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NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XXXIX

January-May, 1937

TEN ISSUES A YEAR

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

VOLUME XXXIX ★ ★ ★ ★ ★ ★ JANUARY 1937

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

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IT is my belief that there is no other institution in the world that quite duplicates the educational services of the American Museum of Natural History.

In Science, Research, and Nature-display the Museum is an acknowledged leader.

The traditions built up around such an institution are many, and they impose upon the men and women in every field of our endeavor the necessity of upholding a progressive standard of excellence.

There is perhaps no better illustration of the sincerity with which we strive to maintain this standard and keep faith with this tradition, than the development of the new NATURAL HISTORY Magazine.

For thirty-six years NATURAL HISTORY Magazine has been the Museum's spokesman. It has been the medium through which the work of the Museum has been communicated to its members. Indeed, for those members who reside far from New York, it is the Museum itself.

It seems fitting, therefore, that so important a feature as our magazine should enhance a reputation, already enviable, by presenting a progressive portrayal of all that is true, all that is illuminating, and all that is beautiful in Nature.

F. Trubee Davison

In Borneo with the Martin Johnsons

America's most popular explorers escort the readers of Natural History on a photographic journey through the jungles of the largest island in the Malay Archipelago: the first published photo-serial of their latest expedition

Reproduction of all photographs is strictly forbidden without express permission of Martin Johnson

Geelie, A Belle of the Kinabatangan River, Borneo

Ever since they visited Borneo eighteen years ago, Martin and Osa Johnson had longed to return to make a complete photographic record of that paradise of tropical wild life. Their giraffe-spotted amphibion plane "Spirit of Africa," which many readers will recognize, was put in commission and re-christened "Spirit of Africa and Borneo." It carried the explorers over hundreds of miles of jungle and served during their year's sojourn as the efficient link between their camp in the interior and the coast.

The sound movies and still pictures which Martin Johnson brought back and is preparing in his headquarters at the American Museum of Natural History are acclaimed by many as the most extraordinary photographic story that the famous motion picture explorer has ever produced

(Above) SPICE-LADEN BREEZES drive picturesque Chinese junks on their mysterious journeys along Borneo's north coast: a scene near Sandakan, the capital of British North Borneo, from which the Martin Johnsons took off for the interior.

The coast line here is broken by many bays and inlets, while the jungle extends everywhere to the very edge of the sea. So flat is the island throughout large areas that a 500-foot rise of the sea would carry oceanic waters almost to its center.

Borneo is larger than Texas but has only a third of its population. Half of the island lies in the northern hemisphere and half in the southern. The rainfall is heavy and often violent, as much as 9 inches having been recorded in a single day

THE MAP OPPOSITE shows the location of the Johnsons' main camp, Abai, six days distant from Sandakan by junk, yet only an hour's flight by plane. By dugout, houseboat, and airplane the Johnsons explored several hundred square miles of the interlacing riverways of the interior lowlands

ZABUK
BAY
Sandakan
Labuk R.
Lokan R.
River
Abai
CAMP
Kinabatangan
Segama R.
Lahad Datu
DARVEL
BAY
Kumpong R.
Tawau
D.F. Levett Bradley
Sandakan
BRITISH N. BORNEO
Brunei
SARAWAK
BORNEO
115°
5°

(Above) TENTACLES OF JUNGLE spread out into a shallow sea in the vicinity of Sandakan. The many-hued coral bottom under low tide shimmers like batique silk, as alternately dense verdure and crystal sea pass under the plane. A few huts like those in the center of the photograph constitute a village, seldom embracing more than twelve or fifteen persons

TALL STILTS SUPPORT the native huts in a region where tides are extremely high, protecting the inhabitants from snakes and other jungle dangers. In former days sudden attacks from hostile natives could best be thwarted by this type of dwelling. Fish from the sea and coconuts from overhead are the native's chief foods

Osa Johnson, D. J. Jardine, C. M. G., O. B. E., Governor of North Borneo, and Martin Johnson, on the occasion of the Governor's visit to the Johnsons' jungle camp

(Above) Quaint junks are the constant home, Borneo's coast the haven, for many Chinese fishing families. The skies are always cloudy, but typhoons never strike

(Below) Squeezed between the jungle and the sea is Sandakan, North Borneo's capital. Only 54 of its 30,000 inhabitants are white, but electric lights, ice plants, sanitation and a motion picture theater make this city a nucleus of western civilization. Notice a portion of the native quarter, built entirely on stilts

SNAKE-LIKE WATERWAYS furnished good landing for the amphibion far into the jungle but made river travel laborious and bewildering. Several hours of paddling might bring you back almost to where you started. The upper loop in this photograph will probably quickly be obliterated by the jungle owing to the river having broken through at the right

(Right) FIRST MEETING WITH MURAT NATIVES, a tribe formerly given to headhunting but supposed now to have given up the practice. Osa Johnson is trying to talk with them, but neither understands the other's language

(Right) Martin Johnson seeks the friendly assistance of the Murat natives, formerly headhunters. They are expert jungle men, skilled in the use of bow and arrow and blow-gun

(Right) The Murat natives, unlike many of the African natives who had seen it, expressed great interest in the plane. Having heard of automobiles, they were not surprised that the motor could propel it, but they never could understand what held it in the air. Note the eye painted on the plane in compliance with Chinese superstition

Extraordinary accuracy with the blow-gun and their jungle knowledge made these natives valuable assistants. The men, who always wear their hair long, look on first glance more like women, and the women sometimes *vice versa*

(Above) A CORNER of the Martin Johnsons' camp, built on the only sizable area of dry land they could discover in several weeks of reconnaissance flying. In an infinity of hard timber, wood that was soft enough to use for construction had to be brought in from Sandakan

(Left) THE JOHNSONS' INTERPRETER. After working a number of years in Sandakan, he had retired to the jungle with his savings of twenty dollars, content to put civilization behind him

(Below) A PICTURE THAT MOVES was almost beyond the imagination of the Murat natives, yet they showed an unceasing interest in the photographic activities

(Above) A GRASS HANGAR was built to protect the plane from the almost incessant rains. The ramp of ironwood was constantly being devoured by tiny insects and had to be repaired repeatedly. To the left of the hangar stands the dining room

(Right) A FRIEND OF EIGHTEEN YEARS AGO: an old native, wise in the ways of the jungle, who had served the Johnsons on their first visit to Borneo

(Left) ONE OF THE MANY VISITORS to whom the camp was of absorbing interest. Fifty Chinese workmen were employed constantly and as many as 300 people were sometimes present

(Left) The Schnozzle Durante of Borneo, the so-called proboscis monkey. No specimen of this animal has ever been in captivity for more than a few days or been taken from Borneo alive

(Right) Osa Johnson's favorite fishing hole near camp, where she spent many hours when not busy at her duties of managing the commissary, hiring and firing the native workers, and attending to the myriad details of camp life

(Right) Flashlight photo of two baby proboscis monkeys. These animals are easy to capture, and even the old ones can be handled without danger. But within an hour of the time when they have been eating and playing they have been known to die

(Right) "Water rock" *(Ayer batu)* was the name that these mystified jungle natives gave ice when Osa Johnson showed it to them for the first time

ORANG-UTANS. Thirty-five of these deliberate and inquisitive neighbors were seen in one day

(Right) A MOTHER BEAR playing with her cubs. This animal, black in color with an orange crescent under the neck, eats insects and never grows much heavier than 75 pounds. Though armed with long claws it is not ferocious unless molested

THE MOST ENJOYABLE TIMES were passed on a houseboat which the Johnsons built and used for making long trips into less accessible sections of the jungle. Ample space for weeks of travel was provided in four rooms: bedroom, kitchen, storeroom, and darkroom. All the comforts of home were contained in this floating cottage; electric lights, electric fans, and kerosene-burning refrigerator

THE RAFT WAS PROPELLED noiselessly by paddlers and polers, allowing intimate observation of the varied wild life. At nightfall it was usually tied up near an interesting native settlement

A VAST LABYRINTH of jungle waterways was the primeval setting for some of the most spectacular nature photography. A completely equipped darkroom, with refrigeration to keep all solutions at proper temperature and protect the film from deteriorating, enabled Martin Johnson to develop many of his pictures on the spot

THE ABUNDANCE OF GAME made it easier to live off the country than in any jungle the Johnsons had previously visited. Deer were so plentiful that they could always be sure of getting one in an hour's time. There were ten varieties of game birds, pigeons were almost as large as hens, and there were many edible mushrooms

(Above) GEELIE IN A DUGOUT or goblong such as the Johnsons used for penetrating the jungle beyond the limits of navigation for their raft. Poling and paddling their way up the shallow streams of the Tengarrah country they came in contact with a race of people differing widely from those in the region of their base camp

When a wider stretch of water was discovered, Osa spent the night in a dugout traveling downstream to where James Laneri, their pilot, was waiting with the plane

When the plane was brought, some of the natives were taken into the air and enjoyed it immensely. While the plane was on the water there was a continuous stream of natives paddling around it in their canoes

(Right) Osa Johnson with former headhunters of the Romanou tribe, with spears and fire-making equipment. An especially hard section of bamboo is used with flint by these natives for striking a fire

(Above) A BABY PROBOSCIS MONKEY, not looking quite as homely as he will when his nose has had time to grow

(Below) THE SIKORSKY AMPHIBION (S-39) was a valuable link between the houseboat and the sea coast. Motion picture film, of which only sample lengths could be developed on the raft, would have deteriorated if it could not have been rushed to the coast in large thermos containers. From Sandakan it was sent by air mail to the United States for developing

Few realize that Martin Johnson secures his extraordinary motion pictures without a staff of technicians. Except for the assistance of a sound engineer, Joe Tilton, he was his own photographer throughout the making of this his latest film. Its artistry supassses the previous interpretations of this past master of both fine photography and exploration

MEET A SAVAGE KING — *A visit with the Lala tribe in Central Africa, which culminated in the first opportunity ever given to a white person to witness the weird ceremony in honor of dead chiefs*

By LUCY POPE CULLEN

MY HUSBAND and I recently spent two weeks as guests of a king. Our royal host was Chiwali the Third, Paramount Chief of the Lala Tribe of Central Africa. The Lala Nation, 120,000 strong, is divided into three main branches. A Paramount Chief rules each branch; under him exists an intricate network of chiefs, lesser chiefs and sub-chiefs. Titles are inherited, and Chiwali is ninth of his family to rule.

We owe our acquaintance with Chiwali to our friendship with one of Africa's real old-timers. "Chirupula" Stephenson was among the first white men to go to Northern Rhodesia. Out from England in 1888 as a youth in search of his fortune, he spent a restless year in South Africa before he drifted to the unopened territory farther north. Here he found his promised land. Prospecting, hunting and trading, he has remained in Northern Rhodesia ever since. He now owns and operates a large citrus fruit farm in the northwestern part of the territory.

In intimate contact

During incredibly long periods of his early years he never saw a white face. It was natural, therefore, that he should come to know the Lalas, who were the only people whom he did see constantly, as few Europeans ever know Africans.

Their feeling toward him is a queer mixture of affection and awe. His servants and farm workers have been with him many years; a sure sign of liking in people to whom money means little. Respect is shown in the name, "Chirupula," which the Lalas bestowed on him. "Chirupula" means that its owner does not strike often, nor unjustly, but that when he does strike, the blow is hard.

Their awe of him derives from the fact that his original arrival in the country took place just at the time a witchdoctor had predicted the coming of a white god. Whether or not they really believe him to be supernatural, the coincidence obviously made a deep impression. He is one of the few white men to whom they give the salute usually reserved for their own chiefs: kneeling, clapping the hands and uttering the word, "mutende."

"Chirupula" knew that Douglas and I shared his interest in native life and customs. He knew, too, the difficulty nowadays of seeing natives in their natural environment in South Africa. In European communities they adopt so many European ways that a great deal of their own distinction is lost.

"Chirupula" asked us one day, while we were staying at his Northern Rhodesian farm, how we would like to go with him to see his old friend, Chiwali the Third. Chiwali lived in a village far out in the bush, and there, "Chirupula" said, we could see Lalas living much as the tribe has lived for generations past.

Envoy

We were, of course, delighted at the prospect of visiting a chief's village with a man who knew the people so well. "Chirupula" accordingly sent a runner at once to tell Chiwali that we were coming. A chief, he explained, is never at his best when startled. The village was 100 miles away by road; somewhat less by the route the runner would take. The runner would arrive in two days; we about two days later. The arrangement would give Chiwali time to get used to the idea of our visit, and would enable him to greet us with undisturbed poise.

We packed our equipment on a Ford lorry and set out. So bumpy was the road that we made only 75 miles the first day. We camped that night near a small native village, and had the doubtful privilege of arriving simultaneously with a large swarm of locusts. It was thick enough to darken the sun as it flew over and around us. The insects were of a giant variety; red bodies two inches long, shading to gray-green tails. Each had four silvery, transparent wings. Thousands of wings in action together produced a dry rattle that could be heard above the roar of the motor.

Ordinarily our arrival would have caused quite a

stir in the village. We were scarcely noticed, however, in the presence of the locusts, which rate high as a table delicacy in Africa. Uttering glad cries, the villagers bounded off in pursuit of the swarm; nor did they return until they had made sure it was settling for the night on trees in the immediate vicinity.

"Chirupula" told us that if we wanted to see the locust crop gathered in, we would have to get up early the next morning. The night's cold deprives the insects of the use of their wings, and renders them easy prey before the sun is high enough to warm them up.

Harvest

We accordingly rose at daybreak, to find the whole village up before us, carrying baskets, gourds, clay pots—anything in the nature of a container upon which they could lay hands. One man simply brought an axe. He chopped down a tree and skinned off a section of bark. With one end stopped up, the bark tube made a fine deep receptacle.

The advance of the villagers upon the swarm was businesslike. Into their containers they shook the inert insects by thousands from trees, bushes and grass. A number of trees too large to be shaken were simply cut down. Small boys carried full containers to the village, and emptied them on grass mats, where other villagers waited. The waiting contingent removed the head of each locust with a single deft twist, and spread the bodies on the mats to dry in the sun before being eaten.

Leaving the scene of these rather unpleasant activities, we went on our way right after breakfast. We reached Chiwali's village about noon. Being the residence of a chief, it was rather larger than the average in Northern Rhodesia. About 100 huts housed from 400 to 500 people.

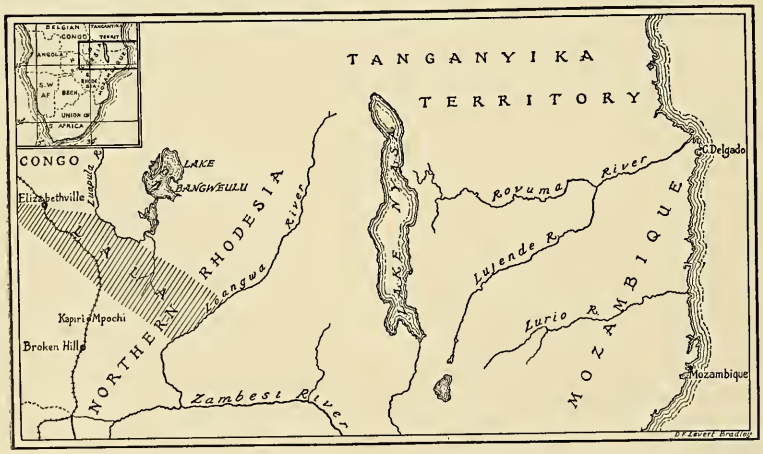
With no locusts to dim our glory, we were given a hearty welcome. A big crowd ran out to meet us, and escorted us in.

Every inch a king

"Chirupula" led us to the largest hut, around which the others were irregularly grouped. After a few moments there emerged from this hut a thin black man, so tall that he had to bend almost double to come out of the low doorway, so old that his woolly hair was gray. (African hair retains its color for many years longer than ours.)

This was Chiwali, chief of the Lalas. I think we would have known it, even if "Chirupula" had not been there to introduce us and in spite of his undistinguished costume. His royal blood was apparent in an immense dignity yet simplicity of bearing, in high cheekbones and in remarkably long, sensitive hands. A single piece of calico was wrapped about his loins, and hung to his ankles like a skirt.

His amazing vitality showed in his upright carriage, and was proven beyond a doubt by the fact that, although well over eighty years old at the time, he was the father of an 18-months-old baby. One day when we knew him better, Chiwali counted up for us as many of his children as he could remember by name, a total of forty-five. At the end of the enumeration he sat for a few moments, with a gleam in his eye.



"I am old now," he said, "and no longer strong. But when I was young—I was a *man!*"

We felt that he spoke but the simple truth.

Chiwali exchanged greetings with "Chirupula" and then with us. He said that some new huts were being built about 100 yards from the main body of the village, and that we might use as many of them as we liked. An elaborate exchange of thanks followed; we for the huts, and Chiwali for the honor of our visit. The formalities over, we retired to establish ourselves.

As we sat outside our dining hut late that afternoon, we saw a long procession slowly approaching in single file. It was led by Chiwali. Behind him walked two ancient women. These were his sisters, Munsele and Wangwa. A number of young men who came next were sons of the sisters; last of all came Chiwali's sons.

A second introduction

This apparent discrepancy in order of precedence was because the Lalas are a matrilineal tribe. The line of descent goes through the woman rather than through the man. At Chiwali's death the next chief will be chosen from among the sons of one of the sisters—preferably from among those of the elder—rather than from among Chiwali's sons. The sisters and their sons are, therefore, queens and princes of the tribe, while Chiwali's wives and sons are not even considered royal.

The procession had come to give us formal welcome to the village. Our meeting of the morning was ignored, and we were presented to Chiwali all over again.

A mat was placed on the ground in front of us. On this Chiwali and his sisters sat cross-legged. Munsele and Wangwa ranged themselves slightly behind Chiwali, Munsele on the west, Wangwa on the east. When Lalas speak of death, they use the term "to go west," to Mbonshi, the Spiritland. Munsele as the elder was presumably nearer to going west than Wangwa, and consequently always sat on that side. The sons sat in neat rows behind, carefully graded according to rank.

Three fowls with legs tied, a bowl of rice and a basket of mealie meal (corn meal) were placed on the ground before us. That these were not only tokens of good feeling, but were also something in the nature of bread cast upon the waters, was made clear in the speech of welcome which Chiwali now delivered. His offerings would be poor indeed, he assured us, compared with the handsome gifts we would undoubtedly make to him before we left. The thought was conveyed with admirable precision and force.

The climax of the occasion was reached when a large object which had been carried by one of Chiwali's attendants was brought forward. It proved to be a "piano" of original design. Two reeds were attached to the sides of a big, hollowed-out kalabash, or gourd. From the up-curved ends of the reeds a flat board was suspended so as to hang just over a hole in the top of the kalabash.

Clasping the kalabash with one arm, Chiwali beat on the board with a stick, the end of which was wrapped in a piece of raw native rubber. The sound produced was low, monotonous, yet curiously sweet. Thus accompanied, Chiwali stood before us and sang. The impromptu words of his song were descriptive of "Chirupula's" known virtues and our own pleasing appearance. His old voice had surprising resonance; its occasional quaver only added to the charm of the performance. Like most African tunes, this one started at no beginning, came to no end; it simply broke off when the singer had finished with what he had to say.

Division of labor

Having welcomed us, the village settled down to its usual routine. Watching the various activities, we were often struck by the curious way in which work was divided between the sexes. The amount of physical exertion involved apparently had nothing to do with it.

In building the new huts, for instance, men cut trees, made logs and placed them in the ground in an upright circle for the hut's stockade-like frame. Women then dug up earth, mixed it with water and carried the resulting mud into the hut, where they plastered the chinks between logs to make a solid wall. The women cut grass and brought it in on their heads in great bundles. Men then thatched the roof with it.

Men clear the ground of trees, women hoe and harvest crops, grind grain into meal, bring up water from the river, do all the cooking and look after the children. A mother always carries a small baby tied to her back, no matter how heavy the task she is performing. In the crafts, men make baskets, weave mats, manufacture cloth from the bark of a tree, forge heads for implements and do wood-carving. Women do pottery.

All work proceeded at a leisurely pace, alternated with long periods of rest. The men devoted hours each day to playing "chisolo," an intricate game of Arab origin, in which a number of stones are moved about a series of small holes scraped in the ground. Although it involves more skill than chance, variations of chisolo are popular as a gambling game all over Africa.

At noon every day, and again in the evening, we

sat in the shade for long talks with Chiwali and a group of his people. We learned a great deal about Lala traditions and customs.

The significance of the lip ring worn by most of the women was explained to us. While it is purely ornamental now, its original use was to disfigure a girl so that Arab slave traders would pass her by in their search for fine looking physical specimens. The ring is carved from a piece of kalabash or ivory, in the shape of a collar button, and fits into a vertical slit cut through the upper lip. Occasionally one is worn in the lower lip too.

In the long ago

Chiwali told us the Lala version of creation. In the beginning there were three brothers, Kashindika, Luchere and Shingo, who lived in the west. Before them there was only Lesa, the Almighty. Lesa furnished the materials from which the brothers fashioned the world. (Lesa is never mentioned by name; an upward gesture of the hand suffices.)

One day the three brothers fell to wondering how far it was from the west to the east.

"Let us travel," said Luchere, "and find out."

The other two agreed, and they all set forth. After a while Kashindika, the eldest, grew tired, and said to Luchere:

"It is a longer way from the west to the east than I thought it would be. I am able to go on no farther, and will return to the west. You are younger and stronger; you go on to the east. The country to the east will be yours, and all the elephants that die looking to the east will be yours. All the elephants that die looking to the west, and all the country to the west, will be mine."

Luchere's assent to this arrangement gave birth to one of Africa's oldest traditions: that ivory belongs to the chief in whose land it is found. Shingo, the youngest brother, had been loitering behind, and the other two had quite forgotten to provide for him. He came up now, and was very angry to hear what had transpired.

"You have divided everything up between you and left nothing for me," he said. "This I will neither forget nor forgive. I will become a lion, and then I will be everywhere. The whole world, both east and west, will be my hunting ground. You and your children will be my enemies forever. I will take my ivory, or anything else I want, where I find it."

With these words Shingo in turn created tradition, for Lala chiefs sometimes follow his example and return to earth as lions. The habit makes things difficult for Lala hunters. To slay a lion is each man's proudest ambition; yet there is always the dreadful possibility of incurring the wrath of a reincarnated chief, or even of Shingo himself. The enmity promised by Shingo lives in the Lala name for lion. It is "Nsukusamende Sombikaluwulaantu," which means, "I never bathe my teeth in water; only in the blood of people!"

Strong medicine

The most deadly Lala "medicine" is lion medicine. A small bundle is made up by a witchdoctor of a fragment of lion scrotum, a tooth, a claw, two "impingu" or small wooden pegs, bound together by a hair from the whiskers of a lion, and a leaf from the Kasabwa tree. The impingu represent the lion's bony structure; the whisker hair is chosen as coming from near the brain. As the Kasabwa is the first tree to put out leaves each year, it announces that spring is coming. In the medicine, therefore, the leaf figures as a tongue.

The whole compound comprises the essentials of a destroyer: tooth, claw, tongue, frame, intelligence and virility or ferocity. The bundle is set down beside a path along which an enemy habitually passes. At the psychological moment it turns into a lion, destroys the enemy and immediately reverts to its former shape. It can be used again and again by its fortunate owner.

The intricacies of the matrilineal succession were explained to us. It is based on the thoroughly sound idea that there is seldom much doubt about the identity of a child's mother.

"While," said Chiwali, "as to the father—who knows?"

Since it is through the "mukoka," or navel cord, that the child is actually joined to its mother, the whole Lala social structure depends on the "mukoka." The word has thus come to have the broader meaning of relationship or family, and is usually translated as "totem."

The practical working of the matrilineal system through the totem can best be shown by an example:

A woman of the Goat Totem marries a man of the Rock Totem. Two children are born to the couple: a boy and a girl. Both children belong to the Goat Totem, since it is their mother's. When the girl marries, her children in turn are Goats. When the boy marries, though he himself remains a Goat, his children belong to his wife's totem.

No Goat child may marry another member of the Goat Totem, no matter how distant, according to our ideas, the cousinship may be. Every member of the Goat Totem stands to the Goat child in the relation of sister, brother or mother. On the other hand, since his father's Rock Totem is different

from his own, he is no kin at all to any of the Rocks, and may marry among them as he chooses.

There are no Lala spinsters; each girl is married as soon as she reaches maturity, her mother carrying on negotiations with all suitors. The successful contender pays for his bride in produce, livestock, and labor in his mother-in-law's service.

We had noticed in the village a very pretty little girl of about eleven, whose head was covered with a close-fitting cap of beads. Half the beads were red, half white. Munsele explained that these had just been strung, one by one, on the hair itself, by women of the girl's totem. Red stands for life to the Lalas; white means youth or immaturity. The joining of the two colors in the head-dress announces to the men of the tribe that the girl has now left childhood behind her, and is ready to enter life as a woman.

Marital difficulties

Not all Lala marriages work out well, and a divorce may be obtained. While British law prevails in the territory, the settlement of a great many matters is left in the hands of the chief of a tribe. Most domestic questions fall in this category. Lala justice is based on a system of payments. If a man wrongs another, he must pay to the offended party an amount equal, in the judgment of the chief, to the damage done. Here, too, payment is made in produce, livestock or labor.

The most serious trouble that can arise in a Lala marriage is a lack of offspring. If a marriage is barren at the end of a year, the couple goes to the chief. Each lodges complaint against the other, and demands damages. The man has a case against his mother-in-law as well as against his wife. His wife is to blame for being inadequate; his mother-in-law for having cheated him in the marriage bargain.

The chief says, "Very well, you may each take another mate, and then we shall see who is to blame."

After some months, the woman comes back to the chief, triumphantly displaying a baby. The chief forthwith summons the former husband. If he is unable to show a child by his second wife, he must pay his former wife twice; once for having been a poor husband, and once for wrongly placing the blame on her. He must also pay his mother-in-law for accusing her of cheating.

One day Chiwali arranged a special tribal dance in our honor. We were amazed to find that the two dance leaders were Munsele and Wangwa, both of whom were well over sixty. One of Munsele's daughters was a soloist. She was painted with a sort of whitewash in spots and stripes to represent a leopard, and did the barbaric and spirited dance with which a successful leopard hunter is greeted when he returns home with his prey.

Savage music

All the women wore fringes of reed around the hips, head-dresses made of zebra tails and clusters of small gourds around their legs. The seeds with which the gourds were filled rattled like castanets. These, with tom-toms, furnished the musical accompaniment to the dances.

On our last afternoon the Lalas invited us to attend a tribal ceremony that had never before been seen by a white person. It was held in honor of their dead chiefs.

At the edge of the village was a small clearing. In the center of the clearing we had observed an odd little structure, the skeleton of a tiny round hut, with widely spaced sticks supporting a thatched roof, just high enough for a man to stand upright under its peak. The hut was about five feet in diameter, and we had taken it for an embryo chicken house. We had noticed, however, that the ground around it was kept scrupulously clean by the stick brooms of the village women, and had wondered why.

We found out the reason when, after a formally presented invitation, we accompanied the villagers to the hut at about five o'clock in the afternoon. Our chairs were placed in front of the door, and a mat was spread next to us for the two queens. The tribe sat in a semi-circle on the ground to left and right, men on one side, women on the other.

Chiwali was the last to arrive. He was wrapped in the usual piece of calico, but now wore a feather head-dress that we had not seen before. The cock feathers of which it was composed were red and black. Black stands for death to the Lalas, just as red means life. The head-dress symbolized the chief's ancient power of life and death over his subjects.

Chiwali's attitude during our visit had been so friendly that we had rather lost sight of his position. From the moment, however, that he seated himself on his throne close to the door of the hut, we realized that he was, in simple fact, a king. His whole personality seemed suddenly changed, more remote, as if his spirit had withdrawn to a far place where no stranger might follow. His throne was a small, wooden affair, more like our idea of a footstool, but it was, nevertheless, the throne, upon which no one but Chiwali might sit.

Three persons only remained standing: Musonde Mutende, Chiwali's son, Chuie Mutanda, son of the eldest Queen, and an old woman named Muhashya. Muhashya was the official chief mourner of

the tribe, whose duty it was to wail at sunrise and sunset each day for a certain period following the death of a chief.

These three spread a new grass mat on the ground in front of the hut. Muhashya went inside, and began lifting down a number of objects from the rafters under the roof. Each was held carefully in both hands and passed to Musonde, who took them in like manner and placed them on the mat in an order directed by Chiwali. Chuie meanwhile, standing near the door of the hut, beat a big tom-tom so softly as to produce only the ghost of a sound.

Sacred relics

One by one appeared eight hunting bows, from which only ragged ends of strings dangled; eight miniature carved thrones, like the one upon which Chiwali sat, wooden platters, a wooden pillow or head-rest, a pair of horns, a little "piano," broken bits of kalabash, fragments of ivory, a double bell forged from one piece of iron, and a handful of rudely carved bone beads on a rotting bit of string.

I glanced around at the silent villagers. Every face was grave, intent, every eye fixed on the mat's contents. For in this strange little collection of objects they saw their most precious treasures, relics of their departed great ones, kings and queens of the Lalas. The royal family as far back as its history had been handed down was here represented: Mwapetembe, Malama, Kalunga, Mawonde, Nkata, Chiwoli, Chiwali the First and Chiwali the Second. Eight generations of chiefs, covering a period of over two hundred years; matrilineal ancestors of the present chief, Chiwali the Third.

A piece of new white calico was now produced, together with a bowl of freshly ground meal. The calico was torn into strips, and a separate piece knotted securely around each relic, after which meal was sprinkled over all of them. This was symbolic of feeding and clothing the royal ancestors, thus showing any of them who might be watching from Spiritland the reverence in which their memories were held.

The silence that followed was broken by a weird sound that seemed to rise from the ground. Starting softly, it grew in volume until we perceived that it emanated from the old woman, Muhashya, who crouched inside the hut. Tapping her mouth with her open palm, she at the same time uttered a thin, high-pitched wail, Chuie began a low, rolling accompaniment on the tom-tom, Musonde beat the double iron bell, Chiwali played on his kalabash piano. The men of the tribe joined in by humming through closed lips, the women with a wail like Muhashya's.

The strange symphony rose to a crescendo of sound that seemed to fill the world, then fell away to silence. It was repeated eight times, alternated each time by the tribe's clapping their hands in slow unison in the same manner: beginning softly, growing louder, then dying. The wordless sounds in the fading light seemed disembodied, their rising and falling cadence achieved the effect of a long procession going by, as though the old chiefs themselves were passing, with their retinues, in review.

Just as the sun reached the horizon it flung a long bar of light across the clearing, touching with soft radiance the roof of the little spirit house, the row of small relics and Chiwali's gaunt, absorbed face. It was like a silent salute from the shining king of day to these black kings of Africa. Darkness fell softly, the last handclap ceased, and the ceremony was over. Still under its spell, the villagers arose quietly and drifted away by twos and threes, leaving only the chief performers and ourselves.

When Chiwali would become a lion

I had noticed while the ceremony was in progress a small bundle hanging by a string from the branch of a tree near where Chiwali had sat. I now asked what this might be. It was, I was told, lion medicine, though not in this case for use as a charm against an enemy. The bundle contained the vital organs of a lion, and was placed here so that when Chiwali went to join his ancestors, he would find no difficulty in assuming the form of a lion if he so desired.

The thought of the eighty-year-old Chiwali sitting so composedly under this macabre preparation for his own death was as chilling as a sudden breath of cold wind. I was grateful for the bit of humor that came at the last, when one of the young men hurried a little in restoring the relics to the spirit house rafters. Chiwali stopped him as he was picking up a relic in each hand, and directed him to replace them as they had been taken out, one by one.

"No ancestor," said Chiwali, "would like to be moved about in handfuls."

MEET A SAVAGE KING

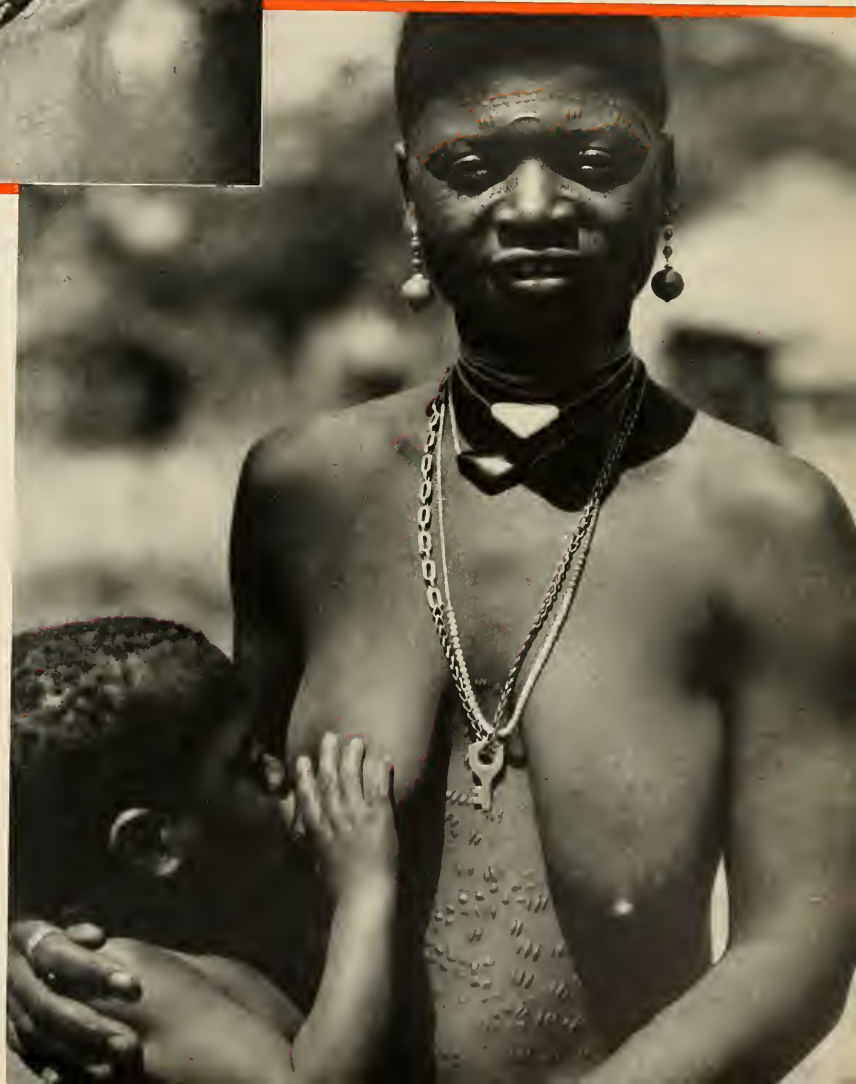
CHIWALI III, PARAMOUNT CHIEF of the Lalas in Central Africa: the potentate whose hospitality Lucy Pope Cullen recounts in the foregoing article. He wears the ceremonial head-dress of feathers denoting his ancient power of life and death over his subjects.

The following photographs which tell the story of their unusual visit were taken by A. Douglas Cullen, the author's husband

THE ABOVE PHOTOGRAPHS illustrate the Lala custom of wearing lip rings. While purely ornamental now, the original use of the lip ring was to disfigure a girl so that Arab slave traders would pass her by in their search for fine-looking physical specimens. The ring is carved from a piece of kalabash or ivory, in the shape of a collar button, and fits into a vertical slit cut through the upper lip. Occasionally one is worn in the lower lip too

(Below) PLAYING CHISOLO, an intricate game of Arab origin, in which a number of stones are moved about a series of small holes scraped in the ground. The game involves more skill than chance. Variations of chisolo are popular as a method of gambling throughout Africa.

(Below) LALA WOMAN AND CHILD. Note ornamental "tattoo" marks on face and body. The Lalas are a matrilineal tribe. This custom with them is based on the idea that there is seldom much doubt about the identity of a child's mother. Hence all children belong to the totem of their mother, and the little boy shown here might, upon growing up, marry a close relative of his father's, owing to the fact that his father's totem is different and his father's relatives consequently unrelated to him



Two girls of Chiwali's tribe threshing grain

Winnowing: the chaff is blown away by the wind

The village smithy, fashioning a shovel blade
(Below) A Lala making reed baskets

A lala man carving a knife sheath

Writing on the daily life of Chiwali's tribesmen, Lucy Pope Cullen remarks: "All work proceeded at a leisurely pace, alternated with long periods of rest. . . . Watching the various activities, we were often struck by the curious way in which work was divided between the sexes. The amount of physical exertion involved apparently had nothing to do with it. . . .

"Men clear the ground of trees, women hoe and harvest crops, grind grain into meal, bring up water from the river, do all the cooking and look after the children. A mother always carries a small baby tied to her back, no matter how heavy the task."

"There are no Lala spinsters," the author continues. "Each girl is married as soon as she reaches maturity, her mother carrying on negotiations with all suitors. The successful contender pays for his bride in produce, livestock, and labor in his mother-in-law's service."

The most serious trouble that can arise in a Lala marriage is lack of offspring. If a marriage is barren at the end of a year a couple goes to the chief. Each lodges complaint, and permission is granted for them each to try a different mate. After some months, if the woman comes back to the chief triumphantly displaying a baby, and the husband is unable to show one, he has to pay his former wife twice, once for having been a poor husband and once for wrongly placing the blame on her.

One of Chiwali's tribesmen weaving a grass mat

Among the Lalas the women make the pottery

A Lala pigeon house, built on stilts to keep out snakes and animals

Likewise the women carry the water from the village water-hole. *(Below)* Lala woman smoking

The trip to the village of the chief was interrupted by an invasion of locusts, in swarms so thick as to darken the sun. When nightfall halted the insects' flight they clustered on trees in a solid coating as shown in the accompanying photograph

Locusts are relished as food in Africa. Accordingly the villagers set out at daybreak to harvest the winged crop. Baskets, gourds and clay pots were used as receptacles in which to gather the insects which, rendered sluggish by the night's cold, were an easy prey

(Above) THE CHIEF'S hut, in the center of the village

CHIWALI III, after meeting his guests, sang an eulogistic welcome to them to the accompaniment of his curious marimba

DANCERS OF THE "ROYAL FAMILY." Two of Chiwali's sisters are shown, Wangwa *(second from left)* and Munsele *(at right)*. The leopard dancer is in the center. The dance, performed especially in honor of the white visitors represented the greeting of a successful leopard hunter returning home with his prey

(Right) AN ELEVEN-YEAR-OLD GIRL whose head-dress signifies that she is ready to begin her life as a woman

AS CHIWALI GUESTS, the crowning feature was the opportunity to witness the ceremony in honor of the dead chiefs. This centered about the Spirit House shown below, where ancestral relics were displayed on a mat and venerated with primitive religious fervor

The Bridge-that-Walks

The Story of Nature's Most Successful Design[1]

By William K. Gregory

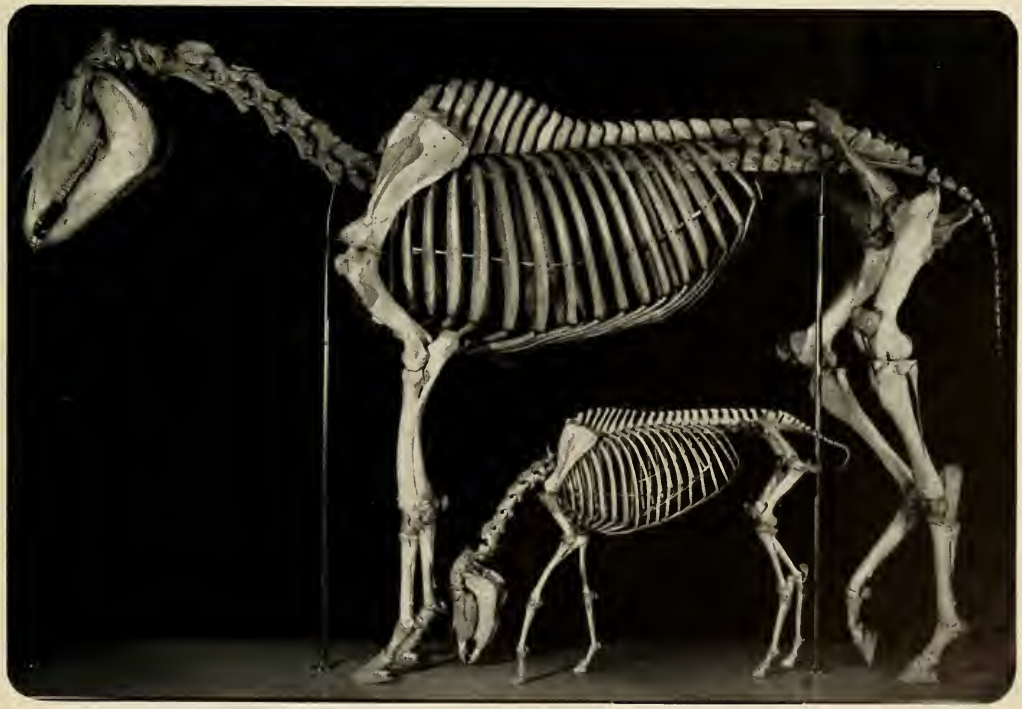
Curator of Comparative Anatomy and Ichthyology, American Museum of Natural History; Professor of Vertebrate Palaeontology, Columbia University

That the most common and familiar object may yield beautiful and inspiring thoughts to the poet must be sufficiently obvious to anyone who will read attentively the works of any of the guild of Burns, Wordsworth, Tennyson and Shelley. But that is only because the poets long ago discovered the trick of suggesting the general from the particular. To the ordinary farmhand a cow may be only a cow, or even worse, but to D'Arcy Wentworth Thompson, who is a poet in spite of being a scientist, the frame beneath the soft colors of a leisurely grazing Scotch cow suggested the essential principles of the Forth Bridge. The far-reaching truth of this comparison is what I hope to demonstrate in the following pages.

The skeleton of a giant draught horse, mounted by my colleague, Mr. S. H. Chubb, may likewise be compared to a bridge. The legs are the towers of the bridge, the backbone is the arched cantilever system that is supported by the towers. The thorax and abdomen constitute the "live load" suspended from the arch. The bridge is continued in front into a drawbridge, or jointed crane, commonly called the neck, which in turn supports a strange contraption that embodies the principle of the forceps and the steam-shovel. This grasping or grappling apparatus forms part of the head. The latter is a house-like structure containing a set of delicate mechanisms that serve to adjust the various parts to each other and to the outside world, and to control the motors; for this grappling-bridge is by no mean stationary but moves around like a modern ditch digger, only far more quickly.

The lower figure is the skeleton of a shetland pony, mounted in the grazing position. Here the drawbridge is lowered and the grappling apparatus is seen as if at work.

[1] Based on a lecture delivered before the Chicago meeting of the National Academy of Sciences, November 16, 1936.



Mounted by S. H. Chubb

In the skeleton of a running horse (at right) we see the pillars of the bridge transformed into powerful, four-jointed springs, which propel the entire apparatus forward. This design as a whole may therefore be called the self-moving grappling-bridge.

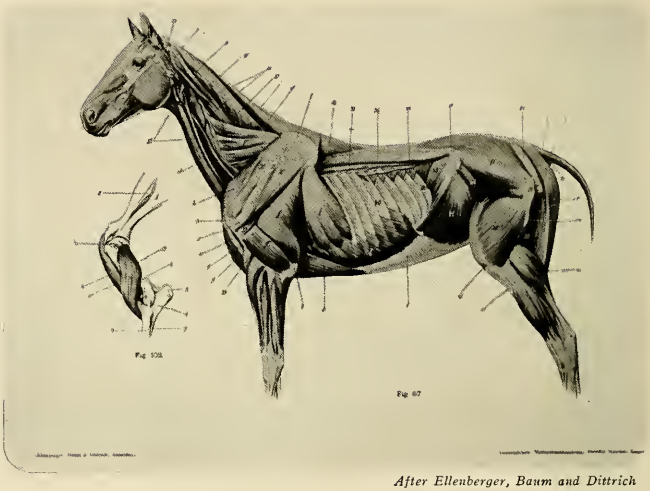
The skeleton, of course, is only the passive part of the entire machine. The active parts are the muscles. The individual bones serve either as levers, which are pulled by the muscles, or as fulcra, bases, supports, pillars, buffers, and so forth. The front pier, represented by the forelimbs, ends above in what we may call the pectoral cradle, between which the whole fore part of the body is slung. The rear pier, represented by the hind legs, is movably connected on each side at the top with a stiff framework called the pelvis. The latter in turn forms the base for the main arch, or backbone.

The "bridge" in action: skeleton of running horse

Mounted by S. H. Chubb

The motors of the "bridge"

The locomotor muscles of the horse well illustrate a principle of organic design that has been stressed by Sir Arthur Keith, namely, that the motors are built into or on to the walls of the machine. In organic designs the wheel, which makes possible complete and continuous rotation around an axle, is absent. The principle usually adopted may be visualized if we imagine two boys of equal strength clinging to opposite sides of an open gate. One boy pulls a rope attached to the outer side of the gate-post, which tends to open the gate, the other boy pulls his rope attached to the inner side of the gate-post, which tends to close the gate. If the two boys pull against each other, a state of equilibrium may result; but if one relaxes gradually as the other increases, and if then they alternate, the gate will swing open and shut. This simple device is almost universally used around the very numerous joints of the self-moving bridge.



After Ellenberger, Baum and Dittrich

●

What has been the origin and history of this remarkable mechanism?

Unfortunately we must begin at the beginning, or as near to the beginning as the astronomers have taken us, and so we have to think of our bridge in terms of the universe or cosmos as a whole. The self-moving grappling-bridge, like all other terrestrial and celestial mechanisms, is evidently in the last analysis a manifestation of cosmic energy, however diversified that energy may be, and it is further a machine for utilizing and transforming minute fractions of that energy. So far as we know it has been developed only in that infinitesimally minute speck of the universe called the earth. And like the earth itself it is especially dependent upon the energy of the sun. The sun is at least the visible centerpiece of the mechanism of its own system and the self-moving bridge is only one of multitudes of natural machines which have come into existence under the primary conditions of this terrestrial ball. One of these primary conditions is the revolving or alternating character of solar influences, which has produced day and night, heat and cold, rain and drought, and so forth. These, together with the force of gravity, have built up the outer shell of the earth in layers and carved it into its present shape.

Cosmic energy visualized. Spiral nebula in The Hunting Dogs

Courtesy of Mt. Wilson Observatory

The record of deposition due to solar energy

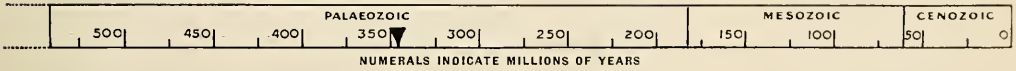
United States Geological Survey

Now in order to view the self-moving bridge in its proper historical perspective we must realize first that geologists classify the rocks that compose the outer shell of the earth into five great systems representing successive eras in the history of life. In the Grand Canyon of the Colorado River (at left) we have an almost diagrammatic record of several of these eras. At the bottom of the gorge we find the crystalline Archaean rocks, which were deposited during the Archeozoic era. Here life, if it existed at all, left no known fossil remains. In the second, or Proterozoic era, represented by a great system of somewhat up-tilted rocks that rest upon the older system beneath them, fossil remains are scarce or wanting and are limited to such low forms as algae and primitive worms and jointed animals. In the third, or Palaeozoic era, seen in the greater part of the side walls of the Canyon, many relatively complicated forms of animals appear: trilobites, brachiopods, molluscs, corals, and so forth. The lowest of the vertebrates, or backboned animals, are not known until the Ordovician, or second period of the Palaeozoic era. The fourth era is the Mesozoic, during which the great and highly diversified class of reptiles flourished and birds and mammals had their beginnings. The fifth era is the Cenozoic, including the so-called Age of Mammals and the Age of Man. Each era is divided into periods and these in turn into epochs and smaller divisions.

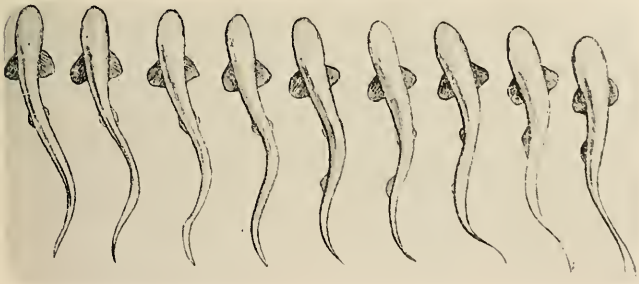
(Below) Earliest known form of the "bridge": Ostracoderm pre-fish

(After Lonkester)

The first recognizable forerunners of the self-moving grappling-bridge are the ostracoderm fishes, or pre-fishes of the early to middle periods of the Palaeozoic era. A glance at one of the ostracoderms (at left) shows the division of the body into a head-shield, containing the grappling apparatus, and a fish-like body, including the locomotor system. The latter is indicated by rows of muscle flakes evidently not dissimilar to those of modern fish. From this simple ground-plan the most elaborate muscular systems of the higher types have been built up, through stages which have been traced in comparative studies of the muscle systems of various ancient and modern fishes, amphibians, reptiles, birds and mammals.



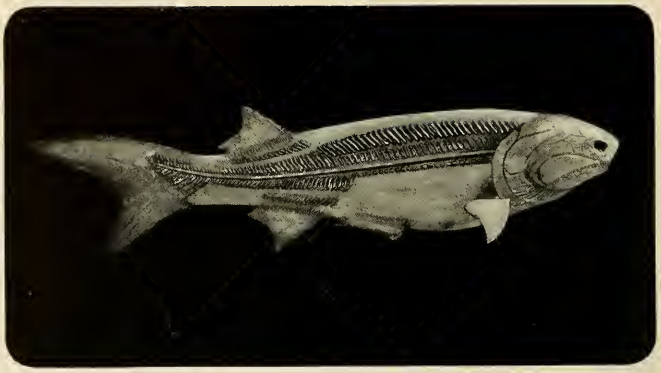
(Below) The "bridge" in motion (After Dean)

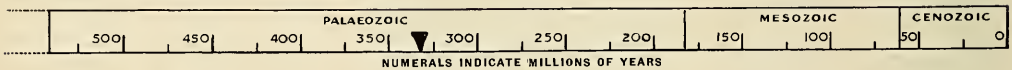


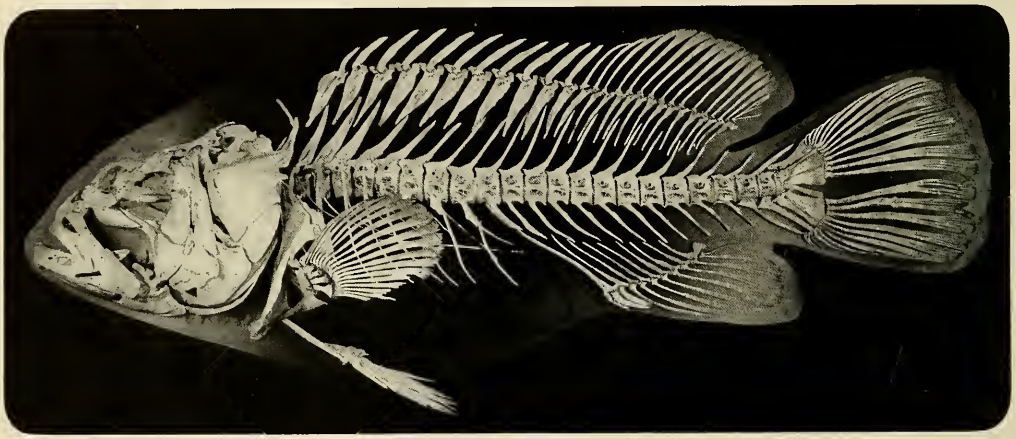
The fish with which we are familiar progress through the water by the rhythmic movement illustrated in the accompanying figure. The muscle flakes of opposite sides do not contract simultaneously but alternately, owing to the crossing-over of certain nerve fibers. The result is that the head is turned first, we will say, slightly to the right, and this starts a wave of contraction which travels down the right half of the body. But immediately after this wave has started, another wave starts just behind the head on the left side and likewise travels along the body toward the tail. These waves propel the fish forward.

The beginnings of the tubular arch

The earliest part of the framework of the future grappling-bridge was a sort of temporary central axis, lying immediately above the digestive tube and below the central nerve cord. The model (at right) of an early fish, *Cheirolepis,* shows the position of this axis. It was a continuous and undivided elastic rod apparently filled mostly with liquid under pressure. This temporary axis, which is called the notochord, was once the chief representative of the backbone, or vertebral column. It is well represented even to the present day in the embryonic stages of all vertebrates, from fish to man, but in past ages its functions were gradually taken over by the bony rings or checker-like pieces which were at first secreted in the connective tissue covering of the notochord.







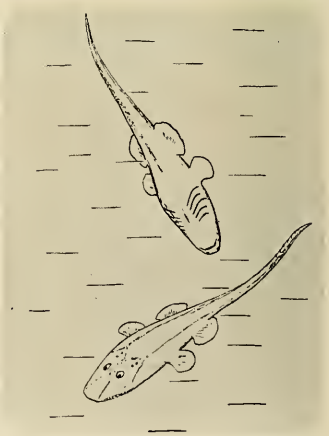
By the time of the higher fishes the jointed backbone included well formed rings, or centra, and bony arches that served to protect the nerve-cord from being squeezed by the muscles, as illustrated by the skeleton of a giant grouper, above.

By this time the grappling apparatus was highly developed, consisting of both upper and lower jaws and of a sort of reversed bellows in the throat which helps to suck in the prey and swallow it. The evolution of this grappling apparatus forms a fascinating chapter in natural history but must be passed by here as we have elected to follow only the story of the locomotor machinery. The jaws and gill supports were attached to a wedge-shaped structure called the cranium, which is pushed through the water by the motor system.

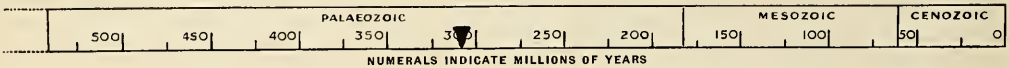
The fins were originally projections and folds from the body wall, serving at first as keels and later as sweeps. The "pectoral cradle," or shoulder-girdle, consists of a complex of bony pieces forming a U when seen from the front and a crescent as seen from the side. This cradle served both as a firm rear wall for the gill chamber and as a base for the muscles of the body. It was fastened above to the back part of the skull and supported the pectoral fins.

What was the use of all this locomotor machinery? It served, of course, to carry the animal toward the life-giving food containing the vitalizing locked-up solar energy. That is the great prize for which all terrestrial creatures have labored and fought through the ages. Unfortunately the only rule has been, "Seize what you can and when you can." The vertebrates have been, on the whole, one of the most successful classes of robbers of solar energy, excelled perhaps only by the insects.

The first forerunners of the paired limbs, which were destined to form the pillars or towers of the self-moving grappling-bridge, were the paired fins, which in the fossil fish called *Macropetalichthys* (at right) projected from the body just behind the head and at the base of the tail.



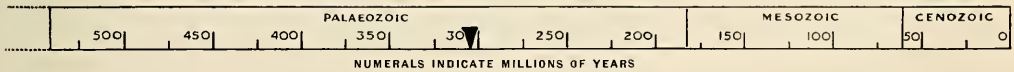
After Broili

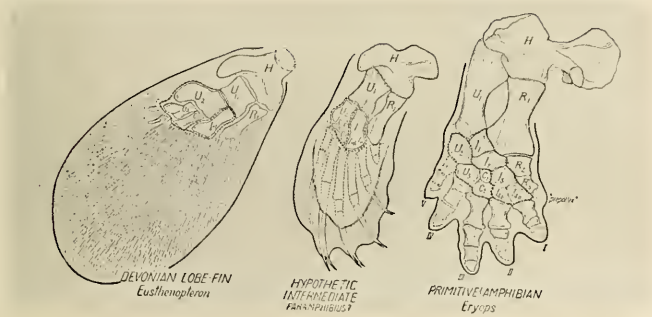


In what manner were these paired finfolds transformed into limbs? The story is long, complex and not clear in detail, but certain it is that by the time of the lobe-finned or crossopterygian fishes in the Devonian period (represented by *Eusthenopteron*, below) the paired fins had changed into paddles with a freely movable fleshy and bony base. This basal portion was lobate in form and contained, among others, a single piece corresponding to the upper arm bone of four-footed animals. The head of this bone could be freely moved at a ball-and-socket joint that corresponds to our shoulder joint. The single upper arm bone was connected at its lower end with a system of radiating bones that give a suggestion of the bones of the forearm, wrist and fingers. If the fish found itself exposed on the mud, the paddle could presumably be turned down, enabling it to serve as a primitive sort of limb.

These lobe-finned fishes approach the oldest known amphibians in skull pattern and there is indirect evidence that they probably could on occasion gulp air to assist their gills in the aeration of the blood in foul water, after the fashion of their contemporaries, the lung-fishes. Furthermore the actual forerunners of the Amphibia recently found in the Upper Devonian of Greenland tend strongly to connect the stem forms of the amphibians with the basal stock of the lobe-finned fishes.

The "lobe-fins" try their paddles on land — *F. L. Jaques*



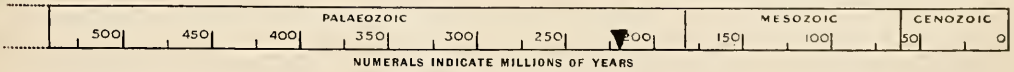


Paddle into foot

As shown at left, the transformation of the paddles of the lobe-finned fish into the five-rayed hands and feet of the earliest amphibians must have involved the bending of the bones at the elbows and knees, the shifting and subdivision of the future wrist and ankle bones, the multiplication and subdivision of the fan-like rods corresponding to the fingers and toes and their reduction in number from eight to five.

With the rise of the amphibians near the close of the Devonian period the primitive tetrapod or four-footed type began to branch out extensively into many body forms. In certain lines the limbs, although always sprawling at the side, became large and strong, giving rise eventually to a leaping or hop-toad type. The fossil skeleton of *Cacops* (at left) from the Permian of Texas illustrates the fact that in the early four-footed creatures there was very little free neck, partly because the pectoral cradle had only recently lost its connection with the skull. The pectoral cradle was especially strong in the early tetrapods. It was really one of the earliest parts of the self-moving grappling-bridge to be emphasized. The pelvis, however, was attached only by ligament to the enlarged ribs in the sacral region. Consequently the close connection of the backbone with the pelvic limbs, which is so characteristic of later vertebrates, had not yet been effected, at least among the earlier amphibians. The grappling apparatus of *Cacops* leaves no doubt of the evil intentions of this extinct robber.

A frog-like bridge with sprawling supports — *Univ. of Chicago*



The skeletal pattern of frogs and toads could have been derived from one of the general *Cacops* type by a marked shortening of the backbone, with reduction in number of the vertebral segments, lengthening of the hip bones and lengthening of the ankle bones. The long ankle bones form an extra unit in the bent spring of the hind limbs, so that the body is propelled by the catapult-like action of the legs. In more general terms, the frog-toad type has been derived from its more primitive predecessor by reduction in number of certain elements and by differential emphasis of others.

Another line of early amphibians, instead of reducing the number of vertebrae and enlarging the limbs, took the opposite path, gradually increasing the number of vertebrae and reducing the limbs. It will readily be seen that a continuation of this process would end in a many-jointed flexible type like a pontoon bridge. In this way many eel-like or serpent-like forms were produced independently in different families of amphibians and reptiles.

An experiment in ballistics: modern horned frog skeleton with leaping limbs

Living "bridges" go in for "mass production"

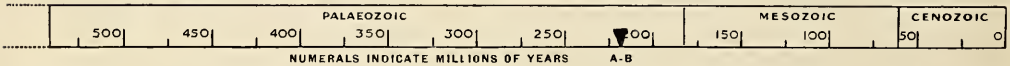
The ancestors of the higher four-footed animals, avoiding either the hop-toad or the serpent-like extreme, arose from the central or newt-like amphibians. The most conspicuous difference between the amphibians and the reptiles was probably that the reptiles early began to lay their eggs on land rather than in the water and to retain the watery environment of the young animal within a more or less tough shell. In this way the free-swimming, fish-like or tadpole stage could be eliminated and the earlier fish-like stages of development were passed through inside the protective walls of the egg.

Seymouria, from the Permian of Texas — *F. L. Jaques*

A primitive type of self-moving bridge: Diadectes. Horizontal wriggling joined with alternate pulling and pushing by the future piers

In the earliest reptiles, best known in the Permian of Texas, the skeleton as a whole is still constructed on a relatively primitive pattern, as illustrated at left. One of the primitive features is the retention of five rays or digits on each of the four extremities. The limbs are held in a sprawling position and crawling rather than true running was the prevailing mode of locomotion. By the differential emphasis of certain parts of the pattern and by the reduction of others the primitive reptilian skeleton gave rise to successive adaptive radiations, first of the true reptiles and then of the birds and the mammals.

Among these swarming reptilian forms some tended to lift the primitive bridge aloft on towers, while others tended to shorten and finally eliminate the towers and to progress by wriggling the jointed axis. Among the former were the various ancestors of the dinosaurs, birds and mammals; among the latter were the ancestors of the limbless lizards and the snakes.



The land bridges invade the sea. Giant sea-lizard from the Cretaceous of Kansas

Charles R. Knight

Many forms tried to compromise or combine different features of the two main extremes, for example, numerous independently derived groups of water-living reptiles, such as the ancestors of the ichthyosaurs, or fish-lizards, and the ancestors of the mosasaurs, or ancient "sea-serpents." All these went in for "reeling, writhing and wriggling," changing their five-rayed hands and feet into paddles, which, however, bore only a superficial resemblance to the paddles of fishes. The creature illustrated at right is a giant sea lizard or mosasaur. The turtles, placodonts and some dinosaurs, partly by depositing bony plates in the deep layers of the skin and partly by developing the horny outer layers, finally managed to enclose most of the grappling-bridge in armor, which finally became a rigid box.

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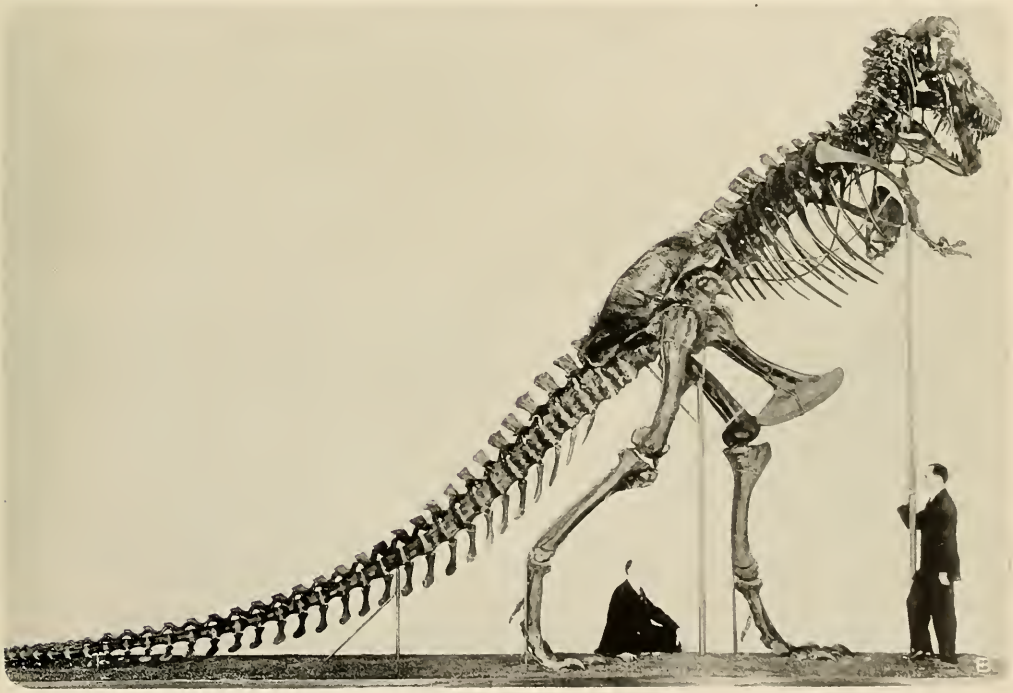
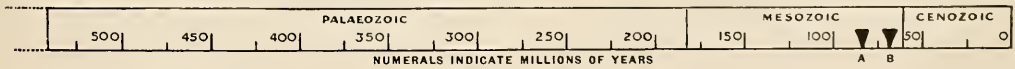
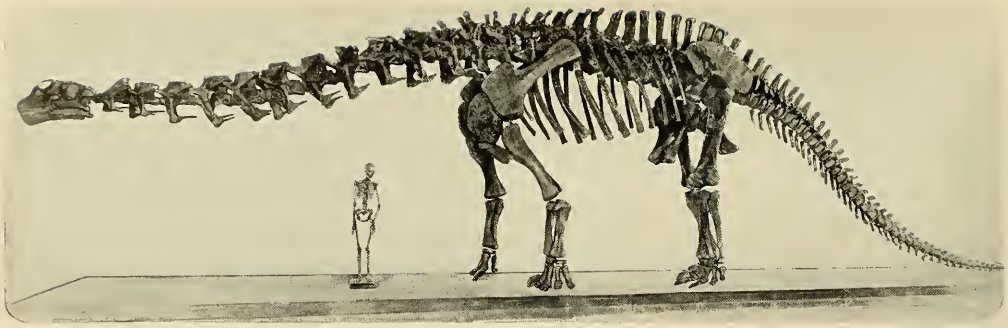
Of the primitive lizard-like reptiles that remained on land, some became swift runners, especially those that reared up on their hind legs, as do certain recent lizards in rapid flight. Such a line developed at first into the light-running, two-legged dinosaurs of the Triassic period and eventually, at the close of the Cretaceous, it culminated in the gigantic *Tyrannosaurus,* shown below. Here the principle of the walking beam or balance is clearly utilized, the pivot being at the hip joint. The pelvic fulcrum is especially enlarged and strengthened to serve as a base for the huge thigh muscles; it also forms with several of the vertebrae a stiffened center of suspension for the vertebral column. The front legs are extremely reduced. The grappling apparatus attained ferocious size and power, serving both to kill and to drag the huge prey, which included the great horned dinosaurs of the period.



A walking-beam bridge: Tyrannosaurus, the last of the dinosaurs





(Above) The climax of bridge construction: Brontosaurus

Along a related line certain primitive light-limbed dinosaurs of Triassic time evolved during the Jurassic period into the gigantic sauropods, including *Brontosaurus* (shown above). Here the principles of the self-moving grappling-bridge are manifested in extreme form. The grappling apparatus has the form of a clam-dredge and may indeed have served to pluck up the mussels which were at that time abundant in certain localities. Each of the vertebrae is a marvelous product of Nature's school of engineering science, being braced with various thin buttresses and piers, fastened with immense cables and yet being able to turn and move in certain directions upon the vertebrae in front of and behind it.

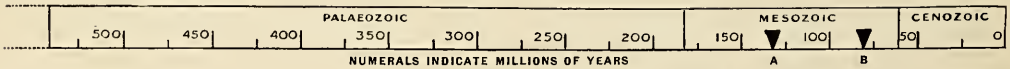
(Right) Nature's scrap heap

The ruins of a whole herd of giant dinosaurs are shown in the diagram at right, as they were found by Dr. Barnum Brown. Their graveyard in Wyoming is the site of an old marsh, where these great monsters seem to have trampled each other to death in a desperate fight for the last drops of water. The upturned edges of the strata near by tell us that the "last round-up of the dinosaurs" took place at a time when the gradual upthrust of the Rocky Mountains was changing the land from a swampy to a semi-arid condition, with the consequent contraction of the environment for the sauropods. By such ruthless methods Nature is constantly scrapping her old models and clearing the markets for her latest designs.

But the possibilities for profitable modifications of the basic design were by no means exhausted. Some of the slender light-limbed reptiles enlarged their hands and took to climbing into the trees, presumably to escape their more ferocious and robust relatives. From this stage it is a relatively short step to the earliest flying reptiles, whose sail-like wings were made from the skin stretched between the enlarged fourth finger and the thigh. This line culminated in the wide-winged pteranodons of the Cretaceous period in Kansas, shown at right.

Barnum Brown

The self-moving bridge tries flying

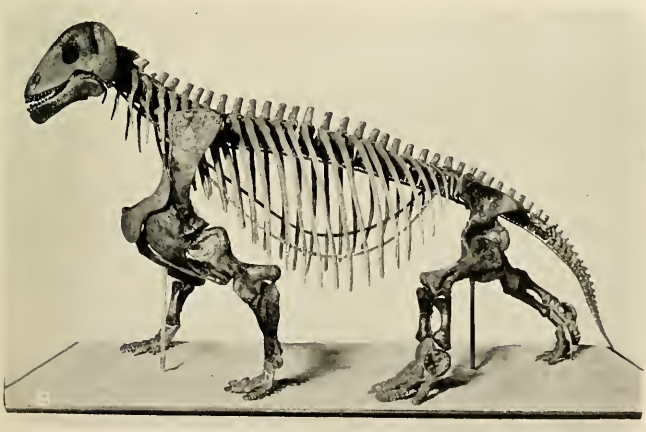


The birds bring out a walking-beam bridge: the giant bird Diatryma

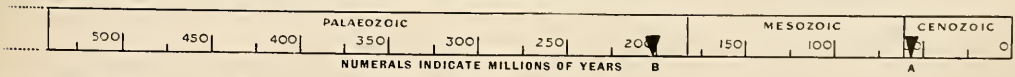
A different lot of light-limbed reptiles with enormously long slender bands, greatly enlarged and subdivided the scales covering the flying membrane and eventually made a true wing by fastening a row of the largest feathers along the back of the forearm and hand. This, the bird-type, also achieved a great advance because it early became warm-blooded. Thus its engines were not only able to maintain a high body temperature but could develop high speed and power with great economy of fuel.

Thus the birds early in the Mesozoic era began to branch forth along various lines, many of which still flourish. Again and again rival stock companies, so to speak, brought out high-speed buzzing types, slow-flapping soarers, expert divers with webbed hind feet and stilted runners, the latter culminating not only in the ostriches, moas, and so forth, but also in the wholly extinct *Diatryma* (at left), of the Eocene epoch, which paralleled the *Tyrannosaurus* in its bipedality, involving the great development of the hind legs and the reduction of the fore legs.

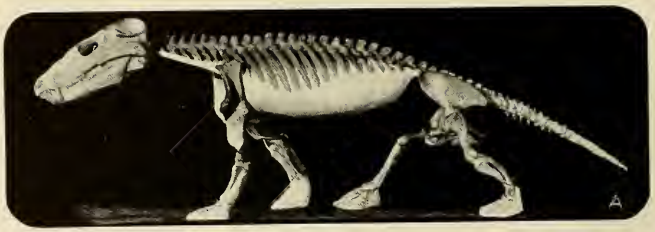
For the origin of the line leading to the mammals we have to go back to such primitive theromorphs from the lower Permian of Texas as *Varanosaurus*. This animal was lizard-like, as its name implies, and it sprawled on its large wide feet, keeping the elbows and knees sharply bent. But in the skeleton of almost any of the true mammal-like reptiles of the Middle Permian of South Africa, such as *Moschops* (below), we witness an attempt to achieve true four-footed running. Here the backward-facing shoulder-joint indicates that the elbows could be drawn in close to the sides of the body, while the well developed contact between the sacral ribs and the pelvis permitted the elevation of the forepart of the body. Thus, while primitive fishes progressed by side-to-side undulations of the body, pivoting on the head, true running became possible only when the body could oscillate chiefly in the vertical plane, with the box-like pelvis pivoting on the hind limbs.



A pioneer in heavy freight moving. Skeleton of Moschops



These features are further emphasized in the cynodonts (right) of the Triassic period of South Africa, which in many skeletal features were approaching the mammalian grade of organization.



The bridge learning to run. Model of a South African cynodont

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The mammals arose before the close of the Triassic period. Specimens from the succeeding Jurassic and Cretaceous periods are limited chiefly to small jaws and teeth, but light has been shed on this critical period by the masterly investigations of Dr. George Gaylord Simpson, to whom the limb bones have yielded evidence that the skeleton was evolving beyond the grade of the mammal-like reptiles toward that of the lowest mammals.

During the later Cretaceous period the direct ancestors of the modern mammals have been found in the same beds with the latest dinosaurs, both in Western North America and Mongolia.

One of the contemporaries of the latest dinosaurs of North America was a direct ancestor of the modern opossum (right). This animal was selected by Huxley, Dollo, Bensley and others as the living prototype of all the highly diversified marsupials or pouched animals of Australia and South America. Space does not permit us to digress upon the amazing adaptive radiation of the marsupials into runners, leapers, climbers, skimmers, diggers, and so forth, into mouse-like forms on the one hand and the almost elephantine *Diprotodon* on the other. But every one of these varied modifications of the self-moving grappling-bridge seems to have been derived from a skeletal pattern of the type preserved in the opossum. This little animal is perhaps our most precious living fossil, although considered by some Americans as only a poor substitute for turkey.

We must turn, therefore, to that other great division of the higher mammals, called the placentals, because in them the placenta, or afterbirth, reaches its highest efficiency in conveying nourishment from the mother to her unborn young. The placentals include all the more familiar animals, such as dogs, cats, bears, deer, sheep, cows, horses, elephants, rodents, monkeys, apes, man, and even porpoises and whales. The basal placental stock first developed from insect-eating or Mesozoic mammals before the close of the reign of dinosaurs. The oldest known placentals were the very small fossil skulls found in the Gobi desert by the American Museum expedition under Dr. Roy Chapman Andrews, in the same beds that yielded the famous dinosaur eggs. Placentals did not however appear in great numbers until the beginning of the Cenozoic era, about fifty-five or sixty million years ago.

By that time many diversified families of placental mammals were already in existence, as we know from extensive collections from New Mexico, Wyoming and Montana. The least advanced of these Paleocene placental mammals were the creodonts, or archaic flesh-eaters, and from the base of this stock there had already branched off a considerable number of families of early browsing hoofed animals, whose remains are relatively abundant.

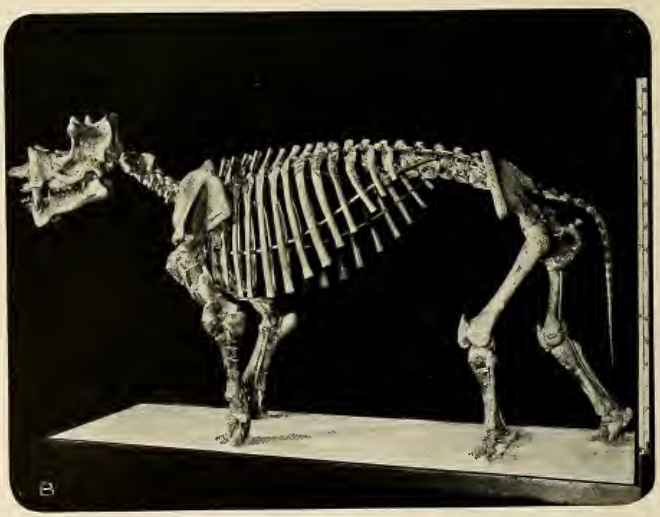
Grandfather Possum, "living fossil" from the age of dinosaurs
(By Jaques)

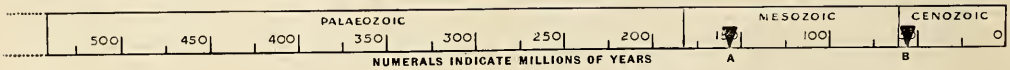
These "archaic hoofed mammals", although not ancestral to our modern forms, are of interest because they illustrate two of the many divergent directions in which the grappling-bridge of the primitive carnivore type became modified.

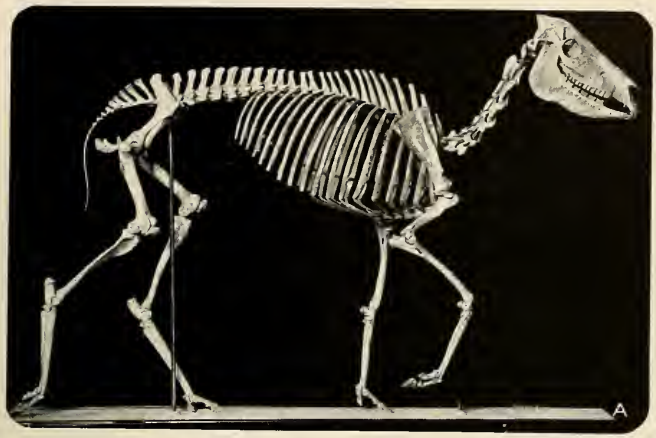
•

A four-poster with ramming propensities

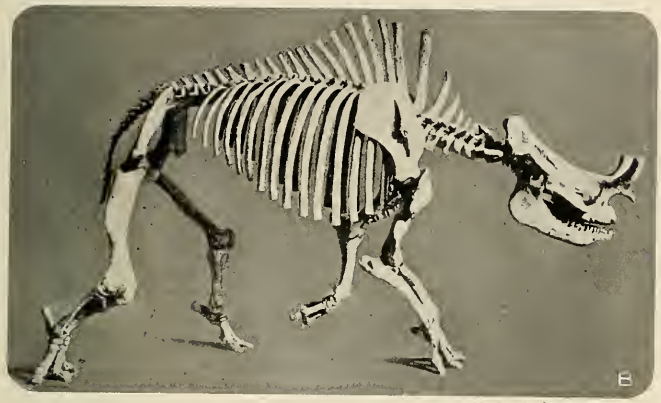
First, in many of the early herbivorous mammals the body became increasingly heavy and at the same time clumsy and slow moving. By Middle and Upper Eocene times some of these "graviportal", or heavy-bodied forms, such as *Uintatherium* (at right) and its allies, had acquired a gigantic body and the limbs had become almost post-like, with long upper bones and excessively short feet. In these "four-poster" forms the self-moving bridge had evidently become adapted, on the one hand, to standing still and, on the other, for striding forward like a charging elephant. Meanwhile the head had become armed with massive horn-like outgrowths and the upper jaws provided with saber-like canines. Evidently this extremely small-brained beast could either stand still and fight or charge with long strides, delivering ram-like thrusts originating in his strong-levered limbs.





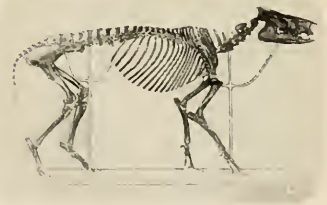


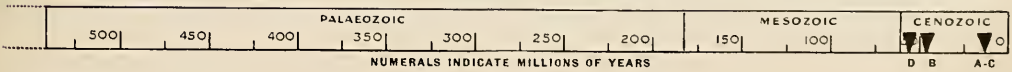
The opposite trend of specialization was entered by the leaping and running herbivorous animals, such as the forerunners of the horses and ruminants, which began to become abundant in the Lower Eocene. Especially in the family of the horses there was a steady emphasis of the adaptations for swift escape. Here the upper limb bones became short, the feet greatly elongated and compressed below the wrist and ankle, so that a powerful leaping effect is produced. At the same time the side toes were reduced, finally to mere splints. Some of the later fossil horses, such as *Neohipparion* (at left), even surpassed the existing race horse in the relative length of their feet, but that was because they were much smaller than race horses and could afford to have relatively longer "throwing sticks" in proportion to their weight. The cantilever construction of the backbone is well indicated, although the picture would be complete only if the tension members, consisting of the muscles and ligaments between the vertebrae were also shown.



U. S. National Museum

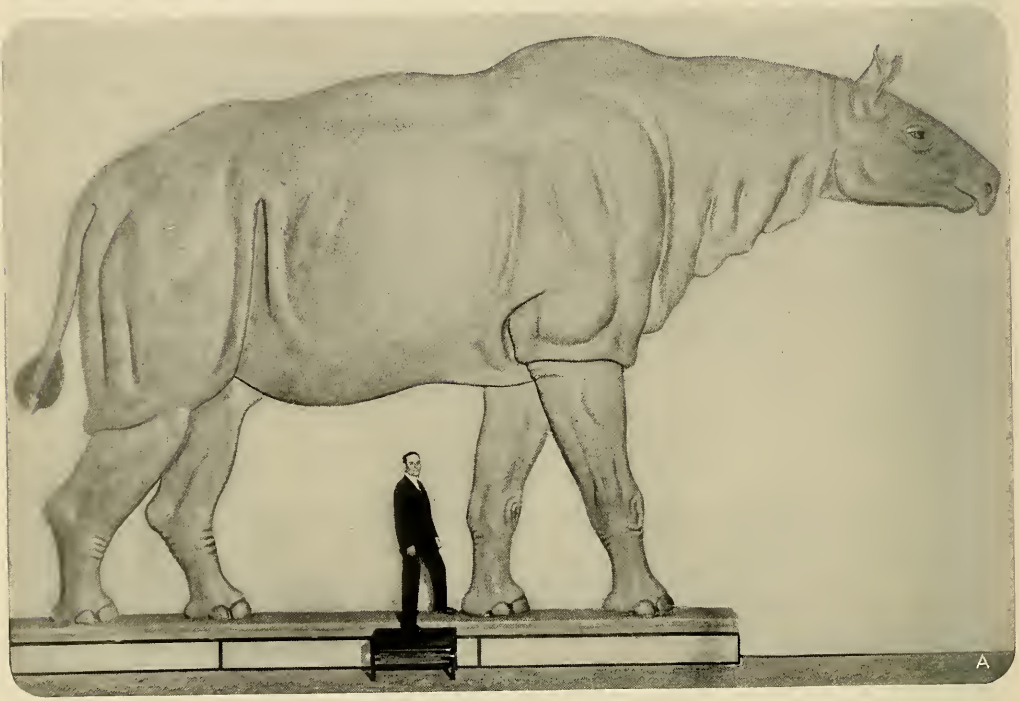
But by no means all herbivorous families followed to the bitter end the straight and narrow path which they had first entered. Some, starting in the direction of the fast-running and leaping types, gave up the effort to remain swift and slender and were content, so long as they could be big eaters, to become massive and slow. For example, in the Lower Oligocene the dominant herbivorous mammals were the titanotheres, which were remotely related to both the horse and the rhinoceros. Starting in the Lower Eocene as small light-running forms with narrow feet, about as big as sheep, many lines of titanotheres grew larger (like the *Brontotherium,* at left) until at the close of the Oligocene they outranked the modern rhinoceroses in size. Meanwhile the feet became short and wide, and horn-like outgrowths appeared on the skull above the eyes. The Middle Eocene forerunners of the rhinoceros family (represented below) were likewise small and swift-running forms. By the Miocene epoch the rhinoceroses had become numerous in North America; they also were greatly diversified, some very small forms becoming swift-limbed, others turning into the opposite path of specialization and ending in the Pliocene *Teleoceras* (left), with excessively short limbs and huge hippopotamus-like body. This latter animal could be compared to a long but sturdily constructed bridge with very low piers, capable of sustaining a tremendous load.





In Mongolia the expeditions under Dr. Roy Chapman Andrews found the members of the rhinoceros family in process of giving rise to *Baluchitherium,* the most gigantic of all known land mammals. Traces of this beast had been discovered in Baluchistan by Forster Cooper of Cambridge University in 1911, and later by the Russians in Russian Turkestan. The neck vertebrae of *Baluchitherium* are almost as large as those of the sauropod dinosaurs and the largest middle metacarpal bone is about three times as long as that of a large white rhinoceros. Prolonged studies of the numerous parts of the skeleton of *Baluchitherium* were made by Doctor Granger and myself as a basis for drawings and models of the animal (see below). The largest remains indicated an animal over seventeen feet high to the top of the hump of the back, but the average male *Baluchitherium* was probably not over fourteen or fifteen feet high. Here then is one of the most striking demonstrations of the adaptability of the self-moving grappling-bridge to the support of very heavy moving loads.

In the Pliocene epoch of the northern world the dominant heavy-bodied hoofed mammals were members of the order Proboscidea, including the elephants, mammoths, stegodonts and varied mastodonts. This order, as intensively studied by the late Professor Osborn, abounds in parallel lines of ascent running through long ages. Most of them increased in size and in the complexity of the molar teeth, but all retained long-striding limbs with very short feet.

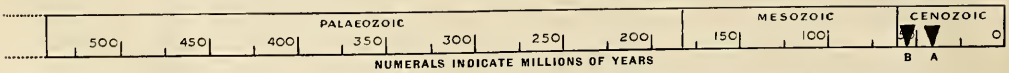


(Above) Baluchitherium, the colossus of Mongolia

(Below) An early South American beast with archaic bridge construction: Thomashuxleya

(After G. G. Simpson)

For millions of years during the early and middle Tertiary period, South America was cut off from North America and the rest of the world, but not before it had become colonized with some primitive placental mammals perhaps related to the condylarths of the Paleocene of North America. The animal colloquially called "Tommy" (*Thomashuxleya*), illustrated at right, as studied by Doctor Simpson, retained a great deal of the archaic appearance of the still more primitive condylarths. Representing the older of the extinct Patagonian hoofed mammals, it may be regarded as a forerunner of the more specialized South American forms of later ages. These "dawn animals" of South America in time populated the country with an extraordinary variety of peculiar looking beasts which played some new variations on the old theme of the self-moving grappling-bridge.

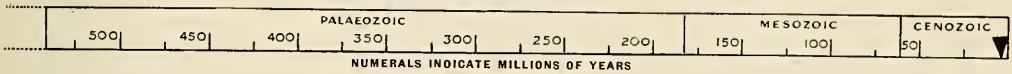


One of the later terminal specializations among the Patagonian forms is *Toxodon* (below), the bones of which were discovered by Charles Darwin on the voyage of the *Beagle*. Here the grappling apparatus is very large and clumsy, the drawbridge short, the cantilever large and the towers short and thick.

The opposite features are seen in the camel-like *Macrauchenia*, which has a small head, long neck and long limbs. The camel-like characteristics, however, are superficial, as *Macrauchenia* belongs to a peculiarly South American order, the Litopterna. Extremely horse-like forms with slender leaping legs were also produced in South America; although their habitus or general appearance is like that of the ancient three-toed horses of North America, a close inspection of their teeth and skeletons reveals many small but decisive traits of resemblance that define their true ordinal position as with the litopterns.

The possibilities of new and profitable modifications of the mammalian type of self-moving grappling bridge were, however, by no means limited to the ground. The kingdom of the trees and the empire of the air were early invaded and conquered through daring innovations in bridge designs made by the ancestors of the monkeys and bats.

A low-pier bridge with high arch and powerful grapples. Skeleton of Toxodon



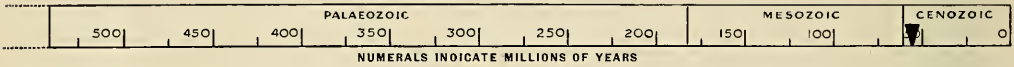
An ominous development: in the opossum the supports of the front pier begin to be used as graspers, supplementing the jaws

Skeleton mounted by S. H. Chubb

Already in the humble opossum (at right) the forelimbs are beginning to be used as hands to grasp the food which is being sheared by the strong jaws. This functional partnership between the forefeet and the mouth never advanced very far in the marsupial group but in the placental order of Primates it led to surprising results.

Little is known of the ancient arboreal forms of South America but in North America the first known representatives of the tree-shrew group date from the Upper Paleocene, while perfected arboreal primates date from the Lower Eocene. The form illustrated in the two pictures below is *Notharctus*. In these the hands and feet were of the grasping type closely similar to those of recent lemurs and monkeys and there can be no reasonable doubt that even at that early date the ancestral primates had learned to preserve their equilibrium and to move about securely in the difficult pathways of the trees. Moreover their skeletal bridges became modified in numerous ways so as to be equally effective whether the animals were right-side-up or upside down.

An invertible bridge with hanging attachments: Notharctus, founder of the primates. F. L. Jaques



The bridge with hooks. Young orang-utan, a specialized side branch of the anthropoid apes

New York Zoological Park

In the monkeys both of the New World and Old World divisions the hands of some acquired a considerable degree of dexterity; in others they became lengthened and the thumb was more or less reduced, so that the hand tends to form chiefly a movable hook for suspension of the body from the branches. Upon this specialization the modern anthropoid apes have all entered to a greater or less degree, especially the very long-handed adult orang-utan (at left).

Now it is a curious fact that Nature's designs often do not "stay put" in any given environment. Having conquered the trees, some of the primates began to come down out of them and to explore the possibilities of readapting the skeletal bridge for progression on the ground. The macaques and baboons show us one way in which this was done, namely, by reviving the ordinary method of quadrupedal running.

When running upon the ground the gibbon, however, adopts the bipedal gait, while the gorilla and still more the chimpanzee can rear up and take a few steps on their hind legs. We see in these "living fossils," which are the little modified survivors from the old Tertiary anthropoids, preliminary and incomplete experiments in turning the self-moving bridge

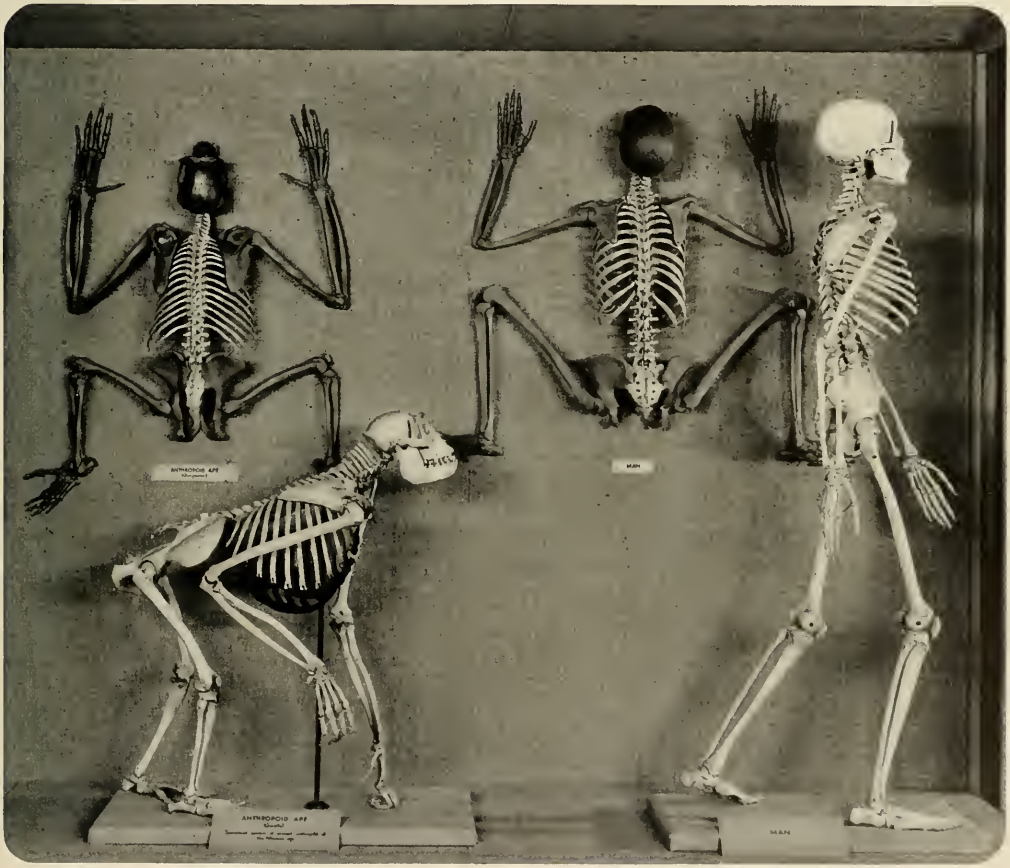
up on its rear tower; but the anthropoids have failed to make the necessary adjustments for balancing the center of the body over the center of support.

This feat was successfully performed by the ancestors of man, partly by developing the "lumbar curve" or forward dip of the small of the back, partly by prolonging the hind part of the blade of the hip bone upward and backward, thus widening the contact between the backbone and pelvis. But the many special adaptations of the human skeleton to the upright posture would deserve a whole course of lectures by itself and it has been ably dealt with, especially by Sir Arthur Keith.

In conclusion, suffice it to say that man, like other vertebrates, derives the energy for all his activities from the solar energy stored up by the plants and that even his more or less impressive face is a modification of the old grappling apparatus of our piratical ancestors.

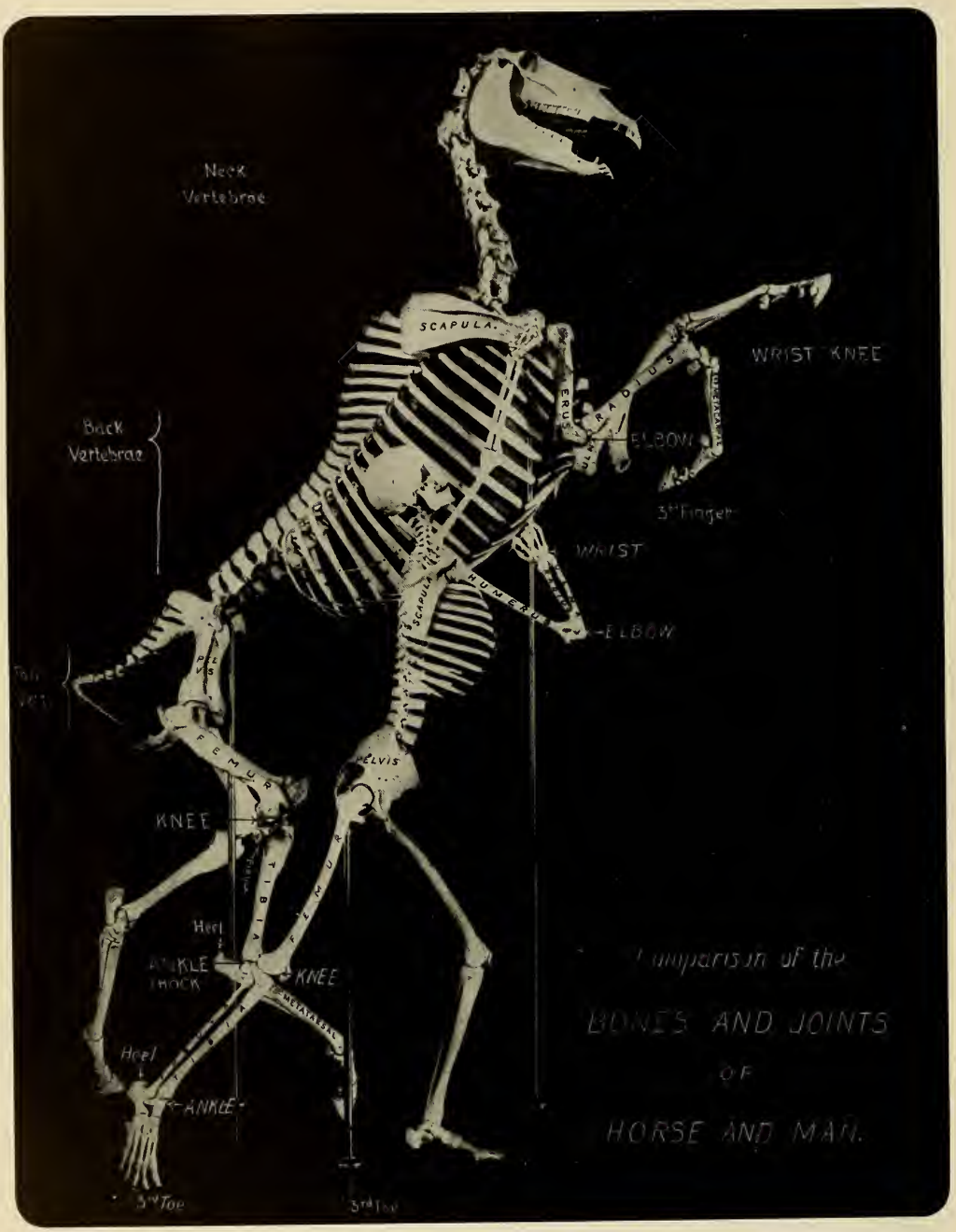
The entire human anatomy bears the plainest traces of derivation from the primitive self-moving bridge type. Man, in brief, is a quadruped turned up on end. This elementary but far-reaching fact, which was well understood by Buffon, Lamarck, Darwin and all later evolutionists, is to this day ignored or suppressed as an unpleasant and uncomplimentary heresy by the vast majority of mankind.

After a century or more of comparative anatomy and palaeontology, by a critical combination of evidence from these and related fields we can even assemble a series of known forms which gradually lead the way from the primitive fish of the Palaeozoic era, up through the air-breathing lobe-finned fishes of the swamps, to the lowly amphibians and reptiles, who carried the self-moving bridge through the early critical stages of adaptation to life on the ground. When we reach the mammal-like reptiles we are almost at the threshold of the mammals. These developed a higher and more stable body temperature and introduced many new improvements in the old design. Eventually some of the more adventurous of the small mammals climbed up in the trees, using their feet as climbing organs. Some of these tree dwellers in turn began to improve the functional cooperation of hand and mouth. The anthropoid apes, coming down out of the trees, began to experiment in turning the bridge up on end and freeing the front supports to be used as true hands. Man, at least so far as his skeleton is concerned, simply carried further the experiments of his earlier anthropoid ancestors. But well might more conservative grabbers dread the coming of the upended bridge with extensible grapples; for with these two convenient hooks the Bridge-that-walked could lay hold of whatever it wanted; nor did it cease until it had ransacked the entire world.



The bridge-that-walks. Skeletons of man and his "poor relations," the gorilla and chimpanzee

In short, a comparison of the skeleton of *Homo sapiens* with those of his nearest surviving relatives shows that he is better equipped for burglary and that his head has become greatly inflated. Perhaps that is why he so often turns his back on his poor relations and refuses to recognize his lowly origin.



Divergent modifications of the self-moving bridge. Skeletons of horse and man.

(Mounted by S. H. Chubb)

But whether or not the self-named *Homo sapiens* will listen to the small voice of comparative anatomy and palaeontology, the facts plainly indicate that the skeletons of both the horse and his tamer, however much they differ in details, are but divergent modifications of the old grappling-bridge type.

CHINESE DESIGN

Basic Symbolic Patterns of Chinese Art

By Herbert P. Whitlock

The contents not of one but many books are back of these designs, handed down as they have been from old China; transmitted from father to son through generations of glyptic artists, and always gaining something of symmetry and of conventional perfectness in the process.

Many of them are wrought in jade, the Jewel of Heaven, honored through the centuries as China's most significant and valued material. The very character which represents it in Chinese writing is derived from, and is almost the same as, that used for a prince.

It is, then, not surprising that much of the philosophy, much of the culture and far more of the symbolism underlying Chinese thought is to be found in the unique and highly decorative carvings which represent the expression of so many generations of these craftsmen.

It is hardly too much to say that all the beauty of Chinese thought as well as all of the wisdom of the years lies here, and that in this relatively neglected field of art, there exists a rich mine of treasure for the decorator and designer in this our Twentieth Century.

The following symbols are given to facilitate identification of the symbolic designs employed in each of the objects illustrated.

THE DRAGON is a mythical animal which is regarded by the Chinese as having a good, rather than an evil influence

CLOUDS. Conventionalized clouds usually surround figures of immortals, dragons, etc.

THE LOTUS, although essentially a Buddhist symbolic flower, is also much esteemed by the Taoists. It is very popular in Chinese design where its symbolism carries auspicious wishes

THE PEACH together with its blossoms is a very important symbol in Chinese design. The peach-tree of gods was said to yield the fruit of eternal life, which ripened once every 3000 years. Hence the Peaches of Immortality

THE SLEEPING SILKWORM: A very ancient motive used as a repeated or "diaper" design

THE COSMIC SYMBOL OF THE DEITY HEAVEN: A perforated disk, used from very ancient times to designate the deity Heaven, one of the six "ritual jades"

THE CONVENTIONALIZED BAT is often used in Chinese design. It is emblematic of happiness and long life

BUTTERFLY. A symbol of immortality which since Ming times has taken a high place in Chinese favor

THE MYSTIC KNOT is a Buddhist symbol derived from India. It is represented as having no beginning and no end, and it is sometimes called the "Knot of Everlasting Happiness"

LONG LIFE. The Chinese character meaning long life has furnished designs which are very popular and widely used

THE GOURD is a Taoist symbol of mystery and necromancy and is the emblem of Li Tieh-kuai, one of the Eight Immortals. The spirals of smoke that ascend from it denote his power of setting his spirit free from his body

THE YIN AND YANG. In Chinese Cosmogony the Yin and Yang are the negative and positive principles of universal life, and are pictorially represented by the symbol which is the diagram of an egg showing the yolk and white strongly differentiated

Yang signifies Heaven, Sun, Light, Male. It is symbolized by the Dragon

Yin stands for Earth, Moon, Darkness, Female. Its symbolic beasts are the Tiger and Hare

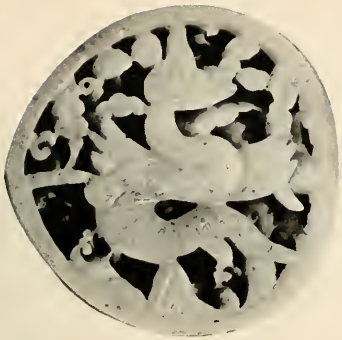
Through their interaction the Yin and Yang produce the Five Forces or the Five Elements

FUNGUS. The fungus of immortality was supposed to grow on the sacred mountain Hua Shan, where it was eaten by gods and immortals

(Left) GIRDLE ORNAMENT carved in two strata from white jade, showing Dragon of the Air motif. Ching (modern) Period (Whitlock Collection)

(Left) WHITE JADE carved in two strata. A Dragon of the Air illustrating the "nine resemblances." Ching (modern) Period (Drummond Collection)

(Below) CHALCEDONY COVERED VASE decorated with Dragons of the Air. Ching (modern) Period (Morgan Collection)



(Above) GIRDLE ORNAMENT carved in two strata from white jade. Dragon of the Water motif. Ching (modern) Period (Whitlock Collection)

(Above) AN ANCIENT (Han Period) disk. Ritual Symbol of Heaven. It is decorated with archaic dragon designs (Drummond Collection)

(Above) DRAGON OF THE WATERS (hydra) showing fish-like characters. Han Period (Drummond Collection)

(Above) WHITE JADE ritual Disk of Heaven decorated with Dragons of the Ming type. Ming Period (Drummond Collection)

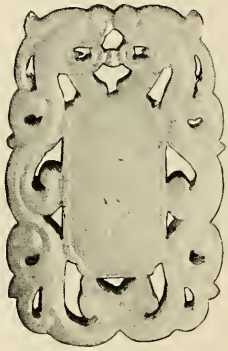
(Below) A CUP DECORATED with Ming style Dragons as stylized in Ching (modern) time. (Drummond Collection)

(Right) DRAGON BUCKLES developed in Ching (modern) Period from designs characteristic of Ming carvings (Morgan Collection)

(Above) An early conventionalized Dragon (Han Period), showing influence of geometric treatment (Drummond Collection)

(Above) An early form of Dragon (Chow Period) showing beginning of tendency to subdivide in curled motives. (Drummond Collection)

(Above) Ancient ritual white jade Disk of Heaven decorated with very early (Han Period) Dragon. Note conventional Cloud pattern on alternate segments (Drummond Collection)



(Above) White jade pendant. Tablet inscribed with word "Purification," supported by highly conventionalized Dragons. Ching (modern) Period (Whitlock Collection)

(Above and below) White jade pendants decorated with highly conventionalized Dragon motives. Notice that the outlines are formed by Cloud designs. Ching (modern) Period (Whitlock Collection)

(Right) Incense burner carved from green aventurine with highly conventionalized design of Dragons amidst Clouds. Ching (modern) Period (Morgan Collection)

(Above) DARK GRAY SOAPSTONE Disk of Heaven, decorated on one side only with very primitive Dragon motif. Han or Chow Period (Drummond Collection)

(Above) A BROWN (tomb) jade Disk, the Ritual Figure of Heaven. It is decorated with an "all over" pattern, called the Sleeping Silk Worm. Sung Period (Drummond Collection)

(Below) ROCK CRYSTAL flat dish in design of Peach Blossom with leaves. Ching (modern) Period (Morgan Collection)

(Above) WHITE JADE PENDANT showing "Peaches of Immortality," presided over by a crane, the messenger of the Gods. Ching (modern) Period (Whitlock Collection)

(Above) BUTTON OF WHITE JADE, a conventionalized Peach Blossom in the center of which is Yang Yin, symbol of Universal Life. (Whitlock Collection)

(Above) LOW BOWL carved from agate with design of Peach Blossoms and leaves. Ching (modern) Period (Morgan Collection)

(Left) WHITE JADE bowl decorated with five conventionalized Bats (the five happinesses). In the center is the Long Life "sho mark" (Drummond Collection)

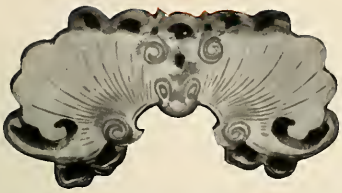
(Right) A FINGERING piece of white jade with brown spots, showing design of Bat (for happiness) and bag of grain (for prosperity). The Bat shows very little attempt at conventionalization. (Whitlock Collection)

(Right) FIGURE OF K'WAN YIN in green aventurine, bearing immortal Peach Blossom. Note conventional lines of drapery (Morgan Collection)

(Left) PRIMITIVE FIGURE of K'wan Yin carved in orange yellow jasper. Ming Period XV century. Note also wooden stand of same period (Morgan Collection)

(Left) FIGURE OF LAN TS'AI-HO, "the immortal street singer" carved in carnelian. This immortal may be recognized by the flower basket that she carries and by her characteristic head-dress (Drummond Collection)

(Right) FIGURE OF K'WAN YIN executed in red amber. A highly conventionalized treatment of this subject. Ching (modern) Period (Drummond Collection)



(Above) WHITE JADE DESIGN showing a highly conventionalized Bat (symbol of happiness). Ching (modern) Period. (Whitlock Collection)

(Right) WHITE JADE PENDANT showing how a design of Bats (happiness) can be used as a symmetrical and balanced pattern. Ching (modern) Period (Whitlock Collection)

(Below) FIGURE OF K'WAN YIN in dark green Yunan Jade holding vase and fly-whisk and surrounded with immortal Peach Blossoms. Ching (modern) Period (Morgan Collection)

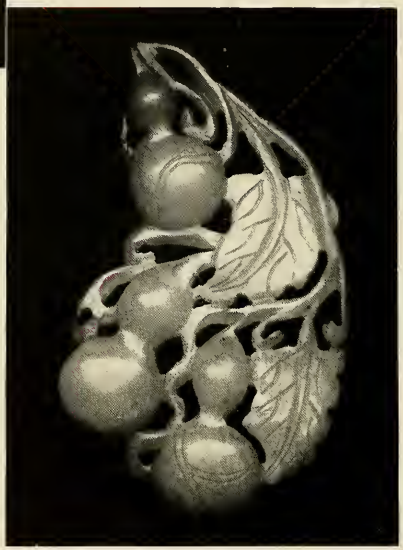
(Below) FIGURE OF K'WAN YIN in Russian malachite. The goddess is shown holding Lotus Pods and accompanied by child, the latter showing Christian influence. Ching (modern) Period (Morgan Collection)

(Below) WHITE "CHICKEN BONE" jade carving, representing the "Earth Mother" riding a Lin. Fungus background. Ming Period (Drummond Collection)

(Below) FIGURE IN SMOKY quartz of Ts'ai Shen, God of Wealth. Note the three little "lucky boys" grouped around him (Morgan Collection)

(Left) WHITE JADE PENDANT representing the Star God of Longevity with his usual accompaniment of stag and Bat, signifying long life and happiness. Ching (modern) Period (Whitlock Collection)

(Above) WHITE JADE GIRDLE pendant carved in designs of Mystic Knot (knot of everlasting happiness) and Bat (happiness). Ching (modern) Period (Whitlock Collection)

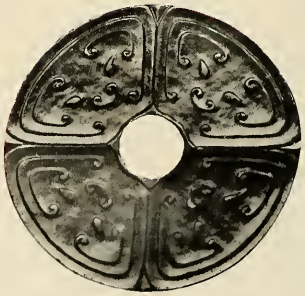


(Right) WHITE JADE PENDANT showing design of gourds symbolizing magical power. Ching (modern) Period (Whitlock Collection.

(Above) WHITE JADE PENDANT carved with design of "Fungus of Immortality." Ching (modern) Period (Whitlock Collection)

(Below) TWO WHITE JADE DISKS in the ritual pattern of the deity Heaven, decorated with Cloud symbols woven into intricate and elaborate designs. Ching (modern) Period (Whitlock Collection)

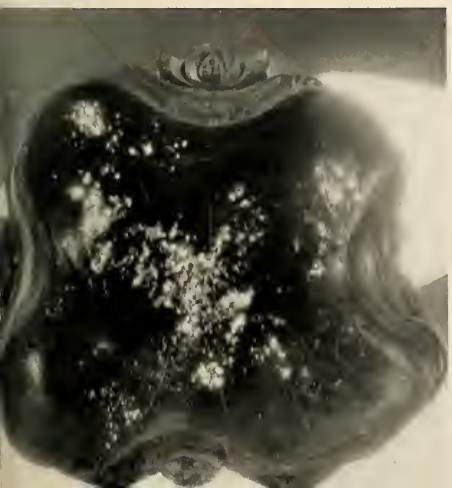
(Lower right) WHITE JADE HAND REST for scholars, decorated on back with Cloud motives. Inscription reads: "Dragons and phenixes are auspicious creatures." Ching (modern) Period (Whitlock Collection)



(Above) WHITE JADE CARVED design of leaves and blossoms of the Lotus. Ching (modern) Period (Whitlock Collection)

(Above) FLAT DISH of Russian malachite, showing conventionalized leaves and Blossom of Lotus. Note characteristic veining of leaves (Morgan Collection)

(Below) DISH CARVED from moss agate showing conventional design of Lotus Leaf buds and pods in very primitive treatment. Tang Period, about VIII century (Morgan Collection)



Two systems of thought, two philosophic ideals, find expression in the many symbolic designs which contribute so much to Chinese art, and of which we have illustrated here some of the more common examples.

On the one hand the older Taoism, steeped in cosmic mysticism has supplied such symbolic entities as the Peaches of Immortality, the Fungus of Immortality, the Star Gods, the Immortals, and the Gourd of Necromancy.

On the other hand, Buddhism, which in the first century of our era brought to China its contribution in the form of a wealth of Hindu-tinged legend, furnished Chinese art with the Lotus, upon which Buddha sits enthroned, the Mystic Knot from the print of the sole of his foot, and the Buddhist Goddess-saint K'wan Yin, with her beautiful legend of sacrifice and renunciation.

All of these symbols, which are expressed in embroidery, ceramics and other arts as well as in jade and kindred carvings, have been subjected to increasing stylization and balance, the culmination being reached during the period of glyptic renaissance which began with the reign of Ch'ien Lung, in the eighteenth century.

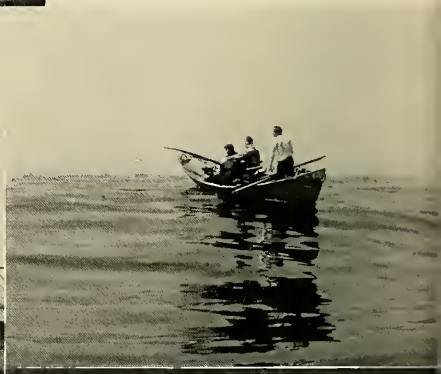
The antique jade and amber illustrations are from the Drummond Collection, and are exhibited in the Drummond Memorial Hall, on the Fourth Floor of the American Museum of Natural History, Southwest Tower. The examples executed in decorative stones other than jade, illustrated, are from the Morgan Gem Collection, exhibited in the Morgan Hall, Fourth Floor. The examples of modern carved jade are mainly taken from a private collection, and are not on public exhibition.

Swordfishing

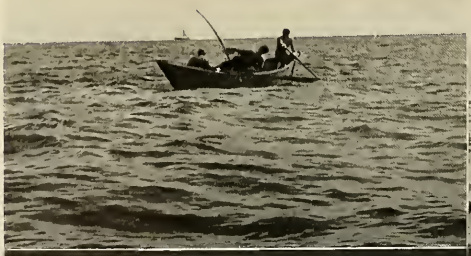
In Nova Scotia with the Lerner-Cape Breton Expedition of the American Museum of Natural History

(Left) Michael Lerner, with his prize, the first swordfish ever caught by rod and reel in Eastern Canadian waters. *(Left to right):* Francesca La Monte, Associate Curator of Ichthyology; J. T. Nichols, Curator of Recent Fishes; L. Ferraglio, staff artist; A. Q. Keasbey, of the Department of Ichthyology; H. C. Raven, Associate Curator of Comparative Anatomy; William Lerner; and Larry Bagby, mate

1 The sea is scanned for fins from the cabin house of the Margaret S. II, Government-loaned vessel, thirty miles off Louisburg

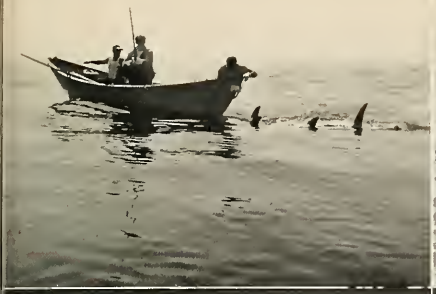


2 A fin is sighted and the dory is put overboard. Mr. Lerner in harness and using heavy tackle puts a hook over



3 A strike and tug of war: Should the line snap, one of the world's champion big-game fishermen would fall over backwards into the sea

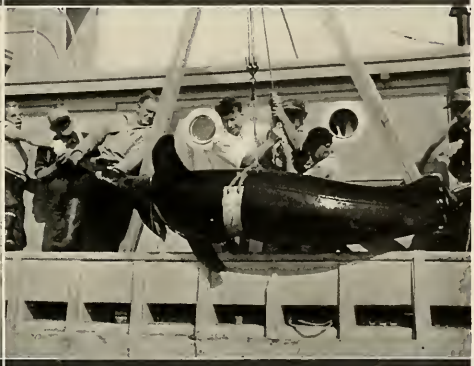
4 The crucial moment approaches. Having tired the swordfish the fisherman attempts to "pump" in his fish preparatory to landing it



5 "How big is he?" The fisherman's familiar question will warrant an impressive answer, to judge from the widely spaced fins

6 The most dangerous moment: Mr. Lerner and Tommy Gifford, famous guide-captain, grab the sword, with which the fish is able to knock a man overboard

7 The fish is made fast to the boat, and Mr. Lerner removes his harness for the run back to the Margaret S. II



8 The laboratory specimen is lifted carefully on board the Margaret S. II. All hands are itching to hoist a white flag to announce their success

A complete laboratory awaits the party back at Louisburg in the sail loft shown in the background of this photograph. So large a fish as the swordfish has to be dissected and studied on the spot. Three specimens were caught, the largest weighing 601 pounds. The skeleton of one specimen is for study and exhibit; and the plaster cast of another is to be exhibited in the American Museum. First opportunity to see the latter will be at the annual Sportsman Show in February. A duplicate cast was given to the Nova Scotian Government by Michael Lerner

TAMING KING COBRAS—*How the world's deadliest snakes respond to patient and humane handling; popular beliefs regarding snake psychology corrected*

By GRACE O. WILEY
Director of Museum,
Minneapolis Public Library

[*The methods of handling poisonous snakes described in this article depart widely from the conventional technique in snake laboratories and zoos. Ordinarily the operator, candidly admitting the danger involved, makes the snake a helpless captive. Those who have observed Miss Wiley's tactics usually contend that she is either uncannily skilful or favored by a guardian spirit. The reader is left to judge for himself. We doubt that even Miss Wiley, whose experience with snakes covers a period of twelve years, would care to accept responsibility for an incautious aspirant to her methods.—The Editors.*]

MY experiences have been so remarkable—unbelievable, in fact—in my association of several years with some of the world's deadliest snakes, that I have thought it worthwhile to narrate them.

Because of the danger entailed, few persons have had the courage to engage in the experiments that are necessary to reach an intimate knowledge of the habits and reactions of poisonous snakes. Early in this fascinating work, the writer learned, or rather came to realize, that one must win the confidence of an animal, before it will act naturally.*

Trustful

Much may be accomplished with snakes without making pets of them, as the writer has done. The padded stick is the greatest asset, along with quiet, deliberate movements. Snakes are very intelligent and "catch on" much sooner than we do, to indications of sympathy—that is, they are not, as a rule, afraid to trust you first. They believe you are friendly, before you are convinced that they have no desire to bite. When you have had sufficient experience, you will quickly note this attitude—always a revelation.

Snakes have various ways of showing their moods, but one must *know* these animals well, to be able to *see* and *read* these signs. That is why one should go very cautiously until one has experience enough to understand. When nervous or excited no one should work with wild, poisonous, or otherwise dangerous creatures. Be calm, quiet, and collected, and keep that way. If anything unexpected happens, "freeze" on the spot, or beat a hasty retreat. Avoid loud talking or undue noises. Keep your mind strictly on what you are doing and eliminate spectators if they are near enough to question you or otherwise attract your attention to disturb you. It is best to work either alone or with one trustworthy person.

A docile pet

"Nosey," my pet Green Mamba *(Dendraspis viridis)*, was an excellent example of gentleness and utter confidence in its human friend. This beautiful seven-foot snake would lie contentedly in my lap as I read or wrote, crawling slowly over to the end table beside the chair, and resting for awhile, then crawling back again to me. It explored around me and upon my head, then came back to rest again. Nothing disturbed her in the least, for she was not afraid of other people. Her cage, for the most part, was a large hat box, with a hinged lid. One day I was sitting beside the open box feeding her. She killed two mice and ate them. When she seized the third mouse, she backed out of the box into my lap, pulling the mouse with her. She remained on my lap after swallowing the rodent, wiping her mouth daintily and carefully on my sleeve! Then with a couple of big yawns she settled down to rest in the most contented manner. I always marveled at the extreme gentleness of this remarkable serpent, whenever I cared for her.

Two huge Gaboon vipers *(Bitis gabonica)* were thin and starved when they arrived. It was absolutely necessary for them to have nourishment at

*"Texas Rattle Snakes in Captivity", Bul. Antiven. Institute of Amer. Vol. III, No. 1. May, 1929.

once. Food was offered but they would not eat voluntarily. The following day food was again offered to them but they refused to eat. These fine snakes were too valuable to let die. I could not conscientiously let any creature perish, no matter how dangerous others might consider it. They were helpless captives in my care! It was with the keenest interest that I set about this duty. I had no dread or fear, for experience had taught me the method to pursue, and there was very little, if any, danger entailed. It took just about twenty-five minutes to convince "Gabby," the male, that he was not going to be hurt, and to feed him three small pieces of beef and a young rat! He made no attempt to strike at me.

Formidable guests arrive

On August 26th, 1934, a pair of king cobras *(Naja hannah)* arrived. They were magnificent snakes of large size. We estimated their length to be ten and twelve feet, but later found that they exceeded this. These snakes were highly excited, rearing over three feet high and spreading their bodies through this entire length. They snorted and hissed and struck at the objects of their fear. The lower jaws hung slightly, exposing the ends of the sheath-covered fangs in the upper jaws—a very threatening attitude indeed. Their eyes had a wild, excited look, as the snakes, keenly alert, stood ready to defend themselves in an instant, should the occasion arise. Much care was taken when the door of their cage was opened—just a tiny crack at first, to note their actions, then a bit wider to permit a better view, and to do whatever was necessary for their comfort. The writer did not permit her assistants to take any chances with poisonous snakes, but requested one or both of them to remain within call when new poisonous specimens were being cared for.

To be able to observe carefully their actions and study their moods by caring for them personally, gave me a splendid opportunity I should not otherwise have had.

Two three-foot sticks were used with the king cobras at first: one with a heavy wire at the end spread out in a U-shape, which was held in the left hand as a shield to push the snake back if it attempted to rush out or strike; the other stick was padded at the end with a soft cloth and was used as a petting stick with which to gently pat or touch the snake. This method of stroking a serpent has proved to be of great value in allaying their fears and winning their trust. It is interesting to note the effect such treatment has on the wildest ophidian in a few days' time. At first the kings were so excited and touchy, they snorted and blowed, reared, spread, jerked and twitched, when the padded stick touched them. Food of various kinds had been placed in their cage, but they made no attempt to eat.

The method of procedure in taming this marvelous pair of cobras might be better understood should I merely present a few notes as they appear in my diary:

August 30th (Four days after their arrival.) I petted the kings for the first time with the padded stick. I tried to force a small dead rat into the mouth of each snake. The rat was impaled on the end of a feeding stick that had been fastened to the end of a three-foot stick. The smaller cobra was easier to manage and I succeeded with the help of the petting stick, in getting this food into its mouth four times, but I could not get the stick free at the same time. The snakes were quite touchy, but did not try to get out or to bite.

August 31st. I attempted to feed them again in the same manner, but had no success in the short time I had for this work. Later in the day I had a little visit with them and told them how perfectly lovely they were; that I liked them and was sure we were going to be good friends.

September 1st. Today I petted the kings on their tails when the heads were far away. I also petted them with the padded stick. When I cleaned the cage, they paid no attention to the operation and seemed to take me for granted.

September 3rd. Petted kings again with padded stick and they did not appear to be afraid, but only a little touchy at the novelty of the experience. I have been working with the door of the cage wide open, leaning into the cage to reach the front when necessary. The cages containing the poisonous snakes are all in passageways apart from the lobby of the building where visitors are. The doors are kept closed. If any specimen should get out of the cage, it could not endanger the public.

They take food

September 4th. Today I succeeded in getting four small pieces of fresh beef into the mouth of the smaller cobra. I laid the petting stick down and used my bare hand to hold or restrain the snake, while I put the food now on an ordinary feeding stick (about fifteen or sixteen inches long) into its mouth. The snake that has been blind (prior to shedding), can now see clearly, and showed no signs of fear whatsoever, at my handling it. I supported the snake, finally letting it rest across my hand, about eighten inches back of the head. It is unbelievable the intelligence these creatures have.

September 5th. I force-fed the larger king cobra with two young rats and a small piece of beef, giving the meat first, I handled him with my bare hands freely. I handled the other cobra the same way yesterday. I am positive that they know and recognize me. There is no "threatening" or "bossing" at all. I patted them gently "geeing" and "hawing" them by touching them first on one side and then on the other, to get them to move right or left. They like very much to be stroked under the chin. These snakes were appoached not with fear but with understanding and sympathy.

September 6th. Today I again fed the king cobra, using a small rat. It was easily accomplished, as the old fellow seemed to understand what I wish to do. Now I

am sure that I have won the confidence of both of these snakes. I believed it could be done, but I never dreamed it could possibly be so easy to accomplish.

SEPTEMBER 18TH. This evening after closing, I fed both of the king cobras, one of which I have named the "King of Kings" and then the other one, the "Queen." They were each given one young rat. It is no trouble to force-feed these snakes unaided. In fact the entire process has been accomplished without help. Both snakes are kept in the same cage.

OCTOBER 22ND. The "King of Kings" is ready to shed his skin.

OCTOBER 23RD. This morning the skin was not shed, but loose in places, giving the snake a tattered appearance. Cobras are said to have much difficulty in shedding when in captivity, especially in casting the eye-plates.

OCTOBER 23RD. (From a letter to a friend.) ". . . I helped the 'King of Kings' shed his skin, I wetted, patted, and pulled off all the old skin, piece at a time. Some of the head scales had been shed, but the eye scales, lips, chin, and several other scales on the head, were still tight. I left the head until the last, and by that time he was fully prepared to let me do whatever I chose. I just had to have some proof of the great achievement in taming him, so I called both of the keepers at the last, so they could see for themselves. I used the small forceps to pull off the eye lids, and this did not frighten him one bit. I stroked him under the chin, and on the head, and gently patted his neck, under and over, and all around his mouth! Then I rested his head on one hand with him facing me. He was unafraid and put out his tongue in such a knowing manner.

"After I had finished, the 'King' rested for a long time, with part of his body hanging over a branch, and his head hanging over a smaller limb. He had the most 'well I'll be darned' look on his face that I ever saw on any creature! Tonight I mounted the eyelids on a cardboard. They look like big pearls, or bubbles. I also pasted some of the ventrals on a card, they were so large."

Contrary to their reputation

NOVEMBER 8TH. My kings are doing finely. They have caught on to the force-feeding now. It is a simple matter to get hold of them, for they never try to bite when caught. It is strange that in all the experience I have had, the "world's most dangerous serpent" should prove to be one of the easiest, if not the easiest snake I have tamed. I too must have had that same look that the "King" had, for I just couldn't believe it was true. Nothing but unfriendly aggressive accounts have been told about this marvelous snake; so taming their Majesties seems little short of miraculous.

NOVEMBER 27TH. This morning we took still pictures of the "King of Kings." We tried to get a picture of him as I held him in my arms, but he wouldn't hold still—just kept going places. I had to put him in an empty cage we had obscured from view. I took him up and let a few feet of his body lie on the door sill, while I draped his head and two feet of his body across my arm. The old fellow was perfectly contented to lie thus, with his magnificent head hanging over my right arm. He rested quietly while we took three pictures of him. Later in the day, I gave him four young guinea pigs. He was so easy to feed, I petted him awhile before I fed him, and he came out on my arm and poked around utterly unafraid.

DECEMBER 10TH. We weighed the "King of Kings" this afternoon. I coaxed him into a pasteboard box or carton. He was very much afraid, and it took twenty minutes of coaxing and petting before he decided it was safe. He weighed twelve and a half pounds. The carton was probably 14" x 14" x 14". I wondered how I could get him into so small a box, since these snakes do not coil up into a round compact coil, but into large loose rather oblong loops. The box was far too small to pick him up and lay him in it. I laid the box on its side, with the opening facing me. He was afraid of the box at first, and came quickly out, when I put his head inside. I petted and coaxed him gently and just kept turning his head back into the box. There was so much of him, that it was a problem indeed. He was now almost blind, so that was a disadvantage. All the time he kept making a little noise through his nostrils, which sounded like he was saying, huh! huh! He put out his tongue and touched my hand and arm every little while. We keep lots of nice oak leaves in the cage and he loves to nose among them, so I took a large handful of leaves and put them into the box.

Weighing

Again I guided his head and part of him back into the box. He nosed the leaves a bit, so I put another handful on top of him, but he came out. I tried again and again, finally I tried leaving my hand in the box and patting his head and throat. Then he rested his head on my hand and remained quiet for a few moments. Then I gently pushed more of him into the box, and more. At last he was convinced, so I had the keeper place the scales in the cage. I picked the box up carefully. It was still on its side, and I balanced it on the scales. He never attempted to come out, or move, but was perfectly quiet. It was so positively thrilling, to have won him so completely, that the keeper and I just looked at each other in amazement. The astounding thing was, he now thought the box was fine and just rested his head on a coil at the front, and remained perfectly still. I took the box off the scales and placed it carefully down where it had been when I coaxed him to stay in. We took the scales out, still he didn't move and when we closed to go home, almost an hour later, he was still in the box.

FEBRUARY 16TH, 1935. The "King of Kings" is tame beyond the telling. He will rear up facing me without spreading, and when I extend my arms toward him, one on either side of him, and lean forward, he will quickly climb to my shoulder, go around my neck, and back into the cage again. It seems like a little gesture of affection. Sometimes he just goes over my shoulder, down my back, and around under my arm, and up in front of me, where he stops for me to pet him! I picked forty ticks off of him today and of course had to give each one a quick jerk to get it off. He didn't care in the least and let me search all over him for them, and held as still as could be. I did not hold him at all, so he was free to do whatever he wished. The kings pay no attention at all to the noise made by the squeaky door as it is rolled back and forth on their cage.

JUNE 13TH, 1935. This morning I weighed the king cobras. I put the queen into a paste-board box petting her as I did so. She is very intelligent and understood fully what I expected of her. She was unafraid and I lifted the box to the scales, where she rested quietly. She weighed eleven pounds, but is not fat. Then I took her out and put the king in the box. He weighed fourteen and three-quarters pounds and is gaining steadily.

In all this research the motive has been an earnest endeavor to learn scientific facts—the *truth* regarding these little-known reptiles. Never has the author for one moment entertained the thought, or had the desire to "show off." It has only been a great pride to demonstrate how truly wonderful were these greatly feared creatures that I had learned to trust and love, just as one likes to show off one's own dog that has learned a new trick or lesson.

Other snakes

I am speechless at the revelations manifested so many times in my close association with poisonous snakes. Not one have I found to be vicious or mean, but only afraid, panicky, terror-stricken, like a frightened bird, or mammal at first. The king cobra, Egyptian cobra, puff adder, Gaboon viper, Australian black snake, Australian tiger snake, the sea snake and the coral snake, as well as the fer-de-lance, the moccasin, copperhead, and thirteen species of rattlesnakes that I have tamed, have all responded to my gesture of sympathy and understanding.

Somehow they know very, very soon that I am friendly, and that I like them. They appear to listen intently when I stand quietly at their open door and talk to them in a low soothing voice. In some unknown manner my idea of sympathy is conveyed to them. Kearton* was also convinced that there was some means of silent communication among penguins in a case of sympathy, although there was no audible conversation at the time. He says, "What is the secret of communication between animals? Giraffes are known to be absolutely silent. No one has ever heard them utter a sound, yet if one giraffe is separated by a hill from the sight of the herd to which he belongs, and that herd takes alarm, the single giraffe knows instantly and gallops to join the others. I do not think we can account for this by suggesting the existence of a sound vibration to which our ears are not attuned; we seem compelled to fall back upon some wave of thought which is used by certain of the lower animals, although unknown to ourselves. . . . It may be that these birds can convey ideas of sympathy and of love merely by expression, I do not know. Indeed as the years go by and my studies of animal life continue, I am more and more impressed at the number of things of which the causes, though not the facts, are utterly unknown, either to me or anyone else. One may study and observe and know a great many facts; but when it comes to the how and the why, one finds one has little knowledge and a great deal of wonderment."

"Island of Penguins".

Forthcoming Articles

Hendrik Willem Van Loon in **The Story of Salt** will trace the important part played by this simple commodity in the making of history with the lucidity which has earned for this writer the high popular esteem that he enjoys.

In South Africa's Wonderland by **Mary L. Jobe Akeley**, author of the recent book "Restless Jungle," will give a magnificent description of her latest visit to Kruger National Park and the story of how that greatest of game preserves has saved the wild life of South Africa from extinction.

The Death-Throes of the Aztec Nation by **George C. Vaillant** disclose a curious note of modernity in this defeat of a native people by professional European soldiers. Lively contemporary drawings by Aztec artists take the place of our modern snapshots of war scenes and add a naive vividness to the article.

The Insect Lore of the Aztecs by **C. H. Curran**, illustrated like the above-mentioned article with contemporary drawings, proves that there was a fundamental interest in natural history in America even before the white man came. The article demonstrates that the Indians were well acquainted with many of our agricultural pests, used other insects extensively as food, and had derived a remedy for the bite of so currently prominent a creature as the black widow spider.

In What to Expect of a Volcano. Frank A. Perret, founder of the Volcanological Museum at the foot of the notorious Mt. Pelee, will tell about some of the extraordinary things a volcano can do.

Amelia Earhart in a fascinating article on the subject of **Speed** will present an interpretive study of the fastest speeds attained in Nature in comparison with the mechanical achievements of Man.

★ THE INDOOR EXPLORER

By D. R. Barton

Ten human heads shrunk to the size of tennis balls is one of the sights that attracts the interest of many an "indoor explorer" roaming the halls of the American Museum. Who can gaze at these blackened features protruding from the long raven tresses of original hair without wondering what story they might tell of violent death and jungle ritual? The writer for one was prompted to inquire into the subject. But you cannot delve far into the literature without discovering that the information is not always dependable. One account stated that shrinking heads is a fiendish practice of a South American tribe of Indians known as Jivaros (pronounce this he-var-o) who often take white men's heads as well as those of rival aborigines. It maintained that the process is perfectly simple. After the head has been severed from the victim's trunk it is thoroughly pounded with a heavy club in such manner that the skull is reduced to fragments which are forced down and out through the neck, leaving a boneless head which shrinks in drying to about one-quarter its original size!

True, the head becomes approximately one-quarter its original size, as a glance at the specimens in the Museum proves, and appears to have become thoroughly dried; but even the more gullible inquirer may question how it maintains its shape so well during the process of dessication, and to others there will occur some mechanical difficulty in forcing skull fragments out through neck-tissue which has not been softened by boiling or by some other process.

In his effort to ferret out the truth of the matter, the Indoor Explorer was encouraged to learn that Dr. Harvey Bassler on the Museum staff, had long resided on the far Upper Amazon and had knowledge of the art of head shrinking; and he set off at once to pay him a visit.

"You do know about them, do you not?" I asked.

"Yes," he replied. "As a matter of fact I have several of them." He got up and took down from a shelf a tightly sealed tin box. The lid was removed with some difficulty. An odor of camphor filled the room. Reaching within he pulled forth the open end of a long cotton sack.

"Reach in and see what you can find," he invited with a hospitable gesture. With some reluctance I gingerly thrust in a hand that trembled in spite of myself. Groping cautiously, the image of your Indoor Explorer which I chanced to see in a mirror

across the room shamed me, for its deathly pallor. My hand closed on a mass of hair.

"Pull it out," commanded my host.

When I withdrew my hand from this gruesome grab-bag it held luxuriant locks of dank black hair from which dangled something that looked like a burnt potato.

"That is the head of Matapa, a good friend of mine," said my host gravely.

I swallowed hard. "Not really," I said faintly.

"Yes. Enemy Jivaros from the far interior raided his home and carried away with them his head which I recovered from them later. Years ago in a successful raid into that very region from whence came the warriors who finally slew him, he was grazed by a spear which partly tore from its attachment the

lobe of one of his nostrils. This resulted in a permanent, slight, but very distinctive, disfigurement which you can see here perfectly preserved in his prepared head." My host pointed with his pencil to this very diagnostic and interesting detail.

"How did you get the head?" I asked.

"In trade," he replied.

This tribe is a large one and is composed of several sub-tribes, each of which upon occasion makes war upon one of the others.

"Do they take heads indiscriminately from the enemy's dead?" I asked.

"No. The taking and preparation of a head has great religious significance for the Jivaro, and is a mark of distinction and honor, and these heads are prized in direct proportion to the fame and valor of the men from whom they were taken. Accordingly, it is not customary to prepare the heads of women. Indeed if they are killed at all in warfare or raids it is usually accidental, and the head of a blood relative is never prepared."

"The taking of the head of a rival chief would then be a glorious achievement?"

"Precisely, and in any case no victory is really complete without the taking and preparation of a head, which these Indians know by the name of 'tsantsa.' "

These raids, according to my host, are usually actuated by a desire to avenge a raid or to secure mates for the marriageable boys of the tribe and occasionally perhaps from the sheer love of an exciting and victorious scrimmage.

To be successfully shrunk, a head must be in fairly good condition and because flesh decomposes with incredible rapidity in jungle heat, the attacking party is at a disadvantage in that the trophies will not keep for long in a raw state and the most zealous young victors must sometimes abandon this valued object because it has failed to hold together until they could reach a place sufficiently secure from an avenging enemy for its preparation—to say nothing of olfactory disfavor!

The Jivaro head-dance or "tsantsa-dance" is a big, rather expensive "party" where the head-taker plays host and pays the bill, so that it is not given too frequently. This feast, perhaps the Jivaro's most important social function, opens the way for him to fame and honor, to wealth, to success in future raids and to a long life. Performed with a freshly shrunken head bobbing about his waist as it dangles, supported by cords from his neck, it is very impressive even when one's imagination has not been stimulated by masato (cassava beer) which looks and tastes not unlike thick buttermilk and, taken immoderately, is intoxicating. It is the beverage and indeed the food as well of jungle Indians throughout South America and plays a major rôle in every feast. It is made by chewing the large, boiled, starchy roots of this plant and then allowing the insalivated mass to ferment in earthen pots.

When all is over and the festive smoke has cleared, the shrunken head loses its ceremonial value and can be secured in trade by anyone prepared to make an acceptable offer (firearms preferred).

"So that is how you secured your friend's head?"

"Yes, but not in exchange for a rifle. The Jivaros are amazingly well-armed, too well, perhaps. In 1913 they wiped out an entire Peruvian military frontier post and took all the rifles and ammunition. We saw among them some of those same rifles as recently as 1928 still in a perfect state of repair, and they have gotten arms and ammunition in other ways, too, usually in exchange for service but never so easily or abundantly that they dare be used in the chase. Every cartridge must, if possible, be made to account for a man. The blow-gun with poisoned darts and the spear are their only weapons of the chase, the use of the bow and arrow not being known to them.

"Do they take the heads of white men?" I asked.

"I know of no instance and all reports to that effect must be regarded with extreme caution. In a natural state they would do no such thing but one cannot entirely predict the degree to which individuals might be degraded and corrupted by the white man himself."

The process by which the heads are shrunken is briefly as follows, according to my informant. First a large leaf is laid upon the ground; the head, which has been cut off as close to the trunk as possible, is laid upon it; another similar leaf is placed so as to cover the head and upon it the victor then sits while one of his friends, the most distinguished one present, blows tobacco juice and saliva *into his nose*—this to insure against all interference or unpleasantness from the ghost of the slain. In other words, the latter has been *effectively sat upon*. After the victor has in turn fortified his companions in like manner the scalp is cut through to the bone, from the nape of the neck up the back of the head to the crown and is then skinned off the skull, first on one side of this cut, then on the other and this skinning is continued forward until the skin of the entire face has also been separated from the flesh, and the skull now freed of all integument can be thrown away. The cut which was made up the back of the scalp is now carefully sewed up again with herring-bone stitch, resulting in a soft flabby scalp-skin bag which is

dropped for a very short time into a pot of very hot water which gives it some firmness. Thereafter the mouth is closed by means of three skewers consisting of hard palmwood pins, laced with a red cord and the eye-lids are closed with a stitch or two. A smoothly rounded, water-worn stone, which has been heated in the fire, is then dropped into this bag and, sizzling hot, is caused by motion of the bag to roll about within it. This large, hot pebble dries up some of the moisture and sears bits of flesh that still cling to the skin and scalp, and when it has become cool it is taken out and put back into the fire from which another, and then a third, in turn are taken and rolled about within the bag and each in turn is returned to the fire. There must be three and no more and they are always left finally in the fire. Then the real shrinking is effected by means of piping hot sand with which our still very pliable scalp-skin bag is half filled. This hot sand is replaced over and over and over again as each lot cools and all the while the bag is swirled with a churning motion so that the sand touches all parts within it, with the result that gradually the whole becomes smaller and harder until it is finally as hard as horn and as small as a tennis ball. It may be of interest to mention here that the ritual requires rigidly that the sand be heated over the fire, never in a new earthen pot but always in one which is old and somewhat damaged. The outer layer of skin contracts at the same rate as the deeper tissue so there are no surface wrinkles such as one sees upon the surface of an apple which has shrunken from its original size. The surface is now blackened with charcoal and the three skewers through the lips are replaced by three long trailing cords and finally a loop of cord is fastened to the crown and the tsantsa is ready for the great feast. Several days of continual attention are necessary for the preparation of this trophy and it is required that the warrior who prepares it shall not once wash his hands from the time it was cut from the body of the slain until its preparation is complete.

Head shrinking among the Jivaros appears to be well on its way to the shelf of lost arts. Apparently the time between "shrinks" is gradually growing longer and longer, and some day, my host believes, a generation will suddenly realize that there is no longer one among them who has seen it done.

In Memoriam

Friends of the Museum and personal friends of Mrs. Rolfe Norton Lord, Secretary of the Department of Vertebrate Palaeontology, will grieve to learn of her death on December 3, 1936.

Mrs. Lord joined the Museum force on June 1, 1927, and through ability, faithful devotion to duty, tact, reliability and cheerfulness of manner soon became one of the most popular members of the Museum family.

Visiting scientists or a casual Museum visitor carrying an odd bone or object for identification, or anyone with a real or fancied grievance; each and all left her office satisfied and with a glow of appreciation for her human understanding.

Mrs. Lord was born on Matinicus Island, Maine, on Thanksgiving Day November 25, 1882. Her father was Aldeverde Norton and her mother Rosilla Abbott, both deceased. She is survived by two sisters and one brother. On June 2, 1909 she married Leon R. Lord, who is now living in Cambridge, New York.

Her early years were spent on Matinicus Island, near which her father was a keeper of the lights on Matinicus Rock, and during this time she was a boon companion to her father, whom she followed faithfully, absorbing his freedom of action and the meticulous care that characterized his life.

Her first business experience was as Secretary and Manager of the J. A. Dowling Auto Agency in Portland, Maine, and later, for several years she was a successful Secretary and Office Manager with the Moon Motor Car Company of New York. This business experience prepared her for the complex office of Secretary in the American Museum, which she so admirably filled.

SCIENCE IN THE FIELD AND IN THE LABORATORY

Plane loss hampers New Guinea Expedition—Trailside Museums—The New Whale Shark—Expeditions in Alaska and Africa

New Guinea Expedition Curtailed by Loss of Plane

Mr. Richard Archbold, scientist, aviator, traveller and sponsor of the American Museum of Natural History-New Guinea Expedition, recently returned to New York from Daru, Papua, where, on July 9, the sudden capsizing of his amphibion caused the temporary curtailment of his efforts to collect birds, mammals and other natural history specimens for the American Museum from the mountainous and inaccessible interior north of the intersection of the Fly and Palmer rivers. This section of Papua (British New Guinea) is practically a virgin field for expeditions. Only two white men have, so far as is known, been able to penetrate to the utmost extent of this uncharted interior. They were awarded Royal Geographical Society medals for this feat.

Because of the well-nigh insurmountable natural and mechanical difficulties, no previous expedition had been attempted.

It was believed, however, that with the aid of Mr. Archbold's amphibion, an expedition of far-reaching range could be conducted without being cut off from its supply source. Accordingly, flight explorations began on March 23 and continued during April in the form of a series of observation flights covering thousands of square miles over the 325 mile gap—as a plane flies—between Daru and the Palmer river junction, and the Central and Victor Emanuel Ranges. Early in May the ground party, consisting of Austin L. Rand, George H. H. Tate, Allan Willis and Michael J. Healy, left Daru for the established base of the expedition. Soon thereafter, Willis and Healy went to a place near Mount Mabion, where they founded a subsidiary camp called "the depot camp." All supplies were to be dropped by parachute at this spot, which was also the starting point for trips into the interior. Five such flights were made; the first being undertaken on June 26. The ground organization at Daru, where the plane was based, consisted of E. C. Julstedt, Mr. Archbold and Mr. Rogers.

Mr. Archbold reports that due to gusty weather, heavy mists and prevailing low-hanging clouds, they usually had to find their way through this unknown and uninhabited country by flying fifty feet above the tree tops—sometimes with a visibility of only about half a mile. At one time the weather was so bad that Mr. Archbold found it necessary to climb more than three miles through solid layers of clouds. After two hours of cruising above the clouds, he and Rogers found a hole, went down through it, could not locate their whereabouts and had to return to the coast.

The Daru base and the expedition were in constant communication by radio. Mr. Tate, Assistant Curator of Mammals, was the radio operator for the advance party, while Mr. Julstedt was chief radio operator.

While no one knows the exact cause of the loss of the plane, it is believed to have been due to a sudden gust of wind turning it over during the night. At any rate, it was an almost total loss, only a few parts of the machine being salvageable. When news of the sinking of the plane was flashed by radio to the ground expedition, hundreds of miles in the interior, members of the party made rafts and floated several hundred miles down the Palmer river until they reached navigable waters where they could be picked up by boat. While the airplane distance from Daru to the camp was some 325 miles, the water-travel mileage was over 550.

The members of the interior party, were picked up by a boat and transported to lake Daviumbu, about 200 miles from their original point of operation. They are at present working in and about the Bensbach river district and expect to conclude their expeditionary work by the first of February.

Bird News

Dr. James P. Chapin is still in Europe continuing his studies for his book on the *Bird-life of the Belgian Congo.* He has just published the description of an astonishing new peacock-like pheasant from Africa which he discovered in the collections of the Congo Museum at Tervueren, Belgium. He has promised to write an article for NATURAL HISTORY on this important find which is, perhaps, the most startling ornithological novelty unearthed in recent years. The authorities of the Tervueren Museum are giving Dr. Chapin every facility in the prosecution of his work. Recently, he was granted an audience with His Majesty, King Leopold of Belgium, who expressed great interest in his work on the birds of the African possessions of his country. It will be recalled that in 1931 the late King Albert conferred the "Ordre de la Couronne" on Dr. Chapin in recognition of his twenty-two years of research on the zoology of the Belgian Congo (see NATURAL HISTORY, Vol. 31, page 564, September-October, 1931).

Word has been received from Mr. W. F. Coultas, who is now in the field with the Crocker Expedition, that he has completed the collection of material for the Hawaiian bird group, following the acquisition of similar material in Samoa. These groups will form part of the series of exhibits of the bird-life of the Pacific now being prepared for Whitney Memorial Hall. Mr. Coultas is proceeding to Laysan Island to secure similar material for still another group in this series.

Recent accessions include some 900 bird skins from central New Guinea obtained by the Archbold-Rand Expedition which is still in the field. The Macmillan Expedition, at work in the New Hebrides, has forwarded further material from that group of islands.

The following note has appeared in the *Bulletin of the British Ornithologists' Club,* Volume 57 for November 11, 1936:

"Mr. N. B. Kinnear announced that the President of the American Museum of Natural History had recently forwarded to the Director of the British Museum, through Dr. Leonard C. Sanford, the type-specimens of fifteen British and Irish subspecies from the Rothschild collection.

"In his letter he says:—'Since the most important pur-

pose that these specimens can serve is to be readily available to European, and particularly to British, ornithological students, the staff of our Department of Birds has felt that it would be helpful to the cause of science to return these fifteen specimens to England for permanent deposit in the British Museum. With these sentiments the President and Trustees of the American Museum heartily concur.' Adding that:—'We hope that the Trustees of the British Museum may see fit to accept the specimens as a gift from our institution, and that their presence in the British Museum may prove of practical and lasting value to ornithology.'

"The specimens include thirteen types described by the late Doctor Hartert, one by that ornithologist and Mr. Witherby, and one by Doctor Hellmayr. The gift of fifteen types by one Museum to another must, I think, be unique in the history of science. I am sure all ornithologists here tonight will appreciate this generous act, not merely for the actual value of the specimens, but for the spirit of cooperation in which it is made."

At the opening of a notable exhibition of "Flight in Nature and Human Flight," at the Franklin Institute, Philadelphia, on the evening of December 2, 1936, the American Museum was represented by Dr. Robert Cushman Murphy of the Department of Birds.

The project, which will continue as a special demonstration for a month, was planned by Mr. Leonard Outhwaite and sponsored by Mr. C. Townsend Ludington, head of the aviation section at Franklin Institute. The demonstrations, which will be conducted twice a day, are in charge of Mr. R. H. McClarren, an aeronautical engineer who has visited the American Museum in order to study types of bird flight. Birds of various sorts, photographs, high speed motion pictures, miniature wind tunnels, apparatus for producing gases which make air currents visible, and many other devices are employed to produce visual results that are truly astonishing.

Man's first attempts at flight in heavier-than-air machines were not based upon the example of birds, but sought rather to conquer the air by brute force. Recent developments in aviation have shown the wisdom of studying nature, and of imitating birds in their streamlining, economy of power, development of wing-slots, retractable landing gear, and in many other respects. At the Franklin Institute demonstration, model planes built to the specifications of definite types of birds perform astonishingly in front of and over the heads of the audience. Among the types which have been thus correlated in successful mechanical imitation are the pelican (weight carrier), the man-o'-war bird (endurance flier), the barn swallow (acrobat), and the swift (speed flier).

Bear Mountain Trailside Museums

The Bear Mountain Nature Trails and Trailside Museums have completed ten years of activity under the joint sponsorship of the American Museum of Natural History and the Commissioners of the Palisades Interstate Park. During the past two years, activities have been carried on both summer and winter with support from the State of New York. Trailside attendance figures reached 420,000 in 1936, bringing the total number of visitors for ten years, to 2,539,000.

Winter operation and the need for additional "snow time" exhibits have provided new and interesting problems. In general, Trailside activities in winter include the maintenance of four buildings, field work in connection with wildlife conservation, lectures in schools and other regular duties. Practically all animals in the zoo area are moved indoors. The Botanical Museum becomes the zoology center for the cold months. Work in the Trailside Craftshop includes the manufacture of relief models, miniature groups, furniture and various exhibits.

Field work during the past year was concerned principally with the Historical and Indian Museum. Forty-two Indian sites were visited and twenty-five hundred specimens were recovered. The artifacts included arrowpoints, celts, hammerstones, knives, scrapers, drills, pottery and other types of Algonquin and Iroquoian implements and materials. Camp sites, rock shelters, and village sites have been discovered and excavated in Orange and Rockland Counties, New York.

Historical field work and research include exhaustive searches for records in connection with the Colonial and Revolutionary history of the Hudson Highlands. More than a year has been spent in excavating the interior site of the picturesque West Redoubt of Fort Clinton, located upon the Bear Mountain Nature Trail area. Materials collected from the site include more than seven hundred musket balls, two hundred and sixty grape shot, ten cannon balls, bayonets, musket parts, regimental buttons and numerous other relics of the British and American engagement that took place on October 6, 1777.

The expanding Trailside Museums program now provides for research endeavor in addition to expositional activities. An ecological survey of the Bear Mountain-Harriman section of the Palisades Interstate Park has resulted in the discovery of interesting information concerning the flora and fauna of the 42,000 acre region. It is planned to continue this work.

Recent developments in botanical displays include a new Trailside Fernery, located near the Bear Mountain Bridge entrance, where rock ledges, field conditions, and a moist area combine to furnish an excellent background for the work. Hundreds of ferns have been collected and transplanted. Fifty-two species are now growing in the fernery.

Work is now in progress upon many additional exhibitions, indoors and out, for the coming season. The Trailside Museums will welcome visitors throughout the Winter. The museums are open from nine to five o'clock daily.

New Whale Shark Exhibit

A mounted specimen of the great "Tiger of the Sea" or Whale Shark, made its first appearance at the American Museum of Natural History in the Roosevelt Memorial Hall on Monday, December 7.

This shark, which was captured by a party led by Mr. Charles T. Wilson of New York City, after a six and a half-hours' struggle at Acapulco Bay off the southern coast of Mexico, measures 18 feet from the tip of the nose to the end of the flukes. The specimen measures 9 feet 8 inches in girth around the thick head, while the mouth, stretching 3 feet from corner to corner, could hold a small-sized man.

After fleshing the 200-pound hide, it was placed in a tanning vat for almost eight months before it was ready to be mounted. Under the direction of Dr. James L. Clark, head of the Department of Preparation and Dr. Eugene W. Gudger of the Department of Ichthyology at the Museum, the skin was mounted and painted by Mr. Ludwig C. Ferraglio. The skin was stretched over a mannikin of stiffened burlap and plaster and then painted the characteristic dark-grey color, splashed with cream-

white spots and stripes along the sides and back to form a checkerboard pattern.

According to Doctor Gudger, who has made a 24-year study of this rare shark, the specimen—a female—is the finest ever exhibited in any museum. There are only five museums in the world which have mounted specimens of the whale shark. With the exception of one in Mr. W. K. Vanderbilt's private museum at Northport, Long Island, the one in the American Museum will be the only one on public display in the New World.

"Little is known about the habits and behavior of the whale shark," said Doctor Gudger. "It is a whale in size and in its manner of feeding. In size it is gigantic—it has been measured up to forty-five feet and estimated by scientists to reach sixty. Like a whale, it feeds by swimming along at the surface of the ocean with its huge mouth open. Into this cavern go small fishes, crabs, jellyfishes, and other surface-swimming creatures. These are sieved out by the gill-rakers, as the great volume of water flows out through the long, wide gill-slits. They are then passed down the throat, which, in the specimen dissected, would about take a baseball or a man's fist.

"The huge terminal mouth in an average-sized specimen would easily accommodate a small man, but the teeth of such a fish are only about one-eighth of an inch long. What they lack in size, however, they make up in number. There are about 3,000 file-like teeth in each jaw, hence its scientific name, *Rhineodon,* or 'the file-toothed.'

"By the general public, sharks are deemed bloodthirsty creatures, and large ones are sure to be characterized as man-eaters. The whale shark is the largest of all living sharks, but far from attacking man, it is harmless.

"The vertical bars and the large spots arranged in vertical rows along the sides of the shark, has given it the name of 'Tiger of the Sea' at Acapulco. But in reality, this great fish is the mildest-mannered shark that swims the oceans. So well is this known that Cuban fishermen call it *pez-dama*—'the gentle one.'

"The Museum is extremely grateful for the gift of the skin of this rare shark from Mr. Charles T. Wilson, a fellow of the Museum, and after the temporary exhibition will place the specimen on permanent view in the Hall of Fishes."

Stillman-Durrell Alaskan Expedition

Late in October Doctor Anthony returned from the Stillman-Durrell Alaskan Expedition, with valuable material for the Department of Mammals. This expedition, which took some two months, was made possible by the generosity of Mr. James A. Stillman and Mr. J. H. Durrell who had planned a hunting trip to the Kenai Peninsula and invited the American Museum to participate by sending a representative to collect specimens. Doctor Anthony was able to secure two Dall Mountain sheep, two black bear and three Alaskan moose, represented in certain instances by complete skeletons in addition to skins. He also had the opportunity to study local conditions, which must be taken into consideration when the plans for the Alaskan Moose Group and the Dall Sheep Group are consummated for the new Hall of North American Mammals.

Dr. and Mrs. James Stillman, Junior, who joined the party in the field, generously donated to the Museum the head of an exceptionally large Alaskan moose killed by them. Another important donation was received from Mr. Henry Boyden, a guide, who presented a head of a Dall sheep second only to the world's record in size.

The party spent most of their time on the Kenai Peninsula, hunting about the headwaters of Funny River for sheep and black bear, and from a camp on the lower Funny River for moose. A great number of these big game species were seen, some hundreds in the aggregate, but in the case of the sheep and moose no heads of record dimensions were observed. As guides, the hunters had Andy Simons and Hank Lucas who are well known as veterans in that capacity and familiar to sportsmen for a generation, and also Frank Revell and Henry Boyden, both of whom have had wide experience. Fortunately, the weather was favorable for most of the trip and only a few days were marred by rain.

At the close of the trip the party crossed Cook's Inlet to the north shore and hunted for the big Alaskan brown bear but with indifferent success as far as large bear were concerned. Only a very few brown bear were seen and these were small, but in the case of Mr. Durrell quite a thrill was provided when four bear came up out of the alders and decided to come down the trail, where he and his guide were surprised by their sudden appearance at close quarters. It required rapid and accurate shooting to stop the bears that were nearest. The foremost bear fell not over fifteen feet from the hunters.

W. D. Campbell African Expedition

A wire has recently been received from Mr. Campbell in which he announced the completion of the collecting of the specimens and accessories for the okapi group. In a previous letter from Epulu-Ituri, Belgian Congo, and dated October 14, 1936, Mr. Campbell tells of their arrival in the Ituri Forest.

"Am very happy to be able to tell you that at last we are established in our base camp, from where we shall make the preliminary search for the okapi. Arrived here last night after a twelve days' run from Nyeri, in perfect condition and everything running very smoothly. Stopped at Carl Akeley's grave on the way out and found it in excellent condition. The climb up Mount M'kino is terrible and took us four hours to get there. Saw plenty of signs of gorilla, leopard, buffalo, and elephant on the way up. This okapi business is going to be a very hard job from what I have seen of the Ituri Forest in the past few days. It is the thickest stuff I have ever encountered, visibility about five feet. However, I have gotten hold of Putnam, who seems to be the greatest authority out here on them and he is of the opinion that I ought to get them both in about two months. I think he is crazy but will hope for the best."

A shipment of East African mammals recently forwarded by the expedition to the American Museum contained 391 specimens. A hasty survey of this material disclosed forty-six different genera and sixty-four different forms. One genus and at least six subspecies are new to the Museum's collection. This shipment also included the skins and skeletons of the rhinoceroses for the forthcoming black rhinoceros group.

Mr. Gardell D. Christensen of the Department of Preparation, who accompanied Mr. Campbell, is expected to arrive at New York with the okapi material about the midde of December.

Gem Gift

Through the generosity of Mrs. George B. de Long the Department of Minerals and Gems has recently acquired a most unusual green corundum gem, weighing 47½ carats.

The Hayden Planetarium

In the Planetarium lecture for the month of January the audience will travel south, studying the southern constellation with special emphasis on the famous Southern Cross. A special feature of the month will be the lighting of the stars in the Planetarium sky by using the energy of cosmic rays. The cosmic rays, coming from outer space, will be heard by the audience clicking as they pass through the "cosmic ray machine," and at a given signal the harnessed energy of one ray will light the sky.

Among the interesting new exhibits in the Planetarium this month will be the aircraft sextant used by Admiral Byrd on his second Antarctic Expedition.

Drama of the Skies

"The Drama of the Skies," presented during the 1935-36 season by the Hayden Planetarium, in co-operation with the Columbia Broadcasting System, will return weekly to the C.B.S. microphones over a coast to coast network on Saturday afternoons from 5:30 to 5:45 p.m., Eastern Standard Time. These broadcasts, which proved a highly popular Columbia feature last winter and spring, will be presented by Dr. Clyde Fisher, head of the Hayden Planetarium, and Hans Christian Adamson, editor of *The Sky*.

Telescope-making Class

A course in Amateur Telescope-making is now being conducted by Mr. Ramiro Quesada at the Hayden Planetarium in co-operation with New York University. The meetings of this class are held on Thursday nights at 7 p.m. in the Hayden Planetarium Optical Workshop, 81st Street and Central Park West. The course consists of a series of twenty-four lessons of three hours each, extending over a period of twenty-four weeks, during which time the student will have the opportunity not only to learn the technique of telescope making but will be expected to complete a telescope mirror which will become his own property at the end of the course. Special mechanical ability or previous technical knowledge is not required. The fee for the course, including necessary supplies, is $35. For registration, apply to Professor H. H. Sheldon, Director of Science Courses, New York University, Division of General Education, 20 Washington Square North, New York City.

Anthropology in New Mexico

The Trustees of the Laboratory of Anthropology, Santa Fe, New Mexico, held their annual meeting in the offices of the Department of Anthropology on November 21. The Laboratory is a research institution devoted principally to the anthropology of southwestern United States and northern Mexico, provided with excellent buildings in the original southwest style of architecture. This institution pursues a liberal policy in co-operating with visiting investigators in all scientific fields, several members of our Museum staff having been, at various times, its guests while carrying on field-collecting in the surrounding country. The Laboratory is intimately associated with the Indian Arts Fund, a local New Mexico body endeavoring to encourage the development of Indian arts and crafts to a higher plane of excellence; for example, pottery, which even now is a distinguishing feature of New Mexico. Further, this organization has gathered a collection of the masterpieces of Indian art, past and present, to serve as an inspiration to aspiring local Indian artists. The collection is on exhibition at Santa Fe.

The Rainbow Bridge-Monument Valley 1936 Expedition

Lying just East of the Colorado River in Northern Arizona, is a spectacular stretch of country consisting of irregular mesas and deep canyons known as the Tsegie Drainage. It comprises an area of some 200 square miles of varied topography, little of which, until recently, had been scientifically explored and mapped. It was a country which for many reasons offered an interesting challenge to scientific study. The Rainbow Bridge-Monument Valley Expedition has for several summers been making an exploration and study of this territory. The general object of the expeditions has been to obtain accurate scientific information regarding the scenic features, geology, archeology, topography and plant and animal life of this little-known region. During 1935 the expedition secured some 300 mammals which, through the generosity of Mr. Ansel Hall, were deposited in the American Museum of Natural History. This year the expedition pushed its activities farther North over the border into southeastern Utah, and Mr. Hall has again very generously contributed the mammal collection of 275 specimens to the American Museum of Natural History.

Education Notes

From January 18 to February 1, the Museum will exhibit in Education Hall a collection of water-color paintings of wild flowers of the eastern and southern states by Mrs. Mary Motz Wills. These paintings have also been shown at Harvard, the University of Pennsylvania, and the University of Georgia.

The American Society of Civil Engineers, which is holding its annual conference in New York City on January 22 and 23, has arranged for a specially conducted tour of the Museum with guides from the Department of Education.

On Tuesday evening, January 5, Martin and Osa Johnson will give a special lecture and first showing of their latest film entitled *Adventuring Through Borneo* to a large audience of Museum members. Admission is by a special ticket, issued to certain members only upon written request. Mr. and Mrs. Johnson have just returned from a fifteen months' expedition into the jungles of Borneo, with beautiful photographic results. The high spot of their experiences was the photographing and capture of orang-utans.

Data for Gobi-Alaska Relationship

Curator N. C. Nelson has just completed a review of certain chipped implements found in Alaska, partly by President Bunnell, University of Alaska, and by field collection in palaeontology operating under the direction of Mr. Childs Frick. The first examples of the flints came to notice several years ago and were recognized by Curator Nelson as the first known exact parallel to ancient implements found by him in the Gobi, Asia. Several hundred such flints from Alaska are now available and the classification of these leaves little room for doubt that an exact parallel exists between the prehistoric culture of Alaska and the Gobi. This comparative study was made possible by the Voss Fund for research in anthropology.

Amateur Astronomers Association

On Wednesday evening, January 6, Dr. Gerald Wendt, Director of the American Institute, will speak on *Cosmic Rays*. On Wednesday, January 20, the Association will be addressed by Dr. John Q. Stewart, of the Princeton Observatory, his topic, *An Astronomer Looks at the Modern Epoch*. These meetings are held at 8:15 in the auditorium in the Roosevelt Memorial Building, and are open free of charge to the public. If you or your friends are interested you will be most welcome.

Junior Astronomy Club

On January 2 Miss Annesta Friedman, Student Assistant at Yerkes Observatory, is to speak on *Working in an Observatory*. On January 16, Mr. William Fisher of the Fels Planetarium in Philadelphia, will speak on *Double and Variable Stars*. On January 30 Miss Dorothy Bennett, Assistant Curator, Hayden Planetarium, will talk on *Exploring the Moon*. These meetings are held on Saturday afternoons at three o'clock in the Roosevelt Memorial Building, and anyone interested is cordially invited to attend.

New Acquisitions

The collection made by the Shelton-Arthur Expedition to China and Borneo has been received at the Museum. The nucleus of the collection consists of twenty-four small Bornean mammals, which were collected in North Borneo and Sarawak by Dr. George Pinkley, Research Assistant on the James Arthur Foundation, and will be used in his studies on the brain. In addition, several gifts were made to the Museum through the agency of Doctor Pinkley, among them two specimens of the rare *Ptilocercus*, presented by E. Banks, Esq., of the Sarawak Museum, brains of *Hylobates* and *Simia* and six specimens of *Hylomys*, presented by F. N. Chasen, Esq., of the Raffles Museum at Singapore, two crocodile skulls and mandibles, presented by H. G. Keith, Esq., Conservator of Forests in North Borneo, two heads of the Giant Salamander, presented by Dr. A. B. Droogleever Fortuyn of Peking Union Medical College, and a head of *Macacus*, presented by Dr. Tsai Ai-le of the University of Hongkong. Also two endocranial casts of *Adapis parisiensis* were presented to the Museum, in care of Doctor Pinkley, by Dr. A. T. Hopwood of the British Museum of Natural History and two endocranial casts of mammal-like reptiles, by Dr. W. E. Swinton of the same institution. Twenty-three endocranial casts of Chinese, Australian, Bornean and Igorot natives were acquired by purchase from the University of Hongkong.

Visiting Experts

Several special studies of archaeological materials in the Museum are under way by visiting specialist Neil M. Judd, Curator of Archaeology, National Museum, Washington, D. C. He is in charge of the extensive series of excavations at the famous site in New Mexico known as Pueblo Bonito, supported in part by the National Geographic Society. Our Museum first worked on this ruin in 1896, securing a large collection, the choice pieces in which are on exhibit in the Museum Hall for the area comprising New Mexico and Arizona. This project was supported by the late Talbot B. Hyde. Curator Judd is preparing a final study of Pueblo Bonito and for the sake of completeness is studying the collection resulting from the Hyde expeditions.

Another distinguished visitor is Mr. Dale King, Archaeologist in National Park Service, stationed in Arizona.

Several years ago the Museum supported a project of archaeological exploration in that State under Dr. Leslie Spier, now a member of the faculty of Yale University. Doctor Spier used a method at that time new, the statistical classification of sites according to pottery styles. Though a technical matter, the basic principle in this method is to collect pottery fragments from equal units of surface at the different sites, classify these fragments and count them. The sites can then be grouped according to these figures. A large collection of pottery samples was brought to the Museum at that time. During the interval great advances have been made in dating ruins by classifying and counting the pottery fragments gathered as random samples. Mr. King's self-chosen task is to rework this material by the newer methods now available.

It is the policy of the Museum to welcome all serious investigators seeking light on their several problems, since it conceives one of its important functions to be the conservation of scientific materials.

New Brunswick Mammals

Ninety-eight small mammals were secured at Lakeside, near St. John, New Brunswick, Canada, by Dr. John Eric Hill, assisted by Mrs. Hill, during a combined vacation and leave of absence, August 10 to September 11, 1936.

The district around Lakeside is only partly cultivated or in meadow. Trap-lines were set along brooks, in cedar swamps, in second growth cedar and fir woods, in primitive hemlock-birch-maple forests, around the marshy margin of a small lake, in and on the edge of a meadow, and in a rocky, logged-off pasture.

Catches were relatively poor; the best night's catch was one animal per fifteen traps, the worst none in seventy-five traps. Short-tailed shrews were the most abundant; specimens were secured in each association. Long-tailed shrews were taken in the cedar swamp and along the edge of the meadow; two belonging to different species were brought in by a cat. Perhaps the most amusing incident of the trip occurred when a single bat was accidentally caught on a fly-paper in a house. Red squirrels were common in the woods, but chipmunks were rare; only one was seen and collected. A black woodchuck and one normally colored were trapped in a meadow-hillside. White-footed mice were taken in the woods and in the pasture. *Microtus* was found on the margin of the mixed woods, as well as in the meadow. Red-backed mice were taken in the cedar swamps and the cedar fir woods. Jumping mice were trapped around the lake, some in underground runways inhabited by shrews, and in the meadow, and a single woodland type (*Napaeozapus*) was found in the open cedar-fir woods.

Porcupines were common. One of their dens was found in a small limestone cave. A pile of the typical elliptical pellets, about a wheelbarrow-load, lay near the entrance and well marked trails led in many directions. There were several large hollow trees which showed signs of temporary occupation by these rodents. The porcupines girdle and kill many trees, and raid the fields of the farmers. They break down and destroy much more grain than they eat. Several skeletons were found in the woods, witnesses to the emnity of the local farmers.

The collection is from a region hitherto poorly represented in the Museum, so that it adds to our knowledge of the distribution of our North American mammals.

YOUR NEW BOOKS—*Restless Jungle—Peary—Romance of Tea—Furniture's Story—October Farm*

FROM FOREST TO FURNITURE

The Romance of Wood

- - - - - - - - - - - - by Malcolm H. Sherwood

W. W. Norton & Co., $3.00

FROM the main title of this book one might expect to find a scientific treatise upon the subject, but this is not the case. Instead we have here, as the subtitle indicates, the romance of wood from forest to furniture, evidently written out of years of experience by one who loves beauty in wood.

The book in the first part consists of sixty short stories, each about a kind of wood used in furniture;—and they are stories. The author is a raconteur who has the rare ability of "button-holing the reader in the first paragraph." If you start to read one of these stories, it is the belief of this reviewer that you will finish it.

These sixty stories are about woods from around the world, beginning with "An American Favorite—Walnut," but there is no continuity. One may begin in the middle as well as at the beginning. They are "one-smoke" stories, just the kind of book to dip into after dinner or before retiring.

In the Butternut or White Walnut, he discusses the "butternut-jeans" of our early American ancestors as well as the value of this wood for interior finishing, in the Birch, the *fasces* of the Roman lictors to the "birch rod" of the old-time schoolmaster, as well as the attractive "curly" birch used in various kinds of furniture; in the Maple, violin-backs and all sorts of furniture to the romantic sugar-making which came down to us from the Indians. And there are stories of Oak, Chestnut, Cherry, Mahogany, Ebony, Teak, Balsa, Redwood, Lignum Vitæ, and Rosewood.

The scientific data about these sixty kinds of wood are gathered together in condensed tabulated form in just six pages—six out of two hundred and eighty-four—in the back of the book. Here may be found the common names, scientific or botanical names, names of close relatives, geographical range or commercial source, weight per cubic foot, and color of wood.

"Chats on the Way Home," the author calls the second part of the book. While each story in the first part of the volume applies to a particular kind of wood, these "chats" are more general. In the first one, entitled "Wood and its Wonders," he mentions a certain species of Eucalyptus of the wilds of western Australia, which is reputed to be the tallest of all trees. He states that if two of these trees could be "placed side by side in front of the great cathedral of Cologne, their upper leaves would be hidden in the clouds the magnificent twin spires seem to support! And should they be planted in Monument Park, Washington, D. C., their tops would almost reach the aluminum cap on the Washington Monument! Living giants—five hundred feet tall!"

The chapter on veneer is most important, as well as interesting, on account of the still wide-spread belief that "solid" wood is better than veneered wood. The author shows convincingly that the opposite is generally true for various reasons, and states paradoxically that "furniture is beautified by wood, especially as veneer."

This is a chatty book and non-technical, in which are presented many fascinating facts about wood, woven into human-interest stories.

CLYDE FISHER.

PEARY

- - - - - - - - - - by William Herbert Hobbs

The Macmillan Co., $5.00

THIS is a scholarly review of the life of a great Arctic explorer. It gathers together and correlates facts with an essential bearing on the career of Robert Edwin Peary, 1856-1920, and is carefully documented throughout. Thus it deals in a measure with material already published by Peary himself, and by others, selecting and arranging it within the compass of one readable volume. Principal discoveries are illustrated by maps, discussed, and their bearing on the advance of knowledge of the north considered. It is shown how, in endeavoring to explain the hostile storm winds of the Greenland ice-cap, an important new field of meteorological inquiry was opened. In fact throughout the book the real though sometimes intangible bearing of exploration on the general advance of science seems to have been in the author's mind.

The outstanding adventures and hardships, feats of daring and endurance, of Peary's classic struggle with the north in his at first defeated and finally successful campaigns to reach the Pole are narrated. Earlier chapters dealing with his boyhood, undergraduate days at Bowdoin, and starting as a surveyor at Fryeburg, Maine, are no less interesting. Here one sees the physical hardihood and dominant personality develop, which turned northward by chance or destiny, would not stop short of this goal.

It is rarely that one finds a man as divergently evaluated by his associates and contemporaries as was Peary, and it is presumably with this in mind that the facts of his human relations are carefully set down throughout. No man could have had more loyal supporters who saw his inflexible purpose and sense of personal responsibility combined with extreme unselfishness and considerateness. Yet he had constantly to meet the hostility of those who saw him in other light. Mayhap his purpose at times caused him to overlook others, as it did to forget himself. An extract requoted from his diary at 89° 55′ 22″ north latitude reads: " . . . 'The Pole at last. The prize of three centuries. My dream and goal for twenty years. Mine at last! I cannot bring myself to realize it. It seems all so simple and commonplace' . . ."

"The determination to reach the Pole had become so much a part of my being that, strange as it may seem, I long ago ceased to think of myself save as an instru-

ment for the attainment of that end. To the layman this may seem strange, but an inventor can understand it, or an artist, or any one who has devoted himself for years upon years to the service of an idea" . . . Such a person was not one to compromise readily with man or fate.

The book deals successively with Peary's early years; Government service including exploratory surveys in Nicaragua; preliminary Arctic expeditions in the course of which the Cape York meteorites now in the Hayden Planetarium were brought to New York; direct assaults upon the Pole, at last successful; misunderstandings, honors and interests of later years. Appendices comprise a Peary ancestral chart, his bibliography and other matter.

Throughout his life Peary had the facility of expressing his keen dramatic appreciation of the grandeur and beauties of nature, so that now as we follow the narrative of his hardships, adventures, disappointments and final success, his quoted words make the cold beauty of the Arctic something real.

J. T. N.

Restless jungle

- - - - - - - - - - - - by Mary L. Jobe Akeley

Robert M. McBride, $3.00

MRS. AKELEY'S latest book is rich and full of interest for all who love animals, travel, and adventure. Her experiences in Central Africa in 1926-1927 left her with a deep interest in the life of that great continent and an abiding longing to return to it. In 1935-1936 she realized this dream, traveling not in the area made familiar in her previous books, but in South Africa, and especially in the Transvaal, southern Portuguese East Africa, and Natal. This book is a result of that visit, but it is not a conventional travel narrative, in the manner of a diary. It is, rather, a logical sequence of discussion of the things that most interested Mrs. Akeley, and that will surely most interest the reader, against a background of personal experience that sustains attention and gives authenticity.

A first desire was to visit the Kruger National Park and lesser game reserves and to see what has been accomplished toward saving the fauna of South Africa, so much of which seemed headed for extinction a few years ago. Mrs. Akeley's report is, in this respect, extremely cheering to all conservationists. "As a result of the warden's understanding of the needs of the animals, and his constant care for their safety," she writes, "the herds have increased astonishingly, and at last the balance of nature has been re-established. Today, in the Kruger National Park there is probably a greater variety of wild life existing in larger numbers than in any other area of similar size in the entire world." The old life of Africa, before the coming of white men, has in considerable measure been reconstructed here. Mrs. Akeley emphasizes what has been accomplished in this respect, just as she emphasizes the more pleasant aspects of human contacts later in the book, and in both cases the result is good reading. It is not concluded, however, that this measure of success in conservation is sufficient nor that it warrants relaxation of effort.

Within this renewed paradise, Mrs. Akeley saw and photographed many species of animals new to her, despite her earlier African experiences, and in each case her enthusiasm is so great and is so well communicated that the reader cannot fail to feel the excitement of the bloodless hunt and the deep thrill when at last some noble creature, great or small, is seen pulsating with life in the midst of its primordial environment. There are numerous lion stories and although these are customary in African books, they are here far from being usual. Elephants, roan antelope, and white rhinos also have chapters of their own, and many other animals, as well as the beautiful scenery and plants, are vividly discussed.

Much space is also devoted to the human inhabitants of this distant land, and especially to the Swazis. They are treated in the best way, without any assumption of superiority and yet without the opposite fault of expecting them to be other than what nature has made them. With no attempt at anthropological study, but borrowing some interesting background from such studies by others, friendly and human contacts with the Swazis are described and much of their daily life and of their recent history is given. Both in this section and earlier in the book something is also said of the whites who have carved out fortunes or careers for themselves in Africa, and of those concerned in safeguarding the animals and in helping to govern the natives. Abundant anecdotes, such as that of the sea-captain who navigated on foot by sextant five hundred miles inland, tempt quotation but should be read in full.

The book is copiously illustrated, for the most part with photographs taken by Mrs. Akeley in Africa, but also with five views of exhibits in the (Carl) Akeley African Hall of the American Museum.

G. G. SIMPSON.

October farm

- - - - - - - - - - - - by William Brewster

Harvard University Press, $2.50

WILLIAM BREWSTER was among the foremost ornithologists of his time but his gifts to posterity were so far below his potentialities that few bird students of today realize the influence he exerted during his life. For this reason we welcome the publication of these selections from his Concord journals covering a period of forty-seven years (1872-1919). In a measure, at least, they will serve to keep his memory alive, they will also reveal his close, loving association with nature, his keenness as an observer and his care as a recorder. But, unless one has the gift of reading between the lines, they will tell us little of William Brewster. Fortunately, this lack is in part supplied by Daniel Chester French's biographic introduction written in 1931, a short time before his death.

Doubtless no one was better qualified to write of William Brewster the man than his life-long friend, Daniel French. The bonds which united them in boyhood were too strong to be broken by the passing years and widely separated homes, and to the end they kept in touch with one another. There has been no better world-picture drawn of Brewster than that which French here contributes, and it is pleasant to recall that French is also the author of the portrait of his friend which occupies one side of the medal now annually awarded by the American Ornithologists' Union for the most important work on American birds during the year.

Brewster wrote for publication with great difficulty. "With me," he once said, "writing is a piecing of words together." But as one reads this clearly expressed, easily flowing, daily record he asks why its author could not with equal facility have prepared manuscript for the printer? The answer is that his standards were so high that he could not readily reach them, and, as French here says, a "lack of confidence" in his own powers.

French's tribute to Brewster's personality could be written truthfully of but few men. To all that his friendship and insight prompted him to say we may add that no one could know William Brewster without realizing that in him was embodied the best the human race had produced. His attitude toward his fellow-man inspired the belief that possibly we each had within us some of the elements that made him a man among men.

F. M. C.

THE ROMANCE OF TEA
- - - - - - - - - - - - - by William H. Ukers

Knopf, $3.00

IT would be hard to find a three-letter word that brings to mind a greater and more diverse array of associations than "tea." China, England, India, Ceylon, revolution, racing clippers, Eastern ceremony, tired nerves, social gatherings—these are only some of the things that one thinks of. In *The Romance of Tea,* William H. Ukers fills 376 attractively printed pages with history, folk-lore, social customs, art, literature, science and agriculture, all tied together by this magic plant.

Although familiar to every English speaking child throughout the world, tea is a word that Shakespeare failed to use for Shakespeare lived in a tea-less England. Lu Yu's three-volume *Ch'a Ching* or Tea Classic, as it is sometimes called, had been published nine hundred years when Englishmen first learned to drink tea. Yet today five times as much tea per capita is consumed in England as in China. Even America has learned to use almost as much tea as China exports and this in spite of that most prolific of tea parties at which our nation was conceived. These are only samples of the many facts to be found throughout this fascinating book.

The body of the book is divided into three parts, the first historical, the second technical, and the third social. In the first, tea is traced from its legendary origin in China through its conquest of the Orient to its introduction into a near-conquest of the Occident. Even Madame de Sévigné made a contribution to tea-lore by being, in 1680, the first to record the mixing of milk with tea in Europe. True to form this incomparable French letter-writer ascribed the recovery of Monsieur le Landgrave to forty cups of tea. If this same Madame de Sévigné had not prescribed freshly cooked vipers as a general tonic I could take her statement about the medicinal value of tea more seriously. A whole chapter is devoted to the clipper ships; the Great Tea Race of 1866 is described in detail. In that most dramatic sea race the *Ariel* was only five miles ahead of its nearest rival, the *Taeping,* at the finish of the course from China around Africa to England. The time was ninety-nine days for both.

The second part describes the growth and manufacture of tea and gives a brief statistical account of its commerce. Fully half of this part is devoted to tea manners and customs in various parts of the world. Among other interesting facts, the difference between green and black tea is shown to be one of manipulation, since both kinds may be produced from leaves growing on a single bush.

The first chapter of the last part takes up tea in painting, ceramics, silver, music, poetry and literature. From this treatment of tea in the fine arts, the reader is taken in the final chapter to more practical aspects of tea: its chemistry and pharmacology, its virtues as the greatest of non-alcoholic beverages and, finally, to detailed directions for choosing and making tea to perfection.

The well chosen illustrations are beautifully reproduced and a good index increases the usefulness of the book.

CLIFFORD H. POPE.

ANIMALS OF THE CANADIAN ROCKIES
- - - - - - - - - - - - - by Dan McCowan

Dodd, Mead & Co., $3.00

DAN McCOWAN, well known as a successful photographer of wild life and lecturer on that topic, has written an attractive book. In *Animals of the Canadian Rockies* he fully demonstrates his success with the camera and presents to the reader understanding and appreciative life histories of a number of Canadian mammals.

The book is divided into twenty-three chapters, each devoted to a species or a small group of species, ranging in size from a grizzly bear down to the common shrew, from the greatest to the least. Habits and other pertinent data are set forth in a very readable style. The author has made a wise selection of his facts and instead of giving a dry, encyclopedic account has brightened his passages by well chosen anecdotes. While preserving the good qualities of the essay, he has introduced the sustaining interest of the narrative and one reads to be entertained, absorbing instruction with a minimum of conscious effort. As a source book for students or as a reference to be cited in reply to the numerous queries as to what mammals do and why they do it, this work will be exceedingly useful.

A proper understanding of any mammal calls for an appreciation of the ecology of which it is a part. That is to say, one cannot expect to truly know a mountain goat by observing the animal in a zoological park. The mountain goat is an inseparable part of a mountain topography, a dweller on lofty crags, a creature of the great open spaces where he displays a majesty of carriage and a fitness to environment never perceived in a zoo animal. The nature lover realizes all this and derives no small part of his pleasure, in photographing wild animals, for example, from the wilderness setting in which he discovers his subject. McCowan is attuned to the environment in his animal biographies.

As a corollary to this thesis, the writer on life histories must take into account the many environmental factors that work upon the mammal. The killer instincts that make a mink in a hen roost a creature beyond the pale, do not ordinarily find an outlet for expression in an uninhabited fastness, and this mammal is an interesting and valuable part of the fauna. Mr. McCowan displays the ability to take his mammals as he finds them and to discover likable qualities in spite of the black marks on the record. His account of the coyote, under the heading "Voice of the Western Wilderness" depicts a maligned and harassed animal, with a depth of understanding much to be commended.

His sentiments are well expressed by the sentence which concludes his story of the chase by two hounds of a coyote which angled down alternate sides of a barbed wire fence to eventual safety. "I was glad when it finally reached a haven in the scrubby thicket, disappearing, not with tail in air, but in all likelihood tongue in cheek." He does not ignore the characteristics of animals which sometimes bring them into conflict with economic interests. He states the facts as he sees them, and a proper sense of discrimination discloses that, in Canada at least, this conflict seldom assumes significant proportions.

To illustrate this point McCowan writes: "When salmon are plentiful, as in many British Columbia streams, the otter catches more than it can eat, taking only the choicest cut and leaving the rest on the river bank . . . But there is really no waste, for here in Canada at least, the otter often provides a free fish dinner for the magpie and the mink, . . . and many other creatures which eat salmon or trout when such food is available."

H. E. ANTHONY.

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[*THE RARE OKAPI—See page 116*]

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

VOLUME XXXIX ★ ★ ★ ★ ★ ★ FEBRUARY 1937

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Secretary, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

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THE GREAT SALT

There is perhaps no better proof of the mighty influence of salt on the history of mankind than this beautifully wrought vessel. Only a craftsman living in a civilization that had the highest regard for this now commonplace mineral could have devoted so much of his art to the creation of a salt cellar.

Above is a photograph of the famous salt presented to New College, Oxford, in 1492.

THE STORY OF SALT—*Once cherished as the symbol of Life, and a cause of bloody wars, this most commonplace of modern commodities is still one of the most valuable to Man*

By HENDRICK WILLEM VAN LOON

With Drawings by the Author

A GENTLEMAN is hungry and he wants something to eat in a reasonably short time. When he walks into his restaurant he has no expectation of paper pantalets on his lamb chops. He is looking for a square meal quickly served, and he gets it. Absently he reaches for the saltcellar—an aluminum-capped piece of glass you could buy in any 10¢ store, and perhaps a little greasy to the touch. Just as absently, he salts his food, unmindful of the spray of minute, curiously uniform white crystals. Soon his knife pries off part of the over-yellow butter chip and spreads it on a roll, and the mechanics of meal-eating proceed.

Food laws or no food laws, that over-yellow butter chip is too heavily salted. There is a surplus of salt over and above that needed for preserving, and that excess is an *adulterant*. What, salt so cheap it pays to use it in the dilution of staple foods? How are the mighty fallen! And that saltcellar, that flimsy atom of mass production, manufactured at the price of a daily newspaper—is this the modern survivor of that noble dynasty of table-ware once wrought by the most articulate hands in all metal craft, the incomparable Cellini's? Table-ware that was, in truth, the very touchstone of medieval wealth and prestige? Verily are the mighty fallen!

But the gentleman is not much concerned with all this. He is busy feeding himself; eating, not

thinking about, salt. His mind is elsewhere and on other matters. But if you asked him, he might tell you of a friend of his, a manufacturer whose laborers, toiling in the frightful heat of a foundry, were subject to painful heat cramps. The efficiency of his friend's business was at stake. Something had to be done. Then he recalled that mine operators had recently discovered that a small amount of salt dissolved in the miners' drinking water would soon relieve all such complaints. This practice was soon installed among his own employees and the heat cramps rapidly disappeared.

Perhaps the gentleman might tell you of some other acquaintance who had a dangerous brain tumor and had to have an immediate operation. "The

tumor was so large, and consequently the brain so swollen, that it would have been fatal to open the skull," he would say, "but what do you suppose they did? Well sir, they just gave him an injection of common salt solution, and would you believe it, the brain actually shrank, in a couple of hours, to sub-normal size. They opened the skull, cut out the tumor, and now he's walking about just as strong and healthy as ever."

But what is the tone behind these little speeches? What is it that impresses the gentleman? Why it's the fact that this cheap, little, common, ordinary salt actually can do rather wonderful things.

Ah, but peel away the centuries! Picture a rude and rutted clay road, slimy under a stinging rain, cutting through a forest in ancient Britain. Rough carts bearing a precious burden wallow in the mire. At length they reach a river, swollen with the downpour. The road ends in a scattering of squat huts, obviously constructed for the shelter of trans-

porters awaiting the receding of the river before fording. The precious burden is salt. The river (then much shallower) is the Thames; the scattering of huts, London.

Now in another land: A sun-baked market place, filled with stench and the high-pitched babble of myriad oriental voices. A black girl stands, chained and half naked, on the slave block. A splendid physical specimen—and who can deny?—perhaps an immortal soul. She is quickly purchased. Her price is little more than a handful of reddish mineral substance, not the fine, bleached crystals in the 10¢ shaker, but nevertheless salt.

Deep in the interior, jungle tribesmen suck rarely comeby rock salt as children do sugar plums, and sometimes, so great is their desire for its flavor, even resort to cattle urine.

A Roman patriarch lies on his death bed. His worldly possessions are to be passed on to his eldest son. Among the very dearest is his large silver salt vessel, his salinium, *sine qua non* of all patrician feasts, which must grace the table of the guest of honor, and be a silent witness and participant of all domestic sacrifices.

The first century after Christ: Europe, a rugged wilderness peopled by fierce nordic tribes. Bull-

chested warriors, bearded and clad in crude armor, meet in bloody battle. To the victor shall belong the spoils. Thousands of these two tribes, the Hermanduri and the Chatti, are slain. But to the victor belongs a thing of great price, a salt-producing stream.

Come the Dark Ages: They pass away as crusades open trade routes.

In feudal society

Torchflares, guttering in their wall sockets, light up a Baronial dining hall. On a raised dais, the host and his family are seated, and with them visitors and companions of noble mien. The lower portion of the hall is given over to the commoners, the retainers, the folk of lesser rank. Separating them —a veritable shibboleth of the entire structure of feudal society, is "The Great Salt," its majestic beauty at once a memorial and a symbol of the age. For generations, the English home preserved this custom, and from its practice arose the expression designating those of the lower classes, who "sit below the Salt."

Even as the gentleman at the lunch counter fret-

fully pounds his moisture-clogged salt shaker, an elderly pious lady of the old school may be reading on some vine-shaded porch how "The Lord, the God of Israel, gave the kingdom of Israel to David forever, even to him and to his sons, by *a covenant*

of salt." Surely salt has today tumbled to a low estate, has reached a dolorous pass.

A symbol of blood-brotherhood

The covenant of salt plays a mighty part throughout the history of all oriental and primitive people. Says Henry Clay Trumbull in his excellent work, *The Covenant of Salt,* "It has among primitive peoples, and ever has had, a sacredness and depth of meaning far beyond what is involved in the ordinary sharing of food. A covenant of salt is permanent and unalterable." It is the ageless creed of nearly every oriental that whosoever eats another's salt in any form, whether it be in bread or meat or in its raw state, that these two shall henceforth be fast friends and blood brothers, espousing each other's causes and protecting each other against all harm. Thus among the Moluccas comes the expression of "drinking an oath" instead of swearing an oath, because the pledge was made by downing a solution of salt water. The expression of undying friendship, "There is salt between us," and the Arabian proverb "My bread has no salt in it"—a means of accounting for an act of treachery toward one who was a partaker of the bread of hospitality —are also derived from the same source.

The story is told of an explorer who was captured, albeit with solicitous oriental ceremony, by an Arab bandit chief. As they sat in the captor's tent, the explorer drew out a case and proffered it to the Arab. The latter glanced at its contents, pure white crystals of European salt, and mistook them for sugar. He took a pinch and tasted. Quickly the explorer placed some in his own mouth. "Is it *sukker?*" inquired the chief's underlings. "No," he cried in dismay, "it is salt." The Arab's hereditary mores, ineradicably instilled by the ages, forbade that he molest or rob the explorer. Indeed, so the story goes, the robber tribesmen started him again on his journey crying "Peace be with thee" to their salt-brother.

Arabi Pasha, once Khedive of Egypt, was faced with the necessity of raising a considerable sum of

money from his people, who had been taxed heavily and were poorer still as a result of a famine. He could not, with safety, impose any further taxes. Presently he hit upon a way out of his dilemma. He ordered his officials to go, early in the morning, and deposit, on the threshold of the houses before their inmates had arisen, four pecks of salt to every two males.

Of course, by the ties of ancient custom, any man crossing the salted threshold was automatically brought into a covenant with the giver. Later in the day, soldiers called at the houses to collect whatever the people would give, according to the dictates of ancient custom, as a reciprocal gift to their king. The appeal was irresistible. Gifts flooded into the royal treasury. And the least that even the poorest man gave, was the price of the salt he had received.

Burton's *Arabian Nights* contains numerous references to this holy covenant of salt. The robber

captain in *Ali Baba and the Forty Thieves* is discovered by his unwillingness to partake of the salted food of the man he plans to murder.

There is a story told, how in a Persian city a clever and daring young outlaw discovered secret access to the king's treasure house, and how, under cover of night, he stole quantities of priceless jewels. But as he was making his way stealthily out of the chamber, he stubbed his toe on a hard, sharp stone. Thinking it might be a diamond he picked it up and tested it with his tongue, after the manner of lapidaries; it was rock salt! Immediately he put down all that he had stolen and left the palace empty handed. The next day, evidence of the abortive theft was discovered, and the king, with mingled joy and curiosity, issued a proclamation that if his unknown visitor would make himself known, a reward would be bestowed on him. The young outlaw came and told his story to the king. So impressed was the potentate by the young man's rigid observance of the sacred dictates of the salt covenant, that he raised him to a position of great honor in the realm.

Imagine the "first men" of two desert tribes gathered to solemnize the declaration of peace and amity between their respective peoples. Inside the spacious striped tent, sheltered from the burning heat of the sun, they squat silently in a circle. The host claps his hands and servants appear, bearing trays of bread and salt. Thereupon, all participants dip bits of bread into the salt dish, and beginning with the chieftain host, they eat, first declaiming "Salaam —I am the friend of your friend, the enemy of your enemy." The imperishable covenant of salt is now sealed. Each tribe is henceforth certain of the other's support in all ventures, and the salt they have shared is held mutually as a talisman against all evil. Persian and Arabic folklore is thus strewn with examples of the importance of this cherished mineral.

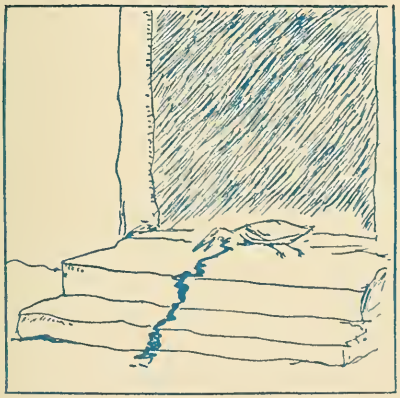
Among primitive peoples, whole ideologies are centered in salt, and the religious rites and ceremonies involving its use are legion.

Back in the days of your childhood you may remember how you and your friends caught house flies, pushed them into vessels of water and submerged them. Presently you pulled two of the unfortunate victims out of the water and placed them on the table. Selecting one of them, you sprinkled it liberally with salt. After a minute, he wiggled his legs. Then he began to shake himself free of the encumbering salt grains. Finally he took to his wings and flew away. The other fly remained motionless. This is but a modern instance of how from earliest times, salt was looked upon as a giver of life. Indeed, in many cults and religions it is identified with life so much as to be its very symbol.

This is not surprising when one remembers the primitive methods of salt manufacture. Either sea water or the liquid leached from certain plants known to contain salt, was placed under the rays of the sun to be evaporated. That Chinese authority of some four thousand, seven hundred and sixty years ago, the Peng-Tzao-Kan-Mu, records that "In the province of Chi-Li, ash from salt plants is boiled in a kettle with sea water over a fire made of salt-weeds. The liquid is evaporated until an egg floats." Now it is well known that the sun has been often times celebrated by the ancients, and indeed

peoples of all races, as the giver of life. Therefore, it was but an extension of the same idea that salt, since it was directly produced by the sun, was likewise a giver of life. "As the sun shines upon the water drawn from sea or lake, the water is evaporated and the salt remains. This is the ordinary process of salt-making with all its benefits in various countries to the present day. What thought is more natural in view of this recognized fact, than that the sun is the generator of the begetter of salt, which is life. If the sun is supposed to bring life, in what way does it more directly accomplish this, than by this salt creation?"*

Anthropological researches mention the custom among many peoples of drinking the blood of freshly killed fowl or cattle. Practitioners of this unsavory habit, it was noted, are indifferent to the use of salt in their food. This fact led to the belief that the salt contained in the blood was sufficient to allay all desire to eat it directly. The practice is reflected in the mores of diverse primitive communities, "the indications being that blood and salt are recognized as in some sense interchangeable in their natures, qualities and uses."† For instance, upon the arrival of a distinguished guest, an animal or bird is often slain and its blood poured over the threshold of the house, symbolizing the blood kinship which is to obtain between host and guest—their communion in the very essence of life. But when the arrival is unexpected, or there is no living sacrifice at hand, salt is often substituted for the blood offering.



Allusions to the high estate of salt are found in profusion throughout antiquity. Plutarch avers that "There would be nothing eatable without salt, which, mixed with flour, seasons the bread also. Hence it was that Neptune and Ceres (or Poseidon and Demeter) had both the same temple." And Pliny discourses lengthily on the uses of salt, closing in thunderous eulogy, "We may conclude, then, by Hercules! that the higher enjoyments of life could not exist without the use of salt: indeed, so highly necessary is this substance to mankind, that the pleasures of the mind, even, can be expressed in no better term than the word 'salt,' such being the name given to all effusions of wit. All the amenities, in fact, of life, supreme liberty, and relaxation from toil, (in a word 'life') can find no word in our language to characterize them better than this."

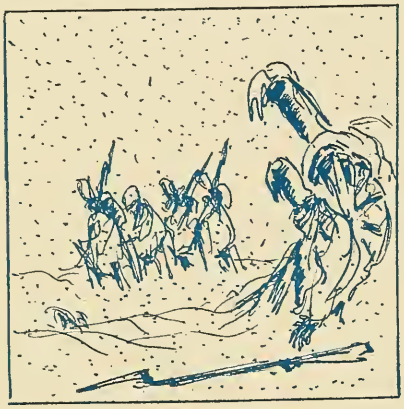
In the restaurant, the gentleman sips his coffee approvingly. "Quite a flavor these big drip con-

traptions give it," he murmurs to himself. Out in the kitchen, a cook lifts up the shiny lid of the "contraption" and spreads a sprinkling of salt over the layer of ground coffee. The gentleman grows reflective over the steaming cup, and perhaps he ponders on his younger days and on the many changes that have come in the intervening years. But what of that little white mineral so near his hand—what changes has it seen, and caused!

A strategic part has been attributed to salt in many of the great military engagements of the last four centuries. Richelieu pointed out its importance in the wars with the Huguenots. Napoleon's soldiers, on the celebrated retreat from Moscow, died by thousands of wounds whose failure to heal was attributed to prolonged deprivation of salt. It is al-

*†Trumbull, Henry Clay, *The Covenant of Salt.*

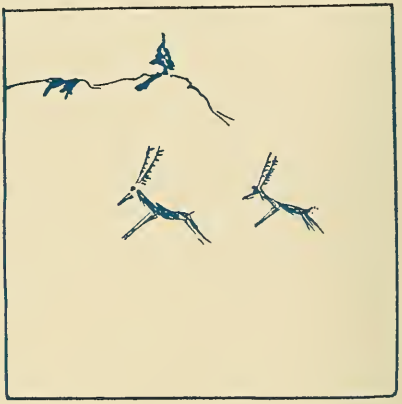
leged that troops in the Paraguayan war of 1864 died of the slightest hurts because their systems had been without salt for months. In the American Civil War several minor campaigns were focused on the



possession of salt sources, notably the Union General Burbridge's expedition leading to the capture and destruction of Saltville.

History is filled with illustrations of the economic pressure exerted on a people by lack of salt. It has forced them to make war, drive hard bargains, migrate, build ships, roads and cities, and enter into commerce on land and sea. This fact has attracted the attention of numerous historians and scientists, and several theories have resulted. It is generally agreed that the idea of any commodity's value being directly proportional to its scarcity or inaccessibility, applies to salt as well as other exchangeable goods, so that salt, throughout the centuries, has gradually lost caste socially and decreased in commodity value as the methods of manufacture were improved and as the sources, through trade, increased transportation facilities and conquest, became more accessible. This much being granted, what puzzled the theorists was the question of the essential physiological motivation behind these empirical mass movements.

Now, scientists noted that the desire for salt was detectable in nearly every branch of the animal kingdom. Almost every herbivorous animal and a few of the carnivorous are partial to salt. Cattle and deer are well known to travel great distances and endure many hardships to reach "salt licks." Ponies in some parts of Africa have been said to go so far as to nibble the sweat-dampened hair of their sleeping owners. The popular belief that monkeys pick lice out of each other's coats and devour them has been shown to be untrue. Actually, they pluck bits of dried skin and loose hairs flavored with the salty gland excretions of the epidermis.

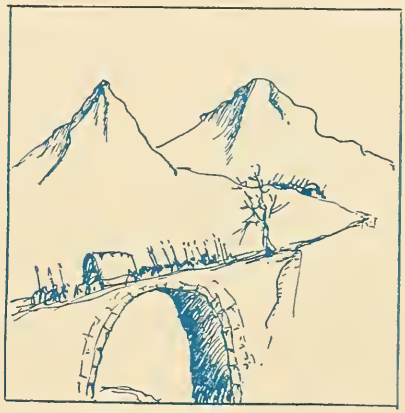


Investigations of the human love for salt revealed that pastoral nations, subsisting on a diet largely made up of meat and milk, and those who hunted their food, were much less inclined to relish salt than the nations living mostly in tropical climates and thriving on bulky cereal foods like maize and rice, or on green vegetables. Science soon peered into the matter of the physiological need for salt. It was ascertained that the human body required a certain percentage of mineral salts, chief of which was sodium chloride. It was then pointed out that various foods differed in their salt content. Meat is richest in salt, especially when roasted or eaten raw. When boiled, meat loses most of its mineral value. Vegetables, in general, contain less salt than meat, and cereals have the lowest mineral content of all. Here, then, was material aplenty for the theorists. It was not long before a widely accepted explanation was evolved of the motivating power of salt in the process of civilization. The theorists held that those fish, meat and milk subsisting tribes who lived in regions where there was no ready source of salt, were not driven to seek out any such source because their physiological salt requirement was satisfied indirectly through their diet. But those tribes who were so unfortunate as to be settled in climates offering largely vegetables and cereals were forced to wring salt from the plants and streams, to supplement a minerally deficient bill of fare.

This seemed an excellent solution to the problem

of why successions of Chinese governments from the earliest record to the present day had been able to depend for the major part of their revenue on the monopolization of all the salt sources and the imposition of heavy taxation of a people for whom salt was a necessity of life because of the predominantly cereal diet. Now, the Chinese, for many extraneous reasons, have remained static for centuries. This people did not interest the theorists beyond the fact that the salt monopoly, always jealously guarded by a ruling class, seemed to retard any progress among the masses because the monopolists cared nothing for improving the means of production and accelerating the distribution of salt.

But since this physiological basis had been established, would it not be possible to further implement it in the formation of some general pattern that people had tended to follow as they progressed toward civilization? They reasoned thus. In proportion as a people moves inland, their need for this mineral increases. Gradually, they begin to feed more on grains, fruits and vegetables, and less on the fleshly prizes of the hunt. Then as, slowly they pass from a pastoral state to one of agriculture, the demand for the satisfaction of the basic requirement definitely asserts itself and a fixed and plentiful source must be secured. Hence the innumerable wars over salt deposits, recorded in the histories of grain-eating tribes in every corner of the globe. Control of a nearby source of salt was one essential of the characteristics of a properous sedentary community. More enterprising settlements were wont to hire out the privileges of their source to less fortunate tribes, and there was a resultant stimulation of commerce. As colonization spread and cities arose, land and water trade routes came into being. Throughout antiquity and the middle ages, salt ranked with spices and seasonings as the most

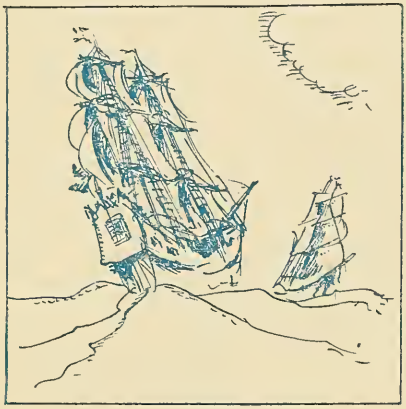


important commodities. Of course, by the time this stage of development was reached, salt had long since passed beyond the category of a simple comestible and certain of its pharmaceutic values had been discovered. Even savages, in isolated settlements where it was plentiful, were known to have used it as a cure for snake bites and spear wounds. Then too, the widespread sublimation of the mineral as an indispensable symbolistic factor in religious ceremonies, had taken firm root in the Hellenic, Roman and even European mores, as well as in the Far East.

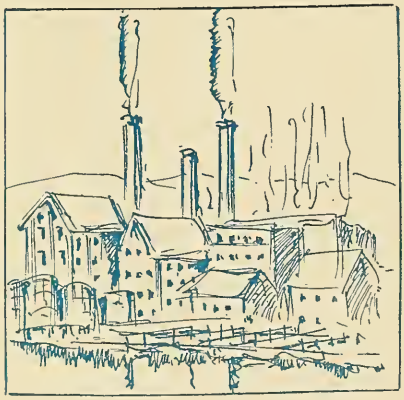
Most important of all was the prevalent use of the preservative properties of salt. These properties were, of course, the independent, simultaneous discoveries of many primitive peoples, and were the basis for much of the religious significance with which salt was endowed. As a preservative, salt remained unrivaled for centuries. The more civilization progressed, the more demand there was for this mineral, and correspondingly, more and more sources were come upon and utilized.

The intricate skein of trade routes doubled and redoubled. Powerful nations arose, whose armies and navies fostered commerce by diminishing the risk of piracy and banditry. Discovery and colonization took place, a bigger and more populous world was opened up. Soon man contrived the steam engine and further speeded up the process of exchange. Still, in all this time, the methods of manufacturing

salt had changed scarcely at all from those in use four thousand years ago. Not until one thousand eight hundred and eighty-six years after Christ was any fundamental change made. In this year, Joseph



Duncan, an American, started his own salt company at Silver Springs, New York. He employed a revolutionizing new method—the vacuum pan evaporation process, in use today. Up until this time, only the expansion of markets and trade routes threatened and indeed, slowly undermined salt's



great and ancient social prestige. This invention was surely the death-blow. From that time forth, salt was so plentiful and so cheap that the basic need of every man, woman and child could be gratified easily. It quickly became so common an article of diet that people like the gentleman in the restaurant would seldom pause to think about it, let alone reverence it.

Salt in diet

Briefly sketched, this was the picture of the rôle of salt in the civilization of the human race, as painted by the theorists. It was based on the belief that the human body required an absolute and more or less constant minimum supply of sodium chloride in order to function properly, if at all. But as medical science began to probe more deeply into the mysteries of animal metabolism, its exponents grew increasingly skeptical of this alleged minimum physiological need. The time came when it was irrefutably demonstrated that common salt was only one of several equally important minerals necessary to the human body, and that the basic requirement was so small and indirect assimilation so easily incurred due to the profuse distribution of salt in nature, that it was seriously doubted whether salt itself was an essential aliment at all. One scientist arose to the defense of the old theory, attempting to make it compliant with the new discoveries by slightly altering its fundamental assumption. Bunge, a French chemist, after restating the numerous instances of the avidity with which agricultural communities seek after salt, submitted that while the minimum need for sodium chloride might not be the cause, it could very well be that the high potassium content of most plant diets sets up a pressing need for common salt in order to create a proper mineral balance in the system. This seemed a logical and up-to-date interpretation. But a compatriot of Bunge's, Dr. Louis Lapicque, neatly punctured this hypothesis. He supported the assertion that certain African tribes leach "salt" from the ashes of plants which they have found by trial and error to contain the desired flavor. But he pointed out that in the overwhelming majority of cases these plants proved to be rich in potassium! Moreover, he stated that these tribes were quite without enthusiasm for the taste of pure sodium chloride. Indeed, they declared it to be too "flat" and much preferred their native product. In conclusion, Dr. Lapicque stated that the evidence was preponderantly in favor of salt as a condiment rather than an aliment.

This contention was ably championed by the noted Arctic explorer and anthropologist, Dr. Vilhjalmur Stefansson. Doctor Stefansson has spent much of his life among the Eskimos, a people who disdain to use salt in any form but who are inveterate tobacco addicts. Until they came into contact with white men who did not use it, they were so firm

in the conviction that tobacco was beneficial both to children and adults that they put it in the mouths of babies only a few months old. While living among them, Doctor Stefansson mildly opposed this practice, but at the same time lamented the

lack of salt with which to flavor the native food. One of his more intelligent hosts thereupon inquired whether the white men, since they could get along without tobacco deemed so essential by the Eskimos, could not by the same token dispense with salt as his people did. This seemed logical enough, since Stefansson could see no reason for believing that men living in opposite ends of the earth differed basically from one another. He soon found that after a time he did indeed lose his taste for salt, and that when by chance he did acquire some, he had little inclination to make use of it. On subsequent Arctic expeditions, Stefansson was faced with the problem of breaking his men of the tobacco habit and of the custom of salting their food, at one and the same time. He found after experimenting on an appreciable number of cases that it took an equal length of time and entailed equal difficulties to be rid of each desire. His men learned to do without both salt and tobacco, and as far as he has been able to discover have suffered no ill effects therefrom. After such experiences, Stefansson could not choose but to regard salt as a condiment, not an absolutely necessary addition to the human diet.

Biologists have reported instances where the growth of chickens and small animals was greatly aided by the addition of salt to their diet, and in fact have demonstrated that dogs entirely deprived of salt soon die. However, this was an artificial case. The dogs' food was deliberately treated to remove all sodium chloride, whereas in the natural state there is no record of any absolutely salt-free diet having ever been found. As against this evidence, Stefansson submits the case of certain members of the deer family both in Montana and Maine. The Montana deer seem to desire salt because they seek salt-licks. But, so far as Stefansson knows, there is no evidence of similar licks nor of any search for them by deer in Maine's interior. Yet both groups seem equally prosperous. Stefansson's explanation is interesting in the extreme. Great wind storms periodically blow clouds of alkaline dust over the grazing lands of Montana, leaving a saline deposit on the grasses which form the chief food of the Montana deer. Thus, for generations, this species has been unwittingly introduced to the taste of salt and has developed a pronounced habit which it has neither the sense, inclination nor need to break. Maine, on the other hand, is unvisited by dust storms, and has a distinctly non-alkaline soil. Therefore its deer have never known salt-flavored food and have consequently formed no

habitual liking for it, but on the contrary find its taste foreign and unpleasant.

Stefansson has come to believe that the predilection for salt, like that for tobacco, is almost entirely a conditioned response, since salt is sufficiently abundant throughout Nature to satisfy the chemical needs of the body. Indications are, then, that salt is a condiment and that the pressure exerted by the lack of it on man and animal alike is due to a sensory craving arising out of the environment of the species in question. It is amazing to conceive that throughout history men have performed such feats to secure salt and have at times almost deified a substance whose

importance lay largely in the fact that their palates had grown fond of its taste.

Orthodox scientific procedure would demand that

extensive research be made into the geological and botanical conditions that existed among peoples addicted to its use. If it could be shown from such investigations that the soil and therefore the plant and animal life of such regions had been gradually depleted of their ancient mineral content, owing to centuries of rainy seasons, or other causes, the idea of an entire people being environmentally conditioned to the use of salt would be more tenable.

A rewarding faux pas

A proof that such a possibility was recognized is the age-old tradition of the Turkish or Tatar nations that a great-grandson of Noah, discovered salt as an article of diet by accidentally dropping a morsel of food onto salt earth. As it now stands, it is easily proven that segments of the race, favored with an abundance of salt, could readily condition their children in its use on the grounds of necessity, just as the Eskimos instil the tobacco habit in their young. But it is difficult to believe that such exaltation as is evidenced in oriental and primitive folk-lore could arise if a people had not once had salt in plenty and later found it increasingly hard to acquire because of some cause unknown to them—and therefore supernatural. Salt, thus become a rare desideratum, would grow rapidly in religious significance and be considered, as in that phrase of Plato's, "a substance dear to the Gods." If such an environmental basis could be established, salt's colorful rôle in the history of mankind would be satisfactorily explained.

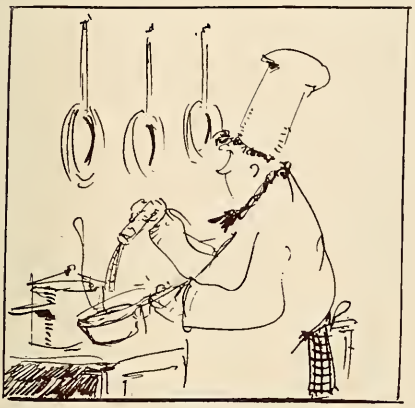
It has been shown over and over again that man quickly loses all feeling of awe and sometimes even respect for any phase of his environment that he

has subdued and enslaved. In this way, modern conditions have vulgarized salt, have made it man's servant. Succinctly, it may be said that the history of salt's social downfall is the history of the improvement of the means and instruments of its production and distribution. The tremendous impetus given to the salt industry by the invention of the vacuum pan process has already been mentioned. "The underlying principle of the process is the lowering of the boiling point of a liquid that results from decreasing the pressure of the vapor above the liquid. . . . The salt produced by the vacuum pan process has a fine luster and a closely even grain. The crystals have nearly perfect cubical shapes that distinguish vacuum pan salt from that made by other processes. The fine grain is due chiefly to the rapidity with which the salt crystallizes, and the rapidity of crystallization depends on the degree of vacuum, amount of steam, the height of brine in the pan, and other factors."*

Such is the character of the salt in that shoddy little shaker beside the gentleman's elbow as, back in the restaurant, he is calling for the bill. He will pay part of his salary for his meal, unaware that our word "salary" is derived from "salarium," the wage given Roman soldiers for the purpose of buying salt. He pays, and presently steps out once more into the jarring clatter of a metropolitan street. In a complex world of radios, skyscrapers and air-

*Salt: Its Romantic History, Its Refining, and Its Many Uses. The Worcester Salt Company.

planes, neither the gentleman nor any of his busily scurrying kind could be expected to build a shrine to common salt, or even to waste much thought on it. They worship other, newer gods. Yet salt is by no means an unimportant factor of present-day civilization. It has adapted itself admirably to its rôle of faithful servant. Salt enters into many re-



frigeration processes, by which the field of its long use as a preservative of foods is broadened. It is indispensable in the chlorination of gold and other metals. It is an important element in the glazing of pottery and is widely employed in enameling and pipe work. The textile, steel and oil industries all find important work for salt to do.

Pliny, in his day at the beginning of the Christian era, records it as a common belief that salt is foremost among human remedies for disease, and among preventives of sickness of all kinds. In the service of modern medical science, salt to this day is a sovereign specific in the prolonging of human life and the alleviation of pain. Apart from its already mentioned use in brain tumor operations, it is invaluable in hundreds of treatments. "First and commonest, it is used in shock—shock due to surgical operations or shock due to injury or disease. Normal saline solution is one of the stock preparations in any modern operating room—in fact, in any modern hospital of any sort. It is a solution of 0.8% salt in water or about a teaspoonful to a pint. This is the concentration of salt in the blood serum. It is given under the skin or in a vein in the presence of shock, after hemorrhage, and in many acute conditions. In acute intestinal obstruction Hayden and Orr have shown that there is a great lowering of the amount of salt in the body, and treatment by replacing the salt has been beneficial."† Here it may be said that salt comes into its own. While probably not a dietary necessity, it has proven itself a precious ally of the art of human healing.

Salt as an historical determinant was instrumental in such bloody upheavals as the French Revolution, the rise and fall of whole nations. As a religious symbol it witnessed many sacrificial cruelties born of ignorance. It is perhaps well that it has fallen from such high estate. It plays, today, a happier rôle.

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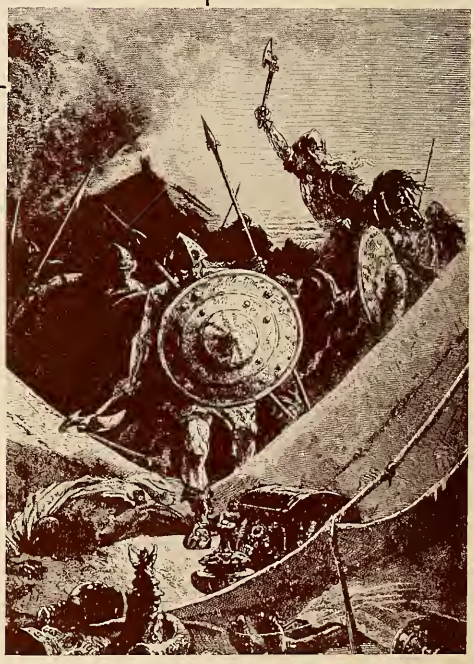
†Salt: Its Romantic History, Its Refining, and Its Many Uses. The Worcester Salt Company.

The Story of Salt

Engravings by Leutemann for Ridpath's "History of the World"



THE DIRE NEED for what are now common and plentiful commodities has caused wars that radically changed the course of history.

The desire to secure salt was one of the most frequent causes of war among the ancients and often led to the virtual annihilation of whole nations. Above is shown an artist's conception of the sack of Carthage. The site of the city was ploughed up by the Romans and sown with salt and a curse pronounced on him who should attempt to rebuild the city

(Right) SALT WAR IN SAVAGE EUROPE: in the first century after Christ thousands died when the Hermunduri and the Chatti, two fierce tribes, fought a bloody battle for the possession of a salt stream

(Above) How salt was manufactured in 2700 B. C. A Chinese artist of that period shows ash from salt-plants being boiled in a kettle with sea water. The liquid was evaporated until an egg could be floated in it

Courtesy, Worcester Salt Company

(Below) Salt evaporation in modern Italian Somaliland: extracting salt from brine by the heat of the sun

It was largely because the output was so limited that salt became a rarity meriting man's deepest respect, sometimes his worship

Photo from Ewing Galloway

(Left) Moroccan salt merchant: in the Orient salt has been a commodity of almost unequaled value. It was laboriously transported from its source by camels, and, for a handful of it one could buy a slave. So highly was salt prized by Orientals that it played a large part in the forming of their sacred traditions. It was considered a talisman, and the most binding of agreements was "the covenant of salt" famous in the Bible

Photo by William Thompson

(Left) Buying salt in West Africa: so fond of the salt-taste are most black races, that natives will go to great lengths to secure a bit of it. Full-grown blacks often suck crude lumps of rock salt as gleefully as our children do sugar plums

Photo by William Thompson

(Below) Salt evaporation plant in romantic Bali: where solar heat is plentiful and the sea is near, the incentive to improve salt production is absent

Ewing Galloway

Ewing Galloway

MACHINES MAKE SALT PLENTIFUL: with the coming of the machine age salt suffered a "social revolution." No longer rare, it was rapidly transformed from an object of worship to man's everyday servant. Above, giant cranes are shown loading salt on a long conveyor belt

Publisher's Photo Service

SALT SPRINGS result when natural brines force their way near the earth's surface, where they can be easily extracted. At right are shown some of the world's largest in Poland

Pictures Inc.

(Right) RUMANIAN SALT MINE. Many people dwelling far from the sea must delve deep into the earth to secure salt. Some scientists believed that when a people moved into the interior their need for salt increased at the same time that its availability decreased, thus explaining why salt became so valuable to the inland savage

Globe Photo

(Above) Transporting from the salt fields in Southern Spain. Along with mechanical improvements in the method of producing salt, the development of transportation has been the leading factor in bringing about salt's social downfall. The disadvantage of means of distributing salt as shown above is obvious. Salt's scarcity and its consequent high value in early times was often due to slow primitive transportation. The invention of fast trains, ships, etc., greatly deflated its value

Publisher's Photo

Globe Photo

(Above) Where the Phoenicians once established a salt base: the modern salt fields near Cadiz, Spain, are the same as those used by the Phoenicians and later the Romans to obtain this valued commodity. During the Roman conquest a sum of money was paid to soldiers to enable them to purchase salt. Thus originated the word *salarium* (salt-money), from which our word "salary" is derived

(Above) Electric wires now span these ancient salt fields of Andalusia. Soon the barge seen above at left will become obsolete

(Left) A PAUSE THAT REFRESHES: a salt worker quenching his thirst in the Andalusian fields

All photos by Globe

(Below) HEAPING SALT BRINE to dry in the sun

(Left) LIKE SNOW FROM A NORTHERN SIDEWALK, workers in the Andalusian fields daily fling thousands of shovelfuls of the substance that has determined so much in the course of history

Ewing Galloway

(Above) INTERIOR OF A HUGE MODERN SALT MINE. Having opened up such inexhaustible sources, man, with mass production methods at his command, can no longer be expected to look upon salt with the awe and reverence of his ancestors

Globe Photo

(Above) HAND MOLDED SALT BLOCKS being laid stairwise for drying: another example of large-scale production

(Below) BLASTING DEEP DOWN IN THE HALLEIN SALT MINE. Many of the 8000 wagon loads that are mined yearly in Austria are extracted from this deposit near Salzburg. Such quantity indicates how modern production can make salt so common an article

Pictures Inc.

(Left) SLIGHT IMPROVEMENT in primitive Chinese salt production: wind mills near Tientsin pump water from the sea into great beds covering hundreds of acres. The water evaporates leaving thick layers of salt

Pictures Inc.

Globe Photo

(Above) SALT FROM THE PACIFIC: in California where the sun is hot this same method can be profitably used

Pictures Inc.

SALT ACCUMULATIONS on pillars in Great Salt Lake, Utah. The crust is 18 inches thick at the water line

(Below) ESKIMOS NEVER EAT SALT, a fact which upset the theory that salt is an essential addition to all diets. Many authorities now believe salt eating to be a habit like the use of tobacco

Donald B. MacMillan Photo

MANY ANIMALS SHARE THE HUMAN LOVE OF SALT: a group of antelope and zebras drinking brackish water. A deep river is nearby but they prefer the taste of this small salty waterhole

Courtesy, Martin Johnson

Fashionograph Inc.

SALT IN ITS PRECIOUS HEYDAY was never so "dressy" a substance as it is today in the rôle of servant. It was not until the invention of modern refining plants that the uniform white crystals, compared below to crude rock salt, first appeared in any quantity

THE HEALING POWER OF SALT was well known in ancient times, but after machines had reduced salt to the rôle of servant, modern medical science discovered new work for it to do. Above is an actual sized photo of salt tablets given to workers in factories, foundries and mines who suffer painful heat cramps due to the rapid loss of their body's salt supply in perspiration. The hospitals in New York City alone use almost one-third of a million dollars' worth of salt solutions per year, to save many lives that would formerly have been lost

WHAT TO EXPECT OF A VOLCANO—*Sudden disaster or the benefits of scientific prediction? Eruptions are the earth's "breathing": they have materially enriched and beautified Man's world*

By FRANK A. PERRET
Volcanologist and Director of The Volcano Museum, St. Pierre, Martinique

It seems to be quite generally believed that when a volcano bursts into activity, there is automatically produced a condition of things which only such adjectives as "frightful," "terrific," or "horrible" are adequate to describe. And while this is doubtless true in some cases, or from a certain point of view, and we shall have something to say regarding what is even "catastrophic," yet those who are most experienced paint quite a different picture of these great natural manifestations which we are beginning to believe are the necessary concomitants of a habitable world.

Mighty forces

It matters not what type of eruption one is witnessing. Every volcanic manifestation possesses a sublimity which lifts the observer into a sphere of experience where the ordinary values are overpassed. It may be the quiet outpouring of molten lava flooding a vast area, or the furious boiling of the same material in a crater lake with fountain jets rising hundreds of feet overhead in brilliant gerbes of fire. Or it may be a mighty crater column a half-mile in diameter and seven miles high lighting the countryside so that you can read fine print at midnight twenty miles away. Or the ash clouds may prevail, with the exquisite "cauliflower" convolutions evolving amid vivid lightning flashes, or rushing down the volcano's flank with the speed of an express train, in the spectacular "fire-avalanche" of the Mt. Pelée type of outbreak. Whatever the spectacle, the observer stands in the presence of so majestic a power as to make it difficult for the moment to realize that "this, also, will pass" and the normal return as before.

In my book on the Vesuvius eruption of 1906, I wrote of its culmination:

"Strongest of impressions received in the course of these remarkable events, greatest of surprises, and most gratifying of all its features to record was, for the writer, that of an infinite dignity in every manifestation of this stupendous releasing of energy. No words can describe the majesty of its unfolding, the utter absence of anything resembling effort, and the all-sufficient power to perform the allotted task and to do it majestically. Each rapid impulse was the crest of something deep and powerful and uniform which bore it, and the unhurried modulation of its rhythmic beats sets this eruption in the rank of things which are mighty, grave and great."

Volcanology and human affairs

The observation of these and other less powerful manifestations permitting close study even while in progress, constitutes Volcanology. It is the science of the living earth, the knowledge of the world which is our cosmic home. It is at present being carried on by a few individuals, the real volcanologists, in different parts of the world, without that coordination and collaboration which is desirable. This condition of things is soon, we hope, to be remedied by the organization of the science in a central institution and clearing house. This will include that contact with the great public which is being found so effective in even the most ancient and conservative of the sciences. It will make known not only the marvels of these great natural manifestations, but the various methods of research, the field tests and collection of gases and other products, and how temperatures of from 100 to 2,000 degrees are measured. Above all, it will make available the knowledge of how it is now possible to diagnose conditions at an active crater and predict its doings. For the activity of the volcano is manifold: there are differences in the volcanoes themselves, and their own characteristics often change with age, so that we have an almost infinite variety of manifestations.

The following photographs illustrate some of the things a volcano may do.

D.F. Lovett Bradley

(Above) MAP SHOWING DISTRIBUTION OF VOLCANOES throughout the world. Triangles mark the active volcanoes, while dots indicate the extinct ones. It will be noticed that most of the volcanoes are relatively close to the ocean, a relationship to be explained by the fact that volcanoes are a land-building force, frequently associated with crustal movement
(After the Oxford Atlas)

(Left) MT. PELÉE WITH A SMALL "FIRE AVALANCHE" rushing down its slope, the distinctive form of eruption which, occurring on a larger scale in 1902, caused the loss of 28,000 lives
(Photo by Perret)

Photos from Perret

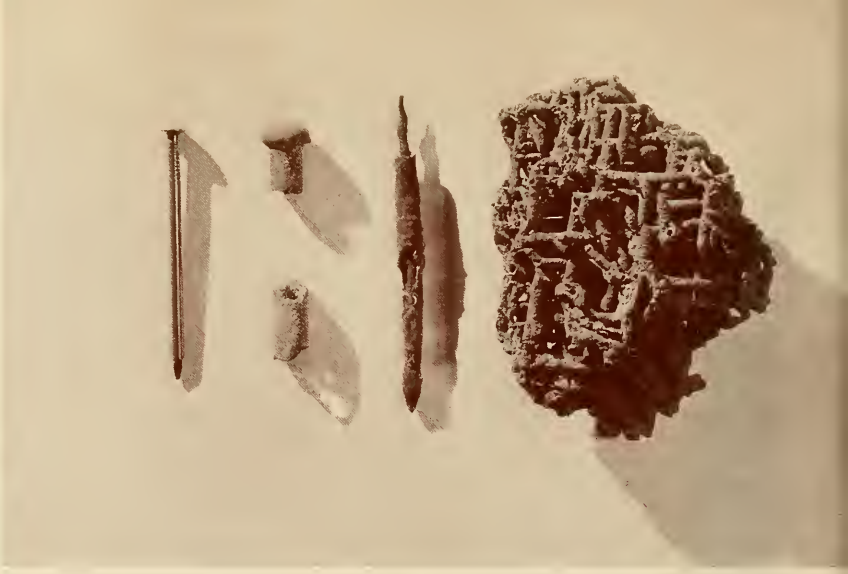
(Above) Sole survivor. Of the 28,000 inhabitants comprising St. Pierre in the West Indies, all except this one man are believed to have been killed by the eruption of Mt. Pelée in 1902

(Above) The strange escape of a single individual was due to his imprisonment in the dungeon of St. Pierre's prison, shown above, from which he was rescued two days after the catastrophe

(Below) St. Pierre before the catastrophe. The inhabitants, not imagining the calamity that was in store for them, remained at the base of the volcano through the first days of eruption

(Below) St. Pierre after the catastrophe. When the distinctive form of "fire avalanche" came rushing down the mountainside at several miles a minute it was too late to escape

Artvue Photos



Perret's specimens: A. M. N. H. photo

(Above) A REMARKABLE RESULT OF VOLCANIC ACTIVITY: nails and chickenwire converted into a metallic shell surrounding the space originally occupied by the substance. This effect is produced by action of the incandescent gases of a "fire avalanche," which convert the iron into iron oxides. The hollow tubes are much larger than the original metal, as shown by comparison with a normal nail. The third specimen from the left underwent only partial transformation. The chemical process by which curiosities of this sort are produced is believed to be similar to that by which hydrogen gas can be made in a laboratory, wherein steam is brought into contact with hot iron filings causing it to decompose into its constituents hydrogen and oxygen, the latter combining with the iron to form iron oxides

PERFECT CARBONIZATION on one side and the absence of any effect on the other is when live shrubs are exposed to the fringe of the "fire avalanche," as shown by the specimen at left. This action is taken to indicate that the active agent is grains of red-hot ash rather than the hot gases, which encircle the stem. In the direct path of a "fire avalanche," a bush of this size would be utterly destroyed.

Cloth and paper that is carbonized without the presence of oxygen retain their flexibility and texture but become jet black

(Perret photo)

(Left) TUMBLERS FUSED into a single mass of glass. Clear glass is sometimes given beautiful sky-blue tints and made iridescent by action of the hot gases. The study of a wide variety of specimens like those illustrated on this page is contributing knowledge to the science of Volcanology

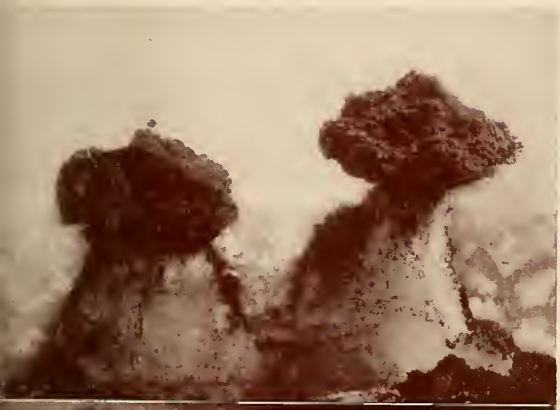
(Below) TABLEWARE TWISTED AND FUSED by hot volcanic gases

A. M. N. H. photos

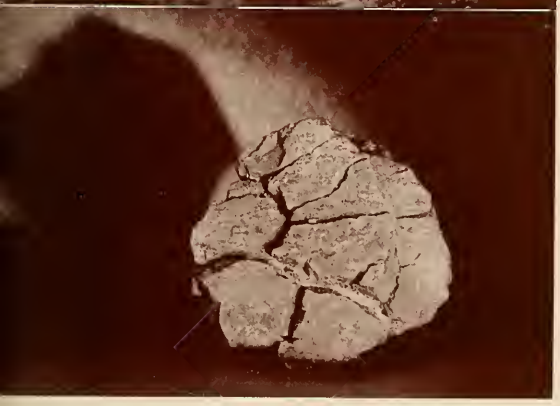
(Right) Scene along the Japanese Seacoast during the eruption of Sakurajima, 1914. This volcano was an island until the eruption, when the flow of lava from vents on one side completely filled the straits separating it from the mainland and turned the island into a peninsula. When molten lava flows into the sea as in this case, explosion is prevented by a protecting skin that is formed on contact with the water. The molten lava will then flow along the sea-bottom without any disturbance at the surface other than the steam clouds of the first contact

Photo by Perret

Perret photo



(Left) Volcanic mushrooms. Lava may flow over ice without melting its way into it, owing to the insulating effect of a glassy skin that is formed when the molten lava cools quickly. The curious parasol effect shown at the left is produced when masses of liquid lava are thrown from small craters onto the snow. After cooling, the masses protect the snow under them from the melting rays of the sun and are consequently left standing on pillars. Thousands of these beautiful formations were to be seen on Mt. Etna in 1910



A. M. N. H. photo

(Above) Volcanic bomb. When lava cools slowly, instead of forming a sort of glass coating, it crystallizes into a hard rock. The "breadcrust" bomb got its cracked surface when it cooled and contracted on its flight. Volcanic bombs are often several feet in diameter, and are hurled thousands of feet into the air

(Below) Lava tunnels. Lava flowing from a vent upon the slope of a volcano frequently roofs itself over with a beautiful arch of congealed material, and upon draining away leaves a tunnel as perfectly formed as if made by man

Perret photo

THE FORMER THEATRE OF ST. PIERRE before the eruption

WHAT WAS LEFT OF IT after the holocaust of 1902

(Above) PARTIAL RESTORATION OF THE THEATRE SITE by the combined efforts of the local government and the Volcano Museum, shown at left

(Left) THOUSANDS OF TRAVELERS come from all parts of the world to Martinique to see "the Pompeii of the western world" and visit this Museum, which presents the history, science and art relating to the region. The volcano with its smoking dome offers excursions of absorbing interest, with a thrill at every turn. The Museum, aside from presenting one of the most interesting collections of volcanic specimens in the world, is an active center for research in Volcanology

Perret photos

In a crater lake of liquid lava, great gas bubbles come up from the conduit below and, bursting forth at the surface, lift the incandescent material to form magnificent fountain jets sometimes hundreds of feet in height. Flashes of burning gas may often be seen bursting from the top, while the scattering drops draw out the quickly cooling liquid into fine glassy threads, known as Pele's Hair.

In the Hawaiian mythology, Pele was the Goddess of Fire, and the lava fountains were called "The Dance of Pele." She rose from the bosom of the lava lake and danced in her golden raiment, tearing out masses of her hair and scattering these to the winds. The material is really a finely spun glass, so quickly cooled as not to show a crystalline structure, and one walks upon a carpet of these glassy threads, which replace the ash of more explosive types of eruption.

"Limu" or "thread-lace" scoria is a froth appearing over lava streams. It is a sort of honeycombed, glassy lava blown into interlaced golden threads, light in weight and so fragile as to be crushed in the hand. Under a glass it is one of the most beautiful of volcanic products.

Ordinary volcanic ash is a powdered, more or less crystalline, form of lava, but in the eruption of Katmai, in Alaska, 1912, there was found floating upon the sea a beautiful form of ash consisting of perfect little glassy spheres filled with gas. Evidently a highly molten lava had filled a crater, holding much gas in solution, and upon release, this gas expanded into these tiny vesicles which separated themselves into independent little spheres, so small that the ash appears like any other to the unaided eye. It has been greatly regretted that only a very small amount was collected because the contained gas is just what we would like to analyze, being the same as that contained in the original crater lava.

Volcanoes and population

For good or ill, humanity has always clustered around the world's volcanoes, partly because of the great fertility of the soil they have produced and partly because of the beauty of the landscape they have created; so that, when an outbreak occurs, there is automatically introduced the element of danger—danger to human life, danger to property. The terrific disaster wrought by Mt. Pelée in 1902 is a case where modern volcano science would have saved the lives, though not the property, of the unfortunate inhabitants of a town built too close to a potentially active volcanic vent. Why, then, does it not prohibit the rebuilding of St. Pierre on the same exposed locality?

This sort of question is one of the most frequently asked of the volcanologist. In some cases, and St. Pierre is one of them, there are the best of scientific reasons for believing that no such disaster will visit the region again. This is deduced from the fact that such catastrophic manifestations as occurred in 1902 are the result of century-long conditions of repose. The volcano's chimney becomes so firmly obstructed that an accumulation of explosive forces able to burst through will necessarily result in an altogether exceptional eruption. After this, the way is more open; smaller and more frequent outbreaks will follow, and these can be easily foretold. A proof of this has recently occurred in the 1929-1932 outbreak of Mt. Pelée, in all respects similar to that of 1902 but far less violent, causing no loss of life and little damage to property.(1)

If we could have witnessed the building up of many of the earth's beauty-spots—among others, the Japanese archipelago, the Hawaiian paradise, the Caribbean chain of islands, and the Hudson Palisades—we should realize what we owe to the *constructiveness* of volcanism. And if to this we add the renewal of the face of the earth by ejected volcanic ash, rich in fertilizing matter, which is carried far and wide by the wind and falls invisibly and all but continuously even where no volcanoes exist; and if we imagine, as we have the right to do, that the incalculable amount of vapors emitted from the more than four hundred active volcanoes must play a beneficent rôle in the maintenance of the earth's atmosphere, we should begin to realize the necessity of this "breathing" of the planet on which we live, and which, in its way, is living too.

The earth's crucibles

A volcano is a natural alembic, evolving from its deeper reaches all sorts of materials which compose this earth of ours. As such, it is one of our greatest marvels: an earth feature of absorbing interest and importance, whose study bespeaks a broad outlook over the field of science generally, and brings pure research into contact with human needs.

This is Volcanology, a science ready to be fully born. The near future will, I believe, see it increase greatly in importance and practical value, as well as in popular interest among those desirous of knowing something of the world on which they live. No field of inquiry offers a greater opportunity for the higher studies combined with benefit to humanity.

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(1) See "The Eruption of Mt. Pelée, 1929-1932" by Frank A. Perret. Car. Inst. Pub. No. 458.

IN SOUTH AFRICA'S WONDERLAND—*Intimate observations among the great game herds of three of the most important wild-life reserves in the world*

By MARY L. JOBE AKELEY

FOR several years, I had dreamed of going to the Eastern Transvaal to see for myself the Kruger National Park, probably the most spectacular wild-life sanctuary in all the world and to renew there my friendship with the noted conservationist, Warden Lieutenant-Colonel Stevenson-Hamilton, largely responsible for the preservation and later increase of the vanishing fauna of South Africa. Finally my dream materialized, and in July, 1935, I had reached Cape Town and in August I began a study of the wild life in this great Transvaal sanctuary. It was an excellent time to travel in that region. In August, spring is already on the way; the days are warm and sunny; the nights are cool and refreshing. The trees are becoming faintly green, and flowers are appearing.

A moonlight journey

As I journeyed eastward from Johannesburg by motor, we climbed among the beautiful rugged spurs of the Drakensburg whose towering distant peaks rise sharply 8000 feet and under the light of the moon, then in its first quarter, we dropped down over broken ridges and along deep gorges, where noisy streams ran swift and clear. Here, one hundred miles west of Delagoa Bay, the wilderness, mysterious and alluring, is spread out on every side. The great interior plateau breaks off abruptly toward the east in a mass of rocky benches, *kopjes,* and cliffs in the midst of which are tiny valleys, well watered and inviting to the primitive native population which has lived there from early times.

Behind me stretching out to the eastward from this broken plateau is a land both vast and strange. From a distance it has the appearance of a limitless undulating plain. In reality it is a maze of rolling hills, deep ravines, or *dongas,* cut here and there by clear streams that become turbulent rivers as they merge and break through the steep, wild and uninhabited solitudes of the Lebombo range on their way to the eastern ocean. This far-flung area, 500 to 1500 feet in elevation is clad in virgin bush. Dwarfed thorn trees, wild fig trees, shrubs, palms and vines crowd along the water courses in an almost impenetrable jungle. Wild grasses thrive everywhere. Thick enough to conceal a lion perfectly, they grow so tall and dense along the rivers that they easily camouflage a herd of buffalo. This wilderness is the Low Veld.

The herds of yesterday

From time immemorial, until the very last days of the nineteenth century, the wide savannahs, the high uplands of South Africa were teeming with game. A large percentage of the African antelope indigenous to the equatorial regions, as well as other African species peculiarly South African, roamed in vast herds over these sparsely settled areas. Here, enormous bands of springbuck migrated to and fro, from the wooded hills of Natal to the very fringes of the Kalahari Desert. They afforded a spectacle rarely duplicated in any other country.

Where the city of Pretoria now stands, elephants moved in slow and silent procession over the rolling hills. They sought lower levels, too, and were found in great abundance from the uplands to the sea coast and from the Eastern Transvaal down to the Addo Bush.

All the streams abounded in hippos not always content with the wide and deep waters of the river's lower course but often traveling toward the headwaters, which were little more than narrow brooks or shallow lakes.

Black rhinos too were plentiful; and the white rhino, ranged in wide areas from the Indian Ocean westward.

Farther south, throughout the present Orange Free State and the Cape Colony, the hoof beats of the quagga *(equus quagga)* were to be heard on almost every hand as they galloped across the flower-filled uplands or ranged among the wooded hills. Little did anyone dream, in that day not so long ago, that this beautiful animal, possessed of speed,

grace and spectacular coloring, would today be exterminated.

His cousin, the beautiful mountain zebra—unfortunately now almost extinct as well—with another relative, the Burchell's zebra, crowded the rugged *kopjes* or the grassy plains.

Other animals rare today—such as the graceful oribi, the sedate blesbuck, the bontebuck and the white-tailed gnu—gave variety to the crowded herds. Another glorious animal then abundant was the true nyala, whose ruddy coat, vividly marked in brilliant white, places him, in charm and beauty, beside the forest bongo.

In those years now past countless other antelope, as well as giraffe, were to be seen at every turn. Along their wake followed the stealthy carnivora—lions, leopards, cheetahs, and wild dogs.

Modern remnants preserved

Today this amazing spectacle of wild life in the once-primitive areas of South Africa has almost entirely vanished. The aspect of the country too has changed. It changed when the white man trekked from the coast into the interior and settled there, and was changed even more by the Anglo-Boer War. At the end of this war and in only one of the wildest areas of the Eastern Transvaal did the remnants of the once incredibly large herds of game persist, secure between high mountains and almost impenetrable bush. It is of the animals in this wildly beautiful and rugged zone that I now write—the area which today is known as the Kruger National Park.

This last stronghold of big game in South Africa, 200 miles long and 50 miles wide touches Rhodesia on the north and Swaziland on the south. Although the Parc National Albert, created in 1925 by His Majesty Albert, late king of the Belgians, was the first national park in all the great continent of Africa, the beginnings of the Kruger National Park, established in 1926, were well under way in 1898 as the Sabi Game Reserve before the Gorilla Sanctuary was dreamed of. Stevenson-Hamilton, as Warden, determined to promote conditions under which the animals would increase normally, and to re-establish the balance of Nature, upset during the war period of ruthless slaughter. After the World War he found large areas devoid of animal life. Impalla were there in fair numbers; but there were very few bushbuck, duiker, or warthog. The greater koodoo and waterbuck were rarely seen, while the wary buffalo and giraffe each numbered only fifteen. The carnivora had reduced almost to the vanishing point the herds of zebra and wildebeest. Lions, leopards, cheetahs and wild dogs were so numerous and the balance of nature so upset, that it was remarkable that the carnivora could gain a living. Obviously these great starving cats might easily prove a menace to human life unless their numbers could be reduced.

Game is increasing

Since 1918 the herds have increased astonishingly, the balance of Nature has been re-established, and today, in the Kruger National Park there is probably a greater variety of wild life existing in larger numbers than in any other area of similar size in the entire world. Many animals equal in numbers the herds of the old days before the coming of the white man. Furthermore, Colonel Stevenson-Hamilton has converted the general public to the idea that a live creature is infinitely more interesting than a dead carcass, even though the latter has food value.

Standing back of this movement for conservation with all the force of his great intellect and personality, was General, the Right Honorable, J. C. Smuts, internationally famous general, League proponent, Prime Minister and coalition advocate, now Deputy Minister and Minister of Justice in the great Union of South Africa. This famous statesman has devoted much time to the study of the problem of preserving for future generations in South Africa their wilderness heritage.

My interest in seeing the remnants of South African wilds had been both stimulated and maintained by my meeting General Smuts on the occasion of his visit to America, and by his kind letters which came to me now and then during the ensuing five or six years. He had been a good friend of Carl Akeley's; and once I reached South Africa the General, as well as the Prime Minister, General Hertzog, rendered me the greatest assistance.

I had scarcely entered the protected zone before I found myself face to face with a creature I had long hoped to see—the greater koodoo, one of the glorious animals of Africa. During our long safari in central Africa, my husband and I had been in koodoo country now and then; but it was not our good fortune to see even one of these antelope which for grace and beauty are beyond compare. The group of greater koodoo in the Akeley Hall sponsored by Daniel E. Pomeroy was collected by him while Carl and I went to the Congo. The animals, mounted by Robert H. Rockwell, are astonishingly lifelike and impressive.

A majestic sight

My first view was that of a great bull, daintily cropping the vegetation from a thorn acacia and

stretching his long neck upward to reach the tender leaves. He was feeding unconcernedly. But as I drew slowly near, he turned and gazed straight at me, taking a step or two in my direction. There he stood without even flicking an ear. Only his delicate nostrils quivered. I shall never forget the noble creature as he faced me, only fifty feet away, his clear eyes gazing into mine. His strong handsome body, vividly barred in white, shone against the reddening sunset. His head was lifted high, while his magnificent spiral horns swept the lofty branches above him. He surpassed in beauty and majesty any other creature I had ever seen.

For what seemed several minutes to me, he stood immobile. Then he stamped one shapely foot on the ground, and in a second he pivoted in his tracks and vanished into the thicket. With the ruff of long, soft grey hair extending from the under jaw down across his chest waving in the breeze, with tufted tail upraised and horns thrown back until they almost touched his body, the koodoo had suddenly become the very essence of life, strength and beauty.

The koodoo is a formidable antagonist. He is powerfully built, has great weight, and stands as high as an ox. When wounded or at bay, the koodoo bull swings his mighty horns this way and that at his enemy with incredible rapidity and force.

During several weeks, it was my good fortune, every now and then, to see and to photograph many koodoo. There were males, usually single or in pairs, ranging near the herds. Then there were large bands of females and half-grown youngsters. Three months later, in December, when the calves are born, the bulls would go off by themselves in groups of twos or threes, and there remain until the mating season.

My enjoyment of this great game reserve was not confined to the koodoo alone. Another animal which I had once seen in very small herds in Tanganyika on the Akeley-Eastman-Pomeroy Expedition was the waterbuck. But here in the dense thickets fringing the banks of the Crocodile, the Komati and the Sabi Rivers, I observed them in large numbers at close range. Of notable size and impressive appearance, the waterbuck when startled or curious, will face the intruder, staring straight at him. His beautiful head, always held high, is emphasized in size and dignity by long horns which curve slightly backward and upward. His rough and shaggy coat varies in color from a silvery grey to a very dark Oxford grey, depending on his habitat. His facial markings of white add great character and boldness to his expression. This creature in the wilds has always suggested to me the proud and lordly aspect of the European stag and is reminiscent of a Landseer painting. I saw many waterbuck apparently taking great delight in wading and swimming about in the streams. When I was camping at Crocodile Bridge, I used to see each morning a herd of four waterbuck—one male and three females—accompanied by a buffalo bull. It was a grand sight to see these animals walk slowly down to the water's edge, then wade in across the shallows, glancing only occasionally here and there, and finally plunge into the deep swift-flowing stream, and without any haste whatever make for the opposite shore. The females are good mothers and are constantly concerned for the welfare of their sturdy, ruddy-coated offspring.

When the waterbuck is really frightened, he can cover the ground at an amazing speed. When in retreat, the markings of the rump are plainly seen, a band of white almost circular in form outlining the buttocks and contrasting vividly with the grey coat.

The sable antelope

During the several weeks I spent in the Kruger National Park, I had a glimpse, now and then, of one of the most majestic creatures inhabiting Africa —the sable antelope. These animals carry magnificent horns and are frequently spoken of as the giant sable. The sable bull is beautifully marked. His body is almost black, shading to brown, while he is creamy white underneath. His horns are long, highly arched, and sharp as a saber. The female is rufous and the calves are a somewhat lighter shade. Visitors to the American Museum of Natural History are familiar with the beautiful group of sable antelope collected by Mr. Arthur S. Vernay and presented to the Akeley Hall.

At first, I encountered only one or two always standing in a thicket, where it was impossible for me to see well or photograph. But on my last day in the reserve, I had all the luck in the world. It was high noon, and twelve beautiful sable antelope stood in the shade of a great acacia tree. There was one gigantic bull, almost jet black. His great arched horns swept the branches above him. Then there were several smaller bulls, all with fine horns standing among cows and calves. It was a peaceful family scene. The cows and calves were lying down. The great bull, separated a little from the others, apparently was on guard. As I drew near, the herd moved slowly off, but I was able to secure a highly satisfactory photographic record.

As the sable sweeps across the veldt with head held high, he appears both fierce and courageous. His long sabre-like horns, the finest weapons carried by an antelope, are so formidable and effective that

(Above) THE KOMATI RIVER flows along the southeastern boundary of Kruger National Park, through the Lebombo Mountains and across Portuguese East Africa to the Indian Ocean

(Above) THE LOW VELD is sub-tropical in character. Palms and wild-fig trees fringe the deep, swift-flowing rivers, while aloes and thorn acacias cover the rolling plains

(Below) WHEN THIS GREATER KOODOO BULL, one of the grandest denizens of the African jungle, posed for the camera, Mrs. Akeley secured one of the rarest photographs ever made

(Below) THESE TWO YOUNG GIRAFFE fed contentedly within close range of Mrs. Akeley's camera-car, while a herd of fourteen stood watching from the edge of the bush

All photos by Mary L. Jobe Akeley

Photo, S. Af. Ry.

(Above) LARGE BANDS of blue wildebeest graze in the open rolling country. Associated with them are the socially inclined but shy Burchell's zebra, closely related to the extinct *quagga*. They act as sentinels to the wildebeest herd

(Below) THE AFRICAN WATERBUCK is truly reminiscent of a Landseer painting, as the creature in the wilds presents the proud and lordly aspect of the European stag. They frequent the swift rivers and densely wooded shores

Photo, S. Af. Ry.

(Below) ONE MEMORABLE MORNING Mrs. Akeley photographed a herd of fifty-one buffalo. One vigilant old fellow is here shown as he remained behind to inspect the photographer, while his companions galloped into the bush

Photo, S. Af. Ry.

Photo, S. Af. Ry.

(Above) USUALLY THE GRACEFUL and fleet-footed impalla love the dense bush but here, well protected and unafraid of man, and existing in herds of almost incredible numbers, they frequently come out into the open glades to browse

(Below) THE STEINBUCK, daintiest and most charming of little South African antelope, love the open. They travel singly except in the mating season, when one pair only will travel together. To photograph them is rarely possible

Photo, S. Af. Ry.

(Below) THE TRUE OR MOUNTAIN ZEBRA, now almost extinct, is the smallest of all zebras. Nature lovers are fighting to preserve the few remaining specimens, which are found in two very small herds in the Cape Colony

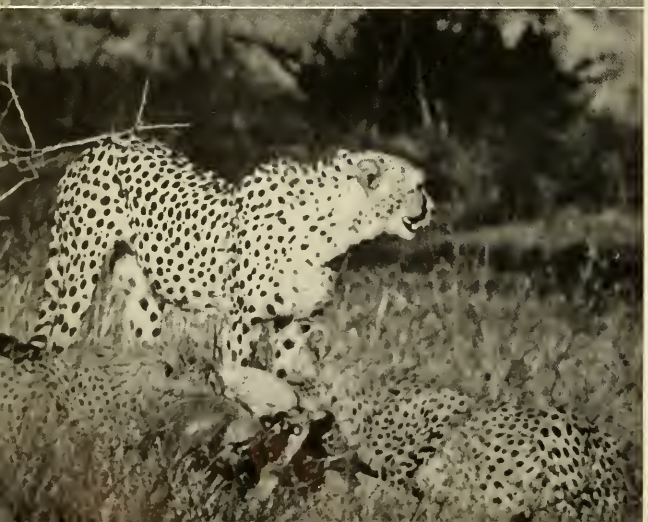
Photo, S. Af. Ry.

(Left) To see the king of beasts walking abroad with measured and majestic step, and to listen to him speaking in the dead of night when no other voice is heard in the jungle, are awe-inspiring and unforgettable experiences of the African wilderness

Photo Mary L. Jobe Akeley

(Left) After posing at close range for her camera, these two great beasts of the jungle, a magnificent pair of mating lions, held up Mrs. Akeley for two hours. They lay down and refused to move from the only possible opening in the jungle through which lay her route to camp

Photo Mary L. Jobe Akeley



(Left) Although the cheetah is less nocturnal than the leopard, Mrs. Akeley considered herself fortunate to film one by daylight. This rare photograph of a cheetah mother and her two youngsters enjoying their breakfast of freshly killed impalla was made one morning shortly after dawn.

Photo Dr. Maxwell Ashton

he fears no enemy save the lion or one of his own kind, when during the mating season the bulls engaged in deadly combat. One of the game rangers told me that he had witnessed a fight between a sable and a lion. In such a combat, the great bull swings his long curved horns back and forth with lightning-like rapidity, thus guarding effectively the entire length of his body, one side after the other.

Colonel Stevenson-Hamilton has said that during his long years of observation, he has never found a full-grown sable bull killed by any of the carnivora except lions; and only one attack by wild dogs upon a sable has ever been witnessed by any of his staff. Although in captivity the sable bull usually becomes vicious and dangerous, in the wild state, notwithstanding his courage and power as a fighter, he is never aggressive toward man.

A zoological kaleidoscope

Many other animals abound in this great game sanctuary. Impalla, perhaps the most graceful and exquisite of antelopes, are here in incredible numbers. This creature is beautifully marked. Its back is a rich bright chestnut, merging into pale yellowish-grey sides, while underneath it is snowy white. The legs are slender, delicately veined, and beautifully modeled. The mature male stands almost three feet high and carries beautifully lyrate horns. Their grace and ability in clearing the ground is almost unbelievable.

Here, too, I saw and photographed many large herds of blue wildebeest, the favorite food of the lion. Usually they stood quietly in the shade of some tree or moved lazily across the landscape. Associated with them are the Burchell's zebra. But the zebra are very shy and will face the camera only for a few seconds. Then they will trot away and frequently cause the wildebeest to stampede. Near the wildebeest herds I occasionally saw the very rare tresseby, swiftest of South African antelope.

In the region of the Lebombo hills and north of the Lataba River, I had an excellent view of large herds of giraffe often numbering twenty or thirty. They were so well protected and fearless that they frequently fed within a few yards of me and seemed quite reluctant to give ground. The situation today is vastly different from when the natives hunted them vigorously with their dogs and *assegais* (spears), and when the giraffe were almost exterminated. I am convinced that the opportunity to observe and photograph these large herds of giraffe in their present happy state is alone worth the trip to South Africa.

This great game reserve abounds in the smaller mammals as well. The South African baboon, known as the chacma, vervet monkeys and warthogs are here without number and I was indeed lucky to see and photograph both leopard and cheetah while in that region.

There is also an abundance of bird life. Bustards, francolins, and especially guinea fowl are frequently met with. Waterfowl, too, are beginning to come into the sanctuary. Knob billed ducks, shell duck and spurwinged geese, saddle billed storks, too, have been seen about the waterholes. Guinea fowl, are so unafraid and numerous that a flock of thirty or forty feeding in the open is a common sight. They are of the greatest benefit in destroying harmful insect life.

Lions

At least nine out of every ten persons who visit Africa are interested above all else in seeing lions. Here in the Kruger Park they are seldom disappointed. The antelope are so plentiful that the lion no longer has a hard time to keep himself from starvation. The lion kills off the old and the unfit.

In the main camp on the Sabi, lions can be heard roaring almost every night or in the very early morning. And often when I was out at dawn, I found lions on their kill. Here in this reserve, they are accustomed to the sight and sound of a motor car and apparently, as yet, seldom associate a car with man.

I saw lions under many varying conditions, each of which revealed a different chapter in their habits. On early mornings, I saw lions and lionesses stealthily stalking the game. I observed a mother teaching her two small cubs to kill. On one occasion, I inadvertently found myself between a lioness and her mate. She was bad tempered. The moment she saw me, she charged my car; but I believe it was a "false charge," in view of the fact that her mate was nearby on the other side of the car. Then, too, my car had been stripped down almost to the chassis, in order to operate the Akeley camera; and it is also quite possible that the lioness may have gotten our scent. However, I did not tarry long enough to find out why she charged.

On another occasion, I saw six lions patrolling one side of a swamp where there was a small pool of water. Herds of thirsty impalla, wildebeest and zebra, and also a big bull giraffe, were marching up and down on the other side, eager for the water but thoroughly aware of the presence of the lions. This jungle drama continued until darkness overspread the scene. But I am sure not long after I made my way back to my camp, the climax of this wilderness show occurred.

An impasse

But the most thrilling encounter which I had with lions was one evening when I was held up by a pair of mating lions. They effectually blocked the only possible track across a deep donga in the bush which separated me from camp. My gun was in its case under the back seat of my car, and it was sealed, too, for we were in protected territory, and that is the way a gun is supposed to be carried, unless an emergency arises. This looked to me like an emergency, but I had no time to break the seal and assemble my gun.

When Carl and I had photographed lions in Tanganyika, and when, night after night, we used to lie and listen to them talking at a waterhole near our camp, I used to feel that my capacity for seeing and enjoying lions was inexhaustible. During the first few weeks of my experience in the great game reserve, I felt just the same way. I believed I would never grow tired of lions. But when this pair of the most glorious lions in Africa completely barred my way to camp, and when the old male got up, every now and then, and talked to me, and continued to do so off and on during two hours, I was almost convinced that I had had enough of lions.

For many centuries, elephants have lived in South Africa. They are so plentiful today along the Olifants River and the Letaba, that on a big tree near a ranger's station there is a conspicuous sign: "Caution—Look out for Elephant"; and in the Afrikaans "Pas of Vir—Olifant." Now this was exactly what I had come to this section of the Kruger Park to do—look out for the *elephant*. But it was not my luck to see any during several days. They had been in that area just before I arrived; and immediately after I left, the herd sauntered down every now and then to drink at the Lataba.

Later, I went down into Portuguese East Africa, where I had a glorious view of a herd of 150 elephants. Near me, drinking at a river, were about forty mothers and many little ones. I counted thirty-five baby elephants. From a high point of land, unfortunately too far away for good photography, I watched the herd for nearly an hour. When they finished drinking, they began to move across the swamp to the forest. The mothers called to their little ones, and there was a great deal of grumbling in reply. Small squeals mingled with the deep notes of the grown-ups. Two old bulls, with great flapping ears waving back and forth and trunks extended to feel the wind, were definitely on guard at either end of the herd. It was a thrilling sight to see the mothers guiding the little ones through the swamp. If an obstreperous youngster, finding the way none too easy, was inclined to loiter, its mother was equally determined that it should not do so. Putting her baby in front of her, she curled up her trunk and prodded him firmly on his little rear end, boosting him along the muddy way. The little one, with every evidence of offended dignity, hunched himself up and squealed like a disgruntled little pig. But this display of temper did not faze mother at all. Forward went her head against his little behind, and on went the unwilling baby, floundering through the mud. Here another mother with a somewhat older calf guided him among the pitfalls with her trunk outstretched along his back and her short tusks almost lifting him along. Others, whose offspring seemed a bit sturdier would walk behind their babies, and spanking the little ones in front of them now and then with their trunks, would shove them over the hummocks and across the pools. Other mothers would walk ahead and pull their babies, each little trunk clinging for dear life to mother's strong reliable tail. The herd was very noisy as it moved toward the cool recesses of the forest.

On the thirty-thousand-acre estate of David Forbes, south of the Kruger National Park, I saw one of the few remaining herds of roan antelope left in this locality. There were twenty-two animals in this herd, and they are strictly protected on this private estate where they are enjoying life at an altitude of less than 2000 feet, although these antelope naturally seek an altitude of about 4000 feet.

White rhinoceros

I now determined to go on to the Zululand game reserves, where I especially wanted to see the white rhinoceros. In the Mkuzi reserve there is the greatest herd of the rare true nyala in the world, numbering seven hundred and fifty animals. In the Umfolozi there is the largest herd of white rhino in existence, numbering two hundred. In the Hluhluwe reserve there are not only white rhino, but a large herd of nearly one hundred black rhino and four hundred buffalo. Then there are also the increasingly rare antelope—the klipspringer, the mkumbi, and the Zululand suni.

It is a well known fact that, with the exception of the elephant, the white rhino is the largest mammal that lives upon the land. He is not "white" at all but a slate gray and only a little lighter in color than the black rhino. He is also much larger, sometimes attaining the height of six feet, six inches at the shoulder, while the black species is rarely more than five feet tall.

One morning at daybreak the Warden, Captain Potter, and I, with native game guards, went down into the lower country where the white rhino dwell.

By the time we had reached the area of dense bush, the sun had climbed above the hills, and the only shadows in the valleys were those cast by the leafless trees. Under such conditions, it would be easy to "spot" almost any animal, and particularly a rhino, even at a distance. In a moment, Potter had located a white rhino mother and her baby. She was in plain sight and could be seen readily with the naked eye. Watching these astonishing creatures through the glasses was like having a grandstand seat for a circus parade. The mother and her youngster were moving slowly but steadily along a trail that, doubtless, many a rhino had traveled before. They looked for all the world as if they were bent on reaching some particular destination at a given hour and were now hurrying in order to make up for a late start. As the female moved along, her head was carried so low that it appeared as if now and then her horn would scrape the ground. She was feeding hastily, grabbing a mouthful here and there; and the youngster, walking ahead and sometimes being boosted along by mother's nose and horn, was old enough to graze, so that he too was picking out the tidbits from among the dry and yellow grasses.

Maternal instinct

Captain Potter probably knows more about the white rhino than any other man living in South Africa today. The white rhino, he says, is a very good mother. Her baby is almost always at her side. She leaves it only to drink and then hurries to the stream and back again. She constantly helps it over the rough ground by pushing it just as did the first white rhino I saw. Captain Potter maintains that although the black rhinos are more ferocious, they are much less careful of their offspring. The young of the black rhino always follows the mother, never going in front as the little white rhinos do. The black rhino mother will leave her calf far behind her, and even though the baby be molested, she will not hurry to its aid. He finds, too, that the black rhino invariably gives the white a wide berth. The white rhino deposits its spoor in the same spot after the custom of the majority of other animals of various species; but the black rhino scatters its spoor, which habit may easily have been acquired in a former time when this animal feared some punishment by the large species and did its best to obliterate its trail. Today, if an intruder goes between a white rhino and her calf, she is bound to charge. Otherwise she is quite gentle.

Preserving the black rhino

As I have said, black rhino are, comparatively speaking, very plentiful in this reserve; and this fact makes this protected area unique because the black rhino is almost extinct everywhere else in South Africa. Not so many years ago the black rhino was so numerous in East Africa that the early inhabitants were being constantly disturbed by them; but they have been killed in great numbers and only a fraction of the original number remains. The same is true of the Eastern Transvaal and Zululand. All over the Low Veld remnants of skulls and skeletons of black rhino are found and in regions so widely separated as to indicate that this great creature roamed about Southeast Africa perhaps in numbers equal to those in the Equatorial belt.

Although I had had great luck in seeing rhinos, both white and black, my good fortune did not end there. One morning while traveling through the sanctuary I had a splendid view of two herds of buffalo. I photographed one band of fifty-three; and another of fifteen.

During more than seven months in the field, I was fortunate in obtaining a fairly comprehensive view of the principal areas of South Africa and the great Transvaal and Zululand game reserves in particular. I was also completely fascinated by the natural beauty of a new land and by this rare opportunity to study unfamiliar species of wild life. I was everywhere greatly assisted and infinitely cheered and delighted with the unfailing courtesy, helpfulness and hospitality of the South African people. To many new friends in that fair land I owe a debt of lasting gratitude.

A MALE OKAPI: a peculiar animal which does not possess the long neck of its nearest relative, the giraffe, but does exhibit a similar pair of rudimentary horns. Specimens of this animal, which had perhaps never before been killed by a white man, were the objective of The William D. Campbell African Expedition

Hunting the Rare OKAPI

DEPARTURE FROM NAIROBI, October, 1936. The main party consisted of ten natives and three white men: Mr. William D. Campbell (center), Field Representative of the Department of Mammals of the American Museum; Major W. V. D. Dickinson, M. C. (right); and G. D. Christensen (left), Preparator from the Museum

TAKING PROVISIONS for five months and expecting to be gone a year, the Expedition set out in three two-ton Chevrolet trucks for the 1367-mile trip to Epulu in the okapi country. Travel was impeded in Kenia owing to bad rains, but roads were excellent most of the way

STREET SCENE in a small village, Luberu, in the gold mining district of the Belgian Congo, through which the Expedition passed. This was one of the points where petrol could be obtained, the price of which averaged fifty-five cents per gallon throughout the journey

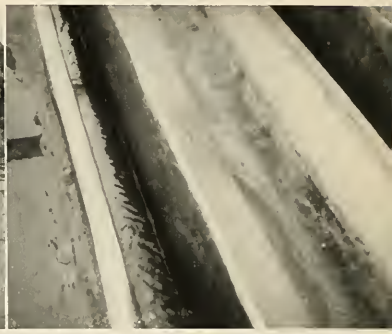
In the Pigmy Country with The William D. Campbell African Expedition of the American Museum of Natural History

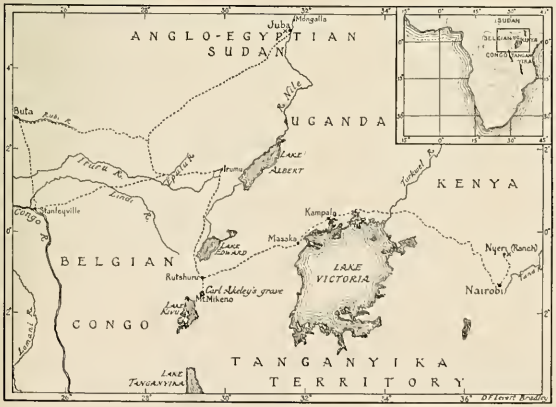
HEADQUARTERS of Mr. Campbell's various Museum expeditions: Monte Carlo Ranch, the most modern sort of establishment that can be built in Africa. Situated 100 miles north of Nairobi and only 15 miles from the equator, the headquarters is fully equipped with workshops for preserving specimens and making plaster casts, darkroom facilities, electric lights and running water

OVERNIGHT CAMP in the pigmy country. Each evening the Expedition cooked a hot meal by the roadside and passed the night under canvas shelter

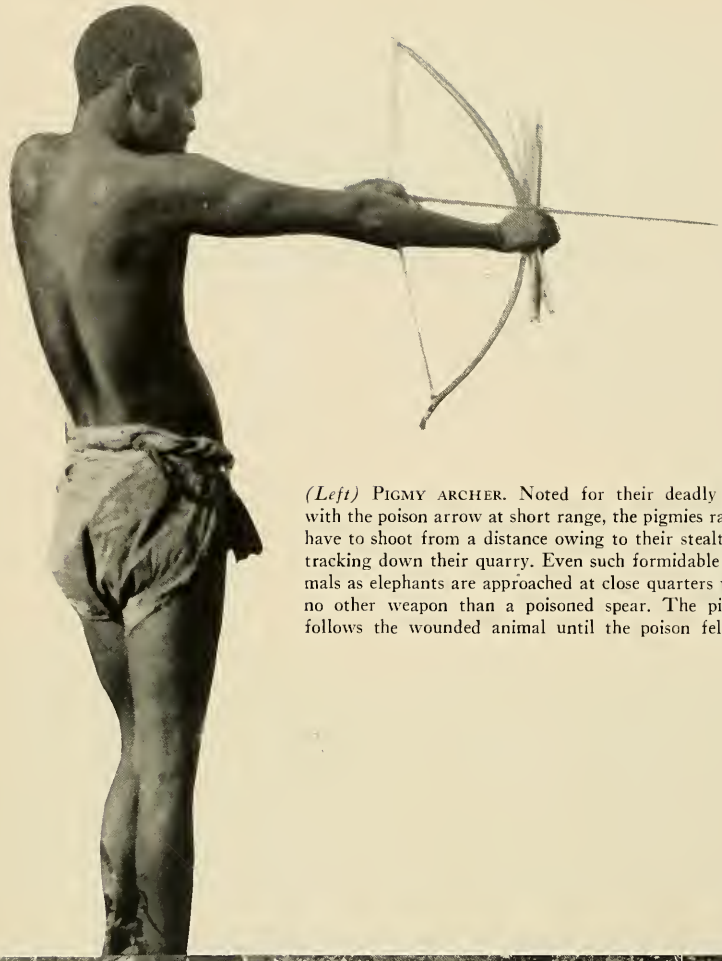
NATIVE-MADE PONTOON FERRY. The boat was drawn by native hands along a cable stretched across the river

CLOSE-UP OF PONTOON. Dug-out logs of this sort served to support the ferry on the water. The journey was broken in many places by river-crossings





(Left) THE EXPEDITION STARTED OCTOBER 2 from Mr. Campbell's headquarters, Monte Carlo Ranch, 100 miles north of Nairobi. The 1367-mile trip to the camp site from which the okapi were procured consumed only two weeks. Contrary to expected difficulties in securing specimens of an animal which has been regarded as rare and elusive, only seven weeks of hunting were necessary to obtain the two animals for the group that is to be exhibited in Akeley African Hall



(Left) Pigmy archer. Noted for their deadly aim with the poison arrow at short range, the pigmies rarely have to shoot from a distance owing to their stealth in tracking down their quarry. Even such formidable animals as elephants are approached at close quarters with no other weapon than a poisoned spear. The pigmy follows the wounded animal until the poison fells it

Jungle hotel: a comfortable stopping place maintained by P. T. L. Putnam, well-known Harvard scientist, in the heart of the okapi and pigmy country, where he pursues scientific research

The pigmy village attached to the Putnam camp, and some of the rarer animals kept under observation by him, attract much interest among passing tourists and big game hunters alike

At a strategic point in the jungle The William D. Campbell African Expedition employed forty men for one week to clear a small camp site for their major activities

FROM THIS BASE the search for okapi was pursued. Torrential rains made tracking through the forest extremely difficult and hindered the photographic studies necessary for a complete scientific record of the animal and its habitat

PIGMY PIPE. The smoker takes in great lungfuls of the extremely strong African tobacco and then spends several minutes coughing. The long stem of the pipe is constructed of a number of strips of wood lashed together

FEMALE OKAPI: one of a pair secured by the Expedition, perhaps the first specimen ever to be shot by a white man. This animal was shot by Major Dickinson, who is seen behind it. Observations indicate that the okapi may be far more numerous than has been supposed

(Below) AN OKAPI IN CAPTIVITY at the mission in Buta. In skull-form the okapi stands between the giraffe and the extinct *Samotherium,* which lived in Europe about 10,000,000 years ago

AFTER A TWO-WEEKS SOJOURN Mr. Campbell left in January to collect animals for the Nile River and Sahara Desert Groups. Further pictures from him may be expected in NATURAL HISTORY

THE BIOGRAPHY OF A FROG—*From the moment the biologist pulled "Cy" out of the snake's jaws he became a laboratory favorite: the story of a rare friendship which lasted five years*

By Roy L. Abbott
Professor of Biology, Iowa State Teachers College

CY was a Leopard frog. I say "was" because he long since disappeared into the stomach of a snapping turtle, and would straightway have become a part of that twenty-pound bundle of ferocity, had not said turtle been thrown at once into a furnace by an irate janitor who was fond of Cy but disliked the "snapper." Hence the end of Cy was the occasion for this, his biography, which embraces a period of five years during which time he changed from a tiny, shot-sized egg, into a robust, long-legged, pop-eyed creature weighing nearly an eighth of a pound.

It was a bitter day in late March when I fished that fist-sized mass of frog eggs—looking for all the world like a lump of tapioca pudding—from a shallow pond. The embryonic Cy, although I didn't know it at the time, was simply one of those four or five hundred jelly-covered, triply-coated brown and white eggs which made up the egg-lump, the whole of which I dumped into a bucket along with some pond water and carried home.

Four or five days later, there were great "goings on" in the egg-mass. What had been in each case a spherical, jelly-coated thing, had taken on a fish-form, and almost before I realized it, the egg-mass fell apart and several hundred tiny, bullhead-like creatures with feathery gills wriggled out, each from its own envelope and looking no more like a frog than an acorn looks like an oak tree.

Mouthless

None of them ate anything for several days—they couldn't. For curiosity caused me to sacrifice several, and my binocular scope gave the obvious reason: a creature can't eat unless it has a mouth; or in this case it would be more accurate to say, unless that beginning-mouth opens into a stomach down below, and theirs didn't. So, like new-hatched chicks which have some of the egg-substance still in their intestines and do not need to eat for a day, my "tads" simply held on to some water-weeds by a means of a sucker and waited calmly for their stomachs and mouths to get into proper communication.

But they had received no lessons in this hanging-on process, or in the eating of vegetable matter which they began a few days later, for I kept them in a tank by themselves. As far as their parents were concerned, the tads were better off to be alone. For even when they had grown to the size of my thumb, whenever I would flip one, wriggling and tumbling, in front of its big spotted grown-up relatives who lived just behind the screen on the other side of the tank, the sequence of action was always the same: a quick dart of forked tongue, a violent clutching of jaws and forelegs—and one less tad to become a frog.

As a result of these experiments in cannibalism, and others, such as inquiring whether tads could live in boiled water—which they couldn't—and whether water-tigers would eat them—which they would—by the end of the first two months, the three or four hundred of the original brigade were reduced to a mere dozen. These were fat, active fellows about three inches long, with thick, clumsy bodies and wide, vertically flattened tails which pushed them ahead with surprising speed.

Cy's rescue

One final experiment led me to discover Cy. I had so often found watersnakes around ponds which were drying up, I had come to believe they were there to feed upon the tadpoles always found in such places. Here was a chance to prove it, so capturing a three-foot watersnake, I dropped him into the tank with the "tads." He was hungry, and almost before I could realize it, he had swallowed five of them and had gripped the sixth, a particularly large one, when I intervened. By hard pressure back of the snake's head with thumb and finger, I soon convinced him that he had had tadpoles enough for one meal—and the rescued one was Cy. This was a

shortening of Cyclops, a name not actually given him until two years later, when a carelessly handled wasp blinded him in one eye by stinging.

Following this incident, Cy came under my close observation and patronage. His size, and the scars left by the snake's sharp, backwardly curving teeth, marked him off from the rest, and whenever I experimented with him, I took special care to see that no actual harm befell him.

I really became acquainted with him; and even a tadpole—which is nothing more than a fish—can, in a way, become acquainted with a human being. At any rate, he would nose against my hand and take bits of meat from my fingers, and even seemed to enjoy, as he did later as a frog, being rubbed gently on the back.

Chiefly interested in food

But like all true frogs, even as a tadpole, he was utterly indifferent to others of his kind. If something seized one of his fellows, he merely moved away from the immediate commotion; if one of his mates shouldered him he moved aside without sign of rancor; and when a piece of meat was found he ate as rapidly as possible, holding his place at the feast by sheer muscular power as long as he could. If pushed away, he crowded back again or, failing in this, he went away in search of another feast; for food-getting seemed his chief interest in life.

Now and then, however, I compelled his interest in other things. I placed a big bullhead in the tank with him, and although slow in movement, the bullhead made things lively for Cy and the others. Cy didn't know a bullhead from any other creature, but something within told him to get out of the way, and this he did with surprising speed. He seemed fearfully scared every time the bullhead struck at him; but although, in a dim way, he kept something of each experience, and so knew better how to get away next time, each fear lasted apparently only as long as the danger threatened. When the bullhead went on about its business, Cy returned at once to his business—gnawing at his favorite foods.

By the first of June, Cy's hind legs were of considerable length and already differentiated into joints, but his front ones were much slower in appearing. Actually, however, although invisible from the outside, they were growing under a fold of skin which covered his gills and I could easily feel them with my fingers.

He began now to behave differently. Up to this time he had remained constantly under water, but something now impelled him to come to the surface where he would thrust his nose out into the air; his skin and gills were no longer satisfying his oxygen requirements. I proved this rather too emphatically by anchoring him down with a weight, and came near having a dead tadpole as a result, but I cut him loose just in time.

Two or three weeks of this periodical excursioning into the air came and went, and then things began to happen so rapidly I could scarcely keep pace with them. For one thing he refused to eat anything. His skin began to shrivel badly and the outer layer to loosen and fall away in pieces like the hair on a shedding colt. His gills, too, disappeared; the horny coverings of his jaws fell away; his mouth lost its rounded, sucker-like form and became amazingly wide; his front legs appeared; and his eyes, which up to this time had been beneath the skin, now came to the surface. So there he sat one morning upon a board in his tank, a squat, four-footed, pop-eyed, air-breather, transformed—save for a bit of tail—out of all semblance to his former fish-like self. He was a frog, but he was not a very big one—three or four grams in weight at most—and hardly seemed as large as when a tadpole. But how different he was! No more half-blind, blundering through water and nosing in the mud for him! He would take to it only when necessity compelled; he liked the outer air with its better visibility and the creeping, crawling things that captured his fancy. Hour after hour he would sit on a board in his tank, scarcely moving except for an occasional blinking of his eyes, his thick hind legs folded beside his body in convenient leaping position. If a painted turtle poked his head too near he would simply give a great push with his hind legs and plunk into the water as if tossed by a spring.

True to type

Whenever he hit the water his procedure was always the same: a dive to the bottom, a shoreward turn, and a few minutes of partial concealment in the mud and ooze. Cy had never seen any other frog do this, but he conformed beautifully to the general behavior of all leopard frogs, thus showing what a victim he was of inherited habit. Also, in true frog fashion, before climbing onto his board again, the sly rascal would invariably poke his nose and eyes above the surface for a preliminary examination of the surroundings, his long legs meanwhile hanging nearly straight downward that their quick flexion might snap him under again if danger threatened. I often amused myself by poking him upon the nose while in this position, but he seemed to remember something of our acquaintance of his tadpole days and soon came to ignore me. When I held a writhing gartersnake in my hand, however, he got out of the way at once.

So far as I could observe, Cy was usually hungry, but by no means finicky about what he ate. In fact, he had only one requirement—his prey must be moving or he would starve rather than touch it. With a flick of his long, sticky tongue which was fastened at the front and free at the rear, and so could be thrown an inch from his mouth, he would capture the unwary spider or insect which happened to come within range. Sometimes when very hungry he would creep awkwardly upon his prey until within striking distance, but usually he waited patiently for it to come to him. If the creature chanced to be an earthworm, or as happened occasionally, when I gave him a very small snake, he would seize it with jaws as well as tongue, using his front feet to help crowd it into his mouth. When he swallowed anything his prominent eyes, the orbits of which opened into his mouth, invariably rolled deeply backwards and inwards, thus helping to force the food down his throat.

As the result of all this food-taking, at the end of three years, Cy was a big frog, as Leopard frogs go, fully four inches in body length with a pair of hind legs that, stretched out, were as long as the rest of him. Thousands of small creatures had been eaten by him and transformed into his two-ounce body, yet not all of his three years had been spent in eating and growing.

Hibernation

Four months or more of each year he spent in a kind of semi-stupor or winter sleep at the bottom of his deep tank. Once I cut through the thick ice and fished him out for examination but he never knew it. His heart had run down to only a few beats per minute, he breathed only through his skin, paid no attention to food, and moved very little, in a state of profound hibernation. I placed him back upon the bottom of the tank again and let him go through with what he had started of his own accord, an over-wintering process at the expense of the reserves he had stored from the animals eaten during the summer, Nature's method of tiding him over an unfavorable season.

Yet always when spring came, he would awake from his stupor and come forth lean and ravenous, seemingly only to begin another summer's eating orgy which would result in fattening him again for another winter. But the spring of his fourth year brought a change. He appeared lean and hungry enough, but with another urge upon him that even food could not satisfy. For when I offered food, he rejected it, and clutched my finger, a thing he had never done before. I presented him with another male frog like himself which he at once clutched for a time but later rejected. Even dead females were clasped for a long time. Could Cy, or any other leopard frog, discriminate a male from a female? I believe so. Just how I don't know—possibly by some odor or glandular secretion emanating from the female's body. But at any rate, although the males were often temporarily clasped by him, he always soon rejected them, whereas he would remain in amplexus with a female for two or three days at a time.

During this short mating period, Cy was a different frog. He seemed utterly oblivious to everything except the female which he clasped powerfully with his forearms, his enlarged thumbs thrust deeply into her flanks. But in spite of his seeming ardor, this business of mating appeared after all to be purely reflex. For when I pried mated pairs apart and substituted other things such as a stick of wood for the female, the foolish fellow still held on. Even when I cut the head from a male—as did Spallazani two centuries ago—he still clasped the female; chloroformed pairs remained in close embrace even when dead.

Death on flies

After three or four days of this mating madness, Cy became himself again. He wanted food now, and wanted it almost continuously until time to go into winter sleep again. What an appetite he had! He would snap up five or six large earth-worms and push them into his mouth one after another, the last one often hanging and wriggling part way out until his tortured stomach made room for it down below. Often, in the fall, when the flies were bad in my office, I would place him upon my hand and hold him up to the window to snap off the flies. He was as deadly and as effective as a fly-swatter.

He seemed to have no particular choice as to kinds of food. I tried him with almost everything: flies, beetles, cock-roaches, butterflies, larvæ of various kinds, spiders, bugs—each and all were alike to him. Even stinging insects such as bees and mud-daubers were greedily seized and swallowed, and though after filling his stomach with such creatures, he would often shrug his shoulders and wiggle his abdomen as if experiencing internal disturbances, I never saw him refuse one of these. Several times, I saw mud-daubers thrust their stings entirely through his tongue, but although when stung he would hurl them violently from his mouth with all signs of pain, he invariably snapped them up again. On one occasion he ate a young white rat, at another time two small mice, and several newly hatched English sparrows were swallowed at different intervals.

To my astonishment, he even ate his age-long

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CONSERVATIVE LIBERALS

LIVING PREHISTORIC ANIMALS

By Erich M. Schlaikjer

ULTRA CONSERVATIVES

RADICALS

LIVING PREHISTORIC ANIMALS—*Ultra-Conservatives from the Age of Reptiles that struggle for survival in a changing modern world*

By Erich M. Schlaikjer

Brooklyn College

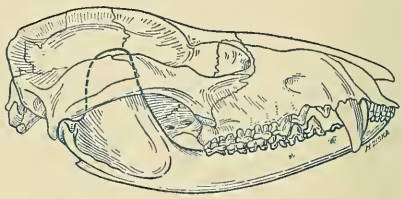
Surprisingly few people, apart from the specialists, are aware that such creatures as a monkey and a whale, a skunk and a man, a giraffe and a bat, an elephant and a mouse, all of which are so strangely unlike in general appearance, belong to the same class of vertebrate animals known as the Mammalia (from *mamma,* the Latin word for breast). If such diverse animals as those just mentioned, as well as thousands and thousands of others living and extinct, all fall under the definition one may well ask, "What is a mammal anyway?"

How to recognize a mammal

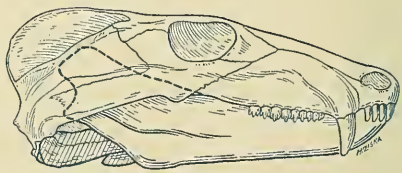
For one thing, all mammals possess hair in one form or another. Even the whale with its glistening nakedness meets this requirement, for on the nose of the young there are a few scattered bristles. Also, all mammals have mammary glands, the secretions of which nourish the offspring. In all of them the body cavity is separated into two compartments by a thin oblique muscular wall, the diaphragm. And in the lower jaw of mammals on each side there is but a single bone, the dentary.

The typical jaw of amphibians and reptiles is composed of several elements, and the very different mammal jaw was developed in connection with certain important changes in the hearing apparatus. When mammal-like reptiles finally became mammals, the need for keener hearing was of primary importance. As the dentary bone in the jaw of the mammal-like reptiles enlarged and eventually formed a new jaw-connection with the skull, the two elements of the old reptile jaw-skull joint became smaller and smaller and finally were taken over into the middle ear where, with the stapes, they form a chain of three small links connecting the ear drum with the inner ear. This refined mechanism facilitates the transmission of more delicate sounds than was possible with the old style single-auditory-bone device used by reptiles and amphibians.

In addition to the above, mammals are distinct in one or two other characters. The red cells, or corpuscles, of the blood are without nuclei, and the brain has attained a higher degree of specialization than in other animals. Then, of course, there are



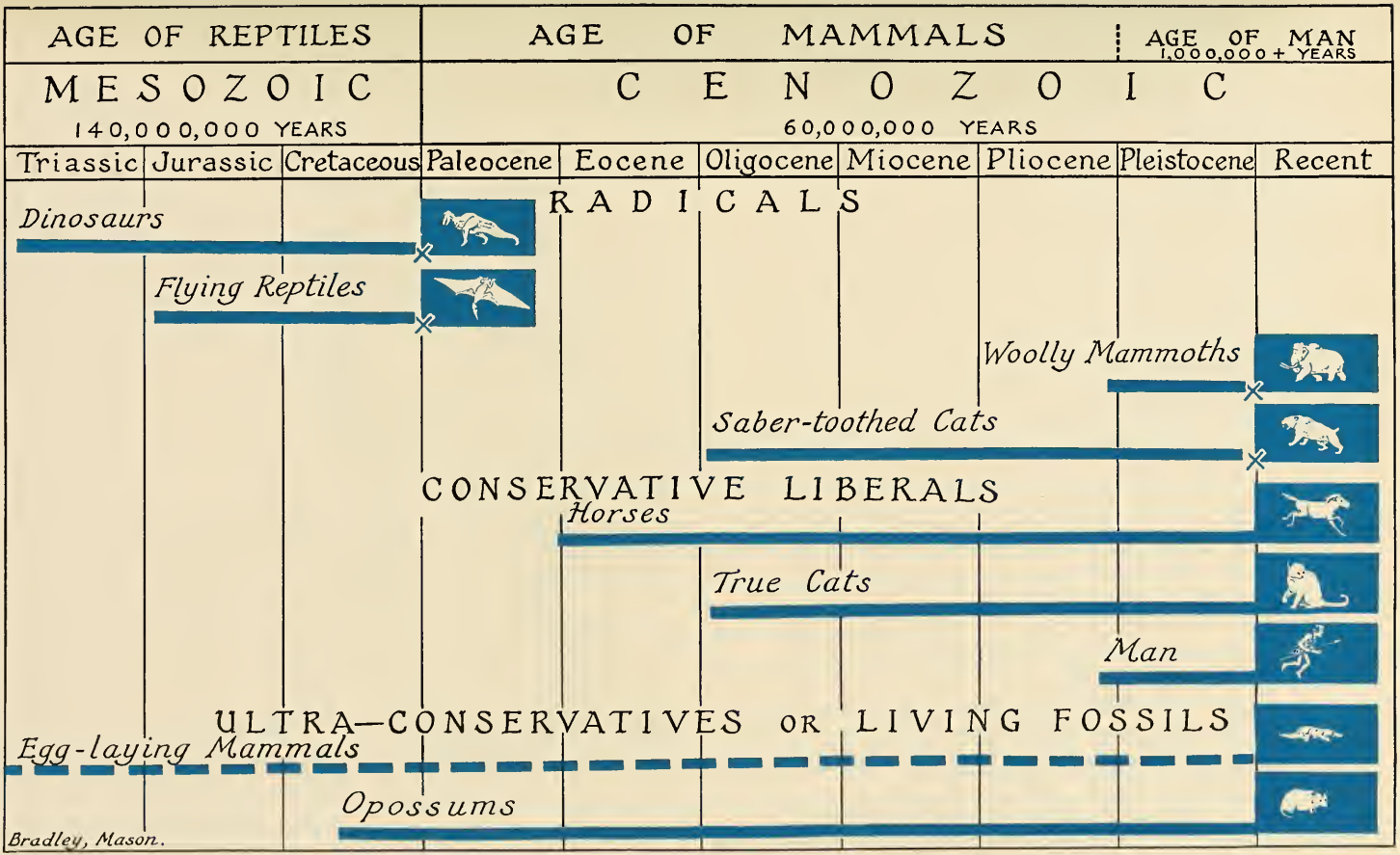
Mammal



Mammal-Like Reptile

The Unique Mammal Jaw

More acute hearing was made possible among the mammals when certain of the "spare parts" in the complex reptile jaw (shown by oblique shading) were utilized to form the inner ear. The single-boned jaw that was left provides scientists with one of the invariable features distinguishing mammals from all other classes of animals



THREE CLASSES OR PARTIES OF ANIMALS

In the struggle for survival, animals may conveniently be divided into three groups: Radicals, Conservative Liberals, and Ultra-Conservatives.

The Radicals are those which become so specialized in their form and mode of life that any environmental change threatens their existence. The fate of the Radicals is always the same, extinction; for the road to extinction is paved with over-specialization.

The Conservative Liberals retain the best features of their predecessors and seem judicious in their selection of new ones. Man, as well as his friends the horse and the common cat, are among the many animals that have followed the Conservative Liberal policy of evolution.

Lastly, the Ultra-Conservatives hold fast to the heritage of the old, and survive only under unusual circumstances. They are the living fossils.

many 'usually this and usually that' characters, which are of no particular concern here. As a matter of fact, it is sufficient to remember that all mammals have hair and a single jaw bone.

In their adaptations, the mammals have become more diversified than any other class of animals. Some have become so specialized for living in the oceans and seas that they can never again return to live on the land. Some have become semi-aquatic, living part of their lives on land and part in the water. Some have become so completely specialized for flight that they can never walk again. And, many are entirely land-livers and have assumed every habitat the continents afford. There is not a climate on the face of the earth in which mammals do not dwell. They have inherited the earth.

Mammals are great reactionaries. Back in the Triassic, 200,000,000 years ago, they freed themselves of reptilian shackles and looked forward to a new order of things. Since then their great diversification has been the result of reaction. Reactionary group after reactionary group has appeared, and out of each there always came three principal kinds, or Parties of mammals.

In the first place, there are the Radicals. I imagine it would be popular today, in some quarters at least, to carry the analogy still further and regard these as the left-wingers. They are the members in a particular group which rebel against and digress most widely from the normal. They take on many new specializations, the kinds of which are dependent upon the particular environment. Their specializations are so over-emphasized that when the environment changes, readaptation is impossible. The answer is always the same, extinction; for the road to extinction is paved with over-specialization. Secondly, there are those forms which can be regarded as Conservative Liberals. They retain the best features of their predecessors and seem judicious in their selection of new ones. It is from these Conservative Liberals that new and advanced groups arise. And lastly, there are those reactionaries that hold fast to the heritage of old. They change but little; they are the Conservatives; they are the living fossils.

Imagine one's astonishment if he opened the barn door some morning and saw a horse sitting on a nest laying an egg. That would be astonishing! Horses just don't do that. Neither do any of the other familiar mammals such as dogs, cats, mice, cows, and humans, which, as we perfectly well know, give birth to their young alive. But hidden away

A Living Prehistoric Animal

One of the strangest creatures on earth: the Duckbill, which has webbed feet and a bill like a duck, a pelt like a seal, claws like a dog, and a tail resembling a beaver's. It lays eggs like a turtle, but nurses its young like a mammal. It is a living fossil which has survived from prehistoric times in the isolation of the island continent of Australia

in that far off lost world of Australia and Tasmania, nature has preserved one of her grandest of all living fossils, a little mammal, scarcely a foot and a half in length, that truly lays eggs. This queer little fellow goes by the common name of Duckbill, because it has a flat and rather large beak that resembles very closely the bill of a duck—although it has never been known to quack. In scientific circles it is called *Ornithorhynchus,* which, of course, means the same thing (concocted from the Greek words *ornithos,* bird *rhynchos,* bill). Now as a matter of fact, for Duckbill to lay an egg is just as unusual as it would be for a horse to lay one. Egg-laying is a bird business, and it was the habit of all the earliest reptiles and still is of many of the recent forms. While the earliest mammals, when they evolved from reptiles in the dim past of the early Mesozoic, probably were egg-layers, this method of reproduction was soon abandoned by the majority. Duckbill, therefore, is little more than a reptile in mammal's clothing. All the millions of years since mammals first appeared, nature has kept these egg-layers as a sample of what mammals used to be like. They probably would not have kept so well had it not been that Australia long ago was isolated from the rest of the world and has remained so ever since. This isolation took place before the Cenozoic, or Age of Mammals, got well under way. At that early date, Australia was populated only by the archaic egg-laying and pouched mammals, and the early separation from the Asiatic mainland prevented the immigration of any of the ferocious flesh-eaters and other competitors which developed so abundantly elsewhere. So Duckbill and its ancestors had a relatively free hand to go about their own business of existence without much interference.

Mistaken for a nature-fake

For a mammal to lay eggs like a bird is one thing, but to try and look like a bird seems to be going a bit too far. Duckbill has done just that. Its bill and entire skull, its webbed feet, and even its intestines are just about the nearest possible approach to an avian assemblage. But then, Duckbill has imitated other animals too, for in addition to these oddities, it has a tail like a beaver, a pelt of fur resembling that of a seal, and claws like a dog! No wonder British naturalists looked upon this animal as merely another product of Chinese craftsmanship when its remains were first presented before their august scientific societies by travelers from the Far East.

The habits of Duckbill are equally striking. It burrows into the bank of a stream or quiet pool just below the surface of the water and excavates an intricate system of subways that communicates with the surface of the ground by a small hole secluded among the dry leaves. Through this opening the animal gets its air. In one of the side tunnels a nest is built where the female deposits her two or three turtle-like eggs. The other tunnels are used for the storage of food, et cetera, and permanent occupancy. When not in the confines of its subterranean home, Duckbill spends the rest of the time living in the water, where it is busily capturing food that consists of small aquatic animals such as worms, crustaceans, and insects. These unfortunates are usually scooped up in the soft muds on the bottom of the stream or pool, brought to the surface where they are spatteringly separated from the ooze, and devoured.

Built for bug-hunting

Although Duckbill is one of the most primitive mammals, it is also one of the most specialized. The majority of the specializations, however, are in keeping with millions of years of aquatic bug-hunting. The duck-like bill, covered with hairless skin which near the face is built up into sensitive folds, is a specialization for getting food. The beaver-like tail and webbed feet are necessary equipments for rapid swimming, and the dense coat of fur acts as a thermal blanket of protection against the chill of the water and the damp coolness of the ground. Moreover, eyes that are practically diminutive black spots at the sides of the head are to be expected in an animal that spends most of its time snooping around in the moss after dark, grubbing in the muck at the bottom of some pool, or creeping about underground where there isn't much to see anyway. It is necessary for such an animal to live almost by its nose alone.

Duckbill is the personification of unaggressiveness and docility. But no animal ever evolved without some sort of offensive or defensive mechanism, and this meek little animal is endowed with a special device all its own. Naturally it is difficult to imagine this small bundle of fur fighting in out-and-out combat with some ferocious beast. This, of course, he never does. If such an occasion arises he either escapes before the fight begins, or is gobbled up immediately by the carnivorous aggressor. When given a fairly even chance, however, he employs a very subtle method of combat—one rather in keeping with the Oriental surroundings. He uses a hypodermic needle.

This instrument, in the form of a small hollow spur, is carried just inside the heel of each hind foot, and is connected with a venomous gland on

European Photos

(Left) A REPTILE IN MAMMAL'S CLOTHING: Duckbill, a living prehistoric animal of Australia. This mammal lays eggs like a reptile, has webbed feet and a bill like a duck, but wears fur instead of feathers. It is no wonder that the remains of this animal were first regarded by British naturalists as a product of Chinese nature-faking. But Nature had out-faked Oriental craftsmanship in this living fossil

(Below) THE DUCKBILL'S SINGLE-BONED JAW, its coat of hair, and its mammary glands identify it as a mammal, but its numerous reptilian and bird-like features mark it as an Ultra-Conservative in the evolutionary scale. Duckbill is the personification of unaggressiveness and docility, but when cornered it employs a subtle method of combat, a poison spur which is located inside of the heel of each hind foot

Drawn by George F. Mason

(Above) DOWN THROUGH THE GEOLOGIC AGES the mother opossum has carried her young on her back in the traditional tree-top home of her ancestors. This Ultra-Conservative has changed but little in 70,000,000 years, and is one of the most significant of all living fossils

Globe Photo

(Right) THE LAZY YOUNG KANGAROO gets free transportation and a pick-up lunch from the comfortable security of his mother's pouch. Because the offspring of a six-foot kangaroo is blind and only an inch long at birth, the pouch has been retained as necessary equipment. The kangaroo is the most familiar representative of the many Australian marsupials

the thigh. Once those hooks get into an adversary, it means much pain, swelling, and drowsiness, although never death. Concerning the people who have been so afflicted, however, one hears various tales. A favorite is that each year on the same day, and frequently at exactly the same hour, the victim suffers a recurrence of the painful effects experienced when he was stricken. This seems to be another "dark of the moon" story. Similar to the story told me by a Nebraska lady of how her little son Johnnie was bitten by a rattlesnake on the Fourth of July and how every Fourth of July he gets deathly ill. What youngster wouldn't after spending that day of celebration eating popcorn, ice-cream, all-day-suckers, and various kinds of Indian candy?

Another specialization of Duckbill is the loss of teeth. To be sure, teeth are present but only in the very young individual. They are so peculiar in appearance that it takes a specialist to recognize them as such, for they are totally unlike the teeth of any other known beast. They are early replaced by horny pads which undoubtedly are of much better service for crushing a soft slippery worm or an elusive crustacean.

Duckbill's brain

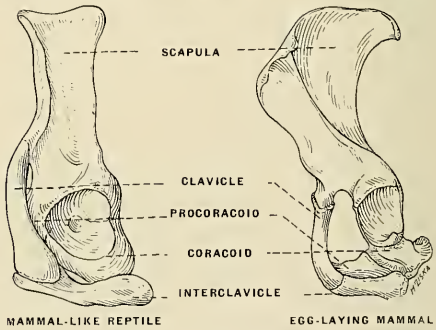
The unusualness of all these characters fades into insignificance when one considers the many reptilian characters which Duckbill has inherited from its Triassic ancestors of the distant past of nearly 200,000,000 years ago. Duckbill is an egg-layer, but it is even more of a reptile than that. As far as mentality goes, it is still in the Triassic, for it has no wrinkles in the cerebrum, or fore part of the brain, which means there isn't much there. Also, the brain has no corpus callosum, a bunch of fibers connecting the two parts of the cerebrum so that one side of the brain will be informed as to what is going on in the other. These features are characteristic of the brain of reptiles. In spite of these mental deficiencies, Duckbill has done pretty well.

In addition to its reptile-like anatomy, Duckbill has a skeleton that is constructed on an equally reptilian ground plan. This is especially true of the shoulder bones. Many mammals have two distinct shoulder bones on a side. Duckbill has four. Or rather, it has a collar-bone (clavicle) and three extra bones to go with it (scapula coracoid, and procoracoid) with a median bone (interclavicle) thrown in for good measure. All of these are found in some of the recent and many of the extinct reptiles.

By this time the reader may wonder why Duckbill cannot be considered a reptile and not a mammal at all. The presence of a single jaw-bone, a coat of hair, mammary glands, and a number of other diagnostic features, forbid this. In these characteristics, Duckbill is every inch a mammal, although the breasts are without teats and are modified sweat glands instead of modified sebaceous, or oil, glands as in all other mammals.

Equally ridiculous in their general make up, and closely related to Duckbill, are two other survivors of this almost extinguished race of egg-laying mammals. One is commonly known as the "Australian Ant-Eater" (it is also found in Tasmania and New Guinea), and is less commonly known by its scientific Greek name *Tachyglossus (tachys,* swift; and, *glossa,* tongue). The other lives only in New Guinea and goes by the Greek appellation *Zaglossus* which means great-tongue. These animals are very deserving of their names, for each has a much elongated tongue that is covered with a thick sticky substance. This kind of tongue, functioning somewhat like a strip of ever-ready fly-paper, is perfectly adapted for lapping up scores of ants with each lick. Sometimes these two insectivorous creatures are collectively spoken of as the "Spiny Ant-Eaters" since, as a means of protection from carnivorous dictators, their sides and backs are covered with many long sharp quills that project beyond the thick coat of hair. Both are very much alike except that *Zaglossus* is somewhat larger, and has a couple of toes reduced. Also, its longer and more down-curved beak and its ears projecting beyond the tips of the surrounding hair, give it the striking appearance of a midget elephant.

From the standpoint of primitive characters, the Spiny Ant-Eater is just as archaic as Duckbill, but



DUCKBILL'S REPTILIAN "WISHBONES"

Though classed as mammals, the egg-laying Duckbill and Spiny Ant-Eater possess a reptile-like skeleton. Three extra distinct shoulder bones of the reptilian plan distinguish these living fossils from all other mammals

in its specializations it always goes Duckbill one better. The fore part of the brain is considerably wrinkled instead of being smooth as in Duckbill. Moreover, through the perfection of the art of ant-eating the snout has become much elongated, teeth are entirely absent, and the jaws are reduced to slender rods of bone, thus giving the skull a very bird-like appearance. Furthermore, whereas Duckbill builds a nest and lays two or three eggs at a setting, the Spiny Ant-Eater lays but one, and not in a nest. About the time the egg is to appear, the female develops a sort of pouch on the abdomen; not a spacious one as in the opossum, the kangaroo, and other marsupials, but rather a sort of vest-pocket addition. The egg is placed in this pocket where it soon hatches, and the tiny helpless offspring receives its nourishment by lapping up the oozing milk from the walls of the pouch. As soon as it is more or less able to shift for itself, it is put out but is allowed to return for meals until the art of ant-eating is perfected. The Spiny Ant-Eater is a rather nomadic individual. Ants, the principal food, do not come to Spiny, Spiny must go to the ants. So, instead of leaving the eggs or the young behind in a nest, this is perhaps a much better way of handling the situation. Wherever Spiny happens to bed down or dig in, there will be Spiny's home and family also.

What strangers these egg-laying mammals are in this our modern world! What strangers they have always been in that changing world of mammals! If we could turn the clock of time back 60,000,000 years to the beginning of the Cenozoic, even then they would be out of date, because by that time the great diversification of mammals was already well under way. We would have to reverse the wheels of time 100,000,000 years more before we would really find them as "modern."

What is the ancestry of these egg-laying mammals? What is their relationship with other mammals? What is the significance of their persistence through the ages? These are formidable questions to answer when the record is so deplorably incomplete. Curiously enough, no fossil remains of these strange beasts have as yet been found in rocks that can be considered definitely older than the Pleistocene. Since hardly a week passes without the announcement of a new and important discovery of some fossil mammal, it is indeed likely that eventually the true ancestry of these egg-layers will be known and they can be given their proper place in the class of mammals. Until then, considerable will have to remain problematical. Certainly many of their anatomical and skeletal characters show that they are not closely related to any of the mammals living today. They do, however, seem to show a slight affinity to an extinct order of mammals, the members of which were equally bizarre. These mammals are known as the multituberculates, because the grinding surface of their molar teeth are characterized by an abundance of tubercles. Beginning back in the Triassic, until they died off in the early Cenozoic, the multituberculates had a world-wide distribution including Africa, Asia, Europe and North America. Evidence shown in the many known fossil forms points to the fact that this group of mammals originated directly from early Mesozoic reptiles, independent of the main ancestral mammal stock. This is probably why they seem so out of harmony with the rest of the mammal world—or, from their point of view, why the rest of the mammals were so out of harmony with them. It is possible that future discovery may substantiate the theory that these unique extinct mammals and the recent egg-layers were derived from a common early Mesozoic reptilian ancestor.

LAND OF LIVING PREHISTORIC ANIMALS

The dotted line shows the probable coastline before the geologic independence of Australia and its island neighbors was established. Accidental isolation for 60,000,000 years has permitted the survival of the weak and obscure egg-laying mammals

The weak and obscure are soon destroyed unless they are tucked away in some remote corner of the earth, where they are protected from the competitive struggle for existence that is always going on in the animal kingdom. The existence of the three obscure little egg-laying mammals is, therefore, of considerable interest. They are with us purely by

accident. It must be kept in mind that through sheer luck there was downwarping of the earth's crust in the southeastern portion of a once larger Asia and finally the island-continent of Australia was separated from the mainland by an inlet or barrier sea. Before its geological independence was declared, Australia, as we have seen, was inhabited only by the egg-laying and pouched mammals. Living conditions, until relatively recent times, have been pretty much the same since then, and the fortunate egg-layers that happened to be there were required to make few adaptive changes. Placed in this stable environment, survival for them was assured for the next 60,000,000 years or more; and, though already quite specialized, they were still variable enough to cope with the minor physical and organic changes which did take place in that land of freedom. So nature gives us today these egg-laying mammals; somewhat specialized it is true, but in spite of this, extremely conservative forms. They have retained down through the millions of years, since mammals first appeared, a great assemblage of reptilian characters. Stripped of their specializations and regarded in the light of our knowledge of the earliest fossil mammal and mammal-like reptile remains from the Mesozoic, we see in these living fossils of the present, the first mammals of 200,000,000 years ago.

Trial and error

Things in nature never seem entirely satisfactory and very frequently they are highly unsatisfactory. New methods are always being tried. Egg-laying for mammals was all right as a beginning and proved satisfactory in some special cases, but as a means of reproduction among the higher mammals it was, of course, out of the question. Proof for this lies in the fact that it was early supplanted by the habit of bringing forth the young alive. The drama of this change is even more striking when we realize that it was entirely accidental. All new inheritable characters that appear are accidents, and each of these may be injurious, indifferent, or beneficial. If the new character is harmful—one which will cause the animal to be out of harmony with its environment—the chances of its spreading throughout the race are practically nil. If it is neither harmful nor beneficial, the chances of its being lost or retained are equally good. But if the character is beneficial—one which helps better to adjust the animal to its environment—then the chances of it being handed on to the coming generations are greatly enhanced, because it increases the probability of survival for a great number of individuals.

The bearing of living young was found to be of great benefit in the precarious existence of the early mammals. This meant that there would be no nest to bother with, and no eggs to incubate over a long period of time. Perhaps the egg-laying parent could escape the attack of an enemy, but she could not take her almost-hatched eggs with her. They would be destroyed. It was much better, then, for the eggs to remain inside the parent where they would be given the necessary protection and constant warmth during the early embryonic stages. This is precisely what happened in the primitive condition of viviparity among mammals. The eggs were kept inside the mother where they eventually hatched.

How the kangaroo got its pouch

This too had its drawbacks. The eggs of necessity had to be small, and since no means had as yet been developed whereby the embryo could get its nourishment directly from the blood stream of the mother, the young were very undeveloped because their only food supply was the stored-up yolk inside the small eggs. Another method had to be invented to care for the immature offspring when they were brought into the world. To meet this need, a sac-like pouch was formed on the abdomen of the female into which the young could be placed at birth and there nursed through infancy by milk from the mammary glands. This is characteristic of nearly all the marsupials (from *marsupium,* the Latin word for pouch), a rather lowly order of mammals, yet one that is somewhat higher up the scale of mammalian development than are the egg-layers.

The kangaroo, an animal familiar to fight promoters, and visitors of almost any zoo, is a good example of a marsupial. It looks like an enlarged edition of a jumping-mouse. It has a small head, a large tail and powerful hind legs which are its sole means of locomotion. It sometimes attains the height of six feet. At birth, however, the size of the blind offspring is about an inch in length. Without eyesight but with a profound instinct and by aid of a large claw on each of the fore feet, this little lump of flesh ambles its way to a teat in the pouch of its mother, to which the lips become firmly adhered. Then the claws are lost and the child-kangaroo proceeds to grow into "kangaroohood." So immature and helpless is the newly born infant that at first the milk is injected into its mouth by muscles in the breast of the mother. Baffled by this unprecedented occurrence of the young, the natives of Australia discredited the kangaroo in believing that the progeny sprouted on the teat of the breast, instead of appearing in the customary way—like Topsy, they just grew.

The young kangaroo enjoys the warmth and comfort of the maternal pouch for several months. When grown to an appreciable size, it begins to venture forth to learn the game of shifting for itself. If startled, the little fellow will jump head-long into the pouch of its parent for protection. Sometimes when running at top speed to escape an enemy, mother-kangaroo will snatch up her young one and place it head first in her pouch with lightning quickness; just the way a quarterback picks up, or, as is more frequently the case, would like to pick up a fumbled ball, and run for a touchdown.

The kangaroo is one of a great number of marsupials that inhabit Australia and immediate vicinity. To a native of that region, the present would seem like the "age of marsupials." Since that land was isolated from Asia millions of years ago, this group of mammals has been unchecked by intruding enemies, and has developed abundantly until competition resulted in many diverse lines of specialization. They have mimicked nearly every other group of mammals, such as dogs, hyaenas, rabbits, squirrels, cats, bears, mice, etc. Nearly all of the living forms in Australia, therefore, have become specialized in relatively recent times and have diverged so greatly from the primitive "type" of marsupial that, with the possible exception of the pouched mouse marsupial *(Phascogale)*, they cannot be considered as good examples of living fossils. We must remember, however, that as a group of mammals, the present members are indeed primitive. For about 50,000,000 years of the later Cretaceous, marsupials were the dominant mammal representatives living along with the last of the great dinosaurs at the closing stages of the Age of Reptiles, and the recent forms have retained the basic primitive features of that group, which represents one of the earliest ancestral stages of all the higher mammals.

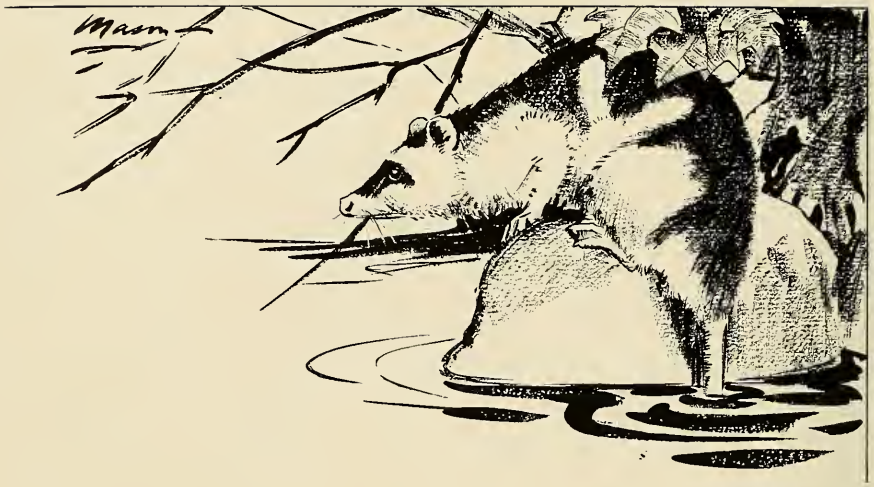
Early marsupials in North America

For the most archaic of the living marsupials, we must turn to parts of the world outside Australia. In the past 60,000,000 years, marsupials had a much greater distribution on the various continents than they have today. There is no conclusive evidence that they were ever present in Africa, but throughout most of the Cenozoic they were widely and abundantly distributed over Eurasia and the New World. Since the earliest known fossil forms were discovered in the upper Cretaceous deposits of Alberta, Canada, it seems logical to conclude that their place of origin was North America. From here they migrated in one direction to Australia and Eurasia, and in another direction to South America. Competition with the higher mammals was keen in the Old World and although they managed to survive there for a long time, they finally had to give up the ghost before the close of the Cenozoic.

In North America the rôle of survival was not so very different and, in so far as we know, all of the marsupials suffered the same fate. In South America conditions were somewhat different and so too were the results. Early in the Cenozoic, that land was isolated from North America by submergence of the land connection now known as Central America; but not before it began to be populated by marsupials and a few of the ancient higher type mammals that wandered down there from Yankeeland up north. This southern continent then enjoyed millions of years of isolation from North America, during which period, especially in the later millions of those years, the marsupials had a glorious time. Isolation meant, as it did in Australia, that the struggle for existence had to be fought out for the most part among themselves. The up-shot of this was that many forms flourished, imitating in appearance the saber-toothed tiger, and various other mammals of foreign continents.

The remarkable opossum

In Pliocene times diastrophic movements in the earth's crust brought about climatic and faunal changes that proved fatal to the marsupials in their South American happy hunting ground. The land bridge between the Americas was once again resurrected and the traffic, as before, was mostly one-way. The invading competitors from the north raised havoc with things, and for the primitive group of marsupials which had reached, so to speak, the end of the rope of specialization, extinction was inevitable. Today there are in South and North America only two distinct representatives that were able to weather the storm. Both are opossums (a modified version of the word, *possowne*, supposedly of Algonkian Indian origin), and we are to expect that they are Conservatives, for only those that did not become ultra-specialized during trying conditions could possibly have survived. One is the Yapock, or water opossum *(Cheironectes*—"hand swimmer") from Central and South America. This fellow found refuge in the water and has, therefore, become quite specialized in his semi-aquatic habit. He was probably the next on the list for extinction. The other, is the true opossum, *Didelphis* (from the Greek words *dis*, double, and *delphis*, womb—in allusion to the pouch on the belly of the female), which has a geographic range from the pampas of Argentina to as far north as New York. The true opossum



YAPOK, A DIE-HARD CONSERVATIVE

An ancient but living South American relative of the opossum, whose swimming and diving ability provided its chief refuge in a greedy world of Radicals. This creature is probably next on the list for extinction among pouched mammals in the New World

was the most conservative of all. Clinging fast to the arboreal habit of its ancient ancestors, the opossum stayed in the tree tops and has changed but little since the late Mesozoic. This remarkable animal is, therefore, the finest example of a living fossil among all marsupials, if not the finest among all mammals.

The opossum is the most prolific of all marsupials. The pouch is equipped with five to thirteen teats but usually in each litter of young there are more than can be accommodated. When born, the young, as in all marsupials, are very helpless. As they appear, the mother places them in the pouch. Each has its own food supply and they remain there until about the size of mice. They then venture forth and become introduced to the ways of life while riding on the mother's back like so many papooses.

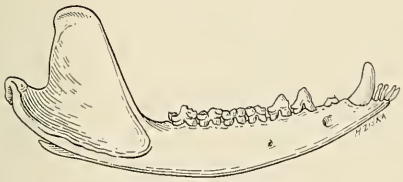
The diet of the opossum is mainly fruits, grains, roots, small animals, eggs and carrion, but they can go without food or water for three or four weeks at a time. They inhabit the forested areas and usually make their homes in hollow trees. They are nocturnal animals, although they occasionally venture forth in the daytime. In the fall of the year, after a season of heavy eating the flesh is especially palatable and is regarded by many as a great delicacy. It is this time of year when that singularly American sport of " 'possum huntin' " gets under way. How truly American is this sport! No thoroughbred horses, selected packs of hounds, especial fire-arms or fine imported liqueurs are necessary. The only requisites are an axe, a dog—preferably a mongrel—possibly a .22-rifle, a lantern, and a goodly quantity of any brand of vile Kentucky moonshine.

Stories about the opossum, especially concerning its tenaciousness of life, are perhaps surpassed only by those of the angler. A friend of mine once related how he had captured an opossum, beat it over the back and on the head many times with a club, and threw the mangled beast into a wire cage. While he was in the wood-shed sharpening his skinning knife, the animal gnawed its way out of the cage and escaped. Maybe it did! Nevertheless, the opossum does have the habit of feigning death when caught. This, of course, is the basis of that proverbial expression, "playing 'possum." So perfected is this habit with the opossum that it will undergo the severest affliction of punishment or even meet its death without displaying the slightest emotion of pain or agony. Colleges and universities have selected such animals as the lion, the tiger, the bulldog, the goat, and the jackass, as their fetishes, mascots, or —I never quite knew what. Before them all, I

should recommend *Didelphis,* for in its own little way, the opossum is perhaps the bravest of them all. Of course, the possibility of it being just plain dumb is also to be considered.

That the opossum is an ancient inhabitant of North America is shown by the fossil remains which have been found in the late Mesozoic and Cenozoic rocks of this continent. These remains, though few in number, are priceless in scientific value.

In the summer of 1915 Dr. Barnum Brown, while undermining the skeleton of a great horned dinosaur in the upper Cretaceous deposits of Alberta, discovered the jaw and some skull fragments of a little mammal. There could be no question about the geological age of this specimen, for it was found beneath the dinosaur skeleton which had remained undisturbed since burial in the Canadian marshland of the later Cretaceous millions of years ago. When shipped back and prepared in the laboratory at the American Museum, this jaw and skull parts were determined as the remains of the most primitive marsupial. Many isolated teeth and other parts of marsupials had been collected previously from the Cretaceous, but all were found in the uppermost levels, and all are rather specialized. The Alberta specimen was found in strata that were laid down at least 5,000,000 years earlier, which fact is established beyond question by its association with the particular primitive horned dinosaur. It is, therefore, the earliest of all the marsupials known.



Opossum Jaw

"Dawn Opossum" Jaw

70,000,000 Years of Ultra-Conservatism

Comparison of the modern opossum with his ancestor of 70,000,000 years ago shows that the only principal change is one of size. (Figures drawn to scale)

This primitive marsupial was named *Eodelphis,* or dawn-opossum, by the late Dr. W. D. Matthew, and a dawn-opossum it is indeed. Compared with the recent form it shows no marked differences. It is smaller and displays slightly different proportions, but these features are of minor importance. Living fossils, it must be remembered, do change a little all the time, but the change in the opossums is insignificant when compared with the striking changes which evolution can produce. An example of this accelerated evolution may be seen in the titanotheres (thunder-beasts)—a group of odd-toed mammals that lived in early Cenozoic times. Toward the close of the early Eocene there appeared in North America the earliest known member of this group, a hornless little creature about the size of a collie dog. By early Oligocene times, the titanotheres had developed into forms of titanic size, and then became extinct. *Brontotherium* (Greek: *bronte,* thuder; *therion,* beast), one of the end-members, had large flattened paired horns on the end of its nose and was approximately the size of the modern elephant. The many changes and specializations that took place in these animals were brought about in 20,0000,000 years, or one-third the time that has elapsed between *Eodelphis* and its present-day counterpart, the opossum. Dozens of other such examples could be cited among the mammals.

The fossil record of the didelphid, or opossum, marsupials is very meagre when compared with the abundant remains of other mammals that have been found, yet it is sufficiently complete to demonstrate that they have been a remarkably constant group during, at least, the last 70,000,000 years. The living opossum has progressed very little beyond the Cretaceous stage. So not only is it a splendid example of a living fossil representative of a single order of mammals—the marsupials—but, as is shown by many lines of evidence, in the general structure of its whole body it is not far removed from the marsupial-insectivore stock of the early Cretaceous that gave rise to nearly all of the later mammals.

Thus we see that the opossum and the egg-laying mammals belong to another world. They represent what was the dominant mammalian life before the fall of the dinosaur empire, and before the advent of the higher mammals, when the continents were clothed with primeval forest and ruled by hoards of giant reptiles. Since then, waves of animals have come and have disappeared, and the earth's surface has undergone many changes, but these Conservatives have stood the test of time. They are living relics from the Mesozoic.

THE FLAMINGOES OF THE GALAPAGOS ISLANDS—

Showing these fantastic birds in their nesting colony at hatching time, amid the desolate beauty of tiny Jervis Island

By WOLFGANG VON HAGEN

THE flamingo is one of the many strange creatures for which the Galapagos Islands are famous. This bird, unlike the Galapagos penguin and most of the other avian inhabitants of the islands, is found generally on the islands of the Caribbean Sea and along the eastern and central American coast. In view of this one might look upon its presence in the Galapagos as a natural thing and think no more about it. However, its occurrence there is strange because the islands are so far removed (more than eight hundred miles) from the nearest known nesting places.

In an archipelago of volcanic origin, where the animal life is drab in color, if not in interest, the flamingo stands out. This and the vermilion flycatcher supply the only note of color among the bird population. Even so the Galapagos flamingo is not quite as gaudily painted as its mainland and Caribbean relatives.

Only five of the thirty-five islands forming the archipelago are honored by the presence of flamingo colonies. These are James, Albemarle, Charles, Indefatigable and Jervis. Lying three miles south of James Island, Jervis is a mere three miles in diameter and might easily be swallowed up in the mouth of one of Albemarle's great craters. Although small in size it is a quaint little place with a charm all its own that lends particular interest to the flamingo colony and the birds' actions.

It was during our fourth month on the Galapagos that we made a reconnaissance trip to Jervis, entirely unaware of the presence of flamingoes on the island. Into a shallow bay on the leeward side of the island our little sloop nosed her way. Before us the sand of the beach stretched away on either side like a broad ribbon of a beautiful beige color. We had seen nothing like it on other islands. The sun was still low in the east and the last delicate clouds of mist were rising, like steam from a plum pudding, from the top of Jervis mountain. The beach three or four yards back from the water was covered with green, succulent vegetation that invited investigation and we lost no time in going ashore.

Eagerly, and with extreme stealth, so as not to disturb any inhabitants of the growth, we made our way through the green verdure. An exclamation brought me to the side of my wife, and, parting the screening bushes, I espied the cause of her excitement. In a small salt pond a score of flamingoes paraded slowly by. The birds, fully three feet in height, were foraging for little salt water sprouts, some of them moving along with their heads entirely below the surface of the water so that only a roseate sphere was visible. The pond, with its gently rippling surface, surrounded by giant cactus trees and with Jervis mountain rising a thousand feet behind it, seemed like a bit of fairyland transported to the rugged Galapagos.

In order to photograph them, we came out into the open. Upon sight of us there was great commotion. Flapping their wings so as to raise their bodies sufficiently to use their legs, the whole flock took off, partly running and partly flying, in characteristic flamingo formation. At the second time around the pond one part of the flock continued flying, while the others came down in the water almost opposite to where we were standing. Again we moved, and again the birds went through the same performance. The dozen flamingoes that came down walked to the opposite side, always gravitating toward a small screened bank. Our curiosity was aroused, and with extreme care and making as little noise as possible, we made our way to the other side of the pond.

The flamingoes rose again when they espied us, circled the lagoon and came down close to the screened area, only to walk slowly and deliberately

(Left) A PAGE FROM ALICE IN WONDERLAND. The flamingo rookery in Jervis Island, Galapagos. It is December and the nesting season; each conical mound contains an egg

away when we arrived at that point. On a small lava hill we espied a conical mud tower and in the gentle hollow on its top, an egg. On drawing closer we discovered tower after tower. It was the flamingo rookery, containing almost a score of eggs in the process of being hatched. Whilst my wife filmed the panorama of the rookery I busied myself with a study of an individual tower. As I carefully turned an egg in order to secure a better picture I was startled by a protesting chirp from within. Simultaneously a bit of shell was chipped off.

Setting the cameras in focus, we awaited the flamingo's debut into the world. An hour, two hours, and the hole was scarcely larger than a five-cent piece. Then it occurred to us that the mother bird might normally assist in releasing its offspring. And even if she didn't, our patience was not entirely inexhaustible. So I decided to play midwife to the embryo flamingo.

For instruments in this accouchement, I had only my forceps, but they proved to be quite the correct thing. Bit by bit the egg was broken, and either from distress, or encouragement, our charge within the egg gave periodic chirps. One has to go slowly as the bird cannot be expelled quickly but must adjust itself to his new ethereal environment. I would stop occasionally to photograph the process, and allow the contortions of the little flamingo to break away part of the egg also. At last we were rewarded in seeing the bird eject itself from the half of the shell that remained. With a final chirp, it shook off the bits of shell adhering to its feathers, and white as a ball of cotton, lay on the conical earth mound.

After we had built a screen of mangrove, the prospective mothers returned to their nests. Timidly they came, chafing one another with their pink bodies. It was a superb picture, these pink flamingoes walking solemnly, with the whole volcanic blackness of James Island as a background. Occasionally one of the birds would rise to its full height and flap its wings, the pure black underpinnings standing in remarkable contrast to the rest of the roseate body. Slightly irritable, and venting their nervousness on their fellow flamingoes, they came closer to the nests. After a good deal of bickering, the flamingoes approached their respective mounds, and resumed the sitting-on-the-egg ritual.

It is a remarkable ceremony, especially in the manner in which the ungainly birds have contrived to surmount the difficulties of their long legs. The conical nests, constructed of mud, are built to a height of twelve to fourteen inches above the surface of the ground. The flamingo approaches the nest, shakes one of its webbed-feet and places it on the edge of the nest, and raises itself to a standing position on top. Often it places its beak on the other side of the nest in order to preserve its balance. Then it shakes the other leg, to free it of water and other foreign material. With both feet on the edge of the nest, it preens its feathers, dislodges a tick here and there, and turns its cork-screw neck in every gyration known to the flamingo. Then suddenly stretching its neck so that its beak rests on the rim of the nest, it drops its body onto the egg with a plop. One might think it would break the egg, but of course, it does not.

For some hours we sat in concealment observing the birds and taking pictures of their mannerisms and characteristic poses. The flamingo whose chick we had assisted into the world during her absence, seemed not in the least perturbed to have the whole thing done behind her back. She, too, mounted the nest and squatted on her chick, and the last we heard when we made our departure was the chirping of the little flamingo and the answering quacks of its mother.

THE GALAPAGOS FLAMINGO unafraid of humans, allows itself to be petted until it espies its mother coming with food

(Right) A COMING-OUT PARTY for a flamingo chick. This little chick has just shaken off the last part of its shell. The author assisted in the accouchement by slowly breaking off bits of the egg

(Below) WITHIN A FEW DAYS after its birth the baby flamingo takes to the beach. It is like a small bit of cotton with roseate legs and beak

(Right) THE SITTING-ON-THE-EGG CEREMONY of the expectant mothers: Flamingoes returning to their nests and going through the strange ritual

Continued from page 122
enemy, the gartersnake. A captive gartersnake in my laboratory produced a litter of twenty snakelings, each about six inches long and perhaps the width of a soda-straw. I presented these to Cy one at a time, and he ate the entire brood in a few days, swallowing them as readily as he would an earthworm. Once he swallowed the same snake three consecutive times, this seeming miracle being due to the fact that I twice rescued the snake from his gullet by means of a long pair of forceps.

Dr. C. C. Abbott once found an eighteen-inch gartersnake in the stomach of a large male bullfrog. Upon examination of the snake, he saw that it had a field-mouse just half-swallowed, and, therefore, was nearly helpless when the bullfrog attacked it. He concludes from this interesting fact that the frog saw that the snake, ordinarily a fearsome creature to him, was helpless and so took advantage of the fact. "For certainly," he says, "no frog, however large, will attack even a small snake if it is possessed of its usual activity." But he was ascribing, as I see it, entirely too much discrimination to the bullfrog. Cy, and many others that I have tried, had no such inhibitions.

I have never found a gartersnake in the stomach of a bullfrog, although I have found some curious things there, including a small turtle, and a two-inch piece of wood about the thickness of a lead pencil. But I have no doubt that the bullfrog swallowed the snake, and that he swallowed it not because he recognized its helplessness but simply because it happened to come near him. Something moving for a frog is something to be swallowed!

Nothing moving, nothing eaten

Cy was mortally afraid of any gartersnake big enough to attack him, for I several times allowed one of them to seize him just to note his reactions, but anything small enough to be swallowed, snake or otherwise, was just so much "grist to his mill." His stimulus to eat came to him only through his eyes; pangs of hunger he may well have experienced, for I compelled him on several different occasions to go two or three weeks without food. But, though he would seize a piece of meat flicked in front of him, or grab at a rolling shot or bean, when left to himself, he obeyed the iron-clad rule of his kind: nothing moving, nothing eaten!

I must record rather regretfully that particularly in connection with his eating, Cy showed but little intelligence. Time and again, he would thrust his head violently against a piece of clear glass which I interposed between him and his victim, and when on one occasion I surrounded an earthworm with a veritable hedge of sharp pins, he lunged at the worm repeatedly until his nose and tongue were literally riddled. He never seemed to learn the meaning of obstacles or pain when something alive moved in front of him.

Although Cy began his existence as an egg in water, and spent most of his early life there, he never knowingly drank a drop of it after he transformed from tadpole into frog. Like all frogs, he was a "total abstainer" and yet an "old soak" for all that, since he took his water literally by soaking it up through his skin.

Recuperative powers

One morning the janitor, who had taken a fancy to the frog, came to me almost with tears in his eyes, and holding out something in his hand. It was Cy, black, dry, shriveled, shrunken to almost half his normal size, apparently dead, but not quite. He had jumped out of the tank during the night. I took him rather hopelessly and dropped him into the water where he sank to the bottom and lay flat on his back, which in a frog is a sign that he is just about "done for." But to my amazement, in a few minutes he began to lose his shriveled appearance, his wasted form took on color and plumpness as if by magic, he turned over on his front, and in a few hours was back on his board again looking as if nothing had happened. Using this as a clue, I experimented with other frogs, and found that they could lose by drying about forty per cent of their total weight without fatal results, and gain it all back again in about six hours. A one hundred fifty pound human losing sixty pounds' weight over night and gaining it all back again next day, would be a strange creature indeed!

A frog may live to be ten or twelve years of age, and Cy had reached five, when, one evening in my absence, a boy brought a huge snapping turtle into the laboratory. Not knowing what to do with it, he placed it in Cy's tank over night for safe keeping. It was safe enough for the "snapper" but highly unsafe for Cy. The turtle had attained his huge bulk by the simple plan of incorporating into himself any and every edible thing that his great, cutting jaws could get hold of, and to him who had "slain his thousands," Cy was only another luscious bit in the process. But he had not counted on the janitor. That worthy chanced to see Cy disappearing down the gullet of the "snapper," and, as I said at the outset, at once threw the turtle headlong into the furnace. Which finished the "snapper," and effectually prevented Cy from becoming what every frog is sooner or later likely to become—a part of some other living creature.

★ THE INDOOR EXPLORER

By D. R. Barton

Three singing mice: Radio listeners throughout the country were recently astounded by the announcement, broadcast from a Chicago station, that they were about to hear the vocal efforts of the much publicized singing mouse lately discovered in a children's industrial home near that city. No listener could have been more nonplussed than your indoor explorer as this strangest of radio debuts, a series of quite musical chirps and trills, reached his incredulous ears.

Having had no previous experience with the vocal achievements of mice other than the usual squeals of fright followed by a scuttling into nearby holes, the writer had supposed that their voices were never more than a means of expressing the most fundamental emotions as briefly as possible. The idea of a mouse radio-entertainer trilling and chirping with professional nonchalance into a microphone gripped your explorer's imagination, and caused him to murmur: "What wouldn't I give for a singing mouse story of my own?"

Though not so suddenly answered, it was almost as if a fairy god-mother, hearing the wish, had waved her wand; in fact she must have waved her wand thrice for, a week or so later, the writer was invited to a concert given by, not one, but *three* singing mice.

The concert took place in, of all places, a New York apartment; but this was not an ordinary apartment—in fact it is probably the only one of its kind.

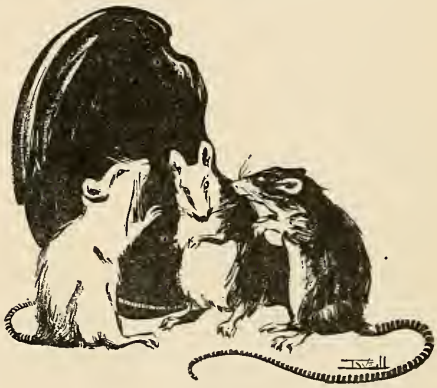
Tenanted by Mrs. William Le Roy Cahall, a member of the American Museum, it contains a living collection of approximately 300 tropical birds ranging from a 30-year-old large-sized parrot, to a tiny song bird about the size of your thumb. Sleeping at night in cages, all these birds have the complete run of the apartment during their waking hours. A flock of canaries, fifty strong, sweeping into the living room, circling, and flying in close formation out along the hall again is a common every-day sight for Mrs. Cahall's visitors.

The extraordinary breeds the extraordinary. It was, therefore, fitting that with all the apartments in this particular building to choose from, the three minstrel mice should have selected Mrs. Cahall's as their winter residence.

Of course, what really attracted them was a small room which Mrs. Cahall has set aside as storeroom for the large quantities of grain and seed necessary to feed her magnificent bird collection.

One evening, a short time ago, Doctor and Mrs. Cahall heard a soft trilling sound which, to their astonishment, evidently came from this storeroom.

The song resembled that of a female canary.



"One of your canaries has slipped in there instead of going to his cage to sleep," concluded Doctor Cahall.

"It doesn't seem possible," replied his wife, "they have never disobeyed me before. When I call them each and every one has always gone to his own cage to sleep, and besides the storeroom door is never opened at bed time."

Fearing that one of the canaries had perhaps hurt its wing and had been unable to get out of the storeroom before it was closed, Mrs. Cahall entered and switched on the light—what she saw sent her running into the living room shouting to her husband to "come and see mice—three of them

—that sing like canaries, nibbling at one of the seed sacks." Doctor Cahall laughed. "Impossible," he said. When she returned with her husband the mice, frightened, had disappeared. Doctor Cahall enjoyed his joke—but not for long.

The next evening, at about the same time, the singing was heard again. This time Doctor Cahall saw the mice: a little one with a shrill, melodious "soprano" a medium-sized mouse with (shades of the three bears), a medium-sized voice, and a big fat one with a deep "chirrup."

These mice have continued to provide the Cahall's with entertainment.

They form a trio and harmonize rather well. As they are quite wild and shy, you must crouch in the dark storeroom to hear them. When the light is flashed on they soon run to cover, usually, however, continuing their song in flight. The little soprano is the most proficient of the three, Mrs. Cahall asserts, and is also the most persistent. Sometimes, unaccompanied by her "supporting cast," she will give solos while on a solitary forage in the storeroom.

"I say 'she' because the little mouse seems like a female," explained Mrs. Cahall. "Although she is the tamest of the three, I have not succeeded in getting on sufficiently good terms with her to examine her very closely. But I am making progress. Just the other night I got her to eat a bit of cheese out of my hand. I want her to get accustomed to the smell of my hand and to associate it with food. In this way I hope gradually to tame all three mice and add them to my pet collection."

The three songsters have all the physical characteristics of the common house mouse. They are steel grey in color. When singing they often sit upright on their haunches, place their fore-feet about their heads and twitter in their respective keys very much in the attitude of dogs baying at the moon.

Mrs. Cahall says that she has every reason to believe that these songs are not indications of impaired breathing or of a diseased condition of the vocal chords. Her opinion is that the mice sing because they want to, and that, if the song means anything at all, it means that the mice are enjoying themselves. She bases this assumption on the fact that the songs are usually forthcoming at feeding time.

Just why the mice did sing was indeed puzzling. The writer made the tentative suggestion that they might have learned the habit from the canaries. This, Mrs. Cahall doubted, since the mice never sang in the daytime when the canaries were singing, and could scarcely be expected to wait modestly until their unwitting instructors had gone to roost before piping their soft-toned imitations.

Nor does one find any support of the "imitation theory" among the papers of Prof. Lee R. Dice of Michigan, who has done considerable laboratory experimentation with singing mice. Not only is Prof. Dice skeptical of the idea that singing mice imitate birds but he doubts that any musical sounds influence them very much. Says Prof. Dice: ". . . the captive male [singing mouse] in my possession did not respond in any way to musical sounds of many different sorts produced for his benefit by the phonograph and by various instruments. This does not agree with the observation of Brehm who states that singing mice are stimulated to sing by piano music."

Despite exhaustive research on the subject, Prof. Dice does not make a definite statement as to the cause of the rare occurrence of a musical song in certain otherwise normal house mice.

After examining many suggestions by others and stating the number of alternatives that occur to him, he concludes that there is a possibility that all mice are singing mice. His experiments do not show, however, that this odd vocal condition (or whatever else may be the cause of the song) is an inherited character, but that ordinarily their song is pitched too high for the human ear and that only an occasional mouse with an oddly constructed vocal apparatus gives song that is audible.

Prof. Dice was able to study the heredity factor in minute detail in his breeding laboratory and found no combination of mates that would result in offspring capable of even approaching the vocal qualities of their sire. However, he feels that more research is needed before this matter can be finally settled.

So your explorer is forced to conclude that singing house mice are simply unpredictable. A person who doesn't take the slightest interest in animals, usual or unusual, may wake up some bright morning with a whole family of singing mice twittering cheerfully at the foot of his bed. While someone who would give his eye-teeth to possess one of the rare creatures might spend a lifetime in fruitless search.

Reports of their existence have emanated from every quarter of the globe. In certain countries where song birds are scarce or too expensive for slim purses, singing mice have been kept in cages as songster pets. Travelers in China during the last century told of the value set upon singing mice as pets in that country, and communities in southern France were said to keep them in notable numbers.

However, so far as your explorer knows, no one has succeeded in setting up, side by side, a collection of every type of canary together with a family

of singing mice. And if Mrs. Cahall is able to tame her mice and bring about this unprecedented relationship, she will have accomplished something that is not only unique in itself but is of value to scientific knowledge.

Both the Department of Mammals and the Ornithologists of the American Museum would be intensely interested in the possibilities of such a liaison.

If she is successful, it will not be the first time Mrs. Cahall has benefited science. She has been a sort of avian cornucopia for the Central Park Zoo, having contributed over 700 birds of all types for public exhibition.

She has also made a study of bird ailments and has learned to cure many of the diseases she has studied. Although the wife of a physician, she took no special interest in the pathology of birds until such an interest was forced upon her. "I learned to care for sick birds," said Mrs. Cahall, "because I could find no veterinary to heal my pets when they fell ill."

It is curious how the various problems that present themselves in the course of pursuing a hobby grow so great that, to solve them, one's avocation must rapidly become one's vocation.

Your explorer is wondering to what lengths Mrs. Cahall's latest hobby, her singing mice, will lead her. He for one is prepared to await developments with the greatest of interest.

SCIENCE IN THE FIELD AND IN THE LABORATORY

News from New Guinea—Trailside Activities—Indian Arts—The Hayden Planetarium—Members' Lecture

Planetarium Exhibits

Two interesting new exhibits are attracting much attention in the Planetarium. One is a collection of instruments used by Admiral Richard E. Byrd and his men on both his first and second Antarctic Expeditions. In this collection are an aircraft sextant, a light portable transit-telephone, a geologist's compass, and a current meter used to measure the velocity of currents in the Bay of Whales.

The other exhibit consists of a large number of astronomical instruments, books (some of them very old), manuscripts and portraits of famous astronomers, from the collection of David Eugene Smith at Columbia University. These items were all collected by Dr. Smith himself in his many and wide travels in all parts of the world. Outstanding among them are two celestial spheres of the 17th century, one from Japan made of papier mache, the other of Hindu origin—orange with realistic silver stars. There is also a telescope made by the famous English instrument maker Jesse Ramsden, about 1775, which is still in working order.

Planetarium Lecture for February

The lecture in the Planetarium in February will show the moon and its movements, its revolution around the earth, its changes of phase with their causes, and many other interesting facts about the lunar body. Among the new features presented will be an appearance of the delicately colored moon halo or "ring-around-the-moon."

Amateur Societies

The Amateur Astronomers Association will hold its regular meetings in February as follows:

February 3—"Speculations on the World's End"—Dr. R. E. Lee.

February 17—"Double Stars"—Dr. C. P. Olivier, Director Flower Observatory. The meetings are held at 8:15 p.m. in the Auditorium of the Roosevelt Memorial Building, entrance on Central Park West at 79th St.

The Junior Astronomy Club will hold its meetings in February at 8 p.m. as follows:

February 13 — Junior Competition — Speaker to be selected.

February 27—"The Earth—Our Own Planet"—Miss Marian Lockwood, Assistant Curator at the Hayden Planetarium.

Members of the Junior Astronomy Club were proud to find one of their members among the Rhodes Scholars selected this year. Dana K. Bailey, for several years an active member of the Club, continued his interest in the J.A.C. as an associate member while studying at the University of Arizona.

Bear Mountain Trailside Museum Activities

During January and February, the Craftshop at the Trailside Museum has hummed with activity. A new power saw, provided by the Palisades Park Commission, is responsible for some of the humming. Five miniature models are now under construction. James D. Burggraf, Trailside Archaeologist, is manufacturing four groups to illustrate Indian camp sites and rock shelters in the Hudson Highlands. The caves and entire structural foreground are carved and chiseled in pine and basswood blocks that have been dried and seasoned for sixty years. Miniature figures are carved from aged mahogany, and the curved backgrounds are constructed of metal. Quarter inch celluloid forms the streams and pools.

Richard J. Koke, Trailside Historian, is making his third model to depict the American Revolutionary campaign in the vicinity of Bear Mountain, New York. The

present model shows the West Redoubt of Fort Clinton, with all details in relief, including battlements, abbatis, and fort interior. The plans followed are largely the result of excavations at the fort site during the past summer. It may truly be said that Messrs. Koke and Burggraf are intent upon their painstaking tasks for many hours each day, and as a result, both are leading "model" lives throughout the winter.

Fortunately the early part of the winter has been unusually mild. Public attendance has more than doubled during the early weeks of 1937. Plans are afoot for the extension of the Nature Trail program next spring. Many new devices, signs and general out-of-doors displays, are under construction by Anthony L. Roos, Trail Chief.

Kenneth M. Lewis, Trailside Zoologist, has been unusually successful in presenting an excellent, living cross-section of the Animal Life of the Hudson Highlands in the winter quarters of the Zoology Museum. Miss Elizabeth Furness, volunteer assistant, has devised several new means of making the mammals comfortable, and has aided in numerous ways to make the Zoology Museum popular with school children and adults alike. More than three hundred insects, amphibians, fish, reptiles, birds and mammals are on view daily.

The Hyde Memorial Library continues to grow with gifts from many friends. Historical and Indian collections have been increased during December and January. A semi-lunar Indian "knife" of red slate, found within the Bear Mountain Park, was presented by Mr. Edward Jones of Stony Point.

Research publications of the Trailside Museum in preparation and completed during the season include booklets on mammals and reptiles of the region, and two pamphlets describing ten years of nature trailing activity and the historical significance of Forts Clinton and Montgomery.

Conducted field journeys into the interior of the Bear Mountain Park have included the bi-weekly expeditions of the Orange County Biology Teachers' Association. Other walks are conducted for boy scouts, school groups, and individual students from many sections of the country.

Doctor Curran's Lecture

On December 2, 1936, Dr. C. H. Curran, Associate Curator of Entomology spoke on *Some Aspects of Insect Life* at a luncheon at the Nassau Club of Princeton, New Jersey.

Indian Arts and Crafts

Dr. Kenneth Chapman, Director of the Laboratory of Anthropology, Santa Fe, New Mexico, well known as an authority on American Indian Arts and Crafts, visited the Museum recently to confer with the Department of Anthropology on new researches in this field. Dr. Chapman is publishing an illustrated book on Pueblo pottery designs with fine color plates, the volume to be issued in Paris. The Department of Indian Affairs in Washington has appointed a commission to study the status of arts and crafts among the Indians of the United States and made suggestions to the Indian Administration as to how these native Indian arts and crafts may be encouraged and directed into promising channels.

Gregory on Gorillas

The serial "In Quest of Gorillas" by Dr. William K. Gregory, which has been appearing in *Scientific Monthly* for the past year (November, 1935-December, 1936, with the exception of November, 1936) will be published early in February by the Darwin Press. The book will be illustrated by 111 full-page plates (171 figures) of photographs taken in Africa by the other members of the expedition, Professor J. H. McGregor, Dr. E. T. Engle, and Mr. H. C. Raven, leader of the expedition, and two endocranial casts of mammal-like reptiles, by Dr. W. E. Swinton of the same institution.

The Appreciation of Gems

Mr. Herbert P. Whitlock will again give a series of four free talks on the "Appreciation of Gems" at 4 o'clock on Saturday afternoons in April. These talks are given with a view to acquainting the general public and especially those engaged in the jewelry trade with the Morgan Collection of Precious Stones. Each talk will be one hour in length and will be illustrated.

Free Lectures for the Children of the Public Schools

The Department of Education has announced ten free lectures for the children of the public schools, to be given in the Museum Auditorium on Friday mornings at 10:30 o'clock. The lectures are as follows:

March 5—*Mexico Today*—by Gladys L. Pratt.

March 12—*The North Atlantic Fisherman*—by John R. Saunders.

March 19—*Big and Little People of Africa*—by William L. Smith.

April 9—*Children of China*—by Marguerite Newgarden.

April 16—*Life in Desert Regions*—by Farida A. Wiley.

April 23—*The Story of Transportation*—by Agnes K. Saunders.

April 30—*Twentieth Century Exploration*—by Georgine Mastin.

May 7—*Our National Parks*—by Grace F. Ramsey.

May 14—*The Indians and Dutch in New Amsterdam*—by Almeda E. Johnson.

May 21—*Grey Owl and the Beaver*—Motion Picture.

Exhibition Hall Talks

Exhibition hall talks are again offered on the spring program of the Department of Education. These talks are prepared as individual lessons correlating with the school curriculum, based on materials in the Museum exhibition halls. They are especially arranged to supplement and not to supplant the work of the teachers in the public schools and are given free to the classes of the public schools of the city and to private schools with membership in the Museum.

The talks include subjects on nature study, geography, history and public health. A booklet describing the talks will be issued upon request and application for the talks is necessary in advance.

Hayden Planetarium

The Hayden Planetarium again offers free showings for classes in public schools, free parochial schools, and the municipal colleges within Greater New York. They are given only at 10 a.m. and 1 p.m. Monday to Friday inclusive, except on holidays during the school year. There

is no free showing during the Easter vacation except by special arrangement. The free showings will start promptly at 10 a.m. and 1 p.m. and there will be positively no admittance after the showing starts.

Requests for reservations should be made well in advance to insure teachers receiving admission cards from the Museum. Apply to the Department of Education, telephone Endicott 2-8500, extension 342.

Special Members' Lecture

On Thursday, February 25, 1937, at 8:15 p.m. in the Museum Auditorium, President F. Trubee Davison will give a special members' lecture called "Jungles, Kings and Hindus." Mr. and Mrs. Davison recently returned from an expedition to India and Nepal, where they made collections for the Museum. In the United Provinces they were assisted by Donald Stewart, Forest Officer, and Major James E. Corbett; in Nepal they collected through the kindness of His Highness the Maharajah and His Excellency, the British Minister Lieutenant-Colonel F. M. Bailey; while in Mysore and Madras Ralph Morris assisted Mr. and Mrs. Davison. Because of the limited capacity of the Museum Auditorium, tickets for this lecture will be issued only on members' signed applications.

Know Your Museum Series

Four informal evening talks are given every spring and fall for members so that they may become better acquainted with the Museum and enjoy its exhibits more fully. The spring series will be given by Mr. Nels Nelson on "Early Man and His Culture." These are held on alternate Tuesday evenings at 8:15 o'clock, beginning February 23rd.

Mr. Nelson will discuss the rise and progress of archaeology, the archaeology of the United States and Canada, South America and Middle America, and the Museum halls to be visited include the Hall of the Age of Man, the Southwest Indian Hall, the South American Hall, and the Mexican and Central American Hall.

The spring series of lectures for Members will open on February 18th with a lecture by Dr. Roy Waldo Miner on "The Pearl Lagoon of Tongareva," describing his experiences during his recent trip to the South Seas to secure data for the construction of the Pearl Fisheries Group for the Hall of Ocean Life. Other speakers will be Captain Peter Freuchen on "Arctic Adventure," and Mr. Bradford Washburn on "Winter Explorations in the Unknown Yukon," an account of the National Geographic Society's expedition in 1935. Mr. Howard Cleaves will open the course for children of members with "Stories of a Camera Hunter" on February 20th. The motion picture, "The True North" will be shown on March 6th, "My Wild Animal Friends" by Dr. Wendell Chapman will be given on March 20th, and the series will close on April 3rd with "Arbutus Days" by Miss Farida A. Wiley.

News from New Guinea Expedition

In a letter written while camping on the north bank of the Fly river opposite Stuart Island, British New Guinea, Mr. G. H. H. Tate, Mammalogist of the American Museum's New Guinea expedition reported the latest developments in the collecting work that has been carried on since the loss of sponsor Richard Archbold's plane on July 9th of last year.

Mr. Tate was forced to take a leave of absence from the field work in November due to a slight illness. He reports that a short vacation in Daru was advisable in view of a program of two months' intensive work along the south coast.

Mr. Tate advised his fellow workers in the Mammalogy department to "expect me only when you see me—probably between spring and summer."

In order to assure the successful working out of all mammal collections taken in New Guinea, Mr. Tate plans to return to this country by way of Europe. This digression will enable him to correct his data against specimens contained in the museums at Genoa, Berlin, Leyden, and London.

Word has also been received from A. L. Rand, Museum Ornithologist of the Expedition. Mr. Rand characterizes the expedition's stay at Davinumbu as "one of the pleasantest and most profitable" made so far in New Guinea. Here he was able to make many observations and collections of undoubted value to ornithology. "Of the new things," he writes, "one is a frogmouth only about half the size of the ordinary one (a new species?") Mr. Rand also took specimens of, among others, a ground thrush (Drymodes), the red forest rail (Rallicula), the flightless rail, and a rare species of Swift.

The Expedition Botanist, L. J. Brass, made extensive collections from the forest flora in this region which included an unusual swamp orchid and a beautiful pink lotus lily.

From all reports, a wealth of specimens in all three fields of investigation represented on the expedition is assured, which together with the observations and photographs that were made, should add greatly to the scientific knowledge of New Guinea.

Anthropological Meetings at Washington and Atlantic City

The American Anthropologists held their annual meetings at Washington, D. C., on December 27th to 29th, and at Atlantic City on the 30th. The American Museum of Natural History was represented by three members of the Anthropology Department, Mr. N. C. Nelson, Dr. George C. Vaillant, and Dr. Wendell C. Bennett. Mr. Nelson was elected president of the American Anthropological Association for the coming year. Dr. Vaillant presented a paper at the meeting on the "Archaeology of the Valley of Mexico" which he illustrated with lantern slides.

At Atlantic City Mr. N. C. Nelson, retiring vice-president of the Anthropological Section of the American Association for the Advancement of Science, presented a paper entitled "Prehistoric Archaeology, Past, Present and Future." This paper will appear in the next issue of *Science*.

YOUR NEW BOOKS—*Beaver Lore—Malayan Return—The Stone Age in Africa—Science*

Stone Age Africa

- - - - - - - - - - - - - by L. S. B. Leakey

Oxford University Press, $2.75

THIS little book is a first attempt to sum up our knowledge about the Stone Age of Africa and as such fills a long-felt want. The author approaches his task from the point of view gained by ten years' intensive excavation and study, chiefly in Kenya Colony, together with brief visits to examine key sites and collections available in other parts of East and South Africa. For the rest of the continent his presentation is based on the now rapidly accumulating literature. The subject matter dealt with includes two chapters devoted to a general treatment of the climate, geography, and fauna of Recent and Pleistocene times; one chapter concerned with the skeletal remains of Stone Age man, another chapter given to Stone Age art; five chapters describing the Stone Age industries respectively in North, East, South, and West Africa; and a final chapter offering comparisons between the Stone Ages of Africa and Europe. The book in addition to map and illustrations is provided with chronological charts, a bibliography, and an index.

Africa, archaeologically speaking, was apparently not on the map until about 1855, when stone implements were first registered in a Capetown museum; but since then by slow stages surface collections have been made in nearly all parts of the continent. Near the beginning of the present century the French commenced actual excavations in their Mediterranean shore possessions and the English at about the same time undertook similar work in Egypt. It is largely within the last decade, however, that really serious investigations, involving stratigraphic methods, have made any progress, particularly in Algeria, Egypt, and Kenya Colony. The result is that we now have not only some definite notions about the geographical distribution of differentiated culture centers, but a good beginning has been made toward arranging these stone-working industries in chronological order. The author, for example, believes that in Kenya Colony he has traced the evolution of his locally superposed industries from simple flaked pebble implements up through more or less typical Lower and Upper Paleolithic forms to those of Neolithic aspect. He also believes that he has found associated with all but the oldest of these artifacts, skeletal remains of a modern type of man resembling the Cromagnon man of Europe, though of much earlier date. All of these Kenya Colony discoveries are correlated with the oscillating rainy and dry periods supposed to correspond with the glacial and interglacial periods of Europe, and the African story of man and culture is taken back to somewhere near the beginning of Pleistocene times.

The little book should prove useful to the specialist, though it will hardly prove easy of comprehension for the general reader. The writer in his enthusiasm is hasty about coining and discarding names for his cultures and his illustrations are too few and not sufficiently related to his text. Also, of course, the book has nothing to say about what follows the Stone Age.

N. C. NELSON.

Race, Sex and Environment: A Study of Mineral Deficiency in Human Evolution

- - - - - - - - - - - by J. R. de la H. Marett

Hutchinson's Scientific and Technical Publications. London 21/-

THE intricate differentiation of mankind is a fact all can see, but its satisfactory explanation has, thus far, persistently eluded the efforts of students of human evolution. It may well be that the process of human evolution and racial differentiation is too complex a phenomena to be analyzed except by equally complex methods. Mr. Marett, in *Race, Sex and Environment* offers a new elaboration of a hypothetical answer to this problem. Stated briefly his thesis is simple. He believes, apparently, that deficiencies in the soil of such elements as calcium, phosphorus and iodine are determining factors in the history of man. Often the relationship is taken to be immediate, but frequently the intermediate agency of the endocrine system is suggested as the casual link. From this innocent-looking thesis the author draws forth an astounding array of corollaries with all the ease of a magician extracting rabbits from a silk hat. He offers explanations of countless phenomena of which the following are but a few: sex, social and religious differentiations, psychological patterns and the nature and origin of war.

It is difficult in this short notice to give an adequate idea of the variety and richness of Mr. Marett's resources which he brings to bear on this subject. He lays tribute on so many fields not often related that the expert in one finds himself a layman in the others. Speaking, therefore, only for my own subject, I find an unfortunate intermingling of fact, hypothesis and fancy. One receives the impression that the uncensored by-products of an active mind are undiscriminated from the legitimate speculation of a close student. Perhaps we may see in this the consequence of a wide reading without the critical checks of first-hand knowledge.

But despite the weakness of many of his assumptions and the occasionally involved form of his style, Mr. Marett has much to say that is suggestive and worthy of consideration.

H. L. SHAPIRO.

Tales of an Empty Cabin

- - - - - - - - - - - - - - - - - - - by Grey Owl

Dodd, Mead and Company, $3.00

GREY OWL may commence a book with an empty cabin but the dwelling and its surroundings soon teem with multitudes of woodland residents ranging from

mice to moose. The volume under consideration may be described as a collection of narratives and essays in three parts. The first section, *Tales of the Canadian Northland,* includes a story titled, *Nemesis,* an out-of-door, winter tale, written in a style that suggests Robert Louis Stevenson.

In the second part of *Tales of an Empty Cabin* one discovers colorful descriptions of the lives of Canadian rivermen. Grey Owl paddles, poles, pushes and perspires on his course, traveling the tortuous and boisterous rapids of the Mississauga. His brawny companions sing as they go, tell jokes, fall in the water and grumble when they arise at three in the morning to continue their strenuous way. Owls call, wolves howl, and the north wind sighs in the trees. Waters boil and dangerous shoals appear from the nowhere, ready to dash frail canoes to fragments.

Grey Owl is ever cognizant of the charm of his surroundings, regardless of toil and hardship encountered on the way. He philosophizes about his animal friends, continually reminding the reader, for example, that, "the skunk is a natural gentleman, but unfortunately not a mind reader, so it's your move. . . ."

This writer Indian believes in the spirit of fair play. Witness his idea regarding the wolf:

"Only those who know nothing about wolves, or have a fear complex, can hate them so very much. And as for cowardice, did you ever hear a badly scared man tell how he was chased by wolves? When all he heard was one wolf, so spent a night in a tree and arrived home swearing that he ran eight miles with a dozen wolves after him before he climbed a tree to save his life. The wolf is no fool, and plays safe; but so does the man who goes into the woods armed to the teeth and shoots an animal that has no chance against his high-powered rifle, and if the animal turns on him in self-defence, the beast is called ferocious, and the man clamours for his immediate extermination because his own hide has been endangered."

The last part of the book contains stories of Grey Owl's beloved beaver family that live in his own cabin. "Jelly Roll" and "Rawhide" are the principal actors. Their house of sticks, mud and twigs is placed within the Indian cabin and provided with a plunge hole to the nearby lake. In this "house inside a house," the stalwart beaver pair raise their families under Grey Owl's watchful and highly appreciative eyes. The beaver possess every confidence in their human friend and do not hesitate to enter his own quarters, drag mud and branches across his floor, and generally make life interesting, if often, exasperating, for him.

The beaver biographer has recorded his observations with some detail wherein the "personalities" of his subjects are concerned. "Jelly Roll" is excitable and affectionate. "Rawhide" stands more upon his dignity and apparently accepts the responsibilities of parenthood with greater seriousness. The accounts of beaver "voices" are extremely interesting. Readers who have had intimate experience with tame and wild beaver will know that Grey Owl has been very careful in his delineation of the animal sounds. His interpretation of the "meaning" of various voice inflections may be questioned but his descriptions of the sounds are excellent. Beaver have an extensive "vocabulary" that has been sadly neglected in natural history literature.

Grey Owl excels when relating the adventures of the "engineers of the animal world." One quickly realizes that the large rodents are true companions, and not mere acquaintances. The writing throughout the book is somewhat uneven and the vernacular often appears slightly forced. The "offset" printing process does injustice to the photographs. Regardless of these discrepancies, *Tales of an Empty Cabin* should, by all means, take its place beside *Men of the Last Frontier, Pilgrims of the Wild,* and other works of this Canadian author who finds his delight in the wilderness that is his home.

W. H. CARR.

SCIENCE

- - - - - - - - - - - - - - - by Davis and Sharpe

Henry Holt & Co., $1.72

THE past twenty-five years have witnessed an astounding growth in science enrolments in the high schools of our country. A fair share of this attitude may be due to the introduction, in 1908, of a new subject called general science. That year the newcomer was taught in eight high schools: six in Massachusetts and two in California. By 1923, general science was being offered in 67 per cent of the schools of the country, and in 1933 a total of 83.9 per cent of our schools were providing this instruction.

Textbooks follow curricular requirements as "trade follows the flag." So it is not surprising to find that a throng of texts designed for general science classes, has been issued during the past five years. Most of the books have revealed two inherent weaknesses, i.e., they have covered too much ground for the average pupil, and they have been made too difficult for the boys and girls of junior high schools and of the first year of senior high school.

The newest arrival on the shelf of general science books has just been issued by Henry Holt & Co. for use in the 9th year. It is entitled: *Science,* and its authors are Professor Ira C. Davis, of the University of Wisconsin, and Richard W. Sharpe, a biology instructor of George Washington High School, New York City.

It is attractively bound in blue cloth and is somewhat larger than the conventional textbook. This makes possible the utilization of more space on a single page for illustrations. The authors have thus been enabled to provide, for the pictorial introduction to each chapter, a full-page plate, each consisting of several associated drawings in outlines and wash backgrounds. The effect is graphic and valuable. In addition, the book is profusely illustrated with small line drawings, diagrams and selected photographs.

Each chapter is introduced by an italicized account, historical and descriptive, of the elements on which the new chapter is based. This idea seems very logical, but the length and maturity of language of some of these introductions warrant the query as to whether the material as given will interest young children.

Before the chapter actually begins, there are "Questions to Direct the Study of the Chapter." Each chapter closes with "Special Reports and Problems," together with more questions calculated to "Test the Value of This Chapter." This is followed by a brief summary of the "Old and New," and exposition of the ignorant point of view and the superstitions of the ancients compared with modern knowledge concerning the subject of the chapter. Many suggested demonstrations and exercises are included in the body of the chapters, which themselves are well organized in sub-divisions, with incisive subtitles in bold

face type. This book thus carries all the accessory organization found in any of the modern texts. Its setting is historical and its keynote is scientific progress.

With such excellent organization it is disappointing to find such statements as the following:

"The food materials are oxidized in the tissues to produce heat energy and to supply materials for growth and repair" (Oxidized food cannot aid growth and repair). "Chinese have been preserving eggs more or less successfully for three thousand years." (Ambiguous.) "If one steps on a rusty nail a deep wound will result." (Inevitably?) "Diseases are caused by germs." (Many diseases are not due to germs.)

Although the textual matter suggests tying the frog's toes to pins, the artist, in fig. 359, has thrust the pins through the toes of the live frog. This is more than unfortunate for children to see. Also the hooks used to hold back human abdominal walls in fig. 355, are rather gruesome.

Some of the topics like digestion are treated somewhat briefly; others like the rings of electrons and certain aspects of electricity might better have been omitted. On the whole, however, the book is so attractive, and it has so many commendable qualities that it should find widespread use.

PAUL B. MANN.

RETURN TO MALAYA

- - - - - - - - - - - by R. H. Bruce Lockhart

G. P. Putnam's Sons, $3.00

WHEN Bruce Lockhart revisited the Malay Archipelago, he brought with him memories of the eastern world of twenty-five years ago. He brought also an understanding, ripened by diplomatic experiences of the international world of today. A highly developed journalistic technique of probing beneath surfaces, together with a speaking knowledge of the native language and a number of personal contacts with influential men in the east, gave him entree into the most intimate circles of Malay society and a rare ability to interpret and evaluate what he saw. *Return to Malaya* is more than an ordinary travelogue. The reader follows a vivid and dramatic account of Bruce Lockhart's experiences, shares his delight in the scenes which present themselves, suffers his discomforts in the vagaries of tropical climate, and with him assimilates some of the feeling of life in the East Indies. But more than this, the reader is given a rare insight into the changes which are taking place in the east, and into the psychology of the native islanders.

Traveling through British and Dutch colonial possessions, Bruce Lockhart interested himself in the life of the native Malayan, Javanese and Chinese, and in their responses to European influences in the East. He talked with native shopkeepers, street venders, servant boys and chauffeurs. Then he questioned government officials, European planters in the orient, and steamship officers on the eastern route. He visited crowded cities and out-of-the-way rural districts. Diffuse in his interests, he dipped into history and mythology, tribal customs and superstitions, economic conditions, literature, painting and music, internal political intrigue, and international relations. His narrative is filled with personal associations recalled by his various experiences, and is enriched by comparisons with European conditions. Among phenomena which he investigated particularly were the highly centralized communistic guilds in Bali, and the Javanese nationalistic movement.

Upon leaving Malaya, the strongest impressions which Mr. Lockhart carried away seemed to be of the great strides in education which had taken place since his earlier visit to the islands, and of the change which had taken place in the natives, as a result of this education and of more frequent contacts with the West. He was particularly interested in the relationship between natives and white men and in the widespread and constantly growing feeling toward native autonomy in the East.

But Bruce Lockhart did not return to the orient for purposes of study and investigation. His observations are the inevitable contribution of a man of his experience and ability as a reporter. Intermingled with these penetrating studies of the colonial situation are descriptions of the country as seen by a man setting forth on a vacation, trying to recapture the glamor of a youthful experience in this tropical island locality. His story is colorful and alive, bringing a real picture of Malaya to the reader, and incidentally adding his valuable interpretations and forecasts. The combination makes an important contribution to our understanding of the East.

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PASSPORT TO *SOUTH AFRICA*

Not many years ago the game country described in Mary L. Jobe Akeley's article, "In South Africa's Wonderland," appearing in this issue, was a closed book to all but the few hardy explorers who could afford the time, inconvenience and expense of an individual "safari." Today, with many miles of good motor roads through Kruger National Park and rest camps at intervals where the traveler may spend the night, a first-hand "close up" of African wild life in this greatest of all big game preserves can be included in the itinerary of the average visitor to South Africa.

MODERN TRAVEL: That more people are now broadening their horizons by visiting for the first time the less traveled parts of the earth is due in part to the disturbed political situation in Europe and the increase in leisure to go farther afield, and, in part, to the increased comfort and efficiency of transportation. First class steamship and railroad service and excellent motor roads make it possible to penetrate the heart of Africa and to cover in a few weeks a great many places of outstanding interest without leaving the path of modern travel.

SIX WEEKS IN SOUTH AFRICA: The following itinerary, suggested by Mrs. Akeley as of particular interest to those who intend to visit South Africa for the first time, is planned for a stay of six weeks or longer. The more important places can be visited by those whose time is more limited and a return made from almost any point in the interior to one of the ports touched at by the passenger lines.

CAPE TOWN: The first port in South Africa on the principal steamship routes, Cape Town, itself, is an historically interesting and beautiful city, situated at the base of the famous Table Mountain on whose slopes grow more different species of flowers than in the whole of England. It is also the starting point for many of the trips into the interior and the "Garden Route" along the coast. Sightseeing in Cape Town should include the trip by aerial cable to the summit of Table Mountain; a visit to the Koopmans-de Wet Museum; the South African Museum with its fine collection of relics from the ancient ruins of Zimbabwe, native ornaments, picture writings and weapons; and a motor ride to Groote Schuur, the magnificent estate of the late Cecil Rhodes and now the residence of the South African Prime Minister.

GARDEN ROUTE: This delightful excursion from Cape Town takes eight days by train and motor, or ten days if the whole trip is made by motor. The route forms a loop through some of the most beautiful and interesting scenery in South Africa. Winding eastward along the deeply indented coast line, through mountain passes and dense forest, past chains of lakes and rushing streams, it takes in the towns of George, Knysna and Oudtshoorn and a visit to the Cango Caves, one of the most remarkable formations in the world. In some of the caves are

the remains of early Bushman paintings of battle and hunting scenes.

DIAMONDS AND GOLD: It is an eight-hour trip by first class train from Cape Town to Kimberley, "the diamond city." Fifty years ago when a stolid Dutch farmer found a child playing with a glistening stone, the site of Kimberley was open veldt. Today it is a modern city built up on a fabulous fortune of diamonds. The diamond mines, which are only a few minutes' walk from the heart of the city, are elaborately guarded, but visitors may obtain permits to go through the gates to see the great excavations and the plants where the cleansing and sifting processes are carried on. At night they may witness the thrilling spectacle of a kaffir war dance.

From diamond mines to gold mines is an overnight trip. Arriving at Johannesburg in the morning, the visitor finds himself 6000 feet above sea level, where the reefs in the freak mountain ridge, the Witwatersrand, or Ridge of White Waters, furnish half the world's annual supply of gold. Situated in the center of the Rand Gold Mining district, Johannesburg is the largest city in South Africa. And yet, in a few hours by motor one can be in the heart of aboriginal Africa.

KRUGER NATIONAL PARK: A sleeper train from Johannesburg gets one to the town of Nelspruit, on the edge of the Kruger National Park, the following morning. From Nelspruit one can travel by motor for days or weeks over the hundreds of miles of roads that traverse the game preserve, described in Mrs. Akeley's article in this issue.

On returning to Nelspruit, one may make this town the starting point for an interesting five-day excursion to Pretoria, Bulawayo, Fort Victoria and the Zimbabwe Ruins. Bulawayo, an historically interesting town, was founded after the defeat of the Zulu tribes, by the British South African Company. Only a few hours drive from Bulawayo are the graves of Cecil Rhodes and Dr. Starr Jameson on their lonely peak in the Matopos Hills. From Fort Victoria one may make a day's round trip by motor to the famous Zimbabwe Ruins, one of the few ancient ruins that have been discovered in South Africa, and which still present a mystery as to their origin and purpose. Due to the existence of ancient gold mines in the district, one of the picturesque theories that have arisen is that they were built by the slaves of the Queen of Sheba and that the neighboring mines constituted the source of her gold supply. These ancient relics of a past civilization are constructed of stone without mortar and constitute a veritable fortress in the wilderness of Mashonaland.

VICTORIA FALLS: Retracing part of the route, you can change at Bulawayo to an over-night train for Victoria Falls, one of the wonders of the world and a highlight of any visit to South Africa. As you watch the waters of the Zambesi River cascade into the narrow gorge 400 feet below you can imagine how Livingstone must have felt when, in 1855, cutting through the heart of the unexplored jungle, he came upon this awe-inspiring spectacle that the natives called "The Smoke that Thunders." Twice as broad and two and a half times as high as Niagara, the falls send up a constant mist that descends in gentle rain on the forest of teak and mahogany, ferns and orchids. The river above the falls is dotted with islands. Below is a majestic palm grove and along the shores are chattering monkeys and the deep trails of hippopotami. The only evidence of modern civilization is the Victoria Falls Hotel, which is situated near the Falls and affords the visitor every modern convenience.

SEAPORTS: The return from Victoria Falls can be made direct to Cape Town by train in approximately fifty-eight hours, or connections can be made at Bulawayo for other parts of South Africa. The latter course is recommended if time permits, as no visit to South Africa would be complete without at least a brief stay in the colorful seaports of Durban and Port Elizabeth. Almost all of the passenger liners stop long enough at these two ports for sightseeing. Sightseeing at Port Elizabeth should include a visit to the museum which has collections representing every branch of South African natural history, botany, geology and ethnology, and the famous Snake Park with its hundreds of varieties of reptiles.

Durban, the largest city in Natal, with its beautiful ocean boulevard, its many East Indian inhabitants in colorful costumes, Zulu ricksha boys in fantastic headdress, Oriental shops and surf bathing in the great rollers of the Indian Ocean, deserves an extended stay. Among the trips to be taken from Durban are an all-day drive to the Valley of One Thousand Hills and the Zulu Kraals, and a two or three-day excursion into Zululand.

CLIMATE AND CLOTHES: There is no particular "travel season" in South Africa for, although the temperature varies between summer and winter (being south of the equator the seasons are the reverse of ours), the climate is generally mild the year round and the heavy rains which are important in the equatorial belt are light in South Africa and have little effect on motor travel. Medium tropical clothing is most suitable for their summer, and fall clothing during their winter. Most people err on the side of too light clothes. It can be surprisingly cool in parts of South Africa and one should be equipped with a coat, a rain coat and old clothes for traveling. A sun helmet is not necessary.

STEAMSHIP DIRECT: The only passenger line sailing direct from New York to South African ports is the American-South African Line, which maintains a monthly schedule to Cape Town, Port Elizabeth, Durban and other ports on the East Coast as far north as Mombasa, returning via the same route except for a stop at Trinidad. The First Class ship *City of New York,* makes the round trip three times a year, sailing from New York on the first of February, June and October and stopping at St. Helena en route to Cape Town. The time from New York to Cape Town is approximately twenty-three days. The round trip from New York takes approximately three months. The other ships sailing monthly on this line are Cabin Class only and take a few days longer. Some have optional stops at St. Helena.

STEAMSHIP VIA EUROPE: The Italian Line makes a through rate to South Africa. Sailing from New York, you may change at Gibraltar or Genoa for Cape Town. The length of time this route takes varies with the sailing date. In some cases you can make an immediate connection at Gibraltar, in others there is a wait over of several days.

There is a weekly sailing to South Africa direct from Southampton on the fast mail ships of the Union-Castle Line, which also maintains an intermediate service. Monthly sailings direct from Europe to Cape Town are maintained by the German-African and Holland-Africa Lines. Other lines which offer special round trip rates from Europe to South Africa are the Blue-Funnel and White Star-Aberdeen Lines.

LOCAL TRANSPORTATION: The railroads in South Africa are modern and the trains comfortable and equipped with luxurious sleeping cars, restaurant and club cars.* The motor roads are good and American automobiles with English-speaking drivers can be hired in even remote districts. It is now possible to motor from Cape Town to Cairo. The Imperial Airways maintain a weekly airplane service between the Mediterranean and Cape Town. Local airplane service has been established between the chief cities of South Africa.

Mrs. Akeley says: "In each city of importance tourists may find every comfort in well equipped modern hotels. Contrary to the popular impression, a journey in South Africa by no means involves a great expenditure of money. It is possible to obtain a comprehensive view of the chief points of interest in this, one of the most beautiful countries of the world, at a surprisingly reasonable cost. In fact, today many people in Great Britain as well as Europe, who have retired from active business life are founding new homes in South Africa where they can enjoy the mild and healthful climate, relief from the burdens of heavy taxation, and the luxuries of life on a modest income."

*Only that part of the railway system pertinent to this article is indicated on the accompanying map.

SIDNEY C. LEE

RECENTLY ELECTED MEMBERS

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IN MEMORIAM

MEMBERS of the Museum and personal friends of Charles Hayden, in whose honor the Hayden Planetarium stands as a lasting tribute, will grieve to learn of his death on January 8, 1937.

IN the death of Martin Johnson on January 13, 1937, the Museum has been deprived of a personality whose loss will be felt by all who even remotely sensed his influence.

[AZTEC PULQUE GO
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NATURAL HISTORY · *March 1937* · *Fifty Cents*

Lowell Thomas on Martin Johnson · Fuertes & Audubon

How to be a Feudal Lord · · Lost John of Mummy Ledge

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The Magazine of the American Museum of Natural History

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Secretary, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

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Campbell Studio

Martin Johnson

1884–1937

The Story of

MARTIN JOHNSON

by

Lowell Thomas

MARTIN JOHNSON—*From stowaway and tramp to the world's greatest photographic explorer: The story of a romantic career which carried two persons to the ends of the earth and into the hearts of millions*

By LOWELL THOMAS

IN the storeroom of a jewelry store at Independence, Kansas, a fourteen-year-old lad was sneaking time away from his job. That job was to make himself generally useful around the store. But for all his father's preaching, he somehow never could get to like the chores of selling rings and watchfobs to the Kansas neighbors, and what he hated most was polishing the silver. Naturally, he never was allowed to handle any important sale such as a gold watch or a valuable diamond. Only the small fry customers were turned over to him. But if he had been entrusted with waiting on the richest people in the state, he wouldn't have liked it. And whenever he could elude his father's watchful eye—for his father owned the store—he was in the back room or elsewhere poring over steamship folders and maps, anything that had to do with travel.

"For to admire and for to see, for to behold this world so wide," that was the ambition of our young Kansan.

When he was fourteen, his father gave up all attempts to hold him down. "Better to let him go with our consent than without it," he had said to the boy's mother. "He hasn't any money, he can't get far, and he'll soon grow tired and glad to get back home."

Globe-trotter at fourteen

And so at fourteen, young Martin Johnson realized his first ambition. He left Independence, left home, left his jewelry store, and went roaming. His father had said that he would soon be glad to come back. Father was right in a way. The boy's first crack at seeing the world was not a tremendous success, and he did come home in a few months. But it didn't cure him. Nevertheless, he got a foretaste of what it means to be knocked around. Washing dishes in hotels, biscuit shooting aboard freighters, doing anything that came to hand, he managed to get around. He found that doing chores in a ship's galley was just as monotonous as doing chores in a Kansas jewelry store. However, he did get around. He saw part of Europe, he saw London, where he was not only broke but ill, he saw Brussels where he almost starved, he saw Brest in Brittany. He returned to Independence pretty much as he had started. To get across the ocean he had stowed away in the lifeboat of a liner. He had had his share of fights, he had learned that a boy, on his own, has to shift for himself when there is nobody to go to. In short, he had done some traveling, but it wasn't so hot. However, in spite of what his father had said, the experience had not cured him. It had merely taught him that when you travel on a beaten track, you see just what other people see. And that was the first voyage of Martin Johnson whose travels were to become famous all over two hemispheres.

As Jack London's cook

Some time later, American newspapers were giving a good deal of space to a story that caught young Martin's eye. Jack and Charmian London were getting ready for the famous and historic cruise of the *Snark*. Said young Martin to himself: "Ah, ha, that's what I'd like to do; I wonder if there's any chance of going along?" The chance seemed pretty remote. Naturally, the Londons were getting dozens of letters every day from all parts of the United States and Canada, from people who were willing to go along in any capacity. Nevertheless, Martin Johnson took a chance and added his letter to the pile. Some quality in it caught the imagination of Jack London. For after several days a telegram arrived at the jewelry store in Independence, Kansas, notifying Martin that he was welcome to come along, provided he could cook. As a matter of fact, he couldn't, but he set himself to learn. He had two weeks to do it in. At least that's what he thought, for the *Snark* was due to weigh anchor at the Golden

Gate in the Middle of December, 1907. Actually, she didn't sail until the middle of April, so Martin Johnson had plenty of time to practice his cooking.

For a week or so he didn't have to practice the newly acquired art, since every soul on board was prone to seasickness, including the cook. Naturally he did not expect to pass the rest of his life as a ship's cook. Whenever he could he watched the sailing master of the *Snark* taking his sights and doing the other things incidental to navigation. He borrowed the captain's books and logarithm tables. Without making too much of a nuisance of himself, using the captain as a model, he tried to learn the art and science of navigation. The captain gladly lent the lad his books and instruments. After a few weeks he proudly showed the results of his labor and was permitted to mark on the ship's chart the position of the *Snark* as he had figured it out. It was a nice job. The only trouble with it being that, whereas the *Snark* was somewhere between California and Honolulu, Martin had her plumb in the middle of the Atlantic.

From cook to engineer

He next started puttering around the *Snark's* auxiliary motor. In so doing he acquired enough knowledge that one day Jack London informed the lad that he was promoted from ship's cook to engineer.

During the months that followed the *Snark* followed a course to Hawaii, the Marquesas, the Society Islands, Samoa, and Fiji. One by one the original members of the party fell by the way until at last only three remained: Jack London, Mrs. London, and Martin Johnson.

In October, 1908, the *Snark* dropped anchor at Penduffryn, Guadalcanar. Shortly before, three Pathé Frères cameramen had arrived from Australia to film the cannibals that inhabited the upper reaches of the Balesuna River. The husky young Kansas giant joined the expedition in order to learn how to handle that box of magic known as a motion picture camera.

When the party returned to Penduffryn Johnson learned that sickness had forced the Londons to abandon the cruise temporarily. They decided to rush down to Australia for treatment. Martin accompanied them to Sydney and there ended the celebrated cruise of the *Snark*.

Martin returned to America via Ceylon, Aden, Port Said, Naples, Paris and Liverpool. He arrived at Boston in September, 1909, home from his first trip around the world.

Back in Independence, he told the folks he intended to settle down. His first move in that direction was to marry pretty little Osa Leightly of the neighboring town of Chanute. Then he opened up a movie theatre. And the next thing he did was to show his films of the Solomon Islands' cannibals. They made a sensation. In fact, knocked the homefolks in Independence right out of their seats. The news reached Kansas City, and a big city theatre manager made him an offer.

Martin fared forth, assisted by his now equally famous wife and before he had finished showing in Kansas City other offers came from other cities. Money was flowing in, and almost before he knew it Martin and Osa were troupers.

Escape from cannibals

The success of the mediocre film he was showing, convinced Martin that he ought to make a feature picture in the wild interior of the island of Malekula, in the British Solomons. His first attempt resulted in pell-mell flight from the clutches of a cannibal chief with just a few pictures, but he went to Australia, re-outfitted, and returned with a better equipped party. He brought out a film of ethnological value, photographically fairly good. But many of the scenes were too horrible for public showing.

Martin dropped down to Australia, and while there he received a cablegram from the film company that was handling his pictures. It read:

"The public is tired of savages. Get some animal pictures."

Packing his equipment he went to Borneo. There he found photographic conditions none too good. The jungles well-nigh impenetrable, the natives hostile, big game scarce. Next his quest carried him to the Malay Peninsula, to Ceylon, and on to British East Africa.

It was in British East that Martin and Osa really laid the foundation of the celebrity that became theirs. It was a rare team they made, this partnership between those two handsome young people from Kansas. Indeed, in the annals of travel and exploration they were unique. They shared each other's thoughts, experiences, hardships, dangers. And I don't know of any couple that had so much and such continuous fun together.

Happy years

Both Osa and Martin always told me that the happiest period of his life, and hers, was the one during which they lived in East Africa. There he had found what the film company had told him to look for: animals, wild animals, plenty of 'em. In

Kenya, as a matter of fact, he discovered literally a paradise of big game. To be sure his first safari there was a bit of a disappointment. True, the plains just teemed with wild life—zebras, gazelles, wildebeest, haartebeest, ostriches, giraffes. Never before had the Johnsons' eyes even imagined, let alone seen such uncountable multitudes of animals. But at that time they were excessively camera-shy. Martin couldn't get the suspicious brutes within close range. And the heat waves that danced over the ground made distance shots unsatisfactory.

So, he lay in wait day after day at the waterholes. Still none of the animals came to drink. There was too great a number of waterholes. If he built his blind at one, the beasts got wind of it and patronized another. After five weeks of this Martin and Osa gave up, and their safari returned to Nairobi. But only for a few days. He had a definite assignment and, like a newspaper man, he was going to fulfil it or bust. So he soon set out again, this time not to the fertile, well-watered plains to the south of British East but in the arid lands of the north. That was better so far as filming game was concerned. The waterholes were few and far between so when the animals got thirsty they had to come within camera range. But here was another difficulty. The holes were so few that most of them were preëmpted by tribes of wandering and none too friendly natives. So the Johnson safari had to trek still farther. And that led to a piece of good fortune.

A paradise of wild life

North of the Kaiscot desert and close to the Abyssinian frontier they came to an extinct volcano. In its crater they came upon the place of their dreams —a beautiful lake a mile and a half long and half a mile wide. From its shores miles upon miles of beautiful trees led upward. Lining its banks was a mass of lovely vegetation. And all around it were swarms of all kinds of animal life. What was more, they had not yet learned to fear man, so they were not camera-shy. On the water floated coots and ducks. In the marshes inshore stalked blue herons and flamingo. Throughout the forests that covered the hillsides could be heard the chattering of baboons, the trumpetings of elephants, the porcine grunts of rhino.

No wonder the Johnsons bestowed upon this elysian spot the name of Lake Paradise. They not only remained there for the next three months, getting some of the best wild animal film that had ever been seen up to that time. When the day arrived for them to pack up and return reluctantly to so-called civilization, they decided that their separation from Lake Paradise must be only temporary. They had to go to America to edit and dispose of the film they had shot. But the minute they had collected the first instalment of the proceeds they took the first steamer back to Nairobi. And soon they had squads of natives building them a jungle home on the shore of that wilderness lake deep in the heart of Africa. Pretty soon an entire village grew up around the Johnsons' house, cottages for the natives, a mess shack, storehouses. And there Martin and Osa Johnson passed ten years which they declared were the happiest of their combined lives.

A fitting testimonial to the unique relations between this pioneering American husband and wife is to be found in the dedication of the book that Martin wrote and published in 1924. It reads: "To Osa, the best pal a man ever had. For fifteen years she has gone everywhere with me. We have done the Great White Way together. We have sailed together into the cannibal islands of the South Seas. We have explored the Borneo jungle together, and together we have lived among the animals of Africa. Osa has stood by me in every emergency. In Africa she saved my life from the elephants of Lake Paradise. She has never failed me. And—what counts most—she likes it all!"

A narrow escape

The life-saving episode occurred while they were filming a particularly magnificent herd of elephants.

"Among them was a bull with the finest tusks I had ever seen. . . . I determined to get him. . . . I turned my camera over to Osa, took up my double-barreled .470 express rifle and crept up within seventy feet of the elephant. . . . I took careful aim and let him have a hard-nosed bullet. The elephant jumped into the air but instead of toppling over, as I had expected, he made for me furiously. After him came not only the six who had been feeding with him but a number of others who had been concealed in the forest . . . there were twelve in all but at that moment I was sure there were a hundred. . . . Through all this Osa kept turning the crank. . . . We had made a pact that, no matter what happened, whichever one of us was at the camera would stick to it until the last moment possible. Just as I gave myself up for lost, Osa decided that the last possible moment had come. She let go the crank, snatched her gun and fired at the leader of the herd. He turned . . . and toppled over dead. The herd that came in his wake parted and went off."

A fruitful period

Africa was good to Martin Johnson and his wife. It gave them happiness, a princely living in their solitary wilderness home and the material for five books, as well as the various fascinating films he turned out. "Camera Trails in the Jungle," "Congorilla," "Safari," "Lion," and "Over African Jungles" were all composed in the Lake Paradise period of their lives.

Back to Borneo

But alas! it couldn't last forever. The film magnates informed them that they had exhausted the entertainment possibilities of Africa, for the time being at least. So they had to find new parts of the world to conquer. In later years their expeditions were accomplished under the auspices of the American Museum of Natural History. When they reluctantly left Africa they returned to the scene of some of their earlier exploits, Borneo. There they procured some amazing photographic material of the private life of the orang-outang, the pictures that have not yet been released.

The end of that glamorous and really enviable life was sudden, shocking, tragic. But I'm sure the suddenness of it is what Martin himself would have wished. Somehow it would be too melancholy to think of him after all his trekkings, narrow escapes and adventurings, passing out slowly, gradually, conscious.

As a matter of fact he and Osa always said upon their return to America that the heart of the big cities was infinitely more dangerous, more frightening than the heart of the jungle.

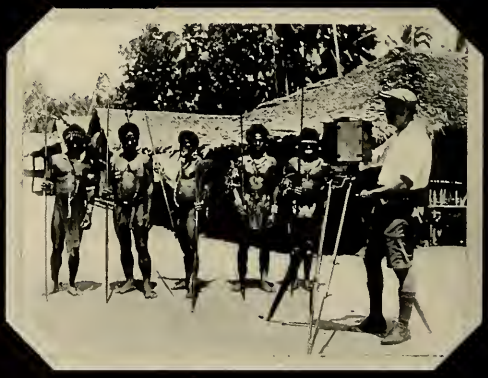
As the Johnson ventures prospered in Africa, as the films drew in their multitudes and the books brought in their harvest of royalties, Martin found himself in the position to blow himself to a plane, in fact to a couple of them. These, of course, considerably widened the scope of his activities and enabled him not only to cover huge distances but to photograph spots that otherwise would have been inaccessible. And so, he and Osa both learned to fly—both became pilots. Martin was completely sold on flying, so much so that when he was in America he never would take a train while a plane was available.

The accident

But his last voyage was made, in spite of some misgivings, because a lecture date in Los Angeles just had to be kept. The rest everybody knows. On January 13, 1937, the country was shocked to learn that for the second time in a month a transport liner had crashed in the hills to the northeast of Los Angeles. It was the plane carrying Martin and Osa Johnson. On the following day the world at large and particularly those of us who were proud to call him friend, learned to our sorrow that Martin had died from his injuries without ever recovering consciousness. And since he had to die it was a consolation at least to know that he had been unconscious in the last few hours as he lay in that hospital bed. At least it was a short, swift finish to a happy, fruitful and useful life.

BUDDING OF A GREAT CAREER: At twenty-three, Martin Johnson first astounded audiences with his pictures of far-flung places. He opened a theater in Independence, Kansas, his home town, named it the Snark after Jack London's famous yacht, and showed the pictures he had taken while cruising the South Seas as London's assistant

MARTIN JOHNSON AT SANTA ANNA in the Solomons. Audience reaction to pictures of the 1917 expedition, when they lived mostly in an open boat, had convinced the young explorer and his wife of the popularity of photographs showing savages



SECOND VISIT TO THE NEW HEBRIDES: Martin Johnson and some of the small people of Santo Island, in 1919. Although badly frightened by cannibals in this vicinity two years earlier, Martin and Osa returned for more pictures because of the enthusiastic reception given the few photographs they had managed to take

UP THE KINABATAGAN RIVER, BORNEO. This picture was taken in 1919 and shows the same scene the Johnsons were to view seventeen years later on their last expedition. They circled the globe six times in the course of their explorations

THE EXPLORING COUPLE AT PALI. Even at this early date the Johnsons had achieved international fame

MAKING VALUABLE PICTORIAL RECORDS OF PRIMITIVE CUSTOMS: Martin Johnson and his attractive wife took their cameras to Tomman Island, New Hebrides in 1919. Above, Johnson is examining the 'cured' head of a cannibal victim

PHOTOGRAPHING ANIMALS IN TANGANYIKA on the 1923-27 expedition. Fickle audiences grew tired of savages, so the Johnsons turned to African animals. Osa drove the car while Martin made photographic records of wild life

MARTIN JOHNSON'S PHOTOGRAPHIC LABORATORY under construction: part of the 'village' that sprang up around the Johnsons' home near beautiful Lake Paradise, where they passed some of the happiest years of their life

A MASTERPIECE: one of the dozen or so photographs that Martin Johnson selected as his best. His legacy to the world is a splendid portrayal of a vanishing wilderness, photographed with patience, courage and artistry

AT HOME ON SAFARI (1923-27): this double tent is the usual type for African camp life; the radio is a typical Johnson innovation. Martin Johnson missed no opportunity to incorporate civilization's comforts into expedition life

SOME OF THE TWO-TON TRUCKS whose cork-insulated compartments kept photographic materials dry and cool during the long trips of the 1928-30 expedition

A HOUSEKEEPING PROBLEM: one day's food supply for the 500 pygmies assembled as actors in the remarkable film Congorilla, which won tremendous popularity in both the silent and 'talkie' version. The Johnsons denuded the landscape of bananas for fifty miles around to feed the pygmies

A HOME IN THE PLEASANT OUTSKIRTS OF NAIROBI: after twenty-two years of roaming the world, this two-story house was the first permanent residence the Johnsons had ever owned

MARTIN JOHNSON CHATTING WITH TWO NATIVE GIRLS whom he directed in the making of the motion picture Simba. The natives, incidentally, were quite unimpressed by the showing of the finished film

THE JOHNSONS TOOK TO THE AIR on their 1933-35 expeditions. Above a rhino shows his resentment of the white man's latest intrusion. As there are many lakes in central and eastern Africa the Johnsons' Amphibians were invaluable for exploration work

A TREETOP 'PENTHOUSE', elevated above the shimmering heat rays which ruin photography. As patience is a cardinal virtue of the animal photographer, the Johnsons constructed this comfortable shelter in which to wait for 'shots'

MARTIN JOHNSON PHOTOGRAPHING ALOFT from the cockpit of The Spirit of Africa. Although many unusual "shots" were made in the air the planes were used chiefly for scouting and transportation

THE JOHNSONS COAXING TOTO TEMBO INTO CAMP shortly after his capture. The little fellow became a favorite pet and drank no less than 5 gallons of milk a day. A deep fondness of animals was one of Martin Johnson's many admirable attributes

ON TOP OF THE AFRICAN WORLD: intense cold and rarefied atmosphere hampered Martin Johnson's photographing of the snow-capped peak of Mount Kilimanjaro

MARTIN AND OSA JOHNSON in an unusual pose beside The Spirit of Africa, the larger of the two planes taken on an American Museum expedition that journeyed 60,000 miles by air

MARTIN JOHNSON AT WORK IN HIS AFRICAN HOME: in addition to the immortal recordings of his camera, he has left the world several books which, taken collectively, are an anthology of the experiences and achievements of his magnificent career

MARTIN AND OSA JOHNSON LECTURING to a boys' club. The famous explorer was always fond of the youth of America to whom he was a splendid example and an inspiration

MEETING MUSEUM FRIENDS IN AFRICA: the Johnsons and the Trubee Davisons, both on Museum expeditions, met on the shores of Lake Victoria Nyanza during the explorer's last tour of Africa

THE SAVAGES TRUSTED MARTIN JOHNSON: his ability to win their confidence and friendship not only saw him through many a ticklish situation but aided him immeasurably in securing the cooperation necessary to his photographic work

MARTIN JOHNSON'S MOST RECENT EXPEDITION was to the jungle of Borneo, where he spent a year photographing the native and animal life

TILL DEATH PARTED THEM, the greatest man and woman in the history of photographic exploration; Martin and Osa Johnson in the African veldt they loved so well

HOW TO BE A MEDIEVAL BARON—*A vivid picture of frontier life in a section of the world where a white man with ingenuity, perseverance and a few dollars can make himself a feudal lord*

By RICHARD C. GILL

FOR years I had wanted to be a modern edition of a medieval baron but with warm-country comforts. The sort of genial overlord, for example, who might own a whole section of remote mountain valley through which an important trail passed. A valley in the Andes seemed about right, with an orchidy, Indian-haunted trail winding down into the vast Amazon Basin beyond. Jungle people had always interested me, and in such a spot as I pictured I could learn something of their mysterious ways and beliefs. Aside from the enjoyment I should find in studying the natives, I might have opportunity to record information of scientific value.

An exotic outpost

It would have to be the sort of place where I could sit on my own wide verandah and sip something handed me by Feliciano or Luis (or any other well-trained, soft-moving, two-dollar-a-month Number One houseboy), and watch with eternal fascination the trail's bizarre stream of humanity bound for the dark tangle of the Amazon or emerging wearily from it: explorers, prospectors, jungle chieftains, *caballeros,* headhunting tribesmen, native runners, and derelicts, all moving to the thrilling beat of high adventure. It must be where there are still faint vestiges of the Conquistadores, where my own Indians and *peones* would call me *Su Merced* (Your Mercy) and follow me, trotting loyally behind my horse, a coppery retinue, when I visited a little white-walled, red-roofed town in the foothills. Where even as I fought the jungle, laying out my plantations, I could drink my fill of tropical beauty. And, where all that I speak of is cheap and within my means, and where my barony would be a self-supporting entity.

You know the sort of thing I mean; you may even have thought about it. I thought about it, too, for years. Then I mentioned it a few times. Five years ago, with my wife, I went to Ecuador and did it.

And is it romantic? It is. Can you do it? You can. But you need some money, infinite patience, mechanical understanding if not actual ability, an ineradicable adaptability and optimism, and a fairly good constitution. While the locality that takes your fancy may be as healthful as it is exotic, there is nevertheless apt to be a climatic and dietary change which you must be able to withstand. You also need, as an untouchable reserve, the steamer fare back home if your experiment in modern romance doesn't pan out. Frequently it doesn't, and in any event you do not want to make it too permanent a thing. Try it as escape, as compensation, as what you will. But don't get the tropical "habit." You are apt to become neither flesh nor fowl.

But it's fun to live on a frontier of the world. It combines the thrills of the Forty-Niners with the satisfaction of being a modern feudal overlord. And there are plenty of transportable modern luxuries, if you can afford them. In fact, you had better not try it if you can't afford some of them; for things like books, magazines, radios and imported foods leaven the situation in a saving way.

However, don't do it banking on making your fortune. That does not happen often enough to talk about. If money is all you want from the tropics, get a job. If you want romance, and possess the very necessary prerequisites, get on intimate terms with the jungle. But find out all you can about it before you try it.

An opportune time

Everyone, quite naturally, wants his romance cheaply, on a practical, working basis. Few can afford it otherwise. But there are a surprising number of people who are financially able to find romance in this way, and who, to judge by the letters that pour in from them, take it seriously enough to consider actually going after it. It is a day of cheap and easy ocean transportation, of devaluated currency in

many of the 'queer' places, of insurance-incomes and annuities. In short, it is within the means of many to live for a while behind the scenes in a country more exotic than their own.

Why Ecuador

A prime consideration in my own choice of Ecuador was the low cost of living in that pleasant little country and the cheapness of the material necessities for the experiment of establishing a hacienda there. I might have decided upon any one of quite a few other equally suitable republics of Latin America; but, at the moment, the feudally run 'Land of the Equator' seemed to offer me my best chance of living not simply *in* a picturesque and exotic country but *with* it. Thus, my own experience should be regarded not as merely typical of Ecuador but as something which can be and is being done surprisingly often in many other countries. To judge by their queries, it is a thing that many people would like to do at least as a temporary escape from the what-ever-it-is that unconsciously appalls most of us in high-pressure civilization.

There isnt much point in saying a great deal about Ecuador generally. It is a nice, smallish, family-run country wtih more diversification of climate than you would believe possible, and with broad social and economic variety. It embraces the cosmopolitanism of modern foreign trade and the ingrown urbanity of its rather timeless, gilt-braided, Paris-gowned capital, down through baronial haciendas to the headhunters of its unexplored, unmapped eastern jungles. The spot I chose is on the edge of the jungles; and that's where I found what I wanted.

Every once in a while, before we actually found the ranch-site and as we wandered through the more settled parts of Ecuador, I had to pinch the Señora, and she had to pinch me, in order to realize that these dream-like prices were really true*: Shoe shine, 2¢; pint of breakfast orange juice, 3¢; second-rate hotel room and meals, 50¢; first-rate hotel suite and meals, $1; tips at 10%; oranges per hundred, 10¢; avocados, 1¢; standard bunch of bananas, 8¢; taxis per hour, 60¢; artichokes, 4 for 1¢; movies, 2¢ to 10¢; cocktails, 6¢; beer (large bottle), 8¢; whiskey (good), $1.10 quart; fancy liqueurs, $1.50 quart.

The only upward exception to these prices is in the capital city of Quito, where living is somewhat higher, though only slightly. On the other hand, in the rural regions and in the very small towns prices are even lower.

While we were exploring for a site for our ranch-to-be, we made our headquarters in the picturesque mountain town of Riobamba, Ecuador's fourth largest city (20,000), situated high in the central Andean plain and nearly in the center of the Republic. It is a superlatively picturesque mass of white-walled, red-roofed houses clotted together near the base of Mount Chimborazo, one of the world's high mountains.

Using Riobamba as a base, we were able to travel, by car at times but mostly by horse-back, to any part of the country we wished to investigate. And we studied the possibilities thoroughly, always being careful, of course, to conceal our real purpose, so that our equatorial brethern would not jump their land-prices for our particular gringo benefit. It is notoriously difficult to convince the average South American that the average North American can be brokish.

But, we certainly could not complain about the high cost of living during our five months in Riobamba. We rented a small villa (with a bathroom of sorts and nearly continuous electricity) surrounded by a fountained garden, had two full-time and two part-time servants, purchased all food, kept rented saddle-horses, traveled where we wished to look at ranch possibilities, and, in the end, didn't economize quite so much as we thought we were going to. It all cost a bit less than one hundred dollars a month. I still cannot believe it when I am away from there.

Selecting a site

In any event, those months of simply looking through the back country of an exotic and varied land, fused into a period of endless joy and adventure. Mainly with pack-train, we rode at our leisure from the wind-swept plains of the highest Andes, rimmed by smoking volcanoes and snowcapped equatorial peaks, rarely crossed except by Quechua Indian-driven trains of shaggy llamas, down through the really not-too-torrid jungles of eastern Ecuador. We visited immense, remote feudal ranches whose owners live in Paris, the mecca of all good South Americans, and jogged through hidden valleys haunted by legends of treasure and the ghosts of the vanished Incas. There the Indians on fiesta days still dress in humble parody of the Conquistadores and greet you with '*Sea alabada siempre Santísimo Señor,*' which is also the way they greet God. It makes you feel funny at first. Afterwards you don't mind it, and you think of Pizarro when you nod back to the flat.

*All prices quoted are in dollars and cents and are based on the *sucre*, the Ecuadorean unit of currency, at the exchange rate for the past few years of 10 *sucres* for one dollar.

wind-seamed faces. Also, in the back mountain country, the Indians will take your hand in theirs to kiss it, but only after carefully wrapping their own in a grimy poncho. (The early Spanish were very thoroughgoing in their ideas of etiquette).

But, we finally decided to establish ourselves in the region about which we had at first thought and heard so much: the eastern slopes of the Andes, inside the fringe of 'cool' jungle, but well up from the steaming Amazonian lowlands. For thousands of miles that same fringe of 'cool' jungle, forms the eastern boundary between the Andean country and the Amazon drainage basin. It is also one of the last great primitive frontiers, a place of cheap life, good men and very bad, and untamed Nature. If you want to put it another way, it is one of the last sites, certainly the largest, of concerted modern pioneering. It is one of civilization's farthest-flung battle lines, where colonists of all nationalities (Italian, French, Czechs, Japanese, English, German, White Russians, North Americans, occasional South Americans) wage ceaseless, sometimes heart-breaking, warfare against the jungle. Sometimes they succeed with their coffee or cotton or timber or prospecting; very often they don't. But win or lose, there seems to be an inescapable fascination in tackling the living jungle, unbeatable as the sea, ever-growing.

On an artery of travel

Our valley has a horse-road (there are no jungle-bound car roads in eastern Ecuador), the Pastasa Trail, and forms one of the main gateways to the Ecuadorean Oriente, as its eastern jungles are called. We own a cross section of the valley from the river back, and the Trail goes by our house on our side of the river. We see everyone who wants to go by our road to the Amazon country for good reasons or bad ones; we also see lots of them come back, up out of the 'green mansions.'

There is no way of telling you briefly how, in eighteen months of hand-labor and animal-transportation, when the lack of a single tool would tie things up for days, we carved out our place. It was a pretty good experiment. There is a seventeen-room house (counting the built-in carpenter shop, the storage room, the hospital room and the study), with a native-made green and white tiled bathroom, and running water from a cold hillside spring. There are also *peon* quarters for the help, a blacksmith shop with a homemade forge and blower, a corral—about everything that is needed to make the place go.

All of the pioneering was as inexpensive as you might think. Carpenters and helpers cost from 8¢ to 20¢ a day. Building materials were also relatively cheap. My own *peones,* on contract, delivered me planks of fine tropical wood (1″ x 12″ x 9′), hand-sawn, for $2.50 a hundred. Sleepers, stringers, crossties, rafters, odd pieces, were at the same relative price. Everything we used was, as far as possible, native-made and cheap in price but had a pioneer staunchness and quality. The furniture, mattresses, hangings, curtains, dishes, even the main pieces in the bathroom, were made within the country.

The setting

The Hacienda Rio Negro, our place, is the nearest thing I have ever seen to a tropical paradise. We are at an altitude of 5,000 feet, above the poisonous snakes and the mosquitos, with a mean annual temperature of 70°. Wild life abounds in the rolling hills behind us, which belong to us as much as anyone, I suppose. We reach the ranch by riding twelve miles of orchid-lined horse-trail from the little village of Banos. It is always good to arrive. The pastures and the plantations blend into the cool jungle, which also is mine.

Our barefooted *peones,* who form a part of the warm, graceful current of tropical life, furnish the patient, serf-like hand labor which is the medieval backbone of our jungle barony. I have always got along quite well with them. They work as hard for me as for anyone, and although I do not pay them any more than anyone else (for I should hate to have another *hacendado* poison my cattle in the night) I *do* pay them. On a New England farm $1.50 is not an excessive wage for an experienced worker; on my hacienda fifteen *peones* cost me exactly that. I punish them when necessary and give them Christmas feasts and doctor their hurts. So, they call me "Your Mercy," serenade the Señora with twisting, pentatonic music, follow my horse proudly into town, are very loyal and faithful, and swing a machete in the jungle for me for ten hours a day, when they work, at a top wage of ten cents.

Here are some more prices, and remember that, after all we *are* foreigners, gringos, and simply have to pay a bit more: Our chef, laundress, and table waiter all for $6 a month; plain cook, $1-2 month; cook for *peones,* 80¢-$1 a month; filet mignon, 2½¢ pound; whole turkeys, 25-40¢; chickens, 10¢; trained saddle horse, $30; made-to-order saddle, $12; Number One houseboy (butler), $1.50-2.00 month; ordinary houseboy or maid, $1.00-1.50 month; ranch foreman, $4.00 a month; mules, $10.00-15.00; cows, same and less; pigs, 50¢ to $1.00; child purchased by indenture, $8.00 if

healthy, less if ill; and (to remote Indians) $6.00 worth of trade goods for an ounce of gold.

And don't think while we are there, we are cut off from the world. We aren't. Our daily news comes by short-wave radio; our library is renewed monthly, and our magazine files are full. I have as much to read down there as any place—and as little time.

The world at your door

In addition to our invited guests, the hacienda is always open to the unpredictable stream of humanity that finds itself on the Pastasa Trail for any reason —petty commerce and trading, a fear-haunted flight from justice, an expedition into the unmapped and unexploited. Most of the passers-by stop and many of them enter. Our guests are as frequent as we could wish, as varied as the weather, and as cosmopolitan as a city newspaper: Indians, from lowly runners up through chieftains with their wild retinues, explorers, authors, prospectors, 'bad men', and missionaries. We had a stage designer, a librarian, three Brooklyn school teachers who had wandered very far; several refugees (one a delightfully entertaining bank robber from Philadelphia), half-crazed tropical tramps, one dormant journalist and several who weren't, an amateur Communist who was most ill-advisedly going to visit the jungle Indians, who are a very practical people indeed; a song writer, miscellaneous scientists, colonists-to-be and colonists-who-had-been, seamy-eyed old-timers with twisted smiles, sun-helmeted first-timers who complained bitterly about bananas growing upside down, assorted grades of diplomats, gay South American *caballeros* whose Andean pacers were hung with silver ornaments, ragged *peones* asking for work, occasional border officials, an Ecuadorian army expedition going to protect the country's eastern boundary from Peruvian-Colombian jungle bickering, a pseudo-Russian prince and a real one; and very inquisitive local *hacendados*, come to see how the gringos are making out. People who whiffed the vital fragrance for several days and wrote books about it and people who spent long, silent, lost years in unwritten places and couldn't tell you ten consecutive words about them.

I never before realized the possibilities of one's visitors. They come and go, and I, talking with them after dinner, learn plumbing, diplomacy, how to shrink human heads, another way to prune my coffee trees, grade-school pedagogy, the scenic details of a forthcoming Broadway production, how to poison my blowgun arrows, what to do in case of botulism, the icthyology of the MacKenzie River, cattle bloat, why the Minister to Zanahorria was suddenly transferred to Remolacha, what happened that time in Antofogasta when. . . . A big, stipple-faced moon of glowing copper comes up over the river-hills, flooding my pastures with mellowness to the edge of the dark jungle-wall, and I sink down in my *mimbre* chair until I feel that Broadway, the jungle, and the Dewey Decimal system are all one. Which they really are when you look at it that way.

The mysterious wild folk

But of all our fascinating guests, our Indian friends, the shy, generous wildmen of the inside jungle, who have finally learned to come once in a while and camp at the edge of our orchid garden, are the most interesting. I have always liked them and, during the past few years, I have been able to learn more than ever of their mysteries. I have traded magic with them and been accepted as a witchman of sorts by a friendly chief who holds sway over a large area just 'inside' from the hacienda. I am always delighted to receive them, or to join them at night as they sit low-voiced and bronze, around their camp fire. There is no end to the primitive lore that my position enables me to record.

Our evenings are calm, peaceful, away from the world but not out of touch with it. We change for dinner, have cocktails, and eat by candle light from a hand-rubbed *canelo*-wood table. Afterward, in the living-room, there are coffee, reading, games, and radio; and, when there are guests, conversation flourishes under the stimulus of the surrounding wilds. And still later, on the hammocked verandah, when the eternally mysterious night-change has swept through the jungle and the things that leap and fly and love and live in the night-forests are playing and eating one another, we don't talk so much. We sit and listen to the far night-sounds back in the hills, the nearby nickering of the pastured horses, the low strumming of a guitar in the *peon* quarters. And a Spanish friend is apt to bid me goodnight with the old-time, courteous formula, "There is peace upon your land, Señor." I tell him goodnight and thank him. I feel there is, too.

Snow-Garlands

A Rare and Spectacular Winter Formation, Photographed by Dr. Monroe A. McIver

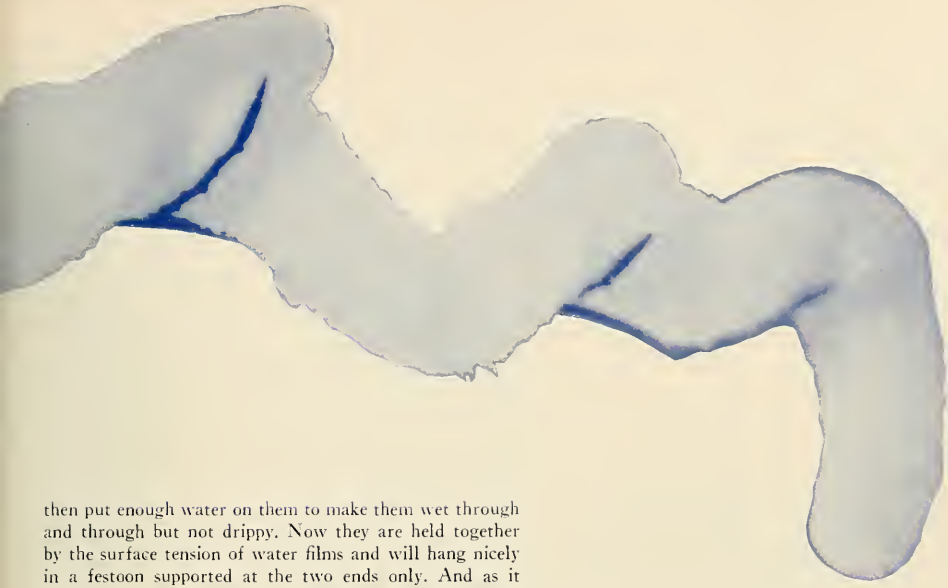
The curious festoons shown on these pages have, to our knowledge, been photographed only three or four times before.

"Once in a 'blue moon,' " to quote W. J. Humphreys in the Monthly Weather Review, May, 1935, "trees and other objects are decorated with snow-garlands—ropes of damp, or re-frozen, snow, several feet long, fast at both ends and hanging in catenary loops in between. . . .

"What is the explanation of this holding of snow crystal to snow crystal in a continuous suspension bridge from anchorage to anchorage? Nothing, we are told, is more impossible than making a rope of sand; and yet of ice sand, that is, of snow crystals, Nature makes suspension bridges, or garlands, if we prefer art to engineering. How does she do it?"

These garlands are formed only when the snow is wet, and W. J. Humphreys points out that the flakes are held together in a "rope" by the adhesive effect or surface tension of the thin film of water between the particles of snow:

"The following experiments are convincing of this: Take a lot of unglazed bits of paper, 1 to 2 millimeters across, and roll them together to the size and shape of a cigarette and try to suspend the collection from its two ends without other support. Immediately it falls apart like the fabled rope of sand. Roll them together again and



then put enough water on them to make them wet through and through but not drippy. Now they are held together by the surface tension of water films and will hang nicely in a festoon supported at the two ends only. And as it is with the bits of paper so it is also with snow crystals. They fall apart when dry and cling together when wet.

"Obviously a wet, sagging snow garland may be subjected to below-freezing temperatures, in which case it then will maintain its shape and position by virtue of the tensile strength of continuous ice, however porous it may be, and not through surface tension as before. In any case the garland is first formed of damp snow whose flakes and particles are held together then, and often for many hours thereafter, by the surface tension of water films."

A somewhat similar but less spectacular formation is the so-called snow drapery, a hanging sheet or clinging mass of snow, or snow and ice. Snow draperies are seen hanging over the eaves of a house when a gentle thaw, especially one supplemented by heating beneath, causes the layer to slide slowly down the roof.

Snow-garlands, however, are much rarer and more beautiful, and in securing the accompanying photographs Dr. Monroe A. McIver, of Cooperstown, N. Y., is to be commended for adding to the scanty pictorial record of one of Winter's most remarkable decorative features.

The Eight Immortals

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A NOTABLE set of eight figures carved in Formosa coral, recently received from an anonymous donor by the Morgan Gem Collection of the American Museum of Natural History.

These figures, representing the Pa Hsien, or Eight Immortals of Taoism, are each about 2½ inches high, and are carved in intricate detail by modern Chinese lapidary craftsmen.

"The semi-historical, semi-legendary men and women they represent," writes Herbert P. Whitlock, Curator of Minerals and Gems, "lived in China at various times from the 10th century B. C. to the 10th century A. D. Each personage is supposed to have attained immortality and is the principal character in some legend. A characteristic emblem is always associated with each, symbolic of his or her mythological rôle. Likewise, through long custom, a certain characteristic head-dress has been assigned to each. By these emblems the immortal Eight may always be identified."

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SYMBOLIC FIGURES whose characteristic emblems denote their position in Chinese legend: a recent acquisition of the Morgan Gem Collection

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1. Han Hsiang-tzu, a famous scholar and musician of the 9th century. His playing upon his magic flute was said to cause flowers to grow and blossom instantaneously. His emblem is the flute

2. Li T'ieh-huai, a mystic always represented as a beggar leaning on a staff or crutch. Accustomed to project his soul from his body, he was on one occasion unable to assume his own mortal shape and had to take refuge in the remains of a lame beggar who had just died. His emblems are a crutch and a magic gourd

3. Chang Kuo-lao, a Taioist recluse of the 7th or 8th century A. D., who exercised supernatural powers of magic. His emblem is a bamboo tube with two rods

4. Lan Ts'ai-ho, the immortal street singer, who is now generally regarded as a woman. She wandered begging through the streets of old Chinese cities, chanting a doggerel verse denouncing the delusive pleasures of this life, and extoling the joys of immortality. Her emblem is a flower basket

5. Ho Hsien-ku, also a woman, who is said to have been the daughter of a shopkeeper of Lingling, Hunan. She ate one of the peaches of immortality and became a fairy. Her emblem is the lotus; and she sometimes carries a fly-whisk in her hand

6. Lee Tung-pin, a scholar and recluse of the 8th century. His emblem is a magic sword with which he traversed the world for 400 years exterminating various forms of evil

7. Chung-li Ch'uan, the Chief of the Eight Immortals, who is said to have lived 1000 years before our era. He is supposed to have obtained the elixir of life and the power of transmutation whereby base metals could be changed to gold. His emblem is a miraculous fan with which he was said to fan the souls of the dead back into their bodies

8. Ts'ao Kuo-chin, a 10th century military commander and brother of a Sung dynasty Empress. He is the patron saint of actors, and his emblem is a pair of castanets which he holds in one hand

LOST JOHN OF MUMMY LEDGE—*The last day in the life of a prehistoric gypsum miner in Mammoth Cave: an extraordinary story told from clues surrounding a well-preserved mummy caught in accidental death*

By ALONZO W. POND

HIGH on a ledge in the eternal darkness south of Waldach's Dome, two men crawled on hands and knees. As they moved cautiously along the treacherous sand their lantern cast weird lights on walls and floor. The hand of one of the men rested for a moment on a round object. With a start both men recognized it as a human head.

Once again Mammoth Cave, Kentucky, had given up a startling secret. The dried body of a prehistoric Indian had been discovered where Death had posed a tableau of primitive, work-a-day life.

Persistence rewarded

For fifteen years those two men, quiet, unassuming Grover Campbell and Lyman Cutliff had been exploring Mammoth Cave. Scores of other guides had done likewise, most of them seeking new passages or more beautiful cave formations. Cutliff and Campbell centered their interest on traces of primitive man.

There were skeptics who smiled at their ambition to discover a mummy in the cave. There were some who even argued obstinately that the burned reeds that had been found in the cave had been washed in by freshets or ancient rivers and that the primitive grass sandals had been carried in by pack rats. But there was ample evidence to disprove any such theories, and the two guides continued to search for human remains.

On that eventful day in June, Campbell urged Cutliff to come up on the ledge in Waldach's Dome, where he had found some mummified bats the day before. Cutliff followed his companion two miles from the entrance of the cave to a high ledge close to the roof and thirty feet from the floor. At the south end of that ledge they climbed down to a broad, sand-covered shelf and examined the mummified bats lying close to a large block of limestone. Then Campbell said:

"Guess I'll crawl down between these rocks. Looks like nobody has ever been down along that sand ledge."

Cutliff followed close behind him. Campbell pushed his head between two large rocks to see what lay beyond in the darkness where no civilized man had ever gone. His lantern cast a circle of bright light, beyond which long shadows played. His left hand rested on what he supposed was a stone, until the light from his companion's lantern dispelled the shadows.

"That's not a stone," he said, jerking away his hand. "What is it, Lyman?"

"Gosh! It's a skeleton! No, it's a mummy," exclaimed Lyman Cutliff.

They knew the significance of their find, for it might answer many questions. Within arm's reach of the body, indeed, were some of the peck-marks in the gypsum-covered walls which in various parts of the cave had aroused curiosity.

The investigation

The Director of the National Park Service in Washington, D. C. was notified and a hurry call was sent for the writer, then engaged in archaeological research on Jamestown Island, Virginia. In a few moments he was speeding over the mountains toward the discovery.

Many years of archaeological exploration on four continents have given me more than my share of 'firsts', but nothing gave me the thrill I experienced as I sat on that narrow ledge in Mammoth Cave with the discoverers and saw with my own eyes the perfectly preserved body of that prehistoric miner trapped at his work centuries ago.

Nothing had been disturbed. The ledge was covered with loose, dry sand over which had settled fine, black soot from the torches of ancient and modern 'cavers'. In the tragic tableau before us, time had stopped centuries ago. With the event of death and the subsequent drying of the man's body the scene

had remained unchanged. Here was preserved one of the most complete chapters in the life of prehistoric peoples.

As I sat there gazing at the dried body of the prehistoric man a host of questions clamored to be answered. For what was he looking? What was so precious that he would dare penetrate the darkness and brave the mystery of the cavern to secure it? Was anyone with him at the time of the accident? What tools did he use? What food did he eat? At what season did he come to the cave? How many centuries had passed since the flickering light of his torch ceased to throw weird shadows on the cave walls? Long I pondered those and many other questions. Then the archaeologist in me stirred and I set to work methodically to study the clues for answers. It is usually difficult to solve a detective case like this where the trail has been cold for centuries; but in the end we had the answer to nearly every question.

Condition of the body

The block of limestone which had caught the ancient miner was about six feet long, four feet wide and three to four feet thick. It weighed between six and seven tons, and rested solidly on several smaller stones. The miner's head, face down in the sand, and the neck, right shoulder and right side of the chest were clearly exposed below the Tomb Rock. The dry flesh of the chest was as soft as velvet, but that of the right arm and, as we later discovered, the rest of the body was as hard as sole leather. The soft flesh over the ribs had been partially eaten away by rats.

As it was too dangerous to work on the ledge I carefully dug away the sand to a depth of twelve or fifteen inches to make a wider, firmer shelf on which to work. Every bit of that sand was sifted for data which might throw light on the life of the prehistoric Indian.

My digging, done with a small garden trowel, soon uncovered two bundles of oak sticks resting in a niche on the rocks about six feet from the miner's body. They were still tied with grass knots. Closer to the body was a small fragment of gourd and under it a hickory nut. Three feet from the dried head was a bundle of reeds and two fragments of excreta.

With small scalpel and camel's hair brush I cleared away the sand about the body. The right arm, when fully exposed showed a compound fracture just above the elbow. It was possible to expose a part of the right leg from the loose sand, but most of the body was hidden beneath the great Tomb Rock and one could only guess at its condition.

During the following weeks the guides took me into many side passages of the cave in search of further evidence of prehistoric visitors. Throughout the dry avenues we found plenty of proof that human beings knew the cave centuries ago. We found definite routes through tumbled masses of rocks, routes marked by quantities of reeds burned only at one end. One day a handful of reeds was discovered down among the rocks, with a knotted grass loop still holding the bundle together. One end of the bundle was charred almost down to the grass knot. One could visualize the prehistoric Indian clambering over the rocks, torch held high to light his route when suddenly the flame burned down to his hand. Surely he dropped that torch with a cry of pain, then lighted another to guide his footsteps.

At some points along these trails the rocks were polished smooth by the countless passings of prehistoric people. There were gourds and fiber cords in niches of the walls. There were sticks scraped and pointed or dulled as though they had been used for digging in the sand. Occasionally we found mussel shells, some with worn edges. All these were evidence of the prehistoric visitors, but the reason for the visits eluded us, perhaps by its very obviousness.

In a few secluded corners of the cave, deposits of epsom salts hang from the walls and ceiling. Gigantic spoor of human kind were abundantly associated with all evidence of man's handiwork in the cave. Some of the guides and visitors suggested that prehistoric man had sought the medicinal effect of the mineral. For a time that idea gathered force, until it was realized that no epsom salt deposits could be found on Mummy Ledge where the ancient miner was trapped. Nor did it exist in many other sections where evidence of man was found.

What Lost John sought

At length certain facts were forced upon our attention by their constant repetition. Wherever we found evidence of man we also found gypsum-covered cave walls battered and scarred by some blunt instrument. Narrow crevices, high ledges, crooked crawl-ways, all had been chipped of their gypsum. On shelves and ledges were many worn, blunt-pointed chunks of limestone, which actual experiment proved to have been the tools that those ancient miners had used in chipping the walls. Gypsum-covered walls, chipped and scarred were so closely associated with gourds, worn stones, fiber cords and reeds that we were forced to acknowledge gypsum as the lodestone which had drawn those ancient miners

far into the terrifying darkness of the cavern. To what use they put the white crystalline material is open to speculation. Possibly they attributed to it some potency as an amulet. It is more likely that they made white paint of it.

Footwear

Some of the narrower passages in the cave had been filled with water-borne silt, and many of these deposits had been dug out. The loose sand that had been piled nearby was rich in human artifacts. The prize relics were sandals. These were woven from the fiber of the inner bark of slippery elm and told a most interesting story of the ancient gypsum miners.

The fiber was first twisted into cord, then woven into a flat piece, the edges of which were finally gathered around the foot and laced over the toe so as to fit snugly. But what a variety! Some were coarse and carelessly made, some were plain and badly worn, some were woven 'over and under', others had the woof strands twisted to make a chevron pattern, and still others had bands of each type of weave. The best specimen of all was decorated over the toe with fine cords as evenly twisted as if they were the product of modern machines. This sandal was the longest and widest of all and we called it the chief's. At no time was a pair found. Some were from the right foot, some from the left, but always they seemed to have been lost from the foot of the wearer while at work in the cave.

One of the most interesting of all was a coarsely woven sandal which had been worn through, then darned with a heavy braided cord. Even primitive Americans 'darned their socks' when they wore through.

Out in Black Chambers, a wild, little-frequented avenue of Mammoth Cave, we found prehistoric Indian ladders, straight sections of tree trunks six inches in diameter with the stubs of branches still protruding as steps. The trees had not been cut down but had been battered free of their stumps with blunt tools like stones. Even the branches had been broken and haggled off instead of cut from the trunk. One excellent example, a red cedar stub about twelve feet long was found below a high gallery leading away from the main avenue. One side was polished smooth by the feet and hands of many prehistoric users. By means of this primitive ladder the writer climbed into the gallery and found more evidence of the prehistoric miners' search for gypsum. This, like other passages, had been partially excavated of its packed, water-borne silt.

On the floor of Black Chambers were many cleared circles, where the tumbled rocks had been thrown aside and the floor was strewn with small flakes of limestone. Careful examination revealed tiny fragments of gypsum among the limestone fragments, and we knew that these cleared circles were the sorting beds of the ancients. Here prehistoric miners had sorted their harvest of gypsum from the chaff of limestone which they had chipped from the cave walls and dug from the silt deposits.

The final proof that gypsum was the material of importance to the prehistoric people was discovered by one of the guides while the CCC workers were moving rocks in trail-building along the ancient trail of the torches. Hidden away under the rocks, right out in the middle of the cave was a cache of gypsum crystals. Almost a peck of gypsum had been carefully hidden away.

We deduced the probable time of year at which the Indian miners visited the scene, by examination of all the reeds and other plant material found in the cave. All the reeds were dry and mature, and there were various local, rank weeds with mature seed pods. Likewise, stems of wild grapes, hickory nuts, dry gourds, and sunflower seeds, all indicated that the cave was visited chiefly in the autumn months when such things were mature and ripe for use.

Negative evidence

Curiously there were glaring absences which told us as much about the people as the constant repetition of positive finds. There is a total absence of bone. No bone tools, no joints of deer or bear or bison have been found in the gypsum-covered avenues of the cave. There are no arrow points, no stone axes, no intentionally shaped stone of any sort. The crude limestone chunks with points blunted by use were abundant, but they were tools of chance, picked up on the spot and likewise discarded. There are no evidences of pottery, either whole or fragmentary. There are no traces of metal, no beads, nothing even remotely suggesting the white man's influence. Not a trace of corn or tobacco, the usual products of Indian agriculture.

These people, skilled in weaving, still relied on wild foods. There is abundant proof that they were very early inhabitants of Kentucky and long antedated the discovery of America.

At no point was there any considerable concentration of data except the reeds along the trail of torches. A single sandal, a bit of food, even the cache of gypsum was not enough to burden a lone traveler. The distribution of such artifacts forced us to realize that the miners worked singly or in small groups. Throughout the autumns of many decades,

perhaps of many centuries, they dug gypsum, from many miles of cave walls.

At length word came from Washington to raise the Tomb Rock and free the mummy for scientific study.

Mr. R. W. Martin, burly, good-natured project Superintendant in charge of the CCC workers in the cave, supervised the erection of a thirty-foot timber tower, from which were hung three chain hoists. Then a steel cradle was woven about the Tomb Rock and attached to the hoists. At last the day came when we called,

"Ready now. Raise the rock."

The ancient scene unfolds

Furiously the chains rattled through the blocks. Breathlessly we watched the Tomb Rock. How slowly it moved! Or did it? It was like watching the hand of a clock. Finally the rock swung free. Civilized man gazed down on a new chapter in his long climb to civilization. After weeks of waiting the complete story of that age-old tragic tableau was ready for interpretation. We saw what lay beneath the Tomb Rock, and knew the story of what had happened there so many centuries ago. . . .

* * *

Through the flickering lights and shadows of a reed torch, an old Indian gypsum miner, barefooted, moved along a narrow ledge high above the floor of the cave. Carefully he laid two bundles of oak sticks in a niche in the rocks, which he would ignite later to help dispel the darkness and drive away the spirits. With similar purpose this man of destiny placed a long bundle of dry reeds close by on the steep slope of that treacherous ledge. He sat down to munch his meager meal of hickory nuts. Curious shadows leaped about the walls of the cave as the torch light wavered. A stone rattled down the ledge momentarily shattering the awful silence as it crashed on the floor below.

His lunch finished, the old man squatted silently a moment. The darkness and the silence of the cavern brought him close to a sense of the eternal mystery. Fear of the darkness, awe in the presence of the mysterious unknown, were overmastered by his intense religious fervor and the desire to secure the sacred gypsum. He touched his polished clam shell amulet.

For two miles he had wandered through the majestic passages of the great cavern, a puny soul wandering in eternity, his footsteps guided by the fitful, yellow glare of a reed torch. Through tortuous rock falls he had clambered where even his precious bundle of torches was a burden. His faith in the sacredness of the tribal need for gypsum, precious ceremonial paint of the ancestors, had driven him on through the silence.

On the threshold of eternity

At last he was ready. He adjusted the folds of his fiber blanket across his hips, knotted it in front and drew a large part of it over his chest, bib-like. Cautiously he crawled under a great block of limestone that had lain for centuries on the steep ledge. He knelt on the loose sand of the ledge. With a large chunk of limestone he started to chip away the gypsum. His position was cramped, awkward. He moved his left foot for greater comfort; it dislodged a small key stone beneath that huge block of limestone!

An agonized scream of terror shattered the cavern's stillness! A few pebbles rattled down over the ledge to the cave floor. The reed fire flared up and flickered out. Silence and the blackness of eternity descended again on the great cave. Death had posed a tableau of prehistoric man's intimate daily life. The strange chemistry of the cave began the process of preservation. A rat gnawed a little on the body, then left its job unfinished. Other gypsum miners worked on a higher ledge. Sand from their diggings trickled down with hour-glass slowness to bury the ledge of tragedy. Eternal minutes in the cavern grew to years. Decades lengthened into centuries.

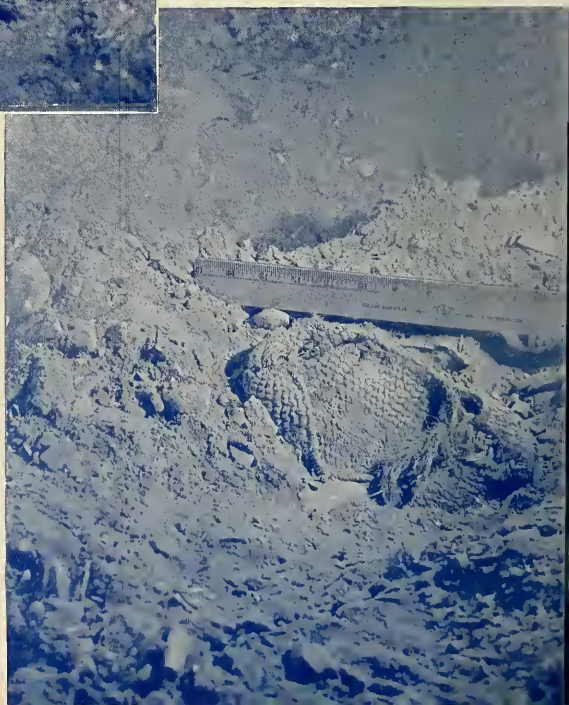
FOOTPRINTS ON THE SANDS OF TIME: Human tracks left by prehistoric Indian gypsum miners in the dust of Barefoot Ledge, Mammoth Cave, Kentucky

When two guides after fifteen years of exploring, discovered a human head under a fallen rock they knew that Mammoth Cave had given up a startling secret of the past

Within a few minutes after he was notified of the discovery by the National Park Service, archaeologist Alonzo W. Pond was speeding to the site, prepared to excavate it with the detective-like precision of the scientific digger

All photos by Alonzo W. Pond for National Park Service

Lost John *of* Mummy Ledge



THE MUMMY ANSWERED THE RIDDLE of the prehistoric sandals, like the one shown at the right, that had been found in the sand of the cave floor

What was so precious that it lured the man into the darkness of the cave? Was anyone with him when he met death? What tools did he use? What food did he eat? At what season did he enter the cave? These were the questions Alonzo W. Pond sought to answer. Although the archaeologist was searching for clues on a trail that had been cold for centuries, the mummy told him a complete story

(Above) THE MUMMY, pinned beneath a six-ton rock, viewed by M. L. Charlet, manager of Mammoth Cave. Stone pecking tools, sandals and reed torches were abundant

(Below) CLOSE-UP OF LOST JOHN OF MUMMY LEDGE, with the dust of ages undisturbed. On the chest the dry flesh was as soft as velvet, elsewhere as hard as sole leather

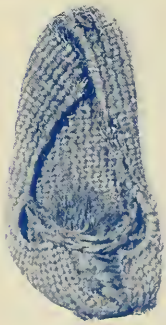
(Right) A CHAPTER FROM THE LIFE of a primitive people was disclosed when the rock was lifted from the body of Lost John. Gypsum, valued as a paint ingredient or for purposes of magic, lured the primitive miners into Mammoth Cave. Ample evidence indicated that they lived long before the discovery of America. They were skilled in weaving, as shown by the typical specimens of sandals reproduced on these pages. No bone tools, arrow points, pottery, metal, or beads were found among the rather abundant artifacts, and no evidence of cultivated plants, indicating that Lost John's tribe relied upon wild foods and were quite primitive

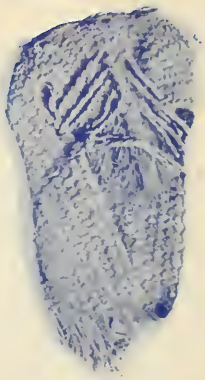
The condition of the plant materials proved that Lost John entered the cave for the last time in the autumn. After wandering to the spot two miles from the entrance, he munched his meager meal of hickory nuts, adjusted his fiber blanket across his hips, knotted it in front, and drew a large part of it over his chest, bib-like. Then he proceeded to chip away the precious gypsum with a crude stone tool. Feeling cramped on the narrow ledge he moved his left foot for comfort and dislodged the six-ton rock above him. Death posed a tragic tableau. The reed torch flickered and died out

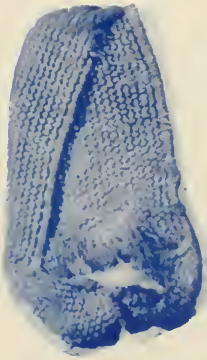
The strange chemistry of the cave began the process of preservation. Sand trickled down with hour-glass slowness to partially bury the ledge. Eternal minutes lengthened into centuries

(Below) SHOWING THE MANNER in which the Tomb Rock was bound in a metal cradle and lifted

Photos by Robert Sparks and Alonzo W. Pond, for National Park Service





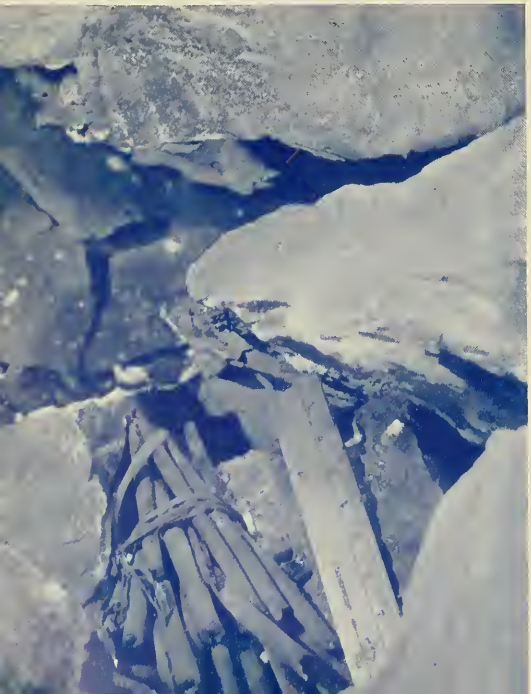


(Above) NOTE THE FRACTURE just below the right elbow, sustained in the fatal accident; and the woven fiber blanket

(Below) A REED TORCH that was "dropped like a hot poker" by the early gypsum miner who held it until it burned too far

(Below) WAS HIS MOUTH OPEN IN A FINAL SCREAM? Front view of Lost John of Mummy Ledge. Measurements proved that the ancient gypsum miner was only about 5′ 4″ tall, and the size of the many sandals likewise indicates that the people of the time were not large

Photos by Alonzo W. Pond for National Park Service



THE DEATH THROES OF THE AZTEC NATION

Disclosing a curious note of modernity in one of the great battles of history. Lively drawings by Aztec artists of the time take the place of our modern snapshots of war scenes

By George C. Vaillant
Associate Curator of Mexican Archaeology, American Museum

The romantic circumstances which attended the fall of the Aztec Empire have long captured the fancy of the European world. A whole nation submitting to a handful of desperate Spanish soldiers offers a dramatic situation, seldom paralleled in our annals. Yet, given the unflinching generalship of a Cortes, the collapse of the Aztec tribes was inevitable. The psychological conditions inherent in this type of Indian culture could not withstand European military technique, any more than could the varied civilizations which became colonies of Europe in every continent on the face of the globe.

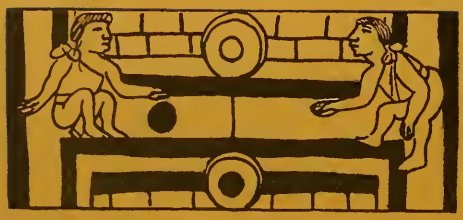
There are times in the history of all nations when the nation will seem to disintegrate before intangible factors individually insignificant. All students of military affairs are familiar with those sudden routs affecting the group stamina of victors and demoralizing the grim fortitude of those who have endured successive defeat. The Aztecs' war against the Spanish Conquistadores is an elusive example of the paralysis of the national morale, followed by a defense carried on with that courage found in forsaken men, in this case abandoned by their very gods.

An examination of the Mexican social structure in relation to the psychological state of the Aztec mind shows that the Spaniards arrived at a very favorable time for conquest. Comparison of the Aztec military technique with the European discipline and armament of the day reveals an exceptional opportunity for the triumph of European tactics. To explain the familiar tale of the Conquest from the Indian point of view may throw into sharper relief this conflict between two systems of civilization.

The Aztecs were the inhabitants of the city-state of Tenochtitlan, and were allied to two other similar political groups, the city-states of Texcoco, and Tlacopan. The social organization of each tribe must have been the same, a group of clans, each with its own residential quarter and farm lands, divided into four larger divisions each under the control of a head chief and the clan elders. In Tenochtitlan, the most powerful of these chiefs for several generations had been selected from one clan or family, and hereditary considerations had so profoundly affected an

THE STORY OF THE CONQUEST OF MEXICO,

1519-21, as reported by native Aztec artists of the time



THE YEARS BEFORE THE SPANISH CONQUEST had been full of evil omens for the Aztecs. To determine whether the dire predictions of Nezualpilli, chief of Texcoco, were correct, Montezuma played and lost a ritualistic game of "basketball" with him like that depicted above
(Codex Florentino)

(Right) MONTEZUMA VIEWS THE MAGICAL BIRD in the head of which was a mirror, showing first the heavens, then hosts of armed men, foretelling, according to tradition, the Spanish Conquest
(Codex Florentino)

(Left) THE SPANIARDS LAND in 1519 at the site of Vera Cruz. Their ship and equipment are carefully shown. At the right, Marina, Cortes' interpreter, is exercising her diplomacy on a native *(Codex Florentino)*

(Right) AZTEC SORCERERS, sent from the highland, offer bewitched food to Cortes and his staff, who disdain the viands
(Codex Florentino)

original free choice as to create a condition closely resembling royal succession.

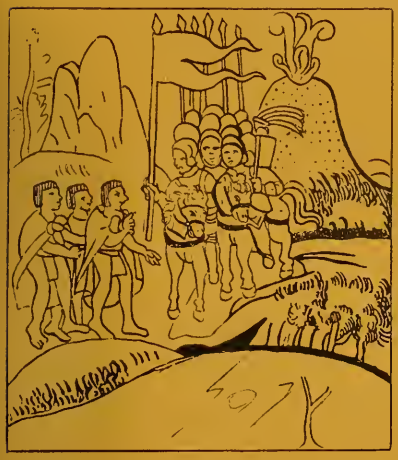
The religion of the Aztecs seems originally to have been a simple nature worship, carried on under the direction of the clan leaders. With evolution in civilization, the religion became more elaborate, and certain gods grew more important than others. This elaboration of ritual transformed the former simple religion into a complex theology of which the clan leaders often became chief priests. Governmental and religious functions became inextricably interwoven since the same individuals, the chief men of the clans, performed both sets of duties. A true theocracy, rule by the gods with the priest chiefs as intermediaries, became the outcome of such a social arrangement, and the tribal policies came to be dictated almost as much by religious as by political considerations. The tribal history up to the time of the Conquest illustrates this point.

The Aztecs came into the Valley of Mexico as a weak tribe and were forced to settle on poor land in the lake. After winning a skirmish with a neighboring group they sacrificed some prisoners and from that date they began their rise to political domination. The association of human sacrifice with material well-being therefore became evident to them. As the Aztec population grew, they needed more land and more food stuffs, and they had to conquer to preserve themselves economically. At the same time to maintain their prosperity it was necessary to keep the favor of their gods, whose benevolence came to depend on lavish human sacrifice.

War became highly ceremonialized. Ambassadors visited a neighboring tribe and invited it to furnish the Aztecs with food, booty, and victims for sacrifice. If the tribal leaders refused, the Aztecs would ceremoniously declare war and, calling on their allies and towns already tributary, would march to the borders of the defiant people who would have marshalled their own forces. Troops were not readily mobil-

(Right) MONTEZUMA, upset by the magical premonitions of disaster and by the failure of his sorcerers, does not know whether to flee or hide in a cave

(Codex Florentino)



(Above) CORTES AND HIS ARMY, on passing the great volcanoes southeast of Mexico City, ask the way. Note the smoke issuing from the crater of Popocatepetl

(Codex Florentino)

(Right) CORTES MEETS HIGH DIGNITARIES from Tlaxcala, the pueblo most loyal to the Conquerors. Marina interprets while supplies of corn, tortillas, turkeys, etc., are accumulated

(Lienzo de Tlaxcala)

ized. Seasonal conditions and the state of the crops had to be taken into account, because at planting time no one would fight. Since all transport was human, it was impossible to carry out a protracted campaign. They probably could not stay more than a fortnight away from their base. Thus a war would depend on the outcome of a single battle, waged as close as possible to the town and permanent food supply of the ally nearest the enemy.

Having arrived at the battleground the Aztecs would try to defeat the enemy by frontal attack or by simple stratagem like feigned retreat. Success lay in putting the foe to rout and burning their temple. However, a basic idea in fighting was not to kill but to take prisoners. The gods preferred war captives, especially valorous ones, as sacrifice, and the individual could increase his social standing and rank through the number of captives he made. When the Great Temple in Tenochtitlan, the modern Mexico City, was dedicated, 20,000 victims were sacrificed. Many wars and levies must have been made to secure this bounty for the supernatural powers.

The Aztec theocracy did not lend itself to governing or incorporating these conquered peoples although in time a social mechanism might have developed. While the Aztecs received tribute from over a wide territory, there were constant revolts and betrayals. Probably this process was carried on by other tribal groups in Mexico, so that political organization for the region as a whole consisted of a seething mass of intrigue and war between a multitude of independent city states further diversified by differences in language dialect, physical type, and geographic economy. An invader, with a strongly disciplined force small enough to live off the country and thus to stay in the field, could have an astonishing success, particularly if he had a taste for intrigue. Cortes, as events proved, was the ideal man for such a purpose, and he was further favored by the psychological reaction of the Aztecs to his arrival.

(Left) THE SPANISH FORCES reach Tenochtitlan, the modern Mexico City, and Montezuma and his nobles come to greet Cortes

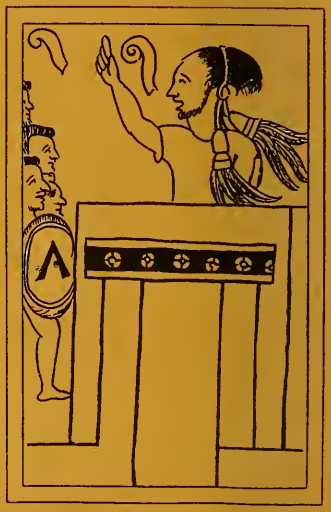
(Codex Florentino)

(Left) MARINA'S VALUE TO CORTES cannot be underestimated. Here she is ordering an Aztec to perform some duty. To judge from the speech scrolls, he complies with ill grace

(Codex Florentino)

(Right) A GREAT AID to the Spanish military success was the use of cavalry. Here we see mounted cross bowmen, whose weapons were no less deadly than the firearms of the day

(Codex Florentino)



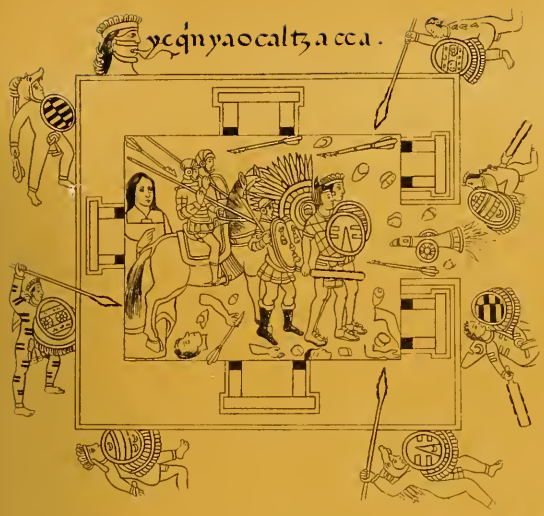
(Right) CORTES SEIZES MONTEZUMA as a hostage. The Aztec chief tries to calm his rebellious subjects who treat him with the contempt due a traitor

(Codex Florentino)

The years before Spanish conquest, had, to the Aztecs, been full of portents, suggestive of future evil. There seems to have been in the air that same sense of paralysis that we moderns knew to our cost in 1931 and 1932. Montezuma, the war chief of the Aztecs and an amateur of witchcraft, had had an experience calculated completely to shake his nerve. He and Nezualpilli, the chief of Texcoco, had fallen to arguing about the respective merits of their soothsayers since the latter had held that strangers were going to rule the land of Anahuac. So convinced was Nezualpilli of the correctness of his interpretation that he wagered his kingdom against three turkey cocks, the result to be decided by a ritualistic ball game with Montezuma. The latter won the first two games but Nezualpilli took the last three in a row. The defeat must have been disheartening to Montezuma not only because he had so much to fear from the future, but also because his own experts had been held so cheap.

In close succession followed a series of phenomena, each bearing its message of woe to come. A column of fire was seen at midnight for a year, two temples were destroyed, one by a sudden fire, the other by lightning unaccompanied by thunder. A comet was seen by day and sudden waves came up on the lake of Texcoco. A sixth sign was a woman's voice crying "My children, we are lost." Monsters appeared and were brought before the chief only to disappear as soon as he had seen them. Most sinister of all was a bird, brought in by some hunters. This creature had a mirror in its head, revealing the heavens, and when Montezuma peered at it a second time, a host of armed men was disclosed. When the chief brought his soothsayers to witness this augury and to explain its significance, the bird flew away. Distorted as these occurrences are, they must have had a most upsetting effect on the population of the Valley of Mexico.

The emotional condition was ripe



FOLLOWING A SERIES OF OUTRAGES committed by the invaders, the citizens rise in arms against the Spanish. At left the Spaniards and their Tlaxcalan allies are besieged in the palace of Axayacatl. In this scene a field piece is shown in action, while the horsemen are held in reserve for a sortie

(Lienzo de Tlaxcala)

(Right) HERE THE SPANISH are dislodging the Aztecs from a temple, where the Indians had gathered to enfilade them

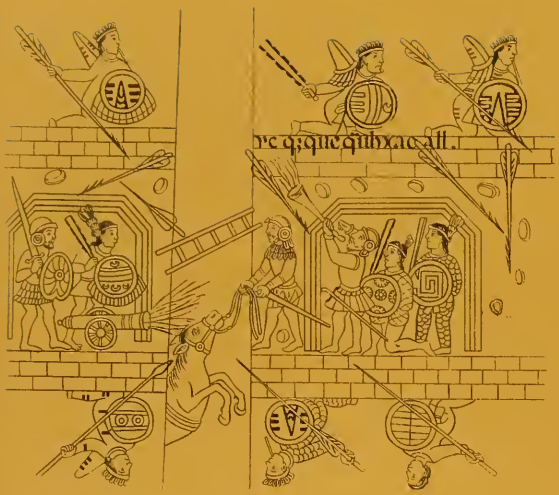
(Lienzo de Tlaxcala)

for the rumors drifting in from the southeast, which told of four-legged monsters with human bodies issuing from their backs. As these strange beings moved up the coast Montezuma's spies and ambassadors began to bring back more precise reports and even presents and messages for their chief.

The strangers were human for they were vulnerable, receiving wounds and dying from such assaults upon them. They had new and strange weapons, noisy and lethal, for cannon, muskets, crossbows and steel swords were unknown to the Aztec. Also novel and dreadful adjuncts of war were the horses and the savage mastiffs of the Spaniards. In battle, the strangers were invincible, operating in a manner completely foreign to Indian principles of war. The simple Indian tactics of mass attack were of little avail against the maneuvering of a well-drilled force, for the native tactics could only bring the merest fraction of their fighting force in direct contact with the enemy.

The Spaniards also resisted witchcraft on the occasion when Montezuma seriously applied it. However, sorcery, according to native standards, is at best a two-edged weapon so that it is doubtful that this failure had any other than a confirmatory bearing on the Indian attitude of mind toward the supernatural quality of the Spaniards. The problem that beset Montezuma was not that the invaders were in themselves gods, but that they were the symbols, the vicars on earth as it were of vast unearthly forces bent on establishing a new social order. As such the Spaniards would require the most gingerly handling.

While the Spaniards were approaching the capital, a political problem entered to complicate the spiritual. The city-states or pueblos between the Valley of Mexico and the coast were independent communities and even if tributary to the Valley powers, were often reluctantly so. Therefore many of these communities, like the Totonac, welcomed the invaders as the spearhead for an open revolt. Others like the completely independent and war-like Tlax-



(Left) WOODEN TANKS were built by Cortes to protect his men when Aztecs took up positions on the housetops out of reach of the sallies of Spanish cavalry. This spirited picture reveals the tanks separated by a canal into which a horse had fallen. The Aztecs on the roofs impede its rescue

(Lienzo de Tlaxcala)

(Below) SUPPLIES RUN LOW and Cortes secretly tries to reach the mainland along a causeway. His retreat is discovered and the Aztecs, massing their forces in canoes, wreak havoc on the Spanish forces. Tearing up the bridges, the Aztecs further hindered the retreat and all but destroyed the invading army

(Lienzo de Tlaxcala)

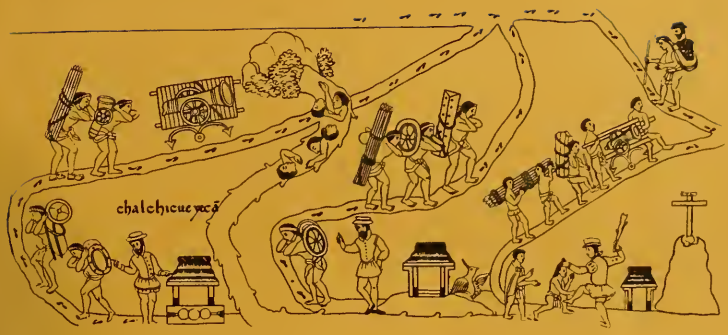
(Left) A HANDFUL OF THE SPANIARDS reach the mainland. The Aztecs, instead of following up their advantages, plunder the bodies of the killed and drowned. Be it remembered, however, the Spanish carried off the entire Aztec treasure

(Codex Florentino)

calans put the power of Cortes to a practical test in open battle and when the Spaniards won, became the most loyal of Cortes' supporters. Cholula, a large town loosely allied to the Aztecs, met the Spaniards as friends, plotting to overcome them by treachery, a good Indian political maneuvre instigated perhaps by Montezuma. The Spaniards, suspecting such a move, counteracted its efficacy by a judiciously executed massacre, and if not gaining a friendly community, at least created a non-combatant one.

Montezuma and his more cautious counsellors watched this slow ascent from the coast, with apprehensive interest. He has been condemned by many commentators as weak and has been made the scapegoat of this great débacle of Indian civilization. Yet consider his position. While the leading man in his community, he was not an authoritarian monarch. For mass action he had to rely on the group action of the clans comprising his tribe, as well as on the very doubtful allegiances of the vassal states whose immediate need would transcend any sacrifice of a far-reaching political nature. Thus not only would the harvest season but also fear of damage to the communal property make communities loth for war. Montezuma had no method of enforcing a long range diplomatic policy such as is so characteristic of European and Oriental political history. Nor must the extraordinary gifts of Cortes and his Indian mistress Marina, be underrated. The pair played on Indian psychology as master pianists would execute a duet on the piano.

Thus Montezuma received Cortes and the Spanish without having struck a positive blow. Then ensued a new chapter in the story. Cortes promptly seized Montezuma as a hostage and the latter's power to influence his tribesmen disintegrated. A mass revulsion against the invaders slowly began to crystallize, but it was confined to the city itself, without extending to the neighboring towns. People confined themselves to their houses, the market closed, but no overt act was made. Cortes was allowed to leave for the coast to subjugate his new commander,



(Left) DUE TO THE HESITANCY OF THE AZTECS, Cortes was able to reach Tlaxcala and refit his army. Here we see military supplies being brought from the coast. In the left center a minor disaster, involving the drowning of several Indian allies, is depicted. At the lower right is evidence that this aid was not always willingly given by the natives

(Lienzo de Tlaxcala)

(Right) CORTES' PLAN TO RETAKE TENOCHTITLAN involved isolating the island city from the mainland. Tenochtitlan is shown in the center of the picture, surrounded by the lake on which float the war canoes of its defenders. The Spanish forces devote themselves to reducing the mainland towns

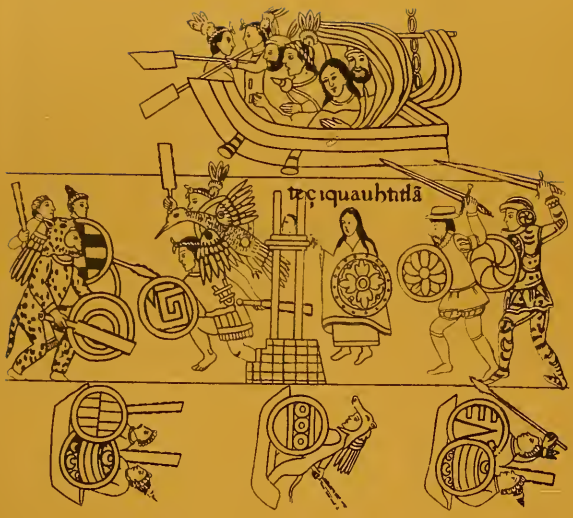
(Lienzo de Tlaxcala)

Narvaez, without open hostilities on the part of the Aztecs.

The storm broke during Cortes' absence. The inhabitants of Tenochtitlan had assembled to celebrate the feast of the god Huitzilopochtli. Alvarado, a tough soldier, lacking all Cortes' gifts at intrigue, scented trouble in this gathering, the innocence of which there is no way of knowing. Following the Spanish technique at Cholula he fell upon the celebrants and killed them all. The city rose like one man and drove the garrison to cover. Actuated by the single motive of revenge against the invaders, the Aztecs were in train to destroy the Spanish garrison. However, the structural weakness of the Indian government became bitterly evident, when the chiefs permitted Cortes and his reinforcements from the army of Narvaez to join the beleaguered troops of Alvarado. The ceremonial aspect of war in Indian Mexico did not permit the splitting of an adversary's army and the separate destruction of its weakened parts a rudimentary law of European military tactics.

Yet once the Spaniards were united in the city, they created an emotional rather than a military problem. The Aztecs having immobilized their enemies, visited their rage and hate in a manner unparalleled in the annals of Indian campaigns. The Spaniards could not maneuvre in the narrow footpaths along the canals and the portable fortresses they constructed of wood, the first tanks used in the New World, were useless against enemies on housetops and in canoes. The Spaniards lost heavily and the unfortunate Montezuma met his death either at the hand of his own people whom he was trying to calm, or, as two authorities would have it, at those of the Spaniards. After a week Cortes decided to withdraw from Tenochtitlan. Just before dawn his forces made their way through the hushed streets out along the causeway to Tacuba.

A woman, getting water from a canal, saw them and raised the alarm. The whole male population surged forth, along the roofs and through the streets. Many seized canoes and attacked the flanks of the marching col-



CORTES BUILT BRIGANTINES to defend his flanks while moving along the causeways into Tenochtitlan. In this picture a brigantine comes to the aid of Cortes and his allies, who are beset by Aztecs afoot and in canoes

(Lienzo de Tlaxcala)

(Right) THE SPANISH FLOTILLA PUTS TO SEA. These galleys, equipped with oars and a sail and armed with a cannon in the bow, could play havoc with the Aztec war canoes

(Codex Florentino)

umn. Three quarters of the Spanish forces were lost in this rout and in the preceding siege.

The Spaniards found a temporary sanctuary on the mainland. Their adversaries instead of following up their advantage, plundered the dead and tried to recover the booty stolen by the Spaniards from the Aztec treasury. However, the Indians made some effort toward concerted military action. The Texcocans, principal allies of the Aztecs, gathered their forces together and tried to intercept the Spaniards, as they made their way cross-country to the homeland of their allies, the Tlaxcalans. At Otumba battle was joined. The cumbrous Indian battle formation could not overcome the mobility and tactical sense of the Spaniards. Wounded as every man was and exhausted from lack of food and sleep, they kept their discipline and a desperate charge by the cavalry reached the chiefs, who fell before the Spanish swords. Once their leaders were slain, the scant Indian discipline dissolved and the tribesmen took to flight. The Spanish made their way to Tlaxcala to recuperate and to await reinforcements.

Montezuma was succeeded by Cuitlahuac, and Cuitlahuac, dying of the fever after four months, was replaced as war chief by the heroic Cuauhtemoc. This strong and courageous leader was unable to overcome the mutual distrust of the Indian communities for each other. When the Aztecs might have joined together with other tribes to overwhelm the Spaniards by sheer weight of numbers, they did nothing.

In the meantime Cortes, having rested his army, began to consolidate his position. He made two series of campaigns, one eastward to the sea and the other in a south and westerly direction in the present state of Morelos. Utilizing Indian allies both as carriers and as a screen to conceal his more serious tactical movements, he subjugated town after town. In each case, the Indian war convention of a single decisive mêlée proved worthless against the versatility of the Spanish attack.

(Left) TIME AND AGAIN THE BRIGANTINES relieved situations like this where armed tribesmen in canoes sailed up to attack the Spanish rear

(Codex Florentino)

THE SPANISH MILITARY PROBLEM was to raze enough of the city to permit the use of cavalry. The drawing at the right shows the gunboats taking part in an offensive with this end in view

(Codex Florentino)

Cortes soon pacified the eastern country sufficiently to try to regain Tenochtitlan.

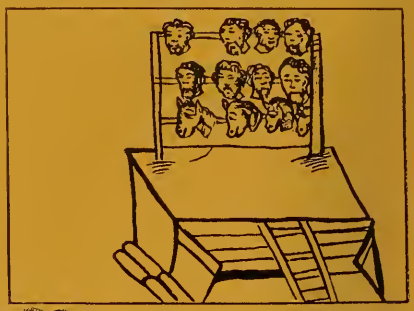
Typical Indian perfidy from our point of view of today, but common sense to the people of that era, virtually accomplished the downfall of Mexico. The Texcocans, closest allies of the Aztecs, and for that reason perhaps the most jealous of their success, resented the part Montezuma had taken in forcing an election of a war chief. When the Aztecs had had a strong chance of maintaining their supremacy after Cortes' retreat from Mexico, they valiantly took the field at Otumba. Now they switched to the Spanish side, seeing a chance of assuming a dominant position in Valley of Mexico affairs. Their defection gave the Spanish a base on the lake of Mexico, and a means of mopping up whatever tribes remained unsubjugated in the previous campaign.

Having quieted the country-side, Cortes put into effect his plan of siege. He launched a fleet of small galleys armed with cannon, which had been constructed in Tlaxcala and brought piecemeal across the mountains to be assembled on the lake. These ships were to sweep the lake clear of canoes and protect the Spanish flanks as they moved in across the three causeways to the island city, Tenochtitlan. His force Cortes divided in three parts to move along these approaches and close in on the capital.

The galleys soon cleared the lake of any hostile fleets of canoes and the Spaniards began to invest the city. The Aztecs, fighting for their lives, stubbornly defended their position. They would sally out at night and destroy the bridges the Spaniards had made across the canals during the day. In fighting of this kind, the Spaniards could not manipulate their troops and neither side had any great advantage. The Aztecs, however, still persisted in trying to take prisoners to sacrifice to their war god instead of exterminating their enemies whenever the occasion offered. To offset this gain the thou-

(Left) PESTILENCE was a formidable ally on the Spanish side. Colds, smallpox, measles, and the like were unknown to the Indians who, lacking any sort of immunity, died by the thousands

(Codex Florentino)



A FACTOR IN THE DOWNFALL of the Aztecs was their custom of taking captives for sacrifice rather than to kill in direct battle. The heads of the sacrificed victims, both men and horses, were displayed in front of the temples, as shown at right

(Codex Florentino)

(Left) CUAUHTEMOC, who conducted the defense of Tenochtitlan, is received with all the honors of war by Cortes and his consort, Marina. In the upper right Cortes may be seen greeting Cuauhtemoc's wife and family. The legend translated reads: "With this event, the Mexicans were finished"

(Lienzo de Tlaxcala)

sands of Indian allies, who flocked to the Spanish side to participate in the expected victory, jammed the causeways and hampered rather than helped the besiegers.

Cortes decided to change his manner of campaign and his solution, while reasonable to us must have been little short of miraculous to the tribesmen. He sent the Indian allies forward to tear down all the houses they could find and fill the canals with the debris. When counterattacked, the allies would retire and leave room for the Spaniards on horse and afoot to deal with the Aztecs. Each day the Spanish forces gained more room to maneuvre and thus could count on recovering more ground on the morrow. The Aztecs, animated by a common feeling, fought desperately but without avail.

Toward the end of the siege an event occurred that indicated to the now desperate Aztecs hope of eventual release in a common rising against the invader. The people from the islands at the south of the lake, the Xochimilcas and their neighbor tribesmen, filtered through the Spanish galleys by night and told the Aztecs that, as neighbors, they should make common cause against the whites. Overjoyed Cuauhtemoc and his chiefs loaded them with ornaments, fine mantles, and cacao beans (precious for the favorite drink of the Aztecs, chocolate). When night closed in again on the beleaguered city, the Aztecs were startled by a great commotion. The new allies were trying to drag off the Aztec women and children as slaves. It is grateful to record that this knavery received its just reward and the Xochimilcas all were either slaughtered or disposed of in sacrifice.

When they could resist no longer, could no longer deal wounding blows, the garrison gave up. Cuauhtemoc took to the lake in a canoe as did many others, including his family. He was picked up by one of the Spanish galleys and brought before Cortes. His dignity and chiefly demeanor received the respectful attention of Cortes and his general staff. Their request for treasure brought the answer that there was

(Above) THE STORY OF THE CONQUEST OF MEXICO IN NATIVE CHARACTERS. In the cartouches are to be seen the symbols One Reed and Two Knife, the Aztec names for the years 1519 and 1520. Under One Reed is a Spaniard from whose horse's foot depends the shield, club, and arrows symbolic of war. At the right the bearded Cortes sits in the temple of Tenochtitlan, represented by the cactus. An Indian with the glyph of Montezuma offers a tribute of gold beads. Under Two Knife we find the battle for the great temple and a comet in the sky

(Codex Vaticanus A)

none. It was buried with the Spaniards who fell in their disastrous escape from the city the preceding winter. Cuauhtemoc underwent prison and torture, to be murdered years later on Cortes' march to Honduras. He is now revered in Mexico as a national hero.

The downfall of the Aztecs cannot be explained in terms of European history and the standard reasons give a false picture. Montezuma, singled out by European authors as a weak and vacillating monarch, was a tribal leader devoid of the constitutional rights of a European sovereign. His empire again is a European creation, since it consisted in reality of communities sufficiently intimidated to pay tribute but in no wise bound to Aztec governmental conventions. Warriors the Aztecs were, but not military men in the European sense. Given, as we have said, the requisite leadership and organization, any European expeditionary force could have taken Mexico. The tragically courageous resistance at Tenochtitlan was not a military defense so much as a heroic group action by individuals fighting for their lives.

Hunger and thirst had literally so weakened the Aztecs that they could not resist. The horrors of that last point held by these desperate people are too awful to describe. All through the Colonial era and even to this day the northern district of Mexico has found favor neither as a residential quarter nor as a business center. Today there are railroad yards and slums where the Aztec civilization bled to death. The ghosts of the heroic defenders still haunt that place.

[Note—The Codex Florentino, from which most of the illustrations accompanying this article were taken, was drawn by native draughtsmen some years after the Conquest and was intended to illustrate the monk Bernadino Sahagun's great work, *General History of the Things of New Spain*, completed in 1560. The text and the illustrations were separated, the latter being conserved in the Laurentian Library in Florence. Two copies of the text existed, one in Mexico and one in Spain, and were published in the early part of the nineteenth century. It was not until nearly eighty years afterward that the Mexican Government reproduced this codex under the editorship of del Paso y Troncoso, and it is from this edition that we have reproduced our illustrations.

The Lienzo de Tlaxcala was painted between 1550 and 1564 to commemorate the exploits of the Tlaxcalans, who performed such notable services for Spain in the Conquest of Mexico. It was published in Mexico by the Junta Colombina in 1892 as a memorial of the fourth centenary of the discovery of America, and the illustrations reproduced here are derived from this edition.

The Codex Vaticanus A seems to be an inferior copy of a mutilated document, the Codex Telleriano-Remensis. It was published in 1900 at the expense of the Duke de Loubat, a former patron of the American Museum.]

INSECT LORE OF THE AZTECS—*Revealing early acquaintanceship with many of our agricultural pests and therapeutic measures against so currently prominent a creature as the black widow spider*

By C. H. CURRAN

Associate Curator of Diptera, American Museum

TODAY most of us are inclined to suppose that the study of insects concerns only a relatively few specialists who have appeared on the scenes only in fairly recent times. We take the accumulated learnings of centuries as a matter of course, and fail to realize that in spite of all the progress of science, the average Aztec of four centuries ago probably knew more about insects than the average city-dweller today. The aborigines of Mexico were acquainted with many of the pests that were later to plague the white man and his crops. They knew the corn ear worm, the stinging ants, the black widow spider, and a host of other creatures. For most of those that were poisonous they had remedies, and many of the others they used as food.

From an ancient manuscript

Proof of the Aztecs' lively interest in natural history is handed down to us chiefly by the Spanish writer Sahagun, whose great work, "General History of the Things of New Spain," was completed in 1560 and published some time later. His diligent pursuit of information on the subject is evidence that a definite interest in insects and their ways existed before the present era of systematic science.

The black widow spider of the Aztecs was the same as that which has attracted so much attention in the United States during the past few years. The Aztecs did not look upon it as deadly, but they did consider it poisonous. Sahagun wrote of this spider: "There are some poisonous spiders in this country, they are black and have a reddish tail. The stings cause great fatigue for three or four days, although they do not kill with their sting."

This is as true today as it was at the time of the Spanish Conquest. The bite may prove to be of little or no consequence, it may result in serious illness for a few days, or it may prove fatal if inflicted on a sensitive part of the body. Several factors enter into the virulence of the bite, namely, (1) its location; (2) the condition of the spider at the time of the bite; (3) the amount of venom injected, and (4) the health of the individual. The black widow spider may puncture the skin without injecting poison, or it may be in a weakened condition, so that little poison is injected. For a human being to suffer serious effects, therefore, the bite must almost necessarily be on a sensitive part of the body, close to vulnerable nerve centers and an abundant supply of blood. A bite on the hand may be no worse than the sting of a bee.

The Aztec treatment for the bite of the black widow, according to Sahagun, consisted of the application of a compress soaked in an alkaline solution and the drinking of about eight drops of alkaline solution in a container of water. It is to be noted that at the present time the bites and stings of insects are treated by keeping them moist with an alkaline solution, such as baking soda. Aside from complete rest, which the Aztecs seem to have recognized as beneficial in the case of black widow spider bite, the treatment recommended today provides the intravenous injection (in solution) of the drug known as Epsom salts.

Virtues of the black widow

To the natives the black widow had certain virtues. The oil from it in a solution they called *vitztli* was regarded as "very good medicine for many sicknesses" and was used "as a medicine to stop pain."

The daddy-long-legs or harvest spiders were not well liked by the Aztecs, nor by the Spaniards, who called them "martinets," the same term applied to them in Spain. The Indian name for them, meaning "feet of hairs" describes them most aptly. They were said to smell badly, but we have not noted this characteristic among any of the species we have handled in the temperate zone. This unpleasant odor may be characteristic of some tropical species.

It is unlikely that the Aztecs were sufficiently interested in Nature as such to connect the various stages of an insect's life, although they were not entirely ignorant of some connection between butterflies and caterpillars. It is not surprising that millipedes and centipedes were classed as insects although we now know that they are merely close relatives; but it comes as a surprise to learn that even small lizards were grouped with them. A glance at the history of natural science, however, shows that the Aztecs were no more mistaken than the civilized people of their time, for as late as 1714, Lawson in his "History of Carolina" lists under insects the animals we now classify as reptiles, and under reptiles those creatures we now call insects. Traces of this archaic classification survive today and the writer has frequently heard insects referred to as "reptiles" in both Ireland and Canada.

The large millipedes were known to be harmless in themselves, but they were said to be poisonous when eaten. They were used for the curing of toothaches. When disturbed the millipede coils up and may remain so for a considerable length of time. In this position they were held against the cheek and it was said the pain left the tooth. In the absence of any known therapeutic value which may be inherent in the secretions exuded by millipedes, it is possible that the practice may have arisen because these creatures feel cold when held against the skin, though they would scarcely take the place of an ice-pack.

The centipedes (*tlalziquiṗilli*), some of which are more than six inches in length, were considered poisonous. It is recorded that their bite resulted in death. The treatment was the same as for the black widow spider.

Ants as enemies

The Aztecs recognized many kinds of ants, classifying them chiefly according to their habits and the intensity of their bite or sting. The stinging ants were considered more poisonous than the biting ones, and were known as solitary ants, a name that is applied to them today although they are really social. These ants are often common on foliage in the American tropics, and a sting from one of them may be quite painful. The solitary or stinging ants are not vicious, like some of the biting ants that live in dead twigs and branches of trees and bushes, and in the acacia plants. These creatures swarm over the unfortunate individual who innocently brushes against their domiciles, and bite with extreme vigor. The Aztecs looked upon them as poisonous, but the writer has never suffered any ill effects other than loss of dignity as a result of his frantic efforts to get free of them.

"There are other ants that grow in warm countries and destroy the trees and whatever there is, they walk in flocks like people at war, they are great destroyers. The naturalists call them 'soldier ants.' " The army ants do occur only in the warm portions of what was the Aztec Empire, being absent from the uplands; but there is an obvious error, because they do not destroy the trees. They are, however, insect terrors of the tropics, and all animal life flees before their advance. Woe betide any insect or helpless small animal that fails to get out of their way. The Indians were well acquainted with their habits and even knew that they did not build nests.

Wild honey

Since the Indians ate honey whenever they could obtain it, it is natural that they should have been well acquainted with honey-making insects. *Nequazcatl* means "honey ant." These ants are well described but they are not pictured in the Codex Florentina. The honey was greatly relished by the Indians, the ants being eaten along with it. In the following quotation, however, there is a mistaken inference: "There are some drone bees in this country that make honey, and construct nests in the earth where they make it. . . . They sting like bees, pityful, and the sting swells." We know that drone bees do not make honey and they cannot possibly sting, because the sting is a modified ovipositor and is possessed only by the females or workers. The statement can refer only to the bumblebees even though they are not common in the Aztec country. The honey of these bees was looked upon with as great favor as that of the stingless bees and the honey-making wasps. The honey of the latter is described as very yellow and very good to eat.

Stingless bees occur in great numbers in the tropics and there are many kinds in America. Some of them build large nests and make a large amount of honey, while in other species the nests are small and the honey present at any time so little in quantity as to be negligible. The consistency and flavor of the honey varies greatly with the season and probably with the species of bee. Most of us would not care for this "wild" honey, particularly when, as was often done, it was served with the larvae of the bees mixed with it. To the Indians this made no difference, since many insects and insect larvae formed part of their diet.

The butterflies and moths were admired for their beauty, but since they did not enter into the economy of the Aztec life they received little attention. The butterflies were associated in a general way with the

caterpillars, but the latter were classed by the Spanish recorder of this knowledge among the "Aphis" or, as we term them today, the plant lice. This was a utilitarian classification: the caterpillars injured plants and it was only natural to classify all insects that injured plants as plant lice.

Of some caterpillars, it was said: "the hairs sting and the sting hurts like that of a scorpion; these also become butterflies." To the entomologist this statement is of particular interest. He at once thinks of the larvae of the *io* moths of which there are many kinds in the Americas. If one inadvertently brushes against the caterpillars of these moths there is an almost instantaneous reaction. It is as though the skin had been pierced by many needle-points; severe itching may continue for several hours and there may be considerable inflamation. The poisonous spines are able to pierce woolen stockings but in such a case the results are far less irritating than when the bare skin comes into contact with the caterpillar.

Measuring worms

It is interesting to learn that the Aztecs had a word for "measuring worms," *tetatamachluhqui,* which has literally the same meaning as our own designation. The geometrid larvae, span worms, measuring worms or loopers have been variously named because of their peculiar method of locomotion by successively arching the body, which is occasioned by the lack of "legs" on the middle section of the abdomen. In some places they are called "inch worms" on the supposition that they measure approximately an inch with each "span," but the distance varies of course with the size of the caterpillar. The Aztecs regarded the "measuring worms" as harmless; but a number of the serious pests of our forests and cultivated trees are of this description.

At least two kinds of larvae living in the century plant were recognized. One boring in the stems was considered very good to eat. The other, occurring in the roots, was red in color, was considered inedible and was said to be harmless. The larvae of a sphinx, or hawk, moth were supposed to have a horn on the head, although it was actually, broadly speaking, on the tail. They were said to be easily frightened. This is explained by the habit of the larva of raising its head and sometimes its tail when disturbed.

The name which the Aztecs applied to people who were clumsy or did things the wrong way, *mextecuili,* was applied also to "white grubs," the larvae of June beetles, because when dug up from the ground they lie on their backs (or side) and are relatively helpless. They were found about the roots of corn. It was believed that they ate the roots during dry weather. Actually they feed upon roots of plants, and particularly of grasses, at all times.

A question of taste

The Aztecs did not object to the presence of caterpillars in their corn. The corn ear worm or tomato worm, a common creature today, was well known. It ate the corn on the cob and the Indians ate both the corn and larva with relish.

Like other peoples possessing an abundance of wood, the Aztecs did not consider the ravages of wood-boring beetles of great importance, but they recognized at least two kinds, in addition to termites. These latter were called *carcoma* in the records and were described as having a very strong beak with which they drilled into the wood. The beak identifies them presumably as the soldiers of *Nasutitermes,* in spite of the fact that in the latter the beak has nothing to do with their wood-boring habits and the Aztecs seem not to have observed the habit of these creatures of spraying a substance that is injurious to their enemies.

The fire-flies, although they are actually beetles, were grouped with the flies. The most prominent member of this group was what our Spanish observer refers to as the "Cucullo," an elaterid or click beetle over half an inch long, that is adorned with a pair of luminous spots on the upper side of the thorax. Those who have visited Cuba and other tropical countries may have seen these insects used as ornaments. Sahagun remarks that the women tied them on their combs, arranged them like laurels on their heads, and strung them around their waists on a thread. The dancers usually put them on their shoes; and in the theater in Mexico City an admission fee of twenty *reales* was charged for the privilege of seeing them displayed. In Vera Cruz they were put in small cages, and were fed on sugar and bathed. They were said to last from March to June.

The true fire-flies were called *icpetl.* One species was said to have a light like a candle on its tail and at times to light up more brightly than a candle on very dark nights, but in this statement we may suppose that the historian yielded to an opportunity to make his report startling. Simple-minded people, according to Sahagun, believed that these insects were witches or wizards that went around at night-time and threw out fire from the head or mouth. It was believed that the flashing of some of the fire-flies was due to the uncovering of the light, which was normally concealed by the wings; but actually the

light organ of the true fire-flies is on the under surface of the abdomen, usually at or near the apex, and is not covered by the wings.

The horse-flies had more than one name, indicating that more than one species was recognized. They were known to attack domestic animals, in addition to man, and were serious pests, as they are today.

Mistaken identity

The so-called horse-fly known as *tzoraatzalton* was not a fly at all but one of the hymenoptera. It was so called because it was believed that it went along the trails uncovering the worms that lived beneath the surface. It is one of the wasps that provisions its nest with caterpillars as food for its young. Instead of digging them up it was actually burying them in order that it might lay eggs upon them. After completing a burrow and preparing a brood chamber these wasps plug the entrance and go in search of caterpillars. When one of them returns with a larva which it has paralyzed by stinging, it leaves it at one side while it opens the entrance. The wasp then drags the larva inside and to the brood chamber. Although we are well acquainted with the habits of these wasps today, it is easy to understand how the Indians misinterpreted the evidence.

The small "mosquitoes" called "Chilton" by the early Spanish commentator, which attacked the eyes, were probably several species of small flies, as well as some of the very small stingless bees, although the majority were evidently black flies. Some of these have the habit of biting near the eyes and at the corners of the mouth. It was said that "their bites sting like chile, and if they get into the eyes it hurts terribly." There is no doubt that some of the flies that got into the eyes were small fruit flies belonging to *Drosophila* and related genera, and Chloropids. These insects commonly hover before the face, evidently attracted by the moisture, and they cause excruciating pain when they do get into the eyes.

Insects as food

The grasshoppers are notable because all were considered edible. They undoubtedly formed an important part of the diet during seasons when they were abundant. If the Aztecs followed the practice of other Indians they removed the legs and wings, and perhaps the head, dried them and later stewed them. They were considered quite tasty, although not as desirable as some of the caterpillars.

One of the grasshoppers was called *acahapali* because it was like an arrow or dart and made a distinctive noise while it flew. The large, flightless grasshoppers, small "blind" locusts and some of the long-horned relatives of the katydids, were well known, but we have no records of distinctive names for them. It is likely, however, that they had names since they were of importance as food.

The Aztecs undoubtedly knew much more about the insects than we have been able to discover in the printed records. Some of them were used as motifs on their pottery and had a place in their calendar, indicating that they were of more than passing importance. It is difficult because of the generalized nature of the drawings to identify many of the insects in other than large groupings. It is possible that further intensive study of the insects occurring in the old Aztec kingdom may enable us to interpret more fully the records and native drawings handed down through the centuries. Without these records punctiliously preserved by the monk Sahagun and a few others, all this primitive lore would have perished.

Forthcoming Articles

ALBERT PAYSON TERHUNE, in **"Why Not Give Your Dog a Chance?"**, will explain some of the peculiar workings of dog psychology which prevent the average dog owner from realizing the mental capacities of his pet.

The fighting and mating habits of the **Siamese Fighting Fish** and their use in sporting contests in Siam will be described by HUGH M. SMITH, who is already familiar to readers of NATURAL HISTORY through his writings on the Walking Fish and the Archer Fish.

In **"How the Moon Got Its Craters,"** WILLY LEY will portray some interesting laboratory experiments which duplicate the well-known scars on the face of the moon and shed light on their origin.

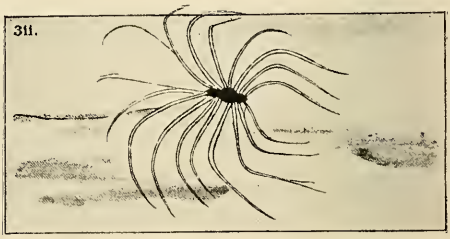
CAPTAIN BOB BARTLETT will tell the story of one of the most gripping and inexplicable adventures that ever happened in his 38 years of Arctic expeditions.

By ROBERT CUSHMAN MURPHY, **Ahunting We Will Go:** a colorful narrative of a day with the Bucks Otter Hounds.

The Insect Lore

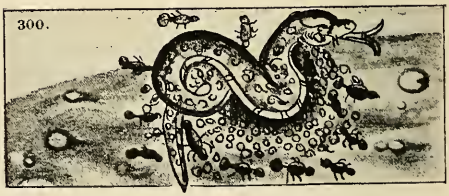
A series of early native drawings, taken from the work of the Spanish monk Sahagun, completed in 1560.

(Left) An Aztec has been stung by a scorpion and is being cared for by his companion. The wound will be kept moist by alkaline compresses; the patient will rest and will be given a drink of an alkaline solution



(Right) The Aztec name for this relative of the spiders means "feet of hairs." Although the daddy-long-legs or harvest spiders are harmless, they were disliked by the Indians

(Left) A conventional design of one of the beautiful swallow-tail butterflies. A number of closely related forms occur in the region covered by the Aztec kingdom, so it is not possible to identify the species figured

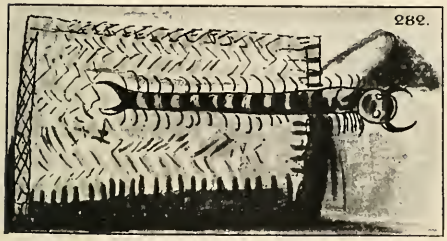


(Right) A blind snake in an ant's nest. The scales form an armor that protects the snake from attack, the head is not clearly differentiated (externally) and the eyes have practically disappeared

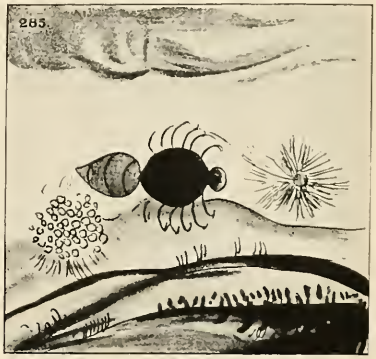
(Left) The treatment of the bite of the black widow spider was the same as for scorpion sting. One of the Indians is shown drinking the alkaline solution

of the Aztecs

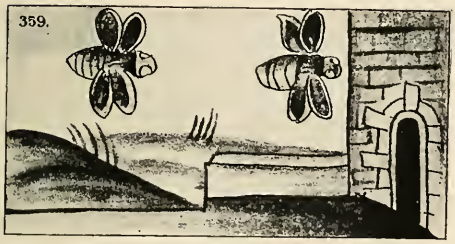
(Right) Some of the mosquitoes are represented as having four or five wings, and their beaks are variously shaped. All mosquitoes have only two wings and the proboscis of the biting kinds is of uniform shape



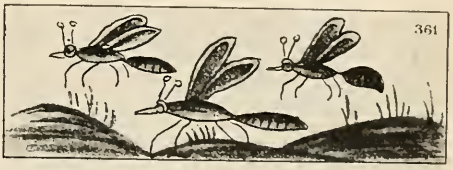
(Left) The Centipedes are distant relatives of insects and some of the Mexican ones grow to a length of five or six inches. Although all are slightly venomous, none are seriously so. The Aztecs considered them poisonous

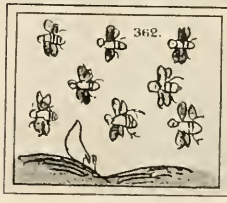


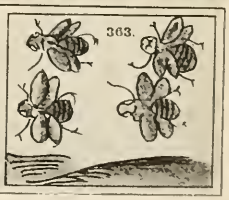
(Right) The black widow spider is described as having a red tail. In some of the Mexican specimens there is much more red on the abdomen than occurs in examples from this country. It was not considered deadly



(Left) The honey of the bumble bees was relished by the Aztecs. They make their nests in the ground and construct "honey pots" in which to store nectar



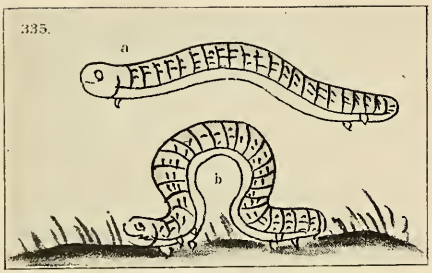




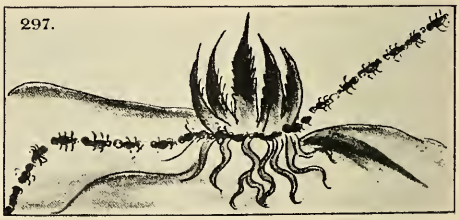
(Right) The upper panel represents wasps that built their nests in the ground along paths, provisioning them with caterpillars. Probably because they were considered to be flies, they are represented as having only two wings. Two kinds of bees are shown in the lower panel

(Left) An ant is shown above the Indian's bare leg to illustrate the reason for his concern. This fairly large reddish ant was said to bite viciously. It is one of those that nest in the ground

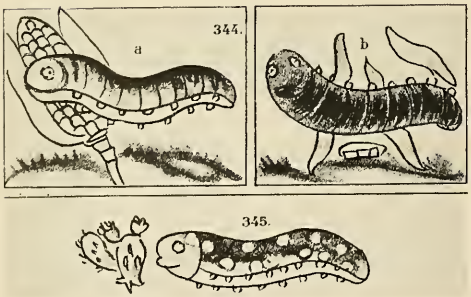
(Right) Wasps visiting flowers. It is not clear whether these are honey-making wasps or the type that search for caterpillars with which to provision their nests



(Left) The measuring worms possibly attracted attention because of their strange habit of locomotion, but they also provided food. The drawing is much more accurate than most

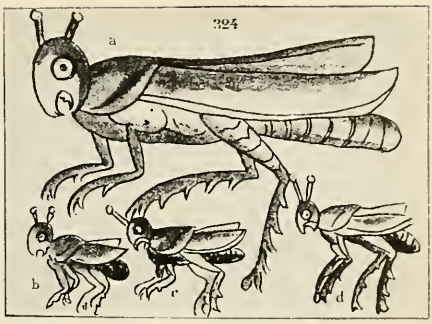


(Right) The Aztecs apparently were well acquainted with the habits of the army ants and knew that they built no nests. At night they form a curtain on trees or bushes by clinging to each other, with the queen protected in the middle



(Left) The corn ear worm attacks both corn and tomatoes and does enormous damage. The Indians did not object to its presence in corn, but relished it as an added tid-bit. The lower caterpillar was also eaten

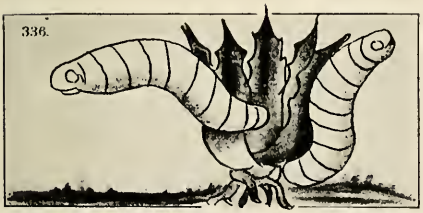
(Right) Grasshoppers of all kinds were eaten by the Aztecs, but the large ones were naturally the most sought after. The artist shows here various stages in the development of these insects. All illustrations omit one pair of legs



(Left) The dung beetles are interesting because of their habit of provisioning their burrows with balls of dung, upon each of which an egg is laid. In this species the male assists his mate

(Right) Fireflies associated with a decaying stump. The Aztecs supposed that the light became visible only when the insect uncovered it by raising its wings, but the light organ is never covered. They recognized several kinds

(Below) Caterpillars attacking the century plant. They were borers within the plant and were considered to be very good to eat. Another kind occurring in the root was not looked upon as edible, but was stated to be harmless



(Below) A large centipede coiled in the characteristic posture these creatures assume when disturbed. They are cold and clammy to the touch and were used for curing toothaches—by holding them against the cheek

FUERTES AND AUDUBON—*A comparison of the work and personalities of two of the world's greatest bird artists*

By FRANK M. CHAPMAN
Curator of Birds, American Museum of Natural History

FUERTES

At the annual meeting of the American Ornithologists' Union held in November, 1896, at Cambridge, Massachusetts, Dr. Elliott Coues, foremost American ornithologist, introduced Louis Agassiz Fuertes, a young painter of birds, on whom he said the mantle of Audubon had fallen. A number of Fuertes' works were exhibited and caused much discussion, not only of Fuertes' drawings but of those of his predecessor. On one occasion, in William Brewster's museum, calling Doctor Coues' attention to the published drawing of a small bird by Audubon, I said: "Doctor Coues, if this drawing were brought you today for publication, would you accept it?" His reply, "Audubon was Audubon and the account is closed," expresses the attitude which the world at large still holds in regard to the paintings of birds by John James Audubon.

Recently, this view has been emphasized by biographers of Audubon and reviewers of their works, whose eulogies prompt the query whether the "account" *is* still "closed" or whether the young Cornell student did not accept the cloak Coues so gracefully placed on his shoulders as something more than a rhetorical gesture. If, therefore, I "open the account," it is not to question the magnitude of Audubon's achievements. Beyond question he was the greatest painter of birds the world had known, but is that a reason why his fame should obscure that of those who followed him and who, through their greater gifts and because of the inspiration derived from his works, have surpassed him in his chosen field? To believe that Audubon still holds the exalted position of the world's leading painter of birds is to admit that there has been no advance in the art of bird portraiture in the past one hundred years. It would be equally untruthful to say that we know no more about the habits of birds at present than we did in Audubon's day.

(Left) PIGMY KINGFISHER, *by Louis Agassiz Fuertes: a striking figure of a bird in which the subject, although at rest, is so endowed with life that one feels it would take wing if he advanced a step nearer. This effect of animation is obviously not secured by motion but by convincing accuracy of line and pose, by a faithful rendering of facial expression, and by the reproduction of an intangible personality possible only to one who reacts sensitively to a bird's appearance, character, and individuality*
(Reproduced by permission of Field Museum)

A growing art

Audubon was both informed and inspired by the work of his predecessor, Alexander Wilson. But advance in the art of portraying birds did not stop with Wilson's death any more than it did with Audubon's death; any more than it will with the death of those bird artists now living. There have been at least half a dozen men in America since Audubon's day whose work is comparable with his. The future will accord each the place due him. But I am confident that together they would acknowledge Fuertes as their leader. His career was among the first to open as it was the first to close. At the time of his death, in 1927, he had been practicing his art professionally for thirty years. But his last field-studies, made in 1926 while a member of the Field Museum expedition to Ethiopia, are admittedly his best and mark a stage in his development which promised even greater things to come.

But if we mourn for the work that Fuertes was not spared to accomplish, we may rejoice in the heritage that he has left us. Thanks to Elliott Coues, his mentor in science, and to Abbott H. Thayer, his instructor in art, his talents were early recognized and from the date of his graduation at Cornell, in 1897, to the day of his tragic death his brushes were rarely dry.

It is true that they were chiefly occupied with the tasks of an illustrator not designed to give full scope to his art. But in spite of the handicap of limited

FACIAL EXPRESSION OF A RAVEN: a living portrait drawn by Fuertes from a dead bird. Long Inlet, Alaska, 1899

(From the original in the American Museum of Natural History)

space, which so often forced crowding and undesirable associations these illustrations are his answer to the demands of the occasion and, in connection with the comparatively rare opportunities which imposed no limitations on his powers, they are representative of his art, as far as it had developed. With the completion of the illustrations for Forbush's "Birds of Massachusetts," the task on which he was engaged when, in 1926, he went with Osgood to Ethiopia, Fuertes planned to accept no more commissions of this kind. Their requirements brought definite restrictions which forbade him from working on the higher plane he felt that he could reach. And there is every reason to believe that his confidence in himself was not misplaced. However, we have not to consider what he might have done to form a just estimate of Louis Fuertes' gifts. They may be fairly judged by what he did.

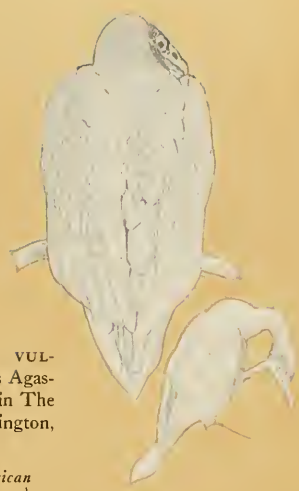
Prerequisites

Before going further it will be well briefly to name the requirements of the successful bird painter as I see them. In a word, he is one who has received the heritage of the bird-lover as well as that of the artist. I have never succeeded in satisfactorily defining the bird-lover. One of my efforts describes him as being "as well-marked a type as the 'born' artist or 'born' musician. Beyond the birds' universal appeal of 'form, song, and rhythmic flight' there is, for the elect something 'far more deeply intertwined,' some rare and precious heritage from ancestors to whose untutored minds birds were signs and symbols of the mysterious manifestations of nature."* But whatever the bird-lover may be, no artist, in my belief, can become a great painter of birds who has not that loving sympathy, that instinctive response to them which marks the born bird-lover. Audubon had it, hence his greatness as a bird painter and biographer. Fuertes had it in an extreme degree. No other living creature had for him the significance of a bird. On a number of occasions I have been with him when he secured some bird for the first time, and from the moment of its capture until he had completed his first examination of it the outside world ceased to exist. In his obituary notice of Fuertes,† Wilfred Osgood writes: "With a freshly killed bird before him he would sometimes sit stroking its feathers in detached ecstasy, purring and crooning over it in a manner that in another might have seemed ridiculous."

Surprising as it may seem, at such times he made no visible sketches, unless the specimen exhibited

*Autobiography of a Bird-Lover, p. 6.

†*Science*, Nov. 18, 1927, and "Artist and Naturalist in Ethiopia," Appendix.



CORMORANTS AND TURKEY VULTURE: Pencil studies by Louis Agassiz Fuertes from living birds in The Zoological Garden at Washington, D. C.

(From the originals in the American Museum of Natural History)

areas, usually featherless, which would lose their colors soon after death. Nevertheless, with every look he was recording impressions which never seemed to fade and on which he could draw whenever occasion required. Or, as Osgood puts it: "He depended upon the genius of his uncanny faculty for retaining vividly impressions of those intimate 'spiritual' qualities which gave each bird he painted its own distinctive 'personal' character." I recall being with Fuertes when in Glen Alpine near Lake Tahoe he, for the first time, saw a living dipper. The bird's distinctive form, poses, and gestures entranced him as he watched it through his binoculars, but not a single sketch was made. Nevertheless, later, when describing the experience, sketches, showing the bird's characteristic actions, rolled from his pencil as readily as though the bird were still before him.

A camera eye

Another incident, related to me by the late Mabel Osgood Wright, illustrates this gift of visualization even more impressively. Together they saw a red-tailed hawk capture a black snake and control its writhing prey before flying off with it. Fuertes made no notes on the spot but subsequently could draw in detail picture after picture of this far from stereotyped scene.

Fuertes was not a painter of landscapes; nor had he marked skill in grouping several birds on one plate, as the requirements of illustration so often compelled him to do. His interests were focused on the individual bird, and as a rule he restricted its surroundings to those necessitated by its habits and pose.

His work, therefore, is to be judged solely as that of a portrait painter of birds. Did he succeed in securing drawings of his originals which so faithfully depicted the color and pattern of their plumage, their form and characteristic poses, their facial expression, their personality, even individuality, that the demands of art and ornithology, of sentiment and science were wholly fulfilled? Let Osgood supply the answer. "Other artists and good ones," he writes, "came into the field, but it was Fuertes who inspired the ideal of all, and by abundant production spread broadcast the charm and beauty of birds, not merely by accuracy of line and color, but in the expression of subtle intangible qualities approaching spirituality."

Fuertes' photographic power to record impressions and later give vivid expression to them was

(Above) A STUDY IN FACIAL EXPRESSION: Portrait of a Black Vulture by Louis Agassiz Fuertes, from a specimen shot in Florida, west of Melbourne, in 1898 *(First reproduced in Coues' "Key to North American Birds")*

(Below) CAMP SKETCHES of a Spur-winged Plover by Fuertes, drawn after seeing the bird in the marshes of the Cauca Valley, Colombia, May 11, 1911

(From the originals in the American Museum of Natural History)

(Left) HITHERTO UNPUBLISHED FIELD SKETCHES by Louis Agassiz Fuertes: Postures of a Black-necked Stilt attempting to protect its newly hatched young by drawing attention to itself. Field-glass studies made at Los Banos, California, May 23, 1903

(From the original in the American Museum of Natural History)

(Right) MEMORY SKETCHES by Louis Agassiz Fuertes: Motmots, Trogons, Toucans, and Jacamars, as observed in Colombia in 1913

(From the original in the American Museum of Natural History)

not alone restricted to the productions of his pencil but in various ways ran through his nature. Added to a keen and appreciative ear for music and a musical memory was a gift of mimicry which enabled him to produce the songs of many birds. Repeatedly I have heard him whistle the hymn of the hermit thrush so effectively that his audience listened as reverently as though they were in the presence of the bird itself.

This ability to record and retain vivid impressions was a basic characteristic of Fuertes' equipment as an artist. Several of his colleagues in ornithology and art agree with me that he could have made from memory a recognizable drawing of any bird with which he was familiar and that if he had known it in nature he could have placed it in a characteristic pose. When it is added that Fuertes had a collection of 4,000 birds which he had himself shot and prepared, and that he had had a wider field experience than any other bird artist of the past or present, one may form some conception of the extent to which he had developed his inherent gifts and equipped himself to use them.

Audubon

While we are here considering Audubon solely as a painter of bird portraits, we cannot ignore the conditions under which he worked. Without funds, with no well-defined plan of either production or publication, encouraged only by his wife, who, moreover, assumed the responsibility of caring for herself and their two young sons, Audubon embarked on an enterprise which was without precedent and has never since been equalled or even approached.

To all the demands on his resources, time and strength imposed by making studies in a still half-settled or pioneer country were added the worries and annoyances of producing and selling his work, while he was still creating it. He was explorer, bird student, painter, writer, engraver, printer and publisher all at the same time. And he alone supplied the power by which these various branches of his undertaking functioned and coordinated.

His drawings are so incomparably superior to those of earlier bird artists that he may be said to have had no predecessors. When, therefore, we compare his work with that of his successors we should remember that they had Audubon while he had no one.

As I have said, he was doubtless inspired by Wilson, but it was probably by the belief that he could excel Wilson's work rather than by any help that Wilson's drawings gave him. The most marked character of Audubon's drawing is the animation exhibited by his subjects. He introduced motion into bird art. Most of his figures are doing something; flying, feeding or fighting, defending themselves from or fleeing from their enemies. Only rarely does he portray a bird in song. His birds were too busy to stop and sing.

The grand scale on which he planned his publication permitted him to portray every species, from hummingbird to crane, the size of life and to place only one species on a page. Comparison of the small figures in the seven volume octavo edition with those of the elephant folio quickly shows how much they have lost by reduction in size. And comparison of the plates in the elephant folio with the originals in the possession of the New York Historical Society shows, in many instances, how much they have lost in texture by engraving.

Audubon also was not a landscapist and his infrequent attempts to place a bird in its habitat resulted in pronounced inaccuracies of relative size and perspective. His figures are usually in one plane and the accessories are restricted to some flowering or fruiting branch or limb against a white paper background. Only rarely did he attempt such elaborate compositions as the mockingbirds and rattlesnake or brown thrashers and black snake.

Writing in Edinburgh, February 10, 1827, of his painting of black cocks then on exhibition at the Royal Institute, Audubon expresses his satisfaction with the birds but adds: "What a difference exists between drawing one bird or a dozen and amalgamating them with a sky, a landscape, and well-adapted foreground. Who has not felt a sense of fear while trying to combine all this?"

I think that we find a further confession of Audubon's limitations in the method by which he prepared his subject for drawing. This is described by Professor Francis H. Herrick from Audubon's "Journals" as follows: "A recently killed bird was fixed in the position desired by means of wires, and placed against a background ruled with division lines in squares to correspond with similar lines on Audubon's paper."* As such models were apparently followed more or less closely it is evident that their value depended on the accuracy with which they were posed. Properly lighted they made admirable subjects for the study and representation of plumage and helped to explain Audubon's suc-

*Audubon the Naturalist, I, p. 183.

(Right) The owls of eastern North America: *an example of Fuertes' conspicuous skill in bird portraiture. The form and feathers were drawn from specimens, the facial expression chiefly from memory*

(From the original in the possession of F. M. Chapman First reproduced in "Handbook of Birds")

Louis Agassiz Fuertes.
19

cess in this field. But they usually failed to show the correct position of the wing and its feathers under the stress of flight, a fact which is reflected in many of Audubon's drawings. Most of his figures of birds in the air are gliding on stiff set wings, the feathers of which show no evidence of the air pressure to which, in nature, they would be, under corresponding circumstances, subjected.

The flying figure in the plate of "Stanleys" (Cooper's) Hawk is a marked illustration of this type of inaccuracy. The bird is apparently in pursuit of a bluebird. Its position is that of a hawk swinging upward after having dived or stooped for its prey and missed it. The wings, acting merely as planes, are exerting no force and the bird presumably is losing momentum. The bluebird, introduced from the plate of that species, is apparently also drawn from an incorrectly wire-posed specimen, and if the hawk is supposed to be in pursuit of it, it should be placed behind, not ahead of its enemy.

Many other instances could be cited of wrongly posed birds in flight. It was evidently difficult for Audubon to place the wing correctly, not only in flying but also in perching birds, in which the scapulars do not conceal the attachment of the wing to the body.

Successful with plumage

Drawing usually from a recently killed bird in the flesh, in which the plumage could be arranged as it was in life, rather than from a skin in which many of the feathers had dried out of their proper position and the true pattern of coloration had been destroyed, Audubon's "method," as he called it, provided admirable models for the study of plumage and in this field he achieved results which are a tribute to his skill, technique, patience and high standards.

Small birds evidently did not appeal to him as strongly as large ones. They presented less opportunity for dramatic treatment and their often complex markings are not drawn with the care he devoted to larger birds. This is notably true of certain wrens and sparrows. But with larger birds he spared no effort to produce the marking and texture of their feathers with the utmost detail. This is clearly shown in many of the originals which have the barbs of the feathers drawn in with fine pencil marks on the water color, producing a surface indistinguishable from that of the original. This is especially true of the tail of the great gray owl in which the velvety appearance of an owl's feathers is closely reproduced. The hard lines of the engraving have largely destroyed this effect.

In the final analysis success in bird portraiture depends on the artist's ability to capture the facial expression of his subject. Herein lies the supreme test of his responsiveness and of his power to interpret and communicate. While expression is, in part, created by the combined effects of the structure, color, pattern and disposition of the feathers of the head, by the size, shape and color of the bill, its essence lies in the color and size of the eyes and the extent to which this feature reveals the character of its owner. Here, it seems to me, lies a fundamental difference in the bird portraits of Audubon and Fuertes. The former secured the effect of life chiefly by motion. Such active figures as he generally drew could not be other than alive. Fuertes, on the other hand, secured his effects, not by motion, but by his ability to produce facial expressions which could be worn only by living birds. This was the core of his art.

Each a master

Compare, for example, the faces of owls as drawn by the two artists and Fuertes' superiority is evident. Extend the comparison to form and pose and one is soon convinced of Fuertes' greater accuracy. This impression is no doubt partly due to the fact that Audubon often presented poses which seem to us to be forced and unnatural, while Fuertes usually confined himself to those with which he was and we are familiar. But it would be a thankless task to make a detailed comparison of the work of these two men. Each was the greatest bird painter of his day. Each was inspired by standards that defied time and strength and patience and was satisfied only when he had given his best.

But the standards of Fuertes' day, reflecting the developments of a century and the criticism of his associates, were the higher and to him was given the power to meet them.

(Right) TAWNY EAGLE: *From a life-size painting by Louis Agassiz Fuertes, which, both technically and as a portrait, shows the artist at his best. Drawn from the living bird, in Ethiopia, 1927*

(Reproduced by permission of Field Museum)

Tawny Eagle

Hibernating Ground Squirrel

EXCEPTIONAL PHOTOGRAPHS TAKEN IN TETON COUNTY, MONTANA, BY A. DAWES DU BOIS

A RARELY OBSERVED SIGHT: An animal discovered in the midst of its over-winter sleep, 5¾ feet underground. Although many animals sleep through the winter and may not yet, as the reader examines these pictures, have thought of emerging, one does not often see them in their burrows and dens.

The picture below is a side view of the nest intact just after the hard-packed subsoil had been cut away. The entrance-passage, which had been closed or nearly so, is seen behind a portion of earth left standing at the right. The creature's reactions on being disturbed were most interesting.

"I found the nest of the 'gopher' (Richardson Ground Squirrel) at a depth of 69 inches below the surface of the ground," writes A. Dawes Du Bois, who took the photographs, "in subsoil so dense and hard that it was necessary to do the digging for the most part with pick and shovel. . . . The camera was pointed almost horizontally. The pit in which the photographs were made had been dug with vertical walls.

"The nest was composed of fine dried grass, well matted together; its walls were about an inch thick. It occupied a nearly spherical cavity in the earth, about six inches in diameter, the bottom of which was not much below the tunnel which entered it at the right-hand side.

"When the nest was opened, the animal was curled into a ball with head bent down beneath the body, and with tail curled under the body and lapping around the head. His eyes were tightly closed. He was cold to the touch. For the most part he remained as motionless as though dead, although occasionally there was perceptible movement. On the left side of his body was a fresh, open sore, as though the flesh had been torn there. On his back and right side were five large ticks, their light gray ovoid bodies projecting through the fur. When I pushed one of these with the end of a stick the ground squirrel slowly moved his body in a feeble effort to reach the place with his hind foot. With a pair of

forceps I pulled off the ticks. This required such severe jerking as nearly to lift the ground squirrel bodily, and he objected with a slight hissing sound; but he showed no further signs of waking from his profound sleep.

'I lifted the animal out of the nest and put him in the warm sunshine, protected from the wind. He lay there, on his side, for a long time. In the course of an hour, however, he began to tremble, and to sway from side to side; then he endeavored to get to his feet, and, partly supported on his legs, he swayed. His eyes remained tightly closed.

"I put him into a box partly filled with rags, where he remained while I ate my noon lunch. After lunch he was able to move around; he opened his eyes slightly; and when I lifted him by the nape he opened his mouth and hissed. When I placed him on the ground he began to crawl about. I put him back into the nest chamber, with the grass material which I had torn out. He turned and crawled about therein, trying to re-shape the nest; then he came out. Soon his eyes were wide open and he was able to run about on the bottom of the pit."

The chance presence of a weasel, the ground squirrel's arch enemy, did not appear to greatly disturb the lethargic little creature: "The pit was close to my cabin. As I looked out from the doorway, to see what the 'gopher' was doing, a large weasel came to the edge of the pit, looked down at the ground squirrel below, made a start as if to crawl down the vertical wall; then, deciding not to try it, ran around the excavation and went down a gopher hole near the corner of the cabin. The weasel stayed for some time in that burrow, then came out and tried another one. The ground squirrel sat motionless on the floor of the pit, evidently quite aware of the presence of his arch enemy. But eventually the weasel went away.

'Once more I placed the ground squirrel in the nest and left him for a while, partly covered with the nest material. When I looked again, he was wide awake and active. The sore had rapidly dried over. He was digging a tunnel, sloping it downward from the old nest, and had progressed about four inches into the hard earth."

COLD TO THE TOUCH and inert was this ball of fur when unearthed late in October. Placed in the sunshine, the creature remained in a stupor for more than an hour. The first purposeful action it showed was an attempt to re-shape its nest. At length, wide awake and active, it proceeded to dig a new tunnel downward from the old nest, obviously intent on resuming the profound sleep from which Nature had not meant it to be disturbed.

These observations represent a novel winter phase of nature-study which many amateur photographers could pursue, to the increase of knowledge in a relatively obscure field of inquiry

★

THE INDOOR EXPLORER

By D. R. Barton

Toward more picturesque exhibits: This Indoor Explorer was in the throes of a brown study as he sauntered along the third floor of the American Museum. His presence in the Hall of Reptiles, of which he was but dimly aware, failed to arouse the slightest apprehensions since he was certain that all of its non-human inhabitants were quite harmlessly defunct. Even the proximity of a disturbingly realistic rattlesnake exhibit made no impression whatever on his after-luncheon apathy. Then all at once—*Bzzzzzzz!*—and your Explorer was startled out of what might charitably be referred to as his wits.

Leaping wildly to one side, he whirled about to face, not a venomously spitting rattler, but a giggling urchin who immediately scampered off to the other end of the hall at sight of the vengeful fire in your Explorer's eye.

His prank had been the mere pressing of an electric button which the Department of Amphibians and Reptiles had placed on the exterior of their rattlesnake exhibit. When pressed, this button caused the snake's tail to vibrate so that all who would might hear him rattle as he had so often done in real life.

Your Explorer soon found that the herpetologists were not the only ones making use of electric devices to vitalize their exhibits. Passing on into the Hall of Insect Life he came upon another case also equipped with an electric button. It will be remembered that some time ago your Explorer called attention to a microphone installed in an insect case for making audible the chirping of a live cricket. This latest electrical display, however, was not concerned with sound effects. Here the trick was to press the button and see a wheel revolve slowly showing the four stages of development in a species of butterfly found in the environs of New York City. There are six such species on exhibition, and the life cycle of each is pictured on an individual wheel. By releasing the button you can stop the revolving stage at any point in the butterfly's life if you wish to study it in detail. The exhibit was really rather impressive when you thought of it: just a few watts of electricity plus man's ingenuity, and the complete biography of a butterfly passed before your eyes in half a minute.

Now there are some people who just won't have anything to do with snakes, and there are others who maintain that studying butterflies should be the exclusive province of those who collect them either as a hobby or a profession. But for proof of the widespread appreciation of the beautiful coloration both these creatures possess, one need only look into the fashionable shops which feature Milady's shoes, purses, and belts done in snake skin, and which tempt the eye with jewelry, glass-topped trays and plaques inset with butterfly wings.

Proceeding into the Hall of Gems, the Indoor Explorer soon came upon another natural source of beautiful color effects which has been enthusiastically exploited in both art and industry. Here was an exhibit which would excite the interest of anyone with half an eye for beauty as well as the student of Mineralogy. It is a visual display of the action of ultra-violet rays on a group of fluorescent minerals. Once more a mechanical electric device is utilized, but there are no buttons to push this time. Ordinary white light is automatically turned on and off so that the minerals may be seen under normal conditions, when they seem a mere collection of common rocks without a distinguishing feature. But when the white light is switched off, instead of utter darkness within the case the seemingly common rocks instantly reflect the most radiant colors in sharp detail. They are transformed into objects of jewel-like brilliance by ultra-violet rays, which although too short to be seen by man are capable of producing this remarkable luminosity in certain minerals.

What causes fluorescence? It seems that scientists have not yet discovered its secret. They have observed countless instances of fluorescence and have even made use of this phenomenon in inventions of considerable practical value, but they are ignorant of the actual cause. The best method of producing the effect is the one used by Mr. Whitlock, Curator of Minerals and Gems, in his exhibition case. The ultra-violet light that is directed upon the minerals, stimulates into visible activity something within

them. What that something is, we do not know, but somehow it is caused to vibrate in such a way that it sends forth light waves of sufficient length to be visible to the human eye. The resulting fluorescent rays are clearly observed and appear as a complete change of color on the part of the mineral. Apple green, royal blue, lemon yellow and dark pink, in their most brilliant aspects, are a few of the colors irradiated by the ordinarily drab specimens in Mr. Whitlock's exhibit.

Man has learned to apply the unexplained phenomenon of fluorescence in solving a wide diversity of problems. The surgeon, by examining a broken bone through a fluoroscope, can see exactly what he is doing when setting it. The gay young blade can determine whether or not the attractive smile of his latest fancy reveals false or natural teeth by luring her within range of some source of ultra-violet light. If she has 'store' teeth they will show up as lusterless; if natural they will gleam with an unusually bright glitter. The most enviable complexion, incidentally, will take on the ghastliest of greenish hues under ultra-violet light, so that in all fairness to the damsel, her escort should apply the test to her teeth alone.

Fluorescence has played far more than a minor rôle in the development of stage-craft. Extraordinary effects, usually of a macaber nature, have been achieved by tinting the props, *décor,* and even the actors, with fluorescent materials which, when exposed to ultra-violet lighting radically alter the entire emotional character of the particular scene.

Tremendous improvements have been made in such cheap sources of illumination as the mercury arc lamp by the introduction of rhodamine, a reddish dye. Light from the mercury arc lamp was lacking in red rays and therefore distorted any colors on which it fell. The addition of the red rays by the fluorescing rhodamine permitted the use of this and similar lamps in all types of advertising illumination and department store display.

Fluorescence has also been of value to mining operators. By turning ultra-violet lamps upon low grade veins of scheelite, quantities of that mineral are discovered which might otherwise have been left unexploited.

As might well be surmised, the action of ultra-violet light on fluorescent substances is a formidable ally of both the criminologist and the industrial detective. The former uses it to detect all manner of forgeries including those perpetrated in the realm of the fine arts. Several paintings offered for sale as original old masters have lately been shown up as fraudulent, when subjected to fluorescent examination. The industrial detective, engaged in tracking down impurities in such products as cereals, canned goods and cosmetics, protects the public against faulty merchandise by the same method.

It is this Indoor Explorer's contention that all these mechanical and visual aids contribute toward the type of museum exhibit which will make the most vivid and lasting impression upon the general public for whose education they are intended.

LETTERS

CORRESPONDENCE CENSORED,
By *R,* Feb. 6, 1937.
New Jersey State Prison.

SIRS:

About two weeks ago, and for the first time in my entire life. I was given a copy of NATURAL HISTORY by an inmate. It is of January, 1937.

I have spent the greater part of two weeks reading and studying this wonderful magazine. It has taken me all through Borneo with Mr. Martin Johnson. It has made me actually see Miss Grace Wiley as she worked among her snakes. I have read so much of Mr. Ditmars about the Mamba that I was tremendously interested in the Mamba's actions. I have also heard much about a "spitting" cobra. Is that true?

I am truly hungry for reading matter such as your magazine contains. It seems to make me forget that I am serving a sentence. I've put 24 years of my life in prison and if you could but realize just how much pleasure and education I can get get out of your great book, I feel certain you would be kind enough to send me some old back numbers—perhaps some that can no longer be sold.

The article about the human heads shrunk to the size of tennis balls has made a big hit. I want many of the men here to read this magazine. I can easily tell which of them are conscientiously interested in its wonders, and then cheerfully lend it out to them without a bit of "jibe."

I am truly deeply appreciative of this reading material and I can't say enough in words to boost this marvellous book. If ever I am liberated I certainly shall subscribe to your splendid magazine all the rest of my life.

Please believe that I shall never forget your great act of kindness if you'll try to help me.

Thanking you for any consideration you may care to give this earnest request, I am:

Very respectfully yours,
(Signed)

If the request of the writer of the foregoing letter for back numbers of NATURAL HISTORY prompts anyone to send some, we shall be glad to forward them.—The Editors.

SIRS:

As a subscriber for some time to NATURAL HISTORY, please accept my congratulations on the new format and general improvement in make-up and presentation of the illustrated and textual matter of your January issue. . . .

All in all, I enjoy NATURAL HISTORY as much as any of the hundred magazines I subscribe to.

NORMAN BEL GEDDES.

New York City.

SIRS:

All praise for the splendid job you are doing on your magazine. I'm sorry I haven't had time to drop in and tell you this personally.

JOHN J. KELLY.

The Associated Press,
New York City.

SIRS:

I want to congratulate you on the beautiful edition of NATURAL HISTORY for January. It is fine in every way and if this issue is a foretaste of what is to come in the future we are in for a rare treat indeed.

W. A. MITCHELL.

Savannah, Ga.

SIRS:

Your magazine for January was so interesting, artistic and readable that I am impelled to drop you this line to congratulate you on the accomplishment.

GEORGE BRINTON THOMAS.

Maplewood, N. J.

SIRS:

I have just at this moment received the new NATURAL HISTORY, and must send a line to express my sense of its truly magnificent appearance and of the work the American Museum is doing for natural history.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colo.

SIRS:

I am dismayed at the change in form of NATURAL HISTORY. Failing to find any editorial explanation, I sought for internal evidence justifying the change. The mystery only deepens. The illustrations remain about the same size, except that a few are larger, and bleed to the edges. The text in a number covers about the same space. This then seems to be no advantage.

I have a run of NATURAL HISTORY from 1919 to date. Space with me is limited. So I am faced with the necessity of choosing between provision of shelf-space two inches deeper and higher, from now on, or giving up the idea of preserving a file. I think I shall adopt the latter alternative.

I cannot imagine why the editors of this excellent periodical chose to inflict on its long-time supporters the necessity of making this decision.

EDWARD A. PREBLE.

Washington, D. C.

Lest it be supposed that in publishing these letters partiality has been shown toward those expressing favorable reactions, let it be said that no adverse letters have been received other than the preceding one.—The Editors.

SIRS:

The February issue of NATURAL HISTORY has just arrived. (My compliments on its appearance.) The article on Singing Mice by Mr. Barton is of peculiar interest to me because at the present time I have as an honored (although captive) guest in my home one of these prima donnas of the world of Mice. At least Tinkle Mouse was a Singing Mouse when brought to me three weeks ago. Just now she is on strike, not a sit-down strike exactly, but just as effective. She simply won't sing. However, it is the privilege of all prima donnas to be temperamental. I have hopes for I know of still another Singing Mouse, Mitzi by name, who has the run of a house and has been under observation for over four months, and she has somewhat prolonged periods of silence.

THORNTON W. BURGESS.

P. S.—Our two Massachusetts mice have conclusively proven that the singing is wholly voluntary.

Springfield, Mass.

ADDENDUM.

Since writing, signing and sealing the letter proper I have received word that circumstantial evidence indicates that some time recently Mitzi of Shelburne Falls received a "bundle from heaven" containing at least one gifted vocalist. Anyway a wee mousie has appeared in Mitzi's home with all the evidences of a prima donna in the making. A little amateurish as yet, all that is needed is practice and maturity. Perhaps Mitzi's periods of silence may be accounted for on the score of motherhood* rightly and properly interfering with concert work. We are wondering now if Tiny Tink will prove to have any brothers or sisters as gifted. I wish my own Tinkle Mouse would present me with some "bundles from heaven" but I suspect that she has been in solitary captivity too long for any chance of that.

T. W. B.

* There are instances on record of female mice singing quite audibly during the birth of their young.—THE EDITORS.

THE COVER THIS MONTH

Tezcatzoncatl ("Mirror Covered With Straw") is one of the 400 gods associated with pulque, an intoxicating drink made from the fermented sap of the maguey. Gods of this type were important, since many rites involved ceremonial drunkenness.

This pluque god carries in his left hand a feather banner and a square shield with special insignia. His right hand brandishes a stone axe. His distinctive nose ornament of gold, represents the moon symbol. His headdress is paper surmounted by feathers.

This drawing is from the Codex Magliabecchiano, a post-Columbian Mexican manuscript of the latter XVI century, now in Florence.

YOUR NEW BOOKS—*Tales of the Explorers—Miracles in Nature Photography—Canary—The Little Wolf—Precious Stones—Gold Fever*

PILLSBURY ON PHOTOGRAPHY: Picturing Miracles of Plant and Animal Life
- - - - - - - - - - by Arthur C. Pillsbury

J. B. Lippincott Co., $3.00

THE hosts of admirers of the work of Arthur Pillsbury, and these include naturalists and biologists as well as laymen, will rejoice that he has written this book, that some of his achievements have been "caught in type and preserved between covers". Many would doubtless change the title of the volume to read "Miraculous Picturing of Plant and Animal Life". He has done so many things with a camera, in fact, he is probably the most versatile photonaturalist that the world has produced, and his pictures are superb. He is a rare combination of artist and mechanic. Without his training as a mechanical engineer at Stanford University, it is doubtful whether he could have designed and built much of his highly accurate and complicated apparatus.

In the book he relates the story of his varied activities as photographer from the time he used the tiny box kodak at a class rush during his student days at Stanford to his unique work of photographing through compound microscopes in tandem and to his beautiful lapse-time photography in color; how he evolved from official Government Photographer with the Census Bureau in Alaska during the gold rush in 1898 and 1899, then photographing on his own the burning of San Francisco, then making photographs from a balloon of the ruins of the City of the Golden Gate; and then his fine work as official photographer in Yosemite National Park, among the results of which was the beginning of protection of wild flowers in our National Parks.

The first chapter is devoted to lapse-time photography, in which a considerable interval varying from a second or so to many minutes passes *between* the successive pictures. When these pictures are projected at the old speed of 16 a second or at the new sound-picture speed of 24 a second, we see flowers open in just a few seconds, or we see other action speeded up in the same way. The author gives full instructions for this branch of photography, based upon years of experience. He tells us that he could almost set his watch by the time that the various species of flowers open. This had to be taken into account as well as the length of time necessary; evening primroses snap open from bud to open flower in fifteen minutes, a cluster of Azalea buds takes four days to open, while in the lady's-slipper three weeks are required for the buds to open.

Pillsbury was the first person to make motion pictures through two compound microscopes in tandem. With this apparatus he has made the greatest enlargements of the nuclei of plant and animal cells that have ever been made. He has photographed conjugating Spirogyra showing various nuclear and other details. He has photographed the pollenation in the spider-lily showing the male nucleus traveling through the pollen tube. He devised the apparatus and made the first X-ray motion pictures. He devised and uses a "traveling" motion picture camera, which, because of its movement on the arc of a circle, makes spectroscopic motion pictures. He has made a photographic record of chemical farming, that is, the raising of enormous crops of potatoes, tomatoes, etc., without any soil whatever.

No doubt the most impressive work the author has done is his skillful color photography, especially his lapse-time motion pictures of flowers in technicolor. He has also photographed crystals in their formation and growth with the astonishing display of color as shown by polarized light. Information on all these fascinating topics is given in this new book in a clear and interesting manner.

CLYDE FISHER.

THE BIOLOGICAL CONTROL OF INSECTS, with a Chapter on Weed Control
- - - - - - - - - - by Harvey L. Sweetman

Comstock Publishing Co., Inc., $3.75

NO phase of the study of insects is more important and none less generally understood than that concerning the natural checks upon the increase in numbers of each of the more than half a million already known kinds of insects. Professor Sweetman's 400-odd pages can, of course, give no more than an outline of the subject, but what a picture is outlined!

The emphasis in this book is upon the diseases and other enemies of those insects that are injurious to man, particularly the injurious insects that have been introduced from one country to another. Such emphasis after all, is only human. Introduced insects are especially injurious and they are especially injurious because they have been introduced without the natural checks upon their increase. A part of man's war upon them consists in the introduction of their natural enemies, trying to establish in the new region a "balance of Nature" such as controlled the injurious species in its natural home. Does all of this sound complicated? It is.

The present volume is primarily intended as a textbook but its style is sufficiently clear for a serious individual reader and there is an extensive bibliography. A person unfamiliar with the lives of insects will be surprised to find that an authoritative and carefully proportioned book such as this devotes only four pages to the part played by birds in the control of injurious species of insects. Readers looking for examples of interesting biological phenomena will find them in such things as the polyembryony of certain of the insects that "parasitize" others. The chapter on the introduction of insect parasites and predators tells of intricate problems that must be solved and methods that must be devised for mass-handling of the delicate creatures so essential to Nature's balance, if man is to use them in the correction of his entomological mistakes and misfortunes.

FRANK E. LUTZ

EXPLORERS CLUB TALES: True Stories of Exploration, Research and Adventure, as Told at the Explorers Club by Men of Daring and Achievement

Dodd, Mead and Company, New York, $3.00

THE books issued by the Explorers Club, of which this is the second, are unique among works of travel and adventure. Devoted to no single subject or part of the world, they are composed of many short chapters, thirty in this case, each by a different author and on a different topic, related to each other only by the fact that all treat some aspect of exploration in the broadest sense. This volume sets a high standard for entertainment and interest. Even if he can resist the temptation to read it straight through, its fortunate owner can dip into it anywhere and for ten minutes or so will be transported to almost any part of the world, in company with an author who knows the subject thoroughly and at first hand.

Most of the contributions are incidents of personal experience. The chapter by Doctor Granger, President of the Club, for instance, tells a little of the work of fossil hunting in a distant land, but is more particularly a vivid and unforgettable first-hand view of how history looks to someone actually on the spot, as Chinese armies in defeat and in victory pour through a village in Szechwan. Reginald Orcutt's tale of entertainment by an Eskimo family is a more placid but likewise fascinating incident with a background of real anthropological value. Durlacher's chapter on Costa Rica, Furlong's on Tierra del Fuego, Pond's on the Sahara, and several others relate adventures less significant than Granger's and more thrilling than Orcutt's but with the same sort of background and the same feeling for what life in these out of the way places is really like. Writing of witchcraft among the Zulus, Carl von Hoffman contributes a less personal but equally informal and informative paper.

Sport is not neglected. Ellsworth Huntington appears in the unfamiliar guise of a buffalo hunter, and John B. Burnham tells of a trip of twenty-one thousand miles considered well repaid by one Siberian wild sheep. Nearer home are tales of riding a swimming bull moose, of an involuntary descent into a puma's den, of salmon fishing in Labrador, and of experiences in photographing wild animals in North America—the last by the late Dr. Frank Oastler whose recent death was a loss to all lovers of nature.

Several of the sketches might be characterized as short short stories. Dunn's tale of the South Seas, "Mara", expertly compresses into ten pages a variety of primitive emotions, and Tom Gill's yarn of Carmelita supplies the sex-appeal otherwise rather scanty in this book of male adventure, with a neat dénouement in which disillusionment provides the only possible happy ending. In his customary humorous and readable style Lowell Thomas writes of the "last crusade", the fall of Jerusalem, Lawrence, and some incidents well calculated to reduce the pomposity of history. Outhwaite contributes an authentic and gripping account of sailing through a hurricane in a small ship. But it is impossible to enumerate all the riches of this remarkable and varied book.

"Explorers Club Tales" has something to interest anyone, and most of it will interest everyone. Most of the authors are not professional writers, and a few are not able writers, but in general this only makes more apparent the authenticity and the informality of their work. Almost invariably what the authors have to say is worth saying and worth reading. The publication in this place and in this form of a translated and annoted excerpt from an old book by Amundsen is of questionable value and taste, and a relatively long and smoothly written story by Don Rockwell carries less conviction than any of the other chapters, but it would be unfair to emphasize these two at the expense of the other twenty-eight entirely unobjectionable and much more worthwhile contributions. The book as a whole is an exceptional opportunity to make the acquaintance of a remarkable group of men and to receive from them royal and personal entertainment.

G. G. S.

THE LITTLE WOLF
- - - - - - - - by Wendell and Lucie Chapman

Charles Scribner's Sons, $2.00

WHEN a naturalist attempts to write the biography of a mammal and uses the fictional method, he treads on dangerous ground. The account swings along, gains momentum, and without any yardstick to distinguish between fact and the fancy of the author, the average reader assumes one of two things, either that the whole fabric is to be trusted, or that it is a piece of "nature faking". In fact, the term "nature faking" was created to describe biological fiction, and few authors have been able to enter that field and emerge unscathed. This is not to imply that "The Little Wolf" falls into this questionable category, but rather to indicate the difficulty confronting the authors.

Furthermore, it is exceedingly difficult to evaluate the behavior of mammals without employing an anthropocentric philosophy. No one knows how mammals "think" or "reason" and it is a common pitfall for an author to imagine himself in the role of the mammal biographed and proceed on that basis. The facts of mammal life-histories are the actual observations of the animals themselves or the logical deductions from tracks or sign that testify to behavior. The general public, and more particularly the juvenile readers, are not nearly as interested in a factual account as they are in an imaginative one which assigns human qualities to the hero of the biography, and hence there always will be an incentive for authors to attempt it.

All this is preliminary to stating that the Chapmans have written a very readable life-history of the coyote, one that my children argued over as to who should read it first, and concerning which one of them said, she liked it because the animal emerged at the end of the story alive and not dead or a captive. The authors have a good background, have taken excellent photographs, and are in sympathy with their subject, at the same time showing an appreciation of the balance of nature and the function of predatory species in relation to that balance.

The coyote is portrayed as the carnivore he is, but one wonders whether, in selecting the high lights from the sum total of known facts, the everyday existence of the animal is not shown in an accelerated tempo. For example, it is related that coyotes "gang-up" on an antelope, running it in relays and finally killing it; and, arguing from this instance, the authors state that if rangers had not broken up the pack of coyotes these

animals would have taken, one by one, all of the antelope in the small band frequenting that region. It cannot be disputed that coyotes do catch antelope, but the mature, uninjured antelope must normally be able to hold its own with wolves and coyotes or they would have been wiped out long ago when there were no rangers to look out for them.

The coyote is a storm center about which the modern theories of conservation rage. As one school would have it, this animal has become increasingly destructive as the face of nature has been altered at the hand of man. A compatible element in the primeval ecology, the balance of nature has been so disturbed in the last few decades that today the coyot. can and does take more than its toll of the wild life about it. Not admitting that this contention is well supported by the evidence at hand, there are those who find the coyote an interesting native mammal, not out of harmony with any environment that preserves a reasonable part of its primitive inheritance, and with so many enemies operating to control it that there need be no cause for alarm that the coyote will assume undue prominence.

At any rate, it is a cunning creature with intriguing ways, and the Chapmans have given us a full account of how he goes about his business. The points on which this reviewer would differ with the authors are primarily those of interpretation and, by the very fact that the coyote mind is a closed book to us, many of these are of a character where one man's guess is as good as another's.

H. E. ANTHONY

THE BANTU TRIBES OF SOUTH AFRICA

Reproductions of Photographic Studies. Vol. IV, Section II, Plates XLI-LXXX

- - - - - - - - - by A. M. Duggan-Cronin

Kimberley

THIS volume is a new departure in reporting on the habits and customs of illiterate tribes. There are 59 pages of text and some 40 plates, 5½ by 7½ inches each, provided with a brief but adequate comment. The tribe represented is the Vachopi of East Africa, a sub-division of the Chopi. Although the text is brief it well summarizes the culture of the Vachopi; thus, they are good iron-workers, fabricate bark cloth and twine, distinguished as wood-carvers and as xylophone makers not excelled anywhere in Africa. The plates are well selected and artistic, presenting in sequence portraits of the native men and women, photographic studies of costume, housing, scenes from daily life, etc. By scanning these photos one can visualize this type of native life. The undertaking was supported by a Carnegie grant.

CANARY, THE HISTORY OF A FAMILY

- - - - - - - - - - by Gustav Eckstein

Harper and Brothers, $2.50

THE least that can be said of this book, from whatever angle it may be approached, is that it is a very unusual work. The author has a peculiar, clipped style and an unorthodox method of expression that suggest hurriedly written laboratory notes rather than finished work and the effect is not conducive to a smoothly running account. The reader's attention, at least in the early part of the book, before there is a certain immunity developed, is somewhat drawn away from the subject matter by these peculiarities of diction which detract from a story that is well worth telling.

The story is a highly sympathetic record of the lives of a roomful of canaries, allowed full indoor liberty in a semi-disused laboratory where they were kept under observation for eleven years. Beginning with a single female, originally purchased as an intended gift for a friend, augmented by a second female, then a male as mate for the survivor of the first two birds, and then another female, the colony attended to its own growth for several years. After a number of deaths reduced the population overmuch, new birds were added each year thereafter, with additional natural increase to enlarge the population. The resultant mixed assemblage was kept under Doctor Eckstein's watchful eye in all its varied activities of communal and individual existence.

Much of the observation was made, as it were, "from the corner of the eye," for it was found that direct attention thrust upon a bird could produce a nervous tension sufficient to interrupt, if it did not disrupt completely, the business of the moment. Nevertheless, the canaries became accustomed enough to human companionship, with certain reservations, to carry on their lives with little inhibiton from that source. Courtship, song, personal rivalry, molt, nest-building, care of young, and similar normal activities all found their place, however distorted they may have been by the artificiality of the surroundings.

The author early found that each bird possessed distinctive peculiarities of song, posture, response to certain stimuli, or other habit that made it recognizable as an individual, and even noted definite similarities of this sort in some of the parents and certain of their offspring. The recognition of this individuality and the resultant character studies of the various birds give the book a particularly human quality even where the author does not emphasize this aspect of the situation. Sometimes this emphasis is given, although the author may take pains to disavow an anthropomorphic concept, seeming to be drawn into such interpretation in spite of himself. Even when the history is divested of these humanized interpretations, there remains a very interesting record of bird behavior under conditions artificial enough, it is true, but probably allowing greater freedom of life than is allotted to most of the species with a similar history of caged ancestry.

It is not apparent that the book is presented as a technical dissertation on bird behavior, although some parts of it have been published in scientific and other periodicals, but there are many facts established by observation which may readily form the bases of more serious experiment. The author is on safe ground in describing what he has actually seen although he may sometimes be questioned on his interpretations or on some of his extraneous comments. Thus his statement that no bird ever climbs a tree by ascending branch by branch is not quite true; some birds do just that. Who knows, then, that "Billie's" aptitude in learning this method of climbing trees may not have been derived from some distant ancestor of all canaries, ages ago, which ascended trees, branch by branch, to gain the needed altitude from which to glide to some distant point, before true flight had been acquired?

In any case, the reader will follow with interest

"Billie's" progress, subsequent to her injury, through her education in various matters which most canaries never need to learn, to her final recovery after several years of invalidism. The obvious display of fear at the production of a curtain-pole which had once been used to assist in catching some of the birds and kept thereafter in a corner of the room where it had excited no adverse reactions; the exhibition of apparently instinctive feeding movements by very young birds without previous experience and without the presence of food as a stimulus; in these and other episodes there is much food for thought. On the other hand, the mode of presentation is so far from a severe tabulation of formal experimentation, which was never made, that the book is certain to be read with interest by many people who are not students of bird behavior and who will like it for its other qualities and, incidentally, probably put more anthropomorphism into their own interpretation of events than even the author intended.

J. T. Z.

GOLD FEVER

- - - - - - - - - - - - - - - - - - by L. M. Nesbitt

Harcourt, Brace and Company, $2.50

IT is of gold mining in Africa between 1912 and 1916 that L. M. Nesbitt writes in *Gold Fever*. After three years as an engineer in South Africa, he journeyed far and wide over four continents. In 1935, just before his death, he portrayed with astonishing clarity his life in the Rand mines. Although work was abundant and extremely well paid in those days, yet the "physical conditions under which work was accomplished," he says, "were taxing, and dangerous accidents were frequent." It was to him "a nightmare experience to descend into the lower mazes of the workings, leaving behind the gay sunlight in the fresh air of dawn."

Now the question is, would the average mining engineer trained to work underground have such reactions? Furthermore, mining in South Africa had advanced far between 1898 and 1912. Some of our distinguished American mining engineers found their life there so desirable that during thirty years they have continued in the mines and still live to enjoy life. No longer is there an "appalling shortage of water in the dry season." Today, the Vaal River has been tapped, so that mines and city have an inexhaustible supply of pure water, comparable with that of any large city in the world.

Nesbitt displays an amazing sympathy for the native mine workers and draws a vivid picture of the native's childishness, his eagerness to learn white men's ways and to assume white men's dress; of his stoicism, and his sense of fatality when "in the midst of danger"; of how he labored humbly and tirelessly with a silent courage.

Nesbitt speaks of recruiting native labor "under pressure amounting to compulsion, and the simple negroes were in almost complete ignorance of what working in the mines meant." Today, there is no such thing as compulsory labor. Natives are recruited voluntarily, after seeing films of actual mining operations. After six months in the mines they may go home on furlough or give up their work entirely. Nesbitt tells of the necessity to maintain a "colossally-high scale of production in order to yield dividends which are quite moderate." As a contrast today, with gold selling at 140 shillings an ounce, only low grade ore is being worked, while the most valuable ore is being kept in reserve against any future day of price decline.

He portrays the spectacle still extant of the native dancers in their compounds. He describes the amusement of whippet racing. Such diversion, and the Sunday holiday which he occasionally spent in the country, are almost the only bright spots in the entire book; and even his days in the open under the clear spring or summer skies of the High Veld, were clouded by the thought that on the morrow he would be back again in the mines.

Nesbitt stresses "the unhealthy conditions" in the Rand mines a quarter of a century ago. Though his reactions were obviously extreme, since then great changes have occurred in the mining industry. It would be as unfair to liken modern mining with that in Nesbitt's time as to compare manufacturing in America in 1900 with that of the present day. Today, dust in the mines has been largely eliminated by air-conditioning and special treatments. Silicosis is relatively unknown, owing to the efforts made by the mining companies to prevent its occurrence. Men underground are in a uniform temperature under expert medical supervision. Vast sums are spent each year by the mining companies and the Government of South Africa in research laboratories where scientists are constantly finding new methods of controlling disease and of improving working conditions. The natives, too, have a properly-balanced ration rigidly maintained. Unprejudiced observers often say "no herd of prize cattle have more careful medical oversight than the Kaffirs employed in the South African mines."

We make no brief in favor of underground work. However, since today the demand for gold is so great, gold mining is bound to continue.

In the final analysis, the effect of such an enterprise on the lives of both white man and black native is the same. Both have "gold fever," differing only in degree. The highly-paid engineer attains the satisfaction of work cleverly done and the luxury of a beautiful home in a modern city. To the native—who here as elsewhere apes the white man—gold means white men's clothes, gay blankets, spending money and great prestige when, on holiday, he returns to his home kraal. One has only to see a gang of boisterous city-wise black boys crowding the railway station at Johannesburg—comfortably and flashily dressed, burdened with enormous bundles, as they wait for the train to bear them homeward—in order to realize what their new earning power means to them.

True it is that many of us, perhaps with an excess of idealism, might wish life underground impossible for any human being; that men of our own race might ever find economic opportunity in the light of day; and that the naturally happy and carefree natives might never be lured by gold away from their wind-swept hills or sunny veld. However, neither such thoughts as these, nor the complete revulsion expressed by Nesbitt to the life he so greatly disliked, can stay that force which the world today calls "progress."

MARY L. JOBE AKELEY.

Continued on page 228

SCIENCE IN THE FIELD AND IN THE LABORATORY

Animals at Bear Mountain—Homo sapiens—Return to New Guinea planned by Mr. Archbold—New Ocean Sunfish

Animal Life on the Hudson

Winter relinquished its stern grip upon the Highlands of the Hudson during the early months of the new year. The typical snow and ice conditions did not prevail. As a result, members of the Bear Mountain Trailside Museums' staff found ample opportunity to travel unhindered throughout the 43,000 acre preserve of the Bear Mountain-Harriman Park, seeking bird and mammal observations. This work has been carried on in connection with the continued ecological survey of the region.

Notes recorded include daily observations of an adult Bald Eagle in various sections of the Park and many rafts of ducks floating in the open Hudson River where, in 1936, the ice supported the weight of automobiles. Chipmunks scurried about among dry leaves during January and early February. Skunks were abroad, and the usually slumberous woodchuck and the slow-moving opossum left their respective fresh footprints in the moist earth. (One night a skunk entered a wire box and left upon the morning breeze a more tangible evidence of his presence in addition to his footprints.) Beaver built their "standard" winter storage food piles despite mild temperatures, thus, effectually losing their renowned reputation as weather prophets.

It has been noticed, with great satisfaction, that the mammal population in the sanctuary is increasing continually. Mink, muskrat, gray and red squirrels and the gray fox seem particularly abundant this year. The deer failed to "yard," or congregate in limited areas, during the months that were normally cold. The animals were observed in scattered groups of two or three individuals, following somewhat the same daily habits witnessed in the early Fall. All of these and many other records of woodland happenings are faithfully recorded in the card catalogue system of the Trailside Museums, where information relating to the wild-life residents of the Park is available to all visitors.

Homo sapiens

Human, rather than animal, relations continue to engage the major waking hours of the staff despite the ever present urge to journey into the forest. Questions from visitors and others, both written and verbal, concern unrelated subjects as, the care and feeding of, "Chinese nightingales," and the recurrent one as to whether or not the "ground hog" does have a premonition about future meteorological conditions. People continue to donate creatures ranging in character from white rats to monkeys. Speaking of the latter, a South American "woolly monkey," deposited with Trailside in January, was promptly presented to the Staten Island Zoo.

The Trailside Museum at Bear Mountain is, indeed, becoming more and more of a clearing house for natural history information. Inquiries arrive from every state in the Union. Among the letters of the past few weeks was one from Delaware with the question, "Is Lamarckism dead, or is there something to the idea of progeny inheriting some of the acquired characteristics of their parents?" Unless the questioner is satisfied with the bibliography we forwarded, the "Lamarckism" query will, no doubt, soon make its appearance upon another desk, "somewhere in the American Museum."

And then there was the unknown gentleman who came to the Park looking for resplendent pileated woodpeckers. It was the first real winter day in February. The thermometer had dropped thirty degrees overnight and a terrific gale shouted straight from the north. The bird searcher appeared at Trailside early in the bitterly cold morning with the pale pallor of the city written clearly upon him. He wore a light overcoat over a business suit and carried binoculars, and a paper bag containing his lunch. We endeavored to dissuade him from going the twelve miles he wished to travel and encouraged him to follow a nearby trail in the shadow of Bear Mountain instead. Our understanding was that he had finally decided to accept our well-meant advice.

The man will never know, unless he reads this, that two conscientious police officers searched in vain for him later on, upon the trails near Bear Mountain, for fear that he might have come to some harm in the frigid weather. Later in the afternoon, he appeared, red-cheeked and cheerful, despite the fact that the woodpecker had eluded him. He had gone the twelve miles, regardless!

Mr. Archbold to Return to New Guinea

Announcement was made recently at the American Museum of Natural History by Richard Archbold, Research Associate of the Department of Mammals, that he plans to lead another flying expedition for the American Museum into the New Guinea region late this year. To this end, Mr. Archbold has acquired a twin-engined, Consolidated Flying Boat which he plans to fly from New York to New Guinea by way of the Pacific. The plane is now under course of construction at San Diego.

The exact route Mr. Archbold will follow across the Pacific has not been determined as yet. But, according to present plans, he will cross the Pacific by way of Hawaii, Midway Island, Wake Island and Guam, from which point he may proceed straight south to New Guinea—a distance of less than 2,000 miles. Mr. Archbold expects to leave New York some time in November.

The plane to be used on the expedition is equipped with two 1,000 horsepower engines. It has a cruising speed of 140 miles an hour. It will have two-way radio equipment and a cruising range of approximately 4,000 miles, which is far in excess of the longest cross-water hop of 2,089 miles from California to Hawaii.

Mr. Archbold expects delivery of the plane sometime this spring—probably in May—after which it will be test-flown by himself and Russell Rogers, the pilot, who was with Mr. Archbold on his recent New Guinea expedition which, as previously mentioned in this department, was somewhat curtailed on July 8, last year when the plane capsized during the night while anchored off Port Moresby harbor.

The object of the expedition into New Guinea is to collect mammals, birds and plants as well as to study the life history of birds and animals in the regions to be explored. Mr. Archbold expects to spend more than a year in this activity. Just how his expeditionary arrangements are to be carried out remains to be decided.

Leader of the scientific members of the expedition will be Dr. Austin L. Rand, who has accompanied Mr. Archbold on three previous expeditions to New Guinea.

The Return of Mr. H. C. Raven

Mr. H. C. Raven has returned to the Museum after four months spent at the Johns Hopkins Medical School in dissecting part of the gorilla material obtained by him on the Columbia University-American Museum African Expedition of 1929-1931. The preliminary dissection and the drawings, especially of the upper extremities, head and neck, have been made and the work will now be continued at the Museum.

Ocean Sunfish Acquisition

A notable addition to the treasures of the Department of Fishes is a splendid specimen of the pointed-tailed ocean sunfish *(Masturus Lanceolatus)*, the gift of Mr. Albert Pflueger, naturalist and taxidermist of Miami, Florida.

The Ocean sunfish is remarkable for the breath-taking difference between its size at birth and its size when it has reached maturity. Scientists have estimated that the larva of this fish measures one-tenth of an inch whereas a full grown specimen measures ten feet. Its weight from birth to maturity is in a ratio of 1 to 60,000,000.

This latest specimen is 5 feet long and 6 feet deep over the long dorsal and anal fins, and was caught off Miami. It was photographed immediately upon arrival at the Museum and a plaster mold made while it was fresh. A plaster cast will be made of the fish which will be hung in the Hall of Fishes alongside that of the round-tailed form, *Mola mola,* so that direct comparison of the two forms can be made. Mr. Raven will dissect the fish so that he and Doctor Gregory may study its anatomy, particularly the skeletal and muscular structures of the hinder end. This will enable them to compare these structures with what they found in a similar dissection and study of *Mola mola.*

Dr. E. W. Gudger is the author of a very informative article on the pointed-tailed ocean sunfish which appeared in the June (1936) number of NATURAL HISTORY. His exhaustive paper on the structure and development of the remarkable tail of this fish has just been published in the first issue for 1937 of *Annals and Magazine of Natural History,* London.

Know Your Museum Series

Registrations for the "Know Your Museum" series are being received in increasingly large numbers. This spring Mr. Nels Nelson, Curator of Prehistoric Archaeology, is conducting these delightful informal gatherings for adults and his general title is "Early Man and His Culture." The series consists of four sessions, the first one being held on Tuesday evening February 23rd. Many members are veteran registrants for the "Know Your Museum" series and have found the evenings a delight both socially and educationally. A number of out-of-towners are included in the long list of attendants. There are five members who motor in from Monroe, N. Y. for every lecture and the present applications reveal an enthusiastic member who will come from Albany, N. Y., each evening that Mr. Nelson meets the group.

New Planetarium Schedule

Beginning the first of March the schedule of hours for lectures in the Hayden Planetarium will undergo extensive changes, as follows:

	Mornings	*General Admission*	*Reserved*
11:00	Saturdays Only	25 cents	(None)
	Afternoons		
1:00	Saturdays Only	25 cents	(None)
2:00	Daily—Sundays and Holidays	25 cents	50 cents
3:00	" " " "	25 cents	50 cents
4:00	" " " "	25 cents	50 cents
5:00	Saturdays, Sundays and Holidays Only	25 cents	50 cents
	Evenings		
8:30	Daily—Sundays and Holidays	35 cents	60 cents

General Admission for Children Under 17 Years Accompanied by Adults 15¢ at all performances.

Children Under 5 Years of Age Not Admitted. Doors Close Promptly on the Hour.

The Planetarium performance for March will be on the subject "The Seasons." Several colorful features will be added this month to the Planetarium sky, supplementing the regular effects. The March demonstration will show the causes of the change of seasons, the striking reversal of seasons in northern and southern hemispheres, and various seasonal atmospheric effects.

Planetarium Exhibits

The Misses Mildred Sawyer and Anna Lord Strauss have presented an interesting armillary sphere to the Hayden Planetarium. This sphere, made of paper-covered wood, was constructed in France in the eighteenth century and shows the planets known at that time of which Saturn was the most distant.

A seismograph of the very modern type known as an accelerograph is now on exhibition on the second floor of the Planetarium. This interesting instrument, which is mounted in such a way as to be operated by the Planetarium visitor, was lent by the United States Coast and Geodetic Survey. This particular seismograph actually recorded the recent severe earthquake in Montana.

A. A. A. Radio Talks

During March the following radio talks will be given over Station WHN on Saturday afternoons at 2:30:

March 6—"Stellar Pioneers"—Hubert Bernhard.

March 13—Topic to be announced—Wayne M. Faunce.

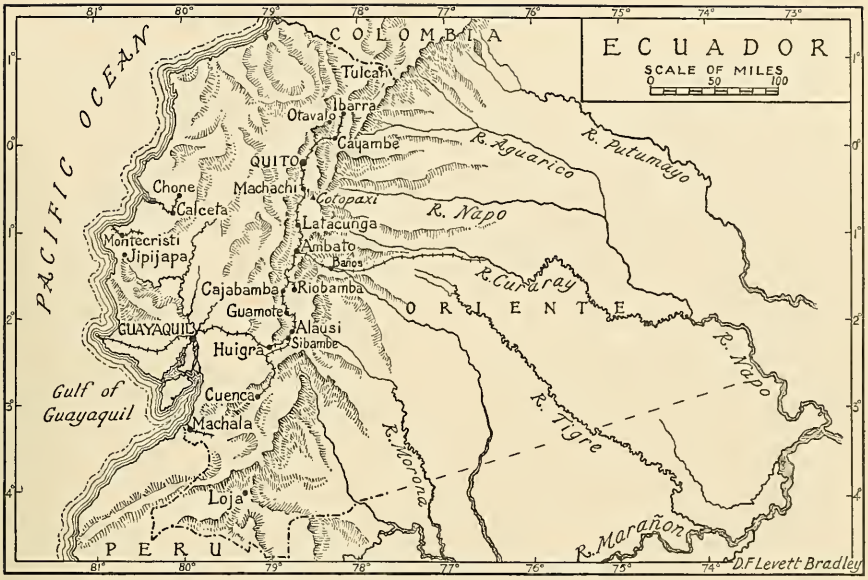
March 20—"Reflections of an Amateur Telescope Maker"—Robert G. Cox.

March 27—"Elusive Mercury"—Charles A. Federer, Jr.

The Junior Astronomy Club will hold its meetings in March on Saturday evenings at 8:00, in the Roosevelt Memorial:

March 13—"All Kinds of Eclipses"—Abe Shanes—Club Election.

March 27—"Why Things Move"—Mr. Charles A. Federer, Jr., Secretary of the Amateur Astronomers Association.



PASSPORT TO *ECUADOR*

Most of us at one time or another, when economic, political and personal problems press too closely, longingly envision escape to a land such as Mr. Richard C. Gill describes in his article, "How to be a Medieval Baron," in this issue of NATURAL HISTORY. Few of us have the opportunity or inclination to settle down permanently in a foreign country of orchid-decked jungles, snow-clad mountains, leisurely ways and quaint customs. But it is within the reach of most of us to spend at least a few weeks in one of the most interesting, beautiful and least traveled republics in South America. It is only eight days on a first class, modern ocean liner to Guayaquil, the gateway to Ecuador.

Dr. Harold E. Anthony, Curator of the Department of Mammals of the American Museum of Natural History, who has done extensive expeditionary work in Ecuador, says, "It is a most fascinating region to the Northerner no matter what may be his special field of interest. For one who finds enjoyment in the observation of native peoples, there are many subjects, ranging from the civilized Quichuas to the primitive Jivaros; for him who takes delight in wonderful scenery and exotic forests, there are countless opportunities for enjoyment; finally for the student of natural history, Ecuador is a veritable treasure house of material and data."

TRAVEL IN ECUADOR: Although transportation facilities in Ecuador are not as extensive or up-to-date as on many of the more usual tourist routes, the average traveler will experience no difficulty in visiting most of the places of outstanding interest and beauty. A railroad connects Guayaquil and Quito and motor roads, though not hard surfaced, are passable. Some of the smaller towns and interesting places can only be reached on horseback but these trips are so well worth taking that even the most timid equestrian should include some riding along with other methods of transportation.

The following itinerary is suggested by Doctor Anthony for the average visitor who intends to spend only a few weeks in Ecuador, and does not include the more remote places where special equipment and arrangements are necessary.

GUAYAQUIL: At the mouth of the Guayas River the ocean liner takes on a pilot to navigate the tricky shoals that lie along the route to Guayaquil, forty miles up the river. As the ship slowly progresses between the low, marshy banks with their tropical vegetation, one gets his first impression of an exotic country. He sees the towering Andes shrouded in mist in the distance, strange river boats scuttling or drifting by on the current, and cattle being floated downstream, tied by the horns to native canoes.

Guayaquil, having been rebuilt after numerous destructive sieges and fires, has little of interest in the way of historic architecture. But the busy waterfront with its native boats unloading fruit from the interior, the pastel-colored houses and the shops, where one may bargain

for carved ivory-nut figures, Indian blankets and the finest Panama hats in the world, contribute to the picturesqueness of this river city. A visit should be made to one of the Balsa mills where you may have the unique experience of lifting a huge log in one hand. Balsa wood, which is lighter than cork and extremely durable, is one of the important exports of Ecuador and is shipped from Guayaquil to all parts of the world for such varied uses as Hawaiian surf boards and airplane cabin insulation.

RIVER TRIPS: Several interesting short excursions that will prove unusual to the most seasoned traveler may be taken from Guayaquil. Among these is a trip by small river steamer up the Guayas River and should include a visit to one of the many cacao plantations and an alligator hunt. Guns for this popular native sport may be secured in Guayaquil.

Although the jungles of the 'Oriente,' east of the Andes, is practically inaccessible to the average tourist, the giant ferns, orchids and equatorial forest of the west coast may easily be reached from Guayaquil. An overnight trip may be made by river steamer down the Guayas River and across the bay to Machala from which town a short railroad spur runs back into dense tropical jungle.

TO THE SIERRA: A half-hour launch trip takes one to the beginning of the railroad to the interior. The train leaves at 6:00 A. M. and for several hours passes through the rice, cacao, banana and sugar plantations of the lowlands. Then, winding through valleys and around mountains, it ascends over one of the most spectacular and awe-inspiring railroad achievements in the world, to the Andes. A short stop is made at Huigra, 4000 feet above sea level, for lunch before the serious ascent begins. At every small station native vendors offer fruit in handmade baskets, steaming chickens and whole roast pigs for sale to hungry passengers. But for those who prefer to acquire gradually a taste for native fare, a box lunch put up at Guayaquil is suggested.

At Huigra begins the amazing zig-zag climb on a five and a half degree grade over a roadbed cut through the solid rock of Nariz del Diablo (Devil's Nose) Mountain. At about 4:30 P. M. the train arrives at Cajabamba. Here, those who wish to reach Quito that night, detrain and find their previously arranged for American automobile and competent chauffeur awaiting them. The five and a half hour drive over good dirt roads from Cajabamba to Quito skirts by moonlight the majestic, snow-capped peaks of Chimborazo, the highest mountain in Ecuador, Cotopaxi and Pichincha. En route a stop is made at Ambato for supper. On the return trip from Quito a longer stay may be made at Ambato. Those who prefer to, may continue on the train to Riobamba, spend the night there and resume the train trip to Quito the following morning.

QUITO: The capital of Ecuador is one of the most fascinating cities in South America. Once the northern capital of the Inca Empire, its history through the days of the Spanish Conquest down to the present would form a thrilling volume in itself. Over 9000 feet above sea level, Quito lies upon the margin of a vast inter-Andean basin rimmed by mountains that tower from 16,000 to 19,000 feet. On a clear day it is possible to see eleven snow-clad peaks from the city. Fairly overhanging Quito is Mt. Pichincha and spread at its feet are the rolling green hills and quilted fields of the Paramo. The prevailing architecture of the capital is Spanish Colonial and the streets are made colorful by the throngs of Quichuas in their picturesque ponchos. Here the Old World and the New meet; cloisters and monasteries built by the Conquerors face across the plazas comfortable hotels and modern cinemas. The diplomatic circle of foreign representatives stationed in the capital make the social life of Quito the gayest in Ecuador.

Sightseeing in Quito should include a visit to the beautiful 'Compania' Church with its golden altars and works of art and the Municipal Museum with its exhibition of ancient Indian art. Eclipsing the latter in importance is the private collection—the gallery of Jacinto Jijon Y Caamano—whose archaeological treasures are internationally famous. Although it is a private gallery, permission may be secured to visit it.

CROSSING THE EQUATOR: Many interesting excursions may be made from Quito. Especially recommended is a full day's trip by motor to Otavalo and Ibarra, which are well worth visiting because of their colorful Indian market scenes and opportunity to purchase fine native ponchos, blankets and varicolored shawls. A picnic lunch may be put up in Quito to be eaten en route on the shore of Lake Mojanda. A feature of the trip is the crossing of the equator at the village of Cayambe. One of the streets of the village is said to actually follow the line of the equator. Two mounds, supposedly of pre-Incan origin, are believed to indicate that these ancient people had marked the equator at this spot before the French engineers in 1870 had scientifically located it there.

Other trips from Quito are a short motor ride to Machachi, famous for its medicinal baths, hot springs and mineral swimming pool, and horseback or mountain climbing trips up the slopes of Pichincha. Here, with great condors circling overhead, one may get a marvelous view of the Andes at sunrise before the clouds swirl up from the valley far below.

RIOBAMBA: Riobamba lies in a fertile valley surrounded by giant mountains, among them, Tungurahua, Chimborazo, and Altar, whose cap was blown off in some past age leaving only the jagged roots to testify that it was once one of the highest mountains in existence. A horseback ride from Riobamba will take you to a point where you can see the volcano of Sangay which has been in continuous eruption since the Conquest and is constantly overhung by a pall of black smoke. The city itself, is an interesting Indian town. The weekly market gathering and fiesta, when the natives bring in cattle, produce and other wares, is a sight worth seeing. Saturday and Sunday should be spent in Riobamba for the weekend fiesta and on Monday a motor trip may be made to Ambato and Banos.

GATEWAY TO THE ORIENTE: Banos, situated at the edge of the jungle, is one of the entrances for parties traveling into the Oriente and Amazon basin. Here the scenery begins to look tropical and a few hours' steep descent on horseback takes one into the heart of the jungle. At Banos you will see the Jivaros, naked savages who hunt with blow-gun or poisoned arrow and shrink the heads of their enemies. As foreign travelers are not among the latter, there is no danger in encountering these picturesque Indians in Banos, and it is an interesting experience to stand so close to the edge of civilization.

From Banos the return is made by motor to Riobamba, with an overnight stop at Ambato. The following day the

train takes you from Riobamba to Guayaquil. The above itinerary is planned for a two weeks' stay in Ecuador, but if more time can be allowed a visit should be made to Cuenca. Near Cuenca are the ruins of the ancient city of Tomebamba, which figured so prominently in the history of the Spanish Conquest. One should also visit the towns of Jipijapa and Monte Cristi, where Panama hats, as soft as fabric, are slowly and tediously made by hand.

TRANSPORTATION: The Grace Line, which operates first class, modern ships between New York and the west coast of South America, maintains a fortnightly schedule to Guayaquil. At the end of the trip, which allows two weeks in Ecuador, you can return to New York (or change at Panama for California) via Grace Line ship or continue down the coast to Peru and Chile. The itinerary outlined above, suggested by Doctor Anthony, can be arranged for through the offices of this line or a travel agency.

Pan American Airways planes leave Miami every Tuesday and Saturday, arriving in Guayaquil Wednesdays and Sundays. Connections can be made from other parts of the United States at Cristobal, Panama Canal Zone, for Pan American planes to Ecuador.

SIDNEY C. LEE.

Recent Museum Publications

No. 891. Some Hamilton Ostracodes from Arkona, Ontario. By H. N. Coryell and Doris S. Malkin.

892. A new Lizard of the Genus *Sceloporus* from Southern Mexico. By Hobart M. Smith.

893. Studies of Peruvian Birds. No. XXIII. Notes on *Doliornis, Pipreola, Attila, Laniocera, Rhytipterna,* and *Lipaugus*. By John T. Zimmer.

894. Studies of Peruvian Birds. No. XXIV. Notes on *Pachyramphus, Platypsaris, Tityra,* and *Pyroderus*. By John T. Zimmer.

895. The Nearctic Atypidae. By W. J. Gertsch.

896. A reversed Almost Wholly Ambicolorate Summer Flounder, *Paralichthys dentatus*. By E. W. Gudger.

897. Ambicoloration, Partial and Complete, in the Southern Flounder, *Paralichthys lethostigma*. By E. W. Gudger.

898. A New Flying Squirrel from Honduras. By George G. Goodwin.

899. New and Little-Known American Bees. By T. D. A. Cockerell.

900. The Brain of the Swordfish *(Xiphias gladius)*. By G. Miles Conrad.

901. Notes on Swordfish at Cape Breton, Nova Scotia. By J. T. Nichols and F. R. LaMonte.

902. Notes on the Alimentary Tract of the Swordfish *(Xiphias gladius)*. By H. C. Raven and Francesca LaMonte.

903. Rotifera from the Adirondack Region of New York. By Frank J. Myers.

904. Notes on the Genus *Sericornis* Gould. By Ernst Mayr.

905. Notes on the Taxonomy and Osteology of Two Species of *Mesoplodon* (M. *Europaeus* Gervais, M. *Mirus* True). By H. C. Raven.

906. New Hesperiidae from the Antilles (Lepidoptera: Rhopalocera). By Frank E. Watson.

RECENTLY ELECTED MEMBERS

New Members

THE following 381 persons have been elected to membership in the American Museum of Natural History since the last issue of NATURAL HISTORY:

Benefactor

Mr. William D. Campbell.

Associate Benefactor

Mr. Philip M. Plant.

Patron

Mr. Andrew G. C. Sage.

Fellows

Messrs. Wyllys Rosseter Betts, Jr., Cyril F. dos Passos, William Monypeny Newsom, Hubert E. Rogers, Earle F. Watson.

Honorary Life

Major W. V. D. Dickinson, M. C.

Life Members

Mesdames Fanny Dwight Clark, Mary Mellon.

Misses Elizabeth M. Bonbright, Constance Everett.

Messrs. Wesley Everett Bell, William Sprague Candee, Herman Kappes, Paul Mellon.

Sustaining Members

Mesdames H. E. Jewett, Gerard B. Lambert, Stafford McLean.

Annual Members

Mesdames John F. Birch, Alan Cunningham, Arthur M. Dole, W. Barton Eddison, Samuel Knapp Frost, Z. D. B. Hallett, Eugene Lewis, F. H. Rosebrock, Edwards Spencer, David M. Wood.

Misses Margaret S. Appleton, Madeleine R. Cook, A. B. Cooke, Marion G. Davis, Winifred M. Dean, Helen T. Farrell, Florence Fitzherbert, Lillian F. Haskins, Jane Kretschmer, Edith Wells Meyer, Jeanette C. Muller, Ethel Madeline Nelson, Leslie J. Schoonmaker, Isabelle Sicklick, Florence L. Warner.

Doctors Maryesther Burns, James Henry Inkster, Fred S. Kent, Alfred E. Thayer, Henry Trautmann, Kay White.

Messrs. Samuel Bonnell, J. A. Brown, Stephen W. Carey, Jr., Howard E. Cole, Arthur S. Dewing, Albert B. Eastwood, J. Wilmer Fisher, Leon Fraser, Nicolas J. Gerald, Harold W. Gillen, Arthur J. Goldsmith, John W. Griffin, Henry J. Grupe, Rupert H. Johnson, Arthur Jones, Leo B. Kagan, Joseph Brady Kennedy, Jr., Albert R. Korn, Richard N. Palmer, James D. Regan, Daniel Rheinauer, Joseph Schwarzenbach, W. E. Simpson, Frederick Swift, Irving Van Zandt, David C. Whitney, Henry W. Wilson, Sigmund Wimelbacher.

Associate Members

Mesdames Robert M. Barrett, A. Eugene Benners, Andrew S. Beres, Jeannette A. Bertolf, P. W. Bidwell, I. Block, John C. Bradley, W. E. Brainard, Edward W. Briggs, Lee Brodie, D. A. Bullock, T. H. Cappeau, Henrietta Carlson, Charles Cooper, C. Burns Craig, Emlen P. Darlington, Hugh W. Davis, Beman Dawes, Jean Decker, Louis deRochemont, Helen A. B. Etheredge, J. L. Flood, E. R. W. Frost, Bertha Glassey, Cora F. Goodrich, L. Dwight Granger, Norman W. Green, Frederik Hamilton, Frank Harr, Richard Heimann, F. V. Henshaw, H. G. Heyson, Ida L. Hicks, Anita Day Hubbard, Otis L. Hubbard, J. Maynard Kissam, Chas. Koegel, George J. Lane, Irene Long,

Warren Lothrop, John M. McMillin, O. W. Merrow, J. Bernard Miller, Edith W. Newcomb, John P. Nickerson, Charles F. Robbins, Jr., Alice H. Rockwell, A. B. Schultz, Caroline S. Spencer, J. Rich Steers, Gisela Hoffman Stout, Josephine C. Swift, A. W. Thompson, Maude B. Upham.

Sister M. Rose Gertrude, O. P.

Misses Winifred M. Altree, Mildred H. Atwood, Marion D. Barker, Edna E. Bloomer, Amy Botsford, Grace Bradley, Pearl F. Brown, Dorothy L. Buck, Florence Button, Emily L. Clark, Lilian Cromelin, Lois Margaret Davis, Mary C. Dennison, Katherine Drescher, Helen M. Fogarty, Alice M. Godard, Natalie Hays Hammond, Almeda B. Harpel, Leona Hogarth, Anne Holdford, Ruth Thelma Horowitz, Ethelyn Hosley, Grace C. Huber, Lucy O. Hunt, Mary Ill, Adelaide LeCount, Tillie Levinthal, Patricia McGraw, Jane L. Moore, Julia L. Morrell, Catherine Ann Phelps, Caroline Pomeranz, Lydia S. Rose, Ruth Skillern, Gale Smith, Margot Sproul, Anne I. Striker, Shirley Taft, Adah Tucker, Ethel Van Houten, Mary Whelan, Helen C. Young.

Reverends Nelson L. Chowenhill, David H. Scanlon, Harry L. Somers, A. J. Walton, P. H. Yancey, S. J.

Major James A. Woodruff.

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A KEY TO PRECIOUS STONES

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As one would expect from such an eminent authority as Doctor Spencer the *Key to Precious Stones* is well written; it abounds with the deftly chosen comparisons which make for clarity in catering to an audience of popular readers.

The first seven chapters are in effect a very much condensed mineralogy, not always strictly confined to the application of the various determinative methods to gem stones. The chapter on "Forms of Crystals" is admirably treated although far too short, while that on "Optical Characters of Precious Stones, and Their Action on Light" is too long, and rather too technical. The latter characterization applies even more aptly to the chapter on the "Geological Occurrence and Origin of Precious Stones". The second part is devoted to descriptions of the various gem minerals beginning, of course, with the diamond.

A number of pages are given over to histories of some of the famous diamonds of the world from the Koh-i-noor to the Jonker. In the chapter on "Opal and Silica Glass" the author recounts at some length his adventures in finding silica glass in the Libyan desert, a story that contributes much to the romantic interest of what might otherwise be a somewhat dry account.

A color plate reproduced by a direct color photographic process and printed on the "dust jacket" does not do justice to the fine examples of the rough and facetted stones, many of them taken from the British Museum's Collection, and far better depicted in that Museum's series of color cards.

H. P. W.

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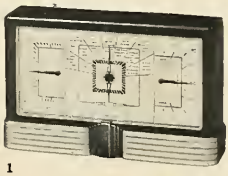

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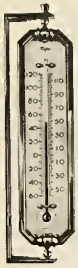

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A Tribute to A Friend

By Roy Chapman Andrews,
Director, *American Museum of Natural History*

I cannot write of George Sherwood other than in a very personal way. For many years he has been my closest friend. He was the first person to whom I spoke when, as a boy just out of college, I came to the Museum on a steaming July day in 1906 asking for a job. Doctor H. C. Bumpus was then Director and George Sherwood was his assistant. I shall never forget the warm smile of welcome with which he met me as I walked into his office. That was almost thirty-one years ago and that same wonderful smile has always lighted his fine eyes during these long years of friendship. It was the key to the warm affectionate nature of a man who never failed in sympathy to one in trouble, and in joy for the happiness of his friends.

He died in the Museum surrounded by his friends, where almost literally his life has been lived. As he was walking to the lecture hall to introduce Peter Freuchen his overstrained heart gave way. His last words were, "I can't do it. Tell Doctor Fisher to carry on."

He was a good soldier. For years he knew that the shadow of death hovered always in the background; that it might descend at any moment to take him from those he loved. Yet never have I heard him utter one word of complaint. The keen edge of his delightful humor was never dulled; no one could have guessed what he carried in his heart.

After graduating from Brown University in 1898 he came to New York in 1901 to join the staff of the Museum as Assistant Curator of the Department of Invertebrate Zoology. From that year until his death on the evening of March 18, 1937, most of his waking hours were spent within the walls of this institution.

He passed through various positions in the Museum until upon the retirement of Doctor F. A. Lucas in 1924 he became its Acting-Director, and Director in 1927.

Although Doctor Sherwood had been warned repeatedly by his physician that his health was in a serious condition, he could not be made to spare himself. In March, 1934 the inevitable happened and he had a serious heart attack while sitting at his desk in the Director's office. During the long months of inactivity first in New York and then at his summer place on the beach near Clinton, Connecticut, his cheerfulness never failed; always there was the one thought of how soon he could get back to give more of himself to his beloved Museum.

No one knows better than I what a blow to him it was to learn from his doctors that he could not carry on the strenuous duties of Director. He said to me a dozen times, "I want to go out here—on the job—where I've always worked."

Yet he took the blow standing up; faced it as he faced all things in life—with a smile. He was made Honorary Director on January 7, 1935 and devoted himself energetically to the Department of Public Education of which he had been Curator since 1906.

Of all the varied work in the Museum he was most interested in education. It was under his direction that the department became a living vital force in the visual education of New York City and the nation. At the time of his death, ninety-two per cent of all the schools in the metropolitan district are being served in one way or another by his department. The impressive record of forty million contacts with school children during 1936 tells its own story of the magnitude of his work.

During the years of his Directorship of the Museum there was not a department and hardly an individual who did not have contact with his friendly personality. To the varied problems which are the Director's he brought always the strict honesty, the sense of justice, the humanness and friendly spirit which were his abiding characteristics.

No one hated eulogy more than he. George Sherwood was a simple, genuine, kindly man who preferred to have his record tell its own story of his work. In the truest sense his life was one of unselfish service to the American Museum and his fellow men.

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XXXIX—NO. 4 ★ ★ ★ ★ ★ APRIL 1937

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Secretary, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

COPYRIGHT, 1937, by the American Museum of Natural History, New York, N. Y.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-seventh Street and Central Park West. Subscription price $3 a year, single copies fifty cents. These rates also apply to Canada, Newfoundland, and all foreign countries. Entered as second class matter March 9, 1936, at the Post Office at New York, New York, under the Act of August 24, 1912.

The True Otter Hunters

Fox hounds at the left, a trio of otter hounds at the right. A pack may meet a score of times, at as many places, between April and June. Such well scattered hunts have much to do with the survival of otters in English streams

AHUNTING WE WILL GO!—*A colorful day with the Bucks Otter Hounds, showing that sport is not always hostile to conservation*

By Robert Cushman Murphy

Otter hunting is a ruthless, brutal, blood-sport, say many kindly persons. It may be so. As a conservationist, I am less concerned with its alleged effect upon the character of the hunters than with a longing to see otters playing and fishing, as they did of yore, in our brooks and little rivers.

In the eastern United States the otter, once abundant, has been mercilessly wiped out of existence by means of steel traps. In ancient and much more thickly settled England, where it is regarded as unspeakably bad form to shoot or trap this intelligent and engaging mammal, packs of otter hounds, worked by devotees of sport, slay surplus otters but preserve the species. The sleek and subtle swimmer still dwells in every English rural stream. Now and again the hounds kill, as the climax of an hour or two of bedlam along green banks and through pools and shallows. But since when has being rent by toothed jaws ceased to be a natural death for a wild animal? Inquire of the fish, frogs, moorhens, ducklings, and leverets eaten by the otter, who is in turn finished off by man's canine playmates instead of by the British wolves or golden eagles that ended the days of his remote ancestors.

Announcement

"The Bucks Otter Hounds will meet (weather and water permitting)," read our invitation for the last day of April, "at Thornton Bridge, nr. Stony Stratford, 10:30 A. M." Consideration for the farmers was indicated by a quaintly worded line at the bottom of the card: "Hounds will stop for the mowing grass."

At the bridge, on a morning of pale northern sunshine, the hounds tumbled out of the van to roll in wet grass, cast off, and take to the winding waterways. Across emerald meadows the royal blue plus-fours and scarlet caps of members of the hunt could be seen amidst a swarm of milling guests and hangers-on. Joining the group meant a demand from the lynx-eyed secretary, who wore an otter pad above his visor, for a "cap" of half a crown apiece; only small boys and local farm hands were spared this formality.

The hunters carried forked blackthorn staves, notched with the lives of otters. One woman rejoiced in about eighty such white nicks. No doubt the walls of her game room at home were dotted with forlorn "masks," "rudders," and "pads," each on its tiny trophy-panel of English oak.

An otter had already been located and the drag was under way. Everybody was doubtless striving to pay attention to the Master, who slopped about tirelessly, mustering the scattered pack with quavering notes on his horn, and bellowing orders mixed with expletives as pink as his cap. However, the focus of interest could not easily be kept in one place; separate clusters of men, women, and dogs would start a local pandemonium, now here, now there, as the "chain" (rising air bubbles) of the elusive otter was spied out anew.

The "stickle"

Pandemonium, indeed, seems to be the motif of otter hunting, despite its strict rules as to just how the quarry may have the honor of being killed, and as to how each member of the hunt must deport himself in the presence of the M. O. H. Next to water polo, this is the wettest of sports. One begins a hunt smartly turned out and ends it looking "like nothing human except the salvage from shipwreck. The one thing lacking is seaweed in the hair." Not only must each participant be ready to wade into any negotiable depth during the formation of the "stickle" or human hedge that may turn a submerged otter back toward the following hounds but, moreover, the hardier male members of the hunt seldom hesitate to plunge into deep pools of yet wintry water when the otter has been brought to bay. Since neither men nor hounds relish their streams too icy, the otter enjoys a holiday from September to April, and by the latter date its whelps are weaned and fending for themselves.

The humans, after all, are largely vicarious sharers in the sport; it is the dogs that are the true hunters. An otter pack is made up of fifteen or twenty couple, comprising three breeds: fox hounds,

A hunting we will go

OTTER HUNTING is the most thoroughly native of English blood-sports, and both invited and uninvited guests join the field with equal enthusiasm. Outside the British Isles there is said to be only one otter pack in the world, that being in France

CALLED BY MANY PERSONS a brutal avocation, otter hunting may be otherwise interpreted by a conservationist. In America we have no otter packs, yet neither have we saved our otters, for throughout the thickly settled states they have been well-nigh exterminated by trapping. In populous England, where it is bad form to shoot or trap an otter, the fascinating mammal has been preserved through an organized sport that slays only the surplus

TYPES IN THE WATCHFUL FIELD. A uniformed member of the hunt, with pole and scarlet head gear; a guest who has paid her two and six; and urchins who are just taking it in regardless

OTTER HOUNDS, representatives of one of the oldest and most thoroughly amphibious of British breeds, lick the wash and sniff the thorn in their tireless quest of the slippery quarry

MASK AND NOTCHES—the Diana of Stony Stratford. The otter's head is in this instance carved on the staff. The notches indicate previous kills within pole's reach of the tousle-headed girl

THE ARMY AND THE NAVY OF OTTER HUNTING IN HOT PURSUIT. Hounds swim while men slop, and all participants keep an eye peeled for fresh "spraints," or otter dung

TEAM-WORK BY THE PACK, and an otter hound in the center expressing his approval in a voice like that of Big Ben. The hounds rely mostly upon their noses, but they also appear to recognize by sight the "chain" of a submerged otter

WATCHING FOR THE "CHAIN" or string of bubbles that rises behind a fleeing otter. It is this telltale wake that enables hounds and men to follow his artful dodges up and down stream

THE "STICKLE." No chance of escape, you might conclude, but the otter often slips through the living pickets, raising the siege for the time and compelling the field to shift elsewhere

THE FIELD EXPECTANTLY WAITS about the "hover where the otter couches," in other words, one of his regular retreats beneath the bank. Much time and ingenuity may be needed to oust him

THE "HOLT" or otter's fastness under an oak. Small terriers, of which one is struggling in the arms of a man on the bank, now become the auxiliaries of the stymied hounds

with the most delicate of specially trained noses to pick up the peculiar scent, and to keep the game confined to water (for on land it is theoretically sacrosanct); terriers, to penetrate like ferrets the cavern or "holt" among tangled oak roots and to drive the otter thence toward more formidable foes; otter hounds, scarcely less aquatic than their prey, which follow the chain of bubbles relentlessly, harry the otter from pool to stickle and back again, and swim and dive in his wake until the fatal moment when he makes his last stand. The otter hound is an almost primordial British breed and is one of the ancestors of the modern and highly synthetic airedale. Its bay is full and round and peculiarly stirring, resembling the voice of a bloodhound rather than of a fox hound. "Do church music or hound cry stir you most?" asks the conventionally pious English farmer of a companion in the field, which is likely to include squire and parson, nobleman and harness-maker, and all the country boys and girls who can contrive to steal away from school or chores.

The otter "clitters"

Cattle in the meadows wonder what it is all about, making half scared spurts out of the way while berserker bipeds and crazy dogs dash by. A jeweled kingfisher, so different from our big American bird, shoots out of the alders like a bullet. Startled moorhens, flushing before the jaws of hounds which do not deign to notice them, flap heavily upstream in vain quest of a quiet nook. The otter peeps from bestirred and muddy water into the gaze of a yelling horde, "clitters" or whistles with the sound of steam blowing off, and then bounds across a shoal, slipping through the stickle, to disappear into the momentary asylum of a pool, while the hounds swim about licking up the scent.

"They're tonguing the ream brave," is a line one can pick out of the noisy jargon. "Heu gaz!"—whatever that means—comes the shout as the chain once more lays its foreboding wake on the surface. "The chain! There he vents! Tally-ho! Seek 'im, me lads! Wind 'im, me lads! Middy-ho! Hi-over, hi-over! Wind 'im out!" The hounds speak, too, in voices like big bells. The cruelly harried otter dashes out of water, after circling the dark pool, and outflanks the re-formed stickle where the frothing Master stands up to his middle, sweeping his pole from side to side. The fox hounds and two or three yapping terriers are already at the banks of the next and shallower pool, where the soaked hunters can watch the shortening dives of the victim until his Nemesis, in the form of an otter hound, thrusts a snout deep down and clamps out a gallant life.

Long live the otter

Englishmen, like most other folk, are jolly rationalizers. They may tell you that they hunt the otter because the latter destroys trout. The true reason, of course, is that they like to hunt the otter. But, bless their souls, they have kept their otters, from the days of Beowulf to the present, and in country corresponding with our suburban counties of Westchester and Nassau!

WHY NOT GIVE YOUR DOG A CHANCE?—*Neglect his education and you may lose a genius; explore that queer mind of his and he will repay you many times*

By ALBERT PAYSON TERHUNE

YOU know infinitely less about your dog than he knows about you. The fault is yours. So is the misfortune. If you would bother to learn more about him, you could teach him much. You could develop to the *n*th power that queer brain and queerer psychology of his.

But you are content, as a rule, to leave him as he is and to rest smugly in the possession of a half-handful of facts about him.

Yes, you know, for instance, that Man and the Dog are the only creatures which worship Man. You know that of all the four-legged or the winged folk, the Dog alone has ranged himself willingly and eagerly on the side of Man in the hunting or the subjugating or the herding of other animals. You know the Dog is mankind's best friend and that he looks on us as gods.

You know those few canine truths chiefly from reading Maeterlinck and his disciples; who couched them in far better words than I can command. But what else do you know about your dog? Precious little. You haven't troubled to explore his nature or his capabilities. Much less have you sought to bring them to fruition. Again the loss and the fault are yours.

The neglected mind

If *you* had been fed and exercised and housed correctly, from babyhood, but if no remotest effort had been made to educate you or to teach you to think, you would have grown into a fool. As does many a dog, under like treatment. Can you blame him? At that, he is likely to think for himself—unguided by his master—and to reason things out and to acquire a code of ethics. Which is more than the average untaught child would do.

I have made an intensive, if clumsy, study of dog nature for something more than half a century. Forty years ago I knew everything that was to be known about dogs. Four succeeding decades of much closer and unending research have proved to me that I know less than one per cent of the subject, and that I never can hope to know more. It is baffling and vexing, this ever-greater ignorance. Here are a few of the countless things I can't explain:

Mysteries of canine intellect

Dogs have senses which we humans lack. (To compensate, perhaps, for senses of ours which are not shared by them.) The saga of a dog which finds its way home over hundreds of miles of unknown territory has ceased almost to be news; so frequent is its recurrence.

Bud, a collie, was taken in a crate in a closed baggage car from Fort Scott, Kansas, to Albuquerque, New Mexico; a distance of about nine hundred miles. He had no way of noting landmarks of the long journey—if indeed dogs can do such things—yet within a few days after his arrival at Albuquerque he started back to Fort Scott. For eight months nothing was heard of him. Then, bone-thin, feeble, scarred, his feet crippled and bleeding, he lurched into the office of Miss Hight, the mistress he worshiped. How had he done it? Nobody can guess.

Bobbie, another collie, found his way back to his master's home in Oregon from central Indiana; and he took six months for the journey. He had swum swift rivers, climbed snowy and wolf-infested mountains, toiled through the sickening heat of the summer prairies. How? Once more, nobody knows.

Certain dogs, I am convinced, can tell by weird instinct the exact moment when some human, dear to them, dies—perhaps fifty miles away. They voice the knowledge by the hideous "death-howl" which is not at all like any other canine utterance. I have proved the truth of this, as has many another dogman. (And God grant I may never hear that ghastly death-howl again!) But no human can hazard the most fantastic guess as to the dog's means of learning that death has occurred.

Dogs of my own have known in advance when I was coming back to Sunnybank from an absence. Other dogmen can tell of like experiences.

Some years ago, at breakfast in our New York

flat, I decided suddenly to run up to Sunnybank for the day. As I finished the meal, I went to the telephone to call my superintendent and tell him to have a car at the railroad station to meet us. Before I could pick up the receiver the telephone bell rang. At the other end of the wire, my superintendent said:

"You're coming home this morning, aren't you, Boss? Five minutes ago, Wolf jumped up from a snooze, here at the Lodge, and he went tearing down to the Big House; and he's running around it, barking like mad. A couple of the other collies have just started down the road toward the station. They always act like that when you're coming home."

Explanation is lacking

How did the collies know? How do they know—and hold a day-and-night Lodge of Gloom—when we are going away? This, before the trunks are brought to the house for packing.

I haven't the answer for any of these questions. If my own dogs alone had done such things, I should not risk the sour charge of lying and of nature faking by repeating the stories. But each and every instance has been noted by scores of other dog-owners.

Almost too frequent to be worth citing here are the true tales of dogs—several Sunnybank collies among the lot—which can recognize the sound of their owner's approaching motor car when it is perhaps a mile distant and when fifty other cars are traversing the same road.

I have touched on perhaps one in ten of the canine brain-twists which no human can solve. I am certain there is no shred of the occult or of the supernatural about any of them. We don't understand them. That doesn't mean a simple explanation could not be found for each and all of them; if only Science would take the pains to make researches into dogs' brain processes, instead of merely into their anatomies.

The striking of a tree by lightning—the unseen force which pushes up the lid of a boiling teakettle—the generating of fire—the reason why people fall down and not up—the semi-occasional eclipse of a noonday sun—all these phenomena were deemed miraculous until Science worked out their causes and learned to profit by some of them. Today, they are normal.

But Science has not deigned to bend its powers to the unraveling of far simpler canine mysteries. Probably because it seemed like going through too much work in order to get too petty results. But can we be positive that *all* the results would be petty; that none of them might lead to something more or less worth while? Think it over.

The slovenly explanation 'animal instinct,' may cover some of the mysteries I told you of. But by no means all of them.

Instinct, as I understand it, is the accumulation of ancestral experiences: the atavistic urge that makes you jump to your feet at some unexpected sound or sight; or to start when someone from behind slaps you on the shoulder. Those traits of yours are bequests from the caveman who wanted to meet danger standing, and to whom a blow from behind meant the presence of a foe.

But how can instinct account for a dog recognizing the purr of one car's motor, among many other such sounds? There were no motors in the days of his wild ancestors. How could mere animal instinct tell my dogs instantly when I decided to go to Sunnybank? What instinct apprizes a dog of his far-off master's death at the moment it occurs?

In the primal forests, a hundred thousand years ago—when ancestral instincts were in course of acquiring—the donning of a Neanderthal man's cap and raincoat were not a signal that he was going for a walk. He had no cap or raincoat. Probably he had no chum dog.

Yet, today, when you or I put on cap and raincoat, our dogs crowd tumultuously around us, avid for the implied walk. That is not canine atavistic instinct. It is the result of reasoning powers; based on personal experience.

His nose knows

There are doggy motivations, of course, which we have taken the pains to work out in logical form. A few of them. But by no means enough. For one thing, we have cleared up certain minor mysteries by discovering that a dog's strongest sense is his incredibly keen power of scent; that hearing comes next; and that his nearsighted eyes are down near the bottom of the list.

Thus, if you hold a looking glass in front of a dog, not once in ninety times will he pay the slightest heed to his mirrored reflection. His eyes tell him another dog is confronting him. His nose tells him no dog is there. His hearing backs up his nostrils. Therefore, he believes his nose and his ears; and he discards the testimony of his weak eyes.

It is by this uncanny sense of hearing that he can discern his master's distant step or motor or horse's hoofs, long before his eyes can detect it and when the wind is in the wrong direction for accurate scenting.

There is something more—something needful—to

be said of his super-acute sense of hearing. If someone screeches shrilly in your ear, you are aware of a sharp pain there. Yet your hearing is not one-fifth as sensitive as is your dog's. To him, a shrill or loudly squeaky sound, sharp and high, is physical torture.

Several times, friends of mine have asked me to watch their housedog's funny efforts to 'sing.' An ultra-high note would be struck on violin or mandolin or fife or bugle, close to where the unhappy brute was standing. Back went his head. From his pain-curled lips issued a scream; followed perhaps by another and then by another.

His fatuous owners applauded and laughed. Dear little Fido was 'trying to sing to the music!'

Dear little Fido was trying to do nothing of the kind. The ultra-high musical note pierced his delicate ear-mechanism as might a red-hot cambric needle. And he yelled with pain. That was his 'singing.'

I have had difficulty in proving this to silly dog-folk who were proud of their musical pet's accomplishment. But it was the grim truth, as any canine aurist could have told them.

Response to soft music

On the other hand, I have had a dozen dogs or more which reveled in the soft playing of a piano or of an organ. The lower and less penetrating notes afforded them genuine pleasure. I have had dogs which would come galloping to the Sunnybank music room at the first light sound of the Mistress's fingers on organ or piano; and would sit or stand there for an hour or more, head on one side, in happy appreciation. When the instrument fell silent, they would nudge the musician with their noses or growl softly, to coax her into going on with the recital.

Should she play a single high note on violin or on mandolin, they would troop whimpering out of the house in hurt disgust.

Remember all this, next time someone brags to you of his dog's love for 'singing.'

Yet it is on his sense of smell, rather than on sight and hearing combined, that your dog relies.

When you meet another man, instinctively your eyes study his face, so you may recognize him in future. When a dog meets a human or another animal, he seeks to impress on his own brain the scent (not the aspect) of the stranger. He does not stare. He sniffs. And he remembers the odor—even if it be much too faint for human nostrils to register—just as you remember the face.

To this all-potent gift of smell, the hunting dog and the sheepdog owe their value as workers. By means of it, too, many a dog can track his master through miles of oft-trodden roadway or pavement.

Yes, we have bothered to find out that much about our dogs, we all-wise humans; even if we have not troubled to delve into deeper and more fascinating branches of canine lore.

Of late years we have gone a step farther in the matter of scenting powers. It has been a matter of research in at least one university laboratory to trace to its source the once mystic 'fear smell.'

No expert can doubt that his dogs scent the presence of fear in mankind. To some dogs this smell awakens pity; to some a cruel sense of mischief—a craving to tease the biped who is afraid. To more it awakens a desire to attack.

A fearless little child may take painful liberties with a savage dog; and its maulings will not be resented. Yet let a frightened adult seek to touch that same dog; and the fear-sufferer's chances of a bite are one hundred to one. (By the way, it is ancient knowledge among riders that a horse knows—instinctively or more likely by scent—when the person on his back is afraid of him.)

And now, as I said, Science has taken a hand in this theme of fear-smell; with the resulting theory that fear releases a flow of adrenalin in the human system; adrenalin whose odor is keenly perceptible to dogs. If this theory has been established—as apparently it has—then let us score one for Science for digging at last into a perplexing canine problem and pulling out an answer!

Weak on character reading

I go a step farther in this matter of dogs gleaning opinions from the testimony of their noses. I have every reason to believe dogs form their likes and dislikes for humans by the quality of the latters' odor; a smell far too faint to be noticed by less acute nostrils, but agreeable or repulsive to your dog.

The holiest man of my acquaintance—one whom I have known since childhood and who devotes his whole life to charity—comes to visit us sometimes at Sunnybank. Not one of my dogs will stay voluntarily in the same room with him. He told me sadly that he loves dogs, but that he has given over any attempt to own them; because he cannot win their liking or even their tolerance.

Another man—one of the most consummate scoundrels I have met—came to Sunnybank to beg me cringingly to try to keep him out of jail for robbing an Orphanage Fund. The most aloof of my collies made friends with him. The dogs followed him wherever he went. I had heard, before then,

that he had the faculty of winning any dog's confidence and liking.

There is no more flagrant lie in all the long list of canine falsehoods than that a person whom dogs take a liking to is trustworthy; and *vice versa*. In Maine and in Pennsylvania, dogs have been sent to penitentiaries to brighten the lives of the prisoners. The animals became devoted chums of the inmates. Yet surely ALL of those convicts could not have been 100 per cent trustworthy and good!

Science and mankind at large have been unpardonably lazy in seeking to solve dog nature. The bulk of dog owners have been still more so, in failing to humanize and educate their four-legged chums and in not bringing out the very best in them.

The task is so easy! Tackled rightly, it is no task at all. If you did nothing more to train and develop your child than you do for your dog, the youngster would grow into a low-grade moron.

How to humanize your dog

In the first place, have the dog around with you wherever you go, if possible. Especially in your leisure hours. Talk to him, as to another person. Most people don't grasp the big value of talking constantly to their dogs.

True, the wisest canine won't understand the precise meaning of one word in twenty. But the sound of his owner's voice is a delight to him. More, it teaches him the owner's moods, his vocal inflections, his wishes. It is a mighty element in any dog's education. I'm not speaking of baby-talk, but of normal diction.

In almost every instance the dog will learn gradually to understand more and more of what you say; and to respond mentally to it. I don't know just why. But it has been proved, innumerable times. It is one of the surest ways to humanize him; to develop his brain and his heart and his personality.

There are two magic passwords to the education of all dogs. They are *patience* and *common sense*.

Simple sounding phrases, aren't they? But not always easy to adhere to. Yet, on them hang your dog's future, as your comrade and housemate.

Your sensitive six-year-old child would not learn much at school if her teacher should bellow at her or hit her over the head or land a kick in her ribs.

It is the same with your dog. Let him become cowed or bewildered or on the lookout for an explosion of temper or of injustice from the owner who is his god, and goodbye to your chances of moulding him into the best type of canine citizen!

If you can't control your own filthy temper, how can you control a dog—or anything or anybody else? You would not slam a $500 watch to the floor, in a fit of temper. You are doing much more harm to your dog's character and to his value to you, by losing your temper with him or by other injustice.

Eager to learn

A dog does not need nor desire to be fondled and cosseted and babied. He does desire and need a square deal. With the use of patience and common sense you can work wonders with him. Presently you will find he is learning faster than you can teach him; and that he has picked up accomplishments on his own account; things he has thought out for himself; things you did not impart consciously to him.

His brain is quick and eager. He wants to learn. He wants to please you. If you fail to take advantage of all this, the blame and the misfortune are yours.

It is wholly up to *you* to decide whether your dog shall be a pet or a pest; worth while or worthless.

Incidentally, if you care to study him closely, you can learn more from him than ever he can learn from you.

There is one advantage in bringing up a dog, over bringing up a child. Your dog, rightly taught and humanized, will be an ever-increasing asset to you, to the last day of his life. He won't slip back. Whereas, many a wisely reared child has turned out so badly that it would take a special act of Congress to make him any worse.

Give your dog the chance he deserves. He will repay it, many fold.

TERMITE ARCHITECTURE

By Alfred E. Emerson

An east-west exposure is invariably achieved by the millions of tiny insects that build this type of nest. It points north and south almost as accurately as the compass needle, and is one of the phases of termite life which tax human belief

TERMITE ARCHITECTURE—*Showing that man was not the first creature to provide his dwellings with rain-shedding gables, chimneys, ventilation shafts and indoor gardens, as well as air-conditioned rooms for various purposes*

By ALFRED E. EMERSON
Professor of Zoology, University of Chicago

MAN is by no means the only inhabitant of our globe who controls his environment by building. Birds' nests often attain considerable complexity; the silken webs of spiders are marvels of construction and utility; and nests of bees and wasps have been a subject for discussion since ancient times.

But probably the most striking examples of architectural ability found among the lower animals are the nests of tropical termites. Travelers in Australia, Africa, India, Malaya, and South America are constantly impressed by the large termite mounds in the more arid regions and the conspicuous structures often seen on the trees in the forested areas. Although the external appearance of these nests or termitaria is arresting, the detailed study of their construction and function offers an opportunity to gain insight into some of the most interesting behavior to be observed among living creatures.

'Compass' nests

The meridian nests of North Australia are probably the most famous structures built by termites. These nests are to be found thickly scattered over open or lightly wooded country in certain restricted districts. The feature which makes them most striking is their orientation to the direct rays of the sun. Each mound is about eight feet high, and its north-south axis is about six to ten feet long while its east-west axis is only about two feet at its greatest width. Without exception, all the mounds show this remarkable orientation. One might guess that such an arrangement would serve a practical purpose in offering the least surface to the sun's rays during the intense heat of the tropical noon, while the greater exposed surface would only absorb the heat of the sun at periods of less intensity in the early morning and late afternoon. The internal temperature of the nest may, possibly, be regulated by the direction of exposure; but when we consider that the structures are built by millions of tiny blind workers, each contributing a small grain of dirt so placed that in the aggregate they form the compass mound, the phenomenon is indeed a great mystery. Other species of the same genus in various parts of the world do not build these 'magnetic' nests.

Rain-proof nests

In the rain-forest of British Guiana another species of termite, belonging to the same genus (*Amitermes*), builds an equally remarkable but distinctly different nest. Nest structures in such a forest must either be sheltered from the heavy rains or so made that they can withstand the deluge. The workers of this species first build a covered tunnel of dirt particles vertically up the trunk of a tree. Then side tunnels are constructed at an angle downward from the vertical tunnel, which adequately shed the rain descending the trunk of the tree during a shower. The nest proper is soon built on the side of the tree with finger-like projections which easily drip off the excess water falling on the nest. Such nests, of course, are built when it is not raining, yet they are admirably adjusted to forestall the dissolving action of large quantities of water.

Another species of termite, *Constrictotermes cavifrons,* belonging to a different subfamily and, therefore, quite unrelated to the genus referred to above, also protects its nest from the Guiana rain. In this case the workers select the side of a smooth-barked tree usually growing at an angle from the ground. Here they construct a dirt carton nest, in which the queen and king with their numerous progeny establish themselves. Sharp ridges largely made of excrement are built about half an inch apart in parallel rows over the surface of the nest and extending down the outside of the tree at a sharp angle. Similar ridges in a chevron-shaped pattern are built for several feet above the nest on the tree. Each ridge is solid and about an eighth of an inch in height. During a heavy downpour, these ridges effectively divert the rain water as it descends the trunk of the

tree so that the nest is not washed away. Major R. W. G. Hingston, in his book entitled "A Naturalist in the Guiana Forest," describes how he cut away the ridges above such a nest with the consequent dissolution of a portion of the nest. In due time the termites repaired the damage, reconstructing the protective ridges.

In the Congo rain-forest, Mr. Herbert Lang studied a nest of a species of termite, *Procubitermes niapuensis,* belonging to still another subfamily (Termitinae), which builds similar chevron-shaped ridges above the nest on the tree. In this case, the ridges are hollow instead of solid, but the function would seem to be clearly the deflection of descending water.

Closely allied species of the same subfamily in Africa build umbrella-like caps on top of their ground nests which give the structures the appearance of large mushrooms. The edges of the umbrella are usually prolonged into finger-like projections which more efficiently shed the water. In some cases, several of these umbrella-like caps may be built one above the other.

That three different subfamilies of termites should all construct rain-shedding nests in regions of heavy rainfall when they are not connected by any related termites exhibiting such behavior, indicates convergent evolution of behavior in response to a distinctive environment.

The nest architecture of termites does not merely meet special conditions of the external environment, however. Termites are rather soft-bodied insects and the great majority of them are unable to withstand the drying action of air when the humidity is not close to saturation. This characteristic probably accounts in large measure for their tendency to live below the surface of the soil and to construct covered tunnels and elaborate nests when they come above ground.

At times of high humidity, termites may wander in open trails over the surface of the ground. *Macrotermes carbonarius* builds smooth roadways over rough ground in the Malay Peninsula. Where the soil is saturated with water at certain seasons of the year, mound nests or tree nests enable some species of termites to live in regions which would otherwise be uninhabitable. Many species are to be found in desert regions but in most cases, particularly among the more highly specialized termites, the insects are never subjected to dry air for long, even in districts noted for aridity, because they avoid exposure through their subterranean habits and sheltered existence. Burrowing in the ground and bringing excavated earth to the surface results in the important influence of the termites upon the soil and vegetation in the tropics, comparable to the work of the earthworm elsewhere.

Occasionally nests may be built below the surface of the ground in damp earth where the elimination of excess carbon dioxide is a serious problem during certain seasons of the year. In this circumstance members of one African genus (*Apicotermes*) leave tiny pores in the walls of their nest at regular intervals during construction, which provide ventilation. While these pores facilitate the exchange of gases, they are too small for the termites to walk through or for most of the predatory enemies of the termites to enter. The pores are about the diameter of the head of a pin and are bent in such a way that they prevent entrance of underground water. The inclusion of this ventilating system might be easier to understand if it were installed after the walls were built, but the tiny architects leave these precisely arranged holes as they construct the nest.

The termite vs. natural enemies

The termite nest is not only a dwelling but a fortress. Its general architecture and the covered tunnels which lead safely from one place to another render the termites relatively immune from attack. However, these insects are no exception to the rule that every creature has its enemies, and there are several specially adapted predators whose methods of assaulting the strongholds of the termites merit attention.

A few species of ants are able to penetrate the walls of the termitaria and carry off their victims in great numbers; and a few birds such as the South American woodhewers may penetrate the superficial galleries with their elongated bills. But the most successful of the predatory enemies of the termites are the anteaters. Anteaters feed extensively upon ants and termites and are peculiarly well equipped for this method of feeding. They have evolved a long sticky tongue for penetrating the nest cavities and gathering the insects. Their teeth are degenerate so that they swallow their insect prey whole without chewing, and their forefeet are admirably suited to digging into the hard nests. Some species of South American anteaters and African pangolins have prehensile tails for efficient tree climbing and are thus able to reach the arboreal nests of termites.

That termite nests and ant nests offer a valuable source of food is shown by the fact that as many as five times in the evolution of mammals specialized ability to prey upon them has been developed independently. The spiny anteater belonging to the primitive egg-laying mammals of Australia; the mar-

supial anteater, which arose from primitive Australian marsupials; and the aardvark, the pangolin and the South American anteaters, representing three convergent lines among the placental mammals, have all adapted themselves to this method of feeding.

But the termites prosper in spite of these enemies and in spite of the less hostile creatures which are attracted by the constant temperature and humidity of the nests, like the large lizard, *Tupinambis nigropunctatus,* of Guiana which regularly lays its eggs in termite nests, and the Monitor lizard of South Africa which has the same behavior.

The intimate action of the termites during the building operations is possibly even more amazing than the finished structure. Typically each worker brings a small bit of material—either dirt, sand or wood, depending upon the species—and works it into place by a rocking motion of the head. The particle is moistened by a salivary secretion which cements the piece in place. The worker may then deposit a droplet of thick anal fluid upon the particle before repeating the operation. Most species use both excrement and dirt or wood in their structures, but some build with dirt and saliva alone, and others use excrementous material almost exclusively. The resulting nest material is partially organic in composition and is usually referred to as carton. Some species vary the composition of the walls of the chambers, the interior construction having a larger percentage of organic material than the exterior portions. Also the thickness of the walls varies, the walls of the royal cell or chamber being usually much thicker than the partitions in other parts of the nest. The size of the chambers is fairly uniform except for the much larger royal cell. The chambers in the vicinity of the royal cell are used for the hatching of the eggs produced by Her Most Prolific Majesty.

The Old World fungus-growing termites build enlarged chambers which are filled with the elaborately constructed fungus gardens made wholly of excrement. Ventilation shafts from the fungus gardens to the exterior are often prominent features of such nests.

The parallel of termite architecture to human architecture has probably already impressed the reader. We find cemented walls, rain-shedding roofs, chimneys and ventilation shafts, as well as air-conditioned rooms used for various purposes. It is easy for us to assume that intelligence must be the explanation. However, we must be on our guard against such an inference. Intelligence involves a learning process while the behavior of termites strongly indicates that they do not learn how to construct their nests. Sterile workers hatch from eggs laid by a queen which never takes part in the construction of elaborate nests. She has flown forth from a nest constructed by her brother and sister workers, but her workers offspring construct the same type of nest without ever having had any training through association with the workers of the parental nest.

How then shall we account for a building technique that rests neither on precept nor tradition? It would appear to be the result of hereditary factors which express themselves in the sterile worker. Thus we find that each species has its characteristic nest architecture and that this difference in the type of building which is observable even among closely related species is due to hereditary modifications in these species. Such adaptive changes cannot be explained as an inheritance of acquired characters for, as has been stated, the workers, which alone engage in the task of nest construction and hence are the only ones to share this experience, are sterile and consequently incapable of transmitting any character, whether acquired or hereditary.

The most plausible explanation of the amazing adaptive features of nest construction would seem to be the following: that those colonies which are well adjusted as units to their habitats have been perpetuated in their entity by natural selection. The hereditary factors that find external expression in such fitness are thus passed on through the reproductive castes and manifest themselves in the sterile workers of the succeeding colonies.

Complex as this explanation may be, it really offers no greater difficulty than the inheritance of the human eye, which for comparative purposes we may think of as one element in a complex physiological organization, just as the termite workers are an element in a complex social-biological organization. Our organ of vision is composed of sterile cells, just as the termite colony embraces sterile units—the workers—yet this organ makes its appearance in successive generations through the activity of hereditary factors in the reproductive cells. We are quite familiar, for instance, with the hump of the camel, the lung of the air-breathing fish, and the prehensile tail of the monkey, each of which serves its owner some specific purpose and is a response to some particular environmental requirement for the good of the individual and the race. But *behavior* adaptation, as distinct from *structural* adaptation, is a less obvious and perhaps even more marvelous manifestation of the method of evolution. And probably nowhere is behavior adaptation and its evolution better exemplified than in the astonishing architecture of tropical termites.

"COMPASS" NESTS: One of the mysteries of termite architecture. These nests of *Amitermes meridionalis* are invariably built so that they point north and south. The effect of the sun on the temperature of these curiously designed nests is suggested as a practical explanation. But the marvel is that each builder, among millions of co-workers, deposits his grain of dirt in such a way as to produce this effect

A CASTLE-LIKE NEST which is the home of a highly organized "city state" of the insect world *(Amitermes sp.)*

(Courtesy of G. F. Hill)

NEST OF AN AUSTRALIAN SPECIES of *Amitermes*. As in other cases, the architecture is distinctive of the species

(Courtesy of G. F. Hill)

THE CONICAL NEST of *Amitermes medius* shows no directional plan like the "compass" nests, although the two species are closely related. Photographed on the savannahs of Panama

(Photo by A. Emerson)

(Above) NATURE'S UMBRELLA: This mushroom-shaped nest of *Cubitermes sankurensis* illustrates an architectural plan which preserves the termite "city state" from dissolution on the edge of the rain-forest of the Congo basin. Sometimes several of these umbrella-like caps are built one above another *(Photo by Herbert Lang)*

(Below) PROTECTION AGAINST TORRENTIAL RAINS: A striking example of the architectural proficiency of termites in tropical South America. In dry weather the workers of this species *(Amitermes excellens)* build a tube vertically up the side of a tree. From this they construct side tunnels extending downward in a chevron pattern, which effectively shed the rains that later descend. Later the nest is constructed as seen on the middle trunk

(Photo by A. Emerson)

(Below) THE NEST PROPER of *Amitermes excellens,* like the preliminary tunnels, is also able to withstand the rains, being equipped with overlapping eaves and finger-like projections which easily drip off the excess water

(Photo by Herbert Lang)

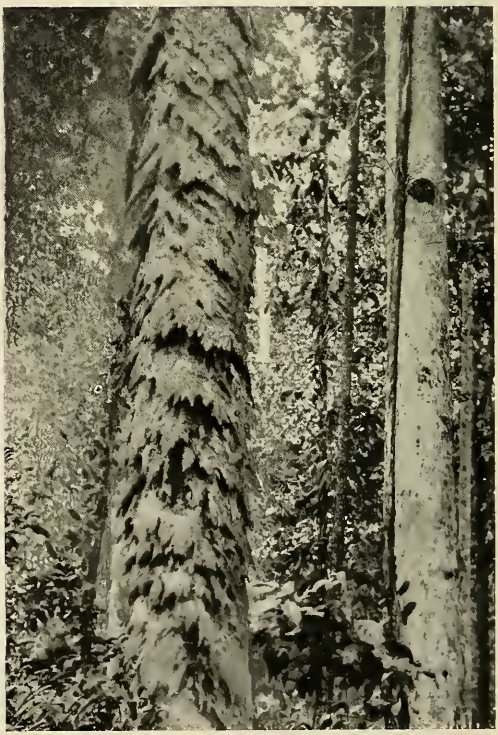


Photo by William Beebe

Photo by A. Emerson

(Above) ROAD BUILDING is an interesting phase of the termites' architectural activities. The highway shown above leads to the underground nest of a Malayan fungus-growing species, *Macrotermes carbonarius*. Note the defensive positions of the large-headed soldiers

(Right) A TINY UNIVERSE: A termite colony equal to half the population of New York City dwells in this six-foot nest in the Guiana forest, all the progeny of a single king and queen

Photo by Herbert Lang

(Left) ELABORATELY BUILT FUNGUS GARDENS made wholly of excrement are cultivated by certain termites as a source of food. In the example illustrated at left from Central Africa, ventilation shafts are incorporated which serve to air-condition the underground gardens

Ventilation

Courtesy of Gertrude Emerson

(Right) AGRICULTURAL ACTIVITIES of the termites: elaborately constructed fungus gardens of a Javanese termite found at the base of a hollow tree

THE TERMITE PROBLEM—*The social organization of these insects, whose ravages are particularly grievous in the tropics, pits man against an ancient and spectacular legion of military engineers*

By ALFRED E. EMERSON

Professor of Zoology, University of Chicago

As the pulse of spring beats more rapidly with the northern advance of the warm rays of the sun, mysterious forces are generated within the bodies of living organisms. The swelling buds of the trees, the appearance of flowers on the floor of the woods, the rhythmic song of the birds —these are the more obvious indications that life is awakening from winter dormancy.

The influence of spring is felt in secretive places not usually penetrated by the inquisitive eyes of man, however. As the frost leaves the ground, myriads of tiny organisms penetrate to the surface from their winter quarters well removed from the freezing temperatures of the first foot or so of soil. Along with the earthworms which become so readily transformed into the evening song of the robin, one notices the excavated soil of the omnipresent ant. If a log on the forest floor is rolled over, one may find tunnels leading from the soil depths into galleries in the wood which have been eaten by termites.

The termites, thus invading the wood in contact with the soil, have spent the winter in subterranean chambers. The rise in temperature seems to influence growth forces which produce the winged reproductive caste. At a period of high humidity, often following a spring rain, these winged progenitors fly forth from exit holes prepared by the wingless sterile workers. At the beginning of the flight, the winged termites fly slowly away in every direction, only showing brief orientation to the source of the most intense light. In a few minutes, however, the response to light seems to be lost and they settle to the earth.

The founding of a colony

As seeds scattered by the wind may lodge in unfavorable situations, the winged termites may end their flight on the surface of a lake or in the web of a spider. Providence is kind to the favored few, however, that may alight more or less by chance near a decaying log. The female quickly drops her four transparent wings by bending them back and breaking them off along a crack or suture at their base adapted to this function. She then lifts her abdomen into the air and emits an attractive odor which entices a male. As soon as the male has found her, the female, followed in tandem by the male, seeks a sheltered niche in or under the log, and together the king and queen seal off the first excavated chamber from the encroachment of their numerous enemies. If all goes well, the bridal couple may become the parents of a small number of white nymphs within a few weeks. These are fed with droplets of food ejected from the mouth by the young king and queen until the nymphs are large enough to forage for themselves and their parents.

The flight of the colonizing termites occurs as early as February in the deep south and is not noticed in the northern states until late April or May. If the termite colony has invaded the wooden foundations of a human dwelling designed to maintain a tropical internal climate in the most severe winter, one may expect to find the flying termites emerging earlier in the season than their relatives in the neighboring woods. They are unable to distinguish the wood of a house from that on the forest floor and they do not react differently to the temperature produced by a furnace than they do to the warm temperature of the southland.

Mistaken for flying ants

The householder who has been unconsciously harboring a colony of termites is astonished at the sudden appearance of the flying forms. He is likely to call them ants unless he has heard that ants have wasp-like waists as compared to the thick waists of the termites. He may also know that termites shed their wings by quickly breaking them along the basal suture, while the winged ants have greater difficulty in shedding their wings which are often broken off along irregular jagged lines.

Whatever the state of his knowledge, the householder is not likely to ignore the appearance of the

THE QUEEN'S CHAMBER IN A TERMITE NEST: The base of operations for one of the most destructive creatures of the animal kingdom. Especially in the tropics, termites cause enormous damage through their wood-eating habits. Here the Queen, a veritable egg-laying machine, is shown surrounded by a few of her myriad offspring. Notice the nozzle-like projections on the heads of the soldier caste, from which they squirt a sticky secretion at their enemies, the ants. The King, who is constantly near the Queen, is seen at the lower left. Near the head of the Queen, at the right, is a termite guest, or termitophilous beetle *(Photo of model by permission of Buffalo Society of Natural Sciences)*

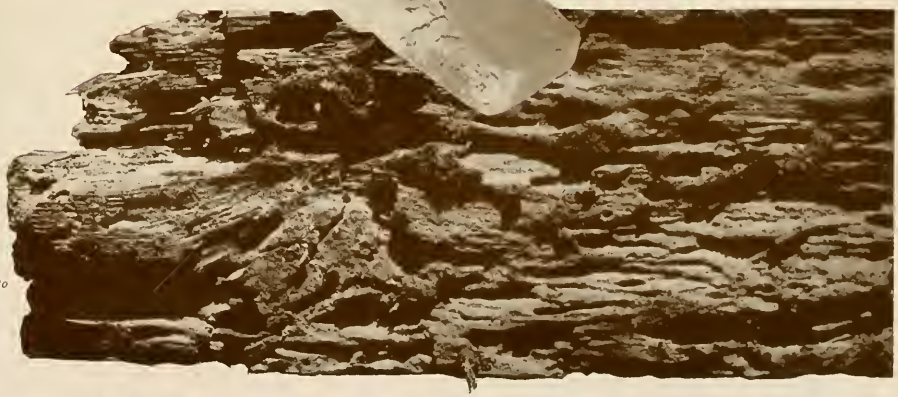
FOSSIL TERMITE WING from Tertiary rocks. Sometime during the Age of Reptiles the termites are believed to have slowly evolved from roach-like ancestors. Their development involved, among other things, a highly specialized caste system with division of labor, and the ability of the winged reproductive caste to shed its wings after the colonizing flight.

Down through the geologic ages the termites persisted and prospered, ultimately to the exasperation of man

COMPARE THE RIGHT-HAND PHOTOGRAPH of an apparently solid timber removed from a New York building with the lower photograph of its underside revealing that it has been almost completely destroyed by termites

Science Service Photos. Courtesy Fordham University

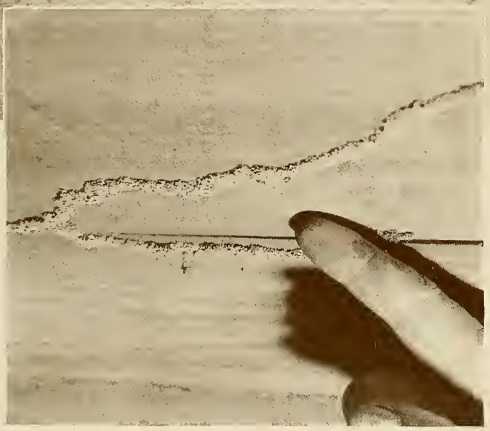
(Below) FOOD AND BUILDING MATERIAL FOR TERMITES: Wood, composed largely of comparatively indigestible materials, is transformed into available nourishment in some termites by action of microscopic single-celled animals which inhabit their minute intestines. These protozoans change cellulose into easily absorbed sugar, and are distributed throughout the colony by the termite habit of eating fluid of each other's excrement



Publishers Photo Service

Science Service Photos.

(Above) OPEN THE COVER OF A BOOK that has been attacked by termites and you may find a pattern of passageways which would delight only the heart of a surrealist. In the example shown above, the termites preferred the pasteboard cover to the pages facing it



Publishers Photo Service

(Left) TERMITE TUNNELS: Protection from enemies and from the drying effect of the air is afforded by these tube-like passageways built by certain termites

Science Service, Courtesy Fordham University

(Left) PLANKING, BOOKS, AND EVEN AN ALARM-CLOCK with a cardboard dial are vulnerable to termite invasion

Our commonest termites must have connection with moist soil; hence an adequate precaution is to keep all untreated wood free from contact with the ground

Certain termites in the South, however, need no connection with the ground, and against them furniture and building wood sometimes have to be treated with penetrating chemicals

flying termites, and before long his friends have increased his worries by tales of collapsing buildings and furniture. Newspaper reporters may even call upon him for a "local-interest" story and, with adequate expansion through the use of vivid imagination and a glance at a handy encyclopedia, the reporter is able to fill a few inches of space in his local paper, to the consequent profit of termite-exterminator companies.

Professor W. M. Wheeler once wrote a delightful satire on human society* in the form of a letter from the king of an African termite colony discussing the problems of termite and human society. One would gather from this letter that termites have a delicious sense of humor and that termite chuckles could be heard at the furor they cause above their quiet underground sanctuary. Be that as it may, the observer of human nature may find much to amuse him and at the same time to distress him when he sees humanity reacting to the fears engendered by ignorance. A very large section of our populace derives its means of economic support through the conscious or unconscious exploitation of such fears.

Instead of looking at termite society from the point of view of the householder dominated by his financial worries, let us penetrate into the life of the termite from the viewpoint of the scientist whose curiosity is aroused by a social organization strikingly parallel to our own. Many of the marvels of existence may be found in the activity of insects, provided one can concentrate on other attributes than their feel and their taste.

At some time during the Age of Reptiles, termites slowly evolved from roach-like ancestors, if we correctly interpret the circumstantial evidence of strikingly similar structure and the scraps of connecting links preserved by fossil impressions. Certain characteristics of termites were already developed in the roaches. A few roaches eat wood in which they excavate their nesting chambers. Wood, composed largely of comparatively undigestible lignin and cellulose would seem to be a poor source of nourishment, but these insects have interesting aids to their digestion. Their intestines harbor millions of protozoans (microscopic single-celled animals) that help to change cellulose into easily absorbed sugar. At least some kinds of termites also have similar protozoan friends that are distributed to all members of the colony by the termite habit of eating portions of each other's excrement as well as wood. The net result is that the termites, by gnawing wood, obtain both food for themselves and a snug dwelling for the colony where it may be relatively secure from natural enemies.

The need for adequate defense against predatory enemies, particularly against the true ants, was met through the development of a soldier caste which evolved strong biting jaws and a correlated behavior well fitted to ward off invasions from without. Efficient specialization of the soldier for defense involved the relinquishment of other functions found in solitary insects. Wings became degenerate and functionless, the reproductive organs, both male and female, became sterile, and the jaws were no longer of use in chewing wood.

Chemical warfare

The soldier caste, once established, further evolved special defensive apparatus such as a head gland for the emission of a volatile liquid which evaporated readily to form a poisonous gas. The soldiers of other termite species adapted the head gland for the production of a sticky secretion which could be shot out of a nozzle-like projection of the head at an ant a half-inch away. In a few cases different types and sizes of soldiers were produced within the same colony with the consequent added efficiency of the army for defense.

The reproductive castes retained the essential characteristics of the roach-like ancestors. They kept the functional wings, eyes and reproductive organs, although the latter became highly specialized for great fecundity in the more advanced termites. Captive queens of tropical termites have been observed to lay over seven thousand eggs a day and in some cases this number is probably exceeded. Egg-laying is a continuous activity in these tropical queens without cessation during the daily or seasonal cycles. After the establishment of the first chamber and the production of the first nymphs, the abdomen of the female gradually enlarges with the growth of the ovaries until it may reach a size several hundred times the volume of the abdomen of the winged female. The enlargement of the abdomen often results in relative immobility and the queen may be confined to a royal cell in the nest from which she could not escape even though she had the impulse. The king remains much the same size he had attained when he possessed wings, and lives constantly with the queen in or near the royal cell. The average life-span of the kings and queens of tropical colonies is probably between ten and fifty years.

In our northern climates the colonizing reproductive pair is often replaced by supplementary royalty. Among even the most primitive termites, supplementary kings and queens may be derived from

*"Foibles of Insects and Men." Alfred A. Knopf. 1928.

fairly mature nymphs which do not undergo further development into winged forms. There is reason to suppose that an inhibiting substance is produced by the queen which prevents the development of the supplementary queens. If the population grows to the point where the inhibiting substance does not reach some of the nymphs in effective concentration, or if the queen is removed from the colony, supplementary queens develop in a few months. Likewise the king seems to secrete a substance which tends to suppress the development of supplementary kings. Extracts of the inhibiting substance of either the king or queen, fed by placing it upon filter paper, tends to delay the production of the respective supplementary reproductive forms. Such chemical agents may also serve to regulate the production of the sterile castes. Thus we have evidence of a sort of social hormone which influences the coordination of the parts of the society much as the true hormones of our bodies are known to produce a balance of functional relationships through their inhibiting or accelerating effect.

Primitive termites had thus progressed beyond their roach-like ancestors in attaining a division of labor between the individuals composing the society which was an outgrowth of a family organization. The basic caste differentiation involved specialization of the functions of defense, reproduction and nutrition. Nutrition, however, was still the function of the young nymphs of the soldier and reproductive castes. The more advanced termites split off a third adult caste through the specialization of soldier nymphs before the soldier characteristics had taken form. This new worker caste did not differ markedly in structure from the soldier nymphs, but growth ceased. This worker caste thus resembled the soldiers in lacking wings, eyes and functional reproductive organs, but retained the jaws adapted to chewing wood which were possessed by the soldier nymphs but had been modified into defensive weapons by the adult soldiers. Nutrition became the first concern of the workers. In an important group of Old World termites, the workers even prepare beds for the growth of nutritive fungi which they harvest. Secondarily the excavating and building habits underwent a remarkable evolution which ultimately resulted in an astonishing complex nest architecture in a large number of tropical species.

Long before man appeared on the American continent, various species of termites were busily engaged in aerating the soil and transforming dead vegetation into plant food. These activities made them an important link in the cyclic chains of organic energy and life. Their rôle was even greater in the tropics where the continuous warm climate was more favorable to their development. Two of the genera now found within the borders of the United States *(Zootermopsis and Reticulitermes)*, however, are practically confined to temperate regions, and fossils from the Oligocene of Europe and the Miocene of Colorado indicate that these genera have been in temperate climates for at least forty million years. The tropical origin of our termite fauna is therefore very remote.

There is no indication whatever that we need fear the introduction of tropical species of termites into temperate regions. Native species, however, have been taken in every state in the United States and are also known from southern Ontario and Vancouver Island, British Columbia. Only a few species are to be found in the northern United States. Thirty-nine species out of the known fifty-seven species in the United States are recorded only from the states bordering Mexico and the Gulf.

When man upsets the balance of nature by cutting the forests and utilizing wood in the construction of his buildings, it is to be expected that termites will be found damaging wood and wood products. The damage caused by termites in the United States every year is probably in excess of $40,000,000. The largest proportion of the damage occurs in the southern states, but the states bordering Canada should also take some precautions against the cellulose appetite of these remarkable insects.

Our commonest termites, species of the genus *Reticulitermes,* must have connection with moist soil for their existence, and the simple expedient of keeping all untreated wood free from ground connections is a sufficient precaution for most construction work. However, certain more primitive termites in the South (species of the family Kalotermitidae) are able to live without ground contact in the dry wood of furniture and the superstructures of buildings. Special precautions through treatment of wood with penetrating chemicals is sometimes necessary to prevent their attack. A few species of the genus *Amitermes* in the southwest are eaters of grass. There is little important destruction by these grass-eaters in our country, though harvesting termites in South Africa and elsewhere are often a serious economic problem.

Detailed studies of the intimate life of these insects are necessary for the development of proper control measures against their destructive activities. And beyond the practical value of further study, the social life and evolution of these insects have much to contribute to the solution of numerous profound biological problems.

THE QUEEN TERMITE—*Enter the royal chamber and see one of the most spectacular creatures in all Nature: an insect mother capable of laying thousands of eggs a day continuously, under the care of an army of 'soldiers' and 'workers'*

By WOLFGANG VON HAGEN

WHAT goes on in that mysterious realm, the termite kingdom? What enables these insects to be one of man's most destructive natural enemies and to make their presence known over such large areas of the globe? If the reader will, he may accompany me in search of the Queen and the secrets of the termitarium.

We enter the dank jungles of the Upper Amazon of Ecuador. The forests are dense with leaves of varying shades of green, and the deeper we enter, the more the forest seems to take on a perpetual dusk, so dense is the foliage. Giant lianas, like boa constrictors, hang from tree to tree in wierd contortions.

This is the termite realm. Attached to trees or lianas, we see an endless succession of termite nests. Most of them are of the genus of Naustitermes, one of the higher groups of termites. The nest before us is four feet in height, five and a half feet in circumference, and must weigh close to two hundred and fifty pounds. It is made of microscopic bits of wood, glued together from the residue of the intestines of the workers. The Queen's chamber, as I have learned from experience, will be found almost in the direct center of the nest.

Exploring an insect 'city state'

With my machete, the utilitarian jungle knife, I cleave off a generous portion of the nest. Immediately it is alive. The soldiers run out and cover the entire nest, the workers scurry about inside, picking up in their mandibles small white eggs. All is confusion.

Inside the hard outer layer, the nest is thoroughly perforated with countless runways that lead, although we can scarcely follow them, into the reproductive chamber. Another stroke of the machete and we are in a humid section of the nest, where we see thousands of small eggs and equally microscopic termites that have just emerged. They are pure white. This means that we are near the Queen's chamber.

Now we must proceed much more carefully. The machete is sharp, the Queen is large; and many are the Queens I beheaded before learning the technique of finding them. Cutting slowly, the machete suddenly gives warning, striking something hard. Here, more or less in the center of the humid section of the soft carton, we have struck the Queen's chamber. The size of this hard portion varies with the species and the size of the nest. In this particular nest it is about four inches in circumference. The nest, however, is so alive with workers and soldiers dropping everywhere, that we will fare better if we merely remove the whole Queen's chamber. Workers crawling up my arm have dug their mandibles into the skin, and their bite is quite real. Any insect that can cut tunnels through the hardest of woods finds little difficulty in biting one's arm. The chamber is finally removed. Now in leisure we can retreat some distance from the nest and examine our find.

In the Queen's chamber

A blow is delivered in the exact center and the nest is cleft, revealing the secrets of the termitarium. Her Majesty the Queen! The sudden parting of the chamber and her exposure to the dry air causes her to show signs of discomfort, and the workers appear to be trying to move her. The Queen is about fifty times the size of the workers. She has difficulty in moving herself. Her body is distended with eggs, for her ovaries have grown immeasurably since the days of her nuptials. When she mated she was only twice as large as the workers; now she is fifty times as large. If the Queen might be likened to anything it might be an elongated potato. For, ludicrous as such an analogy may seem, the tiny head is at first not visible and the chitin plates are so separated that they resemble the 'eyes' of the potato. But there the analogy ceases.

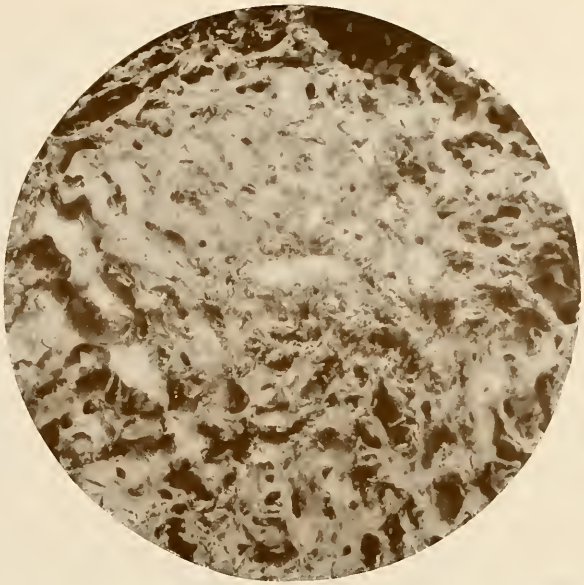
Her large abdomen rests on the floor of the nest, and her small fragile legs, grouped at the forward

Wolfgang von Hagen Photos

Exploring the Royal Chamber of a Termite Kingdom

(Above) IN THE DARK, DANK JUNGLES of the Amazon a common sight on the vine-encircled trees is the termite nest. The nest shown here weighs approximately 250 pounds

(Below) A CLOSE-UP OF THE SAME NEST: It is made of microscopic bits of wood glued together from the residue of the intestines of the workers



(Above) WITH SEVERAL STROKES OF THE JUNGLE KNIFE the elaborately perforated nest is exposed. In the center is the Queen's chamber, a mass about four inches in diameter, where with a single mate she lays several thousand eggs daily, year in and year out

(Below) EXPOSURE OF THE GREAT BULK of the well-nigh immobile Queen causes great disturbance among the workers. Her frail legs are grouped at the forward end of her body and appear hopelessly inadequate, but finally, amid great activity of the workers, she urges herself along

(Wolfgang von Hagen Photos)

TERMITE GUEST: Small specialized beetles (Staphylinidae) like the one shown here highly enlarged are seen running about the nest, where they form a curious partnership with the termites. Each relishes the sweet sticky substance that exudes from the pores of the other

EQUIPPED FOR CHEMICAL WARFARE: Soldier termite *(Amitermes perarmatus snyder),* showing syringe with which it sprays enemy insects with a sticky fluid that disables them. Several thousand of these soldiers, as alike as so many peas, constitute the militia of the colony and the Queen's bodyguard. Certain other termites spray a volatile liquid which evaporates to form a poisonous gas

(Photo by J. M. Leonard)

WARPATHS LEADING TO A TERMITE CITADEL: Roads made by ants invading a nest of *Amitermes wilsoni,* North Queensland, Australia. The ants bore holes in the termitarium, kill and eat the occupants, and take possession of the nest

(Photo through courtesy of G. F. Hill)

end of her body, work futilely. The workers frantically rush about. No one pays any attention to the King, who runs about heedlessly on top of her royal abdomen. With a camel's hair brush I pick him up, and into the vial of alcohol he goes.

Meanwhile the workers appear to have inaugurated a plan for moving Her Majesty. It is difficult to interpret the actions of these tiny creatures and many a scientist may well insist that their frenzied activity on such an occasion as this contributes little or nothing toward actually moving the Queen. But we can only use our best judgment in an observation of this sort, and through the magnifying glass this is what appears to be happening. Some of the workers have hurried ahead of the Queen and are enlarging a space for her. Other workers surround the Queen's head and tug at her antennae, her wing stumps and her legs, which are all situated within small compass at the forward end. Her great distended body extends backward for many times the length of the thorax and is, of course, without legs. But other workers have lined up on opposite sides of the inert body and with their mandibles are pulling at it in opposite directions. This is the very method we might use to move a heavy body, for the first step must be to raise it from the ground. The termites cannot lift the Queen's abdomen from above, but their pulling from opposite sides has the same effect. The great bulk is raised ever so slightly from the floor of the chamber, and the Queen, with her frail legs barely touching the ground is urging her body on.*

It is only in size that the Queen may really be called regal. Actually she is nothing more than an egg-laying machine. The King, who also remained incarcerated, is slightly larger than the workers. He is free to wander, but he seldom does. As in Baudelaire's vision of the giantress, the King lives in the shadow of this formidable '*montagne de force et de luxure*.' Certain it is that the Queen among certain species of termites outrivals in fecundity all other terrestrial creatures. For Queens in Africa are said to lay as many as forty thousand eggs a day and this, ofttimes continuously for years. Yet we must not deduce that this fecundity gives her a power which the term queen would lead one to infer.

Guests of the termites

Running about the reproductive chamber are a number of smaller insects; without a magnifying glass, one would take them for termites. But they are not. Under the glass they are seen to be a form of specialized beetle. These are termite guests, termitophiles, freely running about in the most inaccessible places of the termitarium. One will see some superficial similarity between them and their termite hosts. And this is a strange partnership. For this Staphylinid beetle is tolerated for the reason that both termite and guest relish each other's exudate, the sweet, sticky substance that exudes from their pores. The termitophile may be seen to run about the Queen, and the workers pay no attention to it at all. It is one of the oddest associations in the insect world.

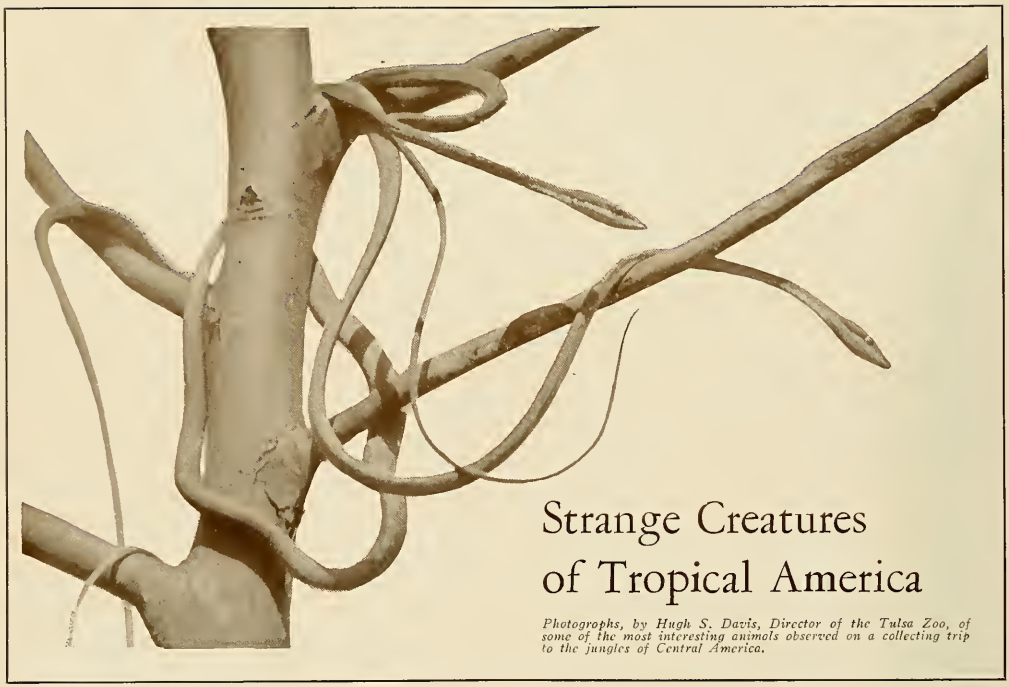
We have found the King, the Queen, the termite guests, and we see that neither the King nor the Queen takes any active part in the 'administration', if one may apply the word. They, like the soldiers, are not capable of feeding themselves. Incarcerated in their dark realm, food is brought to them by the workers. Once the colony has been established, their only task is to continue to reproduce their kind, which they do unceasingly. As soon as the eggs are laid, the workers pick them up in their mandibles, and hurry them away to another part to hatch.

It is exceedingly curious that the termites, unlike other terrestrial animals with the exception of man, have as the basis of their society the pair. A single pair of reproductives institute the colony and serve continuously as its basis. This is not so in the case of other social insects, notably the bee, the wasp, and the ant, where the male merely intrudes himself temporarily on the scene during nuptials and the female retires alone to develop her matriarchy. One mating with the King is not sufficient to fertilize all the eggs to be laid henceforth, so that a permanent association of male and female is continued. This, I believe, is unique in the whole of the animal world.

Each caste within the termite kingdom has a task imposed upon it in accordance with its particular physical limitations and attributes, and the whole responds as a mechanism to a given stimulus.

At stated seasons of the year (in the tropics usually at the beginning, or sometimes at the end of the rainy season) the future Kings and Queens, of the winged caste, leave the nest in countless thousands, to begin a new colonization. Undoubtedly thousands leave each nest, but only a small percentage succeed in establishing colonies. Otherwise the plague would be a tremendous one. As it is, when the swarm begins, ants, lizards, birds, sloths, and yes, at times even man, await their coming: and more than ninety-five per cent never live to found a termitarium. Such, one would assume, is Nature's method of providing a balance in the world of life.

* NATURAL HISTORY is advised that the mechanism of moving the Queen termite described above has not found its way into scientific literature, and that its acceptance must await corroboraton.

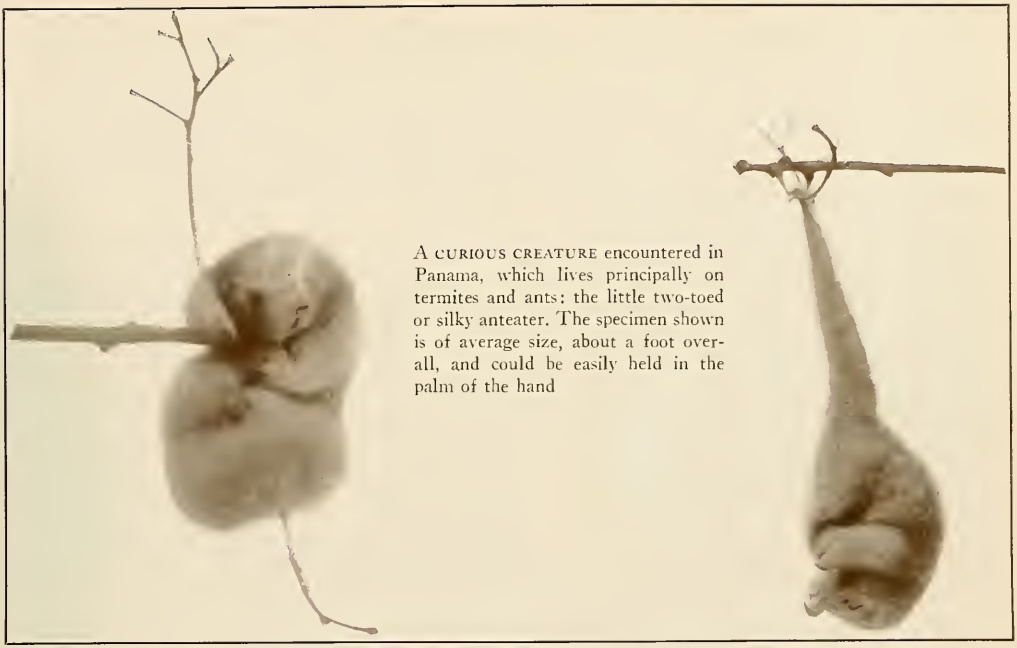


Strange Creatures of Tropical America

Photographs, by Hugh S. Davis, Director of the Tulsa Zoo, of some of the most interesting animals observed on a collecting trip to the jungles of Central America.

SHARP EYES ARE NECESSARY to distinguish the long-headed tree snake *(Oxybelis acuminatus)* in the jungle of Honduras where it is common, for it readily "freezes" into immobility and resembles the vegetation. With a poisonous strike it kills the "chameleons" *(Anoles)* upon which it habitually feeds, but its poison is not serious to man. It is green, grey or brown. The specimens shown were placed in a naked tree for the picture

THE MOST DANGEROUS SNAKE in Honduras: the Fer-de-lance *(Bothrops atrox)*, which resembles the North American rattler minus the rattles. The high death rate from its bite among the barefooted natives is due in part to the length of the fangs (see righthand picture) and to the fact that it gives no warning before striking



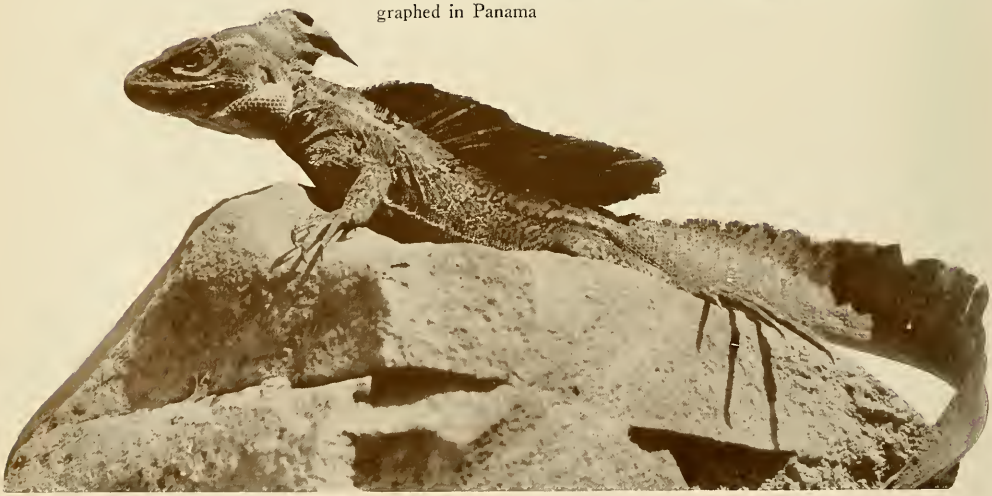
A CURIOUS CREATURE encountered in Panama, which lives principally on termites and ants: the little two-toed or silky anteater. The specimen shown is of average size, about a foot overall, and could be easily held in the palm of the hand

THE THREE-TOED SLOTH of Central America: a close relative of the Brazilian Ai of crossword puzzle fame. This slow creature dwells in trees, where it moves about not by walking but by hanging in an inverted position. On the ground the sloth flounders about awkwardly and is almost helpless

A FISH-EATING BAT *(Noctilio)*, which is often mistaken for the vampire, and is sometimes made to double for it in motion pictures. It lives chiefly on insects but occasionally goes fishing, taking its prey by swooping down and scooping up the small surface-living species

(Right) A SIXTEEN-INCH WING SPREAD makes the fish-eating bat one of the largest in the New World. It has beautiful golden yellow coloring, will bite in self-defense, but is not poisonous

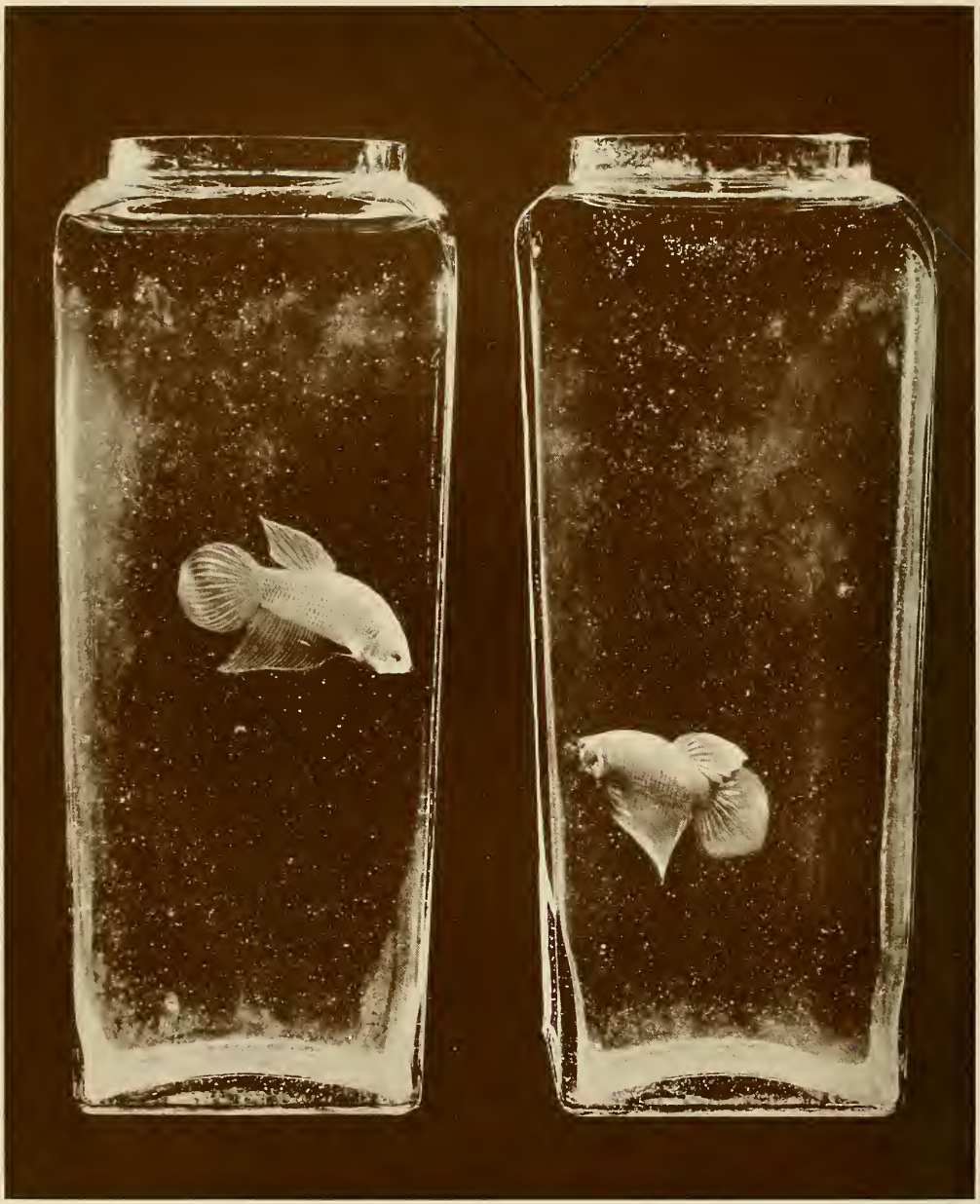
(Below) ITS ABILITY TO TRAVEL on the surface of the water has earned for the Basilisk lizard the name "Jesus Cristo lizard" among the natives of Central America. Although not equipped with foot webbing, it runs at high speed across the water and was seen by Hugh S. Davis to cross wide streams. But if its speed is checked it sinks. The species also climbs trees with great alacrity. Photographed in Panama



FLYING FISH IN FLIGHT: an extraordinary photograph secured by Hugh S. Davis only after many hours of vigilance in the bow of the expedition's little vessel, in Caribbean waters. Note the transparency of the "wings". The flying fish is Nature's closest approach to the seaplane

(Right) A HITCH-HIKER OF THE SEA: the sucker fish, showing the shutter-like organ by which it attaches itself to the shark for a free ride. In attaching itself, the fish opens the "shutters", thus creating a vacuum that holds it in place. If one runs his finger across the "shutters" they close

(Left) THE SUCKER FISH IN POSITION on a sand shark caught in the Bahamas. The sucker fish is common to shark waters and reaches two feet in length



Underwater Pugilists

At sight of each other through these jars that are customarily used for them in Siam, the fighting fish display their gorgeous color changes. The fight that ensues when the two males are put together in a common receptacle may last for hours; yet neither fish is likely to sustain fatal injuries, and the winner is declared when one of the combatants shows a disinclination to continue the fight. Professional breeders in Siam never allow a loser to breed.

These fish will "drown" if kept submerged. But whenever either fish has to go to the surface to gulp air, its opponent invariably suspends hostilities, as though in keeping with a code of ethics

THE FIGHTING FISH OF SIAM—*A spectacular creature for the home aquarium. Its extraordinary habits are the basis of a licensed sport in Siam, its appetite the livelihood for professional mosquito breeders*

By HUGH M. SMITH
Formerly Fisheries Advisor to the Kingdom of Siam

THE SIAMESE fighting fish may rightly be included among those creatures which have officially or unofficially established their identity with a particular country, such as the British lion, the Chinese dragon, the Guatemalan quetzel, and the American eagle. The name of Siam must always be associated with the fighting fish because the fish originated there, in a wild state was found only there, and for many years was known and exploited nowhere else. In recent years it has become a cosmopolite, cultivated and admired by a host of amateur and professional aquarists.

The fighting fish is the most diminutive member of the large oriental family of Anabantidae which includes such well-known species as the paradise fish, the goramy, and the walking fish.[1] Outstanding family traits are the making of bubble nests and the breathing of atmospheric air to supplement the oxygen absorbed from the water by the gills.

In scientific literature the fighting fish was long referred to under the highly appropriate name of *Betta pugnax*. Not until Dr. Tate Regan of the British Museum published his notable revision of the family Anabantidae in 1909 did it become known that the celebrated fighting fish had achieved its reputation under the name of another, closely related species. It was in fact unnamed, and Regan called it *Betta splendens*.

Singularly enough, the Siamese name, *pla kat*, does not mean fighting fish, as asserted by various European and American writers, but biting fish.

The wild fish

This species ranges throughout most of Siam in lakes, ponds, canals, and sluggish streams. It is an inconspicuous, retiring little creature, seeking protection from the glare of the sun's rays and from fish-eating birds like egrets, herons, and kingfishers by hiding beneath and among water plants. A length of about two inches is reached by mature males, the females being slightly shorter.

The general coloration of a quiescent fish is dull grayish brown or green with or without obscure dark lateral bands, and conveys no suggestion of the wonderfully brilliant hues assumed by the male under proper stimulation. Under the stress of excitement, the male fish exhibits a remarkable change. All the fins are widely spread, the gill membranes are expanded and project like a frill or ruff suggestive of the raised hackles of fighting cocks, and the entire body and fins become intensely suffused with a lustrous blue or red color, which makes the fighting fish one of the most beautiful of all fresh-water fishes. The normal incitement to the display of latent colors is the approach of another male, but the same effect is produced when a fish sees his reflection in a mirror.

Observations on fish kept under the most favorable conditions in aquaria indicate that this species is normally short-lived. Possibly as a result of its strenuous activity and rapid metabolism, possibly because its span of life is predetermined by some immutable hereditary requirement, the fish in Siam appears to reach its age limit in two years, but under domestication in colder climes a somewhat greater age may be attained. Some fish in the New York Aquarium are four years old and still in good condition.

Fighting fish contests

The common human custom of making animals compete among themselves for individual supremacy, and of laying wagers on the outcome of the contests, has, among the Siamese, been directed more particularly to fish. At least four different kinds of fish belonging in three families are employed by the Siamese in matched encounters, but only one of

[1] See "A Walking Fish," by Hugh M. Smith, in NATURAL HISTORY, March, 1936.

these has ever attained national importance or international celebrity.

Just how early in Siamese history the fighting fish acquired its reputation is not known, but for several hundred years its pugnacious qualities have been recognized and utilized in popular contests.

Writing in the year 1850, Dr. Theodore Cantor[1] recorded that in 1840 he saw in the possession of a gentleman in Singapore several fighting fish that had been presented by the King of Siam, and made the following note which is one of the earliest references to the subject in a European language:

> The Siamese are as infatuated with the combats of these fishes as the Malays are with their cock fights, and stake considerable sums and sometimes their own persons and their families. The license of exhibiting fish fights is farmed, and affords a considerable annual revenue to the King of Siam.

Reading between these lines, we may readily surmise the abuses that arose in connection with fighting-fish contests. The government had ultimately to intervene, and for many years unrestrained betting has been prohibited and the former evils have been very largely eliminated. The government, while seeking to discourage forms of sport that are demoralizing, recognizes that fish fighting is a mild outlet for the popular propensity and keeps it within bounds by requiring a special license for each contest at which wagers are laid, and before a license may be obtained from the local authorities the application has to receive the approval of the police department. While the fighting fish thus yields a small revenue to the government, the main purpose of the licensing system is adequate control. There are in Bangkok a dozen registered places where fighting-fish fanciers and their friends may gather and bet within reason on their favorites.

The combative instinct

Up to the year 1850 or thereabout, the use of the fighting fish in sportive contests in Siam was confined to fish obtained in open waters; but, in order to insure a regular supply for fighting and betting purposes, domestication and cultivation were then instituted and have since been conducted on an increasingly large scale. It may be noted, however, that in recent years cultivation has been less important as a factor in fighting contests and has represented a better appreciation of the fish's beauty of color and form.

While many kinds of fishes exhibit a belligerent attitude both among themselves and toward other species, it seems probable that in few other fishes is the combative instinct so highly developed as in *Betta splendens*. It is certainly true that in no other fish has the fighting ability been so much improved by cultivation.

The fighting instinct is peculiar to the males and is so strong that a normal fish exhibits it under every condition and at every opportunity. One might reasonably infer that the fighting instinct would develop at the approach of maturity. As a matter of fact, the pugnacious tendency shows itself at an early age; and in captivity fish only two months old and less than half-grown should be separated to prevent continual scrapping.

Because of their ever-present eagerness to fight, adult male fish must not only be kept in separate aquaria but the view of rivals in nearby vessels should be cut off by pieces of cardboard; otherwise their vitality and fighting ability will become impaired by incessant, futile effort.

The fighting fish has responded well to efforts to produce changes to meet the popular demand. Even in the hands of persons ignorant of the laws of heredity, noteworthy improvements in form, size, coloration, and fighting ability have been brought about; and there is reason to believe that still further improvements may be made.

A person seeing for the first time a wild fighting fish would never suspect the wonderful possibilities in coloration that have been realized under cultivation. The most noteworthy of the color phases that have been established, in addition to intensified reds and blues, are lavenders, iridescent greens, cornflower blue, blue and white, and yellowish and reddish creams with bright red fins. The latter were produced thirty to forty years ago and are known to the Siamese as *pla kat khmer* (i. e., Cambodian biting fish), probably from having originated among fanciers in French Indochina.

Along with the development of intensified and new colors, there has come about an increase in the size of the vertical fins, culminating in graceful crape-like effects which vie with those in the veil-tailed and other highly cultivated Japanese goldfish, so that there are now fighting fish whose caudal fins are about as long as the head and body combined. In cultivated specimens, retaining the form of the wild fish and having no disproportionate increase in the size of the fins, a total length of two and a half inches is reached by males.

Fighting stamina improved

Fish caught in open waters and taken into one's

[1] Catalogue of Malayan Fishes.

house will, after a few days, readily respond to an opportunity to fight. The fighting stamina of the wild fish, however, is not sufficiently developed for present-day requirements in Siam, and practically all matched combats are now between fish that have been bred in captivity. Wild fish may fail to show any pugnacious spirit after a few minutes of active attack, and for an encounter between them to last more than fifteen to twenty minutes is unusual.

On the other hand, in fish reared under careful domestication and intelligent selection of parents, the inherent desire and ability to fight are markedly strengthened. Well-matched fish may continue their attacks hour after hour without intermission, with only brief excursions to the surface for air. There is a partial respite from active effort while the fish are in a sparring position, but even then the fins are kept extended, the gill membrances remain expanded, the body muscles are taut, and an alert attitude is constantly maintained. Some of my own fish have remained pugnacious after six hours of uninterrupted combat, but fights do not ordinarily last over three hours. From reputable Siamese informants has come the assurance that there have been instances where fish have struggled for a whole day and night.

A fight described

In Siam, as in the various countries into which the fish has been introduced, the usual procedure in arranging a fight is to select two males of approximately the same size and bring them together in separate jars. If they spread their fins, show their colors, and make head-on efforts to reach each other, they are placed together in the same vessel. An ordinary porcelain or tin wash-basin makes a good arena, but a rectangular glass receptacle like a battery jar affords a better view. The fish immediately approach each other and indulge in a preliminary display of spread fins, expanding gill membranes, and color waves. A common sparring position is side by side with the heads pointing in the same direction and with one fish slightly behind the other. This position may be held for a period varying from a few seconds to several minutes. Then, in quick succession, the fish attack, their movements being so swift that the human eye can hardly follow the actual impact of the teeth, and the assaults are repeated with short intermissions during which the same sparring attitude is taken.

The most common points of attack are the anal, caudal, and dorsal fins. The ventral and pectoral fins may be practically untouched at the end of a protracted encounter but may receive early attention from one or both contestants; the vertical fins, however, are always involved. The first evidence of a spirited encounter is likely to be torn or split fins. As the contest proceeds, there may be extensive loss of fin substance, and with well-matched fish the vertical fins may ultimately be reduced to mere stubs.

The loss or extensive damage of the fins impairs the swimming, steering, and balancing powers and hence places a fish at a disadvantage; but in evenly matched fishes this is not likely to be a final factor in deciding the issue.

Another point of attack is the side of the body. Single scales or clumps of scales may be loosened or detached by a quick nipping act, but in many contests this kind of injury may not occur. Exceptionally the gill covers may be bitten and slight injury may be done to the gills.

An interesting variation in fighting tactics ensues when the fish come together in a head-on assault and lock jaws. With their jaws firmly locked and their bodies extended, the fish struggle while partly or completely rotating on their long axis. In my observations, the locked-jaw attack was always comparatively brief and was invariably terminated by the fish settling to the bottom and remaining perfectly still for, say, ten to twenty seconds. The hold was then broken and the fish rapidly sought the surface for air, and then resumed their ordinary tactics. The locked-jaw position interferes with respiration and lasts only as long as the fish can resist the call of the system for extra oxygen.

During the short interludes in fighting when the demand for oxygen forces the fish to go to the surface for gulps of air, attacks are always suspended. I have never known one fish to assail another at such a time—it is literally a breathing spell provided for in the fighting fish's code of ethics.

The decision

Fighting contests are decided by the general exhaustion and the failure of stamina in the combatants rather than by a definite injury or a knock-out assault. Sooner or later one fish shows a lack of ability or desire to continue the fight and swims away—literally turns tail—when his rival assumes a position for attack. The engagement is then over, the fish are separated, the wagers, if any, are paid, and the owners put their charges into jars and go their respective ways.

It is the practice of persons who make a business of raising these fish for fighting purposes never to allow a fish which has lost a contest to breed.

Fighting not cruel or brutal

At the end of a protracted contest both fish may present a most unattractive appearance because of their mutilated fins, but they seem to experience no discomfort and, if permitted, would fight again the next day. The fins regenerate rapidly and completely, and at the end of a few weeks may show no signs of injury. Loss of scales may be more serious, inducing the development of fungus.

My experience, which extended over twelve years and covered many hundreds of exhibitions, coincides with that of most observers in finding nothing brutal, cruel, or repulsive in fighting-fish contests. The participants seem to get so much satisfaction from their encounters, their physical discomfort is apparently so negligible, and their recovery is so complete that there is little occasion to expend sympathy over them; while their graceful movements, muscular agility, acumen, tenacity, and wonderful color displays cannot fail to arouse enthusiasm even in the most sensitive spectators.

Wholly erroneous impressions on this subject have been conveyed in some published articles. In an account that has often been quoted, one of the unfortunate combatants always terminates his fighting career and his very existence by literally bursting because of his futile efforts to reach his adversary kept in a separate jar. Another description of the fish and their fights concludes with a statement which, if true, would enlist our sympathy:

> The two [fish] are brought together in the same bowl and they forthwith begin to tear at each other with their mouths and sharp spines, until the one is overpowered. The victor seldom lives to enjoy his triumph.

As has been pointed out, fighting is done wholly with the teeth, and one fish is not overpowered. I never knew the victor, or even the vanquished, to succumb to a fight or to undergo serious injury.

Air-breathing necessary

An outstanding peculiarity of the fish is its dependence on atmospheric air. In an open water course, just as in a well-aerated aquarium, the fish cannot obtain through its gills dissolved oxygen in amount sufficient for its needs, and hence it has to make frequent excursions to the surface to take in mouthfuls of air which it utilizes by its accessory respiratory apparatus. The fish does not loiter at the surface where, in a wild state, it is exposed to attack by birds and other fish-eating animals. It projects its mouth for only an instant, expelling a bubble of vitiated air and taking in a new supply, and then rapidly retreats toward the bottom.

The air-breathing apparatus is of simpler construction than in some related species, the "climbing perch" for example, which can and do spend considerable time out of water. Above the gills there is in each side of the head a cavity lined with vascular epithelium, the absorptive surface being increased by several projecting laminae.

The bubble-blowing habit is strongly developed in the male fish. At the time the bubbles are made there is a viscid mucous secretion of the mouth or pharynx which strengthens and makes more lasting the walls of the bubbles and tends to keep the bubbles in a compact mass.

The purpose of the bubbles—to serve as a nest for the eggs and a hover for the newly hatched young—is admirably achieved. As the bubbles gradually lose their stickiness and become scattered or ruptured, one may observe the male constantly engaged in renewing the supply.

Egg laying and hatching

If one day a mature female fish is introduced into a vessel with a male fish which has been blowing bubbles, the probability is that next morning the bubble mass will be found to contain several hundred minute transparent eggs not easily distinguished from bubbles without a magnifying glass.

At egg-laying time the fish consort near the surface, and at short intervals the eggs are extruded in small batches. As the eggs slowly sink toward the bottom, both the male and the female fish go after them, gently take them in their mouths, and returning quickly to the surface blow the eggs into the bubble nest, repeating the performance as often as may be necessary to gather up all the eggs. This continues for several hours until all the ripe eggs have been voided.

The rôle of the mother fish is almost entirely restricted to the production of eggs. After the eggs are once placed in the nest, her family duties cease; and all subsequent care of eggs and young devolves wholly on the male.

The fish is rather prolific. At one spawning period from 200 to 700 eggs may be expelled, the average number for a fully developed normal fish being 400 to 500. A month after one batch of eggs has been produced, a given female may be ready to yield another lot, so that in the course of a year one fish may be responsible for 2,500 to 5,000 or more eggs.

Aided partly by capillary attraction, partly by the viscidity of the bubbles, the eggs are held in the

nest until hatching ensues. The incubation period is remarkably short, covering only thirty to forty hours in water at 80° to 85° F. Should any of the eggs drop from the nest and fall to the bottom, the male recovers them and blows them back.

The newly hatched fish find shelter under the bubble nest, and remain there while their yolk-sacs are being absorbed and their fins are developing. If they stray from their proper place before they are old enough, the male carries them back to the nest and gently ejects them; and during the entire period of infantile helplessness the male repeatedly takes the young in his mouth and blows them out with new bubbles, thus insuring proper oxygenation.

Vigilance of the male

Throughout the nesting period the male fish is extremely busy and his vigilance never relaxes. In addition to making and maintaining the bubble nest, replacing eggs that may drop from the nest, rounding up the straggling young, and mouthing the young at intervals, he is constantly on the alert to protect the eggs and young from intruders that may devour them. The chief offender is the mother fish. In a wild state, she can be forcefully driven off and kept at a distance, but in the restricted quarters of an aquarium she must be removed as soon as egg-laying is completed.

The presence of the male seems to be essential in the development and hatching of the eggs. If the male is removed from the aquarium, the eggs, or most of them, will fail to hatch. Those that fall to the bottom will suffocate; while the vitality of those that remain in the nest may be impaired by the lack of the aeration that comes from mouthing and bubble-making.

It is of interest to note that the forbearance of the male from eating the eggs and young is not due to any temporary impediment to his digestive powers, such as a physiological closure of the esophagus. He can and does eat mosquito larvae throughout his period of guard duty.

With all the solicitude shown by a male for his progeny, it may be noted that he cannot distinguish his own young from those of another parent introduced into his aquarium. Foster offspring receive the same care as his own.

Another aspect of the interesting behavior of Betta is shown when a male parent is taken away from his nest and returned after a few days: he promptly devours his young.

Fish renders valuable service

The fighting fish is a confirmed carnivore. This would be indicated by its dental equipment and short intestine even if not shown by direct observation on wild and domesticated fish.

In a wild state, the fish renders a useful service to mankind and to land animals generally by its destruction of mosquito larvae. The fish inhabits the same kinds of weedy waters in which the eggs of various mosquitoes are laid and hatched, and mosquito larvae are the favorite, often the exclusive, food throughout the year. As the fish's appetite is keen, its digestion rapid, and its feeding activities more or less continuous during daylight, the daily consumption of potential blood-sucking pests is large. Based on the observed requirements and the actual consumption of mosquito larvae by fighting fish in small aquaria, I would not hesitate to estimate an annual intake of 10,000 to 15,000 larvae per adult wild fish under normal conditions.

When the young fish first begin to feed, their mouths are too small to admit mosquito larvae, and during a period of ten to twelve days following the absorption of the yolk-sac they subsist chiefly on minute crustaceans which swarm in the local waters.

The preference is for living, moving food. Given the choice of both active and dead larvae, the fish may entirely reject the latter until driven by extreme hunger. Under the stress of necessity they will take selected non-living food and thrive on it. A lot of fish which I brought from Bangkok to San Francisco were, after the first few days of the voyage, fed successfully on minute scrapings of raw fish provided by the ships' stewards.

The problem of feeding them

In Siam, mosquito larvae are regarded as essential for the proper nourishment of fish under domestication. For supplying the daily needs of my fighting fish in Bangkok, two coolies spent much of their time in locating breeding places of mosquitoes, collecting the larvae with fine-mesh nets, separating the larvae from plant and animal debris, and feeding the clean larvae to the fish at regular times and in quantities based on the reactions of the fish. The wrigglers, held in a coffee cup or rice bowl, were administered with a spoon.

In the capital city of Siam, where there are some thousands of amateur fighting-fish fanciers and many professional breeders and dealers, there is a large and steady demand for mosquito larvae. To meet this demand, which becomes acute during the dry season, there has sprung up the strange business of breeding mosquitoes and selling their larvae to owners of fighting fish; and a number of people thus gain a livelihood.

The Egg Laying of the Fighting Fish

Four stages seen in the Museum's Greenhouse by C. H. Coles, the photographer.

(Above) The Embrace. The male, left, encircles the female which has come to him while he displayed his brilliant red and blue fins beneath the bubble nest of his own construction. The eggs are laid at the moment the female is turned upside down

Maladjustment. Frequently there is some slip in the coordination of movement which takes place at egg laying. The eggs unfertilized drop to the bottom of the aquarium

SUCCESS. But usually the eggs are fertilized at the moment of laying, and the male, leaving the female still partly overturned, dashes after them to seize them in his mouth and later to spit them out in the bubble nest he built for their reception

(Below) ON GUARD. The eggs are protected against the depredation of other fish by the male, which from time to time blows new bubbles and in this way buoys them up. The spent female is treated like other marauders, first with brilliant display of color and then, if this fails to frighten, with vicious bites.

EIGHT OARS AGAINST THE WIND—*The famous Arctic navigator relates one of the most gripping and miraculous adventures of his 38 years of experience in northern seas*

By CAPTAIN BOB BARTLETT
Schooner Morrissey

IN the 38 years I have spent going into the Arctic regions, I have been fortunate in having as shipmates a number of boys and young men from schools and colleges. Exploration appeals to them largely because of the adventures they expect to have. In the end they learn that there is a lot more to be gotten out of it than that. But there are thrills aplenty in collecting specimens for museums and studying the sea and the creatures that live in it. The event I am going to tell about stands out in my mind as one of the strangest adventures that ever befell a group of these lads.

A glamorous guest

It happened in 1901, when my uncle, Captain John Bartlett, and Arthur Moore, son of the late Charles Arthur Moore, a prominent steel manufacturer, went north on a prospecting expedition. The Captain was an enthusiast in this mining game, and he thought he saw copper, lead, hematite, manganese and iron pyrites everywhere he went. Arthur Moore had been with him in the *Hope* when Peary chartered her to bring the 35-ton meteorite from northwest Greenland which is now in the American Museum of Natural History. And by telling Arthur of what he saw or thought he saw, and what he heard from half-baked claim-stakers, the Captain soon sold him on the idea of discovering vast mineral deposits in the northeastern part of the Canadian Arctic.

Mr. Moore Senior succumbed to his son's enthusiasm and offered to supply the major part of the funds for outfitting the expedition. A group of young Moore's friends who were anxious to go along agreed to contribute the rest. The Newfoundland seal-hunting steamer *Algerine* was chartered, and I went along as Chief Officer.

I look back and laugh heartily when I think of that gang of fellows barging into Sydney Harbor on the late express train out of Boston. Some of the lads had been on the way for several days but remarkably enough, they were all together and ready to sail on the morrow. What a thrill we on board got when they hove in sight. It was a summer night, warm and close, with a light rain falling. The clouds were down almost on top of the trees, and the darkness so real you could feel its deep intensity. When we heard them yelling, and saw the ferryboat, ablaze with lights, bringing them out to the vessel, it reminded me of the stories I used to read in the dime novels, of Indians raiding a village.

Before the lines were made fast, the boys made flying leaps from all along the length of the ferry boat. In a flash all were aboard, dressed in white suits, shoes, socks to match, and straw hats with the ribbon bands of their respective Alma Maters. Watching them, Jim Chalker, our Bos'n—a happy soul, full of humor, who loved the sort of boys we had—said:

"Look at the white devils boarding us. Be Jabbers, soon they'll be black ones!"

When our Captain arrived on board in the morning, we were, all told, 37 persons. Many amusing things happened that trip; and how in the name of all that is good and holy we returned without a scratch on us or on the ship is really and truly a miracle.

In Hudson Straits

But this particular incident will always be engraved on my memory. It was around the first week of September. We were anchored in Erik Cove, a snug little place at the southeast end of Cape Wolstenholme, on the south shores of Hudson Straits. The real purpose of our anchoring in this place was to trim our coal bunkers and fill our tanks with fresh water. The boys all wanted to give us a hand, but we had a crew large enough to handle the job and the Captain told them they could have a holiday. He gave them their choice between going ashore and collecting fossils and flowers, digging in the old Eskimo houses, fishing for trout and salmon, hunting caribou, or shooting birds from a boat at the murre loomeries.

So many wanted to go after the murres that it was necessary to take two boats to the loomeries. I was

to go in one boat, but I felt that I should stay and watch the coaling, etc. So I asked permission of the Captain to let the Chief Engineer, who was only too pleased to go, take my place in the small boat. The Captain took five lads besides himself in the 28-foot Scotch whale-boat. In the Engineer's boat, a 16-foot double-ender, there were four boys.

I could see by the blood-red dawn that we were going to have rain, and other indications pointed to wind. As the Captain went over the side, he also predicted bad weather.

I should judge that it was two and a half to three miles from where the ship lay to the point forming the western extremity of the bay, east and west of which were the loomeries. Here the two boats parted company, and as they did so the Captain reminded the Engineer that later on they would have wind, and not to go too far to leeward. The Captain's boat rowed to windward, and the Engineer's to leeward. But the wind was a little off-shore, so the Captain, too, bore away and ran to leeward, at the same time having in mind the weather brewing. For a while the two boats were together. Observing that the wind was freshening and slowly veering on shore, the Captain headed his boat for the ship. The other crew kept on shooting birds.

The lads in the Captain's boat lay back on their oars and pulled for dear life. The 'Willy Waws,' or squalls of wind coming off the mountains, were vicious. During the lulls the men could gain a yard or two, and then the 'Willy Waws,' sweeping down, would lift the oars out of the row-locks. To hamper them more, the tide changed, running against the wind, and the water became exceedingly choppy. So bad did it become, that they had all they could do to hold their own, and but for the constant urging of the Captain, there is no telling what might have happened. However, realizing their plight, he had put off his usual reserve and dignity, and like a football coach, was urging on his men with stinging words, first encouraging one, then another. With his determined spirit and the pluck of the gang in the boat, they managed, during the lulls, to creep in under the point, where, after a brief spell, they worked into smooth water. Once there, they had a fair wind to the ship.

Heedless of the danger

The other crew were so absorbed in shooting birds that they did not realize they were going farther and farther to leeward. Never in their lives had they had so much fun. The sky was literally filled with birds, and the excitement of seeing and killing so many at close range intoxicated them.

When, beginning to tire of this sport and grow hungry, they turned toward the ship, they did not realize that the wind had set them so far from it. At the time they headed back they had just rounded a point, thus putting themselves temporarily in the protection of a small lee. Here they were so close in-shore that the 'Willy Waws' blew above them. But soon they had to row beyond the shelter of the point and face the full fury of the gale.

The rough-and-tumble sea was baffling. They were nearly all university crew men, but they had never experienced anything like this. They were rowing now for life itself. They made good a few miles by following the shore line and taking advantage of every bit of shelter, but the distance was much greater than they had imagined. Bravely they fought on, expecting every point they rounded would be the last one. In the lulls they would forge ahead. The rain and sea-water soon wetted them to the skin. The Engineer steered and bailed. The dark, lowering clouds overhead piled up fast and furious out of the east, across the level plateau and through the gorges and ravines along the coast, soon cutting off the daylight. To windward and leeward waves formed, breaking seas around and about them; rain, wind and hail lashed at them. At times the 'Willy Waws,' tearing down from the tops of the 2000-foot high mountains, caught up the water in spindrift. You couldn't hold a hatchet to windward. Soon darkness would be upon them.

Suddenly a fiercer squall than any that had gone before tore down upon them, unshipping two of the oars. In a 'brace of shakes' the boat's head fell off, and she started head-on for the rocks. The whole length of the shore was buried in foam. Helplessly they watched their tiny craft drive toward that vicious surf. It was at this crucial moment that the extraordinary thing happened.

Deliverance

By some miracle the boat was hurled into a small, unseen cove in the cliff face and landed gently on a pile of rock at the dead end at the base of the cliff. No human hand steered that boat. It was the same Hand that helped Peter on the Galilean lake that guided it for thirty feet through that invisible break in the cliff without hitting a thing.

This refuge had been formed by a big landslide of rock which had broken away from the top and face of the mountain. The whole thing had come down and lodged in the water at the base. The splitting of the rock formed this providential gulch.

Then another remarkable incident occurred. The waves that followed this first one were each a little

smaller than the preceding one, for it was the last moment of high water. The boat was not even scratched, and remained in the same position until we took her away, as upright as if on land in a cradle.

But though this was the end of their anxieties, it was not the end of their surprises. As the crew piled out of the boat onto the rock they were startled beyond words to see in the semi-darkness a polar bear and a very large stag caribou with horns in the velvet. With ease, they killed both and added them to our collection.

I do not believe any of us thought we would ever see the lads alive. What worried us most was that we did not know of any landing-place along the face of the cliffs. We had a forlorn hope that if the boat could keep off the rocks and remain afloat, we might be able to pick it up in the Straits.

When the Captain got back to the ship with his crowd we had coaled, watered, and were all mopped up ready to weigh anchor and begin the search. But darkness was upon us, and the Captain decided to wait until dawn. No one turned in.

The search

Around midnight the wind lulled, and we got under way and slowly steamed out. What a relief it was to be doing something! When we reached the Point at two o'clock in the morning, I climbed up into the crow's nest. It was still dark, and the aftermath of the storm showed itself in the heavy clouds to the northeast that shut out the dawn. I really thought light would never come. At length, slowly—oh, so slowly—it came, and as we were steaming along shore, I saw a wisp of smoke rising against the dark face of the cliffs. All hands below, on deck, forecastle head, and bridge, saw it as well. Then, a little later, we spied the four fellows and we almost went crazy with joy.

Owing to the heavy sea, we waited, but in an hour or so the whale-boat was lowered, and I went to the rescue. I carried about 150 fathoms of ½-inch Manilla line, and a forty-five pound grapnel; also some codfish oil to level off the water. Rowing in, we dropped the grapnel and backed her in stern first, paying out the line and working in with our oars. At the same time a man forward payed out the line, checking her when she got in among the rocks, thus preventing her capsizing. One by one the boys leaped from the rocks into the stern sheets of the boat. In a short time we were all safely on board the vessel again; then we steamed in and anchored in the Cove. When the wind and sea moderated we returned to pick up the boat, the polar bear, and the caribou.

I marveled greatly at the coolness of the Captain. He didn't turn a hair, and yet I knew full well that he was very worried. Although he never hinted or showed it in his manner, I know now that he wouldn't have given the old overcoat he wore for their chances to survive.

Out of the past

Many years have passed since that day. Some of these lads are in their graves now. Others remain. Others are fathers, and even grandfathers. I have had some of their boys with me among the lads I have taken North on the *Morrissey* to Greenland, Baffin Land, in fact, all over the eastern and western Arctic. They are the same breed. They have the same pluck and spirit as their forebears.

In those days when a lad cast off with the last parental kiss he was out of reach until he was back in St. John's, Newfoundland, or Sydney, Nova Scotia. That was before we had the radio, motor boats, frigidaires, and many other gadgets that go toward making life on shipboard livable and safe. But the wonders and beauty of the Arctic will always remain. Today the opportunities for worthwhile scientific work in the far North are much greater than they ever were. And these lads discover that there is still a lot to learn that is not in books.

I am proud of these boys who have gone north with me and later made good account of themselves. If one is to have well-rounded development, youth is the time to acquire it. Life at sea shows them their faults and brings out the best that is in them. The experience of steering a ship, handling and reefing sails, keeping the lookout, and being thorough, careful and quick, stands them in good stead later on. There is great satisfaction in the feeling that these experiences have made life mean more to them.

HOW THE MOON GOT ITS CRATERS—*Experiments duplicate the scars on the face of the moon and support the evidence yielded by the earth's own meteor craters*

By WILLY LEY

WHAT we refer to as "the man in the moon" must have kindled the imagination of mankind from earliest times, and the fanciful myths that have surrounded the moon are perhaps more plentiful than those attached to any other heavenly body. But it was not until the invention of the first, low-powered telescopes that the moon revealed its most interesting physical features, the craters. These "pock-marks" on the face of the moon have been the subject of much scientific debate, and were a topic old in the annals of science even before our own meteor craters on the earth had so much as been discovered.

A graveyard of countless meteorites?

Investigation of the earth's meteor craters and certain experiments I shall speak of later have shed light on the theory that explains the moon's craters as the result of a bombardment by meteoric masses from outer space. The principal alternative theory accounts for them as the craters of extinct volcanoes.

Until about twenty years ago geographers and geologists supposed that meteor craters were extremely rare on earth. Only two had been identified: the large one (called Meteor Crater) near Canyon Diablo in Arizona and the crater field at Podkemmenaya Tunguska in Siberia. Although the crater field on the island of Oesel in the Baltic was known, its meteoric origin was not suggested until 1927, by Reinvald. With so few meteor craters on earth to afford comparison, the meteoric theory of the origin of the moon's craters did not win rapid popularity.

Terrestrial craters as evidence

With the discovery of other meteor craters on earth, more and more attention was directed to the meteoric theory.

A crater field near the Gulf of Aden, discovered and described by the English scientist Philby, comprises a large number of craters the diameters of which range from about 50 to 100 yards. Some of these are hardly recognizable because of sand blown into and over them by the wind, but it is still possible to make out their original size and shape. Proof that the craters are of meteoric origin is seen in large pieces of natural glass, fused from the sand of the desert by the tremendous heat developed by the impact of the meteorite.

Pieces of meteoric iron were also found, and the field is called by the natives Al Hadida, meaning "Place of Iron." Philby believes that Al Hadida is the same place as the fabulous city of Oubar which is said to have been destroyed by fire from the heavens. Most probably a city of Oubar never existed and the craters were misinterpreted as the ruins of a city by the natives. It is possible that the meteorite fell within historic times, although the largest piece of iron (24 lbs.) is rusted all through.

Quite similar to the craters of Al Hadida are those of Henbury in Central Australia, discovered in 1930. The Henbury crater field comprises 13 craters, all of which are circular except the largest, which is elliptical and measures roughly 120 by 220 yards. Many pieces of meteoric iron were found in the vicinity of these craters and also fused sand similar to that of Al Hadida.

Visible from the air

The number of known craters of meteoric origin has been increased since airplanes came into general use, and several sites have been added to the crater map of the United States by this method. Land erosion has doubtless obliterated many craters from the face of the earth, and the absence of it on the airless, waterless surface of the moon has preserved its 30,000 visible craters.

The largest and most famous of all meteor craters on the earth is still Meteor Crater, near Canyon Diablo, Arizona.* It is nearly three miles in circumference and its ring wall rises 130 to 160 feet above the surrounding plane. The crater is nearly

*See Dr. Clyde Fisher's "Meteor Crater, Arizona," Guide Leaflet Series, No. 92, the American Museum of Natural History.

How the Moon got its Craters

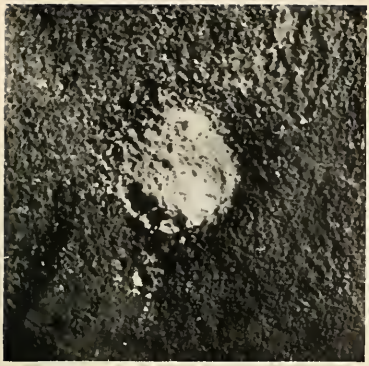
Are the 30,000 "pock marks" on the face of the moon the result of volcanic eruption or the graveyard of countless meteorites? They range in size from a few to several hundreds of miles. In proportion to their diameters they are very shallow

Photos courtesy of Mt. Wilson Observatory

Less than a century ago it was still believed that these ring walls might be of artificial origin. Curiously enough the same has been believed of some of the terrestrial meteor craters

An artificial meteor crater of about 3 inches diameter produced by dropping a spoonful of cement dust on a surface of the same material. The proportions of this crater correspond to those of natural terrestrial meteor craters

What happens to the meteorite? To answer this question plaster of Paris was used for the "meteorite". It was found that the white powder covered the interior of the crater in a thin layer, thicker only on the inner side of the wall



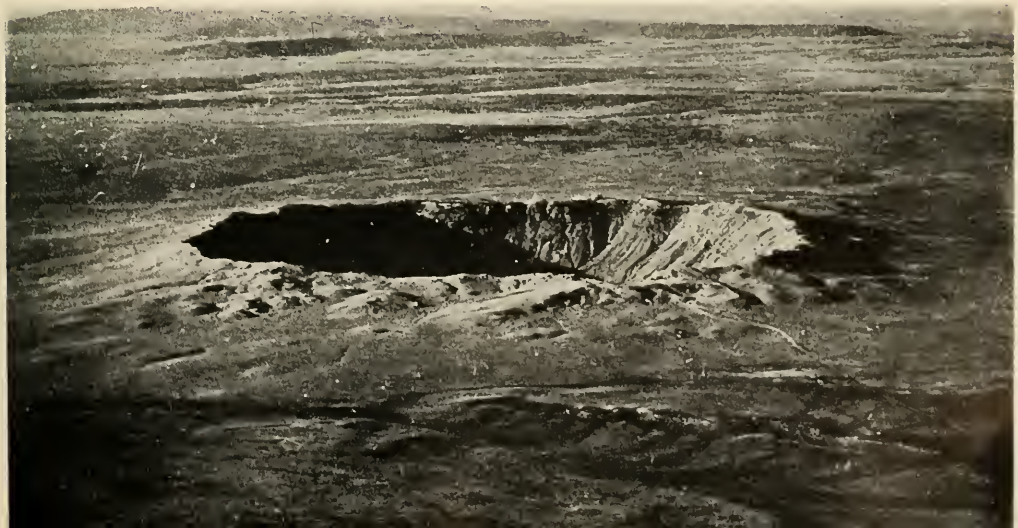
Part of the material of the meteorite was found outside the crater, some particles more than 15 times the diameter of the crater away from its center. This corresponds to natural meteor craters where most of the meteoric matter was found in the vicinity and on the wall of the crater and not on its floor

The central cone characteristic of many moon craters was produced accidentally in the laboratory when a very thin cement-dust surface was used. The central cone was discovered to be ground material not carried away from the center when the meteor struck and scattered

A perfect laboratory meteor crater with central cone

The largest known meteor crater on earth, situated near Canyon Diablo in Arizona. This crater has no central cone, which fact corresponds with the theory outlined in this article

Photo by Clyde Fisher



600 feet deep, and its floor is without irregularities.

When Meteor Crater was first discovered it was explained as the result of a steam explosion; later the theory was advanced that it might be a limestone sink. Finally Mr. Barringer established the theory that Meteor Crater was the scar left by a meteorite. This theory is now universally accepted.

"The meteoric origin of the Crater," writes Dr. Clyde Fisher, "is suggested by the occurrence of literally thousands of pieces of meteoric iron around the crater. These fragments were found as far as four or five miles from the crater on all sides, but the nearer the Crater, the more numerous they were. In other words, Meteor Crater is about in the exact center of an area from which have been collected many more specimens of meteoric iron than have ever been found on all of the rest of the earth's surface.

"The largest piece of which I have knowledge is in the Colorado Museum of Natural History in Denver, and it weighs 1406 pounds. . . . The second-largest piece is in the American Museum of Natural History and weighs 1055 pounds. . . .

"It has been variously estimated that the mass of meteoric iron weighed from 100,000 tons to as much as 10,000,000 tons, that it was several hundred feet in diameter if the larger estimates are correct, and that it was moving from seven to forty miles a second.

"The amount of rock dislodged and partly thrown out of the crater has been estimated at over 300,000,000 tons."

The fate of the meteorite

Impressive as all these figures are they do not answer the question, What happened to the large meteoric mass itself? Many borings have been made in Meteor Crater to locate the main mass, but it has not been found and it may never be. It is hard to visualize what actually happens when a large stony mass strikes the ground at a speed as great as 40 miles a second. It has been suggested that the terrific pressure of impact would cause the meteorite to flow as if it were a gas or to vaporize. In any event, the largest known meteorite is a mere fraction of the calculated size of the mass which produced this crater.

What can we learn from terrestrial meteor craters that will help us to understand the craters of the moon? First, the floors of both lie below the surrounding surface. Second, the bulk of the ring wall in many cases appears just about sufficient to fill the crater up to the level of the surrounding country. Thus the rim suggests to the imagination the circular wave that is produced when a stone is dropped into water or other liquid, except that here the wave has quickly been "frozen" in its tracks. It is not hard to imagine that the ground material may have been utterly pulverized by the terrific impact, and some of it perhaps even made molten by the heat produced at the instant of collision.

It is to be said to their credit that some astronomers suspected that the lunar craters were the scars left by gigantic meteorites even before terrestrial meteor craters were identified as such. Several scientists had gone so far as to try to produce artificial little moon craters in the laboratory by throwing or dropping elastic bodies such as rubber balls against a surface of wet cement or similar material. But the results, although they showed a superficial similarity to moon craters, did not resemble them sufficiently to win converts to the theory.

Laboratory demonstration

It was for Dr. Alfred Wegener (the same scientist who originated the famous theory of floating continents) to explain the failure of these earlier experiments and to present proof of the theory. In short, he pointed out that the laboratory demonstrations had been conducted on such a small scale as to greatly distort the forces operating in the astronomical event. In the experiments, molecular forces such as adhesion and cohesion played altogether too large a part in comparison with gravitation; for in the actual meteoric impact the molecular forces are overshadowed by gravitation.

To ensure duplication of the actual conditions, he realized that it would be necessary to use material that did not possess appreciable molecular forces; hence he chose dust.

The author has duplicated these experiments using the same material and very fine sand, and the accompanying photographs show the results. In these tests, the surface as well as the "meteorite" was dust, which on a small scale behaves as do iron and rock on a large scale.

The central cone

The dimensions of the actual moon craters should be noted. The diameters of some are gigantic: crater Copernicus 56 miles, crater Gauss 110 miles, crater Schickard 134 miles, and crater Bailly even 160 miles. In comparison with their diameters, the craters are relatively shallow. The floor in all lunar craters is even, the principal irregularity being the so-called central cone which is found in about four out of ten craters. The floor of the lunar craters is

always below the level of the surrounding territory, there being only one exception to this rule (crater Wargentin). If there is a central cone it is very low, the highest central cones being just as high as the surface outside of the rim. The most interesting fact, however, is that the mass of the ring wall is just sufficient to fill the crater floor up to the level of the surrounding terrain.

When the first experiments were made it was found that they resulted in miniature craters that did not only look exactly like real moon craters, but they duplicated the ratio of the dimensions except that they were less shallow than the very large craters. Naturally the question arose, What happened to the "meteorite"? For this reason other experiments were made with gypsum in place of cement for the "meteorite." The result was very surprising: the crater was all white and splashes of the material were found outside the ring wall. A vertical cross section through the crater showed that the gypsum covered the crater in a very thin layer, which was slightly thicker on the inside of the ring wall, while a considerable amount of the meteorite was thrown beyond the walls. In his own experiments the writer found particles of it more than fifteen times the diameter of the crater away from its center.

The impact visualized

These experiments, the results of which agree very well with the actual conditions observed near the moon craters, explain the "mechanism" of their origin. The meteor which strikes the surface of the planet vertically or almost vertically is shattered and at the same time it breaks up the ground into fragments which are thrown in all directions until the energy of the impact is exhausted. Some of the loose material (mostly meteoric matter but also ground material) is thrown beyond the ring wall. It can be found in quantities in the immediate vicinity as has been observed not only in Arizona but also in Henbury. These facts explain why the floor of the crater is always below the level of the surrounding territory and why the mass of the ring wall is just about sufficient to fill up the depression: it *is* the material that was originally situated there. The additional mass of the meteorite is compensated for by those particles of ground material that are thrown beyond the ring wall.

An accidental discovery

As for the central cone, Doctor Wegener first obtained one purely by accident. It appeared when he had used a very thin layer of cement dust. By duplicating this condition it is easy to produce craters with central cones, as the writer's experiments have proved. This means that a central cone originates when a solid and thick layer of very dense, hard and heavy rock is found not too deep beneath the surface. This is not the case in Arizona, consequently Meteor Crater is without a central cone. The central cone is (according to the experiments) simply ground material that was not carried away from the center, hence no central cone can stand higher than the original level as shown by the surroundings.

The evidence from these experiments and from terrestrial craters has convinced many that the craters of the moon are of meteoric origin; and the volcanic hypothesis, once so popular, has lost many of its supporters. Today one does not ally himself with a discredited group if he embraces the theory that the face of the moon owes its "pock-marked" appearance to bombardment by meteors similar to the one that in hitting the earth produced the large and famous Meteor Crater near Canyon Diablo in Arizona.

TREASURES OF THE PREHISTORIC SEA—*In Canada's Rockies, fossils depicting an early chapter in the history of Life are sought by both the scientist and the vacationist*

By CARROLL LANE FENTON

OUR train swung through Bow Gap, where the northern Rocky Mountains open to travelers from the plains. Gray peaks stood on either side, while firs and pines framed the stream that led to the distant magic of Banff. As the Three Sisters came into view, five mountain sheep stepped from the bush, posing between the rails while our engine screeched and scraped to a halt. The fireman shouted, the engineer swore—and the sheep picked their deliberate way to a thicket of aspens.

In Banff, our thoughts turned to rocks. While orchestras played we discussed faults: great breaks in the earthcrust which thrust enormous blocks of stone high above the plains. Each block formed a mountain or a range, in which rock layers were bent, broken and tilted. One can see the pattern of these layers in cross-section in the famed Bow View; they dive beneath a green golf course and rise steeply from well-cleared trails. They offered the traveler a course in earth history from his car seat, his saddle, or the paths he might take in climbing peaks.

A geologic jig-saw puzzle

But Nature did not make the course as easy as she might have. Mountain-building upset the geological sequence and left unlike things piled together. The gray beds in Mount Rundle were old ere the first earthquake was felt. Three hundred millions of years ago, there were muds beneath a Coal Age sea where corals and strange shellfish lived. Much younger was the coal mined near Banff, having formed in swamps and mucky shallows during the late Age of Reptiles. Yet in a canyon a few miles away were thick beds or rock built by marine plants almost a half billion years ago. With the layers so much disturbed, even fossil hunters might spend a few days getting the lay of the land!

With maps and books we set out, following the Bow Valley to Lake Louise and down the Kicking Horse River to Field. The road crossed rocks of varied ages, as well as many faults made when the mountains arose. It also allowed us to trace the long winters that came when the mountains became so high and so cold that glaciers formed upon them. Each glacier was nothing more than snow that packed deeply, formed ice and started to creep down a mountain. On the way, it wedged into cracks, pried off sharp-edged blocks of rock and ground them against its bed. Thus it dug a valley, cut steep cliffs and helped to shape massive mountains into crags and "horn" peaks.

The glaciers produced imposing scenery—and they also helped fossil hunters to work. On our first real collecting trip, we came to the foot of a cliff too steep to be climbed except with Swiss guides and ropes. But it had not been too steep for a glacier, which had broken off great blocks of the very strata we wanted to see. Melting, it dropped them beside a lake on whose quiet shore we could rest when pounding and prying became too tiresome.

Three fishermen, casting for trout near us, frowned if we overturned heavy boulders that might make noise enough to disturb their fish. A trail party from Lake Louise paused for lunch and to ask questions. How did we *know* those rocks were formed in seas? What did trilobites look like when alive? To what museum were we sending our collections? Might some of them join us on another trip? Why didn't we drop research for nature guiding—at a stiff rate per day?

Reading the rocks

Between answers we chiseled and pried thin slabs from an enormous, angular boulder. During early Cambrian times, it was part of the sandy bottom beneath a very shallow bay. Winds crossing the water stirred up small waves which reached to the bottom and built ripple marks. Across the rippled sand snails crawled, eating as they traveled and leaving tracks like small furrows, each bordered by ridges. When the sand slowly cemented into stone, both ripple marks and snail-trails remained. We took photographs, made measurements and wrapped all

the specimens we could pry off and carry. Though all traces of the shells had vanished, we felt sure that the fossil tracks entitled us to describe America's oldest known snails.

We found more such trails at Lake O'Hara, a half-day distant by trail. There we "camped" in comfort at a log chalet, ate steaks brought on pack horses every day, and again proved that travelers may see and enjoy geology without going far from civilization or doing hard, dangerous work. At various times we were accompanied by retired professors, artists, elderly ladies whose trail performance surprised them, accomplished alpinists, housewives and fishermen. A Boston merchant helped us rescue a slab of strange worm-burrows that workmen had placed in a muddy spot on a trail. A Swarthmore chemist found a slab of strange little red algae, surrounded by stone that was a mixture of lime and very coarse, sharp sand. A photographer picked up a block of sandstone containing the trails of trilobites —and entrusted his best camera to his wife, so he might carry the specimen down for us. Each day we had help; the result made a full load for two able but somewhat despondent pack horses.

A few days later, we left Lake Louise in search of more fossil algae. We had planned to take guide, pack horses and camp outfit, but the park warden had a better suggestion:

"Jim Boyce has Skoki Camp open; keeps it open all summer. Walk up if you like—it ain't thirteen miles. Jim will give you good grub; he'll take you where you want to go; he'll come after you; he'll pack your fossils. Mebbe he'll find 'em for you, too, for Jim knows a lot about this country. And keep an eye out for grizzlies while you're collectin'. There's a fine big one, creamy colored, lives below Deception Pass."

Where work is play

So again we "camped" in a log cabin with good beds, warm water at rising, and nothing to do but our work. On the first day it took us over rocks formed near shore and in water so shallow that the tiniest waves made ripple marks. On the second, we followed banks of fossil algae five feet in height, searching all day for two specimens small enough to go on a pack horse. On the third day we followed more shores of ages gone, and found a gully where fossil corals had been piled by floods sweeping down a mountain. We also photographed ptarmigan, which, though it was but mid-August, were already turning white, as if in preparation for winter. Two bighorn sheep trotted away and a mountain goat mounted a boulder to watch us. Next morning, a wolverene saw us depart, a coyote stalked marmots beside the trail and the grizzly peered at us through a screen of firs. We caught one glimpse of his creamy coat as he lost interest and left.

We had expected merely to walk out to the railway. Instead, we collected odd things that may or may not be fossils, gathered prints of salt crystals from upturned formations, and filled our packsacks with colonies of algae lying just as they grew on the mud floor of a sea. Once more we had the glaciers to thank, for they had stripped the hardened muds clean of other rock. They even dropped one large slab beside a creek where we could get it without climbing the steep mountain side!

Looking back 400,000,000 *years*

Yet one does not visit those peaks just to trail worms and snails, or to measure thick strata of limy algae. Not many miles away, and in easy reach from chalets, lie rock beds famous for their petrified shells, with sponges, sea weeds and shrimp-like creatures besides. They are perhaps the finest marine fossils in the world; yet more than four hundred million years have passed since they sank into sticky black mud that slowly hardened into shale.

Discovered in 1909 by the late Charles D. Walcott, these strata lie in the high, sharp ridge between Mount Wapta and Mount Field. From them Doctor Walcott and his aides took thousands of fossils, amazing in their detail and perfection. In their delicate films of carbon he found sponge spicules and algal fronds, worms with spines and bristles intact, larval trilobites so delicate that their bodies seemed to be bits of gleaming black lace. Walcott's photographs caused amazement, and museums counted themselves lucky to receive his duplicate specimens.

Since the Walcott quarry had lain abandoned for years, we expected little when we reached it on a hike from the chalet at Emerald Lake. We even talked of hastening back to watch a moose whose calf was hidden in scrub firs near the trail. But the sun was sinking before we at last got away. Two hours' search had brought more fossils than we could carry, and every one of them was good!

While resting on the long, steep descent, we made plans to revisit the quarry, and camp. Maps showed a better trail from Yoho Valley; there we went to make preparations, and also to meet Mrs. Walcott. A woman of more than seventy then, she knew those mountains as we know streets. She gave advice on the place to camp, the spot to get water and the best methods of splitting shale. She even saw us off with a promise to ride up and again spend a day collecting

TRAILS OF SNAILS that fed on an early Cambrian sand flat almost half a billion years ago await the collector in this region

TRAILS OF HUNGRY TRILOBITES mark this slab of standstone, creatures abundant in the prehistoric seas that formed these rocks

Carroll Lane Fenton Photos

BANFF'S FAMOUS "MILLION DOLLAR VIEW" is a panorama through the ages

PEBBLES smoothed and rounded by waves that lapped an ancient shore, now found on a pass above glacier-cut valleys

A MOUNTAIN of marine limestone, broken and tilted when the Rockies were built. Glacial carving has also displaced the rocks

"Fossil" ripple marks on a rock surface laid bare by glacial ice: a page from the geological history of this scenic region

Pebbles torn up, scattered and dropped by ancient waves: evidence of a prehistoric storm of several hundred million years ago

Here amid gorgeous mountain scenery the vacationist may collect interesting geological specimens

(Photo Courtesy of Canadian Pacific)

Each knob is the top of a colony of algae, underwater plants that lived in a warm, shallow sea

These huge colonies of algae were filled by layer on layer of lime, thus building beds of rock even while they were alive

from the ledges her husband had made famous.

But don't picture us setting out, mounted, at the head of a long pack string. With but nine miles to go and four days to stay, we needed no elaborate equipment. Food, bedding, tent and packing materials went on one horse while another was ridden by the guide. We could even have carried enough in our knapsacks, but the load would have been hard on office-weakened shoulders. As it was, we walked with comfortable speed, and at one o'clock were pitching our tent among firs below Burgess Pass.

Daily for four days we climbed the ridge to the quarry, where we hammered and chiseled slabs of hard shale containing the precious black fossils. Each evening we wrapped our finds and filled our knapsacks; then carried them to the tent, which lay eight hundred feet below us. On the way, we caught glimpses of Emerald Lake or watched sunlight gild the ice of Mount Vaux, far beyond the Kicking Horse River. Or we turned to view the President Range, also crowned with the ice of glaciers yet resting on a rich, purple haze that descended into deeply shaded valleys. Once, as we paused, twenty-two mountain goats crossed the ridge and came down to nibble mountain sorrel on slopes above and beside the quarry.

Fossils before food

On the last evening we rewrapped our finds, lest the delicate fossils be scratched when tied upon a pack saddle. Though our outfit included a huge bundle of paper and cord, scraps had to be taken from parcels of food to wrap the last slabs of shale. We could buy more groceries if we needed them, but fossils were not to be had in stores.

As wrapping ended, rain began. We had planned to store bundles in ponchos outside, for a hiker's tent weighing five pounds has very little room for storage. But that now was out of the question, for if those precious papers got wet we should have to go to Field for more before our finds could be transported. And how could we get there and back with the horses due on the morrow, at noon?

Instead of debating, we set to work. Every fossil went into the tent, along with cameras and essential food. At the last we cautiously inserted two tired collectors into the spaces left between sharp stones, tin boxes and hard leather cases. That long rainy night was one occasion when the specimens, instead of the collectors, occupied the most comfortable quarters in the tent.

Morning dawned bright, warm and welcome. We teased ground squirrels who wanted to bathe in our porridge, photographed a large marmot, and tried to picture the mountains as an ancient sea with ourselves exploring the muddy bottom or walking the flat, muddy shores. In imagination we brought our coal-black sponges to life, surrounding their orange, white and crimson fronds with green and red-brown algal plumes that waved in the gently moving water.

Among the algae, translucent shrimps swam to and fro. Mottled crustaceans crawled on the bottom, seeking something on which to prey. Near them were trilobites: wide, flattened creatures with many-jointed bodies and legs and glowing eyes. They were content to eat rubbish that lay on the mud; and some tiny kinds even burrowed in it. We noticed that they also were eyeless. Had they lost their eyes because they burrowed, or did they burrow because they were blind? Or were both blindness and burrowing developed through some process of racial decline about which we knew nothing?

We dropped the question to consider purple-plumed worms that crawled beneath the seaweeds. Near them clustered groups of orange, pink and green lamp shells. Some fastened themselves to dead shells, others bored into the mud with fleshy stalks that twisted like bare, pink worms. When real worms came near, these stalks pulled the shells down out of harm's way. They also drew away from crustaceans with checkered, clam-like shells. Life, color, and bizarre forms mingled in our picture of the past.

It was broken by a purple gleam a half mile down the trail. Our guide and packer had put on the brightest of his bright bandanas to celebrate the return trip. Soon he led two horses into camp, and asked just how he should pack the parcels "to keep them 'trillobits' from gettin' busted." Then he assured us that he could load the material without help from us, that a coyote might be seen on the trail, and that there was no reason, no reason ay-tall, why we should hang around. Suspecting there were reasons why we shouldn't, we shouldered our nearly empty pack sacks and started down the mountain.

The past in panorama

As we reached a point an eagle screamed. Watching it soar upward to the crags, we thought of the vast story of earth, the sweep of geologic change. About us were hardened muds rich in remains of creatures that could live only under sea water. The mountains told a story of uplift: of salt waters draining away to leave land, of ages of coal swamps and ice, of returning warmth that brought flowers, birds and people to valleys left barren by the melting ice. The Indian had come and gone, leaving only names such as Wapta to mark his one-time dominion

(Continued on page 289)

THE "BLOND" ESKIMOS AND THE "CREATED WANT"

—Reduced to moral and economic degradation by twenty years of ruthless exploitation, these noble people are a living proof of the necessity of governmental protection for the native races of the world

By PHILIP H. GODSELL

[*Readers will remember Mr. Godsell as the author of* "Relief" in the Sub-Arctic *in the November, 1936,* NATURAL HISTORY, *and of the book* Arctic Trader *and other writings.*

In 1923-24, as Inspecting Officer for the Hudson's Bay Company, he inspected the entire western section of the American Arctic and arranged for the establishment of three posts. On his return journey he crossed the northern extension of the Rocky Mountains in mid-winter by dog team from Aklavik to Fort Yukon and thence to Fairbanks, Alaska.

He reported fully upon conditions among the natives of the western Arctic at that time with a view toward their amelioration, and it was shortly afterward that the Canadian Government took active steps to give the natives greater protection.—The Editors.]

IN THE circumpolar region beyond the many-channeled Delta of the Mackenzie it was the mammoth bowhead whale that introduced the spearhead of Caucasian commerce. In the summer of '89 the first whaler edged her way between the polar ice pack and Point Barrow, northernmost point on the American continent. Guided by the ice-pilot aloft in the crow's nest, the sturdy *Grampus* buffeted her way through glistening, grinding ice-fields, rounded the frozen headland of Herschel Island and dropped anchor in the narrow harbor known as Pauline Cove.

Friendly natives

Some two thousand Eskimos roamed the Arctic foreshore between the Alaskan boundary and Baillie Island in those days; not the short, chunky chaps usually associated with the North but tall, good-natured, strapping fellows. With the adaptability that characterizes this race they had learned to make themselves relatively comfortable in a land which the white man, with all his scientific knowledge and inventions, has always shunned. From the very snow itself they fashioned a light and weather-proof shelter in the form of the dome-shaped igloo. From bone, native copper, driftwood and sinews they fashioned implements and weapons such as snow knives, awls, fish-hooks, harpoons and bows and arrows. From whale intestines and the skin of the seal they evolved waterproof coats and mukluks. With harpoons shod with detachable barbs of bone they pursued the whale in their flimsy *kayaks* and *oomiaks*—not for the headbone sought by whalers but for the vast stores of food and blubber which one of these animals provided.

Satisfied with primitive life

To the whalers the exploitation of these ingenious natives presented an annoying problem. The Eskimos seemed quite satisfied with their own particular mode of life and wanted little that the white man had to offer save wood, knives, needles, pots and axes. Intoxicants, for which the red man would barter his soul, did not appeal to them at first; liquor made them dizzy, and it was necessary at all times for them to have their wits about them in order to cope with the unrelenting forces of nature by which they were surrounded. They considered fresh caribou or seal meat superior to rancid sowbelly. And they did not see any particular advantage in exchanging their own warm and windproof clothing for the shoddy cotton and woolen goods imported by the *Kablunats*.

From the white man's point of view they would have to be educated into wanting quite a lot of things ere they would be ripe for commercial exploitation. They would, for instance, have to be taught to discard skin coats for sweaters, and to like the taste of flour, tea, sugar, coffee, sowbelly and whiskey; things which could be purchased cheaply in Seattle or San Francisco and sold for an excessive price at Herschel Island.

In the jargon of the fur traders this is known as

(Left) WILL HER CHILD SUFFER the degrading exploitation by commercial freebooters that her parents did? An Eskimo mother and son of the Victoria island tribe whose recent past is a black page in the history of white civilization

(Below) HAPPY SAVAGES, WELL CLOTHED AND HEALTHY. Before white man came the Eskimos were healthy and contented. The "created desire" for civilized ware, purposely instilled by grasping traders, led them to moral debasement

Photos above and below by P. H. Godsell

Courtesy of National Museum of Canada

(Left) RIFLES DEPLETED THEIR GAME; they changed from fur clothing to the white man's inferior cloth, and were sold alcoholic liquors. Disease weakened their racial stamina

Dept. of Interior, Ottawa

(Right) THE ROYAL CANADIAN MOUNTED POLICE "NAVY." The *St. Roche,* which keeps order in the Arctic and prevents poaching upon Eskimo preserves: one phase of the urgent task of salvaging the Eskimos

the "created want" and, while its commercial advantages cannot be denied, its effect on the recipients leaves much to be desired. Only by creating a desire for new things, and altering the native mode of life could the Eskimos be bent to the white man's will and enslaved in the web of commerce.

So Alaskan natives, who had acquired sufficient white sophistication to make them ripe for any rascality, were imported into Canadian territory to help along the good work of converting the "ignorant" Stone Age savages into the white man's way of doing things.

At the time of the coming of the first whalers a large bowhead whale, which would provide around a ton of whalebone, was worth approximately ten thousand dollars. And these virgin waters provided plenty of whales, as was attested by catches often running as high as fifty and more in the course of a two-year cruise. Thus each year saw more and more ships seeking sanctuary from the grinding ice of the polar seas in the comfortable little harbor at Pauline Cove until there finally arose on the wind-flailed strip of sand beside it a number of commodious frame buildings in which to store the headbone.

The Eskimos learn savagery

They were a mixed and motley lot, these whalers; the off-scourings of the Barbary Coast: Negroes, Portuguese, Hawaiians, Frenchmen and Americans, with the occasional morose Russian or slant-eyed Oriental thrown in for good measure. And when they spilled ashore from the decks of a dozen vessels, hell itself was let loose among the driftwood igloos of the Nunatagmiuts. Fighting, drinking and immorality became the order of the day, while shootings were not infrequent. Soon these unsophisticated Huskies learned that their women had a certain commercial value so they hired them out for the price of a gun, a case of biscuits, a demijohn of rum or a handful of tawdry trinkets.

Not until the summer of 1903 did the first sign of law and order appear upon the scene. Then Sergeant Fitzgerald and Corporal Sutherland arrived at this Arctic Babylon and there arose upon that lonely sandspit the northernmost barracks of the Northwest Mounted Police.

So effectively had the commercial exploitation of the race proceeded that, by this time, the original Eskimo population of the Delta had been reduced from some two thousand to four hundred souls. The "created want" had done its work, but it could not create natives to replace those who had succumbed to the effects of its application.

"A lot of liquor came ashore the first couple of days," wrote Corporal Sutherland. "A Huskie fired a shot at the Sergeant but was drunk and missed. We are nearly powerless except for our revolvers, which we have pulled out a good many times the last few days. I thought I knew the depths of a white man's crimes before, but if you only knew the tenth of what these whalers have been up to! The missionary says that if we had not been here, from the time the ships arrived the beach would have been one howling, crying, fighting mob of men, women *and even children.*"

Then that fickle jade, Dame Fashion, took a hand in things. Civilized ladies no longer encircled their fair forms in stays of whalebone! The repercussions were as peculiar as they were far-reaching. The price of whalebone fell from five dollars to forty cents a pound. There was no more money in whaling, and the whaling fleet ceased to visit Herschel Island.

Simultaneously another era was ushered in. Having piloted his little vessel, the *Gjoa,* through the ice-filled Northwest Passage and across the roof of the world, the well-known explorer, Raold Amundsen, brought her to anchor at King Point near Herschel Island. It was the summer of 1905, and the crew brought word of having encountered a race of unknown Eskimos in the vicinity of King William Land, nearly a thousand miles to the eastward.

"Civilization" marches on

The news spread like wildfire. New Eskimos to be exploited! A new race to be trained and moulded so that they would pour a stream of furry wealth into the grasping hands of the whites! The prospect looked alluring. So alluring did it appear that that daring old sea rover, Captain Klenkenberg, overlooking such puny ethics as property rights, calmly appropriated Captain McKenna's ship, the *Olga,* and sailed away to the east to make his fortune. A year later he returned with white fox pelts, skin clothing, stone pots and lamps, copper-bladed knives and bows and arrows, while his crew told exciting stories of the queer race of savages they had encountered to the eastward. Four years later Vilhjalmur Stefansson and Doctor Anderson contacted these Victoria Island Eskimos and soon the newspapers of the world were clamoring over the new biological discovery in the Arctic—the "Blond" Eskimos!

If gold had been discovered in the central Arctic region there could hardly have been more excitement. Traders literally fell over one another in their eagerness to share the spoils. But the country of the Victoria Islanders was inaccessible, and the cost in human endeavor high. Those possessing motor schoon-

ers braved ice and tempest and copper-pointed arrows to reach this Eldorado of the Arctic. Those who did not, followed the fur traders' route from Fort Norman across the frozen surface of Great Bear Lake, then struck northward over the rugged mountain barrier which separates that lonely body of water from Coronation Gulf. Soon flimsy and diplapidated trading posts of spars, galvanized iron and sailcloth arose along the bleak and forbidding shores, while Klenkenberg, the uncrowned emperor of this frigid kingdom, ruled his tawny flock from his "castle" on Victoria Land.

Violence

The first whites to enter Coronation Gulf found the Eskimos hospitable and friendly, but as time went on they proved less docile than those who had dickered at Herschel Island with the whalers. Foremost among their disconcerting habits was that of knifing or shooting in the back those whom they had occasion to dislike. Radford and Street, scientists from the Smithsonian Institution, were speared when Radford displeased them; black-robed Fathers Rouvier and Le Roux were dispatched with copper knives when they angered the *angatkuks* through trying to convert their followers, their raw livers being devoured by the savages under the impression that it would impart to them some of the knowledge of the *Kablunats*. Again, in 1922, Otto Binder, Hudson's Bay Company trader at Tree River, and Corporal Doak of the Mounted Police—a lifelong friend of the writer—fell—before the wrath of these impetuous natives.

Meanwhile the processes which had all but destroyed the native population of the Mackenzie Delta were being repeated in Coronation Gulf. Again Alaskan interpreters were introduced. On the shelves of the trading posts compacts, gold wristwatches, silk lingerie and striped *directoires* jostled tin kettles, nautical caps and ammunition. Sloe-eyed youngsters, who were anything but "blond," substituted chewing gum and strips of sowbelly for *mukduk*. Stone Age Eskimo ladies blossomed forth in green and pink silk bloomers—pulled over their skin pants for the admiration of the men-folk—and daubed their oily noses with greasy powder puffs.

But the big money was in trading rifles, since every Huskie was anxious to discard his ancient bow and arrows for a modern thirty dollar Winchester which sold in the Central Arctic for twenty white fox pelts—*worth from six to eight hundred dollars in London or New York*. A two and a half dollar box of cartridges sold for one white fox—the equivalent of around forty dollars! Soon every Huskie owned a rifle—and then the slaughter started.

There were only certain crossings where the female caribou passed to and from the mainland on their annual migration to the Arctic Islands to do their fawning. Lying in wait at these places the Eskimos had not been able to do much material damage with their copper-pointed arrows. Now the sky was the limit. Thrilled with the power of these new death-dealing weapons they killed and killed and killed. No longer did they kill just to obtain food and clothing. They could dispose of the skins at seventy-five cents apiece to the traders. So they kept on killing, and exchanged the skins for bullets. The shipments of ammunition to these small trading posts, each catering to a mere handful of Eskimos, were enormous. One hundred and sixty thousand rounds were imported to Kent Peninsula post alone in the summer of 1923, while eighteen enormous bales of caribou skins were shipped out from Tree River post by the annual ship, most of them wormy, fly-blown and useless!

If tons of meat rotted on the tundra it meant nothing to the traders. "The sooner the caribou are gone, the better," they said, "then the Huskies will need our flour and sowbelly and sweaters, and be less confoundedly independent. Then they'll *have* to trap!"

As suddenly as it had commenced the trade in rifles ceased. It had reached the saturation point for every Huskie owned one. With characteristic resourcefulness Klenkenberg rose to the occasion. Importing steel ramrods he distributed them freely among the natives, telling them to scrape the barrels of the rifles to take the powder out. Within a month the rifling was destroyed and the guns would shoot around corners. In two months the profitable traffic was renewed.

Dearth

Finally there came a spring when the Victoria Island Eskimos waited vainly at the age-old crossings. For the first time within living memory the caribou failed to put in an appearance. Perplexed, their oily faces lost their customary smiles. They sought out the *angatkuks*, who laid the blame upon the missionaries. "Tell them to make *their* magic and bring the caribou back," they taunted. In vain the missionaries explained that they were men of God and not magicians. But the Eskimos insisted that they go into a trance, as did their own medicine men, and bring the caribou along forthwith. Only the providential intervention of the Mounted Police prevented the missionaries being murdered on the spot.

However, the caribou had made the crossing for the last time. The indiscriminate slaughter had done

its work. Now, in ever-decreasing numbers, they milled around the heart of the Barrens, afraid to venture to the coast. The animal life of the Arctic, which alone made existence possible for the Eskimos, was being wantonly sacrificed to promote a sale for guns and ammunition to put money in the pockets of the traders. The Huskies blamed the traders. The traders blamed the smoke of coal fires. The *angatkuks* blamed the missionaries. But no one blamed the bullets!

Today the "Blond" Eskimos are trapping. They have become completely subjugated to the white man's economic domination. They are fast losing their sturdy independence and are depending on the whites for credit to obtain both food and clothing. They have substituted sowbelly, hard-tack and half-baked bannock for marrow fat and caribou steaks. They have exchanged their warm skin clothing—impervious to the Arctic's frigid blasts—for lousy woolen underwear and sweaters. They've acquired the white man's plague of tuberculosis. And they've learned to get good and drunk on methyl-hydrate—which does not kill but only makes them sick.

At the eleventh hour

So rapidly were these Eskimos reacting to the white man's civilization and his "created wants" that their ultimate destruction seemed inevitable. Then the Canadian Government stepped in. Preserves were set aside on the Arctic Islands wherein Eskimos alone were permitted to trap. White trappers and traders were ejected and trading posts moved to adjacent islands or the mainland. Mounted Police detachments, medical agencies and wireless stations were scattered along the Arctic's rim where once were naught but Eskimo *tupeks*. The importation of methyl-hydrate is now strictly supervised and confined, as much as possible, to the Primus stove which has replaced the Eskimo blubber lamp.

Recognizing, at last, that the Eskimos constitute an economic unit of the first importance in opening up and exploring the Arctic an effort is being made to provide them with a substitute for the caribou they misguidedly destroyed with their high-powered rifles. Hence Andy Bahr's epic trek with 3,000 reindeer from Buckland Point, Alaska, to Kittigazuit at the mouth of the Mackenzie. More than 800 have been born since the arrival of the 2,370 very weary survivors of the trek a year ago. And some day, it is hoped, these reindeer—which have so far cost the Government $300,000—will form the nucleus of half a dozen scattered herds which will insure these genial and over-exploited children of the polar wastes with a plentiful supply of fresh meat and skins for clothing.

White man's responsibility

What the outcome of the mingling of the races will be is still difficult to say. The greatest hope lies in the character of the Eskimo himself. A confirmed optimist, he still looks upon the future with an expansive smile, displaying a surprising resourcefulness, an alertness of mind and body, and a capacity for adapting himself to new conditions which the Indian has always lacked. It is devoutly to be hoped that the paternal intervention of the Government will permit them to long continue to play an active part in the development of the Arctic regions and prevent them from becoming still another sacrifice on the altar of the white man's greed.

TREASURES OF THE PREHISTORIC SEA

(Continued from page 284)

of the wild. Pushing him back came traders, trappers, miners and railroad builders, most of whom also were gone. At last came people like ourselves, who had learned to use the mountains for pleasure and to search them for remains of the past that served to make the present real.

That thought and a shout brought our minds back to fossils. The guide had packed our duffle and was catching up with us; creatures that had lain hidden through millions of years were bouncing and swaying down an open trail. Instead of the deep, dark quiet of rocks, they were surrounded by bright morning sunlight, creaking saddles and clopping hoofs. We stood aside to let the horses pass and to watch the packs just clear a jagged rock. In five minutes they were out of sight, but for an hour we caught snatches of the guide's songs as our trail dropped in switchback after switchback—

"Oh give me a home
Where the buffalo roam,
Where the deer and the antelope play. . . ."

★

THE INDOOR EXPLORER

By D. R. Barton

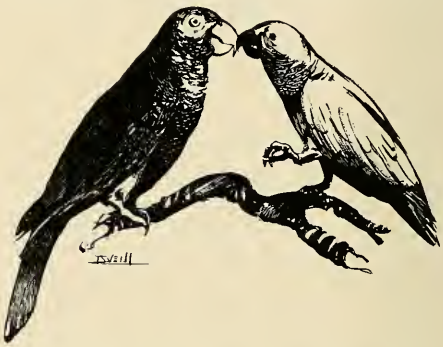
To bird-lovers in northern climes, the coming of spring means the return of their beloved friends from the south. To them it is a season of glad fluttering wings and joyous warblings in near-by trees: sounds that have been all too markedly absent during the dull and dreary months of winter. But there is one bird-lover of your Explorer's acquaintance, Mrs. M. R. Cahall, who long ago made up her mind that neither northern winters, nor the fact that she lived in a large city, were going to deprive her of the companionship of birds the year 'round.

Accordingly she made over two rooms of her relatively large metropolitan apartment into a personal aviary. After painting the walls and ceilings sky-blue to give them an illusion of outdoor freedom, she equipped the rooms with cages, perches, and other appurtenances necessary to the home-making of the surprisingly large and varied collection of birds, chosen for their qualities of song or beautiful plumage.

Today, these two rooms represent the entire world to a remarkable social organization of birds fostered by the lady and her husband who are its god and goddess. And with the growth of this organization, there have developed a number of fascinating individual characters whom it was your Explorer's good fortune to meet. Of these characters, the most impressive is Poba, a 25-year-old Panama parrot who is, every inch, the king of this apartment bird world.

He is a bachelor, very self-centered, vain and rather fussy. He is never caged, but has the complete liberty of the apartment—a liberty which he accepts and exploits with a certain austerity and reserve. Mornings, he wings his way into the lady's boudoir and joins her in bed, where he enters into aviary frolic and conversation. He is bi-lingual, having a vocabulary of some 200 words divided about equally between Russian and English. Poba is vocally inclined in a musical way as well. He sings—but not on a direct pattern of notes. That is to say, he "ad-libs", or, takes a simple combination and extracts all the variations he can out of it. In short, he gives voice to a sort of parrot "swing-technique". Perhaps his most enduring vocal improvisation is his own name; the word "poba" being a transliteration of the sound he first made in answer to the query, "What's your name?".

Poba is at the summit of the social pyramid into which the lives and activities of the birds of this apartment world are regimented. He rules with an iron, if disdainful hand, and is responsible, in his absolute authority only to his god and goddess, the lady and her husband, who are the "spiritual heads" of a unique bird domain of which Poba is the temporal ruler. In general an enlightened despot, he permits his vassals a relatively unhampered existence, reserving unto himself, however, certain privileges which they must not encroach upon. These, he guards jealously—particularly the right of precedence at feeding time, which even the "gods" themselves may not violate. When food is being offered the birds, Poba *must* be served first. At such times, the other birds hang back, waiting until their lord and master has consumed his morsel. And, no matter how tempting the tidbit may be to the birds as individuals, they will refrain from eating it, if, when it is presented to him, Poba declines to taste it. If the gods should have the unparalleled temerity to deliberately feed any other birds before offering to Poba, he will remain aloof in frigid and injured dignity. And if they subsequently offer him food after violating this holiest of his decrees, he will simply ignore both the offer and the gods, and, turning coldly away from them, will refuse to speak



or eat until such time as he has forgotten the insult.

In his relations with the other birds he is calm but nevertheless firm. If any of his more obstreperous vassals happen to have alighted on his particular perch at feeding time (a bit of *lèse majesté* which he would tolerate at any other time)—he stares down his curved beak at them for a moment, then says clearly, quietly, and emphatically, "GET OUT". They pick up their wings, so to speak, in haste. Familiarity with his sacred person is something he allows only rarely. When any of his adoring underlings attempt to curry favor by kissing his noble and ample proboscis, he disdainfully elevates that formidable member to the snootiest of angles and saunters gravely in another direction. His most persistent admirer is Mary, an African gray parrot, who tries to seize his "lips" at any and every opportunity. His customary retaliation to these unwanted endearments is a vexed jostling of Mary with his head. But on occasions when he is solemnly munching a cracker, he will often extend the half-eaten tidbit to Mary and, with the most condescending gesture imaginable mutely invite her to join him. Then there are those rare moments of weakness on his part when, in response to her incessant attentions, he will languidly turn his head and bestow upon Mary that precious favor—the royal kiss.

Violence of any sort appears extremely distasteful to Poba. He likes law and order within the realm and on this point, as on many another, the gods see eye to eye with him. Accordingly, when a couple of male Love birds strike up a heated argument over the right of priority in a certain nest, Poba calls down the wrath of the gods upon the bellicose young bloods, both literally and figuratively. He summons the goddess with screams of "Mamma, Mamma", and she proceeds to set things aright. But Poba would not interfere in the bickerings of his subjects personally—not he. In this respect, even the gods are subservient to him and must police his kingdom for him. Such an uncouth business as pulling a pair of hot-headed young upstarts apart is far too menial a task for his sublimely aloof temperament. Truly it can be said that Poba rules by a right almost super-divine.

How else can you explain the peculiar awe in which he is held by his subjects? For they seem to obey Poba's command, even after divine injunction has failed. Sometimes, after a particularly boisterous evening meal, it is difficult to soothe this jubilantly excited little kingdom into a state conducive to slumber. It is never much trouble to get them into their sleeping cages—quieting them down afterwards is the real problem. The goddess may entreat them to be silent until she is blue in the face, and still the jabbering keeps up—but let king Poba rear back his head and utter one stentorian command, "SHUT UP", and every bird appears to quiet down. But whether this period of calm lasts until morning, there is no way of knowing.

Poba also takes part in the life of the gods at such moments when the affairs of his own state are not weighing too heavily upon him. Your Explorer's acquaintance insists that at the first jingle of the telephone, Poba immediately strikes up an incessant summons, "Mamma, telephone—Mamma, telephone", until she picks up the receiver. He then flies over and perches on her shoulder and patiently awaits his opportunity to converse with the caller. Presently the instrument is held up to him. "Hello", he immediately declaims, "what's the matter—Hello, what's the matter?" Possibly the fact that there is a physician in the family has something to do with this solicitude.

As has already been hinted at, Poba's greatest weakness is vanity. Whenever he is in a cantankerous and uncooperative frame of mind, the gods know that the one sure method of bringing him out of it is flattery. Adopting the most honeyed tone, the goddess will assure him that—"Poba is a BEAUTiful bird, a most BEAUTiful bird, oh, yes, Poba is the most BEAUTiful bird in all the world." These blandishments Poba cannot resist. He walks about nervously for a bit. Then he begins to strut, and finally gives the unfailing sign that he has completely succumbed—he slowly spreads out his tail-feathers to the limit of their fan-like dimensions. From this moment up to a period of about half an hour Poba is intoxicated with his own splendor. He paces tirelessly in front of a mirror, admiring and preening himself. For the rest of the day he is guaranteed to be in the best of moods, and as docile as a lamb.

Next in importance among the citizens of the kingdom is Mary, an African gray parrot about 30 years old who was acquired from the Central Park Zoo. Like Poba she named herself, and as already mentioned, she burns with unquenchable love for the lordly Panama parrot. Unlike Poba, she cannot fly, her wing bones having been rather cruelly clipped by some dealer who secured her in her youth. Except for a very young African gray parrot, named Boba, whose wings have been similarly disabled—Mary is the only member of the bird kingdom to whom the pleasures of flight are denied. She feels this very deeply, and seems to have developed a sort of inferiority complex as a result. To compensate for

her limited locomotive powers she has built up a formidable array of vocal accomplishments which she almost never ceases to display. Her arrival in the kingdom caused no little consternation because of her zoo-acquired predilection for plain and fancy profanity. She would run through her extensive repertoire at the drop of a hat—giving it everything she had, which was, and still is, considerable.

By and large, the birds like to stick together in the two rooms of the apartment that are turned over to their exclusive use, but not Mary. As she does not share Poba's aloof detachment she would like to join in the fun, but is barred from much of it by her crippled wings. Just sitting around makes her restless so that she is ever watchful for a chance to stroll around the apartment. The result is that she is not only seen everywhere but heard. When you come into the apartment she is bound to be there to greet you. "Hello," she squawks as she sidles up to you with her queer weaving stride. "Hello", she repeats just as piercingly, as she playfully tries to tear off part of the sole of your boot. She is shooed away and assisted to a perch on the arm of a chair. So soon as you become engrossed in the conversation and appear to have forgotten her existence, she will start thinking up ways of drawing your attention back to her. She will cock her head a way around to the side and, scratching her brow, take a long, ogling look at you. Suddenly she will scream the word "coffee" at you. "Quiet, Mary", the lady will say, "you know perfectly well that you only get coffee in the morning." Mary ignores this appeal to her reason. "Right away" she insists at an even higher pitch. "Right away nothing" retorts her mistress sharply, "behave yourself, Mary".

There follows a brief respite. You get up to get an ash tray. This move starts Mary off again. "Goodbye", she blares almost commandingly—then a long, shrill whistle, "Goodbye, Goodbye". "Hush, Mary", admonishes her mistress, "no one is leaving yet". Rebuffed, Mary screams for coffee again, with a few sharp interpolations of "Right away, right away". The more pleasing side of Mary's vocalizations include a very accurate imitation of a canary trill, and the occasional use of her lung power in urging the other birds to their sleeping cages, with ear-splitting commands to "Hurry up, hurry up".

The youngest of the parrots in this kingdom is Boba, a two-year-old African gray parrot. He is a comparatively quiet little fellow for a parrot who has had 30 decayed root-stumps pulled out of his wings without anesthetic. His vocal stock-in-trade is limited to "mamma", and a polite "thank you" when given something to eat. But high hopes are held for him as he grows older. Boba is his own name for himself, and he probably chose it because of its similarity to Poba, the name of the king who has established himself as the youngster's special protector; not that he particularly needs one, for all the birds seem to be on excellent terms with him.

Then there is Cuba, a sprightly Cuban parrot who has the distinction of being the only parrot in the establishment who has not named himself. He is much quieter than either of the other adult parrots and is chiefly remarkable for the doting affection that he bestows upon a small parrakeet called Beebee. He refuses to let Beebee out of his sight and follows her wherever she goes. Ever since Beebee was a baby, Cuba has taken upon himself the nightly duty of providing her with the comforting blanket of his wing. But she is growing up now and Cuba is finding the competition for her affections pretty stiff. It seems that a couple of male parrakeets are performing that function which is known in some social strata as "chiseling in".

The most gifted songster of the lot is Nitya, a starling and the official "bugler" of the kingdom. He has been taught a few of the regulation bugle calls which he runs through as efficiently and clearly as any regular army "tooter". He is rather proud of it, too, as you can see by the important way he struts about. Occasionally he varies the bugle calls with "East side, West side", a tune which is particularly appropriate in view of his adopted home town. Nitya can pick a wriggling worm from between the goddess's fingers on the wing as neatly as any movie cowboy ever shot a cigaret out of the villain's mouth. And he'll perform this feat without stint as long as the worms hold out.

The last of the larger birds is Dodo, a cockateel with beautiful tan plumage that has a certain waxen sheen. He can whistle tunefully on occasion, but is a very quiet and peaceable bird, confining his activities to "looking handsome". This function he performs very adequately, having all the personal finery and courtly air of a Spanish aristocrat.

There are many species of birds in this apartment and nearly all of them are exotic. Besides the cockateel, the parrakeets, and the parrots there is a Chinese nightingale, a Japanese robin, and all manner of canaries; steel-gray, blue-gray, dark-gray and white. Not satisfied with this already wide gradation of color, the goddess is anxious to breed a pinkish-red canary. To this Explorer's untutored eye, however, the prettiest bird-family of the lot is a tiny household of Strawberry finches with their pert little red bills, who sleep on a bed of fresh mop strings in a cigar box.

Meticulous organization is the watchword in this miniature bird-world. At 8 A. M. the blinds are raised in the two rooms given over to the birds and they wake up to a new day. Their water is changed, their cages flung open, and amid a symphony of song, the morning bath is taken. There follows a sumptuous breakfast of chopped green vegetables and fruit. Then, as the odor of the gods' percolator is wafted into the sensitive nostrils of the parrots, they set up a clamor of, "Mamma, coffee. Mamma, coffee." Each parrot has his own dish which is presently filled with bits of bread soaked in sweet coffee. While they eat, the gods proceed to set the bird world in apple-pie order. The cages are scrupulously cleaned and freshly graveled, and then the goddess makes her morning health inspection tour. There is a special cage set aside as the bird infirmary, and whenever the slightest indisposition is detected by her expert eye, the invalid is promptly conveyed to the infirmary and a cure prescribed for his particular ailment. The goddess has had considerable success with bird cures, among the most spectacular of which is her prescription for a broken leg. In the case of this disablement as with many others, she is a staunch believer in the curative powers of Nature. She uses no splints, bandages or any other of the accepted applications for broken bones. She simply puts the cripple in a specially constructed cage annexed to the infirmary, which is so built that it confines its occupant to a very limited scope of activity. Instinctively, the bird holds his injured limb close to his body and favors it carefully until Nature has had time to effect the knitting of the bone. At noon the feeding, health inspection and morning gossip period among the birds is at an end, and, with the help of Poba, they are put back in their cages where they settle down to their afternoon nap, which lasts till 3:00. Apart from the ordinary sleeping cages there is a smaller cage called the "Townsend Plan Cage". Here the birds whom old age has made less able to carry on with the more boisterous activities of a younger generation live out the remainder of their days in peace and quiet.

At 3:00 the birds are again awakened and are given a light meal of worms or seed. They fly about, bask in the sun, gossip, chatter, and generally investigate into each other's activities, while their cages are again given a good cleaning. Later on there is the evening meal, followed shortly at 7:00 by lights-out.

The goddess' bounty is extended even beyond the limits of her home. Out in the street in front of her apartment house the Park Department has, at her request, established a feeding station for the pigeons. Each week, she distributes 100 pounds of pigeon food to a vast flock of pigeons which suddenly appear as if by previous agreement at the time she has set aside for their feeding.

The highest tribute is due her ingenuity and goodness of heart for the proof she has given that one does not have to reside in a spacious rural environment to espouse a protective worship of Nature's living creatures, in practice as well as in theory.

LETTERS

SIRS:

I am enclosing two items of information about the habits of the opossum which seem to be contradictory. One is taken from the February number of NATURAL HISTORY, the other from a text-book on zoology. Will you be kind enough to tell me which is correct?

Please let your reply be addressed to Mrs. H. L. Garrett, 1523 31st Street, Galveston, Texas, for whom I am writing this letter under direction.

Very truly yours,
H. L. GARRETT.

From NATURAL HISTORY, February, 1937 (Page 134):

"The opossum is the most prolific of all marsupials. The pouch is equipped with five to thirteen teats but usually in each litter of young there are more than can be accommodated. When born, the young, as in all marsupials, are very helpless. As they appear, the mother places them in the pouch. Each has its own food supply and they remain there until about the size of mice. They then venture forth and become introduced to the ways of life while riding on the mother's back like so many papooses."

From *Outlines of General Zoology*, by Horatio Hackett Newman, 1927 (Page 380):

"Instincts often appear precociously in larvae in adaptation to an early need to shift for themselves. The most astonishing piece of instinctive behavior in very young animals was recently described by *Hartman* for foetal opossums. Seven days after the egg was fertilized the tiny opossum foetuses emerge from the material uterus as blind, naked, pink, grub-like things less than a half inch in length. As they emerge one after the other, they quickly turn toward the anterior end of the mother and begin to plow with surprising vigor through the dense hair of the mother's abdomen, using the abnormally large, flipper-like fore limbs with a hand-over-hand motion like that of a swimmer. Each little fellow plows its way through the hairy forest straight to the marsupial pouch of the mother, enters the latter, and finds a slender teat, which it swallows deep

into its throat and holds fast by means of a precociously developed larval hold-fast mouth. If more young are born at one time than there are teats—and this is usually the case—a struggle for the right to live ensues, and sometimes an early occupant is ousted from his claim by a stronger though later claimant. Once thoroughly clamped to a teat, the larva remains attached for weeks on end, and can hardly be pulled away from it. Hence, unless removed before it is fully established, its success is assured. Thus the standard of strength and aggressiveness is maintained through the elimination of the weak."

Doctor Schlaikjer replies as follows:

SIRS:

I have your communication . . . on whether or not the newly born offspring of the opossum are placed in the pouch by the mother, or get there through their own free will. I have never had the pleasure of witnessing an opossum parturition, so when I wrote my article for NATURAL HISTORY I felt that the observations of the great naturalist, John James Audubon, were authentic enough, when he said:

"we believe the majority of naturalists who had an opportunity of witnessing our experiments came to the conclusion, that the mother after shoving them [the new born young] into the pouch, left them to their own instinct and they became attached without her assistance." *(The Quadrupeds of North America,* Audubon and Bachman, 1854, p. 122.)

Furthermore, on the same page he continues with the following:

"On another occasion, a female Opossum had been sent to us caught by a dog and much wounded, in consequence of which she died a few days afterwards, but first producing seven young which to every appearance had been still born. Yet they were in the pouch, and it appeared to us that the mother's uncontrollable attachment to her young, induced her to place her offspring in the pouch, even after they were dead."

And when I read the account given by the recent and careful worker Dr. Carl G. Hartman, I have no reason for doubting his observation that:

"suddenly a tiny bit of flesh appeared and scampered up over the entanglement of hair into the pouch to join the other foetuses—. Unerringly the embryo traveled by its own efforts; without any assistance on the mother's part, other than to free it of liquid on its first emergence into the world, this ten-day-old embryo, in appearance more like a worm than a mammal, is able, immediately upon release from its liquid medium, to crawl a full three inches over a difficult terrain." (Studies in the Development of the Opossum." *Anatomical Record,* 19, p. 255, 1920.)

Incidentally in his introductory remarks concerning the literature on the subject Doctor Hartman says that he is familiar with only one account of the actual birth of a marsupial—the 1847 observation of Doctor Michel. Apparently he has not seen Audubon's great work cited above. There may be even later accounts but I have not taken the time to investigate.

My only comments on the above are as follows: first, I feel that an experimentation to settle a question of this kind should involve more than one or two individual specimens; and second, I cannot imagine a prolific animal as the opossum not giving at least some attention to directing her dozen or more offspring to their food supply.

Yours very truly,
ERICH M. SCHLAIKJER.

SIRS:

With quite an interest, I read the letter, published in March issue, from an inmate of N. J. State Prison requesting old copies of the magazine. I do not wish to part with my copies, but I am enclosing a check for $3.00 for which please send him a subscription.

Perhaps some arrangements might be made, whereby, when he leaves prison, his interest in this line could be of assistance to him in building a new life.

(Signed)

Albany, N. Y.

SIRS:

I read the letter written by an inmate of the New Jersey State Prison, in the March issue of NATURAL HISTORY Magazine. I will gladly supply him with a back number of this magazine and the *Readers Digest* each month if you will consent to forward them. I hope that he and his friends will enjoy them and derive great benefit from them.

A Young Admirer of the NATURAL HISTORY Magazine.

Larchmont, N. J.

SIRS:

Pursuant to the request of a prisoner in the New Jersey State Prison printed in your issue of March, 1937 I am sending you by parcel post some back issues of NATURAL HISTORY. I will appreciate it if you will forward them.

(Signed)

Upper Montclair, N. J.

NATURAL HISTORY takes this opportunity to thank all those who responded to the appeal referred to above, and to explain that space does not permit the publication of all letters received.

YOUR NEW BOOKS — *the Way of All Snakes — Hawaiian Marriage—Jade Art—Fabre for the Young—the New Physics*

Interracial Marriage in Hawaii

- - - - - - - - by Romanzo Adams

Macmillan Co., $4.00

SUN-LOVING tourists drawn to Hawaii by its romantic decor and by unrestrained press-agentry are apt to accept without much question a unique phenomenon that exists there. Nowhere else have as many varieties of mankind and representatives of as many different cultures come together into such intimate contact with so little apparent racial discord. This is both an achievement and an example in a world sorely troubled by racial and cultural suspicions. It is, therefore, with eagerness that we turn to Professor Adams' magisterial analysis of interracial marriage and adjustment in Hawaii. And, indeed, our expectations are rewarded by this illuminating commentary on race relations in Hawaii, in particular, with auctorial asides of general significance.

When Captain Cook "discovered" the Hawaiian Islands in 1778 they had probably 300,000 inhabitants of Polynesian stock. In 1930 the population reached the total of 347,799, but only 22,636 were Hawaiian, of Polynesian origin. The century and a half which intervened saw the decimation of native Hawaiians by warfare, by diseases imported by white men and by the destruction of native culture. When in the middle of the last century sugar plantations under American management began to be profitable, a depleted native population was the only source of labor. But Hawaiians were unsuited for such exploitation. Their way of life was foreign to the demands of organized agriculture. Consequently the plantation owners inaugurated a series of labor importations which brought to the islands a succession of diverse people: Chinese, Portuguese, Spaniards, Porto-Ricans, Japanese, Koreans and Filipinos. In addition there already existed in the islands a small population of Americans and North Europeans, mainly of British origin, to which numerous accretions have been added in the course of time. Each of these groups differs from the other and from the Hawaiians in race and in cultural patterns of living and thinking. Here was a situation which in other parts of the world might have resulted in a caste system or in a shaky equilibrium balanced by mutual hatreds and injustices. But in Hawaii these were not the results, largely because of the peculiarities of the setting and partly because of the character of the immigrant groups themselves. The existence of a native government preserved the Hawaiians from social degradation. The early creation of a mixed population enjoying equal privileges with the whites and the natives fostered an attitude of tolerance and furnished a liaison group of great significance. Many of the groups of immigrants, such as the Chinese, entered with a predominating number of males which encouraged mixture with the Hawaiians. These and other factors, analyzed in detail by Professor Adams, have served to weld this heterogeneous population into an ever growing homogeneity. At present about 25% of the babies born are of mixed ancestry with the probability of an even larger percentage in the future.

The history of each immigrant group, its adjustments to Hawaii, its occupational history and its tendency toward amalgamation is carefully discussed by Professor Adams. His emphasis throughout is upon the influence of sociological factors in determining the course of racial and cultural miscegenation. He predicts the disappearance of cultural and racial divisions if the present situation is undisturbed.

This is a book of great importance. It is written in a calm, objective spirit and although race purists may object to its sociological philosophy, they cannot ignore its implications.

H. L. Shapiro.

Snakes and Their Ways

- - - - - - by C. H. Curran and Carl Kauffeld

Harpers, $3.50

WITH glad acclaim we announce another interesting addition to the literature on snakes—a literature which is hardly keeping pace with the already very great and still rapidly growing popular interest in this intriguing subject. It is *Snakes and Their Ways,* by Dr. C. H. Curran of our Museum and Mr. Carl Kauffeld formerly of the Department of Herpetology here and now Curator of Herpetology for the Staten Island Zoological Society.

The keen interest in books about snakes is being rather well satisfied from time to time only to break out anew with insistent demands for further facts and greater detail and the work under review, as a splendid supplement to certain existing works of much excellence, will be hailed with delight.

The reader of this latest of the books on snakes will be interested to find a goodly number of facts which in earlier popular works on this subject have been mentioned so rarely that they have something of the quality of "trade secrets."

The authors have, happily, included a check-list, revised to date, of all the 193 recognized forms of serpents in the country together with their respective ranges, which will serve the readers who may delight in a preparation of a list of the ophidian possibilities in the communities in which they live both as a basis for further study and as a goal of completeness toward which to strive in their collections. Tentative determinations may indeed often be made from this list alone.

In this work there is good balance between matters of very popular and more technical interest.

While snakes never voluntarily fascinate in the sense of

casting a spell over creatures about them, they do nevertheless involuntarily fascinate in the sense of causing us to be drawn toward them from any one of several motives. One of these is a species of pleasurable satisfaction in thrills of horror or of extreme repugnance (the attraction to the spectacle of a Chamber of Horrors or to tales of Blue Beards is of this nature). No other group of animals can satisfy this peculiar urge as can the snakes! Thousands, in their ardent interest in all life about them in field and wood, are attracted to these interesting creatures with feelings of affection for those which are lovable and with at least respect and understanding for those which are not. Here again, among the Snakes, we have species, than which, throughout the entire Animal Kingdom there are none that command greater respect and upon the other hand there are species, than which, throughout the whole Animal Kingdom we can find none more gentle and graceful (and lovable, once one has come to that). Many thousands more are attracted to this subject with very little sentiment but with great eagerness to know at least something of the life histories of the species about them and their capacities for good or evil and to know particularly how to recognize unfailingly those that may cause harm. Some are attracted to this group through their general interest in Zoology or in one of its sub-divisions, such as Comparative Anatomy, Evolution or Taxonomy, for here again the student will find problems which in attractiveness are not often surpassed in other groups of animals. Others are attracted to this group through their interest in medicine, for nowhere else in the Plant or Animal Kingdom are there poisons of the same extreme importance to mankind.

Whatever the motivation of one's attraction to Snakes, there will be found in this volume narratives and facts to interest, entertain and satisfy.

H. B.

MARINE FISHES OF SOUTHERN CALIFORNIA

- - - - - - - - - - by Percy Spencer Barnhart

University of California Press, Berkeley, Calif., $4.00

THIS is an annotated, descriptive list of the 370 odd kinds of marine fishes known to have occurred in the waters of Southern California, compiled from available sources. Interesting, brief habit notes on some of the species are presumably the author's, and not to be found elsewhere.

The pleasant shores of Southern California from Point Conception on the North to the United States-Mexican border on the south, have been much frequented by anglers, and by students of fishes. The fishes which occur there are for the most part related to but different from those of our Atlantic coast, and one frequently meets their vernacular names, wonders what sort of fish this may be, and remains comparatively uninformed due to the difficulty of looking the matter up.

Marine Fishes of Southern California has solved this difficulty by gathering together in one volume data concerning the fishes of these waters otherwise scattered in many papers and books. It will also be of great service to one desirous of identifying any fish he may catch there. We have a short description of each different fish, sometimes keys for the differentiation of related forms; and more than two-thirds of the species are pictured in attractive black and white figures at the back of the book. A diagrammatic figure of a fish to begin with, with different parts and fins named, and a page of lucid explanation, make the technical descriptions, which would otherwise mean little to a novice, understandable. There is also a glossary of the technical terms used.

J. T. N.

THE INSECT MAN: JEAN HENRI FABRE

- - - - - - - - - - by Eleanor Doorly

Appleton-Century, $1.50

ANY list of popular books on insects must contain in a most conspicuous position the *Souvenirs Entomologiques,* by Jean Henri Fabre. By reading these works one can learn much of the early life and struggles of the natural born scientist who was destined to leave his mark in the world. The honor of bringing together the scattered fragments in a fascinating book for juveniles goes to Miss Doorly, and she does it in a most satisfying manner.

An English family, with Margaret, "who was only a friend," set out by motor car to visit the land of Fabre. They trace his life from the place of his birth, to his grandparents' farm, back home to school, thence from place to place, until the lad was thrown on his own, to seek a precarious living as best he might. We get glimpses of parts of rural France which have changed but little to this day and we go with young Fabre to school and to college. We learn with him as he learns and we see the things that helped to mould the character of the man who was even then gathering the knowledge that was to be conveyed to us in his great souvenirs. We visit Fabre's friends and talk with those who knew him and we end with a visit to the home where his works were completed.

It is a book for young people, but it is more than that. It will serve as an introduction to the study of insects that can be read with delight by old and young.

C. H. CURRAN.

CHINESE JADE THROUGHOUT THE AGES

- - - - - - - - - - by Stanley Charles Nott

Scribner's, $15.00

THIRTY YEARS ago a wonderful book was published on the subject of jade. This was the two volume work on the Heber Bishop Collection, privately printed in a limited edition of 100 copies, and distributed free to libraries and institutions of learning. The two volumes weighed 150 pounds, and at the time of its production the edition was said to have cost Mr. Bishop $10,000.

So magnificent was this mighty book on jade esteemed that it was thought that no effort of the publisher's art could ever rival it, and yet, today, we have in the work of Stanley Charles Nott, not a rival but a supplanter of the giant of 1906. So far has the technique of color reproduction advanced in the last thirty years that every one of the thirty-nine color plates of the present volume is better as an illustration of the color of jade than any of the lithographs or colored copper plates of the earlier work. The illustrations of *"Chinese Jade throughout the Ages,"* of which there are 148 plates, in color and half tone, are fully worthy, in their superfine quality, of the well

selected pieces from a score of famous collections which they literally bring before the reader's eyes.

As a standard work of reference Mr. Nott's text is bound to take precedence over all preceding books on jade. His style is clear and eminently readable. His facts are supported by phalanges of footnotes, often cited from Chinese classical sources.

The chapter devoted to mineralogical characteristics and occurrences of jade contains a very useful table showing the characters and chemical compositions of jadeite, nephrite and chloromelanite, in addition to a well arranged, tabulated list of Chinese and extra-Chinese occurrences of the same.

The student of Chinese art will find in Chapters II to IX a masterly discussion of the decorative trends from pre-Chow time to the present day. The author places the high point in the production of outstanding pieces of jade carving at about the middle of the Ming Dynasty. It was then that the famous Ming dragon was introduced as a Chinese art motive, although the author definitely states that this characteristic design in Ming art was inspired by the earlier renditions of the Han period.

Particularly illuminating are the copious notes and comments on the kinds and colors of jade and their sources as used by the glyptic artists in the various periods. Under the author's scholarly handling jade becomes literally the milestone of the centuries, gathering variety in color and quality as it also gathered perfection in craftsmanship.

More than half of the text is devoted to animalistic and symbolic designs and representations of gods, immortals and sages. In this, the author is at his best, his method being to summarize the views of various writers, both ancient and modern, rather than to advance theories of his own regarding the meaning and derivation of these essentials of Chinese art. The fund of erudite information displayed in thus balancing opinion against opinion represents the very highest attainment in critical comment.

No small part of the usefulness of *Chinese Jade throughout the Ages* resides in the numerous appendices which list the minerals likely to be confused with jade and how to distinguish them, gives a short glossary of some of the Chinese words used in the text, a special bibliography of Chinese works, a general bibliography, and a list of the important date marks, shou marks and other devises.

An introduction by Sir Cecil Harcourt Smith, K. C. V. O., formerly Director of the Victoria and Albert Museum, London, adds prestige to this volume, which is dedicated to Queen Mary.

H. P. W.

THE REVOLUTION IN PHYSICS

- - - - - - - - - - by Ernst Zimmer

Harcourt, Brace, $3.75

TODAY, everyone is aware of the tremendous strides which have been taken in the industrial sciences. Behind these developments in practical work, there are more astounding ones in theoretical physics and chemistry. To say that a revolution has taken place within the last fifty years describes these changes well. Recognizing this, Ernst Zimmer has attempted to acquaint the layman, not only with the new ideas themselves, but with their effect on modern thinking.

Translated from the German, by H. Stafford Hatfield, *The Revolution in Physics* has lost nothing in clarity, planning and the significance of its message. It is commendably short, presenting first the classical picture of matter and light, then Bohr's useful, but unsuccessful, attempt to construct the inside of the atom, as well as Planck's all-important quantum concept. In the chapters on quantum mechanics and matter waves we are told of the marvelous work of De Broglie, Schrodinger and Heisenberg, which is thought to give the correct mathematical description of the peculiarly dual nature of light and matter.

But, as the translator says in his preface, we (the laymen) "quite rightly believe that this changing conception, originating in mathematical and experimental researches which we can never hope to follow in detail, must necessarily be capable of statement in terms ultimately comprehensible to us." The author knows this, as is evident by his patient exposition of every point throughout the book. There is no doubt that our most complete comprehension of anything is gained when we picture it mentally.

Sometimes, however, we must accept a new concept in its own simplest form. This is a repetition of the situation when Newton published his Principia. Of the new concept of wavicles (the wave-corpuscle nature of electricity and light) Ernst Zimmer writes: "They are, of course, very difficult to conceive concretely. That cannot be otherwise, for only concepts derived from the everyday world are concrete and picturable, but as we use these (new) notions more and more frequently they become more familiar. . . . but the things themselves are not identical with our notions of them. The growing number of sense impressions, including the atomic world, leads step by step to a conceptual world which is increasingly strange to the uninstructed."

Fourteen plates give photographic evidence of the latest discoveries in atomic physics. There are a few formulae in this book, but none which are not fully explained by words and simple diagrams.

To be the wiser then, here is one good book to try. But do not read it hastily. The author has a strange, new message to convey, clear enough now to be put in its simplest terms. If it ever becomes any simpler, it will be when the next "Revolution in Physics" has taken its place.

CHARLES A. FEDERER, JR.

NOVITATES

No. 907. New Species and Records of Chinese Spiders. By Irving Fox.

908. The Physiology, Life Cycles and Phylogeny of the Parasitic Flatworms. By Horace W. Stunkard.

909. Bees of the Genus Sphecodes from Saskatchewan. By T. D. A. Cockerell.

910. A New Bee from Chile. By T. D. A. Cockerell.

911. African Bees of the Genus *Heriades*. By T. D. A. Cockerell.

913. Ten New Rodents from Angola, Africa. By John Eric Hill and T. Donald Carter.

914. New Genera and Species of Neotropical Hesperiidae with Notes on Some Others. (Lepidoptera; Rhopalocera.) By E. L. Bell.

SCIENCE IN THE FIELD AND IN THE LABORATORY

—Trailside Bird Houses—Eclipse Expedition—Gem Lectures—Gift of Pearls—Honoraria—Death of Martin Johnson's Orang-utan

Bird Houses Along the Hudson

This is bird house season at the Trailside Museums of the Bear Mountain-Harriman section of the Palisades Interstate Park. Expeditions into the woods have resulted in the collection of numerous hollow trees and tree limbs. Hammers, chisels, and saws are heard in the craftshop as the raw material is being fashioned. Wren houses, woodpecker and chickadee abodes and other types of residences stand in a proud row upon a long table awaiting placement in nearby trees, under the eaves of buildings and upon posts.

In all of this work, there is only one certainty that the homes will be accepted by hoped for tenants. The house wren provides the assurance. Soon this small, bustling embodiment of restless energy will arrive from the south to poke its active head with inquisitive beady eye into every nook and cranny in and about Trailside. When the period of investigation and trial has ended, it is a foregone conclusion that the wren will select one of the houses to raise at least two broods during the spring and early summer.

As in previous years, all of the bird house bulletins are selected from the library and the pages are spread open upon work tables. These highly valuable publications are issued by leading conservation organizations. Diagrams, measurements, and photographs are all there in fine array. The booklets are studied thoroughly and then houses are built according to Trailside designs after all! If the craftsmen could bring themselves to follow the printed instructions to the letter, the finished products would be doubtless superior to their own attempts; but no matter how misguided they may be, there is something to be said for the ambitions of original craftsmanship, provided the birds are satisfied with the results.

The principal reason for this building activity is to furnish an exhibit of bird houses for the instruction of Trailside Museum visitors. In truth, there are sufficient natural, avian home sites in the Park to accommodate all birds of the region, and many more. Trailside bird homes, we hope, will serve an educational purpose in addition to encouraging several species of birds to nest where their everyday habits may be easily observed.

In writing reports of out-of-door museum activities, it seems there is an ever present temptation to present figures and notes relating to the number of visitors, the importance of new exhibits, the diversity of organization "contacts" and other equally impressive data. All of this is as it should be. But, for the present purposes mention should be made of two unfailing seasonal harbingers—the automobile parking space was filled to overflowing all day long on Sunday, March seventh, and on the same date, a flock of twenty-six robins also visited the Trailside area, en route to the north. The report would be biased if mention were made of one group, and not the other!

In any event, this is spring time, and there is the sound of hammer and saw in the craftshop.

Appreciation of Gems

The American Museum of Natural History possesses many exhibits which are of direct use to people engaged in various lines of technical work. Among these is the Morgan Collection of Precious Stones. With a view to acquainting the general public, and especially those engaged in the jeweler's trade, with this collection, the Department of Education announces the following course of four informal talks to be given by Herbert P. Whitlock, Curator of Minerals and Gems.

Each talk will be one hour in length and the first, second and fourth talks will be illustrated by slides, many of which are colored to represent the actual gem stones.

April 3 "What Is A Gem?"
April 10 "Diamonds: From Mine to Market"
April 17 "Famous Diamonds Of The World"
April 24 "The Art Of The Lapidary."

Gift of Pearls

A group of pearls consisting of two oriental pearls weighing together 51½ grains, and two fresh-water pearls weighing 50 grains were presented to the Morgan Gem Collection by Miss Mary T. Cockcroft as a memorial to Elizabeth Varian Cockcroft. As outstanding examples of these two pearl varieties, this group is particularly valuable in furnishing a comparison in color and orient between oriental and fresh-water pearls.

Death Comes For "Trusom"

"Trusom," the orang-utan whose photograph appeared as the frontispiece of the December issue of NATURAL HISTORY has passed on. This large male orang-utan, captured by Mr. and Mrs. Martin Johnson in British North Borneo and brought to the United States last October, died in Bronx Park on February 28th and its body was received at the Museum the following day. The body has been embalmed and is to be used for anatomical study. This is an especially valuable specimen for the Department of Comparative Anatomy, as it had not been in captivity long enough to undergo any decided morphologic changes in its new environment.

Honoraria

Hugh S. Rice, Associate in Astronomy at the Hayden Planetarium, and a specialist in the study of asteroids, becomes the first New Yorker to have a minor planet named after him. According to word just received from

Germany, this honor was conferred upon Mr. Rice by the Astronomisches Rechen-Institut, headquarters for scientific work on asteroids, in recognition of his great help to amateur astronomers and small telescope users throughout the world. Discovered by Dr. K. Rheinmuth of Heidelberg, Germany, in 1931, the asteroid has been nameless until the present time, when it was decided to designate it *1230* Riceia after the best-known American observer of these tiny members of the solar family.

The Rice asteroid, one of the thousands in the great asteroid zone between the orbits of Mars and Jupiter, may be found at this time of the year in the constellation of Hydra, very close to the celestial equator. It is 164,400,000 miles from the earth and is believed to be about seven to ten miles in diameter. To see his namesake, Mr. Rice must use a 15-inch telescope.

Mr. Rice observed a new comet of the seventh magnitude recently located near 55 Piscium on the Pisces-Andromeda border. Through 18-power binoculars, this comet appeared as a hazy star and was visible for about 2 or 3 hours after sunset. It will be necessary to make several observations of the newcomer before its orbit can be plotted. Mr. Rice has not had word as yet, that the new comet was observed by astronomers in this country.

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Mr. Van Campen Heilner of the Department of Icthyology was an honored guest at the first annual dinner of the New York Rod and Gun Editors' Association which was held in the Grand Ballroom of the Commodore Hotel, New York City on February 23.

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Dr. C. H. Curran of the Entomology Department and co-author of the recent book *Snakes, and Their Ways,* has recently been appointed to the editorial board of the Annals of the Entomological Society of America. He will serve in an advisory capacity.

Distinguished Dutch Zoologist Dies

The Department of Comparative Anatomy has received notice of the death of Dr. Max Weber, the distinguished zoologist of the University of Amsterdam, on February 7, 1937, at the age of eighty-four years.

Dr. Weber was the author of the famous work *Die Säugetiere.*

Symposium on Early Man

Doctors Gregory and Colbert have prepared an exhibit of Siwalik fossil mammals for the Symposium on Early Man to be held at the Academy of Natural Sciences of Philadelphia from March 17-20.

Doctor Gregory and Dr. Milo Hellman will read a paper at this meeting on "The Evidence of the Dentition on the Origin of Man."

Ten Years of Trailside

Ten years ago the Nature Trails and Trailside Museums were opened at Bear Mountain, N. Y., in an area of primitive forest-land lying between the steamboat landing and the Bear Mountain Bridge. By cooperative effort of the Commissioners of the Palisades Interstate Park and the Department of Education of the American Museum of Natural History, these Nature Trails and Trailside Museums have been maintained for ten years. This has been an outstanding contribution to outdoor education as hundreds of thousands of children and adults have enjoyed them. A review of this work will shortly be published by the American Museum of Natural History under the title of "Ten Years of Nature Trailing", which has been written by William H. Carr, the Director of the Nature Trails and Trailside Museums. Copies may be purchased at the Museum bookshop.

Eclipse Expedition

Announcement to the effect that the Hayden Planetarium will send an expedition to Peru, to observe the most spectacular solar eclipse in 1200 years, has been made by F. Trubee Davison, President of the American Museum of Natural History. The eclipse will take place on June 8th. The point of observation will be near Lima.

Details with respect to plans and personnel of the expedition, to be known as the Hayden Planetarium Grace-Peruvian Eclipse Expedition, are now being formulated by Dr. Clyde Fisher, Curator of the Hayden Planetarium.

A unique feature of the expedition is that the Hayden Planetarium will cooperate with the Grace Line—which is conducting the first maritime Eclipse Cruise in history—in providing special observation facilities and lectures on the scene of the eclipse, for those who travel to Peru to see this major celestial spectacle.

Planetarium News

The Planetarium lecture for April, "Other Worlds Than Ours," will deal with the character and movements of the planetary bodies. By means of lantern slides and motion pictures, close-up studies of their surfaces and motions will be presented. The moons of Jupiter passing rapidly through their changing positions with their frequent eclipses are dramatically shown in the famous lapse-time motion pictures skilfully produced at the McMath-Hulbert Observatory in Michigan. The colorful rainbow so frequently seen after April showers will also form a feature of the performance.

During April the Amateur Astronomers Association will hold the following regular meetings in the auditorium of the Roosevelt Memorial:

April 7—"Methods in Astronomical Photography" by Dr. Robert I. Wolff, College of the City of New York.

April 21—Topic to be announced—by Mr. Wagner Schlesinger, Fels Planetarium.

May 5—"Epochs and Eras"—by Mr. William H. Barton, Jr., Hayden Planetarium.

Meetings are held at 8:15 p. m.

On Saturday afternoons at 2:30 over Station WHN the A. A. A. will present the following radio talks:

April 3—"Astronomy the Unknown," by Frank Reh.

April 10—"Rocket Trip Into Space," by Mr. Alfred Africano.

April 17—"The Earth—Our Own Planet," by Miss Marian Lockwood.

April 24—"Your Own Meteor Crater," by Mr. Arthur L. Draper.

During April the Junior Astronomy Club will hold the following regular evening meetings at 8:00 o'clock in the auditorium of the Roosevelt Memorial:

April 10—Junior Competition.

April 24—Demonstrations and Jubilee of Astronomical Projects—Morris Davis and others.

RECENTLY ELECTED MEMBERS

THE following 596 persons have been elected to membership in the American Museum of Natural History since the last issue of NATURAL HISTORY:

Patrons

Messrs. David Bruce, H. N. Slater.

Life Members

Messrs. Henry Gund, Jr., George J. Hecht, Paolo Romano Jennewein.

Sustaining Member

Mr. Lincoln R. Clark

Annual Members

Mesdames Sterling F. Boos, Pierre Bourdelle, William Wade Dudley, John O. Enders, Louis Friedlander, Katharine S. Havemeyer, Francoise Hepworth, G. Kattermann, Ranald Hugh Macdonald, Jr., William Evelyn Porter, James L. Preston, Florence L. Thayer.

Misses Josephine M. Brosseau, Mary E. O'Neil, Marion A. Steinhagen.

Reverend J. W. Chapman.

Captain Paul F. Johnson.

Doctors A. J. Krasny, Herman Rabinowitz, Audley D. Stewart.

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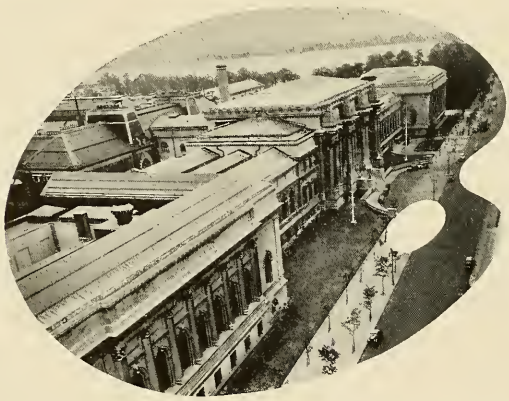

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITOR: Edward M. Weyer, Jr., Ph.D.

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PRODUCTION: Frederick L. Hahn.

ART: Charles Curtis Hulling.

Manuscripts should be sent to the Editor, The American Museum of Natural History, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Secretary, Charles J. O'Connor.

ADVERTISING DEPARTMENT: Sherman P. Voorhees, Manager. W. Ware Lynch.

CHICAGO REPRESENTATIVE: Frank S. Whitman.

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NATURAL HISTORY is publisbed monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-seventh Street and Central Park West. Subscription price $3 a year, single copies fifty cents. These rates also apply to Canada, Newfoundland, and all foreign countries. Entered as second class matter March 9, 1936, at the Post Office at New York, New York, under the Act of August 24, 1912.

ABU MARKÛB ("father of a slipper"), or Shoehill stork: A photograph recently exhibited at The American Museum in the Fourth International Salon of Pictorial Photographers

WILLY LANGE

TWILIGHT OF THE OLD WEST—*Personal glimpses from the memoirs of an anthropologist revealing the final struggle of a primitive race in the grip of the white man's reservation.*

By Clark Wissler
American Museum of Natural History
Curator of Anthropology,
Drawings by Irwin J. Weill

Once while walking in the far-off city of Sydney, Australia, we were startled by two boys dashing unexpectedly from an alley, one with a few feathers in his hat band, a toy hatchet in one hand, a wooden knife in the other, yelling at the heels of the other. It was, however, no strange sight to us; a make-believe scalping was being staged.

It is curious how the Indians of history and story have captured the imagination of the world's children. In our own country we note that this fascination grows with the generations, instead of diminishing, nor is it difficult to find an explanation if we seek for one. The Indian is perpetuated in memory as the most original and conspicuous feature of our romantic history.

Starting with the serious Indian wars east of the Mississippi, the building of the Great West entailed successive encounters, and in them many of our forefathers went down fighting. In general the fights decreased in severity as the wave moved westward, so that by the time it reached the Pacific coast, the struggle seldom rose to the military level. In parts of California the killing of Indians was a sport to enliven Sundays and holidays.

In the wake of the frontier

The wars which caused the subjugation of the Indians led directly to the settling of them on reservations. Following each real conflict the defeated Indian tribe was dispossessed of most of its habitat and settled upon a selected spot, usually the area least coveted by the conquerors. So reservations followed the frontier westward.

But even conquered Indians were troublesome. It had long been their mode to gather food when they saw it, and it was too much to expect them always to pass a farm empty-handed or to be 100% efficient in distinguishing between game and domestic animals. So a certain amount of isolation was necessary to save the Indian from the wrath of those on whom it was his nature to infringe. Hence the reservation and its capitol, the agency.

We realized early in our career that the aboriginal Indian, who has so gripped the imagination of the world, was rapidly being transformed from his old ways by reservation life. The stage was being set for a new order of things in which what went before would be forgotten. If we were to know the American Indian and understand his place in the drama of civilization, we should have to get back-stage during this period "between the acts." And so some forty years ago we heeded Horace Greeley's famous exhortation and went west.

A pioneer land

There were no automobiles in the days of which we write and few real roads. Most of the railroads stopped at the Missouri River, and though a few continental lines stretched away to the Pacific, the traveler to the Indian country depended upon the horse. Could one have stepped from a train into the typical Reservation agency, the sight would have been depressing indeed. But after a long trip with the mail driver, jolting along among tossing mail bags and packages over rutted trails, you felt like cheering wildly when the agency came into view. We well remember one long, dreary drag through mud and chill, when having exhausted all means of entertainment, we lapsed into complete silence, while the driver dozed in his seat. Seemingly, hour followed hour, when suddenly topping a gentle swell in the ground, we were thrilled to see a few low straggling buildings in the distance. With a jerk of the whip, the driver said, "There," as the horses quickened their pace.

Before us lay a valley in which a stream was suspected because of a waving line of green trees, probably willows and aspen. The agency buildings were one story, some with dull red roofs, and we noted two stumpy spires suggesting churches. A wind-mill or two rose above the sky line as landmarks, the whole presenting a bleak outpost appearance.

The hotel was a small house with a long narrow room through the center which served as office and barber shop; on one side was a dining room, on the other two bedrooms. However, the landlord said

these were for transients and since we intended to settle down for a while, he would put us in the attic. This proved to be comfortable enough with a window that could be opened which gave a wide view of the square and so of life on the reservation.

Local Characters

The agency barber was an Indian, but had acquired the characteristics of the trade in one respect, for he talked as he worked; but when not working, he slept in the barber chair so soundly that if you wished a shave, you must first awaken him, then implant in his sluggish brain the idea that he was to arise so that you as customer could take the seat. Sometimes this was a slow process.

A few white men took their meals at the hotel, one of whom always placed a revolver beside his plate. On inquiry we learned that he expected a call from an enemy, the brother of a man he had killed. When we asked what the diners were expected to do when the shooting began, the answer was throw themselves upon the floor. We secretly rehearsed this procedure, but fortunately there was no shooting during our stay.

One day we asked this alert gunman why he stayed in a place where his life was in constant danger, and thereby put ourselves in contempt. As he saw it, only cowards would run away, his self-respect required that he remain as a perpetual challenge to his enemies. Maybe he was right, but it all seemed so unnecessary, so futile, this spending one's life waiting with finger on the trigger, for an enemy whose appearance after all was problematical.

Neither heroic nor picturesque was the bar-room, located in a neighboring town but never on the Reservation itself

One day while sitting by the stove in the hotel, the door opened, an energetic figure in a large coat began stamping off the snow and, this operation completed, entered. In a pleasant deep voice the stranger said it was a "—— —— rotten storm", to which we heartily agreed. However, we were surprised to observe, when the stranger threw off the great coat, that a woman and not a man stood before us. Around her waist was a heavy belt, with cartridges and a six-shooter, which she unbuckled and hung over the back of a chair.

We tried to look indifferent as the conversation began. Our impression was that here was a woman of ability, masculine in manner, accustomed to issuing orders, seeing them carried out, and able to take care of herself in a man's world. No names were exchanged, but we recalled certain stories about a Mother Hinds who held sway in a nearby frontier town, famous for its lawlessness. Finally, we ventured to inquire if she had come all the way from the town and being assured that she had, we felt certain of the identification.

According to the folklore about this lady, we expected her to bear the marks of dissipation and vice, but quite to the contrary. Even her occasional profanity was far from unusual on the frontier and was handled so skillfully that one could not help enjoying it. After a brief visit, she went her way.

Soon a priest entered to absorb a store of heat from the stove; he too had ridden a long way. Somewhat mischievously, we told of our recent guest, and the satisfaction of having met her face to face while in this country. To all this the priest made no reply, so we inquired if he knew the lady. His reply was emphatic, "What, that ungodly woman? God forbid."

Once while waiting at a town for the stage to the reservation, the place filled up with cowboys, given a few days off for their quarterly drunk; but this was not very exciting, because all knives and guns were checked at the store and locked in a safe. Anyhow the boys were soon too drunk to hurt each other. One of them did try to ride his horse into the saloon for a drink, but he was so drunk and the horse so docile, that the sight was neither heroic nor picturesque. We were, to tell the truth, bored, since the actual did not measure up to the story books.

The Major

On a reservation the most talked of person was "The Major". The Indian Bureau addressed him as Agent, but locally he was Major. This had at least one virtue, for though agents came and went with surprising frequency, the Major went on forever. Time and agitation on the part of Indian sympathizers have brought the standing of these officials to such a pass that we are in danger of overlooking their former power and glory. The Major was supreme within his domain, responsible to Washington only. And he was an autocrat, if ever there was one—a dictator we might call him now. True, there were resolutions by Congress and orders from the Indian Office, but these were usually general, whereas he was in supreme command of an Indian population, which deluged him with its troubles and its wants.

So far as our observations go the Indian joyfully acquiesced in the implied wish of the Great Father to share his burdens and at all times hung around the Major's door, seizing every opportunity to lay a batch of troubles upon his desk. We heard that once upon a time in the morning the Major found a dead infant upon his doorstep and made the mistake of giving it a dignified burial in a coffin. Soon other bodies appeared in front of his house, and harsh measures were required to dodge further assumption of such responsibilities. This may not have happened but is in keeping with the spirit of the time and place.

When a white man stepped over a reservation line he proceeded at once to the office of the Major. One gruff Major was frank enough to say to the writer that no one should expect him to believe that an intelligent, healthy man would spend his time going about to hear a few lazy old Indians tell lies. However, he gave his consent that we might stay around awhile to collect folklore, at least, until he found out our real game. We did not blame agents for all this, because we were convinced that a duly suspicious Major was an efficient one.

The troubles of the Major were not always with the Indians or with his staff, but often originated in Washington.

It requires little imagination to understand that among the hundreds of rules from Washington few would fit such an array of human clashes as came to the Major's attention. He was often forced to act upon hunches, at once and arbitrarily. Like the father of a big family, it was up to him to meet the situation promptly and not to be too judicial about it either. To a people among whom the scalping knife and the tomahawk were still handled affectionately, no ruler deserved respect unless his punishments were harsh. The people back home might be scandalized and think how the poor Indian must abhor such cruelty, but we seriously doubt if they understood the Indian they wished to champion. All of which means that Indian Agents often did what would not look nice in print.

Washington and the public expected Indian agents to take the initiative in leading their wards along the white man's road, but failed to realize the resisting capacity of the Red Man, or even to expect that he would resist. Massachusetts Avenue whites might be horrified at some of the things Indians did, never dreaming that those same Indians would have been scandalized over Mrs. A.'s formal house party. Such social blindness has been the plague of the Indian Service for more than a century. Perhaps no department of the government at Washington has been subject to so many sentimental drives as have been made against that of Indian Affairs. It seems that after the Civil War, abolition sentiment shifted from the slave, theoretically no longer existent, to the oppressed Indians, and many rising authors had visions of a second Uncle Tom's Cabin. We are not contending that all this humanitarian effort was misplaced, and grant that the unfortunate lot of the Indian was made a little more bearable thereby. On the other hand, the constant yielding of the Government to these frequent drives, prevented the maintenance of anything like a consistent policy in adjusting Indian life and civilization. Religious and educational enthusiasts probably because their objectives were one hundred per cent good and their understanding of local conditions zero minus, could often cause more confusion and tragedy than the most ignorant agents.

But the Major at his desk, surrounded by his Indians, faced real human problems. Away back in the 70's it was decided to move the buildings on a certain reservation. These buildings were all of logs, so the plan was to tear them down and transport the logs to the new site, setting the houses up again in the same order. Fortunately, the Major was given money to pay for this labor. He was a practical man; he called the chiefs together and offered food and real wages if the Indians would do the job promptly. The chiefs entered into the idea enthusiastically, anything to break the dead monotony of reservation life. And it was an enjoyable time, a great camp was pitched, the camp soldiers set up their tipi and prepared to see that the orders of the chiefs were carried out. The women, the great workers of aboriginal days, took hold with a will; they hauled logs upon horse travois and even put the dogs to work again as in the past.

Well, the buildings were moved in short order, everybody was happy, even the Major. The Indians were sorry when it was all over; they would have liked nothing better than to throw their old-time tribal strength upon some new public works project. However, nothing like this was to happen again, for when the Major's report got to Washington, hands went up in the air; "Women and girls employed at hard labor by the Government—horrible! Stop it!"

Every president from Washington down has shown dissatisfaction with the personnel of the Indian Service. Grant, having faith in the discipline

The Reservation Agent faced real problems

and honesty of army officers, proposed that they be assigned to agencies. The politicians were aghast, recognizing in this a body-blow to graft, and so got a bill through Congress prohibiting the use of army men in civilian posts. Defeated here, the old General tried another method. Having noticed that history claimed the Quakers of Pennsylvania as the true friends of the Indian, he decided that adherents to that religion might do even better than soldiers and forthwith began to fill vacancies with Quakers. So a new kind of Major came on the scene; now instead of resounding to terse words, usually not printable, the walls of the dingy agency offices echoed soft "thee's" and "thou's".

From all we could learn the Indians liked the change, the traders and local grafters did not; but like every other such reform it passed with the next administration turnover. About the only scheme not tried was filling the agent's chair with women; seriously we recommend this to the consideration of the present Government; at least it would relieve the dull monotony of reservation life.

We suppose that most of our readers have ere this wondered if there ever was a good agent, especially since, for a century or more, both official and social Washington have made him the scapegoat. Yes, there have been courageous, honest and lovable men in that office; also there have been rascals and innocent incompetents; this could be truthfully said of any post in the public service.

Some agents sought to please their superiors by boasting of their efforts to crush every native leader. Here is a quotation from one report:

> "I have endeavored to destroy the tribal relations as much as possible, and also to destroy the influence of certain chiefs. I have allowed relatives to band together and would appoint one of the number a chief or headman and suggest to him to take his people off to some good locality and make permanent houses. Of course, every band formed this way weakens the influence of some chief in proportion as it takes individuals from his band. Bands that at one time numbered over a hundred people, have been reduced in this way to less than twenty. I have had many houses made in this way by Indians who never worked before. The advantage to the man appointed by me was that he became more prominent and controlled the funds derived from the sale of beef hides."

Well, all we have to say is that this Major should have been ashamed of himself.

On the other hand, take the case of Captain Bump. How he got into this job, no one seemed to

know, but it was soon apparent that he was a stranger to political precepts, and as to the ways of business he was totally indifferent. Always it had been the way of agents to take the trader's word as to an Indian's debts and wink at the seizing of his cattle and horses, but Captain Bump had never heard of it. Stranger still, he refused to urge the Indians to pay their debts and would not approve the taking of their cattle. Further, he insisted that the account books be opened for his inspection. Of course, when he issued an order, he expected obedience. Such woeful tales did we hear that we made our necessary first call with many misgivings. However, we were received courteously and truly felt that for the first time we sat face to face with an agent who knew what he wanted to do. He brought his great fist down upon his desk with a bang, saying, "You are just the man I have been looking for. Tell me what and who these Indians are."

He told how he had written to Washington for light, but to no purpose. "How did anyone suppose that he could do a good job without knowing something of the history and customs of the tribe under his care." Neither before nor since have we met an agent who even expressed a desire to know any of these things.

Of course, the rugged honesty of Captain Bump soon got him out of the Indian Service, but the Indians were not complaining, nor were they surprised at his passing. Regarding the good intentions of the Indian Service the cynicism of the Indians was boundless.

Sooner or later, if a stranger at the agency, you became aware of a unique institution that arose with the reservations—the Indian police.

Our first acquaintance with the force was both amusing and informative. It was a black night, but a few tiny flickering lights guided us. The agency buildings were arranged in a kind of quadrangle and as we neared the outer line a man, concealed in a shadow, stepped out and stood peering into our faces. Having seen policemen on arriving at the agency, we slowly comprehended that we were now in the hands of the law. Not knowing Indian, we tried English, but there was no response. Finally, after what seemed an interminable suspense, the policeman uttered what sounded like a grunt and gestured for us to go with him.

Presently we came to a rude building before which a lantern on a post flickered fitfully. Inside was another lantern on a kind of bench behind which sat another policeman, while two others sprawled on a couple of plain benches. The man behind the lantern proved to be the Chief of Police and greeted us in English. We began to explain excitedly, but he interrupted smilingly to say that he recognized us, having been standing by when we left the Major's office, and that he had read what was written in the registry, where we stated our business, etc. He was the first smiling Indian we had seen, but we soon found that most of them could smile.

The Chief of Police explained that he would send a man to escort us to the hotel and, when we remonstrated, laughingly remarked that there were several other policemen to pass, each of whom would bring us back to him; we then thanked him for his consideration. When we arrived at the hotel, the landlord had locked up and gone to bed, but our escort pounded vigorously on the door with the butt of his huge revolver. This brought quick results and soon, snugly in bed, we felt that the agency was the safest place in the world.

Several agents assured us that the Indian police were efficient, if properly handled; in fact, too efficient. To a white man, rules and orders are abstractions, or ideals, the enforcement of which is on a 50% level, but the Indian policeman entertained no such irrational ideas; to him orders meant what they said, and rules were rules. Graft and leniency were contrary to his notion of the police function.

"The Chief of Indian Police greeted us in English."

New agents, not understanding all this, were often embarrassed. We recall one such incident. Information came one evening that some ten miles out, a certain white man with an Indian wife was on a drunk and threatening to kill his family. He was said to be a bad man when running amuck. The new agent called in a policeman and ordered him to arrest this man. Thinking it necessary to be emphatic, he said, "Bring him dead or alive; do not come back without him."

Orders were orders

Before the lone policeman arrived at the scene, an Indian had killed the desperado in self-defense and the family had laid out the corpse. The policeman astonished everyone by announcing that he would take the body to the agent. Neither remonstrance nor threats availed; the policeman would take the body or fight to the death. "Agent's order," he asserted. So he borrowed a wagon and started on the long, slow journey alone. About four o'clock in the morning, while it was still dark, he drew up in front of the agent's house, unhitched the team, gave them some hay, then thumped on the agent's door with his revolver. When the agent looked out the Indian, pointing over his shoulder, said, "Him there in wagon," turned on his heel and went to the barracks, with the feeling of a hard job well done.

Written history itself testifies to the efficiency of the Indian police, as for example in the attempted arrest of Sitting Bull. During the Ghost Dance trouble, Sitting Bull was believed the chief conspirator, and the agent of his reserve received orders from Washington to put him under arrest to prevent his taking command of certain Indians preparing to fight the whites. The police were of his own tribe, but they unhesitatingly proceeded to their duty. Sitting Bull's sympathizers resisted, and in the fight Sitting Bull was killed. Several policemen fell, but though outnumbered, they held their ground until reinforced. Many white authors have denounced these police as traitors and murderers, but nothing could be more unjust, for like all good police, they merely obeyed orders, some of them making the supreme sacrifice. Congress was asked to pension their widows, but white agitators saw to it that nothing was done. Perhaps it is just as well to be consistent, because at no time has the nation even considered the important services the Indian police have rendered. Certainly it has not appreciated the fibre of manhood which in those days found expression in police duty.

Again, when the Ghost Dancers threatened Pine Ridge Agency, the police remained loyal. After General Miles took charge of the agency, he detailed a second lieutenant to command the Indian police. This West Point graduate was shocked at the ignorance of these Indians and their unmilitary bearing. So several times a day he lined them up on the quadrangle for drill. One day as they were in line, doing their best to follow the commands of this youth, the chief of police, now treated as a sergeant, saw some hostile Indians crawling in a ravine toward some haystacks. Several times before this, these police had frustrated attempts of hostile Ghost Dancers to set fire to those stacks, so the Indian captain shouted a quick command in Indian and everyone dashed toward the stacks, pouring a raking fire into the ravine. Needless to say, the poor lieutenant felt like a fool. It is said that General Miles saw what happened; he was highly amused, and after the hostiles were repelled, called the lieutenant off with the remark, "Don't drill them; you may spoil them."

There is an interesting story about the first supreme test of the newly organized police on a certain large reservation. The agent was a man of iron nerves who ruled largely by courage and the force of his personality. When the order came from Washington to organize a police force he was skeptical. To him it was just another of those fool ideas periodically disturbing the serenity of the Indian Service. Nevertheless, he called in the Indian head men for a talk; that they thought well of the idea increased his misgivings. Unsuspected by him, the head men designated a former leader of the native camp soldiers as the best man for the chief of police, and so, in due time, the flower of this once powerful and venerated body was enlisted. It was some time before their uniforms arrived. As we remember the Indian police these uniforms were of good blue cloth, liberally supplied with gold buttons and usually in good order, but they rarely fit, giving the impression of a slouching, misshapen human body. The policemen's boots were the high-heeled funny kind worn by fastidious cow-men, and when walking, their wearers tottered along like Chinese women with bound feet. Of course, no feet brought up in moccasins could get on well in such gear. Perhaps this did not matter because every policeman had a horse which he rode at all times. However, the characteristics so far noted were secondary, the essential lines in the picture were defined by an oversized six-shooter, a heavy, broad leather belt full of shells, and an enormous black hat. A repeating rifle usually swung from the saddle. In short, one's first impression of an Indian policeman might include little more than heavy armament and a poker face.

Despite these preparations, no use was made of these new police except to stand guard around the

agency and to recover government horses and cattle when they strayed too far afield; but all this time the native head of the force was training his men to their job.

Finally a new order came from Washington. The Indians of the Plains had a famous annual ceremony called by white people a sun dance. In one spectacular feature of this ceremony a few men tortured themselves by tying ropes to sharp sticks thrust into the skin of their breasts and dancing until they were torn loose. Naturally this was frowned upon by the Government, and so it was not strange that eventually orders were issued to agents to prohibit all sun dances.

The agent in question looked upon these instructions as useless; to his mind, nothing short of two or three regiments of troops could do it. Nevertheless, he welcomed the order, not because he thought it could be enforced, or that he really intended to make an attempt, but because it offered the main chance to show up the utter folly of appointing an Indian police force. At that very hour he knew the Indians were forming a great camp out on the reservation to begin the annual sun dance, so he called in the Chief of Police and read him the order. The Chief had it repeated several times and required double assurance that it came from the Great Father. He then left to order out the force. In about an hour the agent was informed that the troop was ready on parade and that the police wished him to look them over. The sight which he beheld was astonishing. Uniforms had been discarded for breech clout and moccasins; their faces and bodies were smeared with war paint, and feathers and other symbols of the original camp soldiers were in evidence. In fact, about every trace of civilization had vanished except repeating rifles and revolvers. Even the horses wore war paint, scalp locks and feathers.

The Chief addressed the agent, recounting that when they joined the force they promised to do their duty, that now they were assigned to a difficult and dangerous task, that they would not shirk, that the chances were that some, perhaps none, would return, that they now took their leave of him, but not a man of them would return alive if they failed.

The horsemen filed away to the weird strains of a camp soldier song. Needless to say, the agent began to relent, but it was now too late.

The troop approached the great camp of their tribesmen where the chiefs were in control and every Indian armed. Their appearance was unexpected. They first rode briskly around the outside of the camp circle shouting war songs and war cries, they deployed into the circle and fired a volley into the air. Then in a loud voice the Chief of Police began a harangue, the substance of which was that all were to disperse at once to their usual camping places and that no sun dance was to be held, that this order would be enforced.

There were mutterings, tense moments and hesitation, but the troop stood fast, singing war songs and ready to fight to the bitter end. Every Indian saw not the authority of the Government, but a revival of the old camp soldier band; they knew what those songs meant, that though they could overcome the band, the killing would not be on one side only. Soon a few tipis came down, then more, until eventually all Indians had left the camp ground. The troop returned quietly to barracks, washed off their war paint, put on their regulation uniforms and took up their monotonous routine of duty.

Needless to say, the agent was converted. His police soon rose to such a level of prestige, that every young Indian on that reservation hoped some day to be considered worthy of a place in the troop.

Probably but two men ever saw anything inspiring in the appearance of the Indian police: the old-time agent who looked out with surprise upon his troop, naked, in war paint and feathers, singing death songs, setting out to stop a sun dance, and the General who saw a troop spontaneously desert their military drill-master to make a successful charge against an Indian attack on the agency. How could Indian police, motivated by the culture of their fathers, look inspiring in the misfitting gear of a town constable?

Though a profitless pastime, most of us enjoy dreaming of what might have been. So suppose that after the record-breaking explorations of Lewis and Clarke, the United States had set up a police force like the Canadian Mounted, stretching their authority from the Mississippi to the Pacific, what would have been the result? We all know how it worked in Canada. Wild, roving Indians were brought under control with but one serious war. Had there been such a force in our Great West the bad man of the frontier would have been far less conspicuous and there would have been no Indian police. Yet this is a vain dream. Our government would not have tolerated such a force and even if committed to it, would certainly have filled it with temporary political appointees. The lawlessness of the whites even down to early reservation days amazes us. In the 80's many reservations were law and order havens for the surrounding districts because they alone maintained a fearless police force. We once spent some time on a reserve near the two ends of which were towns, which if not wholly lawless, made Indian life look like true civilization.

Man is a social animal, he does best in a crowd. We have heard a lot of talk about rugged individualism, but even the devotee to this philosophy must have a group to support his attainments. It seems to us the history of the Indian police demonstrates the truth of this, for even the police of the Plains Indians were conspicuous only on the large reservations, where they were numerous enough to form a troop. We suspect that pride of the force, the acquisition of traditions and high ideals, cannot be expected among a few lone men.

The plains tribes of aboriginal days knew better than to designate a few lone men as the body to enforce the necessary regulations in the camp and on the hunt. Instead, they organized a society,—a kind of club,—provided the members with a tipi of their own from which women were excluded. Their faith and courage were fortified by ritual and song, sanctioned by the great unseen. Their status carried with it certain obligations, with dignified and correct behavior. They must look and act the part. Their leaders must deserve their respect. Thus, there was a pride in their office; to fail was more than a disgrace. It is easier for such a body of men to achieve distinction than for a lone policeman, for each member of the force knows that there are many comrades standing behind him, who have the same ideals as he and who will be equally smirched if he falters.

Here and there an agent of a large reservation sensed all this and threw just enough solemnity and mysticism around the oath each policeman was required to take; provided a separate building and a barracks, in which by contact and fellowship they developed the pride of the force and the determination not to fail.

But the Indian Reservations of which we write belong to history. The visitor of today will see modern office buildings, another order of life, a different sort of Major and no picturesque police. The period of horse culture is no more; many Indians now use automobiles and tune in on Amos and Andy.

INDIANS IN THE

TOTAL

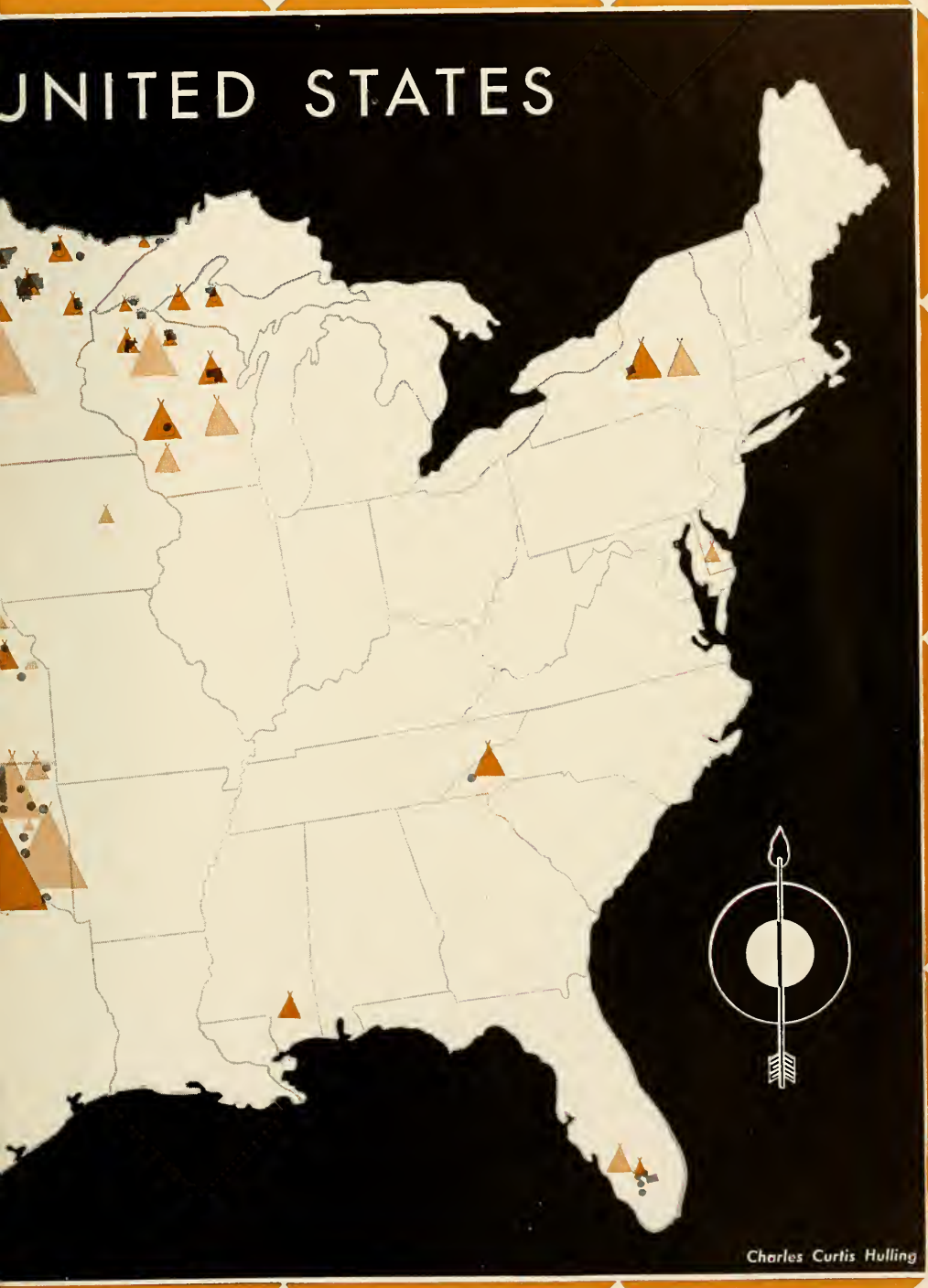
Indian population in 1936 334,013

(By Federal Agencies and including an estimated 95,730 unenumerated)

Indian population in 1861 249,707

(Earliest reasonably reliable estimate of Indian population)

Gray areas and dots indicate Indian reservations, agencies, schools and missions


UNITED STATES
Charles Curtis Hulling

RESCUING AN ISLAND—*The struggle to preserve a piece of untouched wilderness off the coast of Maine as a wild life sanctuary and a nature camp dedicated to Conservation*

By MILLICENT TODD BINGHAM

DUST storms and devastating floods are compelling our attention nowadays to the might of natural forces. These calamities are called Acts of God, the implication being that they are wayward visitations of disaster against which man is powerless. They are of course nothing of the kind. But they are focussing attention on problems of conservation. I should like to focus it still further—on one concrete, direct attack upon these problems, an experiment carried out last summer on an island off the coast of Maine.

In Muscongus Bay, paralleling the shore, looms the long dark outline of Hog Island—three hundred and thirty acres of untouched wilderness. It is roughly a mile and a half in length, half a mile wide, and at the northern end separated by only a few minutes' row from the mainland. Ninety feet in height at the highest point, it is covered with dense forests of pine, spruce and balsam. Here and there, between two rocky points, a spring of clear water overflows across a little crescent beach. The granite ledges of which the island is built crop out along the bare crest. Into the shade of the sweet-smelling balsam woods below the botanist is lured by deep moss and beds of ferns. In June, lady's slippers and the faintly perfumed twin bells of *Linnea borealis* blossom in the shade, to be followed later in the summer by multi-colored mushrooms and the spectral Indian pipe.

Growth of the idea

As with most enterprises, there is, back of the Hog Island experiment, a personal story. It falls roughly into three parts: First, a long period of years during which the island was cherished in its primitive state—a period of incubation for an idea. Four years ago that period came to an end in a sudden catastrophic event—an event which ushered in the second period, one of effort in trying to find some way by which the island could not only be preserved as a wild life sanctuary, but utilized also for the advancement of knowledge concerning the wilderness and the life teeming within it. That goal reached, the third period opened with the establishment in June, 1936, of the first Audubon Nature Camp for Adult Leaders.

The narrative begins when, in the summer of 1908, my father and mother made a visit to Hog Island while cruising along the coast of Maine. My father, David Todd, was for thirty-six years Professor of Astronomy at Amherst College. My mother, Mabel Loomis Todd, a woman of varied interests and accomplishments—artistic, literary, civic, social—cared most of all about the world of nature, particularly about the preservation of forests and their wild inhabitants.

Wild life imperiled

As it happened, a short time before their visit, a forty-acre strip had been cut over. Piles of dead brush and stumps gave to it an air of desolation. There were rumors that the whole island-forest might be similarly ground to pulp. My mother was shocked. She determined to do what she could to prevent it.

It seemed that title to the land rested in the names of many different property holders on the mainland opposite. These transverse strips would have to be assembled, a difficult undertaking. The owners could not always agree among themselves as to the limits of their various holdings and were on the verge of litigation in several instances. But the titles were eventually quieted and Hog Island, except for a peninsula of about thirty acres at the northern end, owned by a man and his wife who ran an "Inn and Bungalows" there for summer boarders, became the undivided property of two persons. My mother owned three-quarters and a friend of hers bought the remaining undivided quarter—not to live on, but as an investment. That quarter was subsequently sold. But we had come to stay. We built a camp in the forest and have been exploring its secrets ever since, each of us from a different angle.

My grandfather, Eben J. Loomis, astronomer and poet, friend of Henry Thoreau, imparted wisdom

about the ways of nature to us all. My father observed the heavens through a little telescope set up on our pier on starry nights. He wrote a book at the island, *Astronomy, Science of the Heavenly Bodies*. My mother studied flowers, ferns and mushrooms. Her last piece of literary work was finished at the island—re-editing her *Letters of Emily Dickinson,* first published in 1894. She wrote little articles about the spiders and cobwebs, the mosses and periwinkles, and was completing a book entitled *The Epic of Hog* at the time of her death. For me, the birds and the physiography of the region—"the meaning of the landscape," as that science has been described—have been engrossing. My grandfather taught me to recognize the common birds before I could read or write. My earliest memory is of sitting in the crotch of a bough overhanging Rock Creek, near Washington, D. C., while he told me stories of the small inhabitants of the banks and surrounding woods. My affection for the out-of-doors began while I was still too young to understand.

Those who love nature usually begin young. In childhood, responses to natural objects are instinctive. If a child's attention is drawn to wild creatures, his acquaintance with them broadens as the years go on. He understands them. They are his friends for whom, as toward other friends, he feels affection.

It is curious about nature lovers. They are well named. For there is in every one, even in naturalists who make the study a scientific life work, an emotional quality—an instant response to the first note of a blue bird in early March before the arrival of other migrants, or to a fringed gentian discovered by chance, which in a sheltered spot, has managed to survive the autumn frosts. This emotion can no more be described to those who do not feel it than the transfiguring effect of a Beethoven symphony could be conveyed to a person who is tone deaf.

"My heart leaps up when I behold
"A rainbow in the sky,"

is not a sentimental figure of speech, but a statement of fact. Enthusiasm engendered by such feelings carries far. It has been characteristic of the Hog Island venture from the start.

Vigilance

But to return to our story. After the Inn and Bungalows were closed in 1919, except for temporary occupants, we lived alone upon the island. My mother protected it in every way she could, from fires left by careless picnickers, from persons cutting masts or Christmas trees or digging for relics in the prehistoric kitchen-midden—for Hog Island was a spot favored by the Wawenock, a tribe of the Abanaki of the Algonkian group, who were here when the first white man came. In 1910 she posted the island against shooting and continued to do so as long as she lived, trying to preserve its wild life—deer, hare and game birds—long before it was the fashion to do so. She was determined to protect the island from exploitation. How this could be continued in perpetuity we often discussed, but never settled.

On October 14, 1932, while packing to leave for the season, my mother died. For Hog Island her death marked the end of an era.

If I say that after my mother's death three-quarters of the island belonged to me I do not feel that that is strictly true. When I walked through the woods and listened to the thrushes, the cry of the Osprey circling overhead, or the boom of the Great Horned Owl at night, I could never feel that I owned such a place. It seemed, rather, the property of all who cherished it and who wished to preserve it for others who would cherish it likewise in years to come. But that was hardly a practical point of view. So I began to wonder how I could make such a dream come true.

For Nature lovers everywhere

First, there was the thirty-acre peninsula with the Inn and Bungalows, now falling into decay. The owners wished to sell. I asked them to give me time to find the right kind of purchaser. This they kindly consented to do. Meanwhile, my dream was widening in scope. Instead of trying to find a private buyer, why not make the buildings a camp for students of nature? They could use the rest of the Island as a laboratory. Here was a wilderness area with well-defined natural boundaries and within a short distance of the mainland. It would be an ideal field station for biological research. I began by trying to interest local Maine groups, bird clubs and societies of natural history. The replies I received were unanimous in commendation of the idea and equally so in reporting that they had no funds. So I turned to other organizations whose interests embrace a wider territory, such as, for instance, the Federation of the Bird Clubs of New England. I met with the same response everywhere. It should be borne in mind that these efforts were made during the years 1933 and 1934. Trying to raise money for any purpose whatsoever at that time was to invite failure.

In the fall of 1934 the owners of the peninsula wrote that they must sell. They were convinced that the "bird people," as they called my hypothetical purchasers, were not interested in the proposition. There was, in fact, "nothing to it." Besides,

there weren't any birds on the island anyway except a few crows.

One winter evening I was speaking of my dilemma to a friend of ours, Dr. James M. Todd of New York. Without my asking him, Doctor Todd volunteered to help me out. He would buy the Inn and Bungalows, he said, and give it to any organization that would use it! It is impossible to describe the effect that his offer had upon me. It was a turning point. I was walking on air.

To find such an organization would be, I thought, an easy thing to do. But it proved to be quite the opposite. After months of endeavor I realized that it would cost so much to fit up the buildings that nobody could afford to accept Doctor Todd's generous offer. It was at this point that proposals from a lumber company and a lobster pound filled me with dismay. Would a business proposition be the only way out? Was this, after all, to be the future of Hog Island?

The last chance

Then came a day in the spring of 1935. The owners of the peninsula could wait no longer. They had decided to cut off their trees. Something must be done, and done at once. Sure at least of finding understanding, but with no formulated request in mind, I went to the American Museum of Natural History and asked for the renowned ornithologist, Dr. Robert Cushman Murphy. He listened to my story. After a moment or two he went to the telephone, called up the National Association of Audubon Societies, and arranged an interview for me with the newly elected Executive Director, John Hopkinson Baker.

A day or two later, clasping the familiar little packet of snapshots under my arm—young herons in the nests of their tree-top rookery, a squirrel perched on the corner of our table as we sat at luncheon, a seal balancing on a rocky ledge—I went to Mr. Baker's office. I shall never forget that interview. I began in the usual way: "I have a beautiful wooded island on the coast of Maine. It has been protected from shooting and other depredations for the past quarter of a century. On one end of it there is a group of buildings owned—" At that point he jumped in.

"Just what I want," he said.

Within five minutes he had developed the idea of a camp for teachers of nature study. He stated its purpose. Only by securing a sustained, genuine interest in nature on the part of children, he said, can we hope for a grasp of the acute need for conserving our natural resources before it is too late. And only by training teachers and other youth leaders in an understanding and appreciation of nature can children's native interest be developed.

Mr. Baker had not only caught my idea before I had uttered it, he ran away with it. Teachers and other adult students were to come in groups of fifty for five periods of two weeks each throughout the summer. If they could not only be filled with enthusiasm, but helped to formulate sound plans for their work as well, the children's interest would be salvaged. Interest is the driving power of education. In this case, it is a question not so much of arousing interest as of capitalizing it. Most children are interested in birds and animals. If wild creatures can be made friends with early in life, these concrete friendships will usher in the abstract concept of conservation unconsciously but inevitably. And the study and enjoyment of nature will become a hobby which will provide for them more real satisfaction than many things which are not there for the asking.

I listened speechless as Mr. Baker developed his plan. Half dazed by the rapidity with which the activities of the imaginary camp had shaped themselves in his mind, I left his office, dived into a subway and made for Doctor Todd's house by the shortest route. He rejoiced that at last the plan seemed about to materialize.

But alas! Another obstacle appeared. Mr. Baker would not accept Doctor Todd's gift of the point and buildings, much in need of repair as they were, and upon which a good deal of money would have to be spent, without assurance that the Association would have the right to use the entire island for purposes of study. Accordingly, I sought out the owner of the undivided quarter to ask whether he would join me in allowing the island to be used for such a purpose. But I could not see him. He was desperately ill, so ill indeed that he could promise nothing. In fact, he was in need of money for doctors and hospital expenses and his property had already been put in the hands of a real estate agent. That quarter of the island would have to be purchased somehow, and at once.

Sanctuary established

To come to the point, with my mother's life insurance money I bought that undivided quarter of the island which she had not owned, thereby enabling me to lease the entire island—except Doctor Todd's point which he proposed to give outright—to the National Association of Audubon Societies on a dollar-a-year basis. By using the money she had saved it became a true memorial to her. The deal was closed within a few weeks, and the Todd Wild Life Sanctuary was established.

Rescuing an Island

Lindsey Photo Service

When in 1908 the untouched wilderness of Hog Island *(right)* off the coast of Maine was threatened with being converted into pulp wood, the long fight was begun to preserve its abundant wild life.

Private title was acquired to most of the island and for three decades the owners set an example for conservationists by their diligent defense of this spot.

Its permanent preservation, however, was imperiled by numberous obstacles, and was only recently assured with the establishment of the Todd Wild Life Sanctuary. As the headquarters for the first Audubon Nature Camp for Adult Leaders, established in 1936, Hog Island has become a vital force in the cause of Conservation

Nearby, old hump ledge is the home of numerous cormorants

Numerous sea birds feed in the waters surrounding the island, presenting an endless panorama of activity

Photos by R. T. Peterson, National Association of Audubon Societies

THE BIRD LIFE of Hog Island is one of its most interesting features, but courses are given during the summer sessions on many phases of the natural history of the region.

Campers come to know Nature at first hand, as demonstrated by the Bay-breasted warbler at left confidently perching on the hands of one of the visiting students

Photo by R. T. Peterson, National Association of Audubon Societies

(Right) MALE PARULA WARBLER bringing food to nest in drooping Usnea lichen

(Below) SO UNFAMILIAR A SIGHT as the Leach's petrel at close range rewards the nature students who make Hog Island their summer headquarters. Little is known of these birds, living far at sea and nesting in dark burrows on unfrequented islands

Photos by Allan D. Cruickshank

Photo by Mark Emerson

(Above) CORMORANTS present an interesting spectacle on the rocks in the vicinity of Hog Island

Photo by Mark Emerson

PERCHED PRECARIOUSLY at the water's edge a raven's nest is a source of continual interest

Photo by R. T. Peterson, National Association of Audubon Societies

THE SEA as well as the land is made to yield its secrets to the zoölogy class: one of the many groups totaling 223 persons in five two-week sessions who received instruction and inspiration in natural history last summer at Hog Island

OPPORTUNITY FOR CAMERA STUDIES is amply afforded and an interesting photographic record of the varied life of this friendly wilderness is being made. Trips by motor boat to neighboring islands make possible the study of the region as a biological unit, toward the solution of conservation problems elsewhere

Photo by R. T. Peterson, National Association of Audubon Societies

THE NESTING COLONIES of many varieties of sea birds are observed in the vicinity of Hog Island to better advantage than elsewhere in the region and illustrate important conservation problems relating to food supply

Photos by R. T. Peterson, National Association of Audubon Societies

(Above) SHALLOW-WATER FORMS OF LIFE lure waders to a precarious spot where their instructor explains the activities in the realm of shoals

(Right) A LIVING MUSEUM has been installed on Hog Island in an old chandlery over the water, where many graphic exhibits are on display.

In the evenings round-table conferences and illustrated lectures by the staff and well-known educators are held

Photo by Allan D. Cruickshank

Photo by Allan D. Cruickshank

GROTESQUE PUFFIN or sea parrot brings home a fish to feed its young in nest under rocks

(Below) THE FAMILIAR PARULA WARBLER feeding her young unconcernedly attracts groups to her nest in the hanging lichen, *Usnea.* The distribution of this bird is largely determined by the distribution of *Usnea,* in pockets of which the eggs are laid

A SANCTUARY for its rich and colorful wild life in a world which is rapidly being devastated by civilization, Hog Island gives inspiration and wisdom in the ways of Nature to a growing group who strive for Conservation

Photos by Allan D. Cruickshank

The third period, to which what has been said is but introductory, begins with the opening of the first Audubon Nature Camp for Adult Leaders, in 1936.

An island at work

When I arrived at the island on the nineteenth of June, the camp was in full swing: groups gathered about the nest of a Parula Warbler, watching the parents go in and out of their nest in the hanging moss, oblivious of the circle of onlookers; other enthusiasts wading out into the water unconscious of their appearance, intent only upon following their instructor to a precarious spot where some shallow-water forms of life were to be seen in action. A boat-load was just returning from the outer islands. Other individuals were darting about in an open space brandishing long butterfly nets, and still others were coming out of the forest, single file, with ferns, lichens and mosses to be identified.

"What!" I exclaimed to the Director. "Are all these groups specializing in different subjects?" "Oh, no," he replied, "they are all studying every day the various aspects of nature, one after the other, because these must be understood in their relationships."

Some students were working early and late fitting up a museum in the old ship-chandlery over the water, a living museum, where life histories were illustrated: a section of an ant hill between two panes of glass revealing the ants busily at work in their corridors; crickets in an appropriate environment; and a snake cage. Just outside, underneath the float, was a collection of rare living marine organisms. In the museum, too, was a calendar of the birds already observed, together with a map, its harvest of red and white thumb tacks marking the sites of nests and the spots where singing males of certain rare species had been heard. There were biological family trees; labelled parts of a lobster's jaw; dried specimens of lichen, ferns and flowers, all arranged on sheets of paper tacked against the wall.

The whole camp exhaled an atmosphere of wonder—the beginning of wisdom.

Here was my forest wilderness, a laboratory of eager students who were not only enjoying it, they were taking it, bit by bit, studying and classifying its resources, making it yield its secrets! And yet with it all, the wilderness remained a wilderness. The solitude was as untouched as ever.

I recalled those years during which I had been trying to convince somebody, anybody, that the island was a good place for a nature camp, and how I had been told over and over again that there were not enough people interested in nature in the whole United States to support such a project. Each time that I heard it could not be done, I turned my thoughts toward those silent, moss-carpeted forests. I listened to the thrushes in the gathering dusk. I saw those magic midsummer nights and the slowly engulfing tide—the tide at the full, the moon at the full—when each stroke of the oars left a cloud of light deep down in the water, and ripples in the wake of the row boat etched the surface with luminescence ploughed up from beneath, sparks on the surface blending with the reflected universe of stars. I seemed to be watching the migration of warblers high up against the disc of the moon, or listening at noonday to the chant of *Vireo solitarius solitarius,* voice of the northern wilderness.

Ah, I thought, if only the island could be saved it would do more for us than we could possibly do for it.

I think I know how a novelist feels when he says that his characters write the story for him. The compulsion, he says, comes from them, not from him. They *have* to act as they do. So it was with Hog Island. Always it was the island which gave me heart. Its mere quiet existence supported me in the knowledge that I was right.

Wide influence

When a thing actually comes to pass the effort expended in making it do so is lost sight of—ploughed in, so to speak. If successful, the result merely seems inevitable. This is what has happened in the case of the first Audubon Nature Camp for Adult Leaders. With a total capacity for the five sessions of about 250, there were, during this opening season, 223 in attendance. Of all ages from seventeen to seventy, they came from twenty-three states, two Canadian provinces, and one foreign country, Switzerland. The number included not only teachers in elementary, high and normal schools, professors and students in colleges and universities, members of the U. S. Departments of Labor and Agriculture, leaders in the Boy and Girl Scouts and the Camp Fire Girls, counselors in summer camps for children, members of Garden Clubs and Societies of Natural History, but representatives of a score of miscellaneous occupations as well. There was even one Brooklyn fireman who came for his vacation because he is thinking of abandoning his present profession in order to become a Forest Fire Warden.

Between the twelfth of June and the ninth of September each person spent from two to six weeks of intensive study. From 6:30 in the morning, when they were awakened by an instructor imitating the

calls of birds, until sunset they were in the field—either on the island, or on the nearby mainland—studying birds, mammals, insects, salt and fresh water invertebrates, all forms of plant life, even a little geology and astronomy. Many of them found their stay a revelation. Some had never before seen the ocean. Trips by motor-boat to the islands and barren pinnacles of rock in the outer bay and beyond enabled them to observe nesting colonies of sea birds—cormorants, gulls and terns, petrels and guillemots—while close at hand the nests and family life of many species of land birds, some of them not found elsewhere in the vicinity, were also studied.

In the evenings there were round-table conferences and illustrated lectures in the museum either by members of the staff or by well-known educators and naturalists who, attracted by the novel experiment, had come from all parts of the country. The director and other members of the staff were peculiarly fitted for their tasks, and were possessed of an enthusiasm lavishly communicated to their students.

For the teachers, of whom there were more than a hundred, special help in techniques of presentation was given, and each one was equipped before leaving with a practical program adapted to his specific requirements.

Most important of all, however, every person in the camp gained a new point of view toward Conservation. They were taught the complex interdependence of all forms of life, both animal and vegetable, and learned in consequence that one form of wild life should not be exterminated—or protected—at the expense of others, without full knowledge of the consequences. Upsetting the balance of nature established before man entered the picture is a precarious undertaking. It usually ends in disaster, not for the environment only, but for mankind as well. Even today, ignorant of results which are sure to follow, we continue to perpetrate deeds of violence, sometimes ironically enough, in the name of Conservation.

And so, it seems, Hog Island has become not only a focus of interest, but a center from which radiate new ideas and new enthusiasm for the preservation of the out-of-doors, indeed, of our whole heritage of natural resources. Similar camps may be established in other parts of the country, each the center for its own geographical area. If so, the popular point of view toward Conservation will gradually be transformed. For by activities such as those of the Audubon Nature Camp an enlightened attitude of mind will be fostered in the children of today who, as leaders of tomorrow, will have not only the power to act, but because of this attitude, the power also to act wisely.

Forthcoming Articles

CAPTAIN BOB BARTLETT will tell the human story of Anarwee, an Eskimo woman of striking personality in far northern Greenland, based upon an acquaintanceship of almost forty years.

DONALD CULROSS PEATTIE in an article on the natural history of one square mile in Illinois will show that enthralling problems await study right in your own backyard.

"THE FISHES' ART OF SELF-DEFENSE" by MYRON GORDON will feature the trunkfish, a strange creature in armor whose motto for 50 million years has been "A good defense is the best offense."

The unsurpassed floral wealth of Crater Lake will surprise many when brought to them in an article on this fascinating region by F. LYLE WYND.

Recent work in the world's largest excavation for ancient man, near Peiping, China, will be illustrated, featuring the Peking Man, anatomically the lowest human ancestor ever discovered.

How Fossils Are Collected

By George Gaylord Simpson
Associate Curator of Vertebrate Palaeontology, American Museum of Natural History

There are as many different ways of collecting fossils as there are fossils. A microscopic fossil sea shell and a dinosaur naturally require totally different collecting techniques. In fact no two dinosaur skeletons could ever be collected in exactly the same way, for in each new case the circumstances differ and the methods must be adapted to them. Then, too, in modern collecting merely extracting the fossil from its bed of rock and transporting it to the Museum without damage is only part of the task, for a fossil has little or no scientific value unless its locality, geologic age, and many other data are exactly determined and recorded.

Varied as the methods are, however, most of the more important fossil skeletons and skulls are now collected by adapting to the individual case one general method. This method is illustrated by a specific example in the following series of action photographs, taken by a working party in the field. They record the discovery and collection of a complete skeleton of a new genus and species of fossil mammal, since named *Scarrittia canquelensis,* in Central Patagonia by the Second Scarritt Expedition.

The collectors shown are Justino Hernández and Coleman S. Williams, and the photographs and captions are by George Gaylord Simpson, leader of the expedition.

A Bone-Digger's Prospecting Kit. In the front row, from left to right, are a whisk-broom for cleaning loose dirt from specimens, celluloid cement for repairing small breaks, two sizes of curved awls and a straight awl for working near the surfaces of bones, a shellac brush, a geological hammer, a hammer for chiseling, a special steel tool known as a digger, a small dust brush, chisels, and a ball of twine for tying up packages of loose fossils. Above the awls are gummed field labels for packages and blocks and a notebook in which all field data are entered. The pick is a one-handed prospecting pick, the bone-digger's most useful and ever-present implement; this one is of an improved type developed in this Museum. Under its head is a roll of cotton batting, for wrapping very small and delicate fossils, and under the pick handle is a sheaf of rice paper. In the background are a water canteen and a shellac can. Wrapping paper, not shown in the photograph, is also included in the kit.

With variations depending on the sort of fossils being sought, these are the tools that a bone-digger almost always carries in his knapsack when he sets out to prospect for fossils. For some particular job he may be able to discard a few of these items, but is also likely to have to carry others: large picks and shovels, burlap and perhaps shears or a large knife for preparing bandages, flour or plaster, and pans for mixing the plaster or paste. Often he must also carry a compass, clinometer, level, and pocket transit, either separately or in a combination instrument, and sometimes a barometer, in order to place his finds on the map and to determine their position in the rock strata. For very extensive quarrying operations heavy horse-drawn or motor excavating machinery may be necessary and sometimes also powder or dynamite and drills for placing the charges.

(Left) First find the fossil: The only way to do this is to look, and it requires keen eyes and an exact knowledge of what to look for. In the center of this photograph are a few scraps of fossil bone, washed out of their burial place in the rock by wind and rain. They look like nothing more than a few ordinary stones and would be passed over without notice by almost anyone but a skilled collector. To him they are the first clue to what may be an important discovery

(Right) The washed-out bone scraps are followed up the slope until the place where they came from is located. If ends of bones are found here continuing back into the rock in position as originally buried they are carefully explored. In this case, small awls and brushes have uncovered the hind feet of a fossil animal, still connected to the lower ends of its legs. The prospect is good that a complete skeleton is buried here

(Right) Now comes the time for serious digging: If collectors excavated at random or every time they found a scrap of fossil bone, they would do much digging and little collecting. Once enough has been uncovered to show that there is a good specimen, perhaps a complete skeleton, it becomes advisable to strip off the overlying rock over a large enough area to expose the skeleton and give working room. One man is working on the outer parts of the specimen while the other digs

(Left) Finally the whole skeleton is exposed, and it lies there just as the animal lay down to die and was buried about 30,000,000 years ago. Its head, the highest part in the picture, is doubled back over the shoulders and its legs are flexed. This is one of the most perfect fossil skeletons ever discovered, with almost every bone still in place, although crushed flat by the enormous weight of the rock that long overlay it. In outlining this specimen another was found below it and has also been partially exposed on each side of the head of the first skeleton

(Right) Both sides of all parts of the specimen are liberally soaked with thin shellac. Sometimes the bone is spongy or ready to crumble at a touch and even when hard it is as fragile as glass and has a thousand cracks through it. In either case shellac is the indispensable preservative. One side of a skull with lower jaws is here being treated

(Left) Then thin, absorbent rice paper is applied to the bone surface, also heavily shellacked and patted down firmly into place with the brush. This serves a double purpose. Although thin and fragile, the rice paper forms a remarkably tough protective shell over the bone when it has been shellacked and dried. It also forms an ideal surface for the bandages which will be applied later and permits the safe removal of the bandages again, without damage to the bone, after the specimen is in the laboratory

(Left) Now the bandages are prepared: They are best made of ordinary coarsely woven burlap, often empty provision sacks, cut into strips three or four inches wide. They are soaked in ordinary flour and water or in fine plaster and then are applied in overlapping strips to the whole surface of the specimen or of the block of rock containing it

The bandages are pressed firmly with the fingers so as to adhere everywhere to the block. When dry they form a tough, hard casing, holding the bones in their proper relative positions, keeping them from coming apart along cracks or from crumbling, and shielding them from the inevitable hard knocks of packing and shipment

(Right) The upper side of a block, in this case containing the hip bone of the skeleton, has been encased in bandages without moving it from its original position. Now the surrounding rock has been cut away so that the block stands on a pillar, and the collector begins to undercut the pillar so that eventually the block may be cut free and rolled over without jarring it

(Left) Sometimes the specimen is so large or so fragile that it is necessary to apply bandages well down onto the pillar below it, so that the break through this will be away from the bone and the subsequent turning will not result in dropping out any part of the specimen

(Right) The specimen, bandaged and dry on the upper side, is removed from the undercut pillar and turned over—the first motion of this animal for millions of years. In this case the block was easily turned, but often this is the most crucial part of the whole process and requires infinite precautions and ingenuity. Sometimes tunnels must be cut under a large block, cutting up its pillar into several, and bandages are run through the tunnels as cinches. In this case, as is usually done, the skeleton is being taken out in several smaller blocks for easier and safer collection and transportation. The hip bones, in the block being turned, have been separated from the backbone at a natural break so that a sharp, clean contact is left and they can be perfectly reassembled in the Museum

(Right) After the block is turned, as much rock is removed from what was the under side as is safe and convenient—how much this is can only be judged by skill and experience. Skull and jaws in this block have been well exposed and in the foreground part of a front leg is still obscured by the rock. The edges of the bandages applied before turning can be seen around the block. These will be trimmed off and this side of the block will be shellacked, papered, and bandaged, overlapping the bandages onto the other side so as to form a unified shell

(Left) Frequently even a well bandaged block is not strong enough for safe transport or for turning, and then braces and reinforcements are applied. Sticks are trimmed to fit and then are fastened firmly to the bandaged block by new bandages

(Right) General view of the quarry with the collecting well advanced. In the right foreground several blocks are completed and are stacked up ready to go. Just to the left of them is a block bandaged, reinforced, trenched and isolated on its pillar, ready to be turned. In the right background a block has been bandaged on one side and sticks are cut and lying on it ready to apply as reinforcements. The rest of the specimen in the background has been left unexposed, with a thin layer of rock over it to protect it until its turn for collecting comes

(Left) The finished blocks are carried to a convenient loading place and then packed on horseback for transportation to camp, whence they can be taken to town by motor car. Fossils have a way of being found in inaccessible spots, and the problem of getting them out to civilization is not the least of a collector's worries. Often they have to be carried by hand for miles, and horses, donkeys, camels, scows, and sleds have all been used for this purpose by Museum expeditions, as well as the more prosaic automobiles, airplanes, railroads, and ships

(Left) Back in the nearest town, all the specimens, and also the camp equipment, are packed in boxes, ready to begin the long voyage to New York. The blocks are braced inside well fitting boxes and tightly surrounded by hay or excelsior so that they cannot knock against the boards. This care ends the task of the collector, and the specimens next go to the Museum laboratories to be prepared, restored, and mounted, which is a different story

(Right) The bones have been removed from the blocks and cleaned and the various parts of the skeleton put back together as they were originally. The skeleton is now on exhibition in the Museum, just as it was buried 30,000,000 years ago and 7,000 miles away

ECLIPSE IN THE ANDES—*The longest total eclipse in 1200 years, which paradoxically begins the day after it ends, will be observed from plane and on foot by an American Museum Expedition*

By CLYDE FISHER

Curator of Astronomy and the Hayden Planetarium, American Museum of Natural History

ON JUNE 8, 1937, the moon will move between the earth and the sun, and cover our central luminary completely for seven minutes and four seconds, giving us the longest total eclipse of the sun that has occurred in 1200 years. The path of totality is about 8000 miles in length, curving for almost its entire distance over the Pacific Ocean, the only land within the path consisting of a few coral atolls in the South Seas and a section of Peru.

Since days begin and end on the International Date Line in the Pacific Ocean, and due to the fact that the moon's shadow will cross this line from west to east, the eclipse will begin the day after it ends, that is, it will begin at sunrise on June 9th and end at sunset on June 8th.

On the coast of Peru the central line of the path passes very near the town of Chimbote, where the duration will be about 3 minutes and 20 seconds, with the sun between 8 and 9 degrees above the horizon, that is, a little more than half an hour before sunset. From Chimbote the path runs close to Huaraz in the Andes about 100 miles to the southeast.

Three observation points

The group which the Hayden Planetarium of the American Museum will send to Peru will observe from three vantage points, in order not to "have all our eggs in one basket." The headquarters will be at Cerro de Pasco, northeast of Lima, at an altitude of some 15,000 feet. A second section will be stationed southeast of Chimbote at an altitude of some 6000 or 8000 feet. The third contingent will consist of the writer, who will make photographs from a plane prepared to fly over possible clouds to an elevation of more than 20,000 feet.

The writer photographed the eclipse of April, 1930, above the clouds, which had an elevation of 17,000 feet, with Captain John O. Donaldson as pilot, the photographs having been made at an altitude of 18,200 feet.

The Hayden Planetarium-Grace Peruvian Eclipse Expedition will consist of the following members:

- Dr. Clyde Fisher—Leader
- Dr. John A. Miller, Swarthmore College—Co-leader and Technical Director
- Hans Christian Adamson—Director of Public Relations
- Wm. H. Barton, Jr.—Executive Officer
- Dorothy A. Bennett—Assistant Executive
- Charles H. Coles—Staff Photographer
- D. Owen Stephens—Swarthmore College Artist
- Mrs. Isabel M. Lewis—U. S. Naval Observatory
- Dana K. Bailey—Observer, of Steward Observatory, University of Arizona
- Dr. Serge A. Korff—Research Associate of Carnegie Institution
- Two Columbia Broadcasting System Engineers

Rarity

A total eclipse of the sun is without doubt one of the most sublime and awe-inspiring phenomena in the whole realm of nature, yet it is withheld from our sight except at infrequent intervals. If the path of the moon around the earth were in the same plane as the earth's orbit around the sun, an eclipse of the sun would occur at every new moon. However, since the moon's orbit is inclined to the plane of the earth's path, the moon, at new moon, usually passes above or below the sun. The maximum number of solar eclipses that can occur in a year is five, while the minimum number for the same period is two. This is, of course, for the whole earth. At any one place on the earth *total* eclipses of the sun are very rare. From 600 A.D. to 1800 A.D., London had only two and Rome only three such events.

The conditions, which make the eclipse of June 8th unusually long, are that the earth is about at its greatest distance from the sun and that the moon is about at its nearest distance from the earth. The greater the distance of the sun, the smaller will be

its sensible disc, and this will make the moon's shadow longer, and its section on the earth larger. The closer the moon is to the earth, the larger will be its shadow cast on the earth during an eclipse. It is therefore evident that both these conditions are conducive to a long eclipse. The longest total eclipse of the sun possible has duration of about 7 minutes and 30 seconds—that is, less than half a minute longer than the Peruvian eclipse.

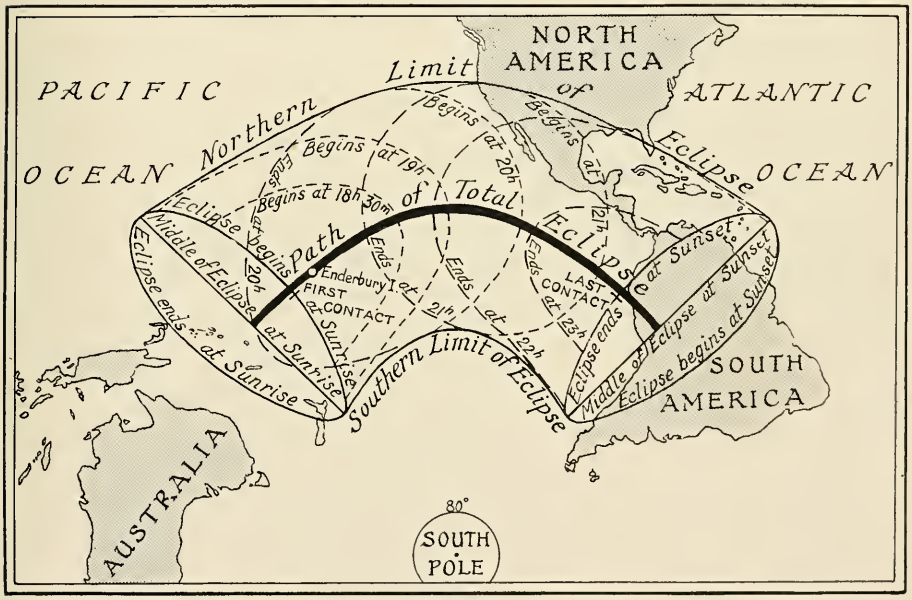
The width of the path of totality, that is, the diameter of the moon's shadow where it strikes the earth, can never be more than 168 miles. The maximum width of the path of the eclipse of June 8th is 153 miles, according to Mrs. Isabel M. Lewis of the U. S. Naval Observatory, and that will be on the meridian where the eclipse occurs at noon.

The partial phases of this eclipse will be visible over about one half of the side of the earth which includes the Pacific Ocean and North and South America. This will include most of California, the line marking the northern limit running from northern California toward the southeast, passing close to Galveston, Texas and including the southern half of the peninsula of Florida.

When the writer photographed the on-coming shadow of the moon in the eclipse of August 31, 1932, there was very little time after the shadow was first sighted to the northwest—perhaps a hundred miles distant—until it passed over the clouds under the plane. The motion picture of this spectacle, which was continuous and complete for the interval indicated above, was made with an Akeley camera at an elevation of 17,000 feet, the billowy sea of cumulus clouds being at an elevation of 8000 or 9000 feet. The picture was made over Conway, New Hampshire, with Casey Jones as pilot.*

Before the dawn of history, the Chaldeans discovered that eclipses occur in cycles, which period they called the *saros,* meaning repetition. The time of this cycle is 18 years and 11⅓ days, or 10⅓ days, if five leap-years instead of four occur in the interval. During a saros there are about 29 eclipses of the moon and 41 eclipses of the sun, 10 of the latter being total. The eclipses of each succeeding saros are practically repetitions of those of the preceding, with this difference, that each one is visible in longitude 120 degrees farther west, due to the one-third of a day in the saros period, which allows

*See "An Eclipse Adventure," by Clyde Fisher, in *Natural History,* Vol. XXXII, No. 6, pp. 481-492.



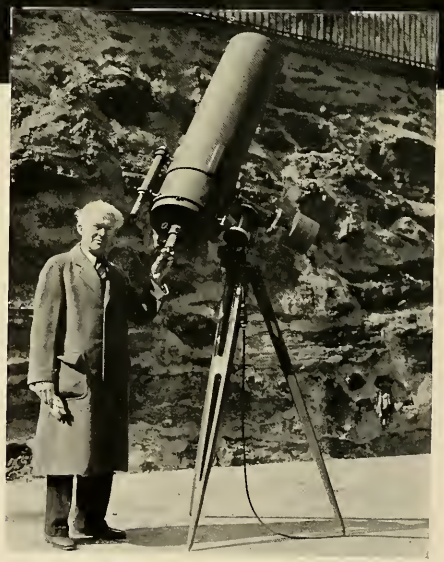
By D. F. Levett Bradley,
Adapted from U. S. Naval Observatory Map

SOLAR ECLIPSE, JUNE 8, 1937

Eclipse in the Andes

FROM THREE POINTS OF VANTAGE the Hayden Planetarium-Grace Expedition plans to observe the longest eclipse of the sun in 1200 years. Two parties will study the rare phenomenon from the ground in Peru and one from the air

Left to right: Hans Christian Adamson, Director of Public Relations; Dorothy A. Bennett, Assistant Executive; Clyde Fisher, Leader; William H. Barton, Jr., Executive Officer; Charles H. Coles, Staff Photographer



LARGE YET PORTABLE TELESCOPES form part of the equipment needed for accurate observation of this remarkable celestial occurrence

ALOFT IN THE ANDES above snow-capped peaks and the clouds encircling them, Dr. Fisher plans to record the eclipse photographically. Like the ground parties, he must work with lightning precision during the eclipse; for although this is an unusually long one, heavenly bodies, like tide and time, wait for no man

Photos, courtesy of Grace Line

VIEW FROM TRAIN of rugged country characteristic of that through which the Expedition will travel to their lofty headquarters northeast of Lima.

En route they will traverse the quaint pastoral regions of the sheep-raising country in which the Peruvian Little Bo Peep at right was photographed

the earth to turn on its axis one-third of the way around. Consequently, after three saroses, or fifty-four years and one month, the eclipses return to approximately the same longitude. However, there will be a difference in latitude. The eclipses of the new series will occur a little farther north if the moon happens to be crossing the ecliptic from the north, or farther south if the moon is crossing the ecliptic from the south.

For example, we had a total eclipse of the sun visible in New York City on January 24, 1925. Therefore, during the last week in February, 1979, we should have another total eclipse of the sun in the longitude of New York City, but farther north in latitude. Upon referring to Oppolzer's *Canon der Finstermisse,* we find that this eclipse will occur on February 26, 1979, and that the path of totality will pass through Canada and across Hudson Bay.

By the way, this wizard of eclipse computation, Theodor von Oppolzer, an Austrian astronomer, has calculated all of the eclipses that have occurred since 1207 B.C., or that will occur up to A.D. 2162, altogether about 5200 eclipses of the moon and 8000 eclipses of the sun, and he has recorded the data with maps in the aforementioned monumental work.

An impressive spectacle

Many persons have attempted to paint a word-picture of this impressive phenomenon, a total eclipse of the sun, but without great success. Most observers feel that it baffles description. Perhaps some pen "which imagination inspires, but accuracy governs" will some time accomplish this. Mr. Howard Russell Butler has achieved it admirably with his brush, as witness the triptych of superb canvases in the Hayden Planetarium.

Since the moon revolves around the earth from west to east, the eastern edge of its disc first contacts the western edge of the sun's disc. In about an hour the moon will have moved entirely between us and the sun. Soon after the sun is half covered a weird darkness comes on, increasing as the crescent of the sun becomes thinner and thinner. This darkness affects both man and animals and even some plants. Birds fly about chirping nervously, chickens go to roost, roosters crow, dogs bark, crickets sing their night songs and certain plants fold their leaves.

Human beings are impressed with the delicate colors that develop over the landscape as the darkness deepens and with the dark greenish-blue sky with the band of salmon-orange just above the horizon. A few minutes, before, and also after, totality, the ghostly and elusive shadow-bands usually appear. These shimmering bands, which are believed to be due to waves in the Earth's atmosphere, were very pronounced on the snow, as the writer and thousands of others observed them, at the eclipse of January 24, 1925.

"Diamond-ring" effect

An instant before totality, the disappearing crescent of the sun breaks up into one or more Baily's beads, which are due to the sun shining between irregularities of the surface of the moon. This last bit of direct sunlight produces the famous "diamond-ring" effect. This effect, can also be observed for an instant at the end of totality.

At the beginning of totality, the corona and the prominences flash out with great suddenness; more accurately, they suddenly become visible. The most beautiful feature of a total eclipse of the sun, the gorgeous corona, is pale silver in color with possibly a tinge of green. Its shape, although never the same at two different eclipses, is correlated definitely with the periodicity of sun-spots. In the eclipse of June 19, 1936, by an interesting coincidence, the corona resembled a five-pointed star.*

The streamers of the corona are seen to extend from the sun usually once or twice its diameter. However, in the eclipse of 1878, Dr. S. P. Langley, from a station on Pike's Peak, observed the corona extending the amazing distance of nearly six solar diameters on one side of the sun and more than twelve on the other. Since one section of our expedition will be stationed near Cerro de Pasco, which is higher even than Pike's Peak, we wonder whether we may duplicate Doctor Langley's rare experience.

At the base of the corona, there may be seen usually with the naked eye, but always with a telescope, rose-red, flame-like prominences. At the eclipse of June, 1936, six unusually high ones were observed. The prominences are also correlated with the periodicity of sun-spots, being more abundant and higher near the maximum of sun-spot activity.

While in the 1936 eclipse both Venus and Mars were visible close to the eclipsed sun, no planets will be close enough to our central luminary to be seen during the Peruvian eclipse. Perhaps we may see a few of the brighter stars.

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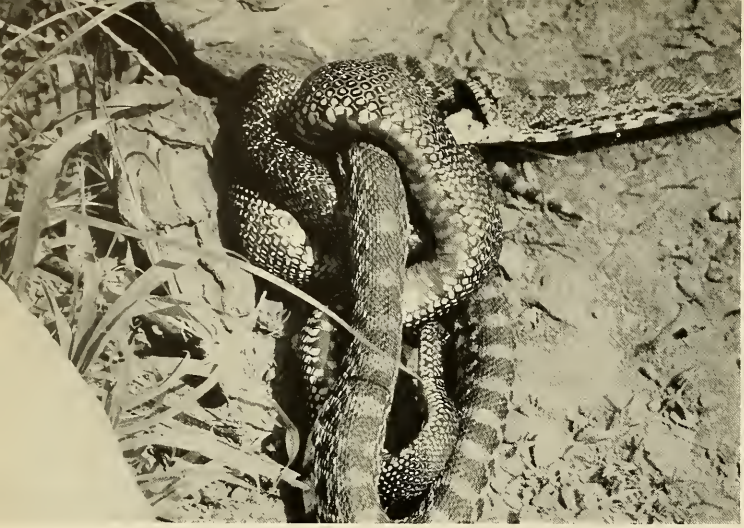
*"The Eclipse in Kazakhstan," by Clyde Fisher, in *Natural History,* Vol. XXXVIII, 1936, No. 3, pp. 203-210.

Snake Eat Snake

As a former Curator of Reptiles in the Tulsa Zoological Garden, Mr. B. Hathcock, who presents these unusual photographs, has handled more than 10,000 snakes, both afield and in captivity.

Few snakes are habitually cannibalistic, but many species will take to the practice occasionally, especially if their normal prey is scarce. The accompanying photographs are a credit to Mr. Hathcock's vigilance as well as to his photographic skill, for the eating of one snake by another cannot be regarded as commonplace.

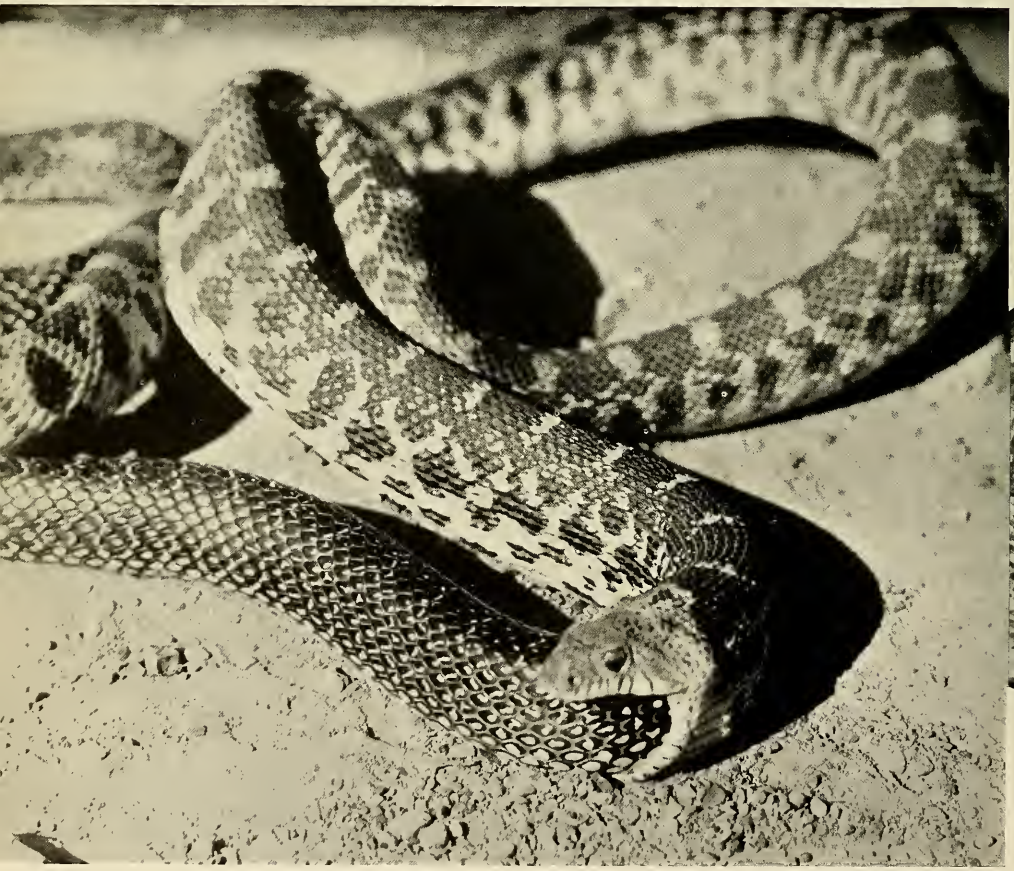
PACIFIC RATTLER EATING A SMALLER SNAKE OF THE SAME SPECIES. When several snakes of a collection of 57 Pacific Rattlers *(Crotalus viridis oreganus)* received by him refused food, Mr. Hathcock one day was confronted with the rare sight shown above. It is believed to be the only picture ever taken of a cannibalistic rattler



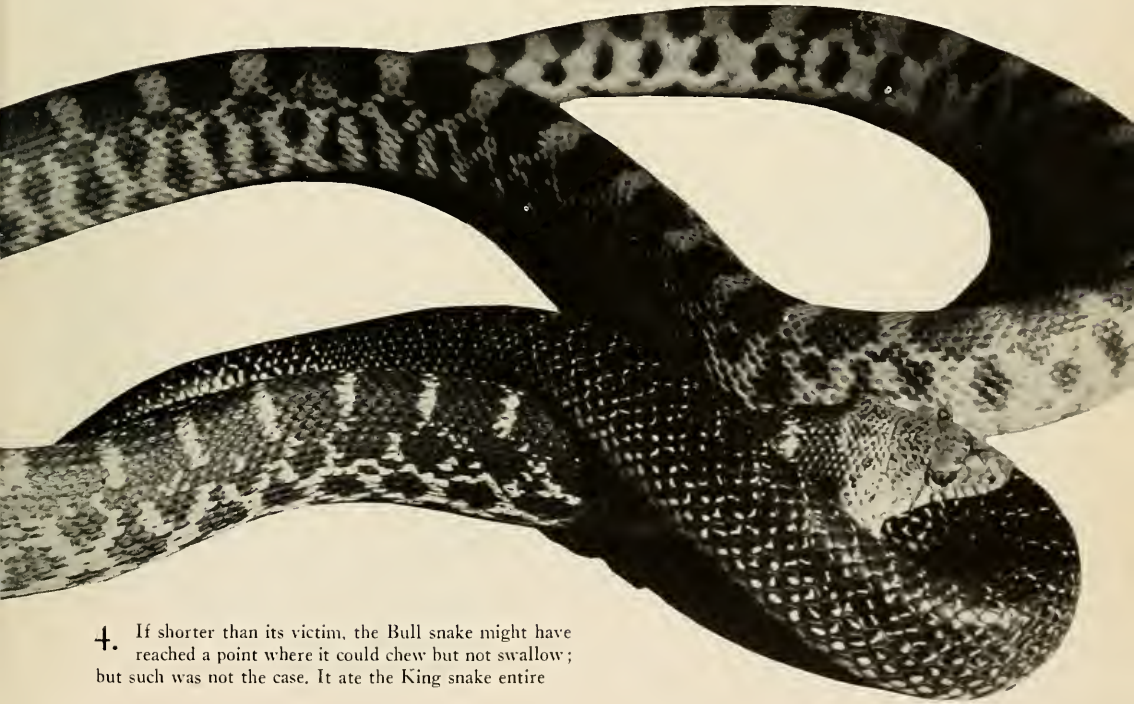
BULL SNAKE VS. SPOTTED KING SNAKE. Four views of a battle in which the King snake was killed and eaten

1. The Bull Snake, in the clutch of the King snake, maneuvers with open mouth for the first bite of a long meal

2. The Bull snake has swallowed the head of its opponent. Note the Bull snake's flatly folded body indicating an empty stomach



3. The victor is apparently enjoying his repast. Snakes' jaws, being unhinged, can spread on occasion to receive creatures much larger than themselves



4. If shorter than its victim, the Bull snake might have reached a point where it could chew but not swallow; but such was not the case. It ate the King snake entire

Though the King snake was the loser in the foregoing series of photographs, Mr. Hathcock states that he has seen Spotted King snakes devour Black snakes, Pine snakes, Copperheads and even Rattlers, as well as smaller and less offensive species, and only rarely has there been a digestive upset.

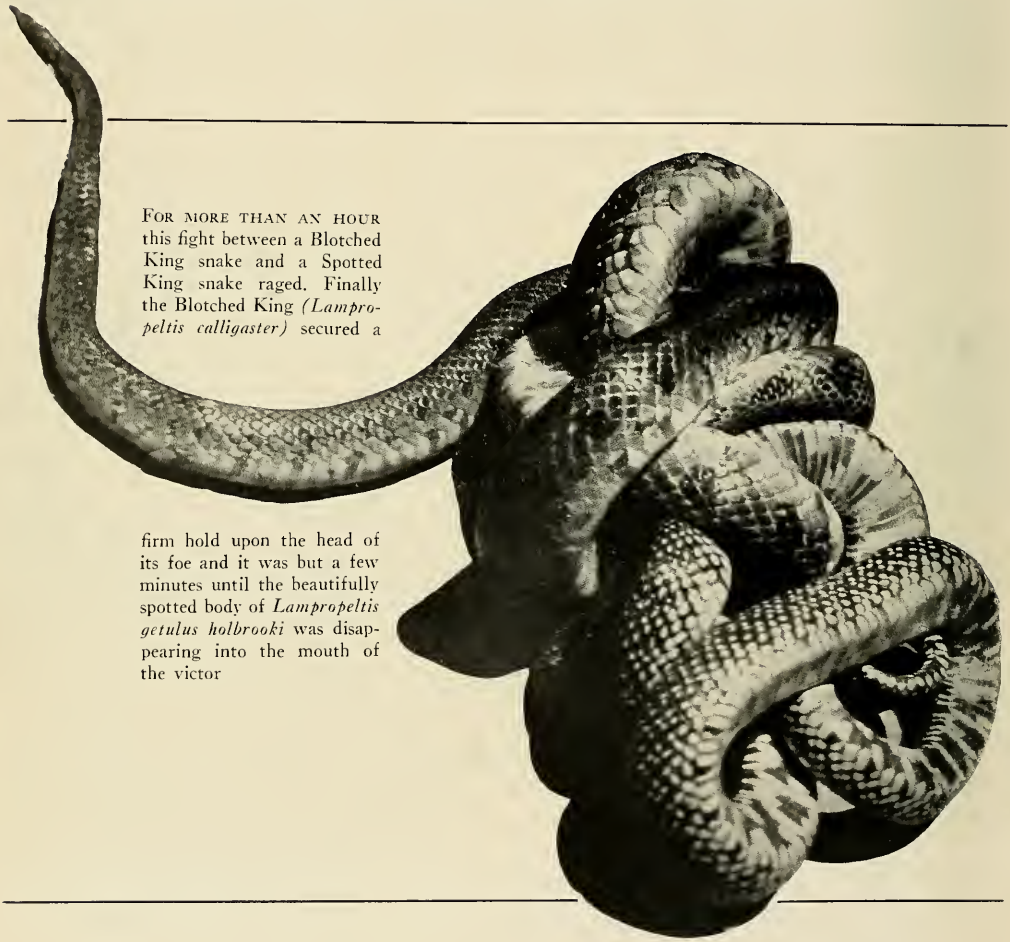
In the wild state, he classes the Indigo as one of the most cannibalistic snakes in America:

"I remember a certain Indigo snake *(spilotes corais couperi)* in my zoo collection, which killed every King snake ever put into its quarters. Its favorite delicacy, though, was a Garter snake, and countless numbers of these small, striped serpents passed through its jaws.

"The poisonous snakes of America are not given to feeding upon their relatives to any great extent, with the possible exception of the Cottonmouth, or Water Moccasin, of the South. This venomous creature has long been known for its habit of eating other water snakes, especially in particularly dry seasons when its natural prey is not readily available. Garter snakes and Ribbon snakes are also often victims of the rarely appeased appetite of the Moccasin.

"I have known of but one case of a Copperhead feeding upon another serpent—a Banded Water snake—though lizards form a portion of the natural diet of this serpent.

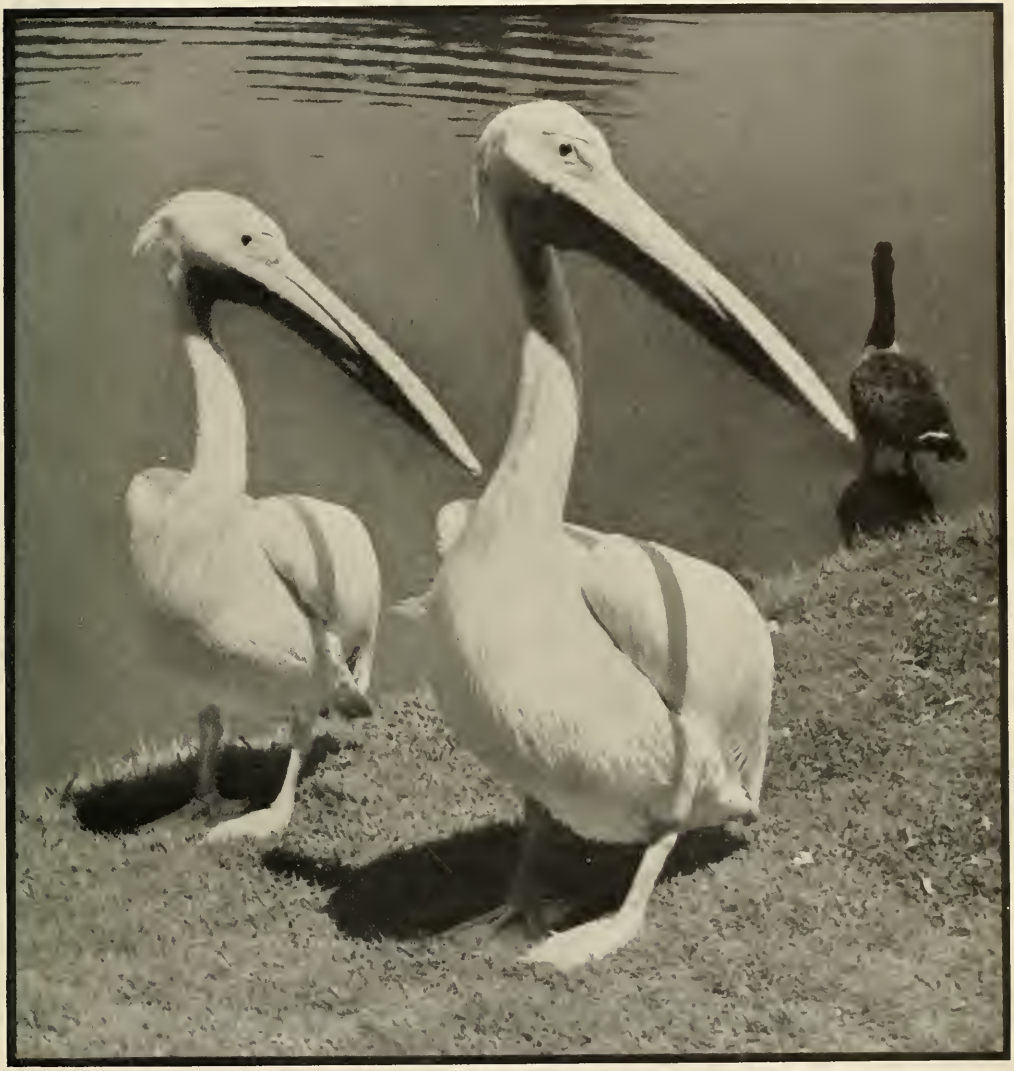
"My friend, Mr. Marlin Perkins, Curator of Reptiles at the St. Louis Zoo, once had a King Cobra, which was as temperamental as an operatic prima donna. This snake utterly refused everything put into its cage but Blue Racers and I still have Perkins' frantic letter, asking for a large shipment from our zoo collection."



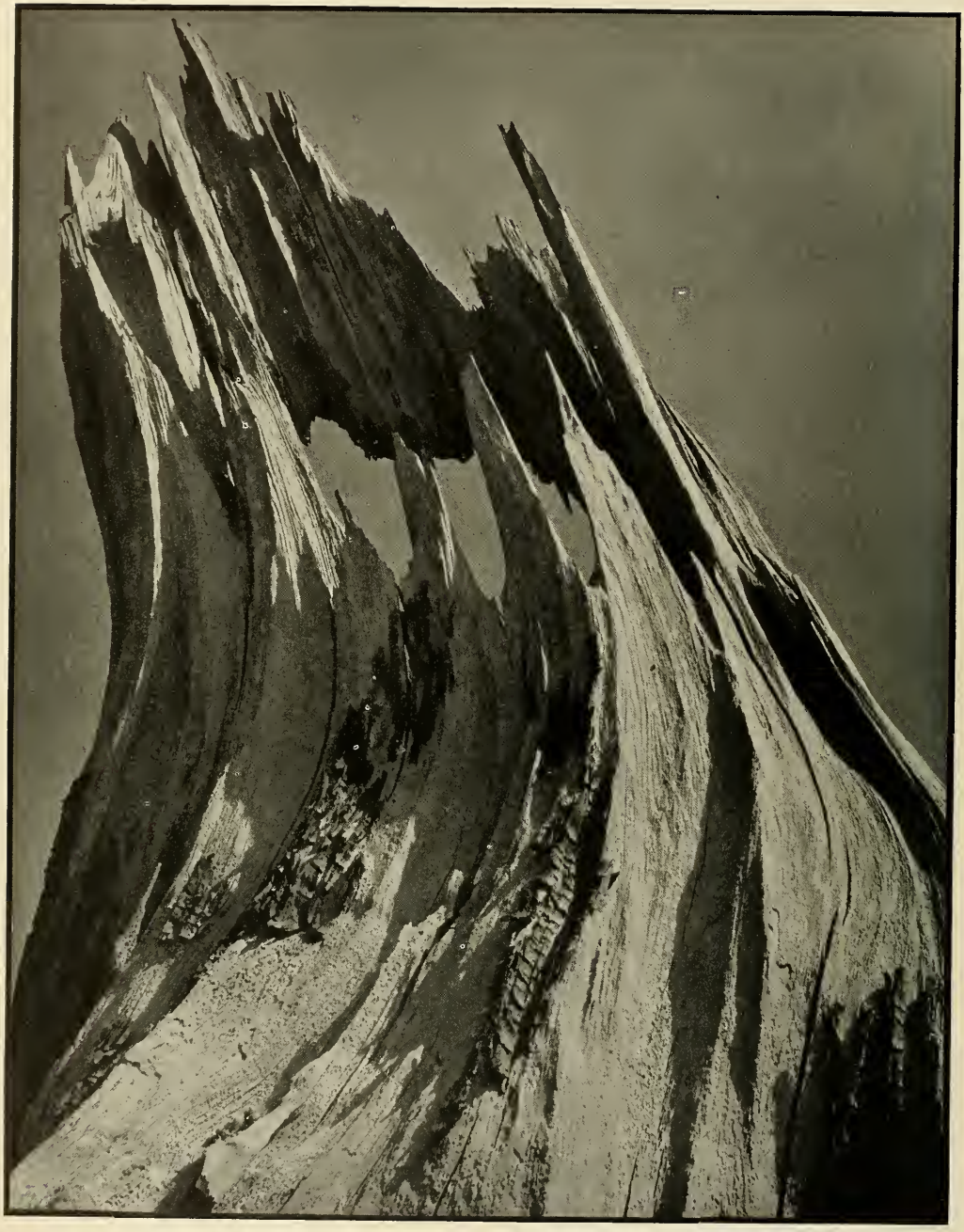
FOR MORE THAN AN HOUR this fight between a Blotched King snake and a Spotted King snake raged. Finally the Blotched King *(Lampropeltis calligaster)* secured a firm hold upon the head of its foe and it was but a few minutes until the beautifully spotted body of *Lampropeltis getulus holbrooki* was disappearing into the mouth of the victor

Through the Camera's Eye

A selection of photographs demonstrating some of the ways in which the camera serves both art and natural history, from the Fourth International Salon of Pictorial Photographers of America, recently exhibited at the American Museum of Natural History



Pose Please — Harry Peterson



NATURE'S WOODCARVING

FRED G. KORTH

Translucence

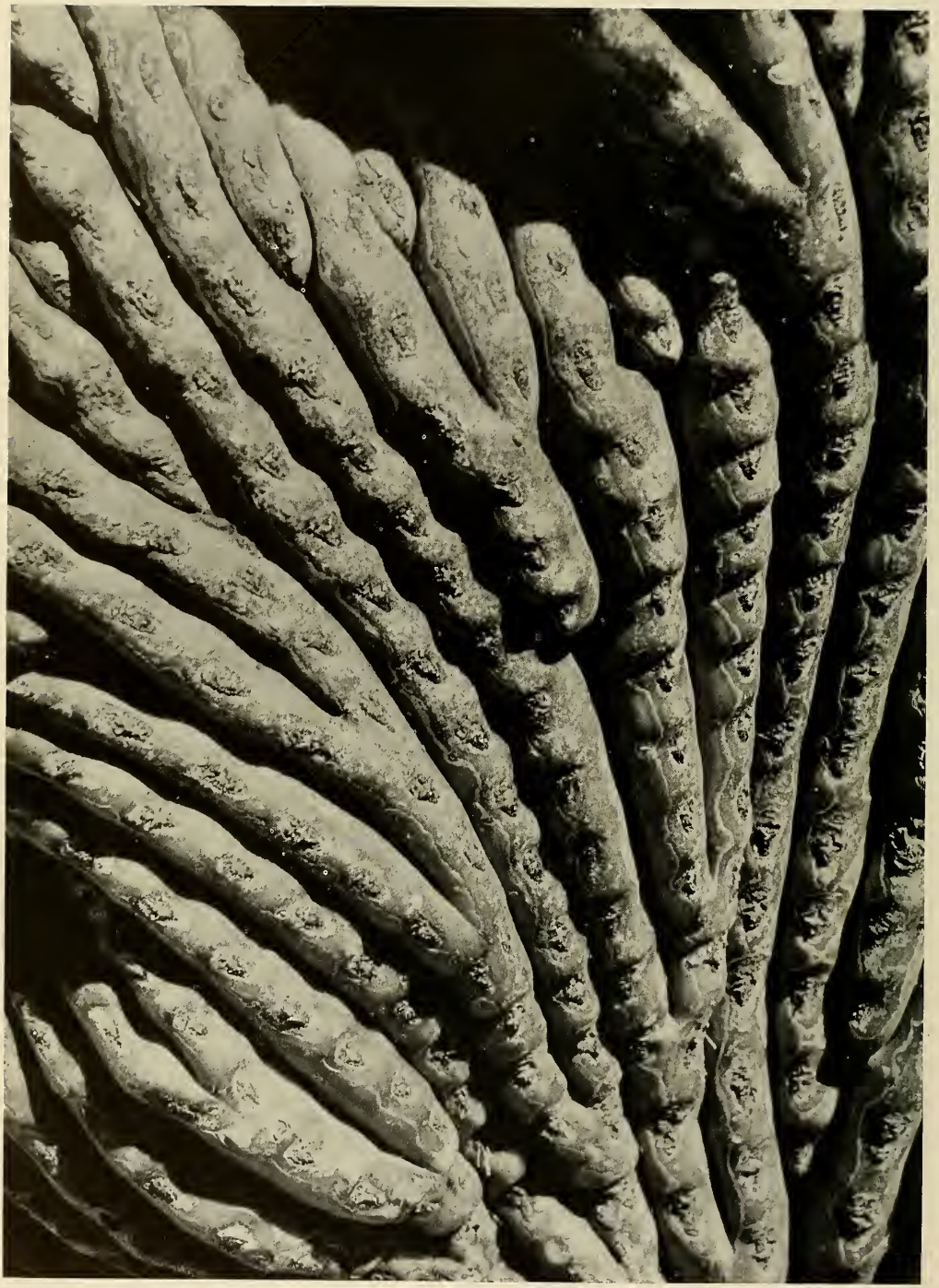
W. C. West

Comrades

Jeno Denkstein

Canyon De Chelly

Laura Gilpin



Cactus Forms

John Paul Edwards

Winter's Jewelry — Lionel Heymann

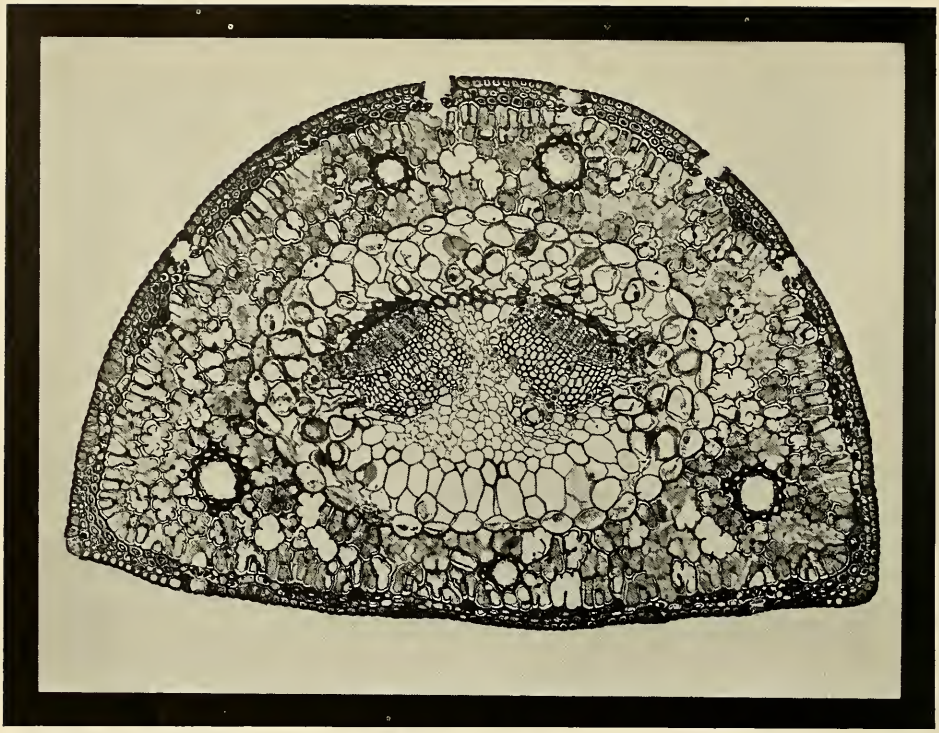
Navaho Summer Hogan with Prayer Rock in Background — Laura Gilpin

Lilium Speciosum — Dr. Ernest Scott

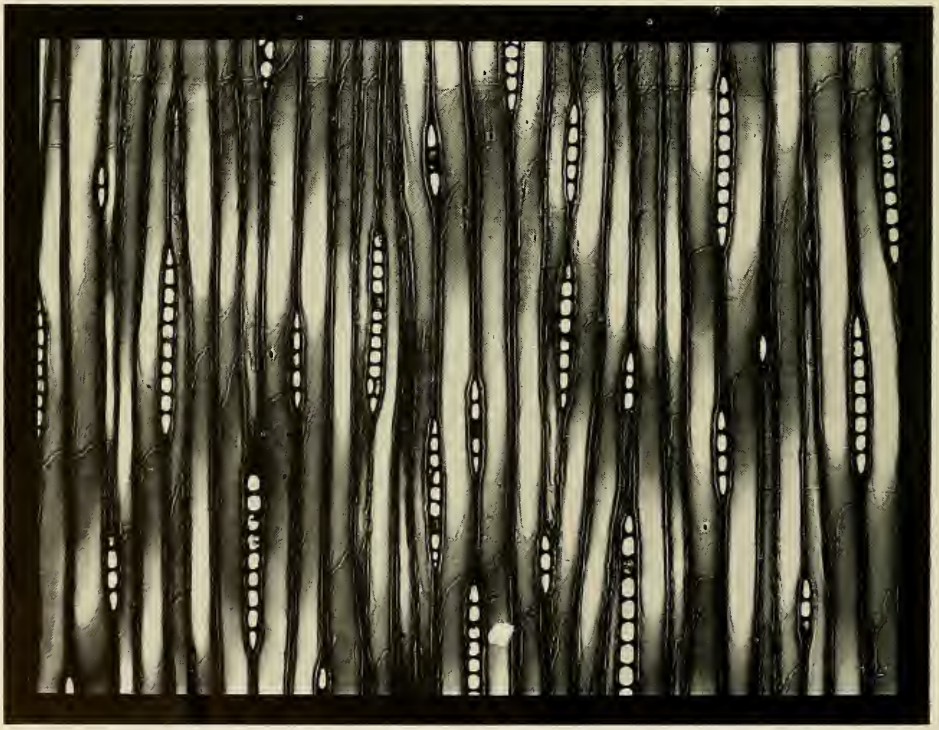
Ice Herd — H. W. Wagner

The Pool, Acoma — Forman Hanna, F.R.P.S.

Daisy and Honeysuckle — Edward W. Quigley



Pine Needle *(Microscopic section)* Richard W. St. Clair



Redwood *(Microscopic section)* Richard W. St. Clair

THE KING OF BIRDS—*The golden eagle is described in combat with its prey and man, and observed caring for its young far up in a Highland glen*

By SETON GORDON

THE golden eagle is one of the most glorious birds, and is found not in one country only, but throughout the world. Without visible movement of its great wings I have seen an eagle climb so high that at last it was invisible except through a powerful telescope. The golden eagle's wing-spread may reach as much as eight feet, and it rises into the blue vault of heaven for the pure joy of flight.

Throughout the ages the Bird of Jove has inspired mankind, and around him have grown numerous myths and legends. Many peoples of the world have adopted the eagle as their emblem, and the use of this symbol in modern times is evidence that the bird has maintained his figurative prestige.

Longevity of Eagle

The golden eagle is traditionally believed to live to a great age. There is an old adage in the highlands of Scotland that

Thrice the age of a dog the age of a horse,
Thrice the age of a horse the age of a man,
Thrice the age of a man the age of a stag,
Thrice the age of a stag the age of an eagle,
Thrice the age of an eagle the age of an oak tree.

It is difficult, almost impossible, to prove the age of any wild bird, yet the veil was lifted for a moment in France in 1845 when, according to a contemporary newspaper, an eagle was shot with a dated collar of gold around its neck. On the collar was the following inscription, *"Caucasus patria, Fulgor nomen, Badinski dominus, mihi est 1750."* That eagle must have been 95 years old and there seems to be no reason why it should not have lived many more years if it had escaped the gun.

The golden eagle probably pairs for life and each pair own two, or even three eyries. The same eyrie is rarely used on two consecutive seasons, for the remains of the prey which accumulate during the time the eaglets are growing tend to foul the eyrie, and a year's interval is necessary to allow sun, wind and frost to purify it. Some of the Scottish eyries are, I believe, more than half a century old.

The eggs usually number two, but old birds lay one only. The first-laid egg is blotched and spotted with rich red-brown; the second egg may be almost unspotted. The egg is approximately the size of a goose's egg, but is more rounded and the shell is thicker. The eggs may be laid as early as mid-March, but a more usual time is toward the end of that month. The incubation period is 40-42 days, and the female takes the entire responsibility of the brooding. The eaglets are hatched early in May, and are fed at first chiefly on grouse's liver. Later their food is the mountain hare, but young rabbits and even squirrels are brought to the eyrie. On a liberal food supply the eaglets grow quickly and are able to take their first flight eleven weeks after they are hatched.

The eagle in combat

A fox and an eagle will sometimes match their strength, and Duncan MacRae, a deer-stalker in Sutherland, witnessed a thrilling encounter between the two. The fox was racing up a hillside less than a hundred yards from MacRae when an eagle flew up behind him, caught him in his talons and lifted the fugitive about a yard off the ground. When the eagle dropped him the fox turned round and the two faced each other, the fox with his mouth open and his teeth bared in a snarl, the eagle with feathers ruffled and neck outstretched. The fox then made off but the eagle overtook him and seizing him by the back lifted him this time at least four yards into the air. When he dropped the fox the two enemies stood facing each other as before and when the fox again fled the eagle pursued but did not again lift him. The fox was a big dog fox, and it was remarkable that the eagle was able to lift such a weight off the ground.

A fight between a golden eagle and a wild cat must have been even more exciting to watch than this encounter between fox and eagle. Donald Crerar, late head stalker in the deer forest of Ardverikie and a direct descendant of the Crerar who

The King of Birds

THE GOLDEN EAGLE AT HOME: Intimate photographs of a difficult subject, by Mr. and Mrs. Seton Gordon. Long and patient vigil at an eyrie far up in a lonely highland glen rewarded the naturalists with a remarkable photographic record and the observations recounted in the accompanying article

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A PROUD MOTHER and her only child. When the downy eaglet lay down to sleep, the mother was observed to arrange small shoots of heather over it. The whole gamut of bird home life was witnessed, from feeding to house-cleaning. The golden eagle probably pairs for life, and each pair own two, or even three eyries, which they generally use in alternate years. An eagle has been known to reach the age of 95, and this is probably well under the limit

is mentioned in Scrope's classic work on deer-stalking, was the person fortunate enough to see this fight. One summer day he noticed that an eagle was swooping, time after time, at the steep rocky face of a hill about seven hundred yards away. The eagle was so persistent in his dives that Crerar at last took out his stalking telescope and watched the bird in the air.

As he followed the dive he saw that the quarry was an animal which was sitting on a round stone on a ledge of rock. At first Crerar thought that the animal was the fawn of a red deer; then he thought that it must be a fox that had been rolling in peat, because of the unusual darkness of its coat. He was kept in uncertainty until the animal, infuriated by the continual swooping of the eagle, sprang into the air, striking at the bird with its fore paws.

Vicious prey

Crerar then saw in a flash that this was a wild cat, an animal that was almost exterminated in the highlands in 1914 but which the Great War years permitted to increase. Eagles relish tame cats, and this bird was determined if possible to make a meal off a wild one! Time after time the eagle swooped down, with strong legs outstretched and talons ready to grasp the tempting prey. Once, when the eagle came very near the wild cat, the latter sprang so high into the air to return the attack that Crerar distinctly saw the whole of the cat suspended for a moment in mid-air.

The eagle dived at the cat thirty or forty times, but the cat sprang at the eagle twice only. The second and last great spring must have alarmed the eagle, for he did not venture so near again and the affair ended when the cat disappeared into a hole among the stones and the eagle sailed away. A few days later Crerar visited the place where he had seen the fight, and found that the cat had her den and kittens among the stones.

An epic battle high in the air took place between a golden eagle and a stoat, or ermine. Again a stalker was witness of the result of this fight, which occurred not far off Cape Wrath in the northwest highlands. The eagle on this occasion was seen to rise higher and higher into the air, and then fall with wildly-beating wings to the earth. The human spectator ran to the place, and was in time to see a stoat appear from beneath the eagle and scamper out of sight. The eagle had apparently lifted the stoat in order to make a meal of it (stoats are indeed sometimes carried to the eyrie as food for the eaglets), and the stoat in desperation had fastened its teeth in the eagle's throat. The eagle when examined was found to have a deep wound in the throat.

The weight that a golden eagle is able to lift has been the subject of much controversy. It is, I think, governed by the conditions, and depends upon whether the eagle is able to approach the prey at speed and lift it, as one might say, in its stride. A highland stalker gave me an interesting account of how he saw a golden eagle lift a lamb from the hillside where it was lying near its mother. The bird flew some little distance, then rested, and the stalker hurrying at his best speed to the rescue of the lamb, almost reached the eagle before it again rose into the air with the animal still in its talons. His vociferous shouting alarmed the eagle and caused it to drop the lamb, which was still alive, and not seriously injured. The stalker carried the lamb home and at once weighed it. The weight, as he told me himself, was 9¾ pounds.

A more remarkable instance was given me by John MacLeod, gamekeeper in the Sleat district of the Isle of Skye. One day in the course of his rounds MacLeod found a golden eagle with a large steel trap, weighing about 8 pounds, hanging to one foot. The trap was of a kind that is not used in the district where the bird was found, and so the eagle must have come at least from the Cuillin Hills, or from the neighboring island of Rum, twelve miles across the sea.

Attack on man

In old books and writings are accounts of eagles attacking anyone venturing to approach the eyrie. It is probable that before the invention of firearms the eagle was bolder than he is today. I have visited many eyries in different parts of the highlands, and have never yet seen an eagle show any disposition to attack. But a deer-stalker named James Fraser, who lives in the western highlands of Inverness, has the distinction of having been attacked by a golden eagle. His story is somewhat as follows. He was sitting on a hillside one day with his dog beside him when a golden eagle in hot pursuit of a grouse passed him close overhead. The grouse to save itself threw itself at Fraser's feet and the baffled eagle disappeared from view. Later the same day the stalker was spying his ground for deer when to his astonishment he was attacked by the eagle, which he was convinced was the same bird that he had seen earlier in the day. The eagle struck its talons deep into the flesh of his ankle and matters began to look serious for Fraser until his dog rushed to his help. While the dog attacked the eagle, Fraser with his free foot succeeded in dealing the bird such heavy blows that he killed it. The eagle's talons were so

deeply imbedded in his ankle that before he could liberate himself he was obliged to cut them out with a knife.

Intimate observations

Far up a lonely highland glen a pair of golden eagles have had their eyrie from time immemorial, and twelve feet from this eyrie my wife and I have spent many hours in a heather-covered hide, photographing and observing the home life of the king and queen of birds. Our first visit to the eyrie was on a cloudless morning of early summer. The glen lies high, and as we walked up it the ground was white with frost and the air very cold before the sun rose above the hill to the east of the glen. We had scarcely come in sight of the eagles' rock when the mother eagle rose majestically from her eyrie and flew leisurely across the glen. So skilfully had the deer-stalker constructed the hiding place of turf and heather that we could not see it until we had almost stepped on the roof!

Twelve feet from the hide was the great nest, built of heather and branches of the rowan or mountain ash. In the nest lay one eaglet, small and downy. As the warm rays of the sun fell upon it the little eaglet panted in distress, but when I stood so that my shadow fell upon it the quick breathing ceased and the baby fell fast asleep.

After I had crept into the hide, with my camera in position, my wife and the stalker, and our collie dog Dileas, walked away down the glen. It is a curious thing that birds cannot count—the golden eagle is no exception—and when they see human beings, which are, I think, registered in their minds as 'danger,' leave the nesting site they never have any suspicions that one of these human beings may have remained behind in hiding.

Through a peep-hole in the front of the hide I could see the eaglet sleeping on its side, one leg outstretched and the small white head quaintly pillowed on heather shoots. During the space of fifty minutes there was silence, then came the rush of wings, and the mother eagle arrived at the nest. Almost at once she fed the eaglet with great care on small tit-bits from a grouse, then she herself swallowed the rest of the carcass, including the entrails. Like a good housewife she next saw to the cleanliness of the home, tidying up the eyrie and arranging small shoots of heather over her only child. She had been a full half hour at the eyrie when for the first time she noticed the eye of the camera lens staring coldly at her. Full of suspicion she took wing with a magnificent gesture, but soon returned and brooded the eaglet for an hour, during which time she was visited by her mate.

Each fine morning during the week that followed we left the stalker's house at sunrise, for no successful photographs—because of the position of the sun—could be taken after eleven o'clock in the morning. It was an effort to leave one's bed before sunrise, when the window was thick with frosted dew, but we were the more ready for breakfast on our return from the watch at the eyrie, at mid-day or even later. In the course of a week the eaglet grew greatly on a generous diet of blue hares, grouse, young rabbits and, on one occasion, a large black water rat.

At the end of the week a thirty-hour continuous watch at the eyrie was arranged. I took the early watch, and at two in the afternoon was relieved by the stalker, who watched until ten at night. At 10 p.m. my wife climbed to the eyrie and took the most arduous watch of the three, for she remained in the hide until eight o'clock the following morning, when I took her place. She was so stiff that it was with difficulty she crawled from the hide, but she had seen interesting things. The mother eagle, standing over the eaglet, had remained motionless in sleep for no less than eight hours. She had never actually brooded the eaglet, although at the coldest hours of the night the shivering eaglet had called plaintively to her from time to time, imploring shelter. An interesting little comedy was enacted just before sunrise. A blackbird which lived farther down the glen flew up light-heartedly to a rowan tree beside the eyrie and sang his full song only a few feet from the sleeping eagle. Opening her wonderful eyes the eagle looked up at the singing blackbird in surprise, and listened a while with mild interest to his flute-like song before closing her eyes once more in sleep.

We had spent altogether fifty hours watching when I was fortunate to see, and to photograph, an incident which was so remarkable as to be, perhaps, unique. A few minutes before the sun left the eyrie the heat was intense, and the eaglet was most uncomfortable. The mother then placed herself between her child and the sun, and very slowly opened her magnificent wings until they were outspread before me in all their beauty and strength. Motionless she stood thus, looking away up the glen while the eaglet slept in the shade of her protecting wings. When the sun was obscured she folded her wings, walked to the edge of the eyrie, sprang into the air, and was gone from my sight.

"HORNED" HORSES—*They weren't exactly unicorns but of the 3300 horses examined 6 had the skin-covered horns which result from a disproportionate development of the skull bones*

By S. HARMSTED CHUBB
Associate Curator, Comparative and Human Anatomy, American Museum

IN ancient writings we find mention of strange and improbable creatures: "unicorns", "horses with horns", "a fiery steed with the antlers of a stag," and other unscientific or fanciful conceptions, many of which figure in mythology. Of these early reports possibly only those of "horses with horns" may have had some semblance of foundation. And as we approach our modern era, these accounts become more tangible and well worthy of attention. Indeed, so important an observer as Darwin* made mention of "horn-like projections . . . on the frontal bones of the horse". In fact, nearly everyone who is associated with or particularly interested in horses has seen or heard reports of "horned" horses.

True and false horns

It is a fact that occasionally a horse appears with a pair of small protuberances on the forehead, above the eyes and a little toward the median line of the skull, as shown in the accompanying photograph. Although these protuberances are commonly spoken of as horns, they should not be associated in any way with true horns, such as we find in cattle, antelopes, sheep and goats. While horns are simply modified hair, growing from the skin, with a bone process rising from the skull to support them, the protuberances on horses' foreheads, though composed of bone, never have any horny growth over them but are covered with skin and the usual coat of hair.

Theories regarding "horns"

The occasional development of these abnormalities has prompted a good deal of discussion among scientists as to their cause and possible significance. Many writers have called attention to this phenomenon but have offered no satisfactory explanation of its occurrence. Some have regarded these protuberances as reversions, a manifestation of the tendency to harp back to some ancestor of the remote past, but now that the evolution of the horse is well known as far back as Eohippus of the Lower Eocene, estimated as being approximately 50,000,000 years ago, and as none of the fossil remains shows any indication of horns, this theory seems hardly tenable.

It has even been suggested that the "horns" may be a reversion to a still earlier reptilian ancestor. We are immediately reminded of Triceratops, an extinct creature suggestive of our modern horned toad. However, acceptance of the reptilian theory would require a rather painful strain of the imagination, quite unnecessary if there is an explanation near at hand.

Then there are others who look upon these "horns" as being prophetic and would expect that in ages to come horses will be equipped with these implements, impediments, or ornaments, as the case may be. This theory is difficult to controvert, for who will dare to say what marks of beauty may embellish the face of a horse only a few million years hence.

Development before birth

But should we not first "seek diligently" for a more tangible explanation? It is true that abnormal enlargements may appear in or under the skin on any part of the body. However, the fact that there is a striking uniformity in the appearance and location of these small protuberances, that they are in the bone, and that they occur in pairs, would lead one to look for a structural cause for their presence rather than a pathological condition.

We would expect, therefore, that the most hopeful line of research might be found in the singular method of construction and growth before birth: hence the further study of the embryological stages.

Before birth, the mammalian skull, of course including the human species, is made up of more than forty separate bones. These bones are constantly being modeled and changed in shape and proportion as they increase in size. This is an operation so com-

*In "The Variation of Animals and Plants Under Domestication."

plicated that we may consider ourselves fortunate if we make the precarious transition from embryo to maturity with a fairly normal head on our shoulders, yet as a rule this delicate process of development is carried out successfully.

Competition in bone growth

It would appear that the colt finds this difficult. For, some time before birth, a pair of wing-like extensions of the sphenoid bone grow just a little too fast for the outside expansion of the growing skull. These wings, known as the orbitosphenoids, even while still in cartilaginous form grow upward and pierce through the frontal bones at a point on the forehead corresponding exactly to the position of the so-called "horns", as shown in the accompanying drawing. Near the time of birth, the frontals normally overtake and outstrip the precocious growth of the orbitosphenoids, leaving the perforations still in the frontals. Normally, these perforations soon become filled with new bone so that the forehead becomes smooth and the facial contour complies with our standards of equine beauty. But we find that very occasionally the orbitosphenoids continue to lead in the growing contest, with the result that these protruding wings become ossified and protrude permanently, giving the colt the distinction of being a "horned" horse for the rest of his life.*

These occasional abnormalities are often regarded as serious blemishes but they in no way affect the practical value of the horse unless from a purely esthetic point of view, which after all may be a matter of individual taste.

*A fuller and more technical account of this phenomenon was published in American Museum Novitates, No. 740, August 17, 1934.

Searching for living examples

Having discovered, as I am convinced, the cause of these protuberances, it was of next importance to find living examples and to get some idea of the prevalence or rarity of their occurrence. Accordingly, I made a systematic search among the horses of New York City and spent many hours dodging in and out of stalls, not only looking horses in the face but carefully rubbing their foreheads, fearing that some slight protuberances might be overlooked in the dim light of the stables. No less than 3300 horses were thus fondly petted and examined. Among this large number only six of the much sought abnormalities were found.

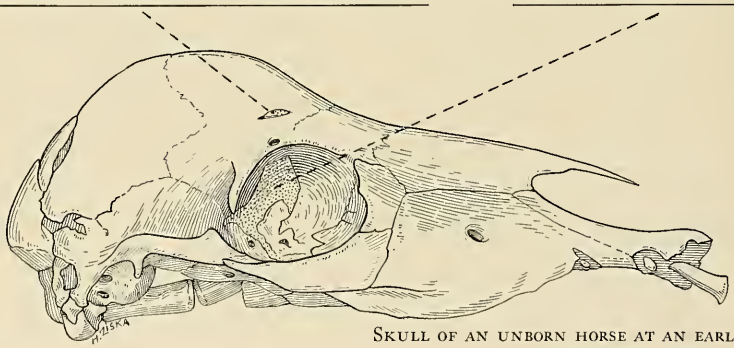
The most interesting individual met with is illustrated in the accompanying photograph. The protuberances in this case were not so prominent as many of those that have been reported. They arose one-half inch above the plane of the forehead and were three and one-half inches apart, three inches above the eyebrows.

This individual, *Gabriel* by name, is owned by Mr. Neuberger of Red Bank, New Jersey, who was much pleased to find that his horse was of great scientific interest. Being a Hunter, *Gabriel,* as well as his master, finds rare excitement in racing over the New Jersey fields in pursuit of the "scent-bag". But it has been promised that, when he finally gives up "the chase", his skull will come to my laboratory for investigation.

For many years I have hoped to procure the skull of a horse showing these abnormalities. When successful, I feel sure that a careful examination of the frontal region will add even further evidence in support of the above conclusions.

The tip of the cartilaginous bone which in one horse in several hundred produces a so-called horn. This bone (orbitosphenoid wing) normally pierces the forehead of the unborn horse through the frontal bone as shown, later to be overgrown by the expanding skull

The lower portion of the orbitosphenoid wing forms part of the wall of the eye socket



SKULL OF AN UNBORN HORSE AT AN EARLY STAGE

Skull construction modified

It has been shown that the perforation of the frontal bones by the orbitosphenoid wings is perfectly normal during foetal life, that occasionally a slight overgrowth of these wings persists after birth, and that, in such a case, these prominences become permanent, and the so-called "horned" horse results. Frontal protuberances in horses should be looked upon, therefore, not as a reversion to an ancestral type, or as a rudiment of some future development, or even as a pathological condition, but as a result of a peculiar method of construction which, in rare cases, becomes only slightly modified and yet affects the contour of the mature skull.

"Horned" *Gabriel:* a Hunter belonging to Mr. Harry H. Neuberger of Red Bank, New Jersey. These horn-like protuberances, sometimes slightly larger, sometimes smaller, can be detected in one horse in several hundred. They are neither a throw-back to an ancestral feature nor the beginning of a regular horn, but the result of disproportionate development of the skull bones. They in no way affect the value or usefulness of the horse

THEY LEARN AND LIKE IT—*New ways in place of old bring the wonders of the world to New York's children, and their periodic visit to the American Museum becomes no less thrilling than a trip to the circus*

By GRACE FISHER RAMSEY
Department of Education

THE difficulty of teaching city-bred children things that lie far beyond the roaring subways, the elevated trains and the towering skyscrapers that are the limit of their experience, is seldom fully realized.

A little girl born in New York's Lower East Side recently showed that she knew what the words "altitude" and "climate" meant, but her understanding of the relationship between them was somewhat twisted to fit her surroundings.

"When I am in the street it is cold," she said, "because the elevated shuts out the sunshine. When I go up on the 'El' platform it is warm. This shows the effect of altitude on climate. Hills and mountains are warmer near the top and so make warmer climate."

The Sicilian hills known to this girl's parents were not for her. She had never felt the mountain breezes nor seen the peak of Mt. Etna hooded in the clouds. The Third Avenue Elevated platform with its clattering trains she had ascended. Her mountain climbing was limited to sixty-four iron steps, each recommending repetitiously the use of Royal Baking Powder.

When the mountain would not come to Mohammed, Mohammed could go to the mountain. Some day, perhaps it will be possible to place the little Sicilian girl and her schoolmates on a magic carpet and waft them swiftly over the peaks of the Adirondacks. In the meantime, curriculum makers insist that children shall know mountains and their effect on climate. How can the mountains be brought to them?

There is white magic at work among the schools of New York City, making vivid and delightful, interpreting and illuminating, the darksome passages of geography—bringing the mountains to the children, who cannot go to the mountains. Let us follow some of these classes.

By subway, elevated, or bus the children and teacher reach the entrance of the American Museum of Natural History, where they are escorted into an attractive room, accommodating the forty or more children in one class. A pleasant-faced Museum instructor now takes them in charge, having previously been told that the children are having a struggle with altitude and climate. When they are asked how many have seen hills or mountains there are three or four children who proudly proclaim that they have seen the "hills" in Central Park. One girl—the only one in the whole class with a first-hand knowledge of mountains—has spent a week at a camp for convalescent children in the Catskills. The little Sicilian girl explains her understanding of the effect of altitude on climate, as illustrated by the Third Avenue "El."

But now the white magic begins to work. The children are no longer confined within the four walls. On a screen in the front of the room wooded hills and snow-capped peaks are projected in all their natural beauty. Storm clouds gather at the mountain tops. There are thirsty plains beyond the mountain range. As the clouds condensing against the side of the mountain barrier are robbed of their moisture, the children see the dam that has been built in the valley below, the irrigation ditches, and the land that is thus made to blossom and bring forth fruit.

Full of eagerness, the children leave the room with their Museum instructor and go to a large habitat group in one of the halls. Before them they see the hot, moist jungles of the Mexican lowlands. Brightly colored red and green and yellow birds poise lightly amid the leafy branches. At an elevation of some ten thousand feet the children's eyes meet the cool greenness of the pine trees. Then, marvelous to these young minds, they see the gleaming white masses of snow surrounding the peak of Orizaba.

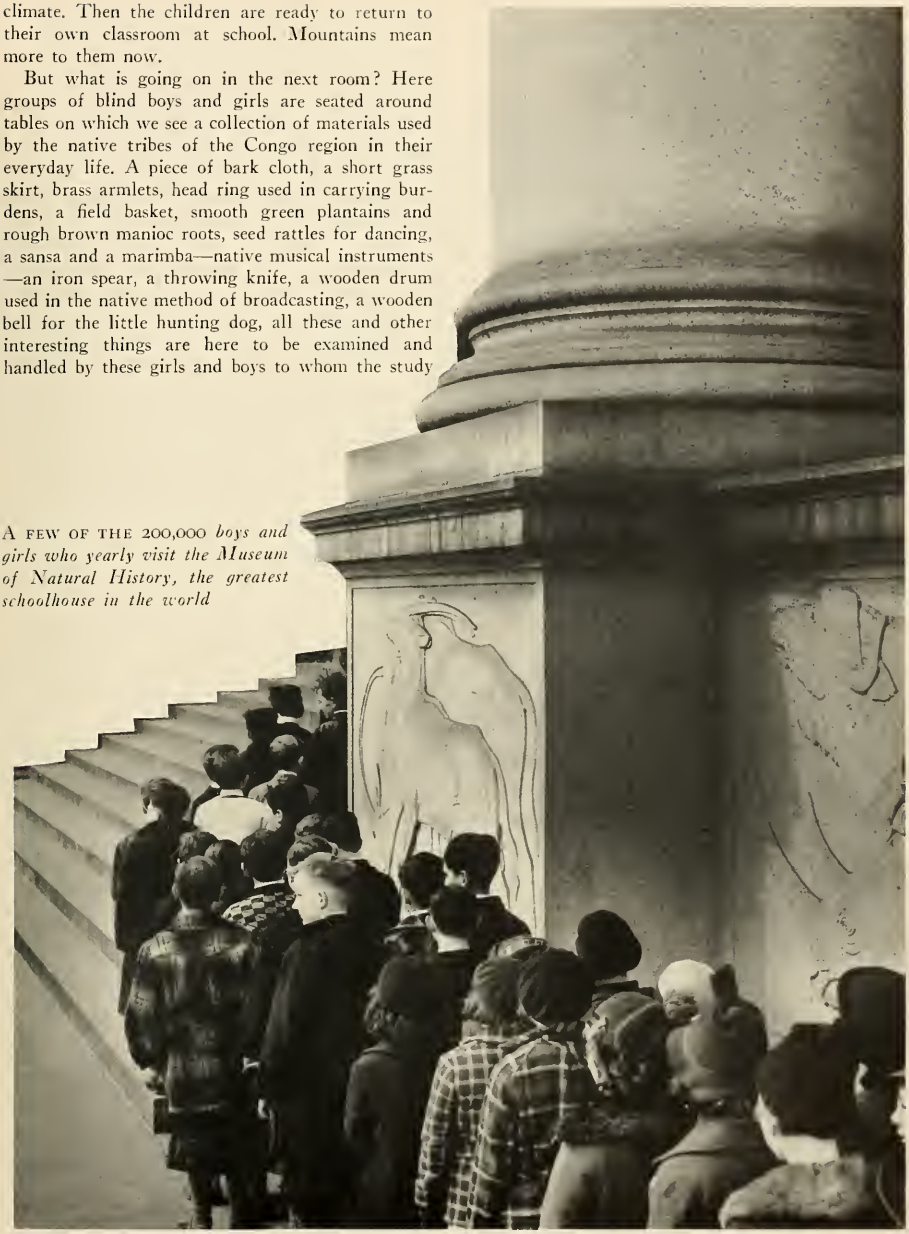
"Is it really so?" asks the little Sicilian girl, revising her opinion of the effect of altitude on climate.

"To make more certain, let's look at another group," says the Museum instructor.

"Yes, there is the same white snow over the top of the Matterhorn," exclaims the child. Another adds: "With all of these beautiful Alpine flowers far below here with the birds." Still other vivid illustrations intensify the relation of altitude and

climate. Then the children are ready to return to their own classroom at school. Mountains mean more to them now.

But what is going on in the next room? Here groups of blind boys and girls are seated around tables on which we see a collection of materials used by the native tribes of the Congo region in their everyday life. A piece of bark cloth, a short grass skirt, brass armlets, head ring used in carrying burdens, a field basket, smooth green plantains and rough brown manioc roots, seed rattles for dancing, a sansa and a marimba—native musical instruments—an iron spear, a throwing knife, a wooden drum used in the native method of broadcasting, a wooden bell for the little hunting dog, all these and other interesting things are here to be examined and handled by these girls and boys to whom the study



A FEW OF THE 200,000 *boys and girls who yearly visit the Museum of Natural History, the greatest schoolhouse in the world*

CITY CHILDREN *revise some of their erroneous ideas about the effect of altitude upon climate when they see for themselves in the Museum's Faunal Bird Hall the snow-capped peak of the Matterhorn in its setting of pink Alpine roses and blue gentians at timber-line. Such vivid illustrations, supplemented by educational motion pictures, are needed to broaden the background of the average city child*

of the Congo has hitherto been almost meaningless, consisting as it has of learning facts from a page printed in Braille. Now those words take on life.

"How long does it take a man to pound a piece of bark into cloth?" "Why does the hunting dog have to wear a bell?" "May I try to carry the pottery dish on my head with the head ring?" "May we play the sansa?" "Please, may I try to 'broadcast' with the drum?" These and many other questions are asked as eager finger-tips try to make up for what the eyes cannot see. After the hour is over the children, faces radiant with enthusiasm over their new meaningful knowledge, return to their own classroom with their guides.

Here we meet another group of eager boys and girls from a private school. With a Museum instructor they are bound for the cases containing the equipment used by Lincoln Ellsworth on his Arctic and Antarctic flights. In a nearby case there are also the two sledges which reached the North and the South Poles, the one with Admiral Peary, the other with Captain Roald Amundsen. How enthusiastically these young people discuss the relative merits of sledges and aeroplanes for polar exploration. Then they enter another hall where again they study equipment. This time it is sixteen cases filled with maps and the equipment selected with such meticulous care by Colonel Lindbergh for the flight made by himself and Mrs. Lindbergh over five continents in their Lockheed aeroplane "Tingmissartoq," which hangs just overhead.

So much for aerial exploration. But here is the bathysphere used by Dr. William Beebe in his undersea explorations. How small it seems but how thick are its walls and its window of quartz!

"Here is a problem for you boys interested in Physics," says their Museum teacher. Before they realize it, laws in Physics, hitherto abstract, have acquired real significance.

Is our present-day education worth while? Does it bring boys and girls into closer touch with life than the old-time drill on the "Three R's"? Put yourself in the child's place and imagine what your reactions would be to the gruelling drill as compared with this "Museum type" of education on an "experience" basis.

BRINGING MOUNTAINS *to girls and boys who cannot go to the mountains. This Museum class studying Geographical Terms see for themselves what a snow-capped mountain peak is really like*

THROUGH THEIR EAGER FINGER-TIPS *children in the Museum classes for the blind "see" what words alone cannot tell them about the daily life of peoples in far-away lands*

BEEBE'S BATHYSPHERE *illustrates to the modern boy the laws of Physics as applied to undersea exploration. This group is keenly interested in a close examination of the interior, also the thickness of the quartz windows needed to withstand immense water pressure. Science clubs in many schools come to the Museum for assistance in making their work graphic and to study research methods*

★ THE INDOOR EXPLORER

By D. R. Barton

Collectors and Their Collections. If the reader will examine the photograph at right he will get a very clear idea of what happens to a bottle of shoe blacking when it chances to be lying about in the vicinity of an erupting volcano. The story behind this particular bottle takes us back to the city of St. Pierre on the island of Martinique.

It is the year 1902, and as the American tourist sets out on a stroll through the streets of that quaint West Indian town, he is accosted by a small French mulatto boy who brandishes a shoe-blacking kit and shouts. "Shine! Shine!" Taken with the boy's earnestness, the tourist starts to converse with him but soon discovers that the word "shine" comprises the boy's entire English vocabulary. Resorting to French, he inquires, "What sort of polish do you use?" For answer the boy holds up a bottle marked *Nubian* which contains a wire attached to a sponge used for dabbing the black liquid on shoes. "All right, go ahead, my boy," says the American, "I've often had that brand used on my shoes in the United States". After the job is completed the American over-pays the shoe shine boy, chats with him for a bit and then goes on his way.

Very shortly after this tourist left St. Pierre, the volcano, Mt. Pelée, erupted, taking 28,000 lives and leaving but one survivor, as related in the February issue of Natural History*. This disaster so affected the tourist that he returned almost immediately to the scene of the catastrophe.

As he made his way among the ruins of the once prosperous and picturesque little city that he had so recently seen in perfect condition, he found near the wreck that had formerly been a house, a *Nubian* shoe blacking bottle with its wire dauber fused into glass grotesquely twisted by the terrific heat of the "fire avalanche".

Until quite recently the tourist kept this strange memento of the tragedy in his possession but on the appearance of the February issue of Natural History, he decided that the American Museum might be interested in adding the bottle to its Mt. Pelèe collection.

**What To Expect of a Volcano* by Frank A. Perret.

This particular tourist is Mr. Charles L. Bernheimer, a Patron, Fellow, and Life Member of the Museum who has donated many an interesting and valuable collection of specimens. He presented the bottle to Dr. Barnum Brown, Curator of Fossil Reptiles, to whom your Explorer is indebted for all the particulars concerning the shoe shine boy of St. Pierre.

If anyone asked you what *Little Lord Fauntleroy* had to do with the insect collections at the American Museum, you would probably pat him on the back and tell him that you had little time for riddles that, to say the least, seemed rather inscrutable. But the truth is that the play had a good deal to do with them.

Back in the '90's, Harry Edwards, an American actor, was touring Australia with a *Little Lord Fauntleroy* stock company. He was a good performer and fond of the theater—but out on this island continent he became interested in a hobby which so fascinated him that his chosen profession became in his eyes little more than a means of subsistence. This hobby was the collecting of insects. When the

tour ended, he caught on with another company and returned to Australia in the same play—not because he felt that Mrs. Burnett's drama offered a unique medium for his self-expression—but for the purpose of rounding out his assortment of insects.

The result was that his collection was acknowledged the greatest of its time and Harry Edwards became one of the founding fathers of that singular group of wanderers, the free-lance collectors who in modern times contribute so much valuable material to museums and zoos.

There were, of course, people of means who built up invaluable collections before and after the time of Harry Edwards. But your Indoor Explorer is here concerned with impecunious folk who found a way to pursue their hobbies in conjunction with their business—and in many cases, to make a business of their hobby.

Harry Edwards, being an artist as well as a "bug-hunter" probably had many of the impractical characteristics that have become the legendary attributes of both professions. It is doubtful that he ever thought of his collection in terms of money. At any rate, it was not until after his death that financial reward was forthcoming. When he died, his insects were presented to the American Museum after having been purchased from his estate for the sum of $10,000. And the acquisition of this collection was perhaps the greatest single step forward in the development of the Museum's young and struggling Department of Entomology.

Although Harry Edwards did not lose his amateur standing until after his death, the sale of his collection set a precedent. Since his day, men from various walks of life whose common interest was the field work of Natural Science, have learned to make an incidental profession of their hobby.

How do these men get started on their careers? What difficulties must they overcome? Well, your Explorer prefers to answer these questions with the story of one of the best known of these collectors, Mr. Albert M. Vida.

His New York school days were no fun at all for Mr. Vida. He simply went through the motions until, with the closing bell ringing in his ears, he could scamper down to the East River wharves. Underneath these structures, in the damp, sea-smelling, half-light, he would wade about catching minnows and the various kinds of shell fish that scuttled among the barnacle-encrusted pillars at low tide.

Holidays found him hiking across Long Island's woodlands intent on a menagerie of garter snakes, toads, or anything else he could get. This collecting habit was no passing childhood fancy, for Vida as a young man was still an insatiable "Nature Prospector." But he soon saw that he had pretty thoroughly exploited Long Island's possibilities; he yearned for wider fields, rarer specimens.

Travel was the obvious answer. But Vida was no gentleman of leisure; his pleasure had to be combined with business.

After thinking things over, he decided to become a ship's radio operator. He went at his studies hammer and tongs and received his license at the end of one year. Presently he shipped to Panama, where he begged sufficient shore-leave to try his hand at jungle game.

At the end of his stay he produced a few rather mangy monkeys, but zoo officials were indifferent; there were plenty of such things, he was told.

Undaunted, he changed ships, securing a similar berth on a Brazil-bound freighter. Brazil was more prolific. It yielded him his first worthwhile collection, consisting of five anacondas from twelve to twenty feet long, six boas of about the same length, one three-toed sloth, one ant-eater, a spider monkey, and four ring-tailed monkeys, two coati-mondis, and an assortment of birds.

Before bringing this miniature zoo aboard ship, Vida made arrangements with the Captain to do clerical work in return for which he was allowed to store the animals in a spare potato bin. But when he arrived in New York, steamship officials purpled with rage at the mess the animals had made of their potato bin, and none too gently demanded Vida's resignation. Soon thereafter Vida felt the urge to explore the African veld and jungles, in search of collections of an even more extraordinary nature. He disposed of most of his Brazilian specimens at the Bronx Zoo and pleaded with the radio company for an assignment on a ship destined for the dark continent. After some delay, he was taken on by a West African freighter which called at eighteen ports, including some along the Belgian Congo. On its return voyage the after part of the freighter's hold rang with the jungle cries of chimpanzees, baboons, small monkeys, gray parrots, etc., and there were large cases of lizards, horned and Gaboon vipers, and several bird cages. For the first time, Vida had achieved a collection that was financially remunerative, as well as a source of personal satisfaction.

The Central Park Zoo received part of this collection, but most of it went to various dealers whose not unenviable fees convinced Vida of the business potentialities of his hobby. From that time forth he became a "charter member" of that small but singu-

lar group of wanderers—the professional free-lance collectors.

It was not long before he was running a figurative fine-toothed comb along the south and east coasts of Africa. His results were sizable, of scientific interest, and often unique. The Bronx and Staten Island Zoos together with the New York Aquarium became his most enthusiastic patrons. He secured a steady berth on a steamer whose radio room has a shelf built around its wall holding six ten-gallon tanks aerified by a small electric pump, all supplied by the Aquarium. These are filled at various places by various methods.

On the Island of St. Helena when hired natives catch the fish and bring them aboard, he pays them off in cast-off clothing, cigarettes, candy and books. At Durban and Beira he does his own fishing and fills his tanks with queer-looking specimens, some of the more unusual of which, such as the zebra fish, mud-hoppers, and lung fish, he has been so fortunate as to bring back alive for exhibition at the Aquarium.

Collectors of almost any type indulge in trading. Just as small boys swap marbles, fish collectors are prone to exchange their catches. Vida frequently has such dealings with Dr. Von Bonde of the St. James Aquarium at Cape Town and with Dr. Nanni of the Aquarium at East London, South Africa. By these and other methods Vida's collecting work is systematized to a high degree of efficiency.

His worst problem is to find out what to feed the different fish and animals during transportation so that they can be turned over to the zoos and aquaria in good health. Some fish will take only live food, but the space and equipment necessary to provide them with such fare is quite out of the question and Vida has had to make extensive experiments in substitute diets. One of the more successful ruses by which he has simulated live prey is threading small bits of beef on strands of black cotton and pulling them with an undulating motion through the water. In the discovery of such diets, patience and inventive genius are indispensable requisites. The food must be made as lifelike as possible and after short hunger strikes, the fish usually condescend to be deluded and will feed readily. A good deal, it seems, depends upon the individual personality. Some zebra fish, for instance, accepted the "prey" while others would not even look at it. But the recalcitrant ones for some reason or other were found to have a partiality for the chopped-up whites of hard-boiled eggs.

Vida has found penguins the most rebellious when it comes to dead food. They will accept no substitutes. Here subtlety is thrown to the winds and brute force brought into play. Dead fish are simply forced down their throats. But their resistence diminishes with each forced feeding, and they will get used to dead fish and accept them without a murmur in short order. The five black-footed penguins which are now at the New York Aquarium became so zealous that they knocked each other over at feeding time, and such was their eventual voracity that they devoured approximately seven hundred pounds of fish in ninety days.

About a year ago, Vida got hold of an aardvark. Ants and termites are this animal's only comestible in his natural state and he is supposed to be able to swallow about two thousand of the insects at one lick. Unable to supply him with his natural food in any such quantity, Vida bent his energies toward discovering an alternative.

He hit upon a menu calling for one pound of fine, cooked corn meal, six fresh eggs, and one can of condensed milk mixed into a sloppy porridge. This mixture was given once a day. At the end of the week, Vida would throw in a handful of Epsom Salts, an original idea of compensating for the animal's lack of exercise. Despite the startlingly foreign nature of this diet, the aardvark thrived; and on arriving Vida was complimented for the perfect condition in which he delivered the animal.

The fish are not the only ones with varying personalities. Vida caught a pangolin, an ant-eating native of Portuguese East Africa. The pangolin absolutely refused to touch the very food on which the aardvark had prospered, became despondent, and died after fourteen days in captivity. Vida is determined to work out an acceptable substitute diet for the pangolin because the animal is very rare and would bring a handsome stipend from any zoo.

Trial and error is about the only method open to a wild animal dietician. Vida will try anything within reason. He carries all sorts of dried food such as flies, shrimps and insects and he has found that brine shrimp eggs are suitable for many species of fish. Since the eggs can be hatched within a period of from twenty-four to forty-eight hours, they constitute a convenient supply of live food in portable form.

Recently Vida secured a very rare owl which he was anxious to bring into this country, and finally did, but not without a struggle. This owl confronted him with what was just about the queerest dietary problem in his entire experience. Having no rats or mice, he fed it meat, which it ate for a time rather indifferently. At Cape Town he managed to get some white rats which were greedily gobbled up. Suddenly the owl stopped eating both rats and meat. With characteristic resourcefulness Vida tried

fish. It is reasonably certain that the owl had never seen them before but he nevertheless welcomed the change and ate fish exclusively for a few days. Then, without any warning, the temperamental creature stopped eating altogether. Vida was frantic, fearing that he would lose his rare specimen. He tried everything, but to no avail. One day he was feeding bananas to some monkeys who inhabited the cage next to the owl's. Now, a story is told how Darwin was accustomed to play his basoon in a greenhouse—a practice which he defended on the grounds that there was no telling what effect music might have on flowers. Vida's experiences had led him into making random experiments which fell little short of the great zoologist's in their breadth of speculation. Calmly, he offered the owl a banana. Just as calmly, the owl accepted his offer and greedily devoured it. For the next two days bananas, and bananas alone, could satisfy him. So far as Vida knew this was the first owl that ever ate bananas, but it was all right with him—he would have given the owl scrap iron if the bird showed the slightest inclination to eat it. Just about the time when Vida was beginning to congratulate himself on solving the toughest catering problem on record, the owl suffered another attack of gastronomic whimsy and stopped eating bananas. "What now," sighed Vida, and despairingly tossed a chunk of meat into the cage. Meat was the first thing he had tried, but the owl seemed to have forgotten, and pleased with an innovation, snapped it up with apparent relish. The ship docked before the owl forced Vida to repeat his entire repertory, and with a feeling of the deepest relief he turned over the rare specimen to the Staten Island Zoo where it is still on exhibition.

Whenever possible, Vida tries to give his animals their natural food, and with one exception, has concocted a substitute diet only when the natural food was unobtainable. This exception occurred in connection with a Stanley crane which he brought back to the Bronx Zoo. This type of crane is a grain-eating bird. But a group of natives stole the entire supply of corn with which he intended to feed it, and he was forced to use meat during the entire voyage. Nevertheless, the crane got along well enough on the strange diet and was delivered to the Zoo in excellent condition.

Vida believes that given time and patience you can make most animals accept a substitute food. Up to the present he has collected over two thousand animals and reptiles for various Zoological Parks, with only a few losses, most of which were due to the animals' fighting amongst themselves.

"I try to separate them as much as possible," Vida says, "but at times the shipments are large and my space is limited."

Vida cautions all aspirants that the collecting of animals is not the easiest vocation. Very often they break loose. It may be a fox, a baboon, or a cobra which must be recaptured, an undertaking that sometimes amounts to a major military campaign and takes several hours. Your reward may be a few bites and scratches, but that is something a professional collector simply has to take in his stride.

Such are the trials and tribulations of the live specimen collector. But the American Museum has for the most part, no place for any but dead animals, and so the free-lance collectors with whom it deals are not confronted with the problem of diets, etc. Theirs are the problems of proper selection, skilful trapping, and perhaps, most important of all, the careful preparation of their specimens for shipment.

Out in the dark interior of the Belgian Congo, there has lived for many years an aged Flemish priest who has taken up collecting partly to break the monotony of his isolated existence and partly to make a little money for his "parish." Fish are his specialty. He sends native boys far along the estuaries to bring back specimens, and many of his fish have been purchased by the Museum.

Then there is a trapper in British Guiana who is one of those rare members of the white race able to bear up under the rigors of that country's climatic conditions. Although without any particular training, his long association with the fish of that region has made him for all practical purposes, a fully accredited ichthyologist. Many a valuable specimen has found its way into various aquaria and into this Museum, that would probably be unknown were it not for his extraordinary ability and delight in his odd profession.

Sometimes a free-lance collector gets such good results that he becomes more or less permanently associated with museums and zoos. But by and large, free-lance collectors lead a rootless life. Either they travel about in the course of some more stable occupation, or they live in distant places where white men are seen but rarely. Many of them have agents who receive and dispose of their findings on a commission basis. The prices paid are in proportion to the rarity of the specimens but seldom mount to figures of particularly plutocratic dimensions.

A collector must be in love with his work, and be willing to devote years to it without much expectation of financial recompense, for the very simple reason that the rarest specimen is almost without exception secured by its most experienced and indefatigable pursuer.

YOUR NEW BOOKS—*the Nile—Women Called Wild—Miller on Mexico—of Birds and their Protection—the Romantic Calendar*

WOMEN CALLED WILD

- - - - - - - - by Rosita Forbes

E. P. Dutton & Co., $3.00

THE *Women Called Wild* who crowd the pages of Rosita Forbes' new book are, as its name implies, women of the less conventional type, few of whom would make suitable members for the Thursday afternoon bridge club. They are slaves, concubines, murderesses, ascetics, revolutionists, prostitutes, warriors, sorceresses.

Miss Forbes did not become acquainted with them by staying at home and attending to her knitting, or even by tripping about the world in a conventional and lady-like manner. She found them in Arabia, Abyssinia, Turkey, Russia, China, Tibet, Tripoli, Guiana, Uruguay, Haiti and other civilized and uncivilized parts of the globe. When she visits a country it is her practice to discard her own English clothes, customs, speech and prejudices, and to become, as nearly as a stranger can, a native of that country. She talks with its inhabitants, eats with them, sleeps with them. She often shares her quarters with the family livestock, and there are few forms of insect life with which she has not come into intimate contact. As a result, her knowledge of a people, the way they live and the things they think about is both first-hand and comprehensive.

It is so that she has come to know the women who figure in this book. Zahara, inmate of an Arabian harem, believing that "a woman has no fate, except that which a man writes for her." Jeanne Marie, follower of woman's oldest profession, remarking philosophically, "It is reasonable that one prefers a bed to a slab of stone in the morgue." The strange brown women of the leaves, who live in fear and who "would as soon die as live." The gently bred Madame Neel, spending solitary years as a hermit high up among the giant peaks of the Himalayas. A Dutch Guiana fire priestess, presiding over a weird ceremony. Francine, the beautiful mulatto, singing with "rather weary sophistication" in a Lyons night club, and later, in her native Haiti, trying to tear her rival's eyes out during a Congo sex dance. Sister Anunciata, once a Parisian aristocrat, working side by side in a tropical leper colony with "Mademoiselle," who has served a prison term for the murder of her husband. ". . . if Sister Anunciata supplied a bridge to heaven, that gay, fanciful heaven of the holy pictures in the chapel, Mademoiselle was a plank by which lost bodies regained the world." An Ethiopian turning herself into a hyena. A young Chinese Bolshevik, singing, "full-throated, to the sky," as she walks out to be shot.

There are many others, for Miss Forbes is prodigal of her material, and often compresses into a single paragraph an incident or a personality that would furnish many an author with the ingredients for a complete book.

Miss Forbes wisely never spoils her dramatic effect by attempting to explain the element of magic that pervades a number of the episodes. She simply sets down the happenings as they appeared to her, and lets the reader draw his own conclusions. In one place, however, she indicates the best frame of mind for appreciating affairs of this sort. In introducing the fantastic scene in which a man's head is apparently cut off and put back on again without any serious inconvenience to him, she says:

"You must leave behind you that portion of yourself which can *not* believe in anything beyond the limited dimension represented by capital cities, steam transport and Progress."

Whether the supernatural enters into it or not, Miss Forbes' material is, in every instance, highly colorful, and is often intensely dramatic. These qualities are enhanced by the author's vivid style; she makes us feel, with poignancy, the tragedy, the horror, the pathos, the gallantry, the humor and the beauty in the lives and characters of *Women Called Wild.* LUCY POPE CULLEN.

MEXICO AROUND ME

- - - - - - - - by Max Miller

Reynal-Hitchcock, $2.50

MEXICO AROUND ME is an unusually competent book about a traveler's personal reactions to Mexico. If you like the author, you like the book. Mr. Miller would be equally delightful were he to relate his adventures in Copenhagen, Medicine Hat, or the steppes of Siberia. He has a quick easy style and a charming way of pointing to the dramatic and visual potentialities of minor incidents.

As for suggesting the true nature of the country by exploring its sociological, economic, or historical backgrounds *Mexico Around Me* gives nothing. The few pages on the Indian population reveal a personal preference for the feats of the Indians of our western Plains, in disregarding the general culture pattern of the sedentary Indian populations of the New World. Like the majority of the post revolutionary works on Mexico, this book disregards the enormous fund of information that has been accumulated in its four centuries of existence as an outpost of European culture. From this viewpoint, *Mexico Around Me* ranks with that rapidly growing series of books on Mexico that will cease only when the last literate traveler has had his last literate say about his experiences.

Mr. Miller disclaims, however, any intention of being a sociologist or an explorer. He adheres to a delightful travel philosophy that enables him to enjoy to the utmost whatever situation he may be forced to occupy. This reviewer will continue to read Mr. Miller for his personal reactions to his geographical environment, but it will always be for the sake of Mr. Miller, not for information on the environment. G. C. V.

LIFE IN A HAITIAN VALLEY

- - - - - - - - by Melville J. Herskovits

Alfred A. Knopf, $4.00

AT last an absorbing, detailed account of the everyday life of the Haitian peasant has been written. Its author stoops neither to sensationalism nor distortion but presents a clear and authoritative picture of Haiti's strange folkways. The fact that this book comes at a time when there is a steadily increasing interest in Haiti being fostered by tourist agencies, literature and even the radio makes *Life in a Haitian Valley* doubly valuable and appropriate.

Doctor Herskovits, Professor of Anthropology at Northwestern University, has drawn abundantly from his previous knowledge of the Negro, both in Africa and the New World, in unfolding the cultural background of the present day Haitian. And even though his field observations were made principally in the country around the interior town of Mirebalais during the Columbia-Northwestern University Haitian Expedition in 1934, much of his discussion is generally applicable to the more than two million peasants throughout the Republic.

A glance at the arrangement and chapter headings of the book will give a good idea of its scope. Part one includes the chapters, "The African Heritage," "What the Slaves Found in Haiti" and "Working the Amalgam." Part two, "The Daily Round," consisting of four chapters, gives in detail the many sides of family life from childhood on. Part three is composed of five chapters on "Haitian Religion." Doctor Herskovits draws a much different picture of the religious phase of Haitian life than have most previous authors. This is not because he glosses over any of it, in fact he discusses details of belief and ritual not found elsewhere. But he shows the deeply rooted, serious and disciplined motives back of these customs and ceremonies and discusses at length the African and Christian derivations and influences. These five chapters describe "Voodoo," the Vodun Service and the Vodun Dance, the Cult of Twins and of the Dead, and finally, Magic, Good and Bad. Part four, "Haiti, a Cultural Mosaic" sums up the peculiar mixture of trends and factors in Haitian life and also briefly discusses the problems of the Negro in the United States as well as elsewhere.

Troupes of "voodoo dancers" allegedly of Haitian or Cuban origin have recently been introduced to night club audiences in some of our cosmopolitan cities and their performances, although probably not authentic, have been enthusiastically received. It is regrettable that these dances should be presented to Americans in a commercial manner and in circumstances that will cause considerable misunderstanding of their true nature and significance.

The thirty-two illustrations are typical and interesting, though some are not as sharp as could be desired. Additional comments, including a glossary of Creole terms used in the book, a list of references and an index complete the nearly 400 pages of the book.

It is unfortunate that the author was not able to continue his studies over a longer period of time. One would like more information on the social activities of the various seasons and holidays and on life and culture in the larger cities. However, for the person contemplating even a short visit to Haiti, for those who enjoy reading of unusual places and people and for the student of the Negro, *Life in a Haitian Valley* will be both enjoyable and of the greatest value.

W. G. HASSLER.

IN QUEST OF GORILLAS

- - - by William K. Gregory and Henry C. Raven

The Darwin Press, $3.50

IN the spring of 1929 Columbia University and the American Museum sent an expedition to Africa to procure for scientific study one or more perfectly preserved specimens of the gorilla, greatest and rarest of the man-like apes. The expedition consisted of leader Raven, naturalist McGregor, anatomist Engle and author and artist Gregory. This book is an account of the journey by way of Dar-es-Salaam to Tschibinda, high in the Uvira mountains where the mountain gorilla lives, and thence down the Congo to the Atlantic. After the other members of the party had returned to New York, Raven went single-handed after the western gorilla in the hills of Cameroun. In this adventure Raven took on a difficult and dangerous task. He survived illness and ever-present dangers only by physical hardihood, and the tale of his experiences as modestly related by himself conveys little of the difficulties which he encountered.

Most of the narrative is in Gregory's words. He has a genius for imbuing indifferent things with immense importance: the contour of a mountain, a foot-print in a muddy road, a shell picked up from the beach, the backbone of a fish salvaged from a native dumpheap, are touchstones which open for him the flood gates of reconstructive imagination. To him the extraordinarily flat nose of a Bantu, a squirming specimen of the ancient fish, *Polypterus,* or a dead lungfish saved from a native's cooking pot, are the thrice sacred relics of the Dark Continent. He is able to perceive, amid the confusion of native tongues and exotic customs, that the black men are primitive and superstitious, but on the whole good natured and honest; and that among them labor is a social event to be lightened by emotional declamation, dissonant song and noisy oratory. One can vividly visualize Gregory clearing a rotunda for himself in the mountain jungle and settling down to wait for a chimpanzee to visit him, or half hoping that he will hear nearby the deep and resonant conversation of a band of gorillas.

The forest in which the gorilla lives is a riotous thicket of buttressed trees, lianas and vines. Vision is limited to a few yards, and except for a rare elephant trail, the hunter must cut his way, or writhe and wriggle as best he can. The gorilla, stooping to rest his knuckles on the ground, moves through this maze quickly, easily and silently. It is not to be wondered that Raven preferred to hunt alone, with at most a couple of Batwa pygmies or Bantus to act as guides. The difficulties were not that he could not catch up with the gorillas, but that he had to hold his gun until he could both obtain a suitable shot and bring his prey down in a suitable locality. For scientific purposes the animal had to be perfectly embalmed, which meant that it had to be killed with a clean wound in the head, and also that it had to be carried back to camp at once—no small consideration with a 460-pound carcass and a 150-pound bier of saplings.

The book is illustrated, in addition to many photographs, by sketches made by Gregory in a pocket memorandum in the field. To judge from these sketches he saw Africa mostly from a considerable elevation; like his narrative, they have a most pleasing perspective and reveal an unusual point of view.

HOMER W. SMITH.

Birds around the year

- - - - - - - - by Lorine Letcher Butler

D. Appleton-Century Co., $2.00

THIS little book presents a series of attractive essays on nature, largely devoted to birds and their ways but bringing in occasional pertinent notes on trees and flowers, insects, mammals, and other wild life, more by way of background than otherwise. Beginning with spring and the bluebird, the book takes up the four seasons in turn and discusses the lives and activities of numerous birds as developed during the changing year. Northward migration, song, mating, and nest-building in the spring; family cares in the summer; molting plumage and southward movement in the fall; and cold-weather tribulations in the winter; these the author has woven together into a pleasant and sympathetic fabric in which appear a multitude of details of natural history that, in the main, bespeak a personal acquaintance with many wild birds in their natural environment. There is a light and airy tone throughout the work that is in keeping with its subject which is not, for the most part, explored to any great depth.

Yet, occasionally, in attempting to explain the causes of some phenomenon or carry a discussion to a broader field, the author makes certain statements that are apt to be misleading if they are not debatable or even opposed to accepted conclusions. Thus an assertion that (land) birds molt only two feathers at a time, replacing two more after the first two are grown, continuing this process until the new dress is complete, can hardly be maintained although there is a fundamental principle involved which is important, a serial replacement which occurs in various areas of plumage at the same time.

The Bobwhite is said to acquire a plume and purplish tints in California, but the Bobwhite is not a native of California and when introduced into that state has not been altered perceptibly; the plumed and purplish California Quail is quite a different bird. Penguins and the extinct Great Auk, being flightless, are said to have progressed little from primitive, non-flying ancestors, but the most recent conclusions are that the penguins are descended from ancestral forms which had evolved far enough to acquire full powers of flight, while the immediate, existing relatives of the Great Auk are strong-flying birds as the ancestors of the Great Auk undoubtedly were also. The flipper-like wings of penguins and the Great Auk are not the primitive appendages one might think but rather specialized adaptations, extremely effective in the proper medium. It is doubtful, also, if the Golden Plovers' choice of different migration routes in the spring and fall is prompted by a pure spirit of adventure in the autumn and, in the spring, a realization of the shortness of the forthcoming Arctic summer. Nor is the statement that the Ice Age developed because the "earth slipped in space, or something," likely to satisfy those persons who wish to get at the root of the matter. That bird migration had its origin in the enforced southward movement engendered by the advancing glaciers probably is true, but its development is likely to have been a gradual one over a long period of time, established by a number of such enforced movements and not the abrupt phenomenon that is implied in the paragraph devoted to it in the work under review.

It is to be regretted that statements like those cited have been allowed to mar this book. The greatest part of the text is reliable and the author's pleasant style makes easy reading. One could wish that the inaccuracies were eliminated leaving a book that might then be thoroughly recommended. J. T. Z.

Adventures in bird protection. An autobiography

- - - - - - - - by Thomas Gilbert Pearson

D. Appleton-Century Co., $3.50

THOSE who have been in touch with bird protection in the United States during the last quarter of a century are familiar with the name of T. Gilbert Pearson. It is indelibly linked with the name of the National Association of Audubon Societies which he helped found and which he served for many years as Secretary, Executive Secretary, President, and now President Emeritus. He was with it through its struggles of organization and public recognition and its equally strenuous efforts to arouse local, county, state, and national conscience to provide assistance and protection to threatened bird life, to its present high position in the modern world of conservation and education. In telling the story of his own life in this autobiography, therefore, Dr. Pearson has told also the story of the National Association, which is inevitable, so closely have the two been united. In fact, except for the chapters dealing with boyhood life, before the Association came into existence, the emphasis in the book is rather on the development of the organization than on the life of the man.

The early chapters deal with the boy, interested in birds and wild life in general; his youthful years in Florida when his enthusiasm in forming a collection of birds' eggs outweighed his interest in the schoolroom, as it has done, in its time, with many another naturalist. Efforts to capitalize on some of his collections eventually provided additional schooling in Guilford College, North Carolina, where the young student was entrusted with the duties of developing the college museum, a task which he found greatly to his liking. Work in the office of the State Geologist later furnished the means to finish his college training in the University of North Carolina.

During these formative years, field trips to various places in the south and east provided much practical experience, not only with birds and their ways, but with the hunting practices of the time, and gave a realization of the handicaps under which bird life was suffering.

When student life was finished, there were various positions as a teacher of biology which provided additional experience and contacts with other people interested in the same subjects. An early contact was with William Dutcher, Chairman of the Committee on Bird Protection of the American Ornithologists' Union, which marked a turning point in Pearson's career. Acting on Dutcher's suggestion, Pearson took steps for the formation of an Audubon Society of North Carolina. As the first major act of this society, a bill was drawn up for the protection of birds within the state and presented to the legislature. When the measure came up in committee, Pearson was called upon to explain its provisions; later he spoke before the legislature itself on the matter. Thus he entered the lists of legislative encounter, in the first of his long series of battles to give birds the protection which they so sorely needed.

After much opposition, the North Carolina bill was

finally passed, but efforts for the enforcement of the law met with further opposition, and the battle became a general engagement. In the meantime, a National Committee was formed, composed of representatives of the various state Audubon Societies, and Pearson attended the first meeting of the organization. Several years later, this committee was formally incorporated in New York as the National Association of Audubon Societies, and Pearson was made its first Secretary. His career thereafter was in the service of the Association and his autobiography thereupon becomes a long history of struggles for the enactment and enforcement of bird protective laws throughout the country. To this was added the establishment of game refuges and the education of the general public in the purposes and needs of the organization. It is the history of a crusade, the objects of which are not yet all obtained, no more than the gains already made secure from further attack.

It should not be supposed that Dr. Pearson is assuming the credit for all these advances. On the contrary, his account is a voluminous record of concerted effort on the part of many workers to each of whom acknowledgment is made. Since by virtue of his official position as well as by his inclinations, Dr. Pearson was in a large proportion of the battles which have developed around the work of the National Association, his story is complete enough to give a panoramic view of the entire struggle. It is to be recommended to anyone who has an interest in this phase of our national development.

J. T. Z.

THE ROMANCE OF THE CALENDAR

- - - - - - - - by P. W. Wilson

W. W. Norton and Company, Inc., N. Y., 1937
$3.00

THE average human being seldom pauses to consider where his methods of timekeeping come from—the daily and constant timekeeping of clocks and calendars. Ordinarily, without inquiring into the origin of his most common timekeeping devices, he accepts them as a matter of course, he understands their practical use to him, and beyond that he does not trouble to go. In reality there is, behind the efficient timekeepers of the twentieth century, a fascinating story, a romance indeed, and to read it clearly one must touch upon many periods of history, from the earliest records of man's activities, down to the present day. And in his book, *The Romance of the Calendar,* this is the story which Mr. Wilson presents to his readers.

All kinds of timekeeping as we know them are actually derived from astronomical concepts and are given to us by the motions of the heavenly bodies including those of the planet earth. The story of the passing of time in seconds, minutes and hours, runs naturally into the recording of days, weeks, months and years. Mr. Wilson deals mainly with the early origins, the development and the present day exigencies of the calendar—its evolution, in other words, through the avenues of time. The average person uninitiated in calendar history, will doubtless be surprised to discover the vast amount of interesting historical material, the long and exciting lineage of that calendar which regularly makes its annual appearance in so compact a form upon our desks and writing tables in these years of the twentieth century.

The Romance of the Calendar is divided into forty chapters arranged in five larger or main sections. These five sections include "Background of Calendar History"; "Chronological Succession" in which the vicissitudes of calendar reckoning are traced down through the Gregorian adjustment; "The Broader Horizon," tracing the path of the calendar's early beginnings in ancient Mexico, in Hindu mysticism, and among the Chinese and Jewish peoples; "Human Yardstick," in which we find the sundial, clocks, etc.; and the last section, entitled "The Future," which is a plea for the adoption of the World Calendar in place of our present system of reckoning. The World Calendar is "based on the use of 364 days in the year as a reckoning for the months, with a Year End Day reserved at the end of December. A Leap Year Day is added for Leap Year . . . all years can be made to start on Sunday and end on Saturday . . . a particular day of the month (for instance, the Fourth of July), must always fall on the same day of the week."

Those who are interested in the problem of the calendar, or in tracing its history, will find this book rewarding. At times Mr. Wilson impresses—one might almost say *"presses"*—upon the reader too vast a wealth of anecdotal material regarding the calendar, jumping about in a rather unorganized manner, until an impression of confusion results. There is obvious also a certain carelessness in statement which should be taken into account, as in the chapter entitled "Stones of Mexico," where there is confusion between the Maya and the Aztecs.

The Romance of the Calendar contains an immense amount of fascinating background material, and should prove interesting to anyone who uses a calendar.

MARIAN LOCKWOOD.

THE NILE, THE LIFE-STORY OF A RIVER

- - - - - - - - - - - - - - - By Emil Ludwig

Viking Press, $5.00

ANY book by Emil Ludwig, the author of so many widely read books, must be hailed by his admirers as an event. *The Nile, The Life-Story of a River,* is biographical, a historical treatise covering, as the publisher states on the jacket, 4000 miles and 6000 years. This is a great expanse of territory, a long stretch of time, and the book, with its more than 600 pages, is in keeping with these large dimensions.

The Nile is an important river considered from any angle. Inseparably associated with the ecology of the entire northeastern corner of Africa, it is the focus of animal and plant life, the arterial system of empires that have come and gone, and it bears a profound causal relationship to all of the major historical events of that region. Volumes could be written without exhausting the subject.

The author has undertaken to deal with such a large topic that his treatment must necessarily be brief and concise. As well as any single book could cover the field, *The Nile* presents a graphic picture of geography and history for the lay reader. To one who is familiar with the fundamental pattern, the volume will not add much in the way of detailed data. To do this for 4000 miles and 6000 years would require not 600 pages but many times that.

One who reads *The Nile* will acquire a liberal education on this corner of Africa. Ludwig, in his easily flowing passages, traces the river from its source, describes

the topography, paints a canvas of the vegetation, the birds, the mammals in bold strokes, and introduces the reader into the home lives of the peoples. In general, the material is treated upon a geographical rather than a chronological basis. Starting at the headwaters, the course of the river flows through the time as well as the space relationships, and not until the reader reaches the lower stretches does he encounter the cultures and complex human data which have made up the fabric of history. This is a logical development of the theme for about the sources of the Nile, the simple beginning, it happens that there has been less change in peoples, no great ebbs and flows of cultures and, in many respects, conditions cannot be greatly changed today from those prevailing 6000 years ago when this account began. About the lower Nile have transpired countless changes. Having once observed the kaleidoscopic parade there, it would seem like an anticlimax to switch back to the banks of the upper Nile.

It is not an easy task for the reviewer of a compendious biography such as *The Nile* to single out passages for particular comment. When he has touched upon the careful selection of data, the agreeable style of the author and the logical plan for presentation of facts it is then up to the would-be reader to decide whether he is interested in the subject. In this case the subject has a potent appeal. The Nile calls to mind a host of intriguing topics. The student of history sees in it the proving ground of human progress and failure, one of the few long and authenticated catalogues of human endeavors. The psychologist finds human nature on the first page of this catalogue very much the same as on the last; the economist sees the workings of supply and demand, the effects of drought, the levying of taxes and all the tribulations and responsibilities that come with the acquisition of property, a constant worry down through the ages and an object lesson to those of today who would invent a panacea to avoid them. Romance resides along the Nile. Tradition, lore and age-old publicity all direct attention to the Nile. Certainly there can be little doubt that as a subject for biography the Nile stands in a class by itself.

To many who read Ludwig's book, it will be an introduction to a more extended study. The interest aroused will not have been satiated, for space limitations force the author to move swiftly if he is to cover his assignment and, having had a glimpse into the possibilities of the subject, one will wish to go deeper. Fortunately for such there is an extensive literature.

The Nile is attractively printed and well illustrated. Apart from the benefit derived from a first reading, it will function as an authoritative and convenient reference. It is, apparently, well on its way to become "a best seller."

H. E. ANTHONY.

SCIENCE IN THE FIELD AND IN THE LABORATORY

—Planetarium to Reproduce Eclipse—New Guinea Expedition Ends —How to Recognize Poisonous Snakes—John Burrough's Exhibit

Doctor Miller to Join Eclipse Expedition

Announcement that Dr. John A. Miller, one of the world's foremost students of solar eclipses, will be Co-leader and Technical Director of the Hayden Planetarium-Grace Expedition—which will observe the June 8th Solar Eclipse from the very region along the coast of Peru where the ancient Incas built temples and offered sacrifices to their Sun-God—was made today by Dr. Clyde Fisher, Leader of the Expedition and Curator of the Hayden Planetarium of the American Museum of Natural History.

"The expedition is extremely fortunate in obtaining the cooperation of Dr. Miller, who, for many years, was Professor of Astronomy at Swarthmore College and Director of Sproul Observatory," said Dr. Fisher in making the announcement. "Dr. Miller began his studies of eclipses at the turn of the century. Since that time, he has observed no less than nine solar eclipses, which have taken him as far a-field as Spain, Mexico and Sumatra. He is noted for his splendid and painstaking work in taking and analyzing eclipse photographs."

Dr. Fisher plans to make motion pictures of the eclipse —a field in which he has specialized for many years. As a matter of fact, he was probably the first astronomer to make motion pictures of eclipses from an airplane. This he did in 1930 and in 1932.

The general purposes of the expedition are to take motion pictures and still photographs, including color photographs of the eclipse, and to make tests to determine changes in light intensities and temperatures as well as spectroscopic studies of the sun's corona. Members of the expedition will leave for Peru on the Grace Line, during the early part of May.

"We had originally hoped," explained Dr. Fisher, "to send an expedition into the mid-Pacific, where the moon covers the sun for seven minutes and four seconds, the longest totality in 1,200 years. But difficulties entailed in such an undertaking and uncertainty as to weather conditions made us decide to observe the eclipse from the coast of Peru, where the duration of the totality will be nearly three and a half minutes. This is much longer than average, in fact, two minute eclipses are considered worth while enough for astronomers to travel half around the world to see.

"According to present plans, the Hayden Planetarium-Grace Expedition will establish at least three points of observation within the rectangle formed by the cities of Lima, Chimbote, Cerro de Pasco and Huarez. The eclipse is slated to take place about 5:20 P.M. Eastern Standard Time, and will occur so close to sun-set that the moon will still cover part of the sun as it dips below the horizon. Inasmuch as clouds and fog make eclipse expeditions the biggest gamble in science, we will try to protect ourselves against cloud curtains by establishing one of the camps three miles high in the Cerro de Pasco region of the Andes."

Planetarium to Reproduce Eclipse

Recognizing the wide-spread public interest there will be in this eclipse, the Hayden Planetarium has taken two steps to give the public a unique advantage to see the eclipse in Peru, or to watch it reproduced with graphic realism on the man-made sky in the Planetarium. These two steps are:

1. Throughout the month of June, the Drama of the Skies in the Hayden Planetarium will deal with Solar Eclipses. The audiences will actually see how the moon blots out the sun. In addition, color photographs and motion pictures of the June 8th Eclipse will be shown as soon as they arrive from Peru by plane.

2. A unique feature of the eclipse expedition is that the Hayden Planetarium will cooperate with the Grace Line—which is conducting the first maritime Eclipse Cruise in history—by providing special observation facilities on the scene of the eclipse for those who travel to Peru to watch the sun vanish.

Planetarium News

The Junior Astronomy Club of the American Museum is sending two representatives with the Hayden Planetarium—Grace Line Peruvian Eclipse Expedition. Dana K. Bailey, former active club member, graduate in astronomy of the University of Arizona, and Rhodes Scholar, will make photographs of the corona. D. Owen Stephens, artist, will make observations and sketches to be used in a painting of the eclipse. He will also make study sketches of unusual astronomical phenomena seen on the trip to Peru.

An interesting exhibition of colorful paintings of the sun, moon and sky is being shown in the Planetarium at the present time. The artist is Mr. Harry Sutton, Jr., of Boston, Massachusetts.

On May 5th Mr. Robert G. Cox will speak before the Amateur Astronomers Association at 8:15 p.m. in the Roosevelt Memorial on the subject "Amateur Optics." On May 19th the Annual Meeting of the A. A. A. will be held, and motion pictures will be shown. At this time the Secretary will present a resumé of field trips during the past year. All those interested are cordially invited to attend these meetings.

MacDougal Expedition Brings Rare Specimens

Mr. T. MacDougall has returned from his recent expedition to southern Mexico and has presented the Museum with a valuable collection of living reptiles. Included in the collection are a series of Basiliscus, a lizard that runs over the surface of the water. The species is related to our horned toad and chameleon. It is nearly two feet long and is equipped with fringes on its toes which help support the weight of this bizarre creature as it dashes over the surface of Central American streams.

Another extremely rare form is the burrowing toad, *Rhinophrynus dorsalis*. This curious creature parallels the narrow mouthed toads of North America in living a subterranean life and having its whole body modified for digging its way through underground tunnels. No other specimen of Rhinophrynus has ever reached the American Museum alive.

A third rare species was the back-fanged snake, Manolepis. This is a poisonous snake which feeds on lizards and carries its fangs in the rear of its mouth. It does no damage to the interested human who examines it. Manolepis is closely related to some of the snakes in Haiti and may actually have been the ancestral stock from which at least one of the West Indian species evolved.

Frogs Eggs for School Children

The annual supply of frogs' eggs for the school children in New York has arrived in the Museum. They have been collected chiefly by Mr. Jack Orth and other members of the Department of Education, and have been deposited in the large temperature controlled tanks of the Laboratory of Experimental Biology. There are over 250 bunches of eggs in the collection this year. These will be distributed to various schools when they will teach the story of development to thousands of New York City school children.

How to Recognize a Poisonous Snake

A paper recently published by Dr. Noble and Mr. Schmidt in the Proceedings of the American Philosophical Society clears up a mystery of long standing. All the New World poisonous snakes, except the coral snake, are distinguished from the harmless snakes by a pit between the nostril and the eye. This facial pit had been the subject of investigation by various laboratories, but the question of its function still remained unanswered. Dr. Noble and Mr. Schmidt have shown that it is actually a temperature detecting mechanism which is utilized by the snakes in detecting the presence of warm-blooded prey. There are snakes, such as the boas and pythons, which have pits on the scales of their lips. These have also been proved to be temperature receiving mechanisms which function the same way as the facial pit of the rattlesnake. Structurally, the rattlesnake's pit differs from that of the boids in having a membrane across the bottom through which the nerve endings are distributed. Because of its peculiar structure, the rattlesnake's pits are also receivers of air vibrations; while the labial pits of the boids serve exclusively as temperature receptors. Many snakes are attracted toward warmth but no others are equipped with mechanisms for directing their strike toward warm-blooded prey.

Education News

On April 1, 1937, twenty-five crippled children and six attendants from Montefiore Hospital were the guests of the Department of Education and Mrs. Binswanger, a Member of the Museum. The day's program consisted of guidance through the Museum, a showing of the motion picture, "Cheenama—the Trail Maker," and, after lunch, attendance at the Hayden Planetarium. This is an annual affair and provides a bright spot in the life of these unfortunates.

On May 14, 15 and 16, the Horticultural Society of New York will show an exhibit of the Tulip and Rock Garden Society in Memorial Hall. The Children's Science Fair of projects by New York City School children will be held in Education Hall from May 9 to 16.

Prize-winning and other meritorious posters submitted in a peace poster contest by art students in the New York City high schools will be on view in Education Hall from June 7 to 14. This contest is sponsored by the Women's International League for Peace and Freedom, with the permission of Superintendents of Schools, Dr. Roberts, Dr. Tildsley, and Mr. Ernst, the purpose being to promote international understanding and good will.

Of John Burroughs

An exhibit of Burroughsiana has been assembled by Miss Farida A. Wiley and placed on permanent view at the entrance to Education Hall as a memorial to the writer-naturalist, John Burroughs. The collection comprises many interesting items, including John Burroughs' famous woodchuck coat, original manuscripts, a cast of his hands, several oil paintings and photographs, as well as various small personal possessions from Slabsides, Riverby, Roxbury and Washington, D. C. The collection was formally presented to the Museum by Dr. Clyde Fisher, president of the John Burroughs Association and accepted for the Museum by Mr. Wayne M. Faunce, Vice-Director. The presentation was made on the evening of April 3, after a meeting of the John Burroughs Association celebrating the 100th anniversary of Burroughs' birth, and was attended by a number of relatives and friends.

Honoraria

Dr. Roy Chapman Andrews, Director of the American Museum of Natural History, has just been awarded the famous gold Vega medal by the Royal Swedish Geographical Society. Notice to this effect has been received by Dr. Andrews from Stockholm. The award was made in recognition of his outstanding contribution to geographical and anthropological science incidental to his explorations in the Far East.

The medal was to have been presented to Dr. Andrews in Stockholm on April 24th by the Crown Prince of Sweden, but owing to the inability of Dr. Andrews going abroad at that time, the medal and the accompanying certificate was presented by Crown Prince Gustaf Adolf to the American Minister to Sweden, Laurence A. Steinhardt, on the above date.

The Vega medal was created half a century ago in honor of Baron Nordenskiöld the great Swedish explorer, in commemoration of his completion of the North East Passage expedition in 1880. The name "Vega" was given to the medal because it was the name of the ship abroad which Nordenskiöld made his voyage.

Only two other Americans have received this coveted prize in the realm of exploration and science. For his brilliant achievements in Africa, Henry M. Stanley was given the award in 1883. In 1920, the medal went to Professor William Morris Davis, the outstanding physiographer and geologist.

As leader of the Central Asiatic Expeditions of The American Museum of Natural History, Dr. Andrews took his first Expedition into the field in 1916 in the territory of Tibet, Southwest China and Burma. His second Expedition went into North China and Outer Mongolia in 1918, and the third Expedition worked in Central Asia, especially in Mongolia, from 1921 to 1930. In the Gobi Desert, this expedition discovered the first known dinosaur eggs, skeletons of the oldest, as well as the largest known land mammals, geological strata previously unknown, and evidences of primitive life. It mapped many regions previously unknown and brought out the largest collection of recent mammals ever taken from Asia.

Dr. Andrews has also received the Elisha Kent Kane Gold Medal of the Philadelphia Geographical Society, the Hubbard Medal of the National Geographic Society, the Explorers' Club Medal and the Charles P. Daly Gold Medal of the American Geographical Society.

Mrs. Agnes K. Saunders participated in a vocational guidance conference at Cornell University on April 17. She discussed women's place in museum work.

The Museum New Guinea Expedition

Writing from his camp at Sogeri, New Guinea, Mammalogist G. H. H. Tate informed the Museum in his most recent letter that his collection has been swelled by 850 additional specimens since Expedition Leader Richard Archibald returned to this country with 500 mammals. Mr. Tate has high hopes of totaling 1500 specimens before he leaves New Guinea for his proposed return trip via the European Museums at Genoa, Berlin, Leyden and London. He believes that his collection includes several new forms as well as many that will fill gaps in material already described.

Mr. Tate reports that his small trapping organization runs like clock-work. By means of a regular rotation system, 350 traps are kept steadily at work yielding catches of from two to three per cent. He expects that he will be able to improve on this average once he gets well up into the mountains during the final phase of the expedition. Mr. Austin L. Rand has terminated his activities as the Expedition's ornotholigist and was expected to arrive with his collections in New York aboard the Italian liner *Roma* on April 22nd.

Visiting Foreign Scientists

A number of foreign scientists have recently been guests in the offices and laboratories of the Departments of Comparative Anatomy, Vertebrate Palaeontology and Anthropology of the The American Museum. Père P. Teilhard de Chardin, the eminent French palaeontologist, is Honorary Adviser to the National Geological Survey of China, and a Research Associate of the Department of Asiatic Exploration and Research of The American Museum. Doctor Robert Broom, noted palaeontologist of the Transvaal Museum, Pretoria, South Africa, is best known for his illuminating researches on the fossil mammal-like reptiles. Doctor G. H. R. von Koenigswald, palaeontologist of the Opsporingsdienst van den Mijnhouw, Bandoeng, Java, is making important researches concerned especially with fossil man. He is responsible for the discovery of a fossil skull of a human child of early Pleistocene (Glacial) age, which may be a juvenile form of the famous Java ape-man, *Pithecanthropus*. Miss M. L. Tildesley, formerly Curator of the Human Osteological Section of The Museum of The Royal College of Surgeons of England, is now engaged in the standardization of measurements in physical anthropology. Professor D. M. S. Watson, eminent palaeontologist and zoölogist of University College, The University of London, will give a series of lectures at Yale University. Dr. T. S. Westoll, also of University College, London, is making important research studies on primitive fossil fishes. Professor C. U. Ariëns Kappers, distinguished neurologist, is Director of The Institute for Brain Research of The University of Amsterdam, Netherlands.

Professors Watson and Ariëns Kappers were the James Arthur Lecturers on the Evolution of the Human Brain at The American Museum in 1934 and 1935, respectively. The first four mentioned scientists were also delegates to The International Symposium on Early Man, held at The Academy of Natural Sciences of Philadelphia, March 17 to 20.

RECENTLY ELECTED MEMBERS

THE following 659 persons have been elected to membership in the American Museum of Natural History since the last issue of NATURAL HISTORY:

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LETTERS

March 22, 1937

SIRS:

Please add mine to the other congratulations you must be receiving about the change in NATURAL HISTORY. It is really a most attractive publication in every way and I look forward to receiving it.

WILLIAM PROCTER.

Field Museum, Chicago,
March 15, 1937

SIRS:

Your statement, in the March issue of NATURAL HISTORY, that only one letter had been received against the recent changes in the new format of your magazine, prompts me to write expressing my views.

Personally, I am very much disappointed in this change. Not so much when one considers only a single issue, but was any thought given those who thought enough of your publication to complete the set and have them bound? This enlarged size, besides breaking the standard of the other bound volumes, makes it impossible to use the sections designated in book-cases for the other volumes. It is also a clumsier magazine, in size, to read; one of the hardest to handle when reading it as a single issue and making it harder to handle as a bound volume, both as to size and weight.

I am sure should everyone write in expressing their opinions, many would feel as I do. Out of five subscribers, known to me personally, not one spoke favorably of the new NATURAL HISTORY.

JOHN W. MOYER.

Boston, Mass.,
March 30, 1937

SIRS:

Herewith I should like to express my real appreciation of and pleasure in your publication, NATURAL HISTORY. I cannot recall ever having received a magazine which so perfectly fulfills the functions for which it was designed. Although I am inclined to favor the original smaller size of the publication, it does not appear that the new and larger format in any way detracts from the many fine points of the work. Some of these points, which have repeatedly aroused interest and pleasure, are the following: excellent general lay-out, including handsome, legible and varied typography, and a refreshing variation in the paper-stocks used for various portions of the magazine; copious but intelligent use of well-reproduced illustrations so as not to disturb the continuity of reading-matter; a welcome revival of the use of line cuts as an offset to the usual over emphasis on photographs; excellent use of color, including really beautiful covers; and, lastly, contents which while sufficiently popularized to be easily intelligible, still manage to contain almost as much real substance as a pure scientific journal.

If the above conveys the impression that I am rather more enthusiastic about NATURAL HISTORY than I am about any other periodical that has come to my attention, it has served its purpose. I do not approve of plagiarism, but if other magazines in the same field should model themselves on NATURAL HISTORY in any of many possible ways, the practice would result without exception in a very material improvement of their respective endeavors.

RICHARD S. SHUMAN.