrity, coolness, knowledge and good judgement in times of danger were tried out when you were with me in '96 and '7." It was characteristic of the man who received this letter of highest praise from such an authority that he should hide it away, suppress it. He knew what Admiral Peary thought of him, but he was unwilling that even his intimates should share this knowledge.

Albert Jasper Ludwig Roccabigliera Operti was born in Turin, Italy, on March 17, 1852. His father, Guiseppe Operti, was a musician, celebrated in his day as pianist to Victor Emanuel II, King of Italy, and later as band master to the Eleventh Hussars, the famous "Light Brigade" of Balaklava, and as director of the Italian Opera Company of London.

The early boyhood of Albert Operti was spent in the British Isles, where he attended school in Dublin, and high school in Glasgow. At the age of twelve, a time of life when most boys of today are well satisfied to read romances of sea life and adventure, he became a cadet in the British Naval School at Portsmouth, and after two years' training went to sea, serving for four years in the British naval marine.

When one looks upon those masterly paintings of ships and expanses of sea which Operti produced in his later life, one realizes how much influence this early experience had upon his work. He painted these things, not from hearsay or from casual observation, but from actual intimate knowledge, the essence of Truth.

During his life at sea, Cadet Operti occupied his spare time in drawing and painting. The passion for art which, no doubt, was his heritage from his musical father, asserted itself to such an extent that upon finishing his naval training in 1870, he resigned from the navy and entered the Glasgow Institute of Art. Here, and later in Paris, he studied painting for five years, specializing in scenic, fresco, and portrait work.

Meanwhile the elder Operti had located in New York as a musical director, and in 1875, Albert joined his father, completing his art studies in America under such masters as Vassili Vereshtchagin, the Russian realist, and Matthew S. Morgan, the founder of the Art Students League. Albert Operti had a talent for scenic composition both in form and color, a talent that found expression in many sets of scenery painted by him in the '80s and '90s for Niblos Garden and for the Metropolitan Opera House where he was employed as scenic artist. Some of us will remember the charm of these old sets for such operas as *l'Africaine*, *Aïda*, and *Cavalleria Rusticana*, which came to life under Operti's brush. They were the finest things in scenery in their day, and like the bygone singers who sang in front of them, they are part of our memories of a time of grace and beauty—the closing years of the last century.

As far back as 1881 Albert Operti began to be interested in polar exploration. The appeal of the sea, of adventure, and the search for new lands in the frozen North fired his imagination. The mantle of William Bradford, one of his masters in painting, descended on him, and in so doing, lost much of Bradford's stiffness and formality. An interview with Admiral G. W. Melville, survivor of the Jeanette Expedition in search of DeLong, resulted in his painting his first Arctic picture "The Finding of DeLong." He also painted at this period a number of canvases of Arctic exploration, two of which, "The Rescue" and "Farthest North" now hang in the Capitol at Washington.

Always scrupulously careful as to the detailed accuracy of his work, Operti now began the fine collection of books on Arctic travel, life, and customs, which he bequeathed to the Explorers Club. He read everything he could find that would help him to depict the great region of frozen beauty about the Pole. But this did not satisfy his passion for truth in art, he wanted to see this country of icebergs and auroras, of vivid sunrises and flaming snow. At last his opportunity came; Commander Peary asked him to join his next expedition to the Far North as official artist. He made two voyages with Peary, 1896 and 1897, bringing back with him a wealth of studies and sketches of the animal life and people of the Polar region, their customs, manner of life, and surroundings. These were made at the cost of the greatest hardship, danger, and privation, and under actual working conditions that would have daunted many an artist of less enthusiasm and resource.

The results of Operti's share in these expeditions are among his best work. Executed in various mediums, his sketches are accurate, vivid, and vigorous. He made the first plaster casts that were ever taken of the North Greenland Eskimos. These are now in the American Museum of Natural History.

With his reputation as an artist of ability now fully established, Albert Operti began to reap the fruits of twenty years of conscientious and talented work. He was one of the official artists selected by the Government for the Chicago Exposition in 1901, and in 1912 he came to the American Museum as general artist and cartographer.

Throughout the last period of his life Operti painted many backgrounds, and some murals and friezes for the Museum. Some of the largest and most important of his backgrounds are now in the Hall of Mammals. They cover a wide range of subjects, but are universally characterized by exactness of detail, which however, is achieved without in any degree sacrificing the breadth and freedom of treatment that constitute their outstanding quality. Among them may be noted habitat backgrounds for the Wapiti Group, the Mountain Sheep Group, the Muskrat Group, the Baboon Group, and the King Penguin Group, ranging in scenic effects from the vivid sunlight of an African water hole to the icy beaches of South Georgia Island, and from the uplands of the Cascade Range in Washington, to a swamp in Plymouth, Massachusetts.

Although notable in his handling of color, Operti was also a good caricaturist and illustrator. Some of his illustrations, executed in line and with the brush, were made for such books as *Northward Over the Great Ice*, *Through the First Antarctic Night*, and *The White World*, as well as for a number of novels by L. P. Gratacap, which include *Benjamin the Jew* and *The New Northland*. In these, as indeed in all of his work, he always verified with careful study the details of his composition, checking his wonderful memory with a voluminous mass of illustrative data which he kept in several thick scrap books. His memory might be described as kaleidoscopic; he could recall and paint scenes that his eyes had looked upon years before. He seemed to have some wonderful gift that enabled him to reach back into his impressions of the past and materialize them as though under the spell of white magic.

Operti was accustomed to paint with great rapidity. A mural which he made for the New York City Bicentennial, and which measured upward of seventy-five feet in length, occupied him but three days. There is a story extant in the American Museum concerning a group of visitors, who happening upon him while he was engaged in painting the frieze background for the dolphins in the Third Floor South Pavilion, were astonished to find the artist, a whitewash brush in each hand, laying on the colors contained in two buckets with dexterous sweeps. They were still more amazed when, after having had their attention called to another matter of interest, they found that the painted ocean had flowed in upon the wall, literally while their backs were turned.

A serious accident, which occurred in 1925, and which nearly resulted in his death, greatly impared the activity of Operti during the last years of his life, and no doubt hastened his end. For nearly a year before his fatal illness, his footsteps faltered and his hand shook. But however much his hand trembled as he went his daily round of tasks, it was always steady when he took up a pencil or a brush, and his last sketch, a design for the menu of a dinner that was to have been tendered to Captain Amundsen by the Explorers Club, was executed with as much vigor and cleanness of line as when he sailed the seas with Peary.

Always averse to advancing his own interests, Albert Operti never reaped the pecuniary rewards which should have been his. He has written many times upon the fly leaves of his books the sentence, "I have resolved to devote my life to the cause of learning. In place of a life of ease and freedom, I have chosen a career of anxiety and toil. A man has higher responsibilities than the seeking of his own enjoyment. He should devote himself to honorable labor and to Love." Such a life was his; his labor was to the highest degree honorable, and his love was great. If toward the end his steps dragged along the way, yet in his heart there was always the song that was often on his lips.

Perhaps I like best to remember him as he sat, dignified yet genial, the guest of honor at a dinner given two years ago by his fellow artists and workers of the American Museum. They acclaimed him one and all as their mentor in art, and they gave him a testimonial which may well stand as his epitaph:

"Because our esteemed co-worker Albert Operti has throughout a life of devotion to Truth and Art made the world about him more beautiful, and by his Courage, Faith and Laughter made the people about him more wholesome and human, we his fellow-workers in the American Museum of Natural History, do hereby confer upon him the degree of Master Craftsman, and do give him this Certificate of our esteem."

Herbert P. Whitlock

NOTES

ASTRONOMY

Dr. Harlow Shapley, director of the Harvard College Observatory, addressed on December 15 the largest audience that had yet assembled at a meeting of the Amateur Astronomers Association. One thousand persons were present and listened with absorbed interest to Doctor Shapley's clear and masterly exposition of "Current Researches at the Harvard College Observatory."

"The Heavenly Bodies" was the subject of the UFA motion picture film shown at the January 5 meeting to an audience of nearly 1300 people.

The Program of Speakers up to March 1, 1928, has been arranged as follows:

January 19—Mr. David B. Pickering, president of the American Association of Variable Star Observers, will speak on the romance of variable stars and the thrill and adventure in their discovery and observation.

February 2—Mr. Oliver P. Medsger, teacher of astronomy in the Lincoln High School, Jersey City, N. J., will speak on "Jupiter."

February 16—Dr. Anne S. Young of the Mount Holyoke College Observatory will describe her trip to Giggleswick, England, for the purpose of observing the recent total eclipse of the sun.

March 1—Mr. Stansbury Hagar, authority on the mythology of the stars, will speak on "The Mythology of the Constellations of the Zodiac."

The American Astronomical Society, the largest group of professional astronomers in America, has just accepted an invitation from Director Sherwood to hold its next winter meeting, December, 1928, at the American Museum of Natural History.

Dr. Clyde Fisher represented the American Museum at the annual meeting of the American Association for the Advancement of Science at Nashville, December 26–31. An outstanding feature of the Astronomical Section was an address before the General Session, Wednesday evening, December 28, upon "Edward Emerson Barnard, His Life Work, " by Dr. Robert G. Aitken, associate director of the Lick Observatory. It is an interesting coincidence that Doctor Barnard, who was one of America's greatest astronomers, began his work in Nashville. A fine exhibit of Barnardiana was arranged for astronomers and other scientists attending this meeting.

At this convention Doctor Fisher presided over one day's meeting of the American Nature Study society, presenting an address on the work of the Coördinating Council on Nature Activities. He also represented the American Museum at the meetings of the Botanical Section and of the Wilson Ornithological Club.

Newton Bicentenary.—The bicentenary of the death of Sir Isaac Newton (1642–1727) was commemorated at the American Museum of Natural History November 25–26. Meetings were held in collaboration with the American Astronomical Society and several other scientific organizations, and were addressed by leading American scientists in the fields to which Newton made contributions. Dr. W. W. Campbell, honorary director of Lick Observatory and president of the University of California, read a paper on "Newton's Influence on the Development of Astrophysics."

Among the Newtoniana which were on exhibition at the Museum for three weeks were all of the various editions of Newton's books, including an extremely valuable copy of the *Principia* from the Babson collection, and a copy which had been presented to Yale College by Newton. A model of the sun dial made by Newton when a schoolboy, and a model of the first Newtonian telescope were also shown. Altogether the exhibit included several hundred items consisting of books, portraits, medals, letters, and documents relating to Newton and his achievements.

BIRDS

Barro Colorado Island Bird Group.—On December 8 the first of a series of twelve groups to illustrate bird life in the principal faunal zones of the world was opened to the public. It is based upon Curator Frank M. Chapman's notable studies at the island in the Canal Zone which has been set aside as a station for the investigation of tropical natural history. Associated in the field with Doctor Chapman were Messrs. Francis L. Jacques, who painted the background of the exhibit, and Raymond L. Potter, who mounted the birds. The group was presented to the Museum by Dr. Evan M. Evans.

The visitor to the new exhibit seems to stand on a vantage point in humid tropical forest, looking down the slopes of Barro Colorado and across the Panama Canal toward distant mountains. The arboreal birds, half hidden in heavy foliage, include macaws, parrots, toucans, woodpeckers, motmots, trogons, woodhewers, cotingas, manakins, flycatchers, and tanagers, while among the ground-living species are tinamous, doves, quail, and ant-birds. The latter are following a train of army ants, feeding upon the insects that the advancing ants have driven from their hiding places. The ensemble gives but a suggestion of the 220 species of birds which have thus far been observed within the 3500 acres of Barro Colorado Island. Nevertheless, the group reproduces something of the illusion of the humid tropics and it takes but a little imagination to conjure up other forms of gorgeous bird life, as well as the tapirs, pumas, ocelots, peccaries, and howling monkeys, all of which still hold sway on this little spot of primitive nature, past which steamers representing all centers of civilization journey every day of the year.

The Snowy Owl Migration of 1926–27.—Professor Alfred O. Gross, of Bowdoin College, publishes in *The Auk* for October, 1927, an account of the remarkable snowy owl migration of last winter. Both the flights and the captures of this arctic bird perhaps exceeded similar phenomena during any previous year of record. The area of the flight, as shown by Professor Gross's distributional maps, covers the entire northeastern parts of the United States and Canada, from the area of the Great Lakes to the sea. As usual, more birds were observed on the coast than elsewhere, the individual records extending southward in abundance to the southern tip of New Jersey and sporadically beyond. Great numbers also boarded transatlantic steamers at points between Newfoundland and Long Island.

Professor Gross states that among previous flights of the snowy owl during the last fifty years, the most notable occurred during the winters of 1876–77, 1882–83, 1889–90, 1892–93, 1896–97, 1901–02, 1905–06, 1917–18. It is of interest that these dates agree in large measure with those characterized by extraordinary irruptions of sand grouse, crossbills, and waxwings in the Old World, and also in certain instances with the so-called "plagues" of lemming and field mice, both in Europe and North America. The studies of Elton and others have rather definitely linked up such extraordinary migrations of northern animals with the sun spot cycle of 11.2 years. Elton holds, moreover, that the larger invasions occur during alternate periods; that is, every 22.5 years. Actual figures are rarely in exact accord with the theoretical forecasts, but when long series of averages are used, the weight of evidence supports rhythms based upon such ordained cosmic phenomena.

Captive Galapagos Penguins.—In the same number of *The Auk* Doctor Townsend, director of the New York Aquarium, reports upon "The Galapagos Penguin in Captivity." Several of these most interesting birds have lived for varying periods in the Aquarium, where Doctor Townsend's keen eye has been enabled to observe habits that might readily escape a naturalist in the field. The Galapagos species, which is one of the smallest of penguins, evidently spends more time at the surface than do most of the antarctic members of the family. In this respect, however, it agrees with its close relatives of the Peruvian and Chilean coasts and of the Cape region of Africa. Submerged swimming, as when in pursuit of minnows, is accomplished entirely by the flipper-like wings. When the birds drop into the water from the coping of the Aquarium tank, they do not go head first but strike flat upon their breasts. This is markedly at variance with the custom of antarctic penguins, which make beautifully graceful plunges from ledge or ice-foot. The molting period of captive Galapagos penguins occupied about three weeks, and an adult bird in good condition weighed exactly six pounds. The birds drink sea water in considerable quantity; in fact, it seems that sea water is necessary to the continued health of the birds.

CENTRAL ASIATIC EXPEDITION

The Central Asiatic Expedition is hoping to continue its Mongolian explorations in the spring of 1928. It will be recalled that in 1926 and again in 1927 the party was blocked from entering its old field, the Gobi desert, by internal warfare and generally disturbed conditions. During these two years, however, important work by small parties has been carried on in the Chinese provinces of Szechuen, Yunnan, and Fukien. This includes palæontological and archæological explorations by Messrs. Granger and Nelson in the first two provinces and zoölogical work by Mr. Pope in Fukien. Since the spring of 1927, no work has been possible because of the intense and widespread disturbance.

The Expedition leader, Doctor Andrews, has remained at headquarters in Peking since last April. Recent letters received from him indicate that general conditions in North China are becoming much more settled and that the prospects for a renewal of the exploration are bright. It has been arranged that Doctor Andrews will cable definitely about the first of February and, if he then thinks it possible to continue work, the various members of the Expedition now in America will sail for China about March 1, arriving in Peking a month later, and will then prepare to start for the desert by mid-April.

CONSERVATION

Franconia Notch in Danger.—The Franconia Notch, one of the famous scenic places of the White Mountain region of New Hampshire, noted for the immense stone profile of a human face which appears in the rocks at the top of one of the cliffs, is now in danger of ruin. The Profile House, for about fifty years one of the best and most popular of the White Mountain hotels, was burned in 1923 and is not to be rebuilt, With its destruction the financial motives for preserving the beautiful forest now clothing the sides of the notch have disappeared, and this forest, comprising some of the last remnants of the primeval spruce woods of those mountains, will become the prey of the lumbermen, unless the sum necessary to purchase it can be raised. The project for doing this includes the preservation of the beautiful Echo Lake and the Flume, a picturesque narrow gorge which attracts thousands of visitors yearly.

The state of New Hampshire has appropriated $200,000 toward this purpose (a liberal sum considering its small population, less than 50,000), and heirs of the late James J. Storrow of Boston have given $100,000. There remains $100,000 more to be raised. The Society for the Protection of New Hampshire Forests, No. 4 Joy Street, Boston, Massachusetts, has undertaken the work of raising this, and appeals to all lovers of the White Mountains to send in contributions, even if only small ones.

The Royal Swedish Academy of Science has published among its papers a descriptive map of the Hamra National Park in Sweden. The various kinds of vegetation in the Park are described by H. Andrén.

The National Parks Association has recently published a pamphlet giving the essential facts of the war on the U. S. National Parks System and its effect on national policy. Anyone interested in this may obtain copies of the pamphlet from the Association at 1512 H Street, N. W., Washington, D. C.

FOSSIL VERTEBRATES

Dr. George Gaylord Simpson became assistant curator of fossil mammals in the department of vertebrate palæontology on November 1. He obtained his degree of Doctor of Philosophy from Yale in 1926 and shortly thereafter went to Europe, under a grant from the National Research Council, where for more than a year past he has been studying the fossil collections of the various museums, paying particular attention to the Mesozoic Mammalia, the greater part of which are in the British Museum. The results of his studies upon this group of mammals will be published as one of the British Museum's Descriptive Catalogues.

Doctor Simpson was a member of one of the field parties of the department of vertebrate palæontology working in New Mexico and Texas in 1924, and he is the author of several departmental papers dealing with the American Museum collection of Mesozoic mammals. One of these papers, written in collaboration with Dr. W. K. Gregory, describes the extraordinary mammals discovered by the Central Asiatic Expedition in the dinosaur beds of Mongolia in 1925.

HISTORY OF THE EARTH

Varved Clays at Haverstraw, New York.—At the annual meeting of the Geological Society of America, which convened in Cleveland, Ohio, December 29–31, 1927, Dr. Chester A. Reeds represented the American Museum and presented a paper on the laminated clays of glacio-lacustrine origin deposited at Haverstraw, New York. During portions of the summers of 1925, 1926 and 1927, Doctor Reeds with various assistants conducted intensive field studies in this district, and collected 258 samples of the clay from various levels extending from seventy-eight feet below sea level to fifty feet above. In the autumn of 1927 the samples from different clay pits and auger holes were orientated in the laboratory with reference to their stratigraphic positions, and correlations were established for all of the material collected. After the summer and winter layers had been differentiated, counted, and diagrammed, a total of 766 varves, representing as many years, was secured. When the bottom and lowermost layers shall have been collected, the total number of varves deposited in this area during the retreat of the ice of the last glaciation will approximate one thousand in number. The presence of quicksand, ground waters, and disturbed conditions resulting from gravitative forces hinders the ready attainment of good samples from the lowest levels.

This quantitative study of alternate deposits of sand and clay laid down seasonally in fresh-water glacial lakes is throwing additional light upon the origin of the terraces along the Hudson River and contributing to a better understanding of the fluctuating climate, varying rate of sedimentation, and number of years involved in the retreat of the ice of the last glaciation. Doctor Reeds will discuss the Haverstraw clays at greater length in a forthcoming number of American Museum *Novitates*.—C. A. R.

HONORS

President Osborn Receives Belgian Decoration.—On November 15 the newly appointed Ambassador of Belgium, His Highness Prince Albert de Ligne, visited the American Museum to present to President Osborn the decoration of "Commander of the Order of the Crown," bestowed by King Albert. Ever since 1908, when plans were being made for the American Museum Congo Expedition, the Belgian government has given its fullest support and coöperation to the work of the Museum in Belgium's immense African colony. It seemed especially appropriate that the Prince de Ligne himself should bring King Albert's appreciation of President Osborn's services in the carrying on of prolonged investigations into the fauna of the Belgian Congo, and in encouraging the establishment of a National Park in the Kivu Volcanoes—as was first suggested by Carl Akeley—for the preservation of the mountain gorilla and all other wild life.

Eighteen years ago, when Messrs. Lang and Chapin were on their way to the Congo, the American Ambassador in Brussels, Mr. Henry Lane Wilson, introduced them to the Colonial Ministry by sending them directly to Prince Albert de Ligne, then in charge of a section of the Colonial Office. Through his kindly interest every arrangement was made to facilitate this beginning of the Museum's studies in the Congo, the published results of which now fill a long series of volumes in our *Bulletin*. The relations between the Colonial Ministry and the American Museum have ever continued to be most cordial and fruitful in the great task of unlocking the secrets of African animal life.

Since the departure of our first Congo Expedition, the devotion of Prince Albert de Ligne to the Belgian Congo has grown steadily, although diplomatic studies have absorbed much of his time. Last year he paid an extended visit to the country around Lake Kivu, where he has acquired a considerable tract of fertile land, and is founding an important agricultural enterprise. Like almost everyone familiar with Central Africa, he longs to return, and might even now be there, had he not been chosen to represent his country at Washington. Recalling the enthusaistic support given by his predecessor, Baron de Cartier de Marchienne, to the project of a gorilla sanctuary, we must rejoice that this important post is again filled by someone with a deep attachment for both Africa and the United States, and long a warm friend of this Museum.

MEETINGS OF SOCIETIES

Annual Exhibition of the New York Academy of Sciences.—Many years ago when natural science was a unified subject and had not yet been divided into the many specialities which exist today, the New York Academy of Sciences held each year a series of demonstrations of current research work in this broad and general field. As time went on the natural sciences were divided into different fields of endeavor and few students attempted to keep in touch with the general field. This was the natural result of the growth and development of the science of life. Recently, however, there has been felt a need to bring the research workers, in at least one or more of the fields, together, to discuss research problems in an informal manner.

Last year the Section of Biology reinaugurated the annual demonstrations of the Academy, but restricted the field to the biological sciences. The plan was such a success that a second demonstration was held this year. Thirty-seven different demonstrations were simultaneously exhibited in the large Education Hall of the new School Service Building. These were exhibits of the research work being carried on in the laboratories of Columbia University, New York

University, Washington Square College, College of the City of New York, Bellevue Medical College, Cornell University Medical College, and the American Museum of Natural History. Several hundred biologists together with a number of interested laity availed themselves of the opportunity to see and discuss current research work of other investigators. There is in New York no other medium for bringing the different groups of biologists together at a single meeting and judging from the attendance and enthusiastic reception given the demonstrations, the New York Academy is doing a great service in holding these annual gatherings. It should also be pointed out that this exhibition was made possible through the assistance and coöperation of the American Museum, for all the installations of exhibits were arranged for by the Museum.

The American Ornithologists Union met in Washington November 15–17. During the three days' sessions sixty-six papers were read, many of which were illustrated with lantern slides or motion pictures. An all-day trip down the Potomac River to observe the water fowl brought the meetings to a close.

Officers elected for the coming year were as follows: president, Alexander Wetmore; vice-presidents, J. H. Fleming and Joseph Grinnell; secretary, T. S. Palmer; treasurer, W. L. McAtee; councilors, A. C. Beret, Ruthven Deane, Harry C. Oberholster, C. W. Richmond, and T. S. Roberts.

The American Anthropological Association met at Andover, December 28–30. Dr. H. L. Shapiro and Dr. G. C. Vaillant attended the meetings and participated in the several symposia held there.

Cardiff Naturalists Society Celebrates Diamond Jubilee. —Dr. F. A. Bather, of the British Museum (Natural History) and a Corresponding Member of the American Museum, represented the American Museum at the Diamond Jubilee of the Cardiff Naturalists Society in Wales, November 2–4.

New York Bird and Tree Club.—At the December meeting of the New York Bird and Tree Club, the keynote was conservation. Members brought substitutes for Christmas greens and decorations. Small living spruce trees with roots intact were presented to the members and their guests, and they were requested to plant these potential Christmas trees for future generations to enjoy.

A call for new members has been extended. Expectations for the future are always based upon the experiences of the past; therefore, it is confidently expected that during the coming year some of the finest speakers will address the Club on the various phases of bird life and forestry. The meetings are held in the American Museum of Natural History.

NEW PUBLICATIONS

The Following Papers have been published in *Novitates* and the *Bulletin*, during the period from November 9 to December 24:

Novitates

No. 291. Wind and the Direction of Insect Flight. By Dr. Frank E. Lutz. 4 pp. November 7, 1927.

No. 292. A New Poplar (*Populus pilosa*) from the Eastern Altai Mountains. By Alfred Rehder. With Supplemental Notes on the Distribution and Habitat. By R. W. Chaney. 8 pp. Three text figures. November 30, 1927.

Bulletin[1]

Bulletin LVI, Art. IV. Contribution to the Knowledge of the Fossil Hyracoidea of the Fayûm, Egypt, with Description of Several New Species. By H. Matsumoto. 98 pp. Forty-three text figures. December 1, 1927.

Art. V. A Study of the Crystallography of the Calcites of the New Jersey Diabase Region. By Hebert P. Whitlock. 27 pp. Twenty-five text figures. December 9, 1927.

Bulletin LVII, Art. III. The Fishes of the Rio Chucunaque Drainage, Eastern Panama. By C. M. Breder, Jr. 86 pp. Plates I to V, 10 text figures. December 8, 1927.

Art. IV. The Chilopoda and Diplopoda Collected by The American Museum of Natural History Congo Expedition (1909–1915), with Notes on Some Other African Species. By Ralph V. Chamberlin. 73 pp. One hundred and ninety-nine text figures, 1 map. December 24, 1927.

SCIENCE OF MAN

Unusual New Burials Found in Cañon del Muerto.—During his recent visit to the Museum en route to Chichen Itza in Yucatan to resume excavations for the Carnegie Institution, Mr. Earl H. Morris reported on a

[1]Errata: On page 506 of Natural History for Sept.–Oct., under *Bulletin*, LVI should read LIV, for Articles 3, 4, and 5.

remarkable find made in the course of his work for the department of anthropology in Cañon del Muerto, Arizona. In the talus of Mummy Cave which had been worked over with considerable care in previous years, Mr. Morris unexpectedly came upon some new burials. One of these was unusual in several respects, since it is the only one known to contain both Post Basket Maker (Basket Maker III) pottery and baskets. The four baskets found in the burial were unusual in form and size, being unlike any found in the cañons during the four previous seasons of excavation there. These miniature carrying baskets are in an excellent state of preservation and are important additions to the fine collections from Cañon del Muerto already in the Museum.

The New Museum and Laboratory of Anthropology.—The Board of Trustees of the newly projected Museum and Laboratory of Anthropology, the headquarters of which are to be in Santa Fe, New Mexico, met in the American Museum early in December. The main purpose of the organization is the establishment at Santa Fe of an institution for research, education, and graduate instruction in anthropology. It is planned among other things, to establish museums for public instruction, to conduct excavations, to provide laboratory facilities for research workers, and to give instruction through lectures and field demonstrations.

Mrs. John H. Lionberger has presented to the department of anthropology a fine painted elk robe. The robe was painted by the son of the famous chief Washakie of the Wind River Shoshoni about 1906 and is a very good example of Indian graphic art of that period, the decoration consisting of many figures of buffalo and horses and the representation of an Indian dance.

Founder of the Italian Institute of Human Paleontology Visits the Museum. The Museum, early in January, was honored by a distinguished visitor in the person of Count David Costantini, Commissioner of Public Instruction in Italy and also Founder and President of the Italian Institute of Human Paleontology.

The Count, realizing the comparatively backward state of prehistoric studies within the Italian dominions, ha deliberately acquired the special knowledge requisite to an understanding of the problems of prehistory and has organized an institution which, with royal patronage, proposes not only to review and republish the old, scattered, and more or less unknown discoveries, but to conduct new field researches both at home and abroad. On invitation of the Galton Society to address its meeting on January 6, the Count detailed the organization and purposes of his Institute, and at the same time presented a Corresponding Membership to Henry Fairfield Osborn.
—N. C. N.

Among Recent Visitors to the department of anthropology were Dr. T. F. McIlwraith, of the University of Toronto and Dr. Ralph Linton, of the Field Museum of Natural History. Doctor Linton has just returned from two years' ethnological work in Madagascar where he gathered a large collection for exhibition in the Field Museum and found definite evidence of old migrations of Malayan peoples to the Island.

The Glozel Controversy.—The International Commission of Anthropologists has finally reached the conclusion that the strange mixture of Paleolithic and Neolithic finds at Glozel is a fraud. This does not mean, of course, that the Glozel dispute is ended, for there are still firm believers in the authenticity of these finds, those who consider the Commission's investigation both superficial and prejudiced.

One of the earliest observers to express doubt was a mining engineer, M. A. Vayson de Pradenne, who, in the October issue of *Les Tablettes d'Avignon et de Provence* (2° année, No. 76), gives an interesting account of the archæological finds and presents evidence to justify his skepticism.

First speaking of the specimens themselves, he states that after careful inspection he found marks on the bones, the polished stones and the bricks, which could have been made only with metal tools. On some of the bones the cut surface failed to show the same patina found on the rest of the exposed surface.

As to the pottery, he states that it was made by a very unskilful hand. The pieces, while very ornate, do not show any knowledge of technique, contrasting widely with primitive work known for its simplicity of form and good technique. As M. de Pradenne puts it: "A Glozel on voit que l'artiste connaît la fin, mais non le début. Il a vu le résultat et ignore le procédé."

M. de Pradenne carried his skepticism to a logical end and went digging for himself at

Glozel. He relates that while working with a knife in the clay strata he found an ornate shingle vertically placed, and by carefully sectioning the clay around it, he was able to discover the tunnel for the introduction of the object. After this discovery he visited one of the so-called "tombs," where he found another inconsistency. The walls of one of these structures was built of loose rock, poorly piled up and innocent of mortar. Despite the fact that this stonework was supposed to have been in the clay soil since Neolithic times, the interstices were not yet filled with earth, nor in fact was the clay even compact nor closed in against the stonework.

It was a sequence of such observations as these that led the Commission in its recent report to declare the whole Glozel field a fraud of the first order and not an archæological find that would revolutionize the known history of early culture of Europe.

THE STUDY OF NATURE

Experimental Embryology.—Professor Thomas Hunt Morgan of Columbia University has recently published a monumental work on *Experimental Embryology*. His contrast between the emotional and the intellectual aspect of nature is so vivid that we may be permitted to quote in full.

> A transparent egg as it develops is one of the most fascinating objects in the world of living beings. The continuous change in form that takes place from hour to hour puzzles us by its very simplicity. The geometric patterns that present themselves at every turn invite mathematical analyses. The constancy and orderliness of the whole series of events, repeating themselves a thousand-fold in every batch of eggs, assures us of a casual sequence conspiring to create an object whose parts are adjusted to make a machine of extraordinary complexity.
>
> This pageant makes an irresistible appeal to the emotional and artistic sides of our nature. Hence, not without a feeling of jealous regret, the old-fashioned embryologists see these gems of nature consigned to test tubes for chemical analyses, to centrifuges to disturb their arrangements, to microdissecting instruments to pick them to pieces, and to endless tortures by alterations in the environment to disturb the orderly, normal course of events. For, it is the automatic self-contained perfection of the developmental process that holds our interest. Yet we feel, too, that if the mystery that surrounds the study of embryology is ever to come within our comprehension, we must try not to be sentimental and have recourse to other means than description of the passing show. The recompense, we hope, will be to substitute a more intelligent interest in place of the older emotional response to the order of nature.

The Attack on the Gene.—Prof. Frank R. Lillie, of the University of Chicago, has recently published in *Science* an address which he gave last summer at Woods Hole.

The great problem in biology is not so much an identification of the hereditary units as genes, but the determination of the nature of these factors and the elucidation of how they do their work. To quote from Professor Lillie's presentation:

> The method of comparing the action of varieties of gene combinations upon known characters of the organism under constant or varied conditions of the environmments is the oldest method of analyzing the mode of action of genes in development, and it appears to me to be the most promising method at the present time. . . .
>
> Morgan's conclusions that a single gene may be concerned in a multiplicity of characters, both in time and in space, and that a multiplicity of genes may be concerned in each character are indeed steps towards simplification. . . .
>
> Physiology of development and genetics both teach us the same lesson, viz., that at the foundation of every phenotypic event there is an unanalyzed ontogenetic process, which expresses itself in time by qualitatively different types of reaction whether to the environment, or to the gene, or to both combined.

It is the analysis of the action of the gene during the ontogenetic processes, or, in other words, during development, that Professor Lillie recommends for detailed study.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 10,021.

Associate Benefactor

Miss Margaret H. Elliot.

Honorary Life Member

Mr. H. F. Varian.

Patron

Mrs. James McLean.

Fellow

Doctor Ira Otis Tracy.

Life Members

Mesdames Edwin Bradley Currier, John R. McGinley.

Messrs. Benjamin Patterson Bole, Jr., E. Fellman, Charles Cauldwell Foote, Harold Rowntree.

Sustaining Members

Mrs. John W. Mackay.

Miss Margaret D. Kahn.

Messrs. Henry O. Havemeyer, W. L. E. Keuffel, Bertram A. Stroock.

Annual Members

Mesdames C. S. Brainin, Eben Dale, Celina F. Elias, James Fletcher, Jr., J. Warner Fobes, Geo. E. Greenbaum, George Laing, T. M. Lamberson, W. J. Logan, M. B. Metcalf, Charles M. Newcombe, Arthur Poillon, Richardson Pratt, Clarence Price, J. N. Rosenberg, Erskine Sanford, Frederick A. Sansome, Bird Stair, Louis V. Sterling, Arthur Wright, George Wuppermann.

Misses Helen I. Buck, Rosa B. Chisman, Lucy H. Kean, Mary Moore Remick, Anna E. Roelker, Emilia Ros, Margaret L. Suckley, G. Waterbury.

Col. H. Harrison Smith.

Doctors Adolpf Bernhard, Clarence Van R. Bumsted, Thomas A. Gonzales, Edson B. Heck, John Horn, Edward J. Ill, B. S. Oppenheimer, Otto Carl Risch, Benj. Morgan Vance, Ralph Ware Waddell, David H. Webster.

Messrs. Fred Aebly, A. E. Borie, Frederick William Bradley, Denison D. Dana, H. C. Denslow, S. E. Doane, Norman I. Dorffman, J. Frederick Eagle, Eckardt V. Eskesen, Edgar Freeman, George C. Haas, A. I. Henderson, Harry G. Huberth, R. C. Jeffcott, Rutger Bleecker Jewett, Sherman B. Joost, Henry I. Judson, Hayward S. Kirby, George A. Kurz, Thomas S. Lamont, Edgar C. Leaycraft, Jacob Levy, Jackson Steward Lincoln, Wm. G. Lord, Malcolm C. Ludlam, Ingo Maddaus, Jr., E. John Magnin, Ralph Melson, James Menendez, G. Albert Messier, William F. Moody, John J. Murphy, C. Aubrey Nicklas, Carl Noell, Beverly A. Norris, Percy C. Paquette, Robert Low Pierrepont, Robert C. Post, Wm. F. Randolph, John Harsen Rhoades, Irwin G. Rosenberg, Oswald R. Schultz, Simon Shapiro, Livingston L. Short, Louis B. Simonds, A. Simonson, Arthur J. Sloss, Franklin S. Smith, William DeGarmo Smith, Douglas Soule, L. H. Sprague, Jr., A. Steers, B. H. Stern, John M. Stoddard, Louis N. Stoskopf, Arthur I. Strang, W. W. Strasser, Myron Sulzberger, Augustus Swart, Rush Taggart, Wm. M. Teetsel, Donald F. Tripp, James S. Tyron, Eliot Tuckerman, Harrison, Tweed, M. S. Van Wezel, Emil G. Veith, D. W. von Bremen, Harvey N. Wadham, A. E. Walbridge, Charles A. Ward, Henry F. Westheimer, George P. Whaley, E. Laurence White, Earle C. Williams, Max Wilner, W. J. Wilson, Frederick H. Wood, Robert G. Woodcock, Christian A. Zabriskie, O. Benedict Zeman, Henry Ziegler.

Associate Members

Professors Barbara H. Bartlett, Gertrude Smith.

Doctor Isabel F. Smith.

Mesdames Norval E. Byrd, Mary P. Granger, H. L. Huebotter, Edward Johnstone, John S. Jones, Robert Seeling, Carrie Laura Simons, Clara B. Stoughton.

Misses: Ruth E. Atkins, Hannah L. Cheney, Mary Dunham, Alma Fillman, Carrie B. Francis, Marion F. Lewis, Mary Haecker Palmer, Hattie C. Rainwater, Edith Rolfe, Barabra Schunck, Ruth Williston.

Bishop Charles F. Reifsnider.

Reverends Ernest Caldecott, J. R. Neale.

Professors Leslie G. Burgevin, F. C. Coker, Frank W. Cushman, A. Henry Fretz, Earnest W. Lundeen, S. A. Mitchell, Leslie E. Swain, W . D. Valleau, Harry W. Wood.

Doctors Gualberto Arcos, Wendell S. Brooks, Clarence Marsh Case, Herbert G. Coar, Wilson Case Dort, Baylis Haynsworth Earle, E. J. Gardiner, Emery R. Hayhurst, Willis H. Jeffery, Walter C. Kraatz, Dana J. Leffingwell, Thomas Ollive Mabbott, Wm. J. Parmelee, G. Cartlon Robinson, Wm. T. Root, Arthur H. Shaeffer, Thos. B. Shaw, W. H. Shideler, Edward Stieren, Charles W. Townsend.

Messrs Norman I. Adams, Jr., Bradford Barton, Elmer Brown, Lyman B. Bunnell, James M. Carlisle, Nathan E. Coffin, Edward L. Corey, Anderson Dana, N. F. Dixon, Thorne Donnelley, L. M. Dorsey, Jr., Maclaren Duhme, John W. Eddy, H. David Evans, John Daintry Fitzhugh, J. C. Fraps, Henry Gearing, Jr., Josuha Green, Chas. Guertler, John W. Hard, James E. Hardman, W. O. Hart, J. H. Hawkins, Grier Hersh, B. H. Hicklin, F. J. Holl, Edward Hurley, Wm. T. Innis, C. V. Link, Darashaw N. Modi, William B. Moore, J. L. Neff, Robert Neely Ogden, H. Park, C. D. Parker, C. S. Parker, W. H. Phelps, Charles Penrose, 2d., Jos. N. Prokes, Theodore H. Read, H. Reus, Jr., Albert A. Riley, George M. Robertson, Murray Ruggles, B. M. Schmidt, Louis A. Scholl, Jr., J. H. Scott, Jack Selby, Charles S. Sellen, R. C. Shanklin, Carl Sheppard, Arthur G. Sherman, Irwin Spalding, Ben L. Statman, Chas. Steinberger, O. A. Stevens, Ogden Stevens, Hugh A. Stewart, Bertram E. Stiles, Herluf H. Strandskov, Robert R. Tafel, Albert M. Turner, F. Milton Weeks, Benjamin West, Frank B. Wiggin, A. H. Wilkinson, Morley P. Williams.

Masters Charles C. Cocco, Boyd Vincent Lyon, Johnny Russel.

THE FISH NUMBER

JANUARY-FEBRUARY

The first number of **Natural History** for the new year will be devoted to the subject of fishes. The contributions include "A Tour of the New Fish Hall" by William K Gregory; "Carl H. Eigenmann, 1863–1927" by George S. Myers; "A Barn-door Skate with Abnormal Pectoral Fins" by Lewis Radcliffe; "A Color Figure of the Louse-fish" by E. W. Gudger; "Habits and Life History of the Angler Fish" by Ulric Dahlgren; "Big Game Fishing in New Zealand Seas" by Zane Grey; "On the Association of the Common Goby with the Oyster, with One Case of Parasitism" by Thurlow C. Nelson; "Something about Flying Fishes" by John T. Nichols and C. M. Breder, Jr.; "The Zane Grey Game Fish Collection" by Francesca La Monte; "The Shepherd Fish and Its Strange Pasture Lands" by G. H. Parker; "Fishing for the Oilfish" by Charles B. Nordhoff; "In Southern Waters After Bonefish" by Van Campen Heilner; and "The Versatile Gurnard" by William Beebe.

BACK NUMBERS OF "NATURAL HISTORY"

Early issues of **Natural History** are greatly desired by the Library. The gift of such issues will be greatly appreciated, and postage will be refunded to the donor. Address, Librarian, American Museum of Natural History

TO READERS OF "NATURAL HISTORY"

Since Natural History is mailed as second-class matter, it will not be reforwarded by your postmaster. To avoid delay and the payment of additional postage, please notify us in advance, on the form below, of any change in your address.

The American Museum of Natural History
77th Street and Central Park West
New York, New York

CHANGE OF ADDRESS

..........................192

Name..

Former Address..

....

Present Address..

....

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

MEMBERSHIP MORE THAN TEN 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 10,000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
Sustaining Member	annually	$25
Life Member		$200
Fellow		$500
Patron		$1,000
Associate Benefactor		$10,000
Associate Founder		$25,000
Benefactor		$50,000
Endowment Member		$100,000

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: James H. Perkins, Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

NATURAL HISTORY, published bimonthly by the Museum, is sent to all classes of members as one of their privileges. Through NATURAL HISTORY they are kept in touch with the activities of the Museum and with the marvels of nature as they are revealed by study and exploration in various regions of the globe.

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented 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 fifty-seven years of public service 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 and in the progress of civilization throughout the world.

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 world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1926 no fewer than 2,070,265 individuals visited the Museum as compared with 1,775,890 in 1925 and 1,633,843, in 1924. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The **EXPEDITIONS** of the Museum for 1926, 33 in number, have resulted in splendid collections from all parts of the world. Among the notable achievements in **Asia** are the Morden-Clark series of *Ovis poli*, ibexes, antelopes, etc. from the remote regions of Russian and Chinese Turkestan, the herepetological survey of the Central Asiatic Expeditions by Mr. Clifford Pope in the Min River Valley from sea level at Foochow to the heights of the Fukien-Kiangsi divide, and in India the Vernay-Faunthorpe collection of mammals; in **Africa** the continuation of Mr. and Mrs. Martin Johnson's photographic records of African wild life, and the work of Carl E. Akeley on the Eastman-Pomeroy-Akeley African Expedition in Kenya and Tanganyika; in **Polynesia,** the continuation of the survey of bird life by the Whitney South Sea Expedition; in the **Dutch East Indies,** Douglas Burden's collection of giant dragon lizards; in **North America,** the valuable collection of narwhal and other sea life secured by the American Museum Greenland Expedition; in the Bahamas, Dr. Roy Miner's expedition for corals and rare fishes for the new Hall of Ocean Life; in the vicinity of New York City, Dr. Chester Reed's field observations on the glacial clays of the Hudson and Hackensack valleys; in Arizona, continuation of the archæological explorations at two important sites; in Hudson Bay, birds collected by the Rockefeller Expedition; and in **South America,** collections of mammals from Peru, Argentina, and Bolivia by Mr. G. H. H. Tate.

The **SCHOOL SERVICE** of the Museum reaches annually about 6,000,000 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 443 schools, and were studied by 765,790 pupils. During the same period 808,789 lantern slides were lent by the Museum for use in the schools, the total number of children reached being 4,358,423. A total of 2,057 reels of motion pictures were lent to 91 public schools and other educational institutions in Greater New York, reaching 530,955 children.

The **LECTURE COURSES,** some exclusively for members and their children, others for the schools, colleges, and 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.

For a detailed list of popular and scientific publications with prices apply to
The Librarian, American Museum of Natural History
New York City

INDEX TO VOLUME XXVII

TEXT AND ILLUSTRATIONS

Names of articles are set in capitals and small capitals. Titles of works are set in italics.